



Building open government data platform ecosystems: A dynamic development approach that engages users from the start

Andreas Hein^a, Martin Engert^a, Sunghan Ryu^{b,*}, Norman Schaffer^c, Sebastian Hermes^a, Helmut Krcmar^a

^a School of Computation, Information and Technology, Technical University of Munich, Boltzmannstrasse 3, 85748 Garching, Germany

^b USC-SJTU Institute of Cultural and Creative Industry, Shanghai Jiao Tong University, A7-A8 Building, 155 Tanjiaotang Rd., Minhang District, Shanghai 200241, People's Republic of China

^c fortiss GmbH, Guerickestrasse 25, 80805 Munich, Germany

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ABSTRACT

Open government data (OGD) platform ecosystems hold immense potential for promoting transparency, civic engagement, economic growth, and improved governmental offerings. The prevailing strategy to building OGD platform ecosystems follows a sequential approach where the OGD platform is built first and the ecosystem is built second, resulting in low engagement. In this paper, we derive insights into an alternative approach to developing OGD platform ecosystems from TourismData, a state-owned tourism initiative in Germany. We report on the phases between 2018 and 2022 and derive four dynamic and incremental phases from which we derive three learnings: context specificity, continuous adaptation, and organic expansion. Our findings have theoretical and practical implications for developing high-engagement OGD platform ecosystems that include and engage ecosystem actors from the start and, hence, take advantage of the generative potential of OGD. This approach illustrates the importance of developing OGD platform ecosystems with high contextual relevance to ensure that data can be used to enable meaningful interactions between ecosystem actors and promote continuous adaptation and expansion.

1. Introduction

Open government data (OGD) describes government-related and machine-readable data made open to the public (Attard, Orlandi, Scerri, & Auer, 2015; Dawes, Vidasova, & Parkhimovich, 2016) to secure transparency and leverage its potential for civic engagement (Ruijter, Grimmelikhuijsen, & Meijer, 2017; Wirtz, Weyerer, Becker, & Müller, 2022). OGD is made available by OGD initiatives, which can take different forms, such as OGD platforms that are “an architecture of data services together with the governance of access and (re-)use, created to allow third parties to create new value” (Danneels, Viaene, & Van den Bergh, 2017, p. 366). These third parties form an OGD platform ecosystem around the platform and use OGD to increase transparency, improve governmental offerings (Altayar, 2018; Dawes et al., 2016), and develop new services (Kassen, 2013; Veljković, Bogdanović-Dinić, & Stoimenov, 2014; Zuiderwijk, Janssen, & Davis, 2014).

Despite their potential, literature and practice indicate that many

OGD platform ecosystems fall short of generating meaningful engagement (Danneels et al., 2017; Zuiderwijk & Reuver, 2021). This is often because platform owners who govern these ecosystems (Bonina & Eaton, 2020) focus on publishing available data first and engage their ecosystem only second (Dawes et al., 2016; Ruijter et al., 2017). This approach results in low engagement as the disseminated OGD frequently fails to meet the specific informational or functional needs of users. In addition, data quality is often subpar, leading to inaccuracies, incomplete datasets, or outdated information (Wang, Shepherd, & Button, 2019; Zuiderwijk & Reuver, 2021). Consequently, OGD platforms that publish first and engage their ecosystem second often fail to spur meaningful participation (Bonina & Eaton, 2020; Danneels et al., 2017).

In contrast to this approach, the literature on citizen engagement and value co-creation advocates for the early involvement of citizens to leverage the potential of OGD (McBride, Aavik, Toots, Kalvet, & Krimmer, 2019; Purwanto, Zuiderwijk, & Janssen, 2020). The empirical findings consistently indicate that meaningful engagement necessitates

* Corresponding author.

E-mail addresses: andreas.hein@tum.de (A. Hein), martin.engert@tum.de (M. Engert), shryu@sjtu.edu.cn (S. Ryu), schaffer@fortiss.org (N. Schaffer), sebastian.hermes@tum.de (S. Hermes), helmut.krcmar@tum.de (H. Krcmar).

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the provision of relevant and high-quality data (Talukder, Shen, Talukder, & Bao, 2019; Wirtz, Weyerer, & Rösch, 2018). Similarly, research focused specifically on value co-creation with OGD reveals that individual barriers, such as data relevance and quality, substantially influence engagement levels (Toots, McBride, Kalvet, & Krimmer, 2017). Thus, a compelling argument emerges for an alternative approach to designing OGD platform ecosystems, which centers on engaging citizens and firms as ecosystem actors from the start (Bonina & Eaton, 2020; Danneels et al., 2017).

In sum, extant literature proposes three typical activities for developing OGD platform ecosystems. These activities start with assessing data and actors, continue with implementing the OGD platform and publishing data, and end with cultivating the ecosystem to foster engagement (Attard et al., 2015; Berrone, Ricart, & Carrasco, 2016). This sequence of activities exhibits limitations, most notably in its early stages, where platform development frequently relies on the available OGD from governmental providers, falling short of delivering relevance and ecosystem engagement (Danneels et al., 2017; Ruijter, Grimmelikhuijsen, Hogan, et al., 2017). Building on recent literature on citizen engagement and value co-creation with OGD, we inquire *how platform owners can design and implement OGD platform ecosystems that engage actors from the start*.

We derive insights on this approach based on an explorative single case study (Yin, 2014) of the OGD platform *TourismData*, launched in 2018 by a state government in Germany. *TourismData* was purposefully built to engage ecosystem actors from the start by designing an OGD platform based on a regional approach with high context specificity through its focus on tourism. This development approach follows the latest research on citizen engagement and value co-creation on OGD to mitigate known problems of low engagement. Focusing on *MountainRegion*, a region in Germany, *TourismData* created a high level of context-specificity, which helped engage the various actors in the ecosystem locally. Our inquiry covers the phase between 2018 and 2022, capturing the development process and milestones of *TourismData*'s OGD platform ecosystem.

Our analysis identifies four sequential stages in the development approach of *TourismData*, each characterized by distinct activities aimed at building and expanding the OGD platform ecosystem. *TourismData* started by conceptualizing a regional value proposition with local actors at *MountainRegion* and dynamically developed a malleable infrastructure in the second stage based on this value proposition that includes core data types and allows actors to work on previously identified use cases. In the third stage, *TourismData* activated further actors within *MountainRegion*, showcased the generative potential of OGD, provided training, and engaged actors through hackathons. Last, *TourismData* developed an expansion strategy by assessing regional similarities and differences and used ecosystem actors as multipliers for expansion.

From this case study, we distill three principal learnings that complement traditional OGD platform ecosystem development approaches: context specificity, continuous adaptation, and organic expansion. On a theoretical front, these learnings complement the conventional linear model (Attard et al., 2015; Berrone et al., 2016), proposing a more dynamic, iterative framework that emphasizes early engagement with ecosystem actors. Practically, the findings offer recommendations for policymakers for when to use the traditional and linear OGD platform ecosystem development approach and when to use the dynamic approach that engages the ecosystem from the start.

2. Theoretical background

In the theoretical background, we first introduce OGD and different forms of OGD initiatives. We then summarize research on OGD platform ecosystems as a specific OGD initiative and the predominant development approach of creating the OGD platform first and engaging the ecosystem second. Next, we bridge this discussion to the literature on

citizen engagement and value co-creation. Last, we explore how these literature streams can enrich our understanding of cultivating active participation from the start, thereby increasing ecosystem engagement.

2.1. OGD and OGD initiatives

The starting point of open government is often tied to former United States President Obama's executive order towards open government and transparency (Obama, 2009). The concept of open government describes "a multilateral, political, and social process, which includes in particular transparent, collaborative, and participatory action by government and administration" (Wirtz & Birkmeyer, 2015, p. 382). These initiatives strive to fulfill dual objectives: first, to ensure data transparency, and second, to unlock the generative potential of OGD by stimulating active engagement from citizens and corporate entities (Gao, Janssen, & Zhang, 2021). To achieve these goals, the government can provide OGD as "machine-readable data (which is) discoverable, available, and downloadable through dedicated internet portals without cost to potential data users" (Dawes et al., 2016, p. 15).

Various OGD initiatives have been designed to serve these overarching goals, yet they differ in their operational mechanisms and target outcomes (Attard et al., 2015; Dawes et al., 2016). For instance, OGD portals primarily aim at data dissemination, focusing on transparency and data consumption (Attard et al., 2015; Wang, Chen, & Richards, 2018). An example of this would be the German government's *GovData* portal, which offers an extensive repository of datasets for public consumption but lacks interactive features to foster engagement.

Conversely, OGD platform ecosystems adopt a more interactive stance, using a platform-based model that orchestrates interactions between actors that provide data and actors that consume data to stimulate generative engagement (Danneels et al., 2017; Parker, Van Alstyne, & Choudary, 2016). This ecosystem structure allows for a more dynamic interplay among actors, which may include both citizens and corporate entities, to collaboratively use OGD in the refinement of existing services or the creation of new, innovative offerings (Dawes et al., 2016; Ruijter, Grimmelikhuijsen, Hogan, et al., 2017). An example is *Data.gov.uk*, which not only provides datasets but also facilitates meaningful interactions among multiple actors, including government agencies, private sector organizations, and individual citizens. The platform is designed to encourage the sharing and usage of open data to solve real-world problems or create new services and applications.

2.2. OGD platform ecosystems: three typical development activities

OGD platform ecosystems use a technological platform to publish data and provide opportunities for ecosystem actors to engage with the platform and use OGD to innovate (Ruijter, Grimmelikhuijsen, Hogan, et al., 2017). We follow Danneels et al. (2017, p. 366), who define OGD platforms as "an architecture of data services together with the governance of access and (re-)use, created to allow third parties to create new value." These third parties represent ecosystem actors that can take the role of providers that provide OGD, developers that can improve existing or extend the OGD platform with new services, and consumers that use OGD or services developed. Within this OGD platform ecosystem, the platform owner constitutes the intermediary in charge of the platform and defines the governance rules to orchestrate interactions between actors (Bonina & Eaton, 2020; Wirtz et al., 2022).

Extant research suggests that a developing sequence of typical activities shapes these ecosystems.¹ These typical activities include assessing data and potential actors, implementing the OGD platform and publishing data, and subsequently cultivating the OGD platform

¹ The typical activities were synthesized from different research papers, who all proposed slightly different activities to OGD platform ecosystem development. A detailed list of the studies can be found in Appendix A.

ecosystem by engaging actors from both supply and demand sides (e.g., Attard et al., 2015; Berrone et al., 2016; Bonina & Eaton, 2020) (see Table 1).

2.2.1. Assessing data and actors

As initial activities, the literature proposes to focus on consolidating and assessing potential data to be published. These activities are often triggered by newly enacted open government policies (Dawes et al., 2016; Janssen, Charalabidis, & Zuiderwijk, 2012). Based on the respective policies and goals, government agencies develop strategies to improve transparency and accountability by sharing data with users (Abu-Shanab, 2015; Danneels et al., 2017; Kassen, 2013).

Platform owners internalize the OGD concept during this activity and accumulate relevant governmental data for dissemination (Boudreau, 2021). This is frequently impelled by legislative initiatives and supported by top-level governmental authorities (Dawes et al., 2016). Such support is crucial for the OGD platform's long-term viability (Cingolani, 2021; McBride et al., 2019). However, challenges such as internal resistance often emerge due to the resource-intensive nature of data selection and publication (Attard et al., 2015; Heimstädt, Saunderson, & Heath, 2014). Hence, most cases involve only governmental actors during the assessment stage (Berrone et al., 2016; Boudreau, 2021). For example, Berrone et al. (2016) investigated the OGD platform ecosystem developed by the Spanish city of Barcelona where the platform owner collected datasets from different governmental entities and only later provided them to the public.

The few studies that involve external actors in the initial stage engage them as passive data consumers. For example, Berrone et al. (2016) describe the importance of external stakeholders, such as private companies, academic institutions, and startups, in making the data collected usable during the early stages of OGD platform ecosystem development.

2.2.2. Implementing the platform and publishing data

In the next typical activity of implementing the OGD platform and publishing data, platform owners navigate data standardization, technical infrastructure, and governance mechanisms (Bonina & Eaton, 2020; Linåker & Runeson, 2020).

Data in OGD platforms encompass a myriad of types and formats, ranging from planning and building permit data (Maccani, Donnellan, & Helfert, 2015) to mobility statistics (Rudmark, Arnestrand, & Avital, 2012). These data are often presented in disparate standards and file types such as CSV, Excel sheets, and XML, posing challenges to stakeholder accessibility and data interoperability (Attard et al., 2015; Thorsby, Stowers, Wolslegel, & Tumbuan, 2017). Thus, machine-readable formats anchored in uniform resource identifiers are recommended to enhance future ecosystem engagement (Abu-Shanab, 2015; Danneels et al., 2017).

OGD initiatives provide data through websites, portals, and platforms as technical infrastructure. While websites and portals predominantly serve transparency objectives (Kalampokis, Tambouris, &

Tarabanis, 2011; Sieber & Johnson, 2015), OGD platforms aim to catalyze an ecosystem of public and private actors for innovative uses of OGD (Bonina & Eaton, 2020; Danneels et al., 2017). However, most OGD platforms statically offer their data with little concern for its usage (Janssen et al., 2012; Matheus et al., 2021).

Besides access rights and quality standards, OGD platforms provide boundary resources, “software tools and regulations that serve as the interface for the arm's-length relationship between the platform owner and the application developers” (Ghazawneh & Henfridsson, 2013, p. 174), to govern third-party engagement. Examples are application programming interfaces (APIs), templates, hackathons, and guidelines to orchestrate interactions in the ecosystem (Bonina & Eaton, 2020). Besides orchestrating interactions, these boundary resources aim to engage external stakeholders (Abu-Shanab, 2015).

Similar to the preceding typical activities, most activities happen without the direct involvement of external actors (Attard et al., 2015; Dawes et al., 2016). In addition, use cases concerning the available data sets are usually not considered at this stage (Lee, Almirall, & Wareham, 2015). Hence, in the following, different actors must be invited and onboarded to the OGD platform to build an ecosystem.

2.2.3. Cultivating the ecosystem by attracting and growing supply and demand

In the ensuing typical activity of ecosystem cultivation, the emphasis shifts towards sustaining the OGD platform and fostering a vibrant ecosystem interacting with the data. On the supply side, the primary contributors of data are typically governmental departments and ministries (Bonina & Eaton, 2020, p. 5). Conversely, the demand side of OGD platforms comprises third parties, such as developers, using the data to create novel applications and services. Bonina and Eaton (2020, p. 12) note that “small size and close-knit OGD communities” serve as favorable conditions for cultivating OGD platform ecosystems.

Communication with current and potential OGD platform ecosystem actors is crucial to initiating value co-creation (Dawes et al., 2016; Evans & Campos, 2013). Events such as hackathons or awards for innovative OGD-based services help to promote value co-creation (Boudreau, 2021; Huijboom & Van den Broek, 2011). However, platform owners must continuously invest in and adjust the OGD platform as barriers to actors' participation often remain (Wang et al., 2019; Zuiderwijk & Reuver, 2021).

Platform owners must actively moderate the content by regularly updating the platform with new or improved data and functionalities (Boudreau, 2021). Furthermore, they must collect user feedback and adjust the platform accordingly (Abu-Shanab, 2015; Altayar, 2018). Typical issues include incoherent standards and interfaces, an overabundance of low-quality data sets, and missing use cases (Wang et al., 2019; Zuiderwijk & Reuver, 2021).

In summary, the development of OGD platform ecosystems is marked by a sequence of typical activities, reflecting an evolving landscape and a growing understanding of relevant activities (Attard et al., 2015; Bonina & Eaton, 2020). Initially, platform owners assess data and identify supportive actors, both internal and external. This is followed by establishing technological and governance frameworks, leading to data publication. Subsequently, efforts are made to cultivate an ecosystem by attracting actors from supply and demand sides. The traditional approach of building the OGD platform first and engaging ecosystem actors last often hinders meaningful engagement, as it relies on existing data, infrastructure, and policy directives, thereby constraining ecosystem involvement (Bonina & Eaton, 2020; Danneels et al., 2017; Slobodova & Becker, 2020).

2.3. Positioning the paper: the potential of building OGD platform ecosystems by engaging ecosystem actors from the start

Due to the low levels of engagement, extant literature critiqued traditional approaches to building OGD platform ecosystems. For

Table 1
Three typical activities in building OGD platform ecosystems.

Typical Activity	Key Activities	Exemplary Sources
Assessing data and actors	- Assess available data - Contact potential participants	Attard et al. (2015); Matheus, Janssen, and Janowski (2021)
OGD platform implementation and publishing data	- Build the infrastructure - Publish data and services	Attard et al. (2015); Bonina and Eaton (2020)
Cultivating the OGD platform ecosystem	- Manage and communicate with new/existing supply- and demand-side actors - Update platform (data and functionality)	Boudreau (2021); Zuiderwijk et al. (2014)

instance, Ruijter, Grimmelikhuijsen, Hogan, et al. (2017) stress that collecting general user requirements and designing the OGD platform without the involvement of prospective users is insufficient to engage them in OGD initiatives. Furthermore, in surveying OGD platform ecosystems, studies show that setting more relevant goals considering the local context helps practitioners implement more successful OGD platform ecosystems (Zuiderwijk & Reuver, 2021). In addition, Danneels et al. (2017) conceptualize autopoietic OGD platform ecosystems, which follow a needs-driven design and foster dynamic coevolution and self-organization of ecosystem actors, resulting in thriving OGD platform ecosystems.

Drawing from the literature streams of citizen engagement and value co-creation related to OGD, we can gain valuable insights into developing more engaging and interactive OGD platform ecosystems. In the following, we will summarize insights of both streams on how to design more engaging OGD platform ecosystems.

In citizen engagement literature with OGD, a recent review illustrates that the use of OGD to innovate is still limited and falls behind its potential (Ansari, Barati, & Martin, 2022). According to this literature, OGD platforms must provide relevant data of sufficient quality (Talukder et al., 2019; Wirtz et al., 2018) that is easy to use and intrinsically motivates developers to use OGD (Souza, d'Angelo, & Lima Filho, 2022). These findings resonate with research on specialized training programs, effective only when tailored to the unique needs, contexts, and expectations of specific user types (Gascó-Hernández, Martin, Reggi, Pyo, & Luna-Reyes, 2018). Additionally, the importance of local embeddedness for achieving meaningful citizen interactions within the ecosystem is emphasized (Reggi & Dawes, 2022).

Research on value co-creation with OGD shows similar results. Again, there are data-based factors, such as relevant and high-quality data (Toots et al., 2017), and developer-based factors, such as the motivation and mental models of developers (McBride, Olesk, Kütt, & Shysh, 2020), that affect value co-creation in OGD platform ecosystems. Hence, a particular focus on OGD developers is needed, as the value created with OGD depends on their activities (Magalhaes & Roseira, 2020). In addition to these points, a recent study on value co-creation illustrates that OGD platforms that want to achieve high ecosystem engagement must work closely with ecosystem actors and communicate to create a shared understanding (McBride et al., 2019).

Incorporating these insights, we propose a more nuanced OGD platform development approach that engages ecosystem actors from the start. Unlike traditional models, our approach encourages platform owners to initiate development within a well-defined context that enables early ecosystem engagement (Gascó-Hernández et al., 2018; McBride et al., 2020). Within this context, platform owners should follow a needs-driven requirements analysis based on scenarios and user stories to better understand potential ecosystem actors and their engagement. This, in turn, could help set more relevant goals for actors to participate in the OGD platform ecosystem (McBride et al., 2019; Zuiderwijk, Shinde, & Janssen, 2019). However, besides this conceptualization, we lack tangible insights on how OGD platforms can be built by integrating ecosystem actors from the start to increase their engagement (Gao et al., 2021).

3. Research approach

We choose a qualitative, exploratory research approach based on TourismData, a single in-depth case study from 2018 to 2022 of an OGD platform ecosystem in German tourism. In this case, we study how OGD platforms can be built by integrating ecosystem actors from the start (Eisenhardt, 1989; Yin, 2014). Case studies are particularly suitable for investigating dynamic, changing phenomena in real-life contexts (Yin, 2014), such as OGD platforms that engage and facilitate value co-creation with an ecosystem of actors.

TourismData was initiated in light of former OGD initiatives that started by providing data without considering the potential ecosystem,

leading to low engagement levels (Zhu, 2017). Based on these insights, TourismData purposefully started in 2018 with a needs-driven requirements analysis of actors in the specific context of MountainRegion. The OGD platform was designed by a publicly funded organization to provide and initiate data exchange and orchestrate interactions between the partners in the ecosystem of MountainRegion to enable purposeful interactions between actors from the start. As this approach deviates from the traditional approach, we have chosen TourismData as an appropriate case to explore how OGD platforms can be developed by integrating and engaging ecosystem actors from the start.

3.1. Case description: the TourismData platform ecosystem

Like many industries, the tourism sector faces the challenge of digital transformation (Almeida-Santana, David-Negre, & Moreno-Gil, 2020). Moreover, its actors, mainly small and medium-sized enterprises (SMEs), face competition and increased dependency on multinational enterprises, such as Google, regarding trip-related information and Airbnb or Booking.com concerning booking accommodation and leisure activities. Hence, the state within Germany that governs MountainRegion aims to strengthen the position of local actors by supporting their efforts towards digitization and expanding their reach through channels other than multinationals. TourismData seeks to enable private and public actors to build and scale new products and services based on OGD to satisfy changing customer needs.

The availability and accessibility of annotated data are at the core of the state government's strategy. This data should enable ecosystem actors through an OGD platform to share data and develop improved tourist services and digital experiences. To that end, the TourismData OGD platform ecosystem was started in 2018 as a three-year consortium-based project comprising seven partners from public, public-private, and private entities with backgrounds in tourism and information systems domains. The present study focuses on this initial TourismData project-based initiative, which operated between 2018 and 2021 and was extended afterward.

The project was piloted in MountainRegion, one of the most visited tourist regions in the state, creating a vibrant context for the OGD platform ecosystem. The initial TourismData project aimed to conceptualize and set up an OGD platform and create an ecosystem, enabling actors to share and consume data and realize the economic potential for the tourism sector within the pilot region and the state overall. In mid-2020, before the official ending of the project in mid-2021 and based on its success, the state government decided to continue the OGD platform ecosystem beyond 2021. It founded a public-private entity as the future platform owner and, thus, made the platform available to additional regions. This considerable financial commitment of the government towards TourismData—made amidst the COVID-19 pandemic in 2020, highlights its confidence in the quality and potential of the results.

The considerable level of user engagement within the TourismData ecosystem can be observed from different angles. First, TourismData managed to include data from different civic and private providers, such as governmental agencies for museums, environments (i.e., lakes), historical sites (i.e., castles), as well as state-level ministries for infrastructure (i.e., roads and parking lots). TourismData includes real-time data about the capacity of over 100 parking lots, ten private restaurants, six shopping sites, 80 institutions that offer free-time activities (e.g., swimming areas, sites, hiking routes, or spas), and 63 points of interest (POIs) and museums.² All this data is available in a machine-readable form and provides real-time information in their most prominent application, the tourism tracker, with over 2.5 million visitors by 2022.

Based on all this information, we argue that TourismData provides a suitable setting for research on an alternative development approach to creating OGD platforms that engage ecosystem actors from the start.

² Data offered by TourismData for the specific day of 24th July 2023.

From its initiation in 2018, TourismData started by integrating a diverse set of public and private actors interacting within an OGD platform ecosystem (Danneels et al., 2017). In addition, MountainRegion provides a concrete context and objective of creating a regional hub for OGD in the tourism domain, providing a concise and close-knit setting (Bonina & Eaton, 2020). Last, TourismData engages local actors as (potential) data providers and consumers during the platform's initial phases, increasing its relevance through real-world use cases (Ruijter, Grimmelikhuijsen, Hogan, et al., 2017; Ruijter & Meijer, 2020).

3.2. Research process: data collection and analysis

The research team collected data from different sources. These sources comprised (1) archival data, such as publicly available information including the TourismData website, newspaper articles, internal data, and documents of the initiative, as well as final reports and recommendations, (2) observational data on meetings and events of the initiative, and (3) semi-structured interviews with the government, as well as actors from the OGD platform ecosystem (see Table 2).

Two co-authors accompanied the project from 2018 to 2021, providing us with unique access to archival and observational data. Their involvement facilitated unique access to both archival and observational data, including meeting minutes, presentations, and reports generated through internal jour-fixes, consortia meetings, and workshops focused on the design and implementation of TourismData. In addition to the meeting minutes and to avoid hindsight bias, two of the co-authors participated in 32 jour-fixes and meetings, as well as in eleven events that range from industry forums to symposia to meetings of regional tourism associations. We selected these meetings and events as they presented important milestone meetings that either helped us to understand why strategic decisions had been made or illustrated how TourismData interacts and engages with its ecosystem. Again, we particularly focused on important milestone meetings that discuss the strategy and development of TourismData. This participation allowed us to triangulate the archival data and avoid a potential bias by solely relying on archival data.

While their insider perspective offers invaluable insights, particularly into the strategic aspects of developing the OGD platform and the integration of actors into the ecosystem, we acknowledge the potential for subjectivity to influence the interpretation of these data. To mitigate this and ensure objectivity, we employed the following measures. First, the findings were critically discussed and triangulated with archival data by authors not directly involved in the project. This external scrutiny served as a control mechanism to counterbalance any inherent biases that might have emanated from the involved co-authors. Second, our methodological approach was grounded in well-established research frameworks (Eisenhardt, 1989; Yin, 2014), which further provided a structured lens for data interpretation and findings.

We complemented our understanding of the development approach of TourismData through 19 semi-structured interviews. Informed by the archival and observational data, we interviewed the platform owner, data providers, consumers, and developers. For the interviews with the platform owner, we selected informants with intricate knowledge about

past actions that could help us better understand why strategic development decisions were taken and how the engagement strategy turned out. For data providers and consumers, we were interested in interviewees that could provide insights about how they engaged with TourismData and how this engagement unfolded over time. Last, for developers, we were interested in informants that could shed light on how they use the data to create novel products and services.³

The interviews were conducted following a semi-structured interview guideline. Embracing the depth and richness of the archival and observational data, we exploratorily followed the requirements and expectations of the different parties and their willingness to engage with the platform ecosystem in the long term. As such, we iteratively revised our interview guidelines based on input from previous interviews (Myers & Newman, 2007). In addition, we investigated the rationale for why and how the platform owner pursued its goal of high ecosystem engagement and how ecosystem actors reacted to these strategies. We emphasized value-creation mechanisms, data types, use cases, and platform design principles influencing ecosystem engagement.

We coded the data following an inductive approach of open, axial, and selective coding (Strauss & Corbin, 1990). This approach allowed us to capture open concepts such as actors subject to different value creation mechanisms, data types, platform design principles, hackathons, and use cases used to activate actors in specific touristic regions. During the axial coding, we grouped these concepts into key activities, such as the platform owner identifying a key set of actors. Last, during selective coding, we inductively derived four stages that describe the formation of OGD platform ecosystems by engaging ecosystem actors from the start.⁴ We did this by iteratively analyzing case data and contrasting inductively emerging concepts with the existing literature (Eisenhardt & Graebner, 2007; Gioia, Corley, & Hamilton, 2013).

4. Results: building TourismData by engaging actors from the start

Based on the inductive analysis of the case data, TourismData engaged in four stages representing a development approach that includes ecosystem actors from the start: 1) *conceptualizing a regional value proposition with local stakeholders*, 2) *developing a scalable infrastructure*, 3) *activating the regional ecosystem*, and 4) *the inter-regional expansion and scaling*. After the inter-regional expansion, the four stages can start again, indicating a new cycle. Each stage consists of *key activities* that describe how TourismData worked with *ecosystem actors* to develop the OGD platform ecosystem (see Fig. 1).

4.1. Stage 1: Conceptualizing a regional value proposition with local actors

The first stage follows three key activities that describe how TourismData conceptualized a regional value proposition with local actors. TourismData started by *identifying a set of key actors* in a specific region, i.e., MountainRegion. Together with these key actors that comprise public and private entities, TourismData continued with the *requirements elicitation* process to define common data standards and categories that aid key actors in developing use cases that would lead to future engagement. Third, TourismData collaborated with key actors to *extend the initial set of actors* to check if the regional value proposition applied to other actors and adjusted it iteratively.

TourismData was *initiated* in 2018 by a publicly funded organization with representatives of municipalities, communities, and areas in MountainRegion that acts as the platform owner. As initial key partners, the platform owner initiated TourismData with two publicly funded research institutions in MountainRegion's largest city. TourismData

Table 2
Overview of data sources.

Data Type	Available Data	Coverage
Archival	Meeting minutes of consortium jour-fixes	92 meeting minutes
	Meeting minutes of consortia meetings and internal workshops	14 meeting minutes; 12 presentations of consortia workshops
	Final reports	12 reports
	Meetings and jour fixes	32 meetings observed
Observational	Events/workshops	11 events observed
Interviews	Semi-structured interviews	19 interviews

³ A detailed list of all interviewees can be found in Appendix B Table 4.

⁴ The detailed data structure can be found in Appendix C Figure 3.

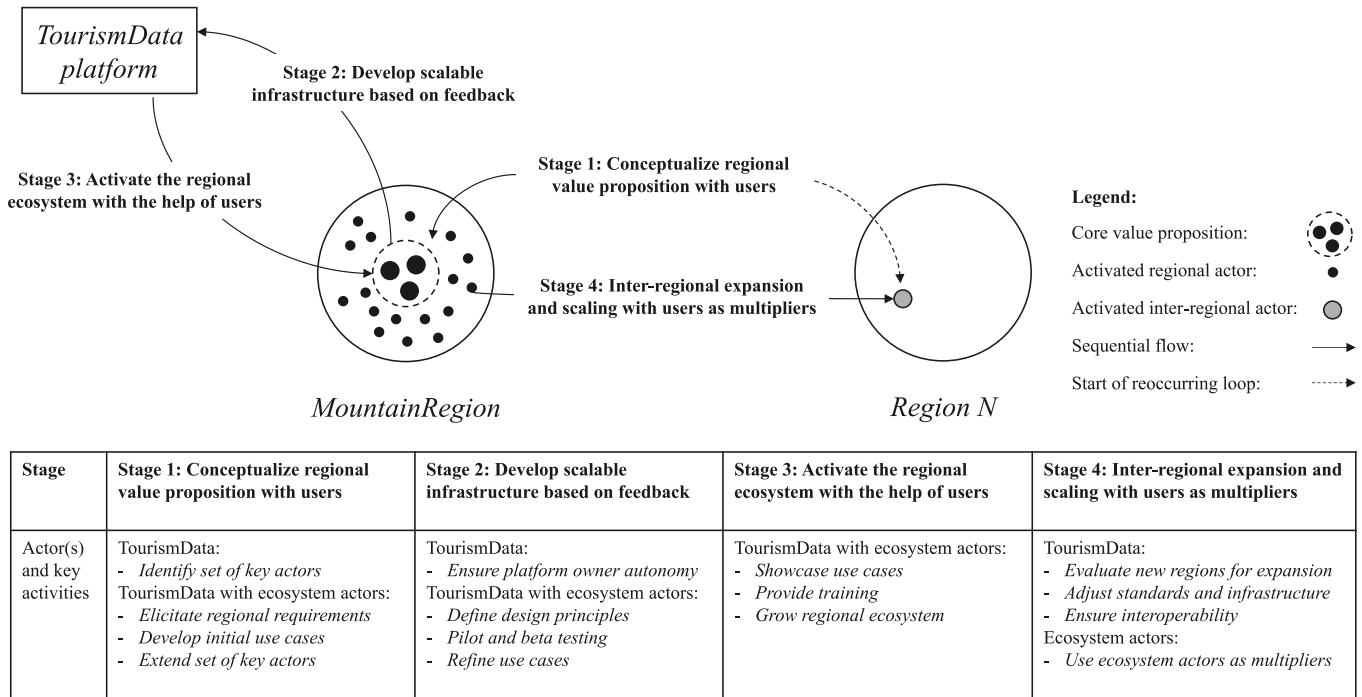


Fig. 1. Illustration of TourismData's OGD platform ecosystem development stages.

started with presentations about the potential of OGD in tourism within industry forums, symposia, and meetings of regional tourism associations. During the first six months, the actors within TourismData developed a profound understanding of MountainRegion, including the ecosystem, interaction between actors, and the use of data for value (co-) creation.

At this time, TourismData identified key ecosystem actors whose participation would be crucial for determining its future success. Among those actors are hotels and accommodation providers, gastronomies, municipalities, tourism service providers organizing hiking or bike tours, and customer management systems (CMS) providers. TourismData included these partners to provide a compelling and integrated experience for tourists who need a place to stay, something to eat, access to information about destinations, and ways to book tourist services. The state ministry that funded the project remembers that “tourists want to have an experience that goes beyond nice sights and includes culture, gastronomy and a nice [hotel to] stay” (IP15).

Another rationale was that sharing data requires ecosystem actors to trust each other. By having a key set of actors that know one another, TourismData ensures that these actors will also collaborate. One of the data providers highlights that “establishing trust was a huge deal because no one wanted to share data without getting access to data from other actors. Interacting with partners we know helps to manage this risk” (IP7).

Together with key ecosystem actors, TourismData engaged in requirements elicitation to develop a common data standard and data categories. Data categories, for example, consist of “five big datatypes: [...] POIs, tour, such as hiking or biking, hosts, gastronomy, and events” (I2) and how the data should be stored and exchanged. The team at TourismData also assessed which data was available, the quality, and how different key actors stored their data. These ideas were built on preexisting vocabulary (i.e., schema.org).

The goal of these meetings and, subsequently, the defined data standards and categories was to understand the requirements for key actors to interact, share data, and eventually create novel digital services. This process also initiated some degree of local actor collaboration and understanding of the importance of data quality: “The quality of data is fluctuating. It depends on the [user], how hard they try. Do they

add only basic attributes, or do they add beautiful tour descriptions?” (I3).

The requirements elicitation activities helped TourismData to determine the technical prerequisites and to define the first set of feasible use cases for interaction. In this regard, the initial five data categories should ensure that existing and new actors in the ecosystem would have access to an initial dataset that creates transparency about POIs, tours for hiking or biking, gastronomic services, accommodations, and regional events. As all this information would be accessible by all actors on TourismData, existing partners could improve their services (i.e., hotels have access to the latest events, and touristic event providers can recommend hotels). New ecosystem actors could use this data to develop value-adding solutions.

After the requirements elicitation and documentation of the first use cases, TourismData engaged with the key partners to extend the initial set of partners within MountainRegion. Based on recommendations from the ecosystem, TourismData started to include smaller actors in MountainRegion that added helpful information on technical aspects and new use cases. These additional actors helped refine previously discussed use cases and data categories for other potential actors in TourismData. In addition, these insights helped TourismData to identify problems that need to be solved before integrating more partners. An example is the integration of mobility providers who possess needed information for tourists on how to get from a hotel to a POI.

In conclusion, TourismData started with high context-specificity by focusing on MountainRegion, integrating key partners, and working with key partners to define a mutual data standard, data categories, and initial use cases that would benefit MountainRegion. TourismData also extended the initial set of key partners to refine the developed use cases.

4.2. Stage 2: Developing a scalable infrastructure based on ecosystem feedback

Based on the insights within MountainRegion from 2018, TourismData needed to develop a scalable infrastructure. This stage comprises the key activities of ensuring the autonomy of the platform owner, considering the platform's design principles, and piloting and beta-testing of conceptualized use cases. All these activities establish trust within

MountainRegion by not disadvantaging regional actors, ensuring data transparency through an open-source design, and dynamically building the OGD platform from a first concept to a prototype to a working OGD platform.

As a first activity, TourismData needed to *ensure the autonomy of the platform*, which was deeply embedded into MountainRegion. The reasoning behind this decision was to have an autonomous platform owner who can also act as an organizational entity and contact point for future regions and not just MountainRegion. Hence, TourismData decided to locate the new organization at the state level and chose a publicly funded organizational form to signal autonomy and neutrality.

After establishing the new platform owner, TourismData needed to consider *design principles to develop the platform*. In this activity, TourismData, under the lead of the new platform owner, engaged with the actors in MountainRegion on how the OGD platform should be designed. Based on a discussion within the ecosystem, the new platform owner decided on an open-source solution. First, this approach would increase the generative potential of all entities and provide new players with opportunities to commit changes and update requests that would help evolve the OGD platform. Second, an open-source OGD platform would signal transparency to actors outside MountainRegion to join and participate. Last, the increased transparency would help actors to collaborate and engage with TourismData. An interviewee remembers the decision as: "TourismData was designed as an open-source solution. [...] Besides open data, we also wanted open source to strengthen the ecosystem, the community, around [the OGD platform]." (I4).

Besides being open source, especially smaller ecosystem actors that do not possess a CRM articulated a great interest in using TourismData as a publicly available digital infrastructure to save on data storage, data sharing, and retrieval costs. One ecosystem actor stressed this aspect by referring to the OGD platform as a "public infrastructure, just like a highway, that the government should provide and maintain" (I2). In addition, TourismData should fulfill the purpose of standardizing data across MountainRegion for the tourism sector and guarantee high data quality concerning up-to-dateness (even real-time), semantic annotation (e.g., digital assistants), and duplicate free data.

During the implementation in 2019, the public-private platform owner emphasized the importance of *beta testing and piloting* with its ecosystem. As shown in the previous stage, TourismData engaged its ecosystem in the conceptual stage of defining important standards and data types. Based on these insights, TourismData engaged its ecosystem and incorporated this feedback dynamically throughout the development cycle, including piloting the first non-functional prototypes to functional beta-testing. For example, actors in MountainRegion could test the implementation with data sets in a "closed-beta" test. According to an essential stakeholder in the TourismData project, "we could go live right now; the platform works" (I4). Nevertheless, the beta test also uncovered that the amount of data was sometimes not enough for certain use cases or that data sets would not have sufficient quality for companies to engage: "People [i.e., startups] request data sets. The question here is can we provide them with data in sufficient quantities and quality for them to build and test their applications." (I2).

To avoid a negative first impression, the platform owners only gave access to some data consumers, as missing data sets or lack of high-quality data would have led to losing trust in TourismData. Other reasons why the OGD platform was not made publicly available immediately were non-technical challenges concerning open data licenses and legal problems. "Big problems are all factors around the project, especially the open data licenses and clearing up the legal situation of data. A particular problem is picture rights." (I4).

Even though the development was not finished, the third stage started. It is important to note that the OGD platform has been treated as an evolving infrastructure that requires input from the core partners. It must also be rigorously tested and activated in the third stage.

4.3. Stage 3: Activating the regional ecosystem with the help of ecosystem actors

The third stage describes the rollout of the OGD platform and the activation of actors in MountainRegion from 2019 to 2020 by *showcasing use cases* that illustrate the generative potential of the OGD platform and *provide training* on how to use it. During the showcases and training, TourismData built on its existing ecosystem to *engage new actors* in MountainRegion to join the OGD platform. Last, through these interactions, TourismData got important feedback on missing data and actors within MountainRegion to create a higher level of engagement.

As an early initiative, TourismData rolled out the OGD platform by organizing three events to *showcase existing use cases* between partners that illustrate the generative potential of OGD and to engage more actors in MountainRegion. For instance, TourismData was approached in the prior phases by an e-bike rental service provider from MountainRegion, who was interested in data on biking routes and POIs. The provider planned to integrate this data into its services to offer customers a seamless experience where they rent the bike, choose their tour and can find current information on interesting sights, events, or restaurants. This, among other examples, helped potential ecosystem actors see the value of sharing and consuming data.

Besides showcasing use cases, TourismData and ecosystem actors *provided training* on how to use the OGD platform. A university in MountainRegion and one of the initial partners within the TourismData ecosystem designed and held a practical course titled "*Building Smart Services for a Tourism Platform*." This course trained and encouraged students to develop digital services for MountainRegion. In addition, TourismData offered training and presentations to help municipalities in MountainRegion without a CMS set up and integrate into TourismData.

Building on these activities, TourismData *engaged further actors* by opening its APIs for startups and hackathons to untap the generative potential of the OGD. TourismData opened the APIs to gain insights into their usability, get feedback on the relevance of the data available, and finally, stimulate the development of new products and services based on the data. This helped TourismData to understand which data is combined for what purpose, the limits regarding aggregation and combination, and how ecosystem actors would use dynamic data types. As a first measure, TourismData participated in a local hackathon with more than 700 participants in 2019 and presented a challenge: "hack winter tourism! Boost tourism experience through digital innovation." This challenge attracted eight out of 23 teams present at the hackathon. In addition, TourismData invited seven start-ups to access their APIs and to develop prototypes. Six of the seven startups developed initial prototypes that illustrate the potential of OGD in MountainRegion (see Table 3: Use cases and requested data types of hackathon participants and mock-startups Table 3).

Engaging those actors also helped TourismData to *identify further data types and actors* needed to develop novel solutions. As shown in Table 3, hackathon participants and startups requested data like weather or public transport, so external actors that could provide this data should be engaged. The early engagement of actors also helped to identify shortcomings in the data. For example, POIs and events were not available for the whole of MountainRegion but deemed necessary for most services. Consequently, actors handling the relevant data were directly approached and included in subsequent discussions by TourismData. Furthermore, specific data types were added based on the feedback, for example, integrating a data type "review" to capture user feedback.

In conclusion, TourismData and its ecosystem activated new actors within MountainRegion by showcasing potential use cases with the data on the OGD platform, training potential ecosystem actors on how to use OGD, and conducting hackathons to reveal the generative potential and missing data and actors necessary to untap it. As a result of these activities, cross-regional ties between actors in MountainRegion and other regions became apparent and provided TourismData with the chance for

Table 3

Use cases and requested data types of hackathon participants and mock-startups.

Startup (S)/ Hackathon (H)	Prototype	Requested Data Types
S1	Connecting hotels and businesses to automate business travel bookings	Hotel capacities, offers, deals, POIs, traffic, public transport
S2	Personalized and weather-based trips using machine learning recommender system	POIs, weather, traffic, routes, reviews, crowdedness data
S3	Personalized city trips based on simple swiping gestures	POIs, events, reviews, crowdedness
S4	Planning and navigation of hiking tours	POIs, weather, hiking routes, geographical data, reviews
S5	Connecting local tourism vendors with micro-influencers	events
S6	Platform to find and match tourists for day trips	POIs, weather, traffic, capacities, public transport
H1	Mobile application with a travel bucket list for tourists, including suggestions and gamification features such as scavenger hunts	POIs, reviews
H2	Mobile application making suggestions of “must-visit places” for tourists with a small quiz to unlock coupons for those places	POIs, reviews
H3	Machine learning-based prediction of hiking route crowdedness for tourists and public actors maintaining the routes	hiking routes, reviews, geographical data, crowdedness
H4	Augmented Reality (AR) mobile application for tourists to explore historical sites and events	POIs, reviews, geographical data
H5	Mobile application for skiing tourists for navigation, guidance, recommendations, and gamification elements	POIs, events, weather, traffic, hiking routes, geographical data, crowdedness, reviews
H6	Mobile application connecting travelers and locals creating unique experiences with gamification elements	POIs, events, reviews
H7	Web application that allows SMEs to predict visitor numbers using live data analytics	POIs, events, weather, traffic, geographical data, crowdedness, reviews
H8	Mobile application for tourists to book skiing trips with one booking comprising hotel, transport, and tickets	POIs, traffic

inter-regional expansion.

4.4. Stage 4: Inter-regional expansion and scaling with the ecosystem as multipliers

In stage four, TourismData used the cross-regional ties discovered in the last stage to activate them and start a new cycle by focusing on a new region. During this stage, TourismData and its ecosystem engage *with actors from other regions*, *validate if the roles of key partners* from MountainRegion also apply to the new region, and *adjust the data standards and technical infrastructure* based on the insights gained. Based on this information, TourismData *develops an expansion strategy* and uses *existing ecosystem actors as multipliers* to activate other regions and ensure *interoperability with other platforms* to ensure scalability and new, inter-regional use case development.

Based on the positive word-of-mouth effect within MountainRegion, TourismData *engaged with other regional representatives*. The conceptual development, showcasing of use cases, and prototypes made representatives from other regions aware of TourismData. Seeing what was possible with OGD in tourism and how it would affect them in their region, these representatives asked TourismData to develop a more scalable approach that could be deployed in their regions. Seeing the

potential synergetic effects, for example, in the case of cross-regional tourism, the platform owner (I2) decided to expand and scale the OGD platform:

“It was good to start in one region, but we need a state-wide focus. The advantages to starting in one region are [...] sensitization for the project, initial communication that does not work in all states, understanding of data flows and existing system, and the challenge of data quality and licensing.”

Having requests from several regions, TourismData needed to decide where to expand next by *validating the role of key partners* in the new regions and how they would differ from MountainRegion. This decision can be best illustrated by two concrete regions that asked TourismData to expand to: CityRegion and WineRegion. Although all regions have a similar set of key actors due to the context of tourism, they differ in touristic attractions, data types, and complexity. For example, POIs and routes in MountainRegion are more outdoor-oriented, whereas CityRegion offers ample opportunities for indoor activities such as museums. In contrast, avalanche warnings as a data type have little relevance for CityRegion and WineRegion. The key learning of assessing different regions was to find similarities and differences between regions that would affect the expansion.

These learnings had also implications for the *data standards* and how TourismData would need to *adjust the technical infrastructure*. For example, through discussions with other regions, TourismData learned that there are four main CMS that different regions are using. However, it is not easy to integrate TourismData's data with other CMS due to different data schemes and formats. There are technical problems concerning APIs and how files are transferred using the File Transfer Protocol. As a result, technical considerations like what CMS a region used needed to be considered when defining the next region to expand to.

Based on the similarities in terms of needed key partners and required adjustments of the data standards and technical infrastructure, TourismData could develop an *expansion strategy*. In this expansion strategy, TourismData develops “guidelines in the MountainRegion how to engage with other regions.” The state ministry underlines this issue, as neither the ministry nor TourismData can “get in contact with 40.000 restaurants or hotels simultaneously,” they need an expansion strategy capable of growing organically (IP15).

The core of this expansion strategy is the integration of ecosystem *actors within MountainRegion as multipliers* to activate actors in the target regions. This approach would utilize the existing ecosystem actors by enabling them to activate actors from other regions they want to collaborate with. Examples are cross-regional use cases where tourists at CityRegion could book day or weekend trips to MountainRegion to make a stay more appealing. Actors in MountainRegion would benefit from these use cases by having access to additional tourists from CityRegion. This example illustrates the win-win situation that results from inter-regional collaborations and why actors of MountainRegion had been keen to activate inter-regional ties.

By shifting the expansion effort to ecosystem actors, those actors engage other actors in target regions autonomously and serve as a direct contact point with a specific use case. The platform owner describes this as a multiplier strategy to expand the ecosystem: “Existing networks are extremely important. For example, in the MountainRegion, there already exist relationships. You never start from zero, so you can move existing partners to work together” (I2).

As a last activity in stage four, TourismData *expanded its relationship with other OGD platforms*. These include the bordering states and neighboring countries. Following a similar logic as cross-regional tourism, foreign data or cooperation with other OGD platforms is especially important for border regions. Those can then offer information about destinations nearby but outside their area. The platform owner describes this as “[a] tourist does not know [inner country] borders, and if I have data from fringe areas, I can use them as well. Maybe there is an event or touristic highlight [...] I can inform them [the

tourists] about it" (I1). Hence, ensuring interoperability between other OGD platforms helps TourismData to increase tourism in its regions and help partners make their services more appealing to cross-border tourism.

In conclusion, stage four describes the organic expansion of TourismData into other regions by using existing ecosystem actors as multipliers. Based on an expansion strategy that assesses the similarities of actors and required technical adjustments between regions, TourismData uses existing ecosystem actors to expand into new regions. In addition to this incremental expansion, TourismData ensured interoperability between other OGD platforms to increase the attractiveness of their touristic regions even further.

5. Discussion

Extant literature on OGD platform ecosystem development proposes typical activities that comprise assessing data and actors, implementing the OGD platform and publishing data, and cultivating the ecosystem by attracting supply and demand side actors (Attard et al., 2015; Berrone et al., 2016). A downside of this approach is that citizens or firms often lack compelling use cases, leading to low engagement in the ecosystem (Bonina & Eaton, 2020; Danneels et al., 2017).

Based on insights from TourismData, we reveal a refined recursive approach that engages ecosystem actors from the start and builds on four iterative stages (Cloutier & Langley, 2020): conceptualizing a regional value proposition with local actors, continuously developing a scalable infrastructure based on ecosystem feedback, activating a regional ecosystem with the help of the existing ecosystem, and using the existing ecosystem for inter-regional expansion and scaling. This approach focuses on a context-specific ecosystem such as the tourism sector of MountainRegion (context specificity), continuously adapts the OGD platform based on the regional value proposition (continuous adaptation), and expands within and across the region with the references of regional actors (organic expansion).

Based on this approach, we will use context specificity, continuous adaptation, and organic expansion as essential learning to illustrate how TourismData iteratively grew the ecosystem while sustaining high engagement.

5.1. Engaging the ecosystem from the start: three learnings

5.1.1. Context specificity

The first learning of context specificity illustrates how TourismData worked closely with local actors to create high engagement. Context specificity describes how OGD platforms could engage their ecosystems from the start, beginning with a specific context. It helps platform owners develop a profound understanding of actors, data types, and interactions needed to develop a mutual value proposition with local actors, leading to high engagement.

Traditional OGD platform ecosystem development approaches usually start by collecting and publishing available OGD that citizens and firms can use to develop novel services (Attard et al., 2015). However, as it is unclear if and how this data provides value, platform owners must actively identify and engage potential users in later phases to increase engagement (Boudreau, 2021). This approach of data collection first and identifying potential use cases second often leads to low ecosystem engagement as the collected data provides little to no value to potential actors in the ecosystem (Bonina & Eaton, 2020; Danneels et al., 2017).

In contrast, OGD platform ecosystems that start with high context specificity by working closely with local actors increase relevance and spur future engagement. For example, TourismData started purposefully with the tourism sectors of MountainRegion and identified key actors needed to facilitate meaningful interactions within this region. This refined approach creates a profound understanding of actors, required data types, standards, and with whom and how these actors interact to create value in a specific context. Based on this high context specificity,

platform owners can develop an OGD platform incorporating important data types and standards, and data to initiate meaningful interactions with key actors in a local ecosystem that lead to high engagement.

In summary, OGD platforms that strive for high engagement should build their ecosystem with context specificity in mind. Context specificity allows platform owners to identify key actors, data types, standards, and interactions required to ensure that OGD facilitates meaningful interaction within the ecosystem.

5.1.2. Continuous adaptation

The second learning illustrates that OGD platforms must continuously adapt to contextual changes to sustain high engagement as the ecosystem evolves. Continuous adaptation describes the learning that platform owners need to continuously adapt the OGD platform as a technical foundation (i.e., data types) based on conceptualizing a mutual value proposition with local actors in a specific context (i.e., stage one). In addition, the activation and extension of these actors within and across the context can lead to further adaptations of the technical foundation (i.e., stage three) that must be considered continuously.

Extant literature predominantly assumes linear OGD platform development that builds on the assessment of available data, the subsequent implementation and publishing of data based on a OGD platform, and the cultivation of the ecosystem afterward (Attard et al., 2015; Danneels et al., 2017). This means that platform owners develop the OGD platform before gaining context specificity and cultivating the ecosystem, impeding ecosystem engagement. In addition, ecosystem actors are rarely involved in changing technological specifications and data types, illustrating the more linear approach (Bonina & Eaton, 2020).

In contrast, we propose a refined approach that builds on the first learning of context specificity to adapt the OGD platform continuously as second learning when changes in the context are sensed. The example of TourismData illustrates that identifying new actors within a specific region, such as mobility providers in MountainRegion, can inform platform development to include mobility data necessary for tourists to get from a hotel to a POI. However, even after the OGD platform is developed and data is published, insights gained from later phases, such as activating actors, can lead to further adaptations. Again, TourismData illustrates how hackathons during the activation stage informed the development of the technological platform to include weather data that are needed for certain use cases. Both examples illustrate how OGD platform ecosystems use continuous adaptation across stages to increase contextual responsiveness (Bonina & Eaton, 2020).

Hence, as a second learning, we propose that OGD platforms that strive for high ecosystem engagement build a malleable platform that can be continuously adapted based on contextual changes (Bonina & Eaton, 2020). As one of the interviewees described, OGD platforms should be seen as a digital infrastructure that must be malleable (Tilson, Lyytinen, & Sørensen, 2010; Yoo, Henfridsson, & Lyytinen, 2010) to adapt to a continuously changing context.

5.1.3. Organic expansion

The third learning illustrates that OGD platforms can expand and scale using their ecosystem based on a multiplier strategy. The multiplier strategy shows that OGD platforms can use their ecosystem to grow organically within and outside regions. This organic expansion has the benefit that new actors already have ties to the local ecosystem and can engage in value-creating interactions, increasing ecosystem engagement based on meaningful interactions.

Extant literature on OGD platform development usually follows a big bang strategy to cultivate and expand the ecosystem after the platform has been developed (Bonina & Eaton, 2020; Evans & Campos, 2013). These OGD platforms use existing OGD on the platform to conduct hackathons and run marketing campaigns to spur generative interactions in the ecosystem (Boudreau, 2021). At the center of all these

actions is the platform owner, who governs the OGD platform ecosystem and uses the data on the platform to find possible actors who could take advantage of it. However, studies show these approaches often fail to facilitate meaningful interactions within the ecosystem, leading to low generativity and engagement (Bonina & Eaton, 2020; Zuiderwijk et al., 2014).

The data of TourismData illustrates an alternative approach by building on actors in the ecosystem as multipliers to scale the OGD platform ecosystem organically from one region to another. Due to the high context relevance, ecosystem actors see the OGD platform's value, advertise it, and extend the OGD platform ecosystem. This expansion can take place within and across regions. TourismData, for example, included museums and theatres in CityRegion based on the demand of actors in MountainRegion to attract tourists from other regions. Actors within MountainRegion proposed including actors they know in CityRegion to allow cross-regional use cases such as day trips to museums and theatres. Hence, TourismData ensured high engagement based on context-specific interactions while organically expanding within CityRegion.

Last, as a third learning, we propose that OGD platforms that strive for high ecosystem engagement utilize an organic expansion strategy that shifts the effort for scaling from the platform owner to the ecosystem. In addition, new actors already have meaningful interaction points to the existing ecosystem that allow for value co-creation.

5.2. Summary of the three learnings

OGD platform ecosystems that aim for high ecosystem engagement can combine all three learnings. First, the learning of context specificity shows how OGD platforms can engage and work with local ecosystem actors to publish OGD, which leads to meaningful interaction at the start. Second, the learning of continuous adaptation illustrates that the OGD platform that thrives for high engagement must stay relevant and, therefore, continuously incorporate feedback from ecosystem actors. Last, the learning of organic expansion illustrates that local ecosystem actors also provide valuable feedback on inter-regional ties that help to inform the expansion strategy.

All three learnings build and complement one another to create a self-perpetuating ecosystem where relevance motivates actors to engage with OGD and expand the OGD platform ecosystem continuously through meaningful interaction (see Fig. 2).

5.3. Implications for theory and policy

The four stages and the derived three learnings have theoretical implications for developing OGD platforms that aim for high ecosystem engagement and literature on (citizen) engagement and value co-creation with OGD. In addition, we provide implications for policy-makers on when to use the sequential approach and when to use a more dynamic and iterative approach that engages OGD platform ecosystem actors from the start.

5.3.1. A dynamic approach for building OGD platform ecosystems

As shown in recent literature reviews, the development of OGD platform ecosystems usually follows a three-step process of assessing data and actors, implementing the OGD platform and publishing data, and cultivating the ecosystem by attracting supply and demand side actors (Attard et al., 2015; Berrone et al., 2016; Wirtz et al., 2022). Although these approaches have advantages, for example, publishing a large amount of OGD to provide government transparency (Boudreau, 2021), they often fail to spur meaningful engagement (Danneels et al., 2017; Zuiderwijk & Reuver, 2021). Hence, extant research indicates the need for more empirical research on alternative approaches to how OGD platforms can be built to generate high ecosystem engagement (McBride et al., 2019; Wirtz et al., 2022). Given the call for new research, we contribute to the literature on OGD platform ecosystem development by revealing a dynamic approach that engages the OGD platform ecosystem from the start.

The proposed iterative approach contributes to extant research on OGD platform ecosystems through four interlinked stages. The case of TourismData illustrates a dynamic approach to engaging the OGD platform ecosystem from the start by conceptualizing a regional value proposition with local actors that creates context specificity about key actors, data types, and value-adding interactions in a specific region. Instead of starting with available OGD and only then looking for actors who could use it (Kassen, 2013), we illustrate an alternative approach that starts by building context specificity about actors who can provide but also take advantage of OGD. In addition, as this first stage is highly conceptual, actors, data types, and standards can be easily incorporated before the actual OGD platform is developed.

Based on this context specificity, platform owners can develop a scalable OGD platform as a malleable infrastructure to adapt to new contextual information. To ensure that the OGD platform is malleable

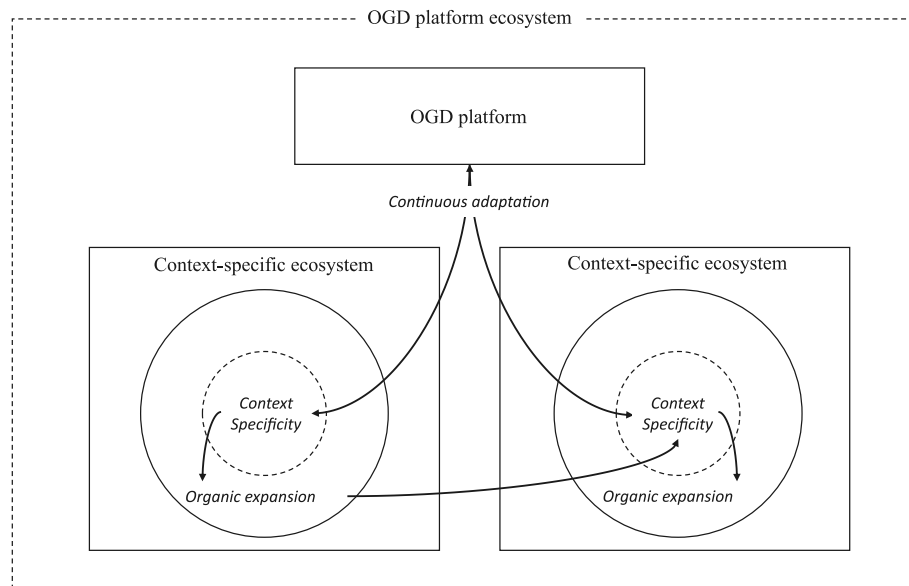


Fig. 2. Illustration of learnings of an OGD platform ecosystem development approach that engages ecosystem actors from the start.

and continuously adaptable, TourismData illustrates established software development guidelines such as modularity, application programming interfaces, and data schemes (Bonina & Eaton, 2020; Constantinides, Henfridsson, & Parker, 2018). It is important to note that this phase is never seen as finished in contrast to traditional approaches (Attard et al., 2015; Wirtz et al., 2022). Instead, platform owners must continuously develop the OGD platform based on sensed contextual changes. Through this iterative and continuous process, the platform owner learns about potential actors and data types that can be incorporated into the OGD platform ecosystem (Dawes et al., 2016).

Although activating OGD platform ecosystem actors through hackathons and other social tools is not new (Ansari et al., 2022; Bonina & Eaton, 2020), extant literature proposed a more linear approach (Attard et al., 2015). Again, TourismData illustrates that hackathons are used in the activation phase primarily for identifying new partners in a specific region and for ideating new use cases that can inform the continuous development of the OGD platform. For the activation, TourismData conducted beta testing with already identified actors to test new data sets and prevented actors unfamiliar with the OGD platform from having bad experiences that lower ecosystem engagement (Matheus & Janssen, 2020; Smith & Sandberg, 2018).

Besides the platform owner actively inviting actors, we also see that other actors can activate actors within and across the OGD platform ecosystem. Whereas extant approaches investigate the OGD platform ecosystem's activation and extension from the platform owner's perspective (Bonina & Eaton, 2020; Dawes et al., 2016), TourismData illustrates the value of including OGD platform ecosystem actors in the expansion process. This organic expansion shifts the effort to OGD platform ecosystem actors that advertise the OGD platform and create new inter-regional use cases without the platform owner needing to invest resources.

The four interlinked and dynamic stages complement sequential OGD platform ecosystem development approaches that start with data, build the platform, and then engage the ecosystem (Attard et al., 2015; Wirtz et al., 2022). Based on the insight from TourismData, we show that OGD platform ecosystems that aim for high engagement dynamically incorporate the learnings of context specificity, continuously adapting the infrastructure and activating actors to use it, and helping them to expand to other regions. Hence, the four stages are highly iterative and interconnected. We contribute to the literature on OGD ecosystem development approaches (Dawes et al., 2016) by showing an alternative approach that follows the principles of context sensitivity, continuous adaptation, and organic expansion to create high engagement.

5.3.2. Context sensitivity, continuous adaptation, organic expansion and engagement

Extant literature delineates multiple factors contributing to high engagement in OGD initiatives, ranging from personal and economic dimensions to social, technical, political, and performance-related aspects (Purwanto et al., 2020). While such literature emphasizes the importance of context in fostering engagement, it leaves an empirical gap regarding how context relevance translates and must be adapted to increase engagement. Moreover, most studies have largely explored OGD platform ecosystems from the perspective of platform-owner-driven governance mechanisms, often overlooking the critical roles of other ecosystem actors in driving engagement (Ansari et al., 2022; Zuiderwijk & Reuver, 2021).

Building on the nascent understanding of the importance of local context in OGD initiatives (e.g., Bonina & Eaton, 2020; Canares & Shekhar, 2016; Zuiderwijk et al., 2019), our study offers nuanced insights by unveiling how TourismData employed *context sensitivity* from the ecosystem's inception. Specifically, through the use of technical boundary resources such as modular APIs and data schemes (Ghazawneh & Henfridsson, 2010), the OGD platform was technically co-created with the ecosystem to be relevant for them and their specific context. In addition, TourismData shows that the OGD platform is not

considered a completed entity but rather a malleable infrastructure that can accommodate changes. This adaptability was made possible through a modular design of APIs and data standards that could be easily reconfigured (Constantinides et al., 2018; Tiwana, Konsynski, & Bush, 2010), thereby aligning with shifts in actors' interests and the availability of new OGD types. This reinforces the notion that OGD initiatives must *continuously adapt* to contextual shifts and emergent opportunities to retain their relevance.

Turning to *organic expansion*, our study expands upon the current literature by demonstrating that beyond platform owners, ecosystem actors can be invaluable in propelling the OGD platform ecosystem's growth. Actors within the ecosystem of TourismData were technical co-creators who continuously helped to improve the OGD platform but relational co-creators by actively suggesting new partnerships and contributing novel ideas for digital services. TourismData used social boundary resources (Foerderer, Kude, Schuetz, & Heinzl, 2019), such as showcases, hackathons, documentation, and training programs to enable ecosystem actors to expand and evolve the OGD platform ecosystem organically. This active involvement underscores the importance of context sensitivity, continuous adaptation, and organic expansion, as actors more deeply embedded in the context can expedite the OGD platform's growth and mitigate trust issues (Matheus & Janssen, 2020).

In summary, our study not only substantiates the theoretical premise that context sensitivity is critical for ensuring meaningful interactions within an OGD ecosystem but also illuminates how such relevance is not static; it must be continuously adapted. Further, we underscore the symbiotic roles played by various ecosystem actors, particularly in a context where the platform is designed following principles of context sensitivity, continuous adaptation, and organic expansion. These findings enrich our understanding of how to construct and maintain highly engaged OGD ecosystems.

5.4. Policy implications

Last, we provide implications for policymakers by differentiating between the traditional and linear approach of creating the OGD platform first and engaging the ecosystem second and the more incremental and dynamic approach of engaging ecosystem actors from the start. We argue that neither approach is superior to the other but that both have advantages and disadvantages, depending on the goal of the OGD platform.

First, studies subject to the sequential approach of OGD platform ecosystems illustrate that this approach is particularly effective when aiming for government transparency and dealing with a vast amount of OGD (Boudreau, 2021; Matheus & Janssen, 2020). One particular advantage of the sequential development approach is that expenses are plannable and that all OGD, independent of the data type, can be published on the platform (Attard et al., 2015). However, a downside of this approach is that platform owners who follow this approach often lack meaningful engagement in the ecosystem.

Second, a dynamic and more iterative approach that integrates OGD platform ecosystem actors from the start is more appropriate when aiming for high ecosystem engagement and utilizing the generativity of the ecosystem (Magalhaes & Roseira, 2020; Ruijter & Meijer, 2020). One advantage is the dynamic development process that builds on context relevance, continuous adaptation, and organic expansion by integrating ecosystem actors to increase engagement. However, a downside of this approach is that platform owners, often governmental entities, must continuously invest time and resources in developing the platform and interacting with ecosystem actors.

Both development approaches for OGD platform ecosystems show that none is superior but that they can complement one another. Take, for example, the OGD platform GovData, which published a vast amount of OGD and increased governmental transparency dramatically. Among others, GovData publishes public transportation data from several

regions in Germany. This data can then be used by more dynamically and incrementally building OGD platforms, such as TourismData, that require high context relevance to spur ecosystem engagement. To achieve this, they work closely with local ecosystem actors to work on innovative use cases. This example illustrates that traditionally built OGD platform ecosystems can act as metaplatfroms providing access to vast OGD. In turn, this data can then be used by a more context-aware, dynamically built OGD platform ecosystem to create context sensitivity and spur ecosystem engagement.

6. Conclusions

The study of TourismData and its subsequent development has several limitations. First, as this study builds on an inductive and explorative case study, the findings of the study are not readily generalizable. Although the literature on value co-creation and citizen engagement with OGD shows that a more incremental and dynamic development approach that builds on high context relevance and engages actors from the start can increase engagement (Gascó-Hernández et al., 2018; McBride et al., 2020), further research is needed to test if the three learnings and the dynamic development approach is generalizable. Hence, we encourage future research to see if the learnings and our development approach are valid for other contextual settings besides tourism. Other promising settings could be environmental and ecological sustainability or smart city initiatives (Bonina & Eaton, 2020; Rudmark et al., 2012), all providing rich OGD and benefiting from engagement on the local level.

Second, the nature of our study and the data do not allow any statements or predictions regarding the medium and long-term impact of our OGD platform ecosystem development approach. Although we view the recent investments made by the state government as a sign of its positive commitment to further developing the OGD platform ecosystems and significantly impacting the tourism sector at various levels, we have yet to determine the limits of this approach. Hence, we encourage future research to follow a longitudinal approach (Bonina & Eaton, 2020) to investigate the influence of increasing complexity on integrating ecosystem actors from the start and how this complexity could be governed.

Last, the case study reports from Germany, which has a federated government, with highly autonomous states and regions. The fragmentation of decision rights at the local and state levels could be a catalyst for the proposed development approach of OGD platform ecosystems. An interesting avenue for future work is to examine the refined

development approach and the particular challenges in more centralized countries (e.g., France or China), which would naturally choose more traditional approaches (Styrin, Luna-Reyes, & Harrison, 2017).

In conclusion, OGD platform ecosystems hold immense potential for promoting transparency, civic engagement, economic growth, and improved governmental offerings. However, most OGD platforms have failed to spur ecosystem engagement (Zuiderwijk & Reuver, 2021), as they tend to follow a linear development approach, which starts with publishing data first and attracting ecosystem actors second. This article proposes an alternative approach that engages ecosystem actors from the start to address this problem. Drawing on a case study of the OGD platform TourismData in Germany, the article identifies four stages of development, which involve conceptualizing a regional value proposition with local actors, developing a malleable infrastructure, activating actors within the region, and expanding the ecosystem through an approach that engages its ecosystem from the start. These findings have implications for developing and designing high-engagement OGD platform ecosystems that take advantage of the generative potential of open data.

CRediT authorship contribution statement

Andreas Hein: Supervision, Investigation, Project administration, Writing – review & editing. **Martin Engert:** Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Writing – original draft. **Sunghan Ryu:** Conceptualization, Validation, Writing – original draft, Writing – review & editing. **Norman Schaffer:** Methodology, Formal analysis, Data curation. **Sebastian Hermes:** Formal analysis, Validation, Investigation. **Helmut Krcmar:** Validation, Resources, Supervision, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Literature on building OGD platform ecosystems

We differentiate between typical activities of OGD initiatives and OGD platform ecosystems that focus on user engagement and innovation.

Type	Author(s)	Typical Activities
General	(Abu-Shanab, 2015)	1) <u>Provide transparency</u> : ensure information quality and accessibility 2) <u>Ensure accountability</u> : ensure privacy, security, disclosure, and standardization 3) <u>Ensure collaboration</u> : communication, partnership, and feedback 4) <u>Ensure empowerment</u> : decision-making by citizens, enforcement
General	(Attard et al., 2015)	1) <u>Pre-process</u> : creating, selecting, harmonizing, and publishing data 2) <u>Exploitation</u> : linking, discovering, exploring, and exploiting data 3) <u>Data curation</u> : maintaining and curating data
General	(Crusoe & Ahlin, 2019)	1) <u>Identify data</u> : identify data and develop idea what can be done with the data 2) <u>Acquire data</u> : acquire data and introduce it to users 3) <u>Enrich data</u> : enrich and add further data 4) <u>Deploy</u> : users assess and explore data
General	(Matheus et al., 2021)	1) <u>Elicit data needs</u> : disclose and get transparency over data 2) <u>Collect data</u> : collect data in any form 3) <u>Publish data</u> : publish data 4) <u>Use data</u> : use data and create insights

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Type	Author(s)	Typical Activities
OGD Platform Ecosystem	(Berrone et al., 2016)	5) <u>Share results</u> : share data with ecosystem 6) <u>Determine action</u> : use data transparency for policy action 1) <u>Open data development</u> : define leadership and governance 2) <u>Strategy definition</u> : define vision, mission and select data 3) <u>Determine value of data</u> : opportunity and ease of opening 4) <u>Develop platform</u> : implement and develop platform
OGD Platform Ecosystem	(Bonina & Eaton, 2020)	1) <u>Establish the platform</u> : develop the platform 2) <u>Facilitate supply of datasets</u> : identify and collect data 3) <u>Facilitate demand for datasets</u> : cultivate and onboard developers 4) <u>Evolve the ecosystem</u> : evolve supply and demand-side
OGD Platform Ecosystem	(Boudreau, 2021)	1) <u>Develop OGD platform</u> : define structure and governance 2) <u>Publish available data</u> : publish available OGD 3) <u>Engage citizens</u> : organize hackathons and engage citizens
OGD Platform Ecosystem	(Dawes et al., 2016)	1) <u>Policy and Strategy</u> : provide legal basis for OGD 2) <u>Data publication</u> : collect and publish available information 3) <u>Data use</u> : provide opportunities for ecosystem to use data 4) <u>Feedback and communication</u> : incorporate feedback and improve the platform
OGD Platform Ecosystem	(Heimstädt et al., 2014)	1) <u>Policy and Strategy</u> : provide legal basis for OGD 2) <u>Develop platform</u> : develop infrastructure and governance 3) <u>Data publication</u> : collect and publish available information 4) <u>Data use</u> : provide opportunities for ecosystem to use data 5) <u>Feedback and communication</u> : incorporate feedback and improve the platform
OGD Platform Ecosystem	(Styrin et al., 2017)	1) <u>Publish data</u> : provide and publish OGD 2) <u>Evaluate and view data</u> : search, find, evaluate, and view data 3) <u>Cleanse and enrich</u> : clean, analyze, combine, enrich, link, and visualize data 4) <u>Get feedback from stakeholders</u> : get and provide feedback from and to data providers 5) <u>Engage stakeholders</u> : engage data providers and consumers in value co-creation process
OGD Platform Ecosystem	(Zuiderwijk et al., 2014)	1) <u>Publish data</u> : provide and publish OGD 2) <u>Evaluate and view data</u> : search, find, evaluate, and view data 3) <u>Cleanse and enrich</u> : clean, analyze, combine, enrich, link, and visualize data 4) <u>Get feedback from stakeholders</u> : get and provide feedback from and to data providers

Appendix B. Overview of interview partners

Table 4

Overview of interview partners.

IP#	Interviewee Organization [Type]	Relation to TourismData	Interviewee Position	Number of Interviews
IP1	DMO* LakeRegion [Public-Private]	Potential User	Senior Product Manager	1
IP2	DMO WesternRegion [Public-Private]	Potential User	Marketing Manager	1
IP3	Accommodation Association [Private]	Potential User	CEO	1
IP4	DMO SouthernRegion [Public-Private]	Potential User	CEO	1
IP5	DMO EasternRegion [Public-Private]	Potential User	Head of Digital Projects	1
IP6	DMO BorderRegion [Public-Private]	Potential User	Head of Digital Media	1
IP7	Climbing Association [Private]	Potential User	Head of Online Portal	1
IP8	DMO NorthernRegion [Public-Private]	Potential User	Head of Online Marketing	1
IP9	Countryside Tourism Association [Private]	Potential User	Head of Marketing	1
IP10	DMO PeakRegion [Public-Private]	Potential User	Tourism Manager	1
IP11	DMO MountainRegion [Public-Private]	Consortium Partner	Digital Marketing Manager	2
IP12	Local B2C Tourism Portal Owner & B2B Software Vendor [Private]	Consortium Partner	Head of Development	2
IP13	B2C Digital Travel Guide	Potential User	Founder & CEO	1
IP14	B2C Digital Travel Guide	Potential User	Founder & CEO	1
IP15	State Ministry	Initiator and Financing	Director Tourism and Digital Tourism	3

* DMO: Destination Marketing Organization

Appendix C. Data Structure of TourismData Development Approach

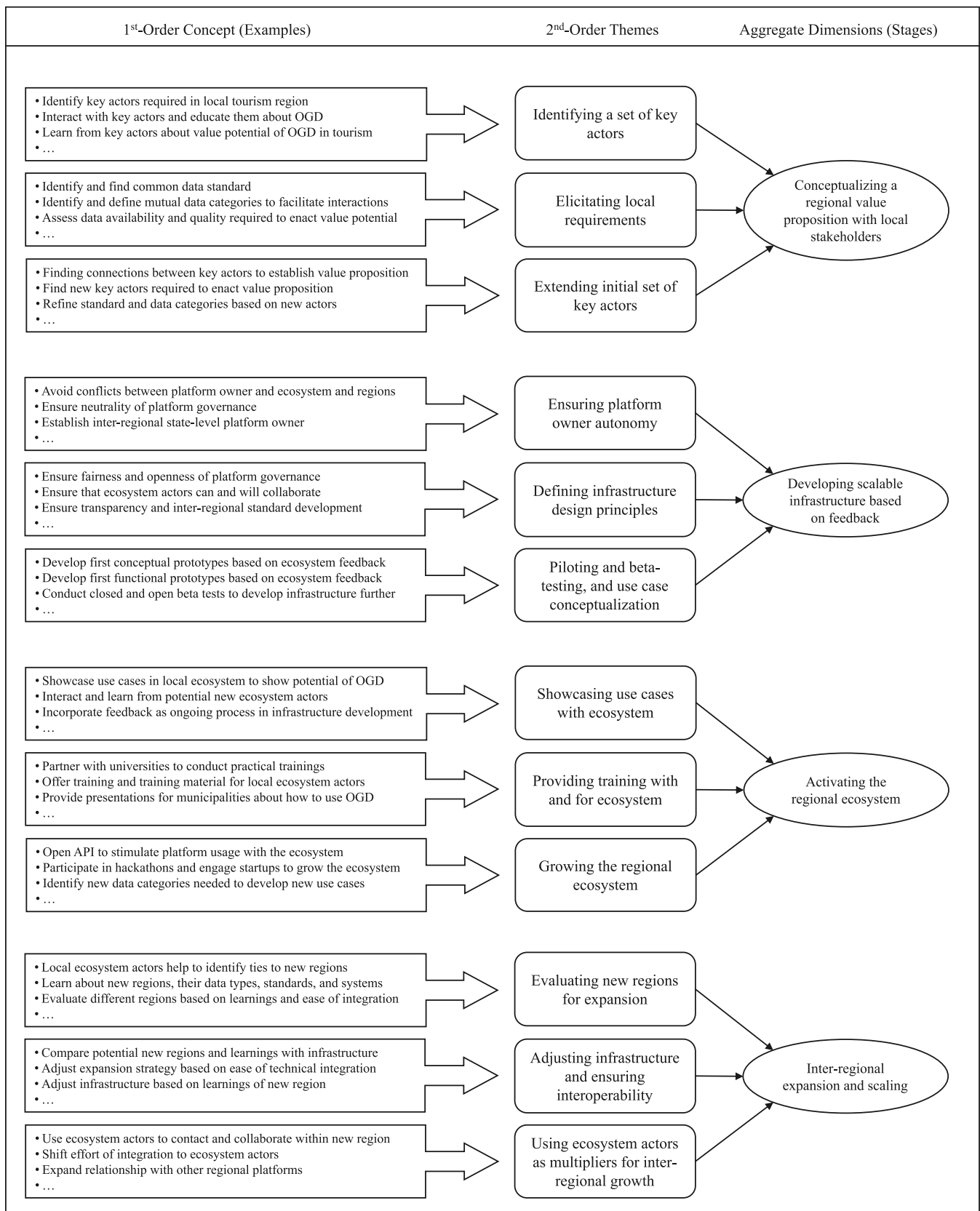


Fig. 3. Data structure of TourismData based on Gioia et al. (2013).

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Andreas Hein is a research group leader at the Chair for Information Systems, Technical University of Munich (TUM), Munich, Germany. He holds a Master's degree at TUM in Information Systems. In addition, Andreas has three years of experience as a Senior Strategy Consultant at IBM. His work has appeared in journals such as the *The Journal of Strategic Information Systems*, *Information Systems Journal*, *European Journal of Information Systems*, *Business & Information Systems Engineering*, *Electronic Markets* and refereed conference proceedings such as ICIS, ECIS, PACIS, AMCIS, and HICSS. Andreas focuses his research on digital platform ecosystems and value co-creation in complex ecosystems.

Martin Engert is a Ph.D. student at the Chair for Information Systems at the Technical University of Munich (TUM), Munich, Germany. He holds a Master's degree in Management at TUM. Martin has experience in innovation and intellectual property (IP) management from both AUDI AG and ZF Friedrichshafen AG. Besides, he worked as a freelance IP consultant. His research interests concern digital platform ecosystems, value co-creation, open-data, and data-driven business models. His work was published in conference proceedings such as AMCIS, ECIS and PACIS.

Sunghan Ryu is an associate professor at USC-SJTU Institute of Cultural and Creative Industry in Shanghai Jiao Tong University. He is also the founding director of the Center for Digital Creative Enterprise Research and serves as the series editor for the Digital Entertainment series of Sage Business Cases. His research interests include digital

innovations in cultural and creative domains and effective digital technology applications in the creative entrepreneurial context. He is the author of the book “Beauty of Crowdfunding: Blooming Creativity and Innovation in the Digital Era” (Routledge, 2019). His research works appeared in top academic journals, including *MIS Quarterly*, *Journal of Strategic Information Systems*, *International Journal of Electronic Commerce*, *Internet Research*, *Electronic Markets*, *New Media & Society*, and *Journal of Marketing*, and were presented at prestigious conferences such as ICIS, HICSS, Annual ICA Conference, and AOM Annual Meeting.

Norman Schaffer is a research associate at fortiss, Munich, Germany, in the Requirements Engineering department. He further pursues a Ph.D. at the Chair for Information Systems at the Technical University of Munich (TUM), Munich, Germany. He holds a Master's degree in business administration and mechanical engineering at RWTH Aachen. Norman has worked for Robert Bosch GmbH and Lufthansa Technik. His research interests concern dynamics in business models, data-driven business models, digital platform ecosystems, digital transformation of SMEs, regulatory compliance of software systems and open data. His work was published in conference proceedings such as AMCIS and ECIS.

Sebastian Hermes is a research associate and Ph.D. student at the Krcmar Lab, Technische Universität München (TUM), Munich, Germany. He holds a Master's degree in Entrepreneurship from the University of Liechtenstein and a Bachelor's degree from the Baden-Wuerttemberg Cooperative State University. Sebastian has worked six years at Roche Pharma and co-founded Thinkfield. His work has been published in *Electronic Markets*, *Business Research*, *AIS Transactions on Replication Research*, and in refereed conference proceedings such as ICIS, AOM, ECIS, HICSS, AMCIS, and PACIS.

Helmut Krcmar is currently a Professor Emeritus of Information Systems with the Department of Informatics, Technische Universität München (TUM), Munich, Germany, with a joint appointment with the School of Management, where he is currently the Founding Dean and Delegate Officer of the President for TUM Campus Heilbronn. His research interests include information and knowledge management, engineering, piloting, and management of innovative IT-based services, and computer support for collaboration in distributed and mobile work and learning processes. He has co-authored a plethora of research papers published in major IS journals including *Management Information Systems Quarterly*, *Journal of Management Information Systems*, *Journal of Information Technology*, *Information Systems Journal*, *Journal of Strategic Information Systems* and *European Journal of Information Systems*. Helmut Krcmar is a Fellow of the Association for Information Systems and a Member of the Acatech National Academy of Science and Engineering.