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Citizen Engagement with Smart Technology in the Rural Setting: Lessons for the sustainability of Smart Cities

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“*Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody”*

Jane Jacobs

Abstract

This research project examines the ways in which smart cities may increase citizen engagement by drawing on lessons learnt from the experiences of a smart village. A large body of research already exists looking at the value of smart city initiatives, the many examples of smart cities already in existence and the ways in which they contribute to building a more sustainable planet. However, little attention is given to the role of the citizen in the smart city and there is a noticeable lack of citizen engagement with many smart city initiatives. This research therefore attempts to address this gap by looking at what can be learnt from smart villages. The research was completed using a case study of Cloughjordan Ecovillage in Tipperary, Ireland. Qualitative research methods were applied through semi-structured interviews coupled with participant observation. The data was analysed under two themes that emerged as key for increasing citizen engagement; 'Discussion, Participation and Collaboration', and 'Ownership and Creativity'. By introducing initiatives particularly addressing these areas, such as the Digital Game Changers implemented in Cloughjordan, it is believed that the smart city would see an increased level of citizen engagement at all levels. This would provide the citizen with greater involvement in decision-making throughout the city. The importance of valuing local knowledge was recognised alongside a need to strive for the decentralisation of manufacturing and food production. There is potential for future research to expand on this study by assessing the impact of incorporating such initiatives in the smart city.

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Acronyms

CEV – Cloughjordan Ecovillage

DGCs – Digital Game Changers

EU – European Union

NGO – Nongovernmental Organisation

O.S. – Ordinance Survey

TSI – Transformative Social Innovation

Chapter 1:

Introduction

1.1 Introduction

As the planet races towards an ecological and biodiversity crisis, calls to slow the rate of climate change are being echoed across the globe. Despite this, our population numbers continue to soar and the pressure that we, as a species, put on the planet increases. The Club of Rome first identified the Limits to Growth in 1972 (Meadows et al., 1972) and nearly five decades on we see their predictions beginning to come true. In light of this, potential solutions to our current crisis are being put forth from a vast array of fields and stakeholders. With the majority of the global population now living in the urban arena (Bull and Azennoud, 2016), huge efforts are being concentrated in developing ways to live a sustainable life within the city. With the advent of the 'Smart Growth Movement' in the late 1990s (Hojer and Wangel, 2015; Spicer et al., 2015) smart cities are being presented as a possible solution to the current problems we face. Smart technology is being used to promote sustainable urban living in cities across the globe from Dublin to Abu Dhabi (Cugurullo and Ponzini, 2019) and Washington D.C. (Attoh et al., 2019) to Passo-Fundo (Macke et al., 2019). However, a distinct lack of attention to the role of the citizen in the smart city has been noted and there are now calls to develop a more citizen focused approach (Saunders and Baeck, 2015).

1.2 Aim of Project

This project, therefore, attempts to tackle the problem of citizen engagement in the smart city, both with the smart initiatives implemented and between individual citizens. Citizen science has been acknowledged as a potential way to bring about citizen participation at a variety of levels (Strasser et al., 2019) and inspire greater

public consultation through renewed interests in personal environments (Cardullo and Kitchin, 2017). Outside of the city, smart villages have already begun to embrace the value of local knowledge alongside a greater sense of community and belonging (Thomas et al., 2016; Macke et al., 2019). Their benefits have been recognised in working towards the development of resilient, sustainable communities. Through the examination of a case study of Cloughjordan Ecovillage (CEV) in Ireland, examples of community engagement with smart initiatives are highlighted and the potential lessons which cities may learn from them are discussed. Increased levels of discussion, participation and collaboration between community members is seen as vital for the success of smart initiatives coupled with a growing sense of creativity and ownership for citizens over the technologies and data produced.

1.3 Outline of work

An in-depth discussion of the relevant literature is provided in relation to smart cities and the use of smart technology in sustainability agendas. Despite calls for greater attention to be given to the role of the citizen in the smart city (e.g. Macke et al., 2019; Ratti, 2016; Thomas et al., 2016; Attoh et al., 2019; Cowley et al., 2017; Trencher, 2019; Cardullo and Kitchin, 2017; Bull and Azennoud, 2016; Shelton and Lodato, 2019), there is little discussion as to how this should be done. To address this gap in the literature and drawing on examples of citizen science and smart villages, a qualitative case study is designed using CEV as an example. Semi-structured interviews and participant observation are employed as data collection methods and the information gathered is analysed through thematic analysis. Six

key smart initiatives implemented in CEV are discussed and their contributions to developing greater community engagement are highlighted. Smart cities may learn valuable lessons from CEV and their smart initiatives to increase citizen participation and community engagement at all levels of the urban environment.

Chapter 2:

Literature Review

2.1 Introduction

This chapter begins with an overview of the discrepancies in current attempts to define the smart city. The role that smart technology can play in sustainability agendas is discussed in line with issues surrounding the smart/sustainable debate evident in much of the smart urbanism literature. Questions surrounding the role of the citizen in the smart city emerge, coupled with calls for increased citizen participation at all levels. Citizen science is put forth as a potential solution to the problem of low citizen engagement before a brief discussion of smart villages and the value they place on community engagement is provided as an area from which smart cities may gain valuable insights.

2.2 Defining the smart city

In recent decades, a significant cultural shift has taken place with the majority of the world's populations now living in cities across the globe (Bull and Azennoud, 2016). In Europe alone, an estimated 72% of the population live in urban areas (European Environment Agency, 2017). To overcome the social, economic and environmental challenges this growth in population has had on cities, policy makers, city planners and local governments have turned to smart technology in search of a solution. According to Gabrys (2014; 30) "cybernetically planned cities" first began to develop in the 1960s with "computable cities" becoming a common occurrence in urban development plans from the 1980s onwards. Others, however, attribute the appearance of smart cities to the 'Smart Growth Movement' of the late 1990s (Hojer and Wangel, 2015; Spicer et al., 2015). Despite general acceptance of the term 'smart cities', little consensus can actually be found in defining it with definitions

varying across sectors (Bull and Azennoud, 2016). This is due to different stakeholders carrying different visions of the city into development and planning (Kitchin, 2015). Industrial companies place technology at the centre of any smart city definition (Bull and Azennoud, 2016; Spicer et al., 2019), while policy makers seek to carve out a more substantial role for citizens within the city (Bull and Azennoud, 2016). Huber and Mayer (2015) break this down into three conceptual frameworks; the instrumental perspective focuses on the gathering of data to improve the efficiency of institutions; the administrative perspective with the goal of unifying the work of institutions; and the governance perspective which believes the citizen should have a major role in decision making within the city.

Shelton and Lodato (2019; 35) argue that efforts to form smart cities are "largely indistinguishable from earlier iterations of neoliberal urbanism". This has been a cause for concern for some due to the overt reliance on 'technological solutionism' (Shelton and Lodato, 2019; 36) believing that all cities problems can be solved through the implementation of various smart technologies by private firms. Söderström et al. (2014; 309) have labelled this process as 'corporate storytelling', a critique of smart urbanism as an ideological construct designed by companies to secure their market position. The focus on 'smart entrepreneurialism' (Shelton and Lodato, 2019; 38) has placed tech firms at the heart of the smart city movement and reduced the role played by the citizen. However, others believe that smart technologies are a solution being offered for problems that have not yet been identified (Trencher, 2019; Frearson, 2016) and that before work on the smart city can begin, questions must be asked as to what uses these technologies can be put to (Saunders and Baeck, 2015). This traditional idea of smart cities has been criticised for favouring the values and desires of the private sector over the public

sector with its primary focus being the diffusion of smart technologies which were beneficial to corporate and economic interests (Trencher, 2019). Gooch et al. (2015) criticise prominent views of smart cities as places in which citizens are granted no agency in decision making or policy planning. Trencher (2019) therefore provides the idea of the "Smart City 2.0" which incorporates a people centric approach to the implementation of smart technologies into the city with a focus on better serving the needs of citizens.

2.3 The role of smart technology in a sustainability agenda

However, simply adopting a smart city agenda does not necessarily mean that the city will be sustainable. A gap remains in the literature as to how the sustainability agenda is actually advanced by smart city initiatives (Haarstad, 2017). It is important to note that "cities can be sustainable without smartness" (Macke et al., 2019; 1) and be smart without being sustainable. The traditional idea of the smart city has faced criticism for favouring neoliberal economic interests and paternalistic discourses at the expense of environmental or social concerns (Cardullo and Kitchen, 2019). To examine what ways an urban sustainability agenda is pursued through smart initiatives, it is important to consider the actors who are pushing for such initiatives to be implemented (Haarstad, 2017). The framing of smart initiatives must be examined with special attention given to how sustainability features within those framings (Haarstad, 2017). Several researchers have noted the need to look at smart sustainable cities as something separate to both smart cities and sustainable cities and consider the intersectionality of the concept in order to gain a more holistic understanding (Hojer and Wangel, 2015; Macke et al., 2019). Hojer

and Wangel (2015) identify five key developments that needed to occur in order for smart sustainable cities to come into existence. Firstly, the globalisation of environmental problems needed to be recognised, urbanisation and urban growth needed to become widespread and a shift needed to take place in sustainable development initiatives to include a focus on the urban environment (Hojer and Wangel, 2015). This was followed by development in ICT and an incorporation of ICT into infrastructure and urban planning forming the beginning of the smart city movement (Hojer and Wangel, 2015). The combination of these factors inevitably led to greater attention being given to smart sustainable cities. Macke et al. (2019) support this work attributing the rise of smart sustainable cities also to a growing debate on sustainable development coupled with increasing urban populations globally. Unlike a smart city concept which focuses typically on economic and sustainable development, a sustainable city focuses on how technology can be used for a "more effective urban transformation, based on sustainability impacts" (Macke et al., 2019; 1). Researchers have looked at ways of incorporating both of these views into a new strategy for cities bringing together both top-down and bottom-up approaches to solving the city's problems. To do this, Macke et al. (2019) draw on Brundtland's definition of a smart sustainable city stating that it is one which brings together the needs of citizens, is supported by smart ICT and performs in a way that is least harmful to future generations and their needs.

Different types of technology have been employed by various cities globally that have contributed to their sustainability agenda often through the reduction of pollution and resource use alongside improved efficiency in infrastructure and services (Trencher, 2019). For example, the Uber Movement initiative in Washington D.C. gathers information about citizens' commutes through the Uber

rideshare app, allowing citizens to make more conscious transport choices and addressing the problem of traffic congestion which plagues many urban areas (Attoh et al., 2019). Similarly, cities such as Manchester, Glasgow (Cowley et al., 2017) and Dublin, aim to provide citizens with real-time transport information in the hopes that citizens will opt for the eco-friendlier option of public transport for their commute. In Passo-Fundo bike-sharing systems and the revitalization of green spaces have been promoted to help regulate the urban climate and promote biodiversity and environmentally conscious choices, however, for some residents it remained difficult to link the concept of smart technology to environmental well-being (Macke et al., 2019). Others focus on the goal of improved efficiency of the city and ensuring its economic sustainability such as the Smart London initiative which uses a collaborative and entrepreneurial mode of governance focused on sustained economic growth in the face of growing populations or the focus on establishing a centre for grassroot innovation in Bristol which will expand the city's knowledge economy (Attoh et al., 2019). While the implementation of technology to promote sustainable agendas has been seen, Macke et al. (2019) argue the real question must be how cities can become smarter and more sustainable and not how can smart cities contribute to sustainability. To do this, the role of the citizen must be considered.

2.4 Where is the citizen in the smart city?

Several researchers have highlighted the need for greater consideration to be given to the role of the citizen in the smart city (e.g. Macke et al., 2019; Ratti, 2016; Thomas et al., 2016; Attoh et al., 2019; Cowley et al., 2017; Trencher, 2019;

Cardullo and Kitchin, 2017; Bull and Azennoud, 2016; Shelton and Lodato, 2019). In an examination of three UK smart cities, London, Manchester and Glasgow, Thomas et al. (2016) noted that citizens were often unaware of the cities' smart city agenda and there was a noticeable lack of involvement with citizens in smart city research and planning. When it comes to recognising the term 'smart city', it is estimated that only one in five UK adults are capable of doing so (IET, 2016). These findings reflect the reality in many cities as citizens are not only absent from the research and planning stage but often show little engagement with smart city initiatives once they are implemented (Vanolo, 2016; Trencher, 2019). In order for smart cities to become more sustainable, the adoption of a "neighbourhood perspective" (Macke et al., 2019; 7) has been proposed which would place community engagement at the heart of any smart city plan and would see a prioritisation of social interactions within the city. Similarly, Saunders and Baeck (2015; 8) believe that cities need to be more "people-centred" or "citizen focused". To do this, Macke et al. (2019; 2) call for "citizen participation" to become a prerequisite for smart city development. It has been suggested that future literature concerning the citizen in the smart city should not focus on the absence of attention given to the citizen but should instead acknowledge that there is an assemblage of complex publicness through which the citizen can operate in and engage with within the city (Cowley et al., 2017). Service-user publicness calls for a more citizen centric view of the city while the entrepreneurial publicness recognises the role citizens may play as co-creators and innovators (Cowley et al., 2017). Civic and political publicness looks for wider public involvement in decision making within the city (Cowley et al., 2017). By recognising the "spectrum of roles" (Trencher, 2019; 119)

that citizens may play, perhaps people-oriented agendas may become common practice in urban planning.

Current smart city agendas have been criticised for treating citizens as mere data points where the goal is the accumulation of big data by industries who can sell this on to governments or other interested parties (Shelton and Lodato, 2019; Cardullo and Kitchin, 2017; Gabrys, 2014; Thomas et al., 2016). Citizens are viewed without agency (Trencher, 2019) and their behaviour and choices are seen as a "hurdle" to be overcome (Bull and Azennoud, 2016; 2). The smart city has also been criticised for adopting a view that technology can solve any problem itself and that citizens can contribute little to solving the cities' problems (Macke et al., 2019). Ratti (2016), in reference to early examples of smart cities such as Songdo City in Korea or Rio de Janeiro in Brazil, is critical of how the city is treated as a "computer in open air" lacking any attention to community engagement or focus on citizens. In these early iterations of the smart city, the citizen only appears in reference to 'civic paternalism' in which those in charge decide what is best for citizens in terms of city planning (Shelton and Lodato, 2019; 37). The Uber drivers in Washington D.C. face "alienation and privatised isolation" (Attoh et al., 2019; 1009) in their city as their personal experience of labour is ignored beyond the collection of data from the app which they use. For Attoh et al. (2019; 1010) the smart city represents a system built on "asymmetrical power relations" where Uber drivers are exploited and their role as data gatherers is ignored and unpaid. To overcome the uneven distributions of power, Cardullo and Kitchin (2017) build on Sherry Arnstein's 1969 (Arnstein, 1969) ladder of citizen participation in planning to develop a scaffold of smart citizen participation. They extend Arnstein's work by recognising that citizens can perform different kinds of roles within the city at the same time and that the city can

simultaneously promote different smart city initiatives that allow different levels of citizen participation (Cardullo and Kitchin, 2017). While citizens regularly engage with smart technology in the city, it is often in the role as consumer or producer of data. This in itself cannot be said to make them smart citizens (Cardullo and Kitchin, 2017). Instead citizens must move up the scaffold and embrace roles of engagement and power and begin playing major roles in the planning and development of smart city initiatives (Cardullo and Kitchin, 2017) to ensure that they are no longer simply "recipients of smart city initiative" but become "fundamental co-creators" (Shelton and Lodato, 2019; 40).

2.5 Citizen Science: a possible solution

Citizen science may be a potential framework which smart cities should adopt to help citizens move up the ladder of participation. The UK Environmental Observation Framework (UK-EOF, 2011) defines citizen science as the volunteer collection of biodiversity and environmental data while others define it more loosely as "the general public engagement in scientific research activities" (Craglia and Granell, 2014; 6). Cowley et al. (2017; 19) question if the reason smart city initiatives in the UK are rarely citizen-centric is due to a "straightforward lack of public interest". Often, when workshops and discussion groups are held at the planning stage of smart cities, there is a distinct lack of public participation despite the meetings being open to all (Shelton and Lodato, 2019). While members of the public have been seen to attend, it was noticed that they rarely acted in the capacity of an ordinary citizen and instead adopted some form of institutional or organizational capacity (Shelton and Lodato, 2019). This reliance on being seen as an 'expert citizen'

indicates that for many the value of being an ordinary citizen and the impact they may have on shaping their city is not recognised. For example, Atlanta's smart city initiatives were criticised for bringing about a kind of "business class citizenship" (Sparke, 2006; 151). Perhaps the direct involvement of citizens through citizen science projects may increase interest and create an opening for citizens to become involved who do not have data literacy or programming skills (Trencher, 2019). There is a need to create "open source urbanism" (Sassen, 2012) where technology is readily available to service citizens rather than the opposite way around. Citizens have been seen to express interest in solving cities problems with technological means through hackathons which promote a more bottom-up, citizen centric vision of the city (Shelton and Lodato, 2019), however, these are often run and organised by companies within the industry meaning that citizens level of participation is "circumscribed" and "driven by neoliberal ideology and corporate interests" (Cardullo and Kitchin, 2017; 820).

Citizen science incorporates this bottom-up approach to science as it involves the engagement of non-experts with the collection and analysis of scientific data which allows for greater public engagement and democratisation of science. As Strasser et al. (2019) have pointed out, citizens do not have to be directly involved in the collection of data in order for the project to qualify as "citizen science". Instead citizens may be involved in such diverse projects as "donat[ing] the processing power of their personal computers to perform scientific calculations" or "classifying online images of galaxies from home" (Strasser et al., 2019; 52, 53). Strasser et al. (2019) identified two key types of citizen science projects. The first type, contributory projects, place all power with the scientists who run the project and the public's primary role is to contribute to the data produced (Strasser et al., 2019). The second

type, collaborative projects, allows the public a more hands on role as they can be involved in all steps of the scientific process (Strasser et al., 2019). It is this second type that the smart city should be most concerned with as it means the public are not simply used as a method of free data collection by the scientists but can also co-create and refine the project at different stages. Thanks to the growth in social media, citizen science projects can be better advertised to the public and new pathways for public consultation created (Cardullo and Kitchin, 2017). Living labs have popped up in cities across the world and the use of Lo-Fi technologies such as an Arduino motherboard equipped with environmental sensors has allowed ordinary citizens to engage with the environmental monitoring of their own environment (Cardullo and Kitchin, 2017). Urban living labs provide a space for innovation, experimentation and knowledge to be fostered within the city with a strong emphasis on participation and co-creation (Steen and van Bueren, 2017). While this is a beneficial outcome of citizen engagement with the smart city, Gabrys (2014) cautions against the over reliance of “citizen sensing” in the absence of actual citizen engagement in the political debate surrounding the planning of the city. Living labs allow citizens to have more of a voice than traditional citizen sensing projects and their ability to facilitate a transition towards more sustainable living has been recognised (Steen and van Bueren, 2017). However, there are calls for further research to be done before the full impact of urban living labs can be assessed (Steen and van Bueren, 2017).

2.6 Smart Villages

Citizen science projects draw on the value of local knowledge and develop a strong sense of community. These factors are developed even further in the context of the smart village. In order to ensure that the social and political dimensions of urban life (Cowley et al., 2017) are not ignored in favour of technological and economic interests, the community perspective must be adopted, and the context specific situation of the city considered. As Hill (2013) puts it “the city is its people”, therefore it seems only right that they should have a say in how the city is run. Research has shown that for some citizens a “sense of community” and “belonging” is what mattered most to them when it came to where they lived (Thomas et al., 2016; Macke et al., 2019). It is important to recognise the value of “social capital” such as the local knowledge of citizens who are better able to see the problems the city may have and are better equipped to “choose appropriate courses of action” (Trencher, 2019; 126). As each situation is unique it must be treated so, given that the idea that all cities face the same problems and that solutions in one area can easily be applied to another is rarely true (Trencher, 2019). While some confusion remains as to how smart initiatives contribute directly to sustainability, it has been noted that the closer we get to the local level the more this becomes clear (Haarstad, 2017). It is therefore important to examine the policies of smart villages.

In relation to this, cities can learn a lot from smart villages which extend the idea of the smart cities to rural areas and place a greater focus on “local communities taking their future into their own hands” (EU Rural Review, 2018; 7). The “primary rationale” between smart cities and smart villages remains the same despite the difference in size, namely to enhance the quality of life for residents (Spicer et al., 2019; 3). Smart villages represent a form of community resilience where local

people can pool together their intelligence and resources in face of specific challenges which they face (EU Rural Review, 2018). For some rural communities, the lack of inwards investments means they have little choice but to tackle these issues on their own. Rural areas often allow the formation of “more complex, intense relationships” than the city due to their size and volume of people (Spicer et al., 2019; 4). In rural areas a strong collaboration between residents and local governments has also been found which provides citizens with greater agency in decision making and keeps “public consultation direct and informal” (Spicer et al., 2019; 10). The ‘one-size-fits-all’ template for smart cities is failing due to a frequent lack of citizen engagement at all levels. In comparison, smart villages are emerging as an example from which the city can learn where a “collective vision” of development, a shared financial burden and informal consultation processes have proved successful (Spicer et al., 2019; 15). In addition, unlike smart cities who attempt to compete with each other, smart villages are seen to cooperate with surrounding villages making the area as a whole more sustainable and competitive in the long run (Spicer et al., 2019).

2.7 Conclusion

This chapter has looked at current definitions of smart cities and how they vary across the literature. It has highlighted the ways in which smart technologies are being used by cities to contribute to a sustainable agenda. However, the current lack of attention given to the citizen in many smart cities is acknowledged alongside calls for greater citizen engagement at all levels of city organisation. Citizen science

and smart villages are both put forth as areas from which cities may learn lessons on how to increase citizen engagement in the future.

Chapter 3:

Methodology

3.1 Introduction

This section will explore the methods that are to be used in this study. It will begin with a brief discussion of the research design followed by a description of the methods employed and why each method was appropriate for the nature of the research that was carried out. The analytical techniques will then be mentioned, before an exploration of any research issues or limitations that were raised and any ethical concerns.

3.2 Research Design

This study is situated in the theory of sustainability and the belief that smart technology can be used to make cities more resilient. From this theory, and through an examination of existing literature, a hypothesis was formed stating that smart cities can learn valuable lessons about citizen engagement with smart technology from rural communities. This study was carried out using a deductive approach meaning the empirical data gathered was used to test if the hypothesis proposed was true (Reyes, 2004; Kalof et al., 2008). Throughout the study the researcher attempted to prove this hypothesis by examining a case study of a smart ecovillage in Ireland. This was an intensive research process as it focused largely on a single case study in huge detail with thick description. A mixed method approach was adopted, which included participant observation of the community coupled with interviews with key community members, to overcome any shortcomings of individual methods and allow for an expansion of the depth and breadth of the data gathered (Malina et al., 2011). Both occurred simultaneously as the researcher only spent a short-fixed period of time with the community. This study focused on qualitative research methods with the aim of gathering quality data rather than a

large quantity of data. Qualitative research attempts to understand the meanings that people give to the world with a particular focus on human behaviour in the context of norms, values and cultures (Fossey et al., 2002).

3.3 Case Study

This study was conducted using CEV as a case study. Gerring (2006; 1) discusses the benefits of a single case study approach to research, noting that “We gain a better understanding of the whole by focusing on a key part”. Case studies, as an example of empirical inquiry, allow for the examination of events “within its real-life context” (Verner and Abdullah, 2012; 871) and have been viewed as a more holistic research method as individuals’ views and experiences are examined in the context of the community as a whole (Feagin et al., 1991; 8). The case study was exploratory in nature looking to see how smart technology and citizen science can be used to promote sustainability. CEV, a 67-acre site in Tipperary, Ireland is part of the Global Ecovillage Network with a focus on integrating ecological, economic, social and cultural dimensions of sustainability into society (Kirby, 2019; 1). These villages may be presented as a solution to “the limits to growth and the unsustainability of our societies” (Kirby, 2019). Ecovillages have been recognised as “living laboratories” (Liftin, 2014) and the lessons which they offer for the development of other sustainable communities has been noted. CEV was selected for this study as it has received national and international recognition and is involved in a number of European led sustainability and smart village initiatives. Many of these are facilitated through Cultivate, a national NGO and Civil Society Organisation (cultivate.ie, 2018), based at the WeCreate centre in CEV. Cultivate

adds a unique element to CEV as it has a particular focus on embracing new technologies to “build resilience” (cultivate.ie, 2018) within their community.

3.4 Research Aims and Objectives

Given the hypothesis stated above, the aim of this study was to explore citizen engagement with smart technology in the rural setting to derive lessons from which the smart city could learn. This aim was broken down into a number of smaller objectives:

- To examine how citizens engage with smart technologies
- To explore how smart technologies, used within a community environment, can contribute to sustainability
- To consider the lessons which can be learnt from smart villages and how their methods can be implemented on a larger scale for cities

From the objectives, a series of research questions were developed which helped to guide the interview schedule as will be discussed below:

- What type of smart technology is available in the village?
- How does this technology contribute to the sustainability of the village?
- How do citizens engage with this technology?
- What lessons can be learnt about citizen engagement with smart technology which may be of benefit to the city?

3.5 Interviews

3.1.1 Justification of Approach

To overcome the strictness of a structured interview, in which responses are more restricted due to the nature of the rigid interview guide, a semi-structured approach was adopted which allowed for the interviewer to change the direction of the interview based on the responses given. Individual interviews allowed each interviewee to give in-depth answers into their involvement, knowledge and experience of the use of smart technology and citizen science in promoting sustainable environments and creates the possibility to “clarify” and “probe” as to what the interviewee meant (Riessman, 1993). As the community studied is slowly beginning to adopt new technologies, intensive interviews are appropriate as they help to unravel “slowly evolving events” (Hoggart et al., 2002).

3.5.2 Sampling Techniques

Purposive sampling was used in this study as participants were selected on the basis of their expertise, experience and knowledge of smart technology in an ecovillage environment and the potential ways it may contribute to the sustainability of the community, both economically and environmentally. A snowball sampling technique was employed aided by the work of a gatekeeper allowing access to the community and identifying those with knowledge pertaining to the study or who may have an interest in participating. The role of the gatekeeper in research has been praised for facilitating the creation of mutual respect between researcher and participants (Singh and Wassenaar, 2016). As this study focused on a small

community, the sample size for interviews was also kept small. Each participant was provided with an information form before the interview took place discussing the nature of the project and outlining that their participation was voluntary, and they would be kept anonymous through the use of pseudonyms (Appendix 1). Participants were then asked to sign an informed consent form (Appendix 2).

3.5.3 Questions

To carry out semi-structured interviews, an interview schedule was produced which included a number of questions to be presented in the interview as a starting point for discussion. The interview schedule was kept short to allow for the direction of the interview to change based on the interviewee's responses and keeping in line with a semi-structured approach. The questions were generated based on the research aims of the project with different questions addressing different aspects of the research. A sample of an interview schedule is included in Appendix 3.

3.6 Participant Observation

3.6.1 Justification of Approach

As a small number of interviews were to be carried out during the study, there was a risk that an incomplete picture of the community would be gathered. To overcome this the interviews were coupled with participant observation by the researcher. Participant observation adopts an interactionist approach situated in the humanist theory as explored by the Chicago School which examines how meaning is constructed through daily life (Hoggart et al.,

2002). This allowed for genuine social interaction in the field with the community and direct observation of their interactions with smart technology in their daily activities within the village. As part of this, informal conversations with a variety of community members took place to gain a more accurate understanding of community engagement through personal involvement by the researcher.

3.6.2 Data Collection

Data was gathered through a collection of field notes from the researcher's stay in the village. Information included description of the setting, the behaviour of the participants as well as descriptions of the conversations held and the actions that were carried out. The 'rawness' (Gupta and Ferguson, 1997) of fieldnotes allows for the researcher to gather data quickly and effectively and can include sketches, diagrams, photographs and leaflets gathered at the scene. Fieldnotes were kept short and concise to avoid the collection of too much detail making the separation of findings into relevant data more difficult (Emerson et al., 2011). In this case, the researcher chose not to take photographs as it was seen as an invasion of privacy for the community members whose homes were being visited. Although, Schwartz (1989) argues that the act of taking photographs may serve as an introduction of the researcher and their aims to the community, this was deemed an insufficient introduction for this project given the short time scale available to the researcher. It must also be acknowledged that photographs are selected and constructed in distinct ways (Harper, 2003) and that there is insufficient scope within this project to deal with such challenges justly,

therefore, the researchers written descriptions were only included in the fieldnotes.

3.7 Analytical Techniques

The data gathered in the interviews was coded using thematic analysis. This was done by analysing the interview transcripts and selecting different pieces of information that fit under some pre-defined themes relating to the projects research aims. There was also room to adapt this if other themes emerged which are also deemed important for the study. Strauss' three forms of coding was adopted, first generating themes, then linking pieces of data to the themes and finally selecting pieces of data which support the research question in a process called selective coding (Strauss, 1987). The field notes gathered through participant observation were analysed in the same way so that the information observed could corroborate and further expand on that of the interviews. Therefore, the same themes were used to analysis data collected through both methods. Just as the interview questions were formed with the research aims in mind, so too were the codes. Sample codes may include 'Current examples of smart technology', 'Smart initiatives in CEV' or 'Community engagement with smart technology'.

3.8 Research Issues / Limitations

There are some limitations to case studies as a research method. For example, generalisations cannot be produced as there is the risk that the observations drawn from the single case study may not be representative of another situation (Gog,

2015). There are also concerns that the “deep involvement” of the researcher may adversely affect the results (Yin, 2014; 20-21).

The time constraints of this project proved to be another limitation. An ethnography was initially proposed to study the community; however, this would traditionally mean the identity of the researcher is not known to the community to allow for more personal relationships to be formed with the study group. Participant observation is just one form of ethnographic research methods (Hammersley, 1995; Atkinson, 1995) which was deemed most appropriate for this study as it can be both overt or covert in nature (Hoggart et al., 2002). Due to the time and cost constraints of this project, the nature of the research and the identity of the researcher was made clear to the community from the beginning. This potentially limited the formation of intimate familiarity between researcher and subjects but allowed for focused research to gather the appropriate data in the limited time frame available.

3.9 Ethics

Ethical approval was sought for this project under the guidelines of the School of Natural Science at Trinity College Dublin. A potential ethical issue identified was maintaining the anonymity of respondents. As the community is small and tight-knit there were concerns that even minor details in individuals’ responses may expose who they are to the community. To help mitigate these concerns, respondents were referred to as Participant 1 (P1) etc. and the use of personal details was limited. A sample of the completed ethical approval form can be found in Appendix 4. Respondents were informed of the nature of the study and that their participation was voluntary from the beginning.

3.10 Conclusion

This chapter has explored the research methods employed in this study. The research design and case study were discussed followed by an outline of the research aims and objectives and research questions used. A description of data collection methods used including sampling techniques was provided. The method of thematic analysis of the data was outlined before a brief discussion of any potential research limitations and ethical issues that may arise.

Chapter 4:

Results and Discussion

4.1 Introduction

This chapter begins with a brief overview of current examples of smart technology used in Cloughjordan Ecovillage (CEV). It then goes on the explore some smart initiatives that have begun to be implemented in the village. These initiatives can be seen to enhance community engagement with smart technology in CEV. The six initiatives discussed are grouped under two separate headings in relation to the areas of community engagement which they most influence. These areas have been derived from relevant literature. Following this, a brief examination of the importance of locality and local knowledge is provided before areas of potential resistance to smart technology implementation in CEV is discussed. The chapter concludes with a summary of the main points mentioned.

4.2 Overview of Smart Technology in Cloughjordan Ecovillage (CEV)

As a relatively new community of just ten years old, CEV is at the beginning stages of incorporating smart technology into the everyday lives of its residents. One of the primary examples of smart technology in CEV currently is the use of sensors on their farm as part of the European Union run GROW Observatory programme. GROW aims to encourage sustainable land use practices through better governance of the land and soil, thanks to the collection of soil data over large geographic scales (growobservatory.org, 2020). Widely available consumer sensors coupled with internet and mobile technologies make this project accessible for a diverse range of communities across Europe (growobservatory.org, 2020). The project aims to “ground truth” soil moisture estimates which were already being predicted from satellite images by expanding the network of sensors across Europe.

The term “ground truth” refers to the process of situating geographic data within its social context (Pickles, 1995). The sensors provide information for a certain location over different time periods, whereas the satellite looks at a wider geographic scale in a single snapshot of time (Ha et al., 2002). Ground truth helps to marry the two datasets together. This involved the engagement of communities throughout Europe in a citizen sensing style project. As part of the project, soil monitoring sensors have been installed on the community farm in CEV. The gathering of data about soil conditions highlights the belief in the community that careful treatment of the land is vital for the sustainability of the planet:

“we are interested in regenerative stuff where your impact on the land is actually improving it somehow”

[P3, CEV Resident and Cultivate Member]

It is clearly evident that the Cloughjordan community is conscious about how they interact with the land and the benefit which increased data may bring. Additionally, Cloughjordan residents took part in a project to name and identify the many different types of apple which were grown on their farm. With the data collected, each individual apple could then be located on O.S. maps creating an inventory of apple trees in the village accompanied by exact locations of each individual apple.

Smart technology features can also be seen in many of the homes and buildings within the village. Energy is distributed throughout the village through a District Heating System which connects all houses together. Each home is also fitted with energy monitors to collect data pertaining to their energy use and to help keep track of the households’ carbon footprint. The rooms in many houses are fitted with thermostats with a pre-programmed temperature allowing heat to be supplied to the

room from the district heating system through underfloor heating. Some houses are also fitted with solar panels connected to online or mobile app resources where energy generation and use can be monitored. While currently smart technology is incorporated at an individual household level, there is potential in the future to upgrade the village energy supply to a smart grid.

Many individuals make use of technology, in particular social media, to grow their own businesses which are vital for the sustainability of the community as a whole. Others have set up apps for carsharing with other community members reducing the need for car ownership. Some residents are sharing their journey as growers, using technology to monitor and record soil and plant information, through YouTube videos.

More engagement with food was recognised as being vital for the sustainability of communities, such as CEV, and the potential of technology to enable this is beginning to be explored. Technology was utilised by various community members in their individual or collective growing processes:

> *"for me I like to do gardening and growing but I'm mainly in an office so I'd be interested in can I monitor and grow in a polytunnel out here from my desk"*
>
> [P3]

An awareness of the future possibilities to create easier, less hands-on, automated management of the growing process was also acknowledged by residents in CEV. Outside of the rural setting, technology was mentioned as a potential tool to encourage urban growing with vertical gardening, wormeries and hydraulic systems being developed for small urban living environments.

As CEV continues to gather data in the future, as part of projects similar to GROW, there is the possibility to better evaluate the success of the CEV model and consider if it is something that can be replicated elsewhere:

"in another ten years we'll have much more data and understanding of what's actually happening here and whether it's a model that can be replicated"

[P3]

While currently other communities, including smart cities, can learn valuable lessons from the Cloughjordan community, the long-term impacts of their methods cannot be assessed due to the project only being operational for ten years. In order to derive concrete plans for other communities to replicate CEV's model, empirical data must continue to be collected through the use of smart technologies such as sensors.

4.3 Smart Initiatives in CEV

There is huge potential and plans in place for the continued expansion of smart technology use in CEV to help build a more sustainable society:

"We would like to explore how to use these digital technologies in a way that helps us to be more sustainable, build communities, could help restore ecosystems"

[P2, Cultivate Member]

Through work carried out by Cultivate, a Civil Society Organisation in Cloughjordan, CEV has become involved in Digitisation: Economic and Social Impacts in Rural Areas (DESIRA) as part of the EU Horizon 2020 Project. The project aims to look at both the threats and opportunities of digitisation in rural areas, including farming

and forestry over the next ten years (desira2020.eu, 2020). The project involves the work of over twenty different partner organisations. Just one example of the outcomes DESIRA aims to achieve is the production of a “Taxonomy and Inventory of Digital Game changers” which can then be implemented into an “online Visualisation Tool” (cordis.europa.eu, 2019). Digital Game Changers (DGCs) can be presented as opportunities of how communities can incorporate technology to advance their own sustainability agenda. Cultivate are working to identify a number of DGCs which they have begun to embrace, with the WeCreate centre being used to showcase some of these. Six key DGCs have been identified in CEV; Coworking and Digital Hubs, FabLabs, FoodHub, Blended Learning and Dialogue, Citizen Science and Citizen Sensing, and Open and Shared Platforms.

Each of these DGCs can be seen as working towards addressing the issues of citizen engagement with smart technology as has been witnessed in the literature (Shelton and Lodato, 2019; Cardullo and Kitchin, 2017; Gabrys, 2014; Thomas et al., 2016). The DGCs have been grouped according to the aspects of citizen engagement which they address for the purpose of further discussion.

Coworking and Digital Hubs, Blended Learning and Dialogue, and Citizen Science and Citizen Sensing are all seen as examples of how to increase discussion, participation and collaboration between community members which in turn allows them to play a greater role in decision making and the planning of projects within the community. Bull and Azennoud (2016; 1) acknowledge that in order for smart cities to become sustainable the “co-creation of knowledge, collaboration and empowerment” emerging from citizen engagement must be utilised. This will enable greater social interaction while creating more citizen focused communities (Macke et al., 2019; Saunders and Baeck, 2015).

FabLabs, FoodHubs, and Open and Shared Platforms all inspire a greater level of creativity from community members, giving them a greater sense of ownership over the production and manufacturing process that occur within the community. This will permit citizens to move up the scaffold of smart citizen participation (Cardullo and Kitchin, 2017) as they become more active community members. It also mitigates concerns raised as to who owns the data, technologies and decision-making process of the smart city (Thomas et al., 2016).

4.3.1 Discussion, Participation and Collaboration

Coworking spaces and digital hubs are highly beneficial for the sustainability of communities as they involve both technical and social aspects and are often linked to “technologically-mediated work practices” (Ross and Ressia, 2015). They allow for the clustering of social enterprise and innovation in rural places which allows people to communicate and work remotely thanks to the availability of services such as highspeed broadband. The WeCreate centre acts as a coworking space for the Cloughjordan community and with the availability of technologies such as Zoom and Google Docs, Cultivate is now able to communicate and engage digitally with partners across Europe on various projects such as the GROW Observatory. The ability to work virtually, and remotely reduces the need to travel for meetings. This reduces their carbon footprint and allows for greater and more widespread sharing of ideas. Benefits from teleworking for businesses include increased productivity levels along with improved employee job satisfaction thanks to a greater work life balance aided by a reduction in commuting time and costs (Ross and Ressia, 2015).

These spaces have also presented an opportunity for local governments to enhance regional economic development (Ross and Ressia, 2015).

Coworking spaces help to facilitate another of the key DGCs; Blended Learning and Dialogue. CEV is embracing this new way of learning and sharing of ideas as part of ECOLISE, the European network for community-led initiatives on climate change and sustainability (ecolise.eu, 2019). This includes projects such as Transition Towns and Ecovillages alongside community energy and food co-ops, both of which can be seen in CEV. When this 46-member meta network from across Europe meets it participates in blended meetings which includes people participating in a room with others participating virtually in breakout rooms using technology such as cameras, microphones and screens. This encourages digital dialogue and blended learning meaning that experts can be beamed into the classroom or facilitate bigger discussions than the space would traditionally allow by digitally involving groups in other hubs nationally or globally. Blended learning should be encouraged with blended dialogue to ensure the sharing of ideas between lay people alongside lecture style classes by professionals. These technologies have the potential to decentralise large international conferences leading to massive social and environmental benefits such as reducing carbon produced by air travel and allowing people to work almost anywhere and continue to engage and learn.

The sharing of resources, knowledge and labour can reduce costs and make certain lifestyles more achievable for some people highlighting the value of community engagement:

"You can't be out in a field in Carlow on your own with 30 acres, two kids and a partner and it doesn't work unless you have lots of resources and you buy in help,

which is a community in a sense, so here is where you're not necessarily paying for it, you have it here, its vitally important"

[P1, CEV Resident]

The environmentally and economically sustainable livelihoods that these residents aspire to is only viable through community engagement. Participation from the community, for example in a common shared agricultural scheme in which one farm produces food for all those who pay a subscription fee, makes these livelihoods more attainable without the individual need for a huge amount of resources.

Citizen sensing can also be seen as building community as it encourages people to partake in projects together, whether it is counting birds together or going out and taking photos of a place for a national database which help to overcome the "straightforward lack of public interest" (Cowley et al., 2017; 19) witnessed in many smart city initiatives. Citizen sensing acts as a DGC as it allows better monitoring of environments enabling individuals and policy makers to see what is needed for the environment and to track progress of environmental restoration efforts. Cultivate is also interested in the establishment of open O.S. digital maps where information from different time periods may be knitted together, allowing information from the GROW project, for example, to be included on maps containing previous information about field conditions. Citizen science projects and coworking spaces also allow the sharing of ideas and knowledge through the community making it more sustainable in the long-run as was identified by participants:

"100% it's all about citizen science yeah. It's hard to get to be skilled in it to like maybe me learning the basic programming, I can do it but it's a relative challenge

but a programmer type person, where other friends here it's just easy for them and the growing part is hard for them which I do very well so its sharing"

[P1]

"if you can understand what you need like if I know that I need to programme something that can do this then I can find people that can do that so they're collaborative spaces"

[P3]

However, while the benefits of citizen science are being recognised at all levels there remains a disjuncture between smart city initiatives and citizen science projects (Craglia and Granell, 2014). As a result, the data gathered, and the services developed between each project are rarely shared with other projects and places. This lessens the achievements of each individual project as widespread scientific advancements can rarely be gained. Combining citizen science projects with open source platforms, as will be discussed later, has the potential to overcome this problem, therefore, highlighting that the maximum gain can be achieved from DGCs when they are used simultaneously.

While community engagement and the sharing of ideas were recognised as being vital for the sustainability of the CEV community, it was important also to note that there was not always agreement about how things should be organised, or the allocation of resources. Despite all choosing to live in a particular type of community, it would be wrong to assume that CEV residents share one singular perspective on life as different residents move to the community for different reasons such as health, environment or safety. The differing of opinions as a result of a vibrant mix

of people was seen as a benefit for the community rather than a hinderance and allowed for more informed decisions to be made:

"you need debate, you need discussion, not everything is clear at all, the solutions aren't clear because there is always something that gets impacted when you implement one type of solution"

[P3]

Discussion was seen as essential for decision making in CEV as it enabled a broad range of impacts to be considered resulting in a more just outcome.

4.3.2 Creativity and Ownership

FabLabs, or Fabrication Laboratories, another key Digital Game Changer, have been characterised in its simplest term as "a community workshop where members share access to tools in order to produce physical goods" (Van Holm, 2015). They inspire a deeper level of community engagement as they allow citizens to become "fundamental co-creators" (Shelton and Lodato, 2019; 40) in their own communities. They typically hold five main machines including a laser cutter, vinyl cutter and 3D printer, making the replication of manufacturing processes between different labs achievable. Having a FabLab onsite at the WeCreate centre presents a huge opportunity to show communities how these technologies can be used. FabLabs are seen to encourage community engagement:

"a lot of ideas just emerge when people begin to understand what's possible. You can't really predict what's going to happen and how people might want to use it"

[P3]

The coming together of community members from diverse backgrounds makes the FabLab an ideal place for creativity to emerge as the possibilities are virtually endless. FabLabs also allow for the spread of engagement to wider communities through education workshops which may be held. In this way, FabLabs, as a DGC itself, becomes an example of a Coworking Space and has the ability to facilitate blended learning.

FabLabs are strongly linked to another key DGC, Open and Shared Platforms and perhaps their greatest benefit is the ability for users to utilize opensource designs and the sharing of ideas easily throughout the FabLab network. The benefits of open data strategies are widespread from innovation to transparency to greater social and political engagement (Craglia and Granell, 2014). Open and Shared Platforms have also been seen to reduce costs of manufacturing making the process more accessible to a wider audience. While currently obtaining a FabLab licence comes at cost, the potential to reduce overall costs of manufacturing, by reducing the time spent on design and obtaining certifications has been recognised:

"eventually I think the more we open up our technologies and understandings about things then not everyone is having to constantly go through the same processes to reach the certifications needed, you need an open base template"

[P3]

While CEV is considered a

"middle class type of community"

[P1],

it is worth noting that the potential benefits obtained by technology are not limited to those who have money. In fact, FabLabs and open hardware make such technologies far more accessible to those in lower income communities:

"that's the advantage of open hardware, it's probably more advantageous in places with lower wages"

[P3]

The ability of FabLabs and open hardware to open up these technologies to areas with lower incomes, make the DCGs a transferable model for a wide range of communities regardless of wealth status.

The opportunity for the decentralisation of production and manufacturing that FabLabs offer, pave the way for community engagement at the highest level allowing for self-sufficiency and sustainability:

"it's actually making people much more aware of the problems in the world but also giving them a voice and a way to participate in the process of manufacturing and consumption"

[P3]

While this is seen at a relatively small scale in CEV, globally cities such as Barcelona are expanding on the FabLab concept by declaring themselves as a FabCity. This line of thinking would make Barcelona a completely self-sufficient city with the manufacturing and production of all goods consumed within the city taking place within the city itself.

Drawing on the idea of FabLabs, FoodHubs were also recognised as a potential DGC. The WeCreate centre has its own FoodHub which can be used for distribution. There is also the option of using it to add value, by installing machines which could be used, for example, to turn farm produce into organic baby food or for helping the community get over the “hungry gap” caused by eating seasonally where the food in storage is running out and the food being grown in the fields is not yet ready for harvest. In this case, preserved foods such as Sauerkraut could potentially be produced in the FoodHub. The potential to use digital platforms, such as Facebook, has also been acknowledged to allow small producers to aggregate value and to get their product to market. Rural communities in Ireland have made use of the Finnish model of a Reiko Ring using digital platforms to advertise products to sell and products to purchase, meaning a person can be both a producer and consumer simultaneously. The exchange of goods can be facilitated in a rented space weekly, allowing the social network building that would occur at a traditional market to continue to take place.

4.4 Locality

While these initiatives are seen to inspire community engagement, other factors must be acknowledged. The value of local knowledge in the successful implementation of smart village strategies has been seen in the literature (EU Rural Review, 2018; Spicer et al., 2019) as focus can be placed on designing a system based on the needs of citizens. Local knowledge and citizen engagement are vital for the success of citizen science and citizen sensing project and have been shown to contribute to a greater sense of place and belonging for some participants. The

DGCs identified by Cultivate benefit greatly from the value of local knowledge and expertise. Greater involvement by citizens in the production of food through accessible farming or in the manufacturing of goods through FabLabs has the potential to impact consumer patterns and encourage the use of technology in appropriate and valuable ways:

"they are not just passive consumers…they actually are considering and building and making things that are appropriate to their own needs locally"

[P3]

At a broader city scale there is a danger that the needs of consumers are not being met in the most appropriate or sustainable way due to the competitive nature of production companies. Allowing consumers to also become producers rewrites the narrative of cities towards one of civic paternalism giving citizens a more central role in decision making (Shelton and Lodato, 2019).

The DGCs identified by Cultivate can be classified as Transformative Social Innovation (TSI). In order for innovation to be classified as TSI it needs to be embedded in place, be community or citizen driven, be for the benefit of people and not just profits of companies and be disruptive in a positive way such as influencing the consuming patterns of citizens.

It is important also to note that CEV is a specifically designed community and so questions must be raised as to whether their techniques of technological implementation would be as successful in a community that is well established. However, it must be considered that not all communities specifically designed around a smart sustainable agenda have proved to be as successful as CEV. Masdar City for example, a specifically designed smart city in Abu Dhabi, may be

viewed as a failure in many ways as the influence of smart urban technologies extend over only a minority of the population (Cugurullo and Ponzini, 2019).

4.5 Potential Resistance

Concerns have been raised throughout the literature over the ownership of data collected (Thomas et al., 2016) and the use of citizens as mere data collectors (Attoh et al., 2019; Shelton and Lodato, 2019; Cardullo and Kitchin, 2017). The scepticisms surrounding technology use has also been witnessed in CEV often resulting in less active participation:

"you do need more active people on the ground to really make an impact on this, and at the moment a lot of people here would be a bit sceptical about technology"

[P3]

By using the opensource model, data can be shared more freely for the benefit of everyone which may reduce some potential resistance to it:

"open hardware is to be kind of transparent"

[P3]

More transparent technologies reduce concerns over ownership or privacy (Thomas et al., 2016) coupled with fears of exploitation and asymmetrical power relations between those who own or create the technologies and the end users (Attoh et al., 2019).

However, questions must still be asked as to who do these technologies serve. This is seen in both the literature and from members of the CEV community. Trencher

(2019; 22) draws on Calzada and Cobo's (2015) key question of "Will these devices serve the citizens more than the citizens serve the devices?". In order for successful engagement between community members and technology, it must be shown that these devices will better serve individuals and are not just being implemented for the monetary gain of large companies.

"Now we have this digital revolution, the promise of the internet of things. And who does this serve? Does it serve people and communities, local economies? Or does it serve the need of institutions and big corporations?"

[P2]

"We need to be using technology for the service of society and the environment and not for the interests of business"

[P3]

To overcome these concerns, emphasis needs to be placed on the appropriate use of technology. As technological production comes with environmental concerns in the form of carbon production and waste, ensuring technology is only used where appropriate may reduce the production of technology for accumulation purposes:

"toxic pollution from producing technology is not being valued in its procurement for instance and the carbon effects of technology is not really being added into the system so appropriate use would be where I'd be focused"

[P1]

“a lot of the people who come to ecovillages are almost anti-technology and business just by default because they see those things as what is destroying the environment and yeah there’s truth to that but it’s the way that it is implemented”

[P3]

The appropriate use of technology will encourage greater community engagement with technology as the purpose behind the implementation of devices and who they serve should become more apparent thus reducing anti-technology feelings.

The FabLab facility provides the community with potential to produce their own technological devices, as was seen with the production of prototype sensors which may be used on the farm:

“we buy all our electronics off the kind of mass market and we don’t really consider the impact of that as much, but it has an equal if not more of an impact” (in relation to an awareness of mass food production and the value of local food)

[P3]

This in turn will aid the decentralisation of the production process and reduce emissions and transport costs which are often not considered, as the traditional consumer model pushes us to have the “latest-and-greatest” version of products.

Opensource designs have been criticised for a reduction in individuality, leading to everyone having the same version of each object. However, as the FabLab has shown, this is not that case:

“it brings back creativity and design into the manufacturing process and probably the more important thing is that it makes people participate more in the economic activity, so they are not just passive consumers”

[P3]

Creativity remains a central component for FabLabs and through involvement in the production process from the beginning of the design stages, citizens are seen to have greater ownership over the products they use. A greater sense of respect for the production process is developed and it has been shown that when citizens design and build their own product they hold onto it longer, therefore, reducing waste accumulation.

4.6 Conclusion

Above all building a resilient society was seen as vital for the community at CEV with a focus on long term thinking. Cities can learn valuable lessons from the CEV model with a focus on building self-sufficiency and resilience as was seen in CEV, coupled with sharing of resources:

“so, a mixture of in-house city resilience which is growing your own food, doing your own manufacturing and then also more compact cities obviously less sprawl and a greater ability to share resources like district heating”

[P3]

CEV has the ability to act as a “small demonstration centre” for cities to model a new form of urban living that is more resilient and sustainable. However, in order for this to occur citizens need to become more engaged in society and more conscious

of their consumption patterns, a change which technology has the potential to facilitate:

"there's lots of ways which cities can be retrofitted but we just have to have people more active in society in relation to what they consume themselves and not dependent consumers so more participatory"

[P3]

To encourage wider community engagement with technology the appropriateness of the technology must be made apparent. It must also be made clear how these technologies can benefit the user, whether that is saving them costs on the heating of their home or improving their quality of life by providing them the opportunity to grow their own food. The availability of resources such as opensource hardware and software and facilities such as the FabLab make these technologies more accessible and less expensive. They also demonstrate that a high level of technological or data literacy is not necessary and that design skills are perhaps more valuable. Ultimately a change in consumer patterns must arise resulting in a wider decentralisation of food production and manufacturing in order for both rural and urban communities to become more sustainable. These may be facilitated through further adoption of the DGCs discussed in order to encourage greater discussion, participation and collaboration between community members while instilling them with a greater sense of creativity and ownership over the manufacturing and decision-making processes that occur within the community.

Chapter 5:

Conclusion

5.1 Lessons for the Smart City

A number of key areas have been identified from the case study of CEV which smart cities should pay particular attention to in their strive to increase citizen engagement. In CEV, the decentralisation of food production and manufacturing were noted as vital steps in the creation of a sustainable community. When these issues are not addressed there is a risk that smart technologies will be continuously produced with the aim of being used to address sustainability issues, but the impact of the manufacturing process is not considered. Without taking this into account “smart cities will only exacerbate the same problems that they claim to be solving” (Cugurullo and Ponzini, 2019; 159). The notion of ownership has been recognised as being one of the key factors required for the decentralisation of control within the smart city (Trencher, 2019). CEV utilised opensource platforms alongside facilities such as the FabLab to instil a sense of ownership and creativity over the manufacturing process in the community and demonstrate ways in which the community could become more self-reliant. Not only do these initiatives inspire engagement from the community, they also reduce costs of importing goods. A lower cost of living was seen in other parts of the village such as in reduced heating bills thanks to energy efficient houses. These measures were promoted as ways to encourage further interest in a move towards a sustainable, and in many ways cheaper, life. The transparency of opensource platforms and technologies were also acknowledged as a potential way to reduce any resistance to the implementation of smart technologies.

A key point reiterated by many residents in CEV was that technology should only be used where appropriate. This reduces the unnecessary manufacturing of technology which has huge ecological consequences. To identify where technology

is most appropriate, the value of local knowledge cannot be ignored. This is strengthened through discussion, participation and collaboration between community members. Initiatives such as coworking spaces and digital hubs were recognised as important for facilitating this level of community engagement. They also highlighted that having a high level of digital or technological literacy was not necessary and that an interest in design and creativity was more valuable. If the smart city were to adopt some of the initiatives seen in CEV, it is likely that a higher level of community engagement would be achieved.

5.2 Future Research

This study has made an attempt at addressing the lack of attention given to ways of increasing citizen engagement in the smart city. Despite having identified key lessons for the smart city, the impact of implementing these strategies in the urban environment have not been assessed. There is potential, therefore, for future research to begin implementing the smart initiatives identified in CEV to the smart city. Monitoring of citizen engagement should take place to uncover if it increases once these initiatives are implemented and the outcomes increased citizen engagement may bring to the smart city.

It is vital to remember that CEV is still a relatively new community and that the long-term impacts of their strategies cannot yet be assessed. Alongside this, CEV is a purpose-built community with a strong focus on building sustainability and resilience. It cannot be said with absolute certainty that the initiatives implemented in CEV would have the same impact in already existing communities. However, as has been seen in the case of Masdar City, being a purpose-built community does

not always work (Cugurullo and Ponzini, 2019). There is more to be considered than simply the implementation of smart technologies as these on their own cannot build resilient communities. Kirby (2019) has acknowledged this challenge in relation to CEV: “Building CEV has required pioneering new technologies and ecological building techniques, but it has learnt that building a resilient community is the greatest challenge”. Given the evidence from this study and the wider literature, we must consider that what matters most in building a sustainable community is the people for as Hill (2013) puts it “The city is its people”.

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Appendices

Appendix 1

Participant Information Form

School of Natural Sciences, Trinity College Dublin

Title of Study: Citizen engagement with smart technology in the rural setting.

Principal Investigator: Tara Donohoe, 4th year Geography student

Institution: Trinity College Dublin

Introduction

This study aims to explore how smart technology can be used to make an area more sustainable. The study will answer this by considering the lessons which can be learnt from smart villages, and how their methods can be implemented on a larger scale for cities. It is hoped that by examining how the ordinary citizen engages with this smart technology in the rural setting, valuable insights may be gathered which will be of benefit to the city. As a sustainable eco-village community, I feel Cloughjordan may be able to provide some valuable examples of how smart technologies used within a community environment contribute to sustainability. Currently, there is much literature of how smart technologies can be used in cities but there is little attention to the role that the ordinary citizen can play in contributing to the city's sustainability agenda. The study will adopt a bottom-up approach, instead of looking at the city as a success story on which rural villages should be modelled, it will instead consider what the rural villages can teach the city. Participants will be asked to participate in a one-on-one semi-structured interview with the researcher. It is expected that these will be once of interviews.

Procedures

Participants will be selected based on their own expression of interest with the project. They will be required to participate in one semi-structured individual interview which is expected to take no more than an hour to complete.

Benefits

It is hoped that throughout the study valuable information on the role that the citizen and community play in using smart technology to make an area more sustainable will be exposed. This information can be of huge benefit to cities where smart technology is readily available, but the citizen is not engaged with it. Lessons learnt from smart villages may help to bridge this gap in the city.

Risks

No potential risks are foreseen in this study.

Exclusion from Participation

Any individual under the age of 18 is excluded from participating in the study.

Confidentiality

Your identity will remain confidential. Your name will not be published and will not be disclosed to anyone outside the study.

Voluntary Participation

You have volunteered to participate in this study. You may quit at any time. If you decide not to participate, or if you quit, you will not be penalized and will not give up any benefits which you had before entering the study.

Reimbursements

No additional incentives are offered for this study.

Stopping the study

You understand that the researcher may stop your participation in the study at any time without your consent.

Permission

This study has School of Natural Sciences Research Ethics Committee approval.

Access to data

You can have access to your own data at any time under the Freedom of Information Act 2014.

Sharing the results

The research results will be shared with the participants and the community before publication.

Further Information

You can get more information or answers to your questions about the study, your participation in the study, and your rights, from Tara Donohoe who can be contacted at donohoet@tcd.ie

Appendix 2

Informed Consent Form

School of Natural Sciences, Trinity College Dublin

Title of research study: Citizen engagement with smart technology in the rural setting.

This study and this consent form have been explained to me. I believe I understand what will happen if I agree to be part of this study.
I have read, or had read to me, this consent form. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction. I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights. I have received a copy of this agreement and I understand that, if there is a sponsoring company, a signed copy will be sent to that sponsor.

Name of sponsor: N/A

PARTICIPANT'S NAME:

PARTICIPANT'S SIGNATURE:

Date:

Date on which the participant was first furnished with this form:

Participants with literacy difficulties:
I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely and understands that they have the right to refuse or withdraw from the study at any time.

Print name of witness: _____
Signature of witness: _____
Date (Day/month/year) _____
Thumbprint of participant:

Statement of investigator's responsibility: I have explained the nature, purpose, procedures, benefits, risks of, or alternatives to, this research study. I have offered to answer any questions and fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.
Researcher's signature: **Date:**

Appendix 3

Interview Schedule

1. What is your role within the Cloughjordan community?
2. How do you define sustainability?
3. Can you discuss the running of the community and the role that each community member has in this?
4. Are you aware of the term smart technology?
5. If yes, how do you define smart technology?

   If no, offer definition of smart technology.
6. Are you aware of any examples of smart technology currently being used in Cloughjordan Ecovillage? What are they?
7. What role does smart technology play in the daily lives of community members?
8. Do you identify a link between your understanding of sustainability and the use of smart technology? If yes, what is this link?
9. How do community members use smart technology to contribute to the sustainability of the community?
10. Do you feel that community engagement with smart technologies, is important for sustainability? Why? In what ways?
11. Do you view smart technologies as a *necessary* tool for sustainability?
12. Do you feel that community engagement with each other, is important for sustainability? Why? In what ways?
13. Do you think the community could be sustainable without the active engagement of citizens within the community?
14. If you were to identify any key lessons that a larger urban environment could learn from Cloughjordan, in order to be more sustainable and to encourage the active involvement of their citizens, what would they be?

Appendix 4

Research Ethics Application

School of Natural Sciences, Trinity College Dublin

Section 1: Applicant Details

Name (Student/lead researcher)	Tara Donohoe
Staff/Student Number	16324454
Applicant E-mail Address	donohoet@tcd.ie
Name(s) of Additional Researcher(s)	***N/A***
Name of Supervisor (for students)	**Dr. Federico Cugurullo**
Supervisor E-mail Address	***cugurulf@tcd.ie***
What School/Discipline are you affiliated to?	**School of Natural Science - Geography**
Title of Project	**How can we use artificial intelligence and citizen science to make cities more sustainable?**
Brief description of the project (max 200 words)	The study will answer the research question "How can we use artificial intelligence and citizen science to make cities more sustainable?" by considering the lessons which can be learnt from smart villages, and how their methods can be implemented on a larger scale for cities. As a sustainable eco-village community will be used as a case study which will be able to provide some valuable examples of how smart technologies used within a community environment contribute to sustainability. Currently, there is much literature of how smart technologies can be used in cities but there is little attention to the role that the ordinary citizen can play in contributing to the city's sustainability agenda. The study will adopt a bottom-up approach, instead of looking at the city as a success story on which rural villages should be modelled, it will instead consider what the rural villages can teach the city. The data will be collected primarily

	through semi-structured interviews with key members of the community followed my focus groups with ordinary committee members to allow them to share their experience with smart technology. Informed consent forms will be necessary for all participants. No incentives or compensation will be offered.
Highlight the category that best describes the research	Undergraduate project / Taught MSc project Full-time postgraduate research project Staff research project
Has this application been submitted to another TCD Ethics Committee for approval?[1]	***No***
Has ethical approval for this project been sought from outside TCD? What was the outcome?	***No***

[1] All research involving animals (vertebrates) must ultimately be approved by the Animal Research Ethics Committee (AREC); research involving vertebrates in their natural habitats will be assessed by the SNS REC initially and then the decisions will be overseen by the AREC, but any research involving vertebrates in a laboratory setting needs to be submitted directly to the AREC.

Section 2: Initial Research Ethics Checklist

DOES YOUR RESEARCH PROJECT FALL CLEARLY UNDER ANY OF THE FOLLOWING CATEGORIES?

	YES	NO
1. Quality assurance study (e.g. assessment of teaching practice)[2]		X
2. Audits of standard practice (not involving identifiable records)		X
3. Research on existing publically available information, documents or data (i.e. already gathered and in the public domain)		X

If you have answered YES to one or more of the above questions, your research project can proceed without the need for ethical approval from the School Research Ethics Committee (REC). Please be aware that all researchers have a responsibility to follow TCD's Policy on Good Research Practice, (available here) as well as any academic or professional code of practice or guidelines relevant to the specific research project. Even if you answer YES to one of the above question, **please return a signed (Section 5) copy of this form to the Chair of the SNS REC** as a record must be kept of all projects.

If you have answered NO to all of the above questions, proceed to Section 3 to determine whether your application is suitable for consideration for the School REC or if the application needs to be evaluated by a Level 2 committee.

[2] Quality assurance and audit studies do not routinely require ethical approval. However, if following the study there is scope to publish the findings of a study, an REC may grant a letter of approval if required.

Section 3: Checklist for School REC suitability

This checklist needs to be completed in order to determine whether your application is considered "low risk" and is therefore suitable for consideration by the School REC[3]. Please indicate if your application falls into any of the categories below (categories from TCD "Criteria for Research Ethics Committees" document, Jan 2014). Answer "NO" if your work does not involve the scenario. Answer "YES" if it does and ethical risks cannot be mitigated. Answer "YES but see…" if ethical risks can be mitigated by appropriate actions such as designing the study to minimize the chances of potentially endangering people, populations of study organisms and/or the environment (and list these in Section 4).

	NO	YES	YES but see mitigation strategy in Section 4
1. Surveys asking questions of a sensitive or private nature	X		
2. Questionnaires or observational studies involving children or vulnerable adults.	X		
3. Research where there is a risk of a participant feeling undue pressure to participate by virtue of his/her relationship with the researcher (e.g. student/supervisor; patient/clinician).	X		
4. Projects involving a justifiable degree of deception.	X		
5. Analysis of archival irrevocably anonymised human tissue samples for which consent for research was not originally given, and was not acquired in the course of clinical treatment. (Archived samples taken for a previous research study must always get new ethical approval).	X		
6. Research involving invasive procedures on humans (other than those listed above).	X		
7. Research other questionnaires or observational studies involving vulnerable persons[4].	X		

[3] In situations where research ethics approval has been granted by an appropriate body outside TCD, approval must also be sought from an appropriate TCD REC, although, at the discretion of the REC chair, the submission may qualify for fast-tracked approval.

[4] Vulnerable persons: Certain individuals who face excessive risk of being enrolled in research include those with limitations in their ability to provide informed consent to research because of factors such as immaturity or cognitive impairment. Vulnerability can also stem from individuals' relationships with others, and it is imperative that coercive situations are avoided. Such cases may occur when an employee/student/dependent is asked to participate in research being conducted by a supervisor/mentor. Additional social factors, such as poverty and lack of access to health care, can also make individuals vulnerable to coercion, exploitation or other risks and need to be considered and appropriately mitigated for.

8. Research where identifiable information obtained may have legal, economic or social consequences for research subjects.	X		
9. Research that may identify illegal activity on the part of the participant.	X		
10. Projects where each subject is paid (over and above token gestures).	X		
11. Research that may potentially cause irrevocable damage to[5] the population of subjects, and/or researchers, and/or 3rd parties, and/or the environment. **See note below.**	X		
12. Research involving the collection of human tissue.	X		
13. Research that may have a direct military application.	X		
14. Potentially harmful research involving humans conducted outside Ireland[6].	X		
15. Research involving psychological intervention.	X		

Official Approval/licensed research: Research involving elements that may cause harm to the environment, to invertebrate animals or plants; or deal with endangered fauna and/or flora and/or protected areas; or involve the use of elements that may cause harm to humans, including research staff; may need formal approval/licensing by outside body, and such approval for the research (e.g. from the relevant Government Department) must be attached to this application. If formal approval for the work has been granted please give details in the box below:

Approval for work granted by:	*N/A*
Licences held relating to research activities	*N/A*
Details of approval:	*N/A*

If you have answered YES to any of the above questions and cannot mitigate ethical risks, then the application is deemed to be of moderate or high risk (*i.e. risk or discomfort is greater than that usually encountered during normal daily life*) and should be

[5] Relevant Health and Safety Risk Assessment forms must be completed before work can be undertaken.
[6] Does not apply to material publically available in another jurisdiction. Note that the same ethical standards will apply to research carried out by SNS researchers within and outside of Ireland. Work must comply with legal requirements of the State in which it is carried out.

submitted to the appropriate Level 2 Ethics Committee. The applicant should download the application and procedures for the appropriate Level 2 REC (the Faculty of Engineering, Mathematics and Science REC, or the Animal REC for vertebrate research).

If you have not answered YES to any question in Section 3, your application can be submitted for consideration by the SNS REC after completion of Section 4.

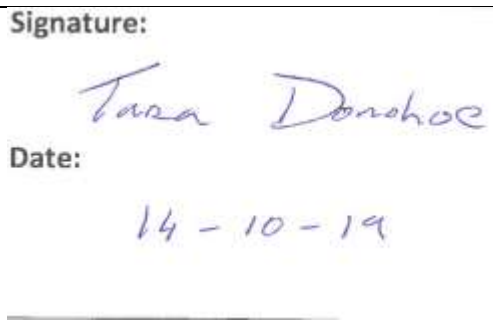
Section 4: Ethical Approval Application Form for School of Natural Sciences Level 1 REC

All student applications should be reviewed and approved by the project supervisor prior to submission.

Project Description

Title of research project	**How can we use artificial intelligence and citizen science to make cities more sustainable?**
Start date of research project	**October 2019**
End date of research project	March 2020
Potential ethical issues	
Ethical issues may arise with regards to maintaining the anonymity of all participants. Due to the small tight-knit nature of the community being studied, there is potential that even minor details of individual's response may indicate to other community members who they are.	
Ethical considerations, reducing potential risks and mitigating impacts	
To overcome any potential ethical issues, pseudonyms will be used to conceal the identity of all participants. Any information that may expose the identity of the respondent will not be included in the published results. The nature of the project and the use of the information given will be clearly explained to all participants and they will be assured that their involvement in the study can end at any time. I do not foresee any reason where additional support service may be necessary.	
Data storage	
To preserve confidentiality and anonymity of all participants pseudonyms maybe used in the publishing of the results. All data will be kept secure on the researcher's individual private compute and files will not be shared without participants consent. Once the project is completed the data will remain stored on the researcher's computer in case there is a need at a later stage to expand on this research. Participants data will not be used for any other study without their written consent. Again, pseudonyms will be used on all pieces of published work.	
Published ethical guidelines to be followed	
Trinity College Dublin's policy guide on good research practice.	

Section 5: Declaration

Signature of applicant *I declare that the information given herein is accurate. I have read the TCD Ethics Policy and will follow the guidelines therein. I have read and understood the TCD Data Protection Policy.*	**Signature:**  **Date:** 14-10-19
Signature of Supervisor (in case of students) *I declare that the information given herein is accurate. I have read the Ethics Policy and will follow the guidelines therein.*	**Signature:**  **Date: 14-10-2019**