

Smart Village Concept: What are the Crucial Categories of Elements?

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Abstract: Over the past few decades, villages have faced significant challenges, such as depopulation, that have hindered their development. To address these issues, the concept of a Smart Village has emerged as a potential solution for rural development. The present article aims to investigate the essential categories of elements that comprise this concept by conducting an international literature review in multiple languages, including Polish, English, Spanish, Italian, French, and German. The article begins with an introduction that discusses the current challenges facing rural development, followed by a detailed analysis of various aspects of the Smart Village concept. Additionally, the article presents case studies from different countries to illustrate how the concept has been implemented in practice. Finally, the article employs inductive reasoning based on the previous literature review to identify four fundamental categories of elements that underpin the Smart Village concept.

Key words: Smart Village, New technologies, ICT, Public management, Strategic planning

1. Introduction

Today's village faces various challenges that are social, organisational, demographic, and economic in nature. However, the emerging concept of the Smart Village provides a new approach to addressing these challenges. The issue of Smart Village need to be reviewed to systematize and to expand the knowledge of the concept and its practical application - the article responds to this need. In this article, the author first examines the challenges facing villages, followed by a detailed analysis of various aspects of the Smart Village concept. Additionally, the article presents case studies from different countries to illustrate how the concept has been implemented in practice. Finally, the article employs inductive reasoning to classify the essential categories of elements that underlie the Smart Village concept into various categories. The conclusions drawn from this research provide valuable insights for policymakers and stakeholders in rural development.

In Western countries one of the main challenges of village development is the aging population and depopulation partly rooted in leaving villages by younger generations. Older people prefer to stay in village but the problem is how to engage them into village organization (Gammonley et. al 2019). Still issues of involving inhabitants of villages into not only consultations on village development but as well as into cooperation in governing are vital (Rumkel et al. 2019).

Also in Poland, for many villages the basic dilemma consists in whether depopulation is an inevitable trend that will continue in the following decades. This is particularly true of villages located in peripheral areas - they are not located in the immediate vicinity of large cities and urban agglomerations. Depopulation entails both social and economic negative consequences - the level of socio-economic development decreases which also results in a lower quality of life, which then contributes to the low attractiveness of such areas, in turn causing an increasing acceleration of rural depopulation (Wesołowska, 2016, p. 269).

The challenges that Polish countryside has to face include, for example:

- further increasing the standard of living for the rural population, improving the agrarian structure, and modernizing agriculture;
- creating new jobs in the countryside apart from agriculture;
- motivating rural communities to create new local development programmes - rebuilding social capital and civil society. Residents of rural areas should not look at others - waiting for someone else to solve their problems;
- active and efficient local governance - putting a dam on the passivity of local leaders and individual residents;
- developing rural infrastructure;
- creating opportunities for entrepreneurial people (Kłodziński, 2010, p. 24).

In the broader spectrum of elements relevant to future rural development, it is possible to point to the spreading of remote working, which was one of the consequences of the Covid-19 pandemic. Information concerning the dangerous health situation led to adopting remote working as a method of maintaining health

while staying active (Torres 2021, p. 13). Moreover, high-level strategic development planning is important for village development. The development strategies of rural municipalities should not only be a tool for promoting the municipality, but most importantly, within traditional village activities new methods should be found to improve breeding animals in village – e.g., poultry (Tuan Chu et al. 2018). Poor villages look for their chance in tourism which could be an opportunity for sustainable development (Sesotyaningtyas 2015).

2. Smart Village Concept – Chosen Aspects

The Smart Village concept has gained increasing attention in recent years. However, despite its growing popularity, it lacks a well-established theoretical framework and remains largely undefined. Furthermore, there has been little exploration of the relationship between the Smart Village and the better-defined Smart City concept. Clarifying this relationship is a necessary step in understanding how smartness can impact social and environmental aspects of rural realities. From a practical perspective, designing and implementing the Smart Village concept in European countries, drawing on experiences from Africa and Asia, could contribute to the EU's green and digital transformation agenda by emphasizing sustainability and environmental protection (Gerli, Marco, Whalley 2022, p. 15).

The Smart Village concept rests on several fundamental assumptions, including food security, democratic engagement (achieved through effective local governance and social development), health and well-being (supported by environmental and personal development), education (which provides basic knowledge to raise awareness), and local businesses (which promote economic development). For the Smart Village concept to effectively contribute to sustainable development, there is a need to redirect the focus of education. Education plays a critical role in promoting sustainable development, and basic education forms the foundation for environmental and development-related education, which should be prioritized in educational curricula. Developing ethical awareness, values, attitudes, skills, and behaviors in line with sustainable development is essential for effective public decision-making, including public participation. Moreover, education should be accessible to people of all ages (Somwanshi et al. 2016, p. 397). In order to promote rural development, it is necessary to tap into the knowledge held by leaders and members of a given community. Today, knowledge acquisition is not limited to formal education, such as earning a bachelor's or master's degree. Knowledge can be acquired through a variety of means, such as listening to TEDx speeches, where experts who have dedicated decades of work to a particular field share the most important conclusions from their experiences in concise 20-minute talks.

The implementation of the Smart Village concept faces significant challenges. One such challenge in many countries is the lack of adequate digital services in rural areas. Additionally, there is often a lack of networking between residents, communities, and local administrations. The levels that comprise the digital ecosystem of a Smart Village include: digital services that require collaboration with the citizens who use them, a technical platform that integrates the main technical aspects relevant to the functioning of digital services in rural areas, the availability of digital infrastructure, which is a necessary but not sufficient condition for digital innovation. The latter can be fostered through initiatives such as Living Labs and Rural Digital Hubs (Gallardo-Cobos, Sanchez-Zamora, 2022, p. 409). Elements that may be duplicated and disseminated are developed in terms of the Smart Village concept. One such element is the concept of an information system for managing the infrastructure and activity of a rural municipality. The idea is to create a very useful but minimalist system, consisting of four main activities: collecting data (linking objects), storing data (NoSQL database), prediction (model composed of algorithms, learning automatically), and data visualization (Kibana) (Antoine-Santoni et al. 2019 p. 8).

Smart Village also encompasses the development of rural tourism, which has been greatly impacted by the Covid-19 pandemic. Villages that had previously succeeded in attracting tourists experienced a significant decrease in tourism activity. Therefore, it is essential to carefully examine the conditions under which this activity takes place, including the governance models at both the national and local levels. This requires a detailed analysis of the theoretical and practical foundations that impact the development of tourism in smaller village-type locations (Bravo et al. 2021, p. 269).

There are many investments that qualify under the Smart City concept, and many solutions implementing this concept appear. The case is different for the Smart Village - a concept that lacks a large number of village-focused, specific implementations (Park, Cha 2019, p. 177). However, more and more solutions are emerging that fit into the Smart Village concept and can contribute to developing villages, such as theme parks. These parks should take advantage of the assets of a given village or town and be specific enough to stand out and attract interested parties, including tourists. They should promote beauty and good taste, be accessible to all,

and be an attractive location in terms of composition and aesthetics (Poczobut 2013, p. 380). Theme parks have been successful worldwide, including small-scale parks. Creating a website and a special app for smartphones that lists theme parks would fit in with implementing the Smart Village concept. The app should be based on a clear and logical typology, with proper criteria for qualifying sites. Parks that meet the criteria should combine interactivity, fun, and education (Doroz-Tomasik, Jankowski 2016, p. 30). Historical parks can play a special role, referring to historical events in a particular place, such as a battle during the Invasion of Poland at the beginning of the Second World War. Such parks can be an interesting element of tourist development if they meet the criteria of interactivity, fun, and historical education.

Another example of Smart Village activities may be the neighbourhood help - transport sharing app. A resident travelling by car to a large city makes this information available on an app that other residents can view. A resident without available means of transport opens the app, enters a date and destination and then receives information about people who are going to the city on that day. When using such an app, the challenge will be to ensure the security of people and data.

3. Smart Village Concept - Experiences of Various Countries

In Germany, attempts are being made to break down the barrier in the form of poor digital services in the countryside. An example consists in the actions taken by the Fraunhofer Institute, which has invested € 4.5 million until 2019 in cooperation with the Ministry of the Interior in a pilot digital villages project including digital services for residents of villages, a digitalized marketplace of local services, access to mobile digital services, an app with local news in typical areas, and a digital lead platform for two-way communication between local residents and the local administration (Park, Cha 2019, pp. 178-179). Furthermore, in Germany, a part of the "Smart Village" concept consists of creating a web-based platform that collects and links data, which is then available to interested parties in the form of well-visualized interfaces. Data from a large number of sensors is transferred to a 3D platform, allowing for efficient access to information on electricity production from photovoltaic panels in a given village or the entire municipality, as well as heat resources and energy obtained from the use of biomass. Thanks to these applications, it is much easier to plan the development of photovoltaic installations in a village, for example (Santhanavanich et. al 2020, pp. 56-57). Especially in Germany, data security issues, including personal data, are also being raised in the context of the Smart Village. In some advanced IT systems, there is a high risk of reducing a human to an object that will also follow the commands of artificial intelligence machines. Numerous examples from East Asian countries, shaped by Confucian philosophy, show that such systems can already be quickly introduced today. In Germany, it is indicated that systems reflecting historical experience, the rule of law, constitutionally protected rights, and data protection principles should be developed. In particular, a careful examination of solutions already proven in other cultural circles is called for (Von Lucke 2019, p. 59).

In Italy, the "Smart Village" concept is being analyzed in terms of its use in previously marginalized areas. An example of the analysis concerning potential applications in such areas can be found in Sardinia. It is indicated that using ICT instruments, big data, and the Internet by public authorities in cooperation with private entities can bring solutions to revitalize the rural space in terms of strategic sectors such as public transport, distance education, rural tourism, health, or renewable energy, working in favor of developing new forms of sharing economy as well as new relations with the outside world. In terms of the EU's programming of development for the years 2021-2027, the Smart Village may gain a real dimension not by replacing the instruments already in place but rather by integrating them in a way that serves sustainable development (Lampreu 2022, p. 77). The Smart Village concept in Italy was already known before 2012. There have been pilot projects integrating three spheres: the outdoor lighting system - smart lighting that adapts to conditions, smart building networks, and smart mobility. These projects, such as the one carried out by the state agency ENEA, were focused on developing such an integrated model for a specific locality (village) so that it has the potential to be extended not only to following villages, but also to small towns (Annunziato et al. 2012, p. 6).

In France, in the context of smart villages, a hybrid model is indicated. This model is a combination of a territorial approach, social innovation projects in conjunction with economic models, and the combination of public and private entities as well as resources in the form of public-private partnerships, along with a simultaneous presence in multi-entity local projects for public and private services. In this way, co-responsibility is shaped, as evidenced by the development of a cooperative society for implementing a collective goal. The multiplication of locations and levels constitutes an indicator of this hybridisation dynamic (Association ADRETS 2021, p. 11). Research carried out in France also attempts to build a more solid theoretical basis for the Smart City concept described as a multi-faceted and hitherto unspecified concept.

Appropriately, this research can also be applied to the Smart Village. It is proposed to base this concept on three immanent pillars: acquiring and using megadata, modernizing public services, and the political will to support greater citizen participation (Eveno 2018, p. 37).

The following points, among others, have been highlighted during research carried out in the Czech Republic in the context of implementing the Smart Village concept:

- there is no technological or cost barrier associated with using modern ICT technologies in rural areas, network coverage is not as intense as in urban areas, but the vast majority of rural residents have access to the Internet;
- a lower level of education results from less use of the web for more practical purposes, residents tend to use the Internet for entertainment, shopping, or participating in social media
- remote work may be more attractive for rural-to-urban migrants who can combine living in a rural environment with an attractive and well-paid remote job. However, it seems that fully remote work is rarer, most often it has to be combined with visiting an office in the city;
- improving the skill level of rural residents should include improving IT proficiency in relation to rural development instead of improving only formal education (Vaishar, Stastna 2019 pp. 657-658).

Also in developing countries like Algeria, it is pointed out that in peripheral regions, rural development (especially in the current era of globalization) can be the driving force of economic development by ensuring an improving the wealth with a sustainable character. Such development should be based on developing own resources (Agharmiou-Rahmoun 2021, p. 144). In Cuba, the concept of smart municipalities is advocated while pointing out that implementing this concept towards sustainable development constitutes a complex process involving social, economic, political, environmental, and cultural dimensions. In turn, this process must be based on education, which moves towards assigning individual actors their roles according to their knowledge, experience, attitudes, and values (Rodriguez, Perez 2020, pp. 33-34).

In poorer countries, the Smart Village concept appears as an opportunity to move towards a new level of development. The developed model of the integrated development of the Smart Ayllu (Bolivian village) points out the significance of, among others, the following elements: the revalorization of the Ayllu living system, recognizing the centrality of the family as an integral part of the community, where ancestral principles allow strengthening the sustainable drive of village development and community well-being; appreciating existing social ties crucial to the living system; recognizing the central role of citizens in the interaction with the community; and strengthening a new complementary relationship between space and inhabitants using different technological systems (Yujra, Medina 2021).

4. Crucial Categories of Elements of the Smart Village Concept

Based on the above literature review, including the experiences of individual countries, and taking advantage of inductive reasoning, the following categories of Smart Village elements can be distinguished: the digital elements category, the socio-organisational elements category, the domain elements category and the educational elements category. The elements of each group are listed below. Surely, the catalogue of individual categories can be developed further, as well as the number of categories themselves and their nature, which can also be refined in the course of further research.

Digital elements category:

- complete availability of digital services;
- web platforms and other digital applications;
- visual interface of clean energy production;
- data security;
- living labs.

Category of socio-organisational elements:

- participation of residents in the development of the village community;
- developing social ties (including traditional ones);
- public-private partnership.

Domain elements category:

- smart lighting (street lighting and other public infrastructure);

- smart mobility (transport sharing among others);
- smart buildings;
- tourism development (theme parks in this);
- economic development (remote work in it).

Educational elements category:

- adapting formal education curricula to the challenges of smart villages and sustainable development;
- education related to improving IT proficiency;
- education related to changing habits so that residents take advantage of the internet not only for shopping and entertainment, but also for life-long learning.

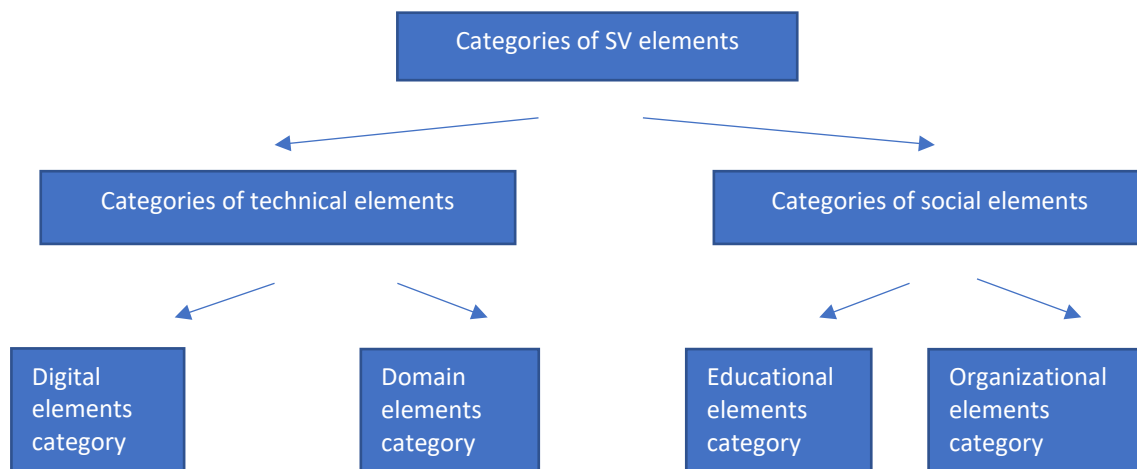


Figure 1: Categories of Smart Village Elements. Source: Author's own figure

Two of the above categories have more technical character (digital elements category and domain elements category) and the other two have more social character (category of socio-organizational elements and educational elements category). Categories of more technical character seem to be easier to introduce but need more financial resource and categories of social type maybe would cost less but are more difficult to introduce because the process takes more time to bring effects.

5. Conclusions

Today's village confronts a range of challenges, and depopulation represents a particularly pressing issue in many countries. The Smart Village is a new concept which is intimately linked to sustainable development. Attempts to categorise the various elements of the Smart Village have been explored in the literature. One such categorisation scheme is based on a set of key assumptions that prioritise food security, democratic engagement (through effective local governance and social development), health and well-being (through environmental and personal development), education (through basic knowledge to promote awareness), and local businesses (through economic development). By identifying and categorising these crucial elements, policymakers and other stakeholders can more effectively design and implement strategies to foster sustainable development and promote the vitality of villages.

Experiences of various countries show that stress within the Smart Village concept could be put on various elements. In the article, the author used especially the elements from Germany, France, Italy, the Czech Republic, Algeria, Cuba, and Bolivia. Basing on sixteen elements stemming from multilingual international literature review the found elements of smart village were grouped into following four categories: digital, socio-organizational, sectoral and educational. Two of the these categories have more technical character (digital elements category and domain elements category) and the other two have more social character (category of socio-organizational elements and educational elements category). Categories of more technical character seem to be easier to introduce but need more financial resource and categories of social type maybe would cost less but are more difficult to introduce because the process of their implementation takes more

time to bring effects. The catalogue of various categories can be developed, as well as the number of categories themselves and their nature can also be developed in the course of further research.

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