

ARE SMART VILLAGES JUST SMALLER SMART CITIES? CALL FOR A REGION-TYPE-SPECIFIC APPROACH TO THE SMARTIFICATION OF COMMUNITIES

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Abstract

This paper presents a conception for a region-type specific approach for understanding and developing region-specific smart communities in predominantly rural areas. The concept is based on a discussion of the topic of smart communities from the points of view of (1) data economy, (2) regional communities, and (3) smart technologies as well as a discussion of “smartness” in context of smart communities. The paper points out the lack of differentiation between the different smart-community types in current models and typologies and argues that even a differentiated view is not sufficient in face of the high level of connection and interplay between the different communities. The paper proposes to develop a region-specific smartification model that considers the region-specific context and interaction with more urbanized regions, especially for rural areas.

1. Introduction

The idea of making communities “smart” has been considered with regard to different types of communities and regions, most commonly as smart cities, but also smart villages, or smart rural areas. The topic has been approached from different angles, often with a clear focus on technical solutions and concrete applications, but also many non-technical dimensions as well [25]. However, smart communities present complex socio-technical systems, typically facing difficult problems; for this reason, “smartification” ought to be approached systematically, from point of view of governance and e-government [20]. Typologies and models play an important role in mapping existing knowledge, providing a foundation for sharing insights, as well as gaining a deeper understanding of the field [18]. Among the different types of smart communities, smart cities have been particularly well researched, which means that typologies and models from this area are mainly concerned with smart cities. Other community types, such as smart villages, are attracting increasing attention in research and practice. This raises the question to which extent existing research findings related to smart cities are applicable and relevant to other community types [31]. This paper will address the following questions:

- What are region-type specific characteristics of a data economy for rural regions?
- What are the different characteristics of a data economy for each type of region, in terms of needs and application areas, data ecosystem and its actors, digital technologies and ICT infrastructure?

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- Is there a need for region-type-specific implementation models for data economy?
- Is there a need for new typologies, taxonomies and morphologies or are already existing models sufficiently suitable?

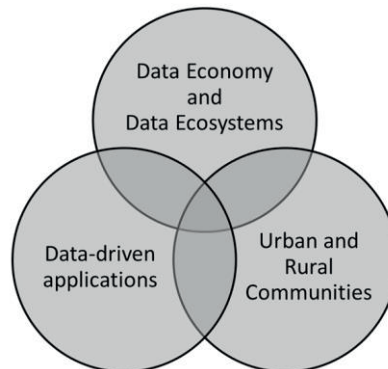


Figure 1: Areas related to Smartification of Communities

To address these question, section 1 first addresses smart communities based on three related topics: (1) data economy and data ecosystems, which explores the economic issues and opportunities of greater reliance on digitization and datafication, (2) the different types of urban and rural communities and their implication of smartification of communities, and (3) a discussion about data-driven applications (see Figure 1). In section 2, we discuss the differences and similarities between smart communities, such as smart cities and smart villages. In section 3, we consider whether typologies and models related to smart-cities are directly applicable to smart communities of a different region type. Finally, in section 4, a region type specific model is introduced and presented for discussion.

1.1. Data Economy and Data Ecosystems

The term data economy is used in many different ways and in this article, we focus on its use in the economic policy debate, taking the European Union's data-related policies as a guide. [6–8] The European Commission defines the term "data economy" as follows. "The 'data economy' is characterised by an ecosystem of different types of market players - such as manufacturers, researchers and infrastructure providers - collaborating to ensure that data is accessible and usable. This enables the market players to extract value from this data, by creating a variety of applications with a great potential to improve daily life (e.g. traffic management, optimisation of harvests or remote health care)."[6] The focus of this definition is on the relevance of data ecosystems, with the purpose to improve daily life of the ultimate users, namely the European citizen. From our point of view, such a goal of value creation for the citizen implies a value co-creation mechanism based on a service-dominant logic. [3] This approach is reflected in our basic model in Figure 6.

To understand the value of data and the range of data-driven economic activities, Géczy [10] described four dimensions of a data economy, namely trade, labour, education and government (see Figure 2). This conceptual framework underlines the importance of a comprehensive approach to smart community development that involves all actors in the respective data ecosystem and remains open to further dimensions of a data economy. In the strategies of the European Union, the focus also includes all four dimensions. The focus on data-driven products and services and above all the creation of a single European data market are particularly worth mentioning here. [7]

In the literature, smart communities such as smart cities are also consistently proposed as holistic approaches in the context of data economy as by Géczy.[10] The U.S. Nation Institute of Standards

and Technology's (NIST) Smart Cities model, as one of the most referenced models, includes the six components of government, economy, mobility, environment, living, and people. Khatoun et. al explicitly pointed out that this holistic approach is necessary, but often falls short in practice. In this context, reference is made to The Policy Department of the European Parliament, which found in 2014 that only 34% of smart cities in Europe take all six components into account in practice. [14] In comparison, Söderström et al. also point to the ambiguity of covering so many different dimensions. [29]

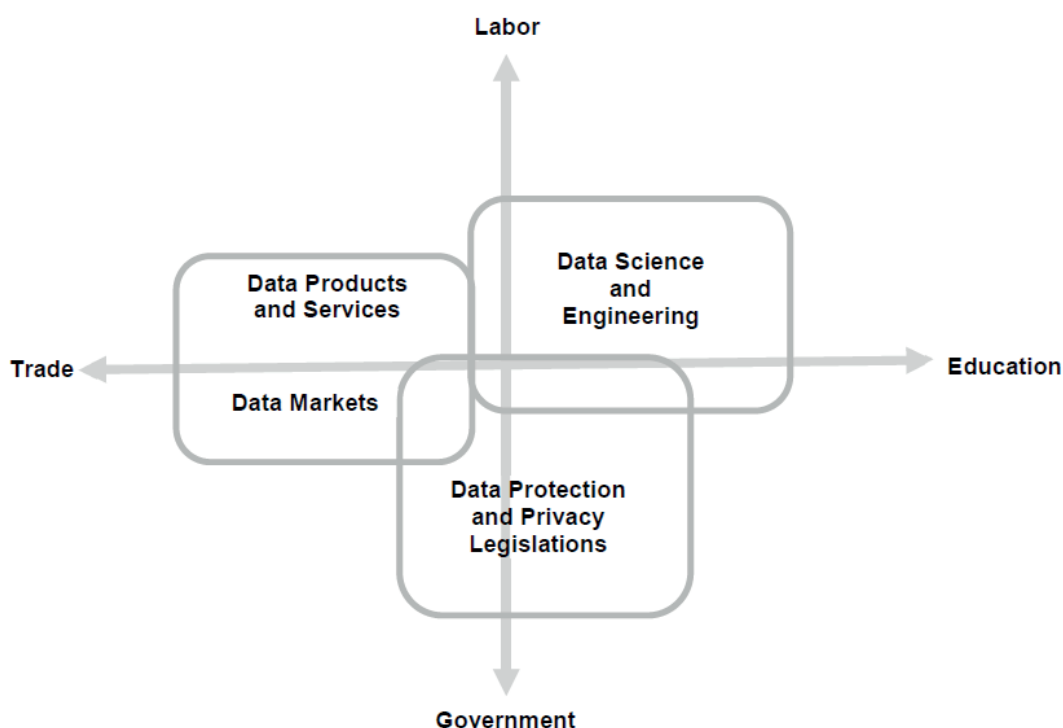


Figure 2: Data Economy Dimensions [10]

1.2. Urban and Rural Regions

The classification of regions to explain differences between rural and urban regions is an established approach in economic analysis and policy. The OECD has introduced a regional typology that initially uses three types of regions, namely predominantly urban (PU), intermediate (IN) and predominantly rural (PR) [23]. The main distinguishing criterion is based on the percentage of the regional population living in urban or rural communities. This concept was extended to include an accessibility criterion in the form of distance to a populated centre. The resulting classification consists of five region types: Predominantly Urban (PU), IN close to a City (INC), IN Remote (INR), PR close to a City (PRC), and Predominantly Rural Remote (PRR). [23] As an example, we can view the Lower Austria region, which is located around the predominantly urban (PU) city of Vienna. The regions within Lower Austria are classified as Intermediate close to a City (INC), Intermediate Rural (INR) and also Predominantly Urban close to a City (PRC). One region is classified as Predominantly Rural Remote (PRR). This shows that different region types do not exist separately, but form intricate networks.

We assume that the OECD typology of regions for explaining economic and labour market development is also a suitable basis for developing a region-type-specific data management model for the smartification of communities. The necessity to consider urban and rural spaces simultaneously is supported both by literature [28, 30, 32] and by European Union initiatives regarding smart villages [9, 27] and smart rural areas [5].

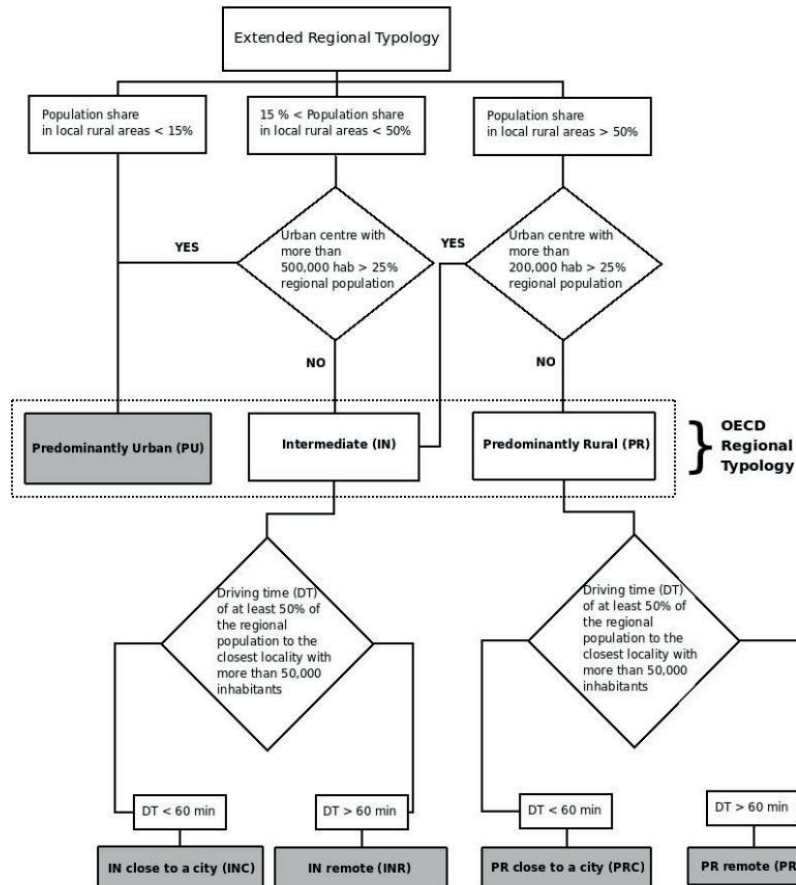


Figure 3: OECD's Extended Regional Typology [23]

1.3. Data-Driven and Smart Application

The ability to realise the potential of the data economy in the quest of improving the living and working experiences of citizens in different rural and urban settings rests to a large degree on technology. Whereas automation, in the sense of “using machines/computers/robots to execute or help execute physical operations, computational commands or tasks” [22] has a long history of application in various urban and rural context, there has been a rising increase of interest in application that make an explicit use of data. There is no clear definition or even a single term that describes the technologies that provide benefit through collecting, processing, and presenting data; in the literature and public discourse, these may be termed “data-driven”, “data-intensive”, or simply “smart”, with the latter term being increasingly popular, but also extremely ambiguous [25].

Such data-driven applications have been developed to take advantage of the increasing availability of data, which is driven by number of factors: Due to digitalisation, large amounts of data are now directly available in digital form (e.g messages, but also accounting or transactional data). In addition, meta-data data that describe different aspects of our daily lives are actively collected as a form of datafication [2]. Finally, there are data collected and exchanged by machines [15]. The

applications have, in general, two broad goals: to manage the (often complex) data streams as well as the data themselves and to provide means of effective and efficient data analysis [12]. These can be broken down into more detailed tasks, amounting almost to a process of data utilisation [12, 15, 24, 25] (see Figure 4).

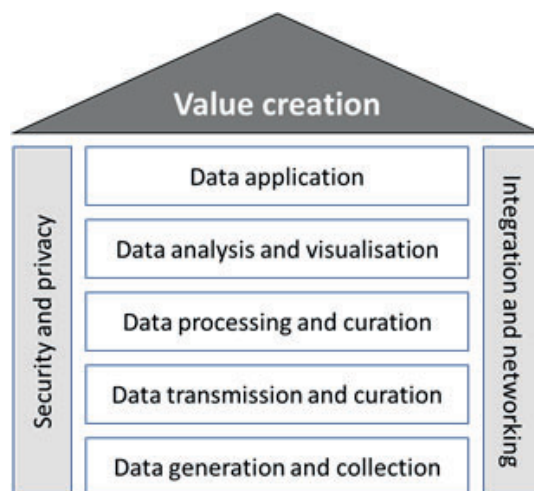


Figure 4: Areas related to Smartification of Communities (author's chart)

Besides the reliance on data, the “smartness” of data-driven applications is often explicitly named. The general term of the term “smart” is very loose and often serves merely as a marketing narrative [29]; however, the literature does provide clearer definitions of the term. According to Martin et al., “smart” applications possess “self-managing capabilities” (such as self-diagnosis, self-correction, and self-control) and are therefore able to react dynamically to diverse situations, even improving their response through learning [19]. For Jovanović and Vollmer, “smartness” can be driven by three dimensions – technologies can be “smart” if they are integrated and interconnected, intelligent, or autonomous, but they do not have to possess all three properties to an equal degree – their “smartness” can be centered even on a single one of them [13]. Goddard et al. stress the ability to interact with the environment but also the capability to perform the action as a feature of “smartness” [11]. Overall, the represented discussion of “smartness” in context of technology is very much feature-driven, centering on performance and features of smart technologies. As we discuss in section 2, this definition cannot be directly applied to the concept of smart communities.

2. Types of Smart Communities - and the other Meaning of "Smart"

The term “smart” in connection to smart cities, smart villages, or smart rural areas does not have the same meaning as with regard to “smart” technology. Here it is a part of a broader narrative [25, 29]. There can be a number of meanings, even totally unconnected to ICT, implied by the “smartness” of a community, such as [34]: (1) systematic planning and infrastructure development, (2) citizen empowerment, (3) government and efficiency, (4) sustainability and resilience, (5) data and technology. These dimensions of “smartness” often overlap or interact with one another; notably, the use of data and technology can occur in conjuncture with another dimension. Overall, the aim of smart communities is increasing the quality of life of the inhabitants as well as the sustainability of the community itself [34].

These overarching, general aims seem to be shared by different types of smart communities, such as smart cities, smart rural areas, and smart villages. But in other respects, it also seems difficult to distinguish between the goals and implementations for the different types of smart communities.

Even when the indicators used to compare smart cities and smart villages are analysed in more detail, similarities remain. Sharifi [27], reviewing indicators for smart cities, identifies as relevant indicator categories economy, people, governance, environment, living, mobility, and data. In comparison, Mishbah et al. [21] draw up a conceptual model for smart villages and come up with nearly the same set of categories. Does this mean that the different types of smart communities do not need to be treated separately? There is no clear consensus in the literature on this. Cvar et al. [4], while acknowledging the differences between smart cities and smart villages (mentioning different levels of infrastructure concentration), suggest that technical solutions are transferable and even applicable independent of culture or context.

Other authors point out to differences between the types of smart communities:

- **Different goals:** The research on the different types of smart communities is driven by different aims: research on smart megacities gravitates towards increased efficiency and improved infrastructure [31], smart cities research is concerned with sustainability [31], and research on smart villages (at least in European context) is focused on preventing the depopulation of rural areas [32]. This mirrors the different key concerns of the communities and implies that some generally applicable concepts and implementation, might not be equally relevant for all types of communities.
- **Different needs:** Although the categories of a “good quality of life” might be comparable across different types of communities, there are intrinsic properties that lead to different concrete needs. Maja et al. [17] systematically compare indicators for smart cities and smart villages, showing differences such as connectivity to infrastructure or even vulnerability to environmental changes.
- **Different challenges:** The infrastructural differences also cannot be considered merely as providing a different environment - they can also represent a considerable hurdle in the implementation of smart community concepts, as disadvantaged rural areas that would most benefit from innovation at the same time require considerable infrastructural investment before it can be affected [16]. This means that some ideas, while theoretically viable for different types of smart communities, are pragmatically not applicable.

While the commonalities are at a higher level of abstraction, the differences are at the level of the more immediate goals, needs, and challenges faced by communities of different region types. From the authors' perspective, this is an instant indication that smartification research does not yet adequately account for region-specific differences in its models.

3. Models and Typologies

In acknowledgement of the complexity of the topics related to smart communities, models and typologies have been developed that describe the different facets that need to be considered. Due to the early focus on smart cities, these typologies are often related to city-level smart communities. In sections 1.2 and 2, we have already discussed the differences between communities of regional types and their smartification. In this section, we discuss, whether existing typologies that were typically developed for smart cities are directly applicable to other region types. For this purpose, two typologies serve as examples, showing typical issues that occur in smart-city typologies.

Abu-Matar [1] presents a reference architecture model, depicting relevant views for smart-city solutions (see figure 5). Although strongly technology-driven, the model depicts a number of non-technical views, such as the participants and the related business processes. The model appears

applicable to any smart community, but it does not explicitly include the concerns and the context that communities of different region types have. Higher-level (strategic) goals are not present as a view; only the capability (i.e. the problem-solving functionality) is considered. Governance view is also missing from the architecture as are considerations of the overall ecosystem and interplay with other communities.

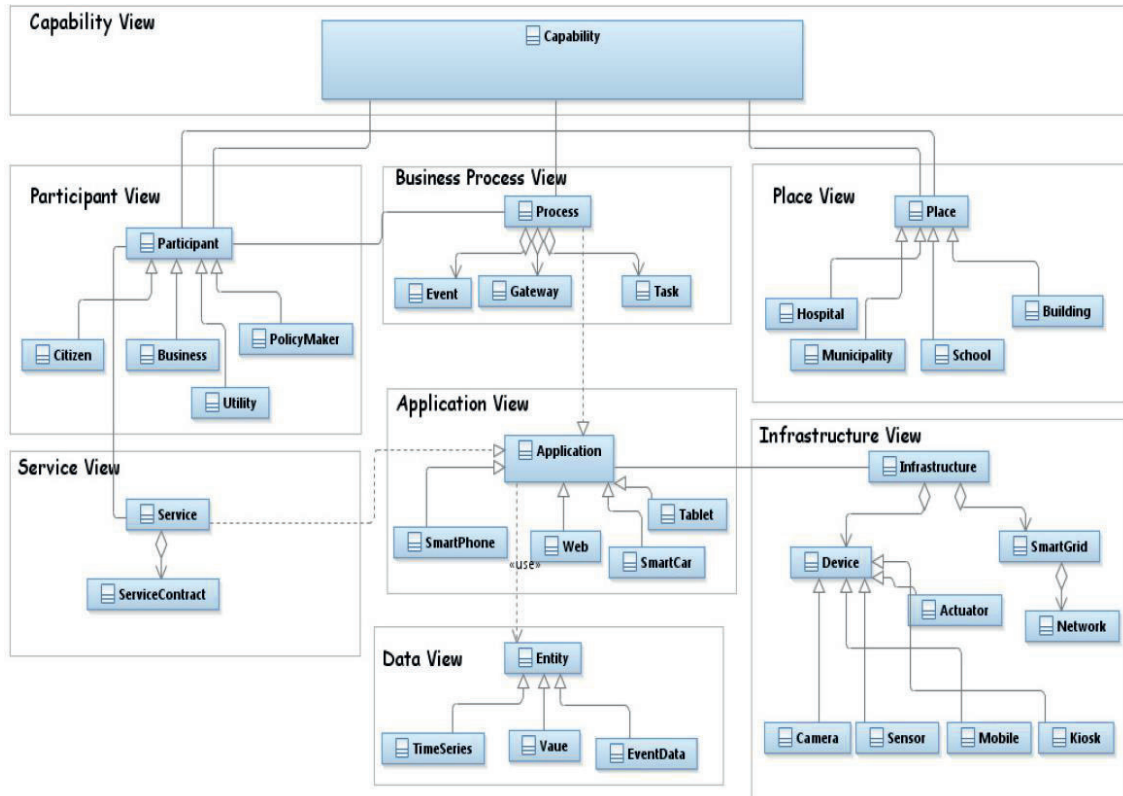


Figure 5: Smart City Reference Architecture Meta-Model by Abu-Matar [1]

In comparison, similar issues can be seen by Wolff et al. [33], who provide a user-centric typology for categorising smart-city applications based on the process of data processing, assuming that the main purpose of smart-city applications is to allow the users to benefit from the data (human-data interaction). The typology describes smart applications through nine properties, connected to the data-processing process. The overall typology is generally suited for classifying any kind of data-driven applications and its relevance to smart cities is only visible in the offered subcategories. From the authors' point of view, this model implies uniform objectives and needs for all types of smart communities. However, this assumption was challenged in section 2. The typology is focused on applications and neglects categorical distinctions by smart-community type. In addition, it is assumed that the data are both generated and used within the community - interconnectedness with other regional communities and the supra-regional character of data ecosystems is not considered.

Other models are concerned with describing smart community goals and indicators [17, 21, 26]. On an abstract level, the models identify the same set of overarching categories (such as economy, people, governance, environment, living, mobility, data, resources), making them appear universally adaptable, provided that the indicators within the categories are adapted to the goals of the community. Unlike technology-oriented typologies, these consider the broader views such as economy or governance, but neither the differences between communities nor the interaction with other communities of the region type are considered.

4. Discussion: Region-type-specific approach to the smartification of communities

In this paper, we have presented a discussion of smart communities, considering their regional type, their role in a broader data ecosystem as well as the role of data-driven applications in this context. We considered smart communities as complex entities whose smartification requires a holistic approach and systematic governance [20]. We were particularly concerned with the differences between smart communities of different regional types. While such differences are being considered (as is visible in the growing body of research on smart villages), we felt that the role of the regional type in the smartification of communities has been neglected. Many solutions, typologies and models focus a single community type and consider it as autonomous communities, without relevant dependence on other communities, failing to view smart villages as part of a region and ignoring their unique region-specific characteristics.

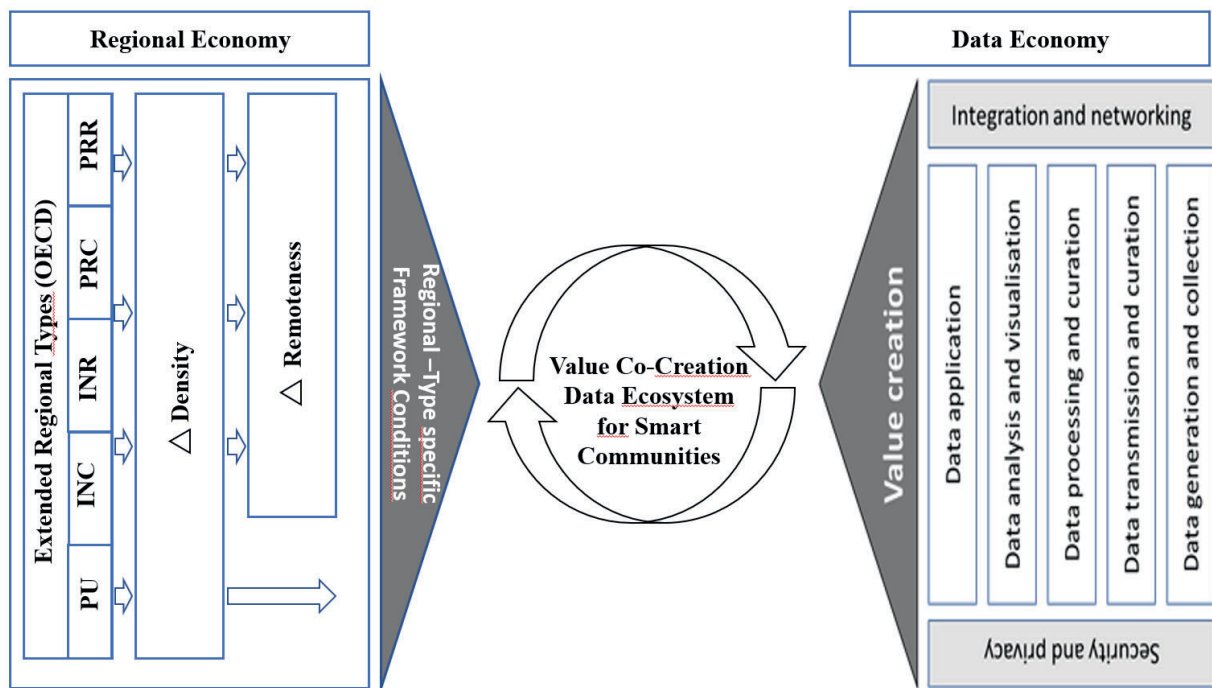


Figure 6: Region-specific-Data-Economy Model [author's chart]

As successfully applied in the context of economic and labour market analyses, regional-specific characteristics and related problems and objectives are important to understand in order to advance the smartification of communities. Srivatsa [30] points out, that the goals and problems are often directly interconnected, such as the problems of depopulation of villages and overpopulation of cities - both of which have been targeted in (separate) smartification research. We therefore consider the simple distinction between smart communities as insufficient to fully tackle the specific problems and goals for smartification initiatives. The smart communities' classification a) overestimates the degree of autonomy of single entities such as smart villages to truly generate benefits on their own, and b) underestimates the regional and supra-regional specific character of problems, goals, and data ecosystems. Both the value proposition and value creation for smartification initiatives should be region-specific rather than smart community type-specific.

The authors therefore propose to develop a region-specific smartification model that takes into account the region-specific context and interaction with more urbanized regions, especially for rural areas. The conceptual approach (see Figure 6) assumes three main variables: (1) the density variable in the form of the percentage of the regional population living in urban or rural communities, and (2) the distance variable in the form of the distance to a populated centre, both derived from the OECD's extended regional typology model. (3) The data ecosystem variable and the associated value co-creation mechanism of the actors involved is derived from the concepts of a data economy.

In conclusion, this paper suggests that smartification projects should take a region-type specific approach that considers the full and unique context of each region under consideration and understand communities such as smart villages as only part of smart regions. As a logical consequence, smartification projects should consider a whole region with all its communities of different types and not focus on individual communities of a region. The cross-regional character of data ecosystems in particular requires this. The basic region-specific data economy model presented in Figure 6 puts the focus on the process of value co-creation in the tension between a data economy and a regional economy. In this context, it is not only necessary to empirically study the value co-creation mechanisms of smart applications, but also to engage in further theory building.

5. Acknowledgements

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