



Municipalities' digitalization and sustainability transformations: A network approach for designing a transdisciplinary knowledge community

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ABSTRACT

In response to changing climatic conditions and the increasing need for more inclusive and participatory municipal service provision, many municipalities are undergoing a dual transformation process, one digital and one socio-ecological one. However, municipalities are at different stages and with different paces, often neither know what each other's transformation processes look like nor have the tools and resources for meaningful cooperation. To foster knowledge sharing and mutual learning, we use a network approach for designing a transdisciplinary knowledge community for municipalities undergoing such transformation processes. This research in progress serves to improve the transfer between science and practice.

CCS CONCEPTS

• **Human-centered computing** → HCI theory, concepts and models; Social networks; • **Social and professional topics** → Sustainability.

KEYWORDS

municipalities, knowledge networks, transdisciplinary research, community building, digitalization, sustainability transformation

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1 INTRODUCTION

Municipalities are currently facing a dual transformation process. One, they want to improve their public municipal services, for example through more citizen participation and involvement and more convenience through digital technologies, and two, they want to become more environmentally friendly and minimise the negative impact of digitalization on the environment [7, 32]. Despite this broad range of tasks, municipalities face similar challenges in transformation processes. For example, if the choice of participation tools, such as open source tools [8], and providing environmentally friendly, just, and inclusive digital public services from energy and water provision to education and care [9]. We argue that municipalities, local citizens, professionals, and researchers can—given enabling context conditions—profit from exchanging practices, knowledge, and tools, and from joining future projects to share and adding up their limited resources while learning from each other's experiences.

Municipalities are clearly segregated areas without geographical overlap. Different locations lead to varying contexts of each municipality, with regard to the local systems in use, people, spaces, and organizational procedures. For this reason, transformation projects often happen in isolated ways. Municipalities lack the time and resources to connect with similar municipal projects as well as the specialized expertise to be able to adequately use existing knowledge [3]. Cross-departmental cross-cutting issues in particular pose a challenge for administrations. Conducting transformation is therefore less about technological innovations, but rather about sound adaptation for the local context and thus about social innovations [20]. Digital technologies can help achieve such innovation in certain use cases, but even more central is the community learning process, which constitutes forms of appropriation, agency, and ownership – rather than an externally perceived dynamic.

Since early work, knowledge sharing is considered as a crucial issue for C&T, e.g. [30]. Recently, researchers highlighted the “need for orienting future C&T efforts away from depoliticisation and towards a more active pursuit of targeting meso- and macro-levels of community institutions, political framing, and planetary impact” [13]. We present an approach that is directed toward this

need: for a transdisciplinary knowledge community to support and promote municipalities' self-determined digitalization and sustainability transformations. This community is built by using a network approach. A primary community goal is creating and exchanging knowledge to foster learning and collaboration between different concerned stakeholders, such as academia, civil society, business, and municipalities. The municipalities shall be enabled to exchange sub-goals, practices, and lessons learned, while preventing errors, discussing technologies in use, and coordinating potential joint public tenders for sharing efforts and benefits.

2 BACKGROUND

2.1 Transdisciplinary research

In transdisciplinary research, practitioners are substantially involved in a research project and not only the object of investigation [17]. Such collaborations are dedicated to improving the transfer between science and practice, which is promising to meet societies' need for sustainable development [15]. Likewise, research can profit from transdisciplinary projects since results and conclusions are strongly grounded in the fields. Research efforts aim for tackling complex and wicked problems of municipal transformation. Therein, scientific knowledge is used to facilitate both digitalization and sustainability transformation [25]. Characterized by the mutual learning of the involved actors and the claim to develop concrete solutions, transdisciplinary research can be achieved by approaches of co-creation, co-design, and co-production [6, 17, 27] in diverse contexts, e.g. urban planning and municipality development [19].

2.2 Knowledge network community

The characteristics of social relationships and the resulting networks have a major impact on the effectiveness and efficiency with which individuals and organizations (co-)create knowledge by influencing their ability to access, transfer, assimilate, and apply knowledge [22]. This type of knowledge network involves interconnected individuals or higher-level organizations that serve as heterogeneously distributed knowledge repositories and agents that seek, share, and create knowledge; at the same time, networks can enable and constrain efforts by individuals to acquire, share, and create knowledge [22]. This networking aspect positively affects the learning curve of the network participants [24], which in turn, is highly likely to positively affect respective transformation quality and velocity. However, such network effects require a constant effort in network management including communication, negotiation processes, moderation, fair distribution of effort and returns, and building trust [26]. In this context, the possibilities of digitalization allow to integrate distant, distributed actors and their knowledge into knowledge communities [cf. 11]. Networking positively affects the knowledge exchange since organizations positioned in networks of external relations adopt more administrative innovations and do so earlier [29].

3 CASES

We have so far collected two municipalities in Germany who seek advice, support, and guidance in their complex transformation projects struggling with wicked problems, conflicting objectives, legal uncertainties as well as limited resources of time, knowledge,

and budget. First non-standardized meetings with people in charge in the two locations took place and we got access to respective project proposals and strategic documents.

3.1 Case 1: Treuchtlingen

The City of Treuchtlingen, having a population of 13,600, is located about 120 km north of Munich. The population has been nearly constant for more than three decades. In 2001, Treuchtlingen was one of the first cities in Germany to convert its IT infrastructure to free open-source software (FOSS). Ever since, the city administration has benefited from the freedom to understand, use, and adapt transparently designed software without restrictions [21]. Based on more than 15 years of experience in using FOSS for services, city administration describes this strategy as "mindfully digital." For example, in administrative processes, the German XÖV data exchange format, open document formats, Linux-based operating systems, the "freedesktop.org" standards, and the Firefox browser are employed. The administration exerts control over the software used, thereby enabling resilient and future-oriented administration services. As an additional benefit, FOSS in Treuchtlingen is primarily implemented by regional IT companies in cooperation with the city administration.

3.2 Case 2: Eberswalde

The City of Eberswalde having about 40,000 inhabitants is located about 60 km north of Berlin. The city population shrank after German unification but has been stable for about five years. Eberswalde is not a pioneer in tackling the dual transformation processes. One specific starting point is the city's cooperation with the Eberswalde University for Sustainable Development. In student projects, approaches for sustainable public services were developed in direct exchange with representatives from administration and politics. One case study found self-determination as a particular challenge for developing municipal digital infrastructure [28]. FOSS, as implemented by case 1 could be part of a solution for such demand of case 2. At the same time, the city administration is aware that not all citizens have the same access to and conditions for participating in digital platforms and formats. Therefore, analog offerings need to be created to counteract exclusion [28].

4 APPROACH

4.1 Community Development Approach

Resonating with questions and concerns of the municipalities and different stakeholders, we apply a knowledge networks approach to create a transdisciplinary knowledge community. The networks approach integrates different perspectives on similar challenges, brings together experts on different topics, and allows for in and outflow of loosely coupled members. It shall emphasize "the triad of people, place, and technology [... and] the softer aspects of information exchange, communication and interaction, social networks, and human knowledge" [12][p.5], one of the core concepts of urban informatics.

The knowledge community shall assemble a variety of practice and research projects represented by a network of participating researchers and partners in the domains of urban and municipal

transformation. Following Krebs and Holley [18], vibrant community networks are often built in four phases: 1) Scattered Clusters, 2) Single Hub-and-Spoke, 3) Multi-Hub Small-World Network, and 4) Core/Periphery Network.

The initial task of intentional community building from scratch is assembling the distributed parties. The participants who are municipalities, researchers, civil society, and professionals at least partly share common interests and goals. However, they use to act in an isolated manner. To meaningfully connect different participants, an active community network manager needs to be assigned who takes responsibility for the network-building process. The manager creates interactions between the parties by exchanging contact details and existing materials between the municipal community members and setting introductory (virtual) meetings, leading to the emergence of a community structure. Furthermore, technological infrastructure for exchange needs to be provided. We will create a low-barrier website that contains basic information about the municipal transformation projects and (contact) details of the people in charge of particular domains.

The community network manager functions as a hub, that is, s/he serves as the central node in the network and can, thus, quickly disperse information. Requirements to the manager are vision, active engagement, and sufficient social skills to connect to the diverse individuals and groups as well as starting to flow information to and from the participants [18]. This process will be supported by creating a mailing list and a messenger chat group. All the network partners take responsibility to share their challenges and experiences and — of the same importance — bring in resources and innovation. Further, the community needs a transdisciplinary problem description as a common ground for joint network activities. Crucial tasks are the identification and formulation of a common network goals and the development of a joint vision of the transformations ongoing for example by activities such as (virtual) meetups and workshop. After having an overview, the community manager starts connecting individual parties and encourages parties to weave further synergistic ties in the network regarding particular topics, for example regarding municipal use of FOSS. For such meetings, we will primarily rely on virtual formats of collaboration because, in addition to eliminating travel time and costs, they can be integrated more efficiently into everyday office life and are more likely to allow smaller communities with few employees to participate [15]. At this time, it is equally important to further develop the network and seek more municipalities that already developed approaches concerning particular issues.

Introducing parties with the same goals and challenges or complementary skills can lead to weakening the ties to the initial central community manager hub but also creates new thematic-specific hubs. Such hubs democratize the community, support thematic experts, and also increase network resilience. However, the community manager remains central in the overall administration of the network and its activities. His/her role changes towards being a facilitator of network building throughout the community. This role is about both building relationships and trust as well as creating new central actors. Thereby, the advantages of weak ties [1] can be leveraged for the network. Dispersed hubs shall be connected for creating a multi-hub community, which focuses the knowledge transfer and joint learning on specific problems of the involved

municipalities. The next step is to transform weak ties into strong ties in the network, e.g., via full community meetups, idea summits, and social events that take place annually for example at the institution of the community network manager. Finally, the network core comprises key community members that have developed strong ties between themselves. The periphery contains actors that are new to the community and is a vibrant place for new ideas, information, and challenges. The core on the other side allows acting on those ideas by conducting specific thematic workshops.

In the beginning, a low-threshold cooperation by virtual meetings including case 1 and case 2 will set impulses that can be strengthened and deepened by further projects and an inter-municipal exchange. For instance, participants could learn from each other about the use, goals, and limitations of FOSS for self-determined municipal governance while research is actively participating in this exchange and generating new knowledge from it.

We are aware that people living in the communities but without particular interest in a dual municipal transformation and/or who are generally lacking time and resources will highly likely not be able to become part of the knowledge community. To increase the diversity of voices and participants in the planned workshops, we plan to conduct sidewalk interviews in different local areas beforehand, for example in front of schools, companies, kindergartens, job centers, refugee hostels, and shopping streets. This data will be represented by the academic knowledge body in the community workshops.

4.2 Transdisciplinary knowledge community

All bodies of the transdisciplinary municipal knowledge community (see Figure in appendix) are represented by actors practicing in their respective fields. All knowledge bodies shall inform the knowledge and practices of one another focused on specific practical problems of municipalities and hence benefit from participating in the community. (1) The civic knowledge body which will be provided by actors like engaged citizens, and civil society organizations (CSOs) would be enabled to increase citizen participation, inclusion, and empowerment. (2) The professional knowledge body would include actors like journalists, designers, IT experts, and urban planners who would have advantages from the community in terms of improving their products and services, practicing joint innovation, and building a future audience or client relations. (3) The municipal knowledge body includes knowledge from city managers, political actors, and administrative staff who would profit in terms of an organized inter-community exchange, scaling effects, sharing of financial resources, and academic consulting. (4) The academic knowledge body would be provided by participating researchers (and students) who would benefit from the community in terms of fieldwork access, the possibility to check the validity of the research findings, and increased academic transfer to society. In a broader sense, we design this knowledge community for enabling more general benefits such as strengthening co-creation, transfer, and transdisciplinarity. The community will support the complex shift towards sustainability in communities, primarily by considering and understanding how “sustainable development” can be fostered and “participation” can be implemented in each of the municipalities and by what concrete digital means this can be addressed.

The coordination effort, especially in the institutionalization of the community, is very high, likewise, the selection of appropriate formats is essential. Virtual collaboration formats [15] and in-person formats need to be combined meaningfully. Particularly with regard to empowering citizens on transformation issues and urban interventions, for example, citizens' assemblies and ideas summits can activate a broader public [2]. For instance, casual local festivals present a beneficial context for launching new technologies [16]. Since this research is in progress and the community is in its infancy, there are several tasks at hand. A permanent community manager needs to be assigned, regular formats conceptualized and institutionalized, and stakeholders with an overlap in interest connected. A community vision and common goals need to be developed, multiple thematic hubs and experts gathered, the technological infrastructure for the network provided, regular formats for information and knowledge exchange established, and trust and relationships cultivated.

5 DISCUSSION AND CONCLUSION

We present an approach for a transdisciplinary knowledge community of municipalities undergoing digitalization and sustainability transformations. We apply a network approach to improve interactions among the members and to foster knowledge exchange among sub-communities. The connection of many different municipalities allows for joint learning, and quick information flows through the network, leading to transparency and accessibility regarding individual skills, goals, challenges, and solution approaches. The community also allows for the aggregation of demands, which can be communicated to governments and funding bodies. Active development, managing, and steering of the community are necessary and need to be adjusted to the evolving community structure. Further challenges appear in creating a transdisciplinary community. The next steps are the design of local workshops and the increasing of voices who have a say in these workshops. Language barriers between disciplines and also between different stakeholder groups need to be overcome. We are well aware of contextual particularities (e.g. geo-locations, socio-economics, cultural differences, administrative challenges), pre-existing relational structures, and challenging legal frameworks that cannot always be solved within design research. Still, we believe that the diversity of non-academic practitioners from municipalities can provide such knowledge. To bridge inter-community knowledge gaps using technology and personal networks, individual local collaborators can translate more abstract community knowledge into local contexts and vice versa [5]. Nonetheless, scaling up practice-based design activities depends on community networking activities [31]. For example, networking with similar initiatives, navigating value diversity, establishing larger organizational structures, contributing to public discourse, and engaging policymakers are identified as important factors for scaling design activities [31]. Ultimately, municipal transformation processes are closely linked to infrastructure change and creation and the process of infrastructure structuring [10, 14, 23] and impose a high degree of responsibility on the transdisciplinary knowledge community.

Early conversation-based investigations in the communities brought up important issues demanding further exchange and discussion.

Streaming the citizens' meetings in Treuchtlingen, for example, highlighted a conflict of objectives between protecting citizens' privacy and a high level of inclusion. The point is that inclusion cannot be assumed *per se*, but must be proven and monitored. However, the streaming service intentionally does not require registration and does not collect metadata. This high standard of privacy makes it difficult to compile statistics on the diversity of participating citizens, which is often required when exploring inclusivity and participatory design of technological applications. Although virtual participation is "encouragingly high", city government officials can only assume that this audience reflects the diversity of the citizenry. A second issue this time from Eberswalde shows how municipal digitalization efforts do not seem to meet the needs of citizens. The city has adapted an existing smart city mobile app to its local context, but the number of users remains very low. The desired impact of the app - improving digital connections between the city and its citizens - has not happened. What we take away from this example is that it is crucial to first understand the needs of the citizens before introducing a digital tool with a barely defined goal. Other participating municipalities can learn directly from this experience. A third issue from Treuchtlingen also relates to the considerations in Eberswalde: the staff in the administration does not always appreciate the use of FOSS - for reasons that are seemingly foreseeable and could possibly have been prevented otherwise.

We have further learned about existing collaborations between the municipal administrations with local media journalists and local universities we will consider these ties in our community building process and invite them to join. Currently a team of interdisciplinary researchers is acting as network manager and seeks further connections to IT experts and design researchers, for example on international conferences. We also believe that durability is the key to building a meaningful knowledge community. For this reason, we do not want this community to be dependent on specific research project funds, but rather we focus on building small hubs that can persist independently of project funds.

We briefly outline the external conditions of our framework in the following: We see two primary prerequisites of our approach. One is that interested participants are able to allocate time and resources to get involved in the community. The other is that mutual learning requires trust since the simple provision of information does not necessarily initiate learning processes. Furthermore, our approach has limitations: Sustainability and digital transformation processes are of general interest, systemic, and hence governmental duties [4]. Resources should therefore be made available for such transformation tasks. The legal framework for digitalization in particular should be designed with sustainable development in mind. In the end, the functioning of a transdisciplinary knowledge community depends very much on a supportive governmental framework as well as individual's resources, motivations, and capabilities.

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A FIGURES

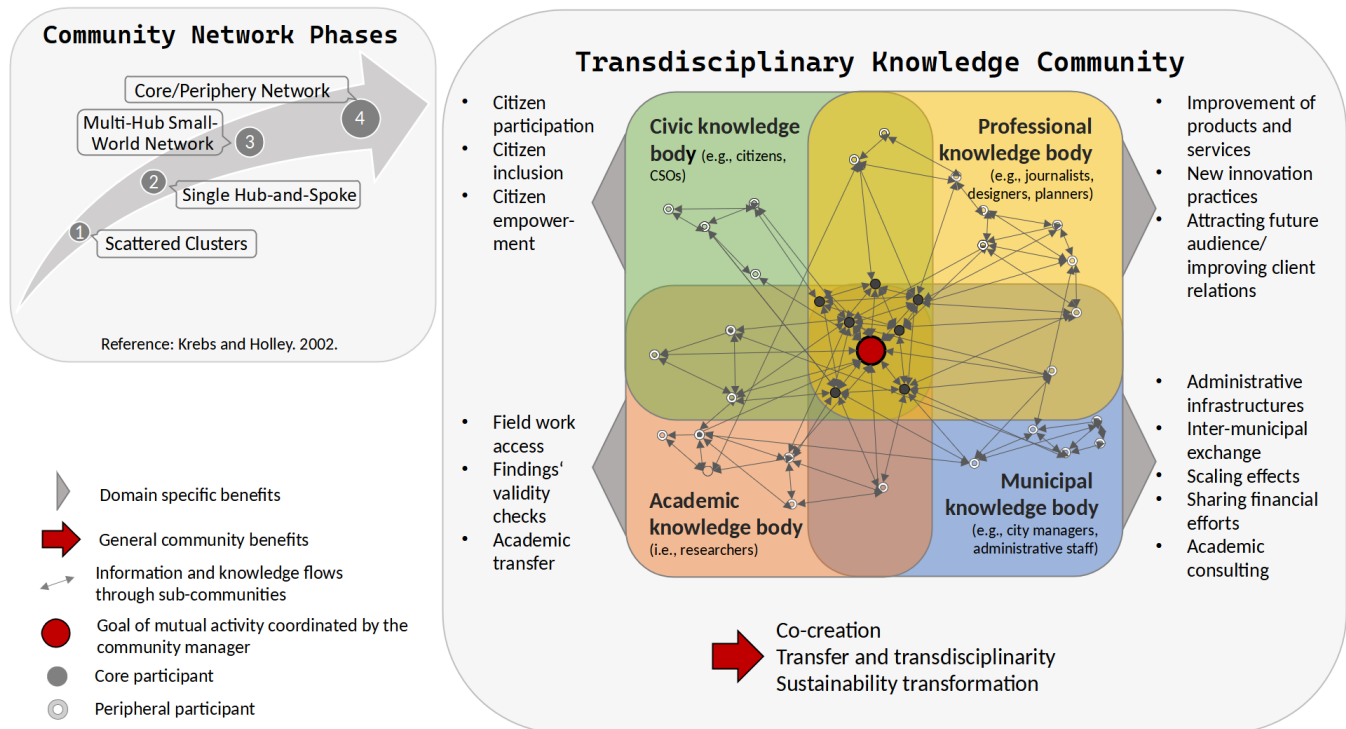


Figure 1: Using a network approach for building a transdisciplinary knowledge community. Locations of the nodes in the network are for illustrative purposes and can vary. If a peripheral participant exchanges information and knowledge with other actors from more than 1 knowledge body, he or she would not be peripheral anymore.