Citizen -centric Smart City Planning for Africa: A Qualitative Case Study of Early Stage Co-creation of a Namibian Smart Community

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Abstract— This paper examines social and economic development of African urban areas using the Smart Community concept. Sub-Saharan African communities face an urgent need for affordable housing, new working and learning environments, and new technologies to support sustainable development. The paper provides insights to the main research questions: 1. How can citizen-centric engagement process for community development be enhanced in an African context? 2. What kinds of information and communication technology (ICT) tools can support such processes? and 3. What is required for citizen-centric Smart Community development? We conducted a focus group study in Keetmanshoop, the Karas region in Southern Namibia. The main lesson learned focus on the need to develop a reliable ICT infrastructure along with affordable housing and feasible services.

Keywords-Citizen-centric; Smart City; co-creation; virtual reality, Africa, developing economies.

I. INTRODUCTION

In Sub-Saharan Africa, there is an urgent need for affordable housing, new working and learning environment and new digital services to support societal and economic development. The African population will continue its radical shift from rural to urban areas; in 2010 urban dwellers made up nearly 40 percent of the total population, and the estimation for 2030 is 50% and for 2060 65% [1]. The urban population of Namibia has been increasing from 28% in 1991 to 33% in 2001 and to 42% in 2011. The evolution of the society requires public administrations to tackle many new challenges, including civic rights, gender equality, employment, mobility, digitalization, security, environment and many others. One of the main challenges in African governments is to develop more democratic and transparent societies without corruption. The widespread use of new technologies, such as social media and mobile services, has increased the demands for openness and transparency for public decision-making and administrations. There is a need to enhance the communication between citizens and government, and to increase public engagement and to help citizens stay informed about decisions.

Urbanization in Africa tends to differ from the experiences acquired from other parts of the world. In Africa, urbanization is "decoupled from overall structural transformation of the economies". According to a theory, urbanization is a process of transformation where economies evolve from rural agricultural economies towards industry- and service- based economies, and they simultaneously move from low-income to high-income societies [2]. However, in Africa urbanization seems to miss this link to development towards industrialization and higher income. Instead, urbanization in Africa frequently refers to "resettlement from the rural hinterlands, to rural market towns". In fact, over 70% of African populations live in towns with less than 100 000 inhabitants, in sparsely populated small towns and along the road networks. There are only a few mega cities in Africa [3].

However, Smart Cities are frequently linked to big cities and advanced technologies that improve the living conditions and foster economic growth in these highly populated and well-connected urban agglomerations. Slavova and Okwechime [3] emphasize the fact, that African urbanization provides some preconditions, which should be considered when the Smart City approach is used to foster the urban and economic development in Africa. They make a distinction between "hard" and "soft" qualities, or best-practices, as domains that Smart City approach provides for city planners and stakeholders, who may then select a combination that best fits for their city's needs. Hard domain includes, for example, physical infrastructure like water resources, which can be used more efficiently with more innovative management solutions. Soft domain includes social issues that may be ameliorated, for instance, by provision of housing and social services with integrating such services with ICT. Also fostering of economic development through innovation and entrepreneurship may be considered as a soft approach.

Slavova and Okwechime [3] also point out different strategies needed for different agglomerations; mega-cities (over 5 million), medium cities (from 5 to 0,5 million) and small cities (less than 0,5 million) and other urban (less than 0,3 million), that cannot be developed with similar agendas. To simplify, soft qualities – social and human oriented development – are likely to be emphasized in small towns and rural environments rather than technology and data driven solutions. Rather than "hard domains", that are typical to big cities (e.g., physical infrastructure, urban density and congestion) more generic challenges of poor regions (e.g., slums and informal settlements) and especially qualities of "soft domain" (e.g., low quality and segregated social services, unemployment) are key elements to focus on in case of small towns [3]. It should be noticed, that in Namibia small towns, rather than cities are typical urban agglomerations. Event the biggest city, Windhoek, has less than million inhabitants. In our case town Keetmanshoop, there is only 30 000 inhabitants approximately, although it is major urban agglomeration in southern Namibia, and locates close to South Africa, which is Namibia's main trading partner. Therefore, "soft and human" solutions of Smart City approach are especially important in this case. Keetmanshoop also hosts different social and ethnic groups that have had conflicts in the recent history, which may influence the socio-economic development in the context of urban development also in the future. Having these guidelines in mind, it is safe to conclude, that especially social and human aspects of Smart City approach are relevant for the development of communities in the case area. In addition, it is more appropriate to discuss Smart *Communities* than Smart Cities in this context, as maybe is the case in most areas in (Sub-Saharan) Africa. Finally, due to decoupling of socio-economic development and urbanization in Africa, it is even more important effort to apply approaches like "Smart City" in this context, in order to converge these processes in the immediate future.

Widely acknowledged as the administrative capital of southern Namibia, Keetmanshoop attracts significant interest from private and public investors. Investment opportunities range from real estate, retail, solar energy, to logistics and hospitality. Some of the most significant projects on the horizon include the University of Namibia Campus, with 420 upmarket residential plots and a 10 000 square meter retail centre. The Municipal Council values the importance of Private Public Partnerships aimed at delivering essential infrastructure and welcomes investors to tap into the opportunities.

However, the development and building projects may face many challenges starting from the decision-making about the land, to transparency of the communication processes, getting raw materials and qualified professionals to work for the building sites. Our aim in this study was to examine the possibilities of co-creation approach in the context of building new affordable housing in the Keetmaanshop area. Moreover, user needs for local service infrastructure, public and private service development and business possibilities are also studied. In Smart City planning, the open innovation approach and new technologies are increasingly used to support stakeholder communication in urban planning. Advanced virtual reality (VR) models and tools, such as augmented reality (AR) and mixed reality (MR) can be used to visualize future urban plans. These kinds of tools can significantly improve the understanding of what is being proposed and the potential impacts of different alternatives on landscape and living environment as it is shown earlier in quantitative studies with citizens as well [4]. Moreover, we were interested in to finding out how this kinds of tools would support the co-creation process in Africa. To understand the challenges of current housing situation, and citizens' needs for Smart Community development, we conducted five focus groups in Keetmanshoop, the Karas region in Southern Namibia.

This paper focuses on communities based development possibilities, to enhance socially inclusive bottom-up approach that harness the collective intelligence and creativity of communities. The paper is structured as follows: Section II describes the concept of Smart Community. Section III presents the VR and MR tools for urban planning. Section IV explicates the focus group study. In Section V, we draw conclusions and define next steps of the research.

II.   SMART COMMUNITY OR SMART CITY?

In European and in other industrialized countries contexts, there has been an intensive development work, projects and research on the concept of Smart City. The Smart City concept is often approached from a technology-oriented, systemic perspective that provides new technological solutions, big data and innovations to make the living environments smarter through the application of digital technologies [5]. Less attention, however, is given to societal aspects of the Smart City for instance smart governance, smart people, sense of community and social learning [6]. In addition, what seems to be largely missing is empirical insight into the extent to which different smart city aspects can be applied in different geographical or in decisively different cultural contexts [7]. In addition, less is discussed how to involve citizens and other stakeholders for the development processes with new digital tools for sustainable, long-term results.

Why is the concept of Smart Communities relevant in the African societal contexts? Smart Cities go hand in hand with smart communities and one is dependent on the other. Smart Cities need also smart citizens – the citizens who live and work in these cities need to participate in adoption and usage of new solutions, at least. Smart Community concept allows socially, economically, technically and environmentally sustainable solution for urban living and advanced digital service-ecosystem for health, wellbeing, and equity of citizens (see Figure 1).
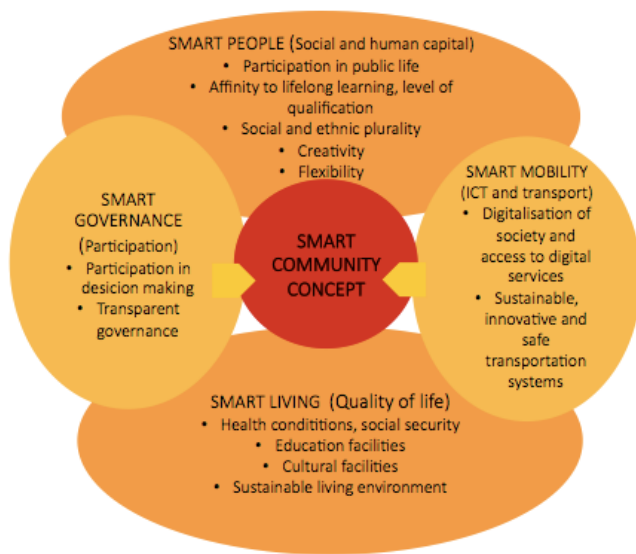
Figure 1. Elements of smart community as modified from [8][9].

In other words, Smart Community resembles Smart City approach that foster broad social, economic and environmental sustainability in urban development. However, Smart Community is application for smaller scale solutions and especially targeted for the less advanced regions, with more emphasis on social and economic sustainability ("smartness in people") than on technology and digital solutions ("smartness in technology"), as is often the case in Smart City concepts [5][6][7][8][9]. The Smart Community approach aims to introduce an organized and systematic approach to community development that provides better living conditions for local people. The specific qualities that may be considered as benefits of Smart Community solution include emphasizing local value addition in the construction process, environmental sustainability and cultural and social advantages and long-term sustainability.

Smart management and communication technologies give citizens the opportunity to shape both the culture and the structure of cities. A successful governance of the accelerating urbanization in Africa is a key process in terms of a positive economic and social development of the continent. One of the major systemic challenges based on the observation is that the growth of cities will foster the economic development and growth in the continent, but the low quality of infrastructure and urban planning hinders the positive socioeconomic impacts of the processes. For example, Namibian cities act as nodes through which development occurs and the rapid urbanization simultaneously poses risks that affect sustainable livelihoods of people [10].

Hence, citizen participation and social capital are essential elements of Smart Community. In Social scientific research, the term 'community' may refer to both to communities that are location-based, whose social ties rely mainly on geographical proximity (such as neighborhoods) or modern communities that are rather formed around interests and skills (such as professional communities) than around locality [11]. Social scientific research has also recognized the concept of 'imagined communities', understood as socially constructed community, imagined by the people who perceive themselves as a part of that group [12]. In addition, online and virtual communities have gained recently more and more attention. They have been defined as a combination of people, who have a shared purpose, and computer systems, to support and mediate social interaction and facilitate a sense of togetherness [13]. In this context, we are researching mostly local communities – although all kinds of modern communities, including imagined, online and virtual communities have impact on people's sense of community.

Citizen participation and social capital are essential elements of Smart Community. In Europe, governments have been launching ICT platforms to facilitate citizen participation for Smart City development. They allow different types of citizen participation, such as voting, rising public awareness and monitoring political processes. One of the main challenges of adopting advanced VR technologies, which are quite mature tested and capable in the Europe and in the industrialized world, in the African context, is the slowness of the internet connection. The average download speeds in Northern Europe are among the highest in the world (over 25 Megabits per second). In Namibia it is 7,5 -10 Mbps, which is higher than the average in African and Sub-Saharan African countries in general, but still low compared to the more digitalized areas of the world.

Moreover, co-creation and co-design of urban public services support resilience building and acceptance of public urban services that support sustainability [14]. Co-creation has impact on experienced quality of living environment. Co-design activities affect the experienced quality of a living environment, and diverse fields have recognized the relationship between the citizens' sense of the place, social cohesion and public health outcomes [15][16][17].

III. VIRTUAL AND MIXED REALITY TOOLS FOR CO-CREATION OF SMART COMMUNITIES

Recently VR and MR tools have been created to involve citizens and other stakeholders contributing to urban planning. Traditionally, urban planning processes are regulated by the public legal service sector. However, legal requirements typically base on a top-down distribution of information, even if the perception among different stakeholders of, for example, the characteristics of urban attractiveness and livability may vary significantly. To make cities more inclusive, planning processes should be developed towards exchanging of ideas. Such processes could use computer-aided design, including VR and MR

modelling. Moreover, co-creation and co-design of urban public services support resilience building and acceptance of public urban services that support sustainability in the long run [14][15][16][17].

Currently, in Africa, urban planning proposals are communicated to stakeholders and the public to a varying extent and by different means. Often only, a limited amount of stakeholders is well informed and new technologies, such as virtual models, are not widely used. However, statistic images and technical reports may be inadequate if a meaningful participation and convincing common vision is desired [18].

MR models and applications have been increasingly piloted in various urban planning and renewal projects [19]. VR and MR technologies can provide users ubiquitous experience: need for information any time anywhere with their smart mobile devices. In addition to visualizing future city environments with VR and MR models, more recent extension of this technology allows citizens to comment and ask city planners questions considering the future plans. Mobile applications for instance, have been recently piloted for developing two-way communication between city governance and citizens. The piloted applications allow citizens and city officials to discuss local urban planning development issues [20].

A prototype of MR application supporting a range of devices for a collaborative multimodal interaction was developed by Wagner et al. [19] to enable a group of participants to create a vision of urban projects. The stakeholders and users involved in the urban planning project had various backgrounds ranging from local urban planning specialists to other stakeholders such as members of local commerce. MR visualizations proved useful in enriching the available representations and enhancing stakeholders' understanding of urban situations. 3D visualizations, videos and sounds helped to express and co-construct their ideas.

Smartphones for urban planning have been piloted with citizens [20]. An augmented reality (AR) prototype system on smartphones was experienced as a useful tool for visualising proposed architectural designs [21].

The mobile and MR and AR technology tools above described, have been applied in various parts of the world like in Europe and in New Zealand [19][21]. Consequently, we were interested in to finding out how these kinds of tools would support the co-creation process in Africa.

One possible way to communicate Smart Community planning in the future was by using a virtual reality solution that was developed in order to visualize the planned residential area in Namibia. The system was developed by engineering firm A-insinöörit using virtual models by architecture firm Aihio Architects (Figure 2 and Figure 3).

Figure 2. Virtual reality models from the future housing area planned in Keetmanshoop, Namibia.

Figure 3. A Virtual reality system with devices for demonstrating virtual reality solutions.

The aim of the virtual reality model is to visualize the future residential area and to enhance the co-creation process with different stakeholders. The virtual model also aids in visualizing and choosing different material for houses and overall planning of the area. The system uses devices for demonstrating VR solutions such as AR and MR head mounted glasses (HMD) and their peripherals to produce a fully immersive simulation of the area. Furthermore, to create virtual worlds from a real world environment, special capturing devices are needed, for instance drones equipped with camera. Fully immersive simulations are able to provide very realistic user experiences by delivering a wide field of view and high resolutions.

IV.   A CASE STUDY - METHODS

We conducted a focus group study in Keetmanshoop in February, 2017. The aim of the focus groups was to discuss and share ideas about living, planning of the future houses and environment in Namibia and Keetmanshoop with different stakeholders. After conducting the focus groups, we were able to present the findings and discuss them with Keetmanshoop Municipal Council and the decision-makers. The focus groups were selected from different social groups including: young people, families, mobile professionals, social and health workers and traditional community leaders. The groups were selected to provide different insights for the

new area under development. Five separate focus groups were conducted with the following groups in Keetmanshoop:

- Potential dwellers who are listed by the Keetmanshoop municipality and First Capital Housing Fund (8 persons)
- UNAM final year students (8 persons)
- UNAM faculty/Staff members (3 persons)
- Social and community development workers (4 persons)
- Community leaders representing different parishes (4 persons)

Figure 4. Five focus groups were conducted in Keetmanshop in Namibia.

Because of the slow internet connections in the whole area, we could not use any internet-based VR visualization methods. Instead, we used different visual material to facilitate discussing such as photos, post-its and drawings (Figure 5).

The focus group study was exploring the following topics:

- Living and finance- how the dwellers perceive housing prices in Keetmanshoop and Namibia, and how does it impact on the participant's future location?
- Housing styles and alternatives - new solutions and materials in housing
- Social and cultural sustainability of the neighborhood – safety, diversity and community building issues
- Needed public and private services for Smart Community

V. RESEARCH FINDINGS

In general, the need for development of wiFi network, as well as the need for affordable housing and feasible services was most highlighted in young people's focus group. However, these themes came up in all other focus groups as well. House may be smaller and cheaper at first, and as prosperity and family grows, it may be extended by building new rooms to the house. At the moment housing markets are not very dynamic, and houses are seldom sold by the individuals, but mostly by investors or contractors who have new housing projects.

In the families focus group, it was interpreted as a positive way to create areas with more various income levels to make housing markets more dynamic. People are ready to accept also less typical solutions, also partly because for the many the situation or circumstances is that "you have to take what you got", due to growing price level and low availability of houses. One suggestion was that the government and relevant authorities should offer more affordable options and venture cheaper building materials as most Namibians cannot afford the housing prices at the moment. However, some people also expect more expensive and unique solutions than standard houses; more spacious, two-storey houses and using quality materials for walls, doors etc.

The families also expected more transparency about the housing situation. At the moment families do not know, and cannot check, what is their position in the municipality's waiting list for a new apartment or a house. It may also be unclear, how one proceeds on the list, and why someone receives an invitation to see the house and some others do not. Support for local companies and constructors is seen as a good thing, but not at the expense of the quality: quality of houses is not always good and cracks to walls may come fast. Regarding sustainable energy solutions, already now for example solar panels are widely used for energy, so sustainable (solar) energy sources are not distinctive factor as such, but rather usual solution.

The mobile professionals' focus groups ephasized the wide awailability of different affordable services and quality housing. The mobile professionals, even though they had a job at the city were not planning to stay permanently at this stage. They emphasized the need for liveable service structures, including a wide range of public and private services. For instance libraries, schools, commercial services, day care with qualified people and good quality premises were seen as important. Many basic services, like car maintenance, are still missing or too expensive in the rural areas, which is keeping professionals living in two locations simultaneously.

The social workers and community leaders also pointed out the need for more healthy and safe recreational area choices like playgrounds, parks, gymn, libarary and sports clubs for kids and young people to keep youngsters out of bars.

VII. CONCLUSIONS AND FUTURE WORK

The participatory urban planning processes and Smart City development are sensitive for different cultural and global contexts. The advanced virtual reality technologies may work well in the countries and areas with high WiFi speed, but these kind of technology-driven solutions may be less usable in rural regions with occasionally very slow internet access. Consequently, there is also a need for lightweight mobile solutions, which could function more securely in rural areas to involve more citizens in the co-creation process.

To enhance citizen-driven planning processes, more transparency and information sharing is need. Citizens in general were expecting more transparency to the urban planning and housing projects. In particular, simple online tools that would inform citizens about their position on the municipality's waiting list for new apartment or house and would notify about the progress of the building project, would improve the communication between government and citizens.

Different citizen groups such as young people, families and mobile professionals have different needs for Smart Community development. Typical standard house solution is not serving all groups and especially mobile professionals were emphasizing a wide variety of both public and private services. However, the most highlighted issue in the all groups was the need for affordable houses. At the moment housing markets are not very dynamic and cannot provide apartments for all.

Our qualitative study is limited to one rural, but developing community in Namibia and as such, the results cannot be generalized to all African or Sub-Saharan countries, as the socio-economic situations might be quite different. In the next stages of the research, we are going to focus on developing frugal innovations, i.e., adapting local technology and locally designed and co-created solutions for engaging citizens in planning or developing in their living environments and service-ecosystem in Namibia. Moreover, other important questions to research further are: how local people can be engaged to participate in planning, what kind of feedback channels do people need and how should be the communication and the interaction in between the governance and citizens in urban planning be developed.

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