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Sustainable and Community-Centred Development of Smart Cities and Villages

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Abstract: The article highlights the need to rethink and reconceptualise the accepted concepts of smart cities and villages by shifting the attention from technology and technological solutions and moving it towards understanding the significance of communities and sustainability. The conceptual framework combines four essential features—community, village, city and sustainability—and analyses the links and relationships between them. A new community-centred approach to development is suggested in order to emphasise that sustainable living cannot be achieved only through technological solutions. Instead, we suggest that to ensure social sustainability, appropriation, and effectiveness of new solutions in the long term, the process has to start, be adapted and led by people and their needs. In this light, the article analyses three dimensions of smart living—energy, mobility, waste—through the prism of rural–urban linkages and the role of ICT. Core principles and recommendations (calm technology, community size, identification of community leaders, surveillance and control issues, community building) for designers of ICT solutions and developmental projects in smart cities and villages are presented. These principles take into account people and communities and combine findings of engineering and social sciences, especially anthropology, psychology, and sociology.

Keywords: smart village; smart city; community-centred development (CCD), sustainable communities; mobility; energy; waste; ICT; quality of life

1. Introduction

The idea of sustainability is central to debates on visions of the future and has entered many global, national and regional developmental agendas. Although the challenges of sustainable development for the future—including the urgency to address climate change—have formally been addressed by the United Nations (UN) already in 2015 with the document Transforming our World: the 2030 Agenda for Sustainable Development [1], in practice a lot of work still needs to be done to bring the Agenda to life. Within the Agenda, 17 Sustainable Development Goals (SDG) were formulated. They address various aspects of human life and are of great importance when discussing sustainability. They have been the subject of several criticisms for being difficult to quantify, monitor, and implement (for the most rigorous critique see Easterly [2]; see also Bali Swain [3]), but on a global scale SDGs readily serve as a key instrument for setting the guidelines for achieving social and environmental sustainability. Even though SDGs set a basis for understanding sustainability in contemporary public and academic discourses, concepts and terms surrounding it are very broadly defined, allow broad interpretations

and are therefore elusive. In connection to this, our paper aims to address and contextualise popular concepts, such as sustainable and smart development, smart city, smart village, and also introduces the concept of community-centred development (CCD). As shown by Mansuri and Rao [4] and elsewhere [5], the *community-based development* approach has been present for a few decades and could be understood as an umbrella term for approaches accelerating the participation of communities in development processes. Our specific approach, community-centred development, is built with special focus on the possible contribution of ICT in the future of sustainable communities. CCD is promoted as a way to incorporate local knowledge and empower communities, but also to accelerate the crucial role of (local, regional, national) authorities in the transformative process for a sustainable future. On a more general note, the interconnectedness of rural and urban areas and the role of digital technologies in approaching sustainability are also discussed through examples of the above stated concepts.

The main purpose of the article is to highlight the need to rethink and reconceptualise the accepted concepts of smart cities and villages by shifting the attention from technology and technological solutions and moving it towards communities and sustainability. This way we can support a shift from a mainly techno-centric to a more community-centric development of rural and urban living communities of the future. Such communities will take into account "the needs of the present without compromising the ability of future generations to meet their own needs" ([6] (p. 8)). Hence, an approach will be relevant for planners, designers, and developers of future digital solutions, emphasising the human and environmental aspects of smart cities and villages. New solutions will help enable a climate neutral position by changing the paradigm, jumping from standard urban and rural planning patterns to the changed mind-set of communities. An important part of this is to put more attention on empowerment at both individual and community levels, and to ensure the social acceptance of new technological solutions to successfully implement new mind-sets and related policies and actions. In our opinion, those changes have to be achieved on two levels, firstly on the level of individuals/communities that should start understanding that technologies are not "scary creatures" but can instead serve as tools to improve living conditions, and secondly on the level of authorities and economy that should focus their attention on the actual needs of the communities without anticipating the results in advance. Here we agree with Schot and Steinmueller [7] when they emphasise the need for new framing for science, technology and innovation policy that should put the understanding of "how to use science and technology policy for meeting social needs and address the issues of sustainable and inclusive societies" (p. 1555), thus emphasising that sustainable living cannot be achieved only by technological solutions. Instead, to ensure social sustainability, appropriation, and effectiveness of new solutions in the long term, the process has to start, be adapted and led by people and their needs and powered by open (social) innovation.

2. Conceptual Framework

If the community is to be positioned at the centre of this article, it should firstly be explained what exactly this term signifies and how it is useful for understanding villages, towns and cities, and their role in a sustainable future. The conceptual framework attempts to bring together four essential features—community, village, city, and sustainability—and to analyse the links and (co)relations between them.

2.1. Community

The discussion on the importance of community and its understanding has been present for a long time in social sciences, and especially in sociology and anthropology (e.g., [8] or [9]), but has a much shorter tradition in some other fields, such as rural development, or in more technical fields (such as information and communication technologies (ICT), digital transformation or development of new digital services and applications). If a very superficial definition of a community can be based on boundaries set by geographical characteristics and limitations, such as borders of villages, towns, municipalities or regions, the discussion of a community-based approach challenges this interpretation

and calls for a more contextual one. Anthony P. Cohen [10] stresses that community is one of the terms we manipulate with and comprehend on a daily basis, yet it is quite troublesome, at least within academic discourses. Further, Ferdinand Tönnies [11] understood "community" (Gemeinschaft) as a counterpoint to "society" (Gesellschaft), which according to him signified a cooperating group of people focusing on common goals. Following his thought, the community is an entity joining people who are convinced they belong together. A similar distinction has been nurtured by other crucial thinkers, among them Émile Durkheim [12], who distinguished between mechanical and organic solidarity, and Max Weber [13], who treated Gemeinschaft and Gesellschaft as types of social relations.

In developing a community-centred view of sustainable development from the perspective of smart villages and cities, the necessity of contextualising the community becomes obvious (see for example [4] (p. 8)). Stemming from this, the definition proposed by González de la Fuente and Salas Quintanal [14] (pp. 45–46) on the case of community projects in rural Mexico seems to combine all the different—also social—components: "/.../a community is a social group articulated by relationships of cooperation and conflict, whose institutions promote direct and constant contact between as many as possible of the members of the group and as frequently as possible." Our own understanding of a community is built on this definition: we understand community as something mostly defined not by geographical components or location, but relations(hips), interactions and feelings of "belonging together". We acknowledge that within a village, city or urban region multiple communities are existent simultaneously, their existence and objectives being defined by the point of interest, and can be converging in the long term (e.g., sustainability) and possibly very diverging in the short term (e.g., NGOs compared to SMEs etc.). The contextual consideration of a given community is thus of vital importance. Therefore, to put the community at the centre of research and interpretation does not indicate only a new, community-centred approach but is also a strategic, almost political act, with the main aim to make developmental projects and approaches sustainable and (socially) just.

2.2. *Village, City*

Dividing the world into two poles, namely rural and urban, has been criticised from many perspectives. One of the most recent discussions on this matter was organised by the United Nations' Statistical Commission on the topic of methodology in defining cities and rural areas to enable international comparison [15]. Instead of a dichotomous view, a discussion recommended a two-step recognition process based on population density, contiguity and population size. First, grid classification of urban centres, urban clusters and rural grids, and second, classification of local units: cities, towns and semi-dense and rural areas. Despite some sub-categories developed in the discussion, for the purposes of the paper we focus on the robust, main three categories as follows. A city is defined by more than half of population living in an urban centre (e.g., at least 1500 inhabitants per km^2 with population of at least 50 000) and villages have the largest share of population living in a rural cluster (e.g., 300 inhabitants or less per km2 with population between 500 and 5000). Areas that have a good share of the population divided into both, densely and sparsely populated areas, are classified within semi-dense areas [15] (pp. 10–11). More specifically, national or regional definitions are built on national and specific contexts. Therefore, despite the urban–rural continuum described above, we have made a short social contextualisation of villages and cities, to shed some light on the social (instead of only factual) layers of the areas considered.

Villages represent rather small communities: small settlements, hosting from a few dozen to a few hundred inhabitants, inextricably linked to the rural areas. In general, the socio-economic contexts in which rural communities are developing in the 21st century are changing fast, but they are still marked by some characteristics which distinguish them from other types of settlements, for example infrastructure or availability of services. One of the most important lacks of infrastructure in the countryside is noted within the scope of mobility. Another is evident in digital infrastructure and digital skills. In the case of EU the overall level of digital literacy among adults was the lowest in the rural areas (e.g., only 48% of rural population had basic or above digital skills) and the highest in urban

areas (e.g., 62% of adults living in urban settlements) [16]. There is also a lack of centrality in the sense of administrative, cultural, logistic, social, education organisations. This does not imply that there are no such organisations at all, but those are mostly peripheral, and the majority of things still has to be arranged in urban centres. Globally speaking, villages are also affected by the persisting challenges of rural shrinkage, which is tightly connected to the above stated reasons (for the case of the EU see [17] and [18]. Lastly, based on the importance of the feeling of belonging together, processes of community building are an important factor in defining rural areas. Having a relatively small population, contacts are more often personal, people see each other more often and know each other personally, which means that feeling of belonging together comes also from the frequency of personal/physical contacts. Despite the relatively small number of inhabitants, the notion of multiple communities and multiple interests being present is of great importance. As clearly described by Mansuri and Rao [4] (pp. 10–24), mechanisms to identify stakeholders are crucial for successful implementation of the projects, especially when the access to project resources in unequal; it is observed how in rural areas, wealthier and more educated individuals are more prone to take leadership positions (p. 18). To enable orientation and proper understanding of the social fabric, qualitative (field) research approaches are needed.

As shown in Figure 1, a smart village wants to overcome deficiencies listed above by activating the community to collaborate in a search for solutions to existing (local) challenges by using local (natural, social, intellectual, cultural) resources. The on-going processes are—where meaningful—supported with the use of ICT and (social) innovation [19] (p. 3).

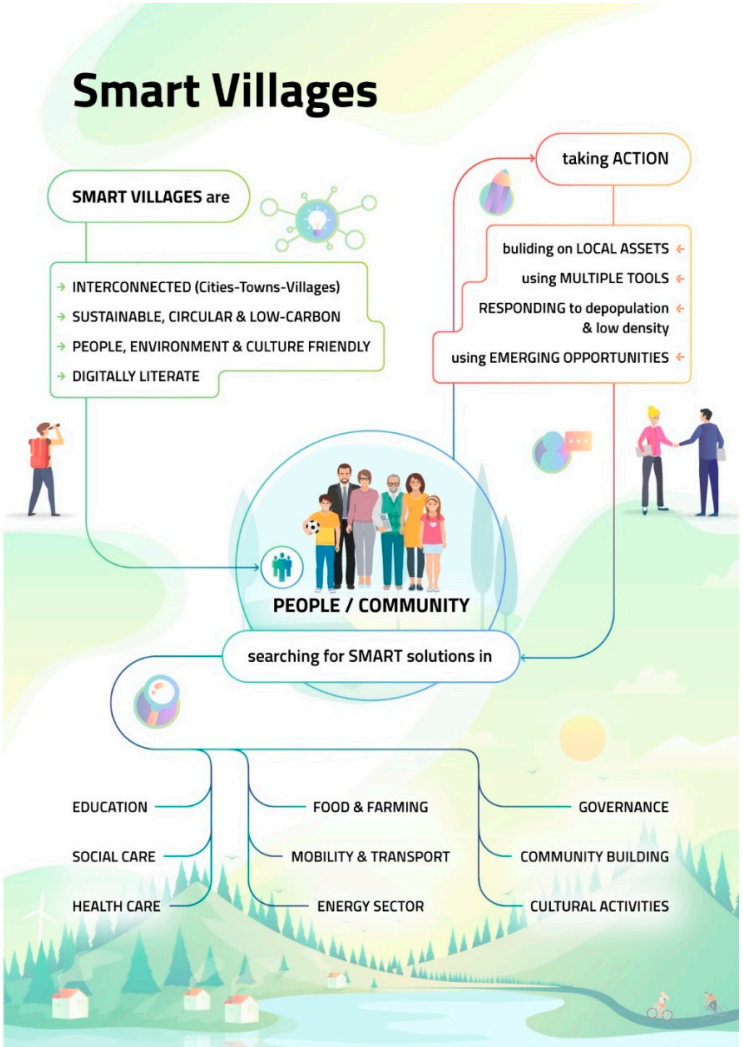

Figure 1. Smart village ecosystem.

Cities, by definition, are densely populated settlements where at least half of the population lives in an urban centre. An important part of defining a city or an urban area is to also consider its "communication patterns", for example, commuting zone, area considering also the employment patterns of a city or wider urban area [20] (pp. 2–3). However, each country has its own criteria, often based on historical and geographical conditions, population density and size, mobility options, etc. In the EU, two out of five residents live in a city with a centre of 50.000 inhabitants and one out of five lives in a commuting zone of these cities. Together about three out of five residents live in a city or a commuting zone (or a larger urban zone). This share, however, changes substantially between countries. In Slovenia, in European comparative view, urban settlements are small, only two of them having the population of more than 50,000 inhabitants (Ljubljana as a medium-sized city and Maribor as a small city). Despite this, and considering the specific historic (e.g., medieval status) and economic development and population size (more than 3000 inhabitants), Slovenia officially recognises 67 cities [21] and is one of the countries with the lowest share of their population living in a city or its commuting zone (40%). Germany, the UK and the Netherlands, on the other hand, have the highest shares of the population living in a city or commuting zone (73%–74%). Cities are defined and treated differently in Slovenia and the European Union.

In an understanding of urban areas, the phenomena of global urbanisation and urban sprawl can hardly be overlooked: the first describing the growing number of global urban population which is expected to grow up to 68 per cent by 2050 [22], and the second describing somehow reverse "urban development pattern characterised by low population density" [23] (p. 5), for example, process of people living in densely populated urban centres that are moving to its suburbs, with low population density. The latter has proved to have environmental as well as social and economic consequences [23] (p. 11). We recognise the described urban development processes and the importance of understanding urban regions as an entity, however, we keep the concept of the city—as described above—as one of the focal points of our discussion.

Cities and urban regions provide a different way of life than rural areas. More jobs are available in different sectors, and many times there are obvious in-migration patterns noted. Cities are marked as governmental, commercial and logistical hubs with reliable infrastructure that supports the flow of events and enables access to services [24] (pp. 1–2). On the other hand, access to healthy, local food products is hindered in cities, which has become especially prominent amidst the current Covid-19 pandemic, an unexpected event where rural areas have a considerable advantage in the terms of food supply. Thus, the main issues to be tackled in cities lie in proper coordination and optimisation of services. Given the described characteristic, a smart city could be defined as a city that uses the ICT to make the use of resources more efficient and intelligent, which results in improved services, reduced costs, energy savings and reduced environmental footprint [25] (p. 178).

2.3. Sustainability

Sustainable development is perhaps one of the most over-present concepts of last decades, actively directing and determining the creation of new policies, (global) strategies and actions. Again, social sciences have a long tradition of discussing the concept (also critically), whereas the development is not understood unilinear but instead mostly in two distinctive ways. First perspective sees Development (with a capital D) in the sense of progress, inextricably linked with the process of modernisation and is many times subject of criticism in sense of continuing neo-colonial processes [26] (p. 63) and reproducing inequality. From another perspective development is to be understood as an unplanned practice, in the light of on-going social, historical, endogenous processes within society [26] (p. 63). Problems of uncritical understanding of developmental processes have been addressed by various authors (for example [27] or [28]). A call for a more critical, participatory, and holistic view of future development is also made by Schot and Steinmueller [7]. They promote socio-technical system changes under the concept of "transformative change", which advocates for a more participatory and inclusive approach to innovation, education and policy making in all dimensions of everyday life.

Similarly, through the deconstruction of the concepts discussed analogous claims have been made here, especially in connection to the central role communities should play in sustainable development.

Agenda 2030 that promotes Sustainable Development Goals (SDGs) includes multiple measures that should contribute to balance the protection of universal human rights, protection of environment and economic development [29] (p. 179). Although having a great impact on the formulation of global (Agenda 2030), regional (e.g., EU Sustainable Development Strategy [30]) and national politics and being a useful tool in understanding global and local issues, SDGs and their indicators have also been widely criticised for giving a false feeling of simplification of very serious issues that could be reduced to numbers and achieving economic growth (see for example [31]). Despite the criticisms we keep SDGs as a relevant category towards understanding sustainable development. As a response to the (un)usefulness of the concept of sustainable development other developmental models have been popularised in the expert and public discourse (see e.g., [32]), including "circular economy", "steady-state economy", "post-growth", "buen vivir", "degrowth" and aforementioned "transformative change". Since these new concepts and models need to be evaluated, we decided to keep the terms sustainability as an ability of a system, including a smart city or village, to exist through time and on a longer scale. For similar reasons we also keep the term sustainable development. The article promotes the transformation of approaches to development to achieve sustainability. It does so by combining analytical insights gained by qualitative approaches characteristic for social sciences, and solution-oriented approaches of technical sciences. Promotion of social innovation is in line with one of the main challenges of innovation in contemporary world, as they have been recognised by Martin [33] (p. 436), namely the need to move from innovation for economic growth to innovation for sustainable development.

3. Community-Centred Development of Sustainable Solutions

People-centred development (PCD) puts people in the centre of developmental processes as beneficiaries and as drivers [34] (p. 2). In practice PCD attempts to make a move from the mind-set of experts, professionals and academics to the specific needs and experiences of people. In this approach, people play an important part in the innovation, design, co-creation, testing of solutions and in developing project plans. The basic premise of the PCD is to include people already in the first steps of the development process, so they can—through the participatory process—actively co-create decisions already from the beginning. The approach has been tried by numerous international companies, cities (see for example [35]) and some organisations (for an example see [34]). In the 1970s, Xerox relied on a people-centred approach to improve the usability of their first photocopying machine; in the 1990s, Boeing employed ethnography to design the 787 Dreamliner aircraft, and Microsoft used it to improve their operating system. In the new millennium, several other companies, including Intel, Google, General Motors, Motorola, Nissan, and Volvo, started to hire social scientists and rely on PCD for the design and development of their products and services [36]. Organisations such as the United Nations within their Development Programme (UNDP), have applied a people-centred approach in broader context, for example in repairing the damage of natural disasters in Haiti [34] (p. 3) or in aiming to lessen the effect of poverty in Armenia [34] (p. 10).

For purposes of this article, we adapted the PCD approach, shifted attention from individuals to groups of people, living and collaborating within cities and villages and renamed it to community-centred development (CCD); however, the updated approach keeps the main properties of the PCD. Similar to PCD, CCD can also be divided into four basic steps. The first step, identification, is about defining the community whose problems are actually being solved. In this step we should answer the question, whose problem are we actually solving and who are the people within a broader community we are focusing on. Usually, a universal solution will not satisfy all parties in wider community; therefore, there is a need to identify more specific group(s) of people and find out as much as possible about them. We can pick a smaller sample of people who represent the users or clients, or we can try and talk with everyone in focus—it all depends on our individual project, as well as

capabilities, budget, skills, staff, etc. [36]. In the second step, the research and analysis of the needs of the community is carried out by using and combining different approaches, from interviews, focus groups and participant observation to surveys, experiments, data mining etc. By combining what Wang described as "big data" and "thick data" analysis (cf. [37], [38]), for example, qualitative and qualitative data analysis, we learn about people's everyday experiences, practices and habits to find out what they need and want. In this process we do not perceive people as research subjects; instead, we treat them as (local) collaborators and co-creators. The third step is interpretation. On the basis of research findings and in cooperation with the experts we prepare suggestions on how the situation could be improved. The key idea of CCD is that communities can and should be included in this part of the process not only as informants but also as active and engaging partners in the participatory process. CCD is an iterative process, which means that we continuously return to people and their communities, either in cities or villages, to repeatedly ask questions that shed light on how our envisioned solutions meet their needs and desires. In addition to listening attentively, researchers observe what people in communities do and how they interact with technologies or each other; they might even live with them for a while to learn about their daily habits and practices and to understand more in depth how communities actually function and how people interact. They use techniques that transform research participants into active co-creators or collaborators, they let them take the lead and they learn from them to find out how new solutions, products and services, co-created with the communities and for the communities, could improve their lives.

As described above, rural, and urban spaces are interconnected and can hardly be separated into two distinctive units, but regardless, the CCD in both cases should build upon local knowledge that is conditioned by distinctive either rural or urban ways of life. This is especially important as the challenges and opportunities of a smart city and a smart village can be diametrically opposite. Services and products developed with the use of community-centred approaches have a great potential to successfully address the existing urban–rural and rural–urban linkages/continuum [39] entailed within SDG 11 (Sustainable cities and communities). The formation of new links and lessening the rural–urban divide is also encouraged: "in order for urban and rural areas to be sustainable they must develop in tandem, inequalities must be reduced and the development gap bridged" [39] (p. 4). ICT solutions developed with the help of community-centred approach offer great possibilities.

Summarising from the above stated, the CCD for smart cities and villages could be described in the following four principles:

1. A shift from developing for communities (top-down) to developing with communities (bottom-up). Community members and other stakeholders are an integral part of all phases of the participatory CCD process.
2. All community members and other stakeholders possess valuable knowledge, expertise, and experience for creating smart cities and villages—they become collaborators, co-creators and co-workers.
3. Smart and proactive citizens are the driving force of smart cities and smart villages; capacity and community building, empowerment, and behavioural change are inseparable part of the development of smart and sustainable solutions, individually and collectively.
4. Innovation for smart cities and villages requires an inter- or trans-disciplinary R&D approach that combines engineering, natural sciences, social sciences, humanities, arts and other fields of science—in this way a holistic development of solutions is ensured.

4. Dimensions of Smart Living

It has been claimed elsewhere [40] how frameworks of smart development are not connected only to technological aspects but should be thought broader. In this context, technology and technological solutions should be understood as a tool to develop solutions and services, and achieve sustainable living, and digital transformation should be understood also as a social process. Long-term assets of living in a smart community have been linked to various aspects of life, most notably to increased

community engagement, a sense of being part of the community, and social inclusion [41] (p. 155). To capture the conceptual breadth of smart living in cities and villages, our discussion is interpreted from the perspective of energy, mobility, and waste. The decision to address the chosen categories stems from their importance for both rural and urban areas, their importance on local as well as on global levels (SDGs no. 7, no. 11, no. 12) and from our own research experience. Research experiences in particular, have provided us with the insights on how the (same) concepts can manifest themselves completely differently depending on the before existing (infra)structures in different communities—social, cultural, physical, educational prerequisites, economy structures have proved to be of great importance. In the following sections we present a general overview of the chosen categories, exposing some of the most pressing challenges in either rural or urban communities, and provide some (context-specific) solutions to some of the stated challenges. Our illustrative examples should be a further reminder of the necessity of the transformation of approaches to development and innovation. Similarly to the view of socio-technical system transformation [7] (p. 1562), the call to community-centred development could be seen as a call to holistic transformation in the view of skills, infrastructure, user/consumption/production preferences, industry structures etc.

4.1. Energy

Globally speaking, issues of sustainable energy are at the centre of modern, energy-dependent society [42]. "Energy systems have underpinned and constructed deeply unequal social relations, as well as imbalanced nature–society relations, since the dawn of the fossil fuel area" [43] (p. ix) and sustainable energy has been viewed as a catalyst for access to good (education, economy development, healthcare etc.) services and achieving equality. In order to achieve sustainability, we have to change how we generate, use and think about energy. A shift from fossil fuels towards renewable sources and technologies is therefore inevitable and has been indirectly addressed in the Paris Climate Agreement and very straightforwardly in SDG 7 (Ensure access to affordable, reliable, sustainable, and modern energy for all). Even so, in 2019 around 840 million people still had no access to electricity [44] (p. 13). Especially in remote rural areas, the access to (sustainable) energy sources plays a major role in community development. It was already discussed how enabling off-the-grid communities the access to energy lies at the core of many global smart village initiatives [40], but energy is also one of the foundations for building/transforming into a sustainable smart city. Stemming from the findings of Haarstad and Wathne [45] (pp. 918–920), the acknowledgement that only smart technology/technological approaches might not be enough to achieve sustainability, has to be made as the access to energy accelerates also a plethora of social actions. However, on both levels (rural and urban) the differences between "developed" and "developing" countries should not be neglected.

As great consumers of energy, cities and towns are placed in the heart of the discussions on climate change. Can the urban infrastructure be developed in a sustainable way but still maintain high quality life for its citizens? Addressing those concerns, in recent years one of the most appealing and popular possibilities that rose up is the idea to decentralise the distribution systems and make the electricity power more localised [46]. This was the case with Japanese Fujisawa Sustainable Smart Town [47], where micro-grids increased resilience and lowered carbon emissions for approximately 70 per cent. It is claimed that in the future of smart and sustainable energy systems an important role will be played by computational intelligence and machine learning which will enable optimisation, coordination and control of energy [48] (p. 582). Fields included in achieving sustainable energy in smart cities encompass a wide array of activities—from building energy efficient/passive houses or retrofitting old ones, more efficient systems of water usage, heating, indoor and outdoor lighting. An operative Slovenian example to illustrate these prospects is Tango, an IoT platform that collects, verifies and processes large quantities of data, facilitates sophisticated data analysis and machine learning, and makes the optimal planning and management of the energy and environmental solutions offered by the company easier. Its flexibility means that the platform is useful to users of smart cities,

as it enables data to be converted into usable information from which rapid, reliable decisions can be made [49].

Globally speaking, (sustainable) energy in smart rural areas is often associated with off-the-grid systems and is tightly connected to the community. To evaluate local infrastructures and available resources, and to consider the skills necessary to maintain the system is of vital importance in the process [50] (pp. 21–27). However, speaking of rural areas where basic infrastructure is already provided, for example in the EU, off-the-grid discussions become obsolete and are focused on a more sustainable and renewable sources of energy for rural communities. In Slovenia, a pilot case for sustainable energy is village Luče, included in an EU project Compile [51]. The project aims to help local energy systems to make a transition from centralised towards decentralised and therefore more flexible energy networks. One of the objectives of the project is to show how local energy islands help community building, and increase social and environmental benefits; for example, in operating local (agricultural) business.

With the support of ICT, energy plays an important role in connecting rural and urban areas and accelerating the urban–rural continuum. ICT, and consequently the energy sector, highly contribute to balance the opportunities and increase the quality of life and access to social goods in rural areas. Global aspirations on a sustainable future therefore must understand the access to (sustainable) energy sources as an essential human right, and community members not only as consumers but rather as prosumers also in the energy sector. An LUT University and Energy Watch Group study suggests that global transition to 100% renewable energy across all sectors—power, heat, transport and desalination—before 2050 is feasible and no longer a matter of technical feasibility or economic viability, but one of political will [52]. Renewable energy technologies, including storage, have potential capabilities of generating the required energy supply throughout the year. An important concern that has not been accordingly dealt with yet is the provisioning of a system service that will ensure the operational stability of the electricity system. To accomplish this, we need ambitious targets, but also stable, long-term, and reliable policy frameworks, adapted to regional conditions and environments.

4.2. Mobility

Another important area of contemporary life is the mobility of goods and people. In this regard, sustainable mobility plays a crucial role in achieving the objectives foreseen in the SDGs. The sustainable mobility paradigm [53] builds upon three principles to achieve reasonable travel time along lessening the environmental impact: reducing the need for travel (the Avoid principle), modal shift towards more sustainable modes (the Shift principle), and increasing travel energy efficiency (the Improve principle). Even though technology can improve efficiency, it has to be combined with behavioural change [54] (p. 422); [53] on the individual and broader levels, such as regional governance bodies. In the last decades, the main paradigm in mobility systems is the use of ICT-based innovations, often regarded as the smart mobility sector. 'Smart' and 'sustainable' are sometimes understood as synonyms, but it should be noted this is not necessarily the case [54] (p. 422). 'Smart' mobility concepts seem to be a more attractive subset of the larger 'sustainable' mobility paradigm, the part regarding the improvement of such systems. It is predominantly focused on 'hard', techno-centric infrastructure connected through 'soft' tissue of interconnected ICT services and with governance bodies, citizens and commercial initiative [54] (p. 422); [55,56].

In an urban environment, 'smart' mobility is consistently connected with ICT services and platforms working inside intelligent transport systems [57]. These techno-centric, inherently digital approaches [58] rely on improving the efficiency of transport and travel in the context of numerous mobility options, optimising citizen input and energy used [59]. ICT solutions, such as automated and autonomous driving, integrated and connected vehicles (vehicle-to-vehicle, vehicle-to-infrastructure), mobile applications for car sharing, car-pooling, ride-sharing, ticketing, parking, navigation, traffic information integrated into intelligent transport system (ITS) [55], are also promoted. However, for multilevel and perplexing societal problems we cannot realistically rely on

exclusively technological fixes. Fostering behaviour change is a focal point of several initiatives and projects. For example, project SaMBA [60] entails optimisation of traffic infrastructure, ICT solutions and new mobility options mixed with individuals' motivations through reward and pricing schemes. It illustrates the intricacy of possible factors of influence as individuals' mobility behaviour is of situational and personal origin [61].

When we think of technology and innovation for moving to low-carbon mobility, we must recognise we can make a significant impact with relatively simple solutions, especially if they are tailored to local communities as was the case in the DriveGreen project. The initial plan was to develop a simple and affordable smartphone application to determine how economical, safe, and environmentally responsible driving was. However, anthropological research in five cities (Ljubljana, Belgrade, Budapest, Newcastle, Durham) showed that neither the cost of fuel nor the data on greenhouse gas emissions were effective motivations [62]. That is why the project team prepared a concept of a smartphone application that shows how much and how people move in the city. The main innovation of the application is the social dimension that connects people in a community to work together toward a common goal [63,64] especially when it comes to sustainable mobility [65].

Existing good practices on smart rural mobility can be clarified in three main categories, whereas the focus is on the shared mobility solutions: (1) Flexible transport services such as Door-to-Door or Flexible route demand-responsive transport; (2) Asset sharing, for example, car or e-bike sharing and (3) Ride sharing in the form of Car-pooling, E-hitchhiking and Volunteer lift giving for distinct societal groups, such as elderly (for Slovenian example of community-led initiative see an initiative Prevoz.org) [66]. Two selected examples will illustrate this. The Slovenian institute Sopotniki (Eng. Co-travellers) started out as a small local initiative in 2014 to provide the elderly with mobility opportunities and to activate their social life and intergenerational solidarity. It mobilises volunteer drivers and offers free transport services to the elderly, in order to "prevent the state of isolation and loneliness of elderly people from small, remote villages/.../" [67]. Ummadum [68] is an application that encourages ridesharing. It was first launched in Tyrol, Austria in November 2019 and has since then started to operate outside the primary locations. By using the application and sharing rides, the users collect points that can be used as a discount in local retailing stores—both the driver and passenger are rewarded. Municipalities and local businesses help establish the ridesharing and rewarding systems, so their role is crucial.

4.3. Waste

Globally, waste is expanding at an alarming rate. According to the World Bank, global solid waste will rise from 3.5 million tonnes per day in 2010 to 6 million in 2025. In Europe, for example, people annually use 16 tonnes of material per year, 6 tonnes of which become waste and only 36% of this waste is recycled. On average, each person in Europe currently produces half a tonne of household waste alone and only 40% of it is later reused or recycled. In some countries more than 80% of waste is directed straightforwardly to landfills [69]. It should be noted, however, that such global and European trends and statistical averages are broad estimates only as rates vary considerably by region, country, city, village and even within cities. In general, the rule is that the higher the income level and rate of urbanisation, the greater the amount of solid waste production. OECD countries, for example, produce almost half of the world's waste, while Africa and South Asia regions produce the least waste [70] (pp. 8–12). In addition, local practices of waste management differ substantially depending on whether we discuss rural/(semi)urban areas and developed/developing countries.

There are several on-going projects connected to establishing smart solutions for waste management. Some of the project results can be applied to both cities and villages, whereas some solutions are designed especially to enable the management of waste in more urban areas. One of the projects is Waste of the World funded by ESRC and conducted by universities in Sheffield, London and Durham. It deals with how and where we turn things into waste and how we deal with the increasing amount and complexity of waste. An applied solution is myWaste, a personalised application

that provides support to households concerning environmental regulations. Another is TrashTrack developed by MIT's SENSEable City Lab that uses miniature RFID tags attached to different types of trash so that they can be tracked through the city's waste management system. The ICT solution, developed in the Invisible Life of Waste project, similarly visualises the paths of waste in various phases—from households to landfills—and actively promotes sustainability by offering constant user feedback. It consists of four integral parts: 1. smart trash cans for households with radio-frequency identification (RFID) tags; 2. smart waste containers with RFID tags and sensors for measuring weight and volume (fullness) that will be connected to CVS Mobile's telematics system; 3. a smartphone and PC tool for visualising waste management processes and presenting recommendations for waste separation and recycling; and 4. an online community for sharing tips on waste management and comparing achievements via social networks. This ICT solution attempts to be more robust than other solutions because RFID-based trash cans and waste containers will be used for longer periods. The development is based on CCD approaches and began with an analysis of waste management practices in six cities: Ljubljana (Slovenia), Graz (Austria), Trieste (Italy), Zagreb (Croatia), Oslo (Norway), and Dubai (UAE). In this way, particularities of different locations can be taken into account when adapting the general ICT tool to different cases and their socio-cultural specifics, people of different age, gender, social and employment status who live and work in different settings, locations, and buildings. Instead of a universal ("one-size-fits-all") approach, the ICT solution will be tailored to different cases and specifics of communities, who will have a possibility to change and adapt the tool to their needs and existing habits and practices.

If in densely populated urban areas we can clearly speak of smart approaches to waste management, many times rural areas have to deal with different perspectives of waste. Households in rural areas are more prone to use papers, wood waste and parts of agricultural waste as resources for wood stoves and open burning practices or for home composting. Both can be cheap and environmentally sound solutions if performed right [71] (pp. 2–3). In developing countries many times the costs of waste management activities in wide, sparsely populated rural areas with rugged terrain are not fully facilitated which leads to inadequate services to rural households, whereas in, for example European countries, waste management in rural areas should be fully covered by management services [71] (p. 6) but sometimes the realisation side is lacking [72]. Building on this, one of the biggest challenges, especially for rural areas is the issue of wild dumps [71] (p. 1) [72] (p. 1).

5. Discussion and Recommendations

Following examples and cases presented in this article, we believe the process of establishing, designing and defining smart and sustainable cities and villages should be reconsidered by making a move from top-down and techno-centric solutions to bottom-up and community-centric solutions. Communities should be, as we tried to highlight in this text, put in the centre of attention when new technological solutions are being envisioned, designed and implemented, and people's opinions should be taken into account throughout the CCD process to assure long-lasting, human-friendly and sustainable solutions. A crucial role of governments should also be recognised and reinforced as only through their power as decision makers an effective transition towards sustainable communities can be made. We also agree a city or a village to be smart when "investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economy and high quality of life, with a wise management of natural resources, through participatory governance" [73] (p. 50).

The 2020 Covid-19 pandemic has most rudimentarily demonstrated the importance of community-led emergency reaction and food distribution. To illustrate: planting and door-to-door delivery of fresh vegetables have significantly increased in spring 2020. Members of communities have come to help farmers and gardeners with the work in the field. The Open Food Network, deployed in 13 countries, outlined an innovative approach to getting small producers to market through "software designed for food", and similar platforms are being emulated everywhere to provide small farmers with

a window to directly reach customers with their products in a sort of digital Community Supported Agriculture (CSA) scheme [74]. Such initiatives and actions can and should be encouraged on a daily basis if we are to achieve sustainability and clearly, ICT can offer a strong support in development of such (social) innovations.

Among the core principles and recommendations for developers of new ICT solutions, development projects and others, we would like to emphasise some we see as the most relevant for creating smart and sustainable cities and villages. These principles take into account people and communities and combine findings of engineering and social sciences, especially anthropology, psychology and sociology (cf. [75], where ten such principles are presented).

5.1. Calm Technology

The development of ICT solutions for smart cities and villages should rely on the Calm Technology principle [76,77], which suggests that the most robust, reliable and sustainable technologies are those that disappear and weave themselves into the fabric of everyday life until they are indistinguishable from it. To implement the principle in practice, it is necessary to follow the four-step approach of the CCD presented above. This means involving community members in the processes, understanding the existing habits and practices and incorporating the ICT components of the smart cities and villages in their everyday life without a need to establish new habits and practices or redesigning the existing ones.

5.2. Community Size

According to findings of anthropologist Robin Dunbar [78,79], 150 individuals seem to be the cognitive limit of the number of individuals that a human can know as persons, meaning those with whom she or he has defined and long-lasting personal relationships. According to his findings, contemporary communities with a larger number of inhabitants (those in large cities or online social networks [80]) witness problems of social bonds breakdown. Therefore, planning for smart cities and villages should take into consideration the manageable community size. The planners, developers, academics and other professionals should support development of new ICT tools, services and projects that enable creation and keeping ties by offering personalisation opportunities for communities of manageable size.

5.3. Identifying Community Leaders for Making a Wider Impact

When implementing new technologies, developers should put special attention on early adopters, trendsetters and influencers who are able to motivate others to use a certain novelty in a local community. Furthermore, local leaders can help spread the main message about an ICT solution in the community and beyond. In practice, this could be achieved by identification of existing formal and informal communities and their leaders in cities and villages and involving these individuals in the four steps of CCD. For example, within the project Smart Villages that focuses on digital transformation of villages in the Alpine space, researchers started identifying #LocalHeroes [81], proactive individuals that are tightly connected to activities of communities, are trusted by other community members and whose actions and decisions are well accepted by the community. In this way the researchers want to increase collaboration activities and the trust of communities in the results of the project, but also show how the two-way flow of communication can significantly improve research and development processes. A similar approach was taken in project TripleA-reno where "heroes" help fellow residents in energy efficient building renovations [82]. In both cases, the key finding is that fellow community members are far more effective in transmitting the information and introducing new technologies as outsiders (e.g., developers, academics, policy makers etc.) or even as technology.

5.4. Readdressing Surveillance and Control Issues

In addition to the three core principles, the problem of surveillance and control should be addressed to assure the most democratic functioning of newly established ICT solutions. In a smart city,

as Griffiths [83] (p. 31) argues, "smart norms, protocols, procedures and considerations could develop which limit access or deny urban participation to stakeholders, if they are developed conceptually, democratically and empirically unexamined, without priority attention being paid to investigating project 'failures'". We agree with this opinion and believe that the transfer of control to people and urban/rural communities should be made early in the design and development process, since it empowers community members to make decisions on their own and to co-create meaningful technological solutions with the community members—and not just for them.

5.5. Enhancing Community Building Processes

The main characteristic of community as understood within CCD is a feeling of belonging together. In a digital age, where individuals have many opportunities to connect, social engagements are proliferating through the use of ICT. Such interconnectedness "builds awareness about politics and local issues, and culminates in citizen collaboration, which promotes effective communities through positive community change and leads to positive benefits such as longer, healthier lifestyles" [41] (p. 157). Enabling and enhancing local networks where community members are/can be (inter)connected is therefore essential in creating an ecosystem where people are willing to work towards a common goal (e.g., achieving sustainability).

6. Conclusions

Following the paradigm of sustainable development, the article has deconstructed popular features of community, smart village, smart city and sustainability, and brought them back together in accelerating the importance of CCD of products, services and applied (development) projects. It has shown the importance of the central role of communities in developmental processes, accelerated the need to understand the community within a specific context and showed how only by community's active engagement sustainability for the future can be achieved. Further, it has been accelerated how sustainability should be(come) immanent to all development processes. In order to achieve this, the opportunities offered by ICT should be (re)considered and included in strengthening the collaboration between (all levels of) decision-making authorities, communities, developers and researches and envisioned in a way that enhances links between rural and urban areas. The article acknowledges the presence of multiple communities within a village or a city and the possible divergence of their short/long-term objectives. In this light, qualitative approaches and long-term collaboration and presence "in the field" are accelerated. For future research, the need for more precisely defined approach to recognising existing communities and their objectives/needs has been identified.

From this recognition of manifold communities and the diversity of their characters, it is impossible not to infer a demand for further research into the multi-level systemic approach of initiating and sustaining (smart) communities, based on a combination of methods that grasp their existing attributes, qualities, resources, and needs, both from a qualitative and quantitative perspective.

This article also acknowledges that, as much as bottom-up community-led action is imperative, we must also recognise and enforce the crucial role of governments and other regional and local authorities that, through their power as decision makers, need to demonstrate and execute their political responsibility for an effective transition to a sustainable future.

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