

Co-producing public value through IoT and social media

Ulf Hedestig
Department of Informatics
Umeå University
Umeå, Sweden
ulf.hedestig@umu.se

Daniel Skog
Department of Informatics
Umeå University
Umeå, Sweden
daniel.skog@umu.se

Mikael Söderström
Department of Informatics
Umeå University
Umeå, Sweden
mikael.soderstrom@umu.se

ABSTRACT

The past decades a number of new perspectives on public administration have emerged, for instance New Public Service, New Public Governance and Digital Era Governance. Several of these perspectives seem to have the concept of co-production in common, implying that the public sector engages citizens to take part in the design and execution of services. A rather new way to achieve co-production in the public sector has been to utilize crowdsourcing or social media monitoring. However, the way these 'methods' has been implemented in public sector is often associated with difficulties, and to overcome some of them we propose an Internet of Things (IoT) approach that hopefully will create improved conditions for data-driven business development, and innovative citizen sourcing. At present, the approach is tested in a local government in northern Sweden in which we have set up a Low Power Wide Area Network (LoRa) designed for wireless battery-operated sensors. Although the test is still in an initial stage, results so far are promising and combining IoT and social media may be one way of creating co-production of public sector services.

CCS CONCEPTS

• **Applied computing** → **E-government**; • **Information systems** → *Collaborative and social computing systems and tools*; *Sensor networks*; • **Human-centered computing** → *Social media*;

KEYWORDS

Co-production, crowdsourcing, citizen sourcing, social media monitoring, Internet of Things, business development

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1 INTRODUCTION - CITIZENS AS CO-CONSTRUCTORS OF PUBLIC VALUE

Creating public value is the most important topic for public sector, but it is not always that easy to know what citizens need and prefer. Internal organizational changes towards more LEAN-oriented value

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flows as well as new digital services, are examples of public sector transformations based on new needs and demands from different stakeholders in society. But, still the public sector in many ways struggle to find means that help them figure out what citizens actually want.

The last century we have also witnessed a shift of perspective from the traditional public administration characterized by Herbert Simon's "administrative man", with a rather passive view of the citizen as a voter and a client. This perspective changed when the New Public Management movement entered the arena as a response to public sector's problems with efficiency and effectiveness. The focus shifted towards the "economic man", which, among other things, resulted in outsourcing of governmental processes to private companies. Within this perspective the citizen is regarded as a customer.[5, 11]

With the arise of globalization and digitalization new perspectives on public administration have emerged such as New Public Service [11–13], Public Value Management [46], New Public Governance [40] and Digital Era Governance [33, 34]. These perspectives have a mutual starting-point, the "reasonable man", which is based on dialogue and deliberation. In this view, the citizen often is regarded as a problem-solver and co-creator engaged in creating what is valuable and good for the public together with the public sector. Other consequences of the new perspectives concern the shift from an inside-out approach of offering service to focusing on service or citizen journeys, from plan-driven projects towards more agile ways of working, and realization of a do it yourself strategy with self-service opportunities.[8]

Several of these perspectives seem to have the concept of co-production in common [29], or co-creation as it sometimes is called, meaning that the public sector engages citizens not only to provide opinions on the services it delivers, but also to take part in the design of new services, the redesign of existing services and the actual execution of services, partly or fully. A quite recent way of establishing co-production in the public sector has been to apply information technologies into active or passive settings. One example of an active setting is crowdsourcing [30], and one example of a passive setting is social media monitoring [20].

However, the way crowdsourcing has been implemented in public sector is often associated with difficulties, and some of them are also associated with social media monitoring. Perhaps the most important issue is related to the nature of the crowd. The question of who forms the group, how it is organized and what task the crowd is involved in effects the outcome of the crowd's performance. Challenges that needs to be managed include for instance; the existence of a sufficient diverse and knowledgeable active crowd, the task and

the crowdsourcing process that the crowd is supposed to participate in, and the channel, or the media, in which the crowdsourcing occurs.

To overcome some of the difficulties associated with crowdsourcing and social media monitoring we propose that an alternative or complement to crowdsourcing and social media monitoring may be to use Internet of Things (IoT) technology to gather data regarding citizens' everyday behavior and the actions they perform in the real-world. By doing this we are trying to investigate the research question whether or not sensor data can be used as an input to data-driven business development in the public sector. You might say that this is an IoT approach to citizen sourcing that hopefully will create improved conditions for business development, and innovative citizen sourcing in public sector organizations. Janssen, et al [25] presents similar ideas of data-driven innovation in the public sector but in a big and open linked data view that is more comprehensive than the IoT/social media view of this article. The IoT approach is currently tested in a local government in Northern Sweden, where we have implemented a Low Power Wide Area Network specifically designed for wireless battery-operated sensors.

The remainder of this paper is organized as follows. In the next section we present the research site and method. In chapter three, we explore the idea of the citizen as a creative co-creator of public value, and how social media can be used as an interactive arena for co-production. Then we report from an empirical case study of how social media is used by local governments in the northern parts of Sweden and Norway. In chapter five we introduce and discuss the IoT approach to citizen sourcing, and describe the results of the on-going test. Finally, we conclude by arguing that although the test of the approach is in an initial stage, results so far are promising and combining IoT technology and social media may be one way of creating co-production of public sector services.

2 RESEARCH SITE AND METHOD

The field study presented in this paper is a part of a larger research project in which two universities, five local governments and two national agencies participate. All participants are either Swedish or Norwegian, and the main goal of the project is to meet the rising digitalization through close co-operation over borders in order to develop sustainable innovation capacity, more effective organization, and challenge driven business development in public service.

The part of the project described in this paper concerns social media, citizen co-production and data-driven business development in public service. Project work is conducted through action research [47] in which people from the local governments and national agencies work together with the researchers from the two universities to address issues and solve problems related to the main goal. Action research was chosen because of two reasons; a) the participating organizations hopefully receives practical problem solving, and b) we hope to be able to create generic knowledge development based on mutual experiences and joint learning [43].

Project work at large is done in five phases; investigating the present situation, both in general and in the participating organizations, development of new solution, test, evaluation and reflection. All tests and the corresponding evaluations are performed in the

participating governments' and agencies' everyday business. Sections three and four of this paper presents the investigation of present situation regarding citizen co-production through social media and the agencies' and governments' use of social media, while section five presents the proposed new solution.

3 CITIZEN CO-PRODUCTION THROUGH SOCIAL MEDIA

During the last ten years or so social media such as for instance, Facebook, Twitter and YouTube, has become an important channel, or tool, for public sector [7]. Many are expressing high hopes that social media will be an important part in the process of transforming public administration to become more citizen oriented in terms of citizen participation and collaboration, being the facilitator of this participation and co-production [7, 29, 42]. Furthermore, Linders [29] also claim that there are high hopes that social media will provide public sector with the means that will help them to find innovative new ways to deliver public value.

It has even been argued that social media should be perceived as a disruptive technology for government [36], enabling better and more effective service and management [6]. In recent years it has also been a growing interest in research and practice to use social media to foster innovation in public sector [7, 30].

The interest in social media and its use in public institutions is framed under different labels as for instance; citizen sourcing [48], open government [15], government as platform [39] and social government [44]. Several of these labels seem to be built around the concept of co-production [29], or co-creation as it sometimes is called, meaning that it is important that public sector engage citizens not only to provide feedback on the services it delivers, but also to take part in the design of new services, the redesign of existing services and the actual execution of services, partly or fully.

In an attempt to bring order to this diffusion of concepts Linders' [29] developed a typology for "understanding, comparing, and guiding implementations that recognizes the varying degrees and typologies for coproduction in the age of social media". In short, the typology is based on scholarly literature on relevant domains identified by Linders. The literature review results in a matrix-like classification scheme which combines three categories of co-production of public services with three stages of service delivery [44]. The three categories of co-production - *citizen sourcing*, *government as platform* and *do it yourself government* - defines the spectrum of the government-citizen relationship, and the three stages of service delivery - *service design*, *service execution* and *service monitoring* - defines the spectrum of public service delivery partnerships.

Linders' typology is useful when analysing real-world implementations of the ICT-facilitated co-production types identified in the typology. The idea of using sensors to find out which services that are used, which times they are used and how they are used proposed in this article, is an example of citizen sourcing for consultation and ideation during both the service monitoring stage and the service design stage of the service delivery lifecycle.

It is not easy to predict what the future of social media in public sector will be, but given the widespread and growing use of the

Internet, the ongoing development of new social media applications and citizens' expectations to interact with public administrations through the same tools that they use in private life it seems likely that social media will continue to be a "central component of e-government" [3]. It may become even more central if the quite novel research field of the use of social media to foster innovation in public sector [7, 30] continues to grow.

A recent way of establishing co-production in the public sector has been to apply information technologies into active or passive settings. One example of an active setting is crowdsourcing [30], or citizen-sourcing as it is called by Linders [7]. Other terms have also been used, such as peer production, user-generated content, and smart mobs [14, 22]. In this article we use the terms crowdsourcing and citizen sourcing as synonyms.

Researchers have since Howe [24] coined the term, given alternative definitions of crowdsourcing. Examples of such can be found in Brabham [4], Nam [37], Dutton [16] and Hilgers and Ihl [23]. We have chosen a more complex definition offered by Estelles-Arolas and Gonzalez-Ladron-de-Guevara [18] describing the various target areas involved:

"Crowdsourcing is a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task. The undertaking of the task, of variable complexity and modularity, and in which the crowd should participate bringing their work, money, knowledge, or experience, always entails mutual benefit. The user will receive the satisfaction of a given type of need, be it economic, social recognition, self-esteem, or the development of individual skills, while the crowdsourcer will obtain and utilize to their advantage what the user has brought to the venture, whose form will depend on the activity undertaken."

This process is active since the crowdsourcer has a problem that is actively addressed to the crowd, often through social media. In this sense the process follows a top-down approach where the process is directed and managed by the owner of the problem, that is, the public agency [4]. According to Nam the purpose of crowd- or citizen-sourcing, can be categorized as image making, information creation, service co-production, problem solving or policy making [37]. Brabham [4] has also developed a typology of existing crowdsourcing types, which are; knowledge discovery and management, broadcast search, peer-vetted creative production, and distributed human intelligence tasking.

Applying social media into passive settings often means that you conduct so called social media monitoring (SMM). SMM has been defined as "the continuous systematic observation and analysis of social media networks and social communities" [20]. According to Loukis, et al [30] SMM has initially been used by private firms to collect knowledge, ideas and opinions about their products and services from external sources, but the literature on the use of SMM by public sector agencies is still quite limited. Nevertheless, the public sector could gain a lot from collecting citizens' knowledge and use that information when developing their business. Loukis,

et al [30] accordingly claims that the public sector has started to apply ideas from crowdsourcing and SMM but extensive research on this area is needed. Although doing it in a big and open linked data perspective, Janssen, et al [25] also maintain that ideas from crowdsourcing and SMM have become an important means for public sector innovation.

However, the way crowdsourcing has been implemented in public sector is often associated with difficulties, and some of them are also associated with SMM. One of the most important issues is related to the nature of the crowd. The question of who forms the group, how it is organized and what task the crowd is involved in effects the outcome of the crowd's performance. Researchers have pointed out a number of challenges and dilemmas related to this. The first concerns the existence of a sufficient diverse and knowledgeable active crowd. Public sector differs from private sector in the sense of serving all citizen, and the challenging task is to have representatives from every segment of the population in the crowd. If not, the risk is that the data and solutions from the crowd can be questioned, biased, manipulated, or of bad quality [30]. Another dilemma is that parts of the population sometimes have problems to participate via digital platforms due to the existence of digital divide and participation inequalities [4]. Sweden, as one of the most digital countries, has 500 000 inhabitants that do not have access to the Internet, and in the last statistics only 71 % of the citizens felt that they were a full participant in the information society [9]. In relation to the crowd, the crowdsourcer also must take into account transparency and trust issues. The crowd has to receive a clear problem from the initiator and some data can in certain circumstances reveal weaknesses and inabilities within the initiator's organization that the initiator does not want to expose in public [4]. This becomes even more important to manage when public authorities use data-driven approaches, such as social media monitoring. Links between transparency, openness, accountability and trust are in this case often unclear [17, 25].

The second challenge with crowdsourcing, but not to the same extent with SMM, is related to the task that the crowd has to deal with, and the crowdsourcing process. Many crowdsourcing events encourage competition in hackathons or makethons which is opposite to the intent of a crowdsourcer, namely to encourage collaboration [1]. Creative collaboration requires familiarity with the collaborators, where people can discuss conflicting viewpoints, engage each other, and negotiate possible solutions [32]. The crowd can in this sense be regarded as strangers that need time and effort to become aware of the task at hand. According to Majchrzak and Malhotra [32], the participant in a crowd acts as in online communities which means that they spend little time and the majority of the participants never submit any idea or comment.

A third challenge regards the channel in which the crowdsourcing occurs, and parts of this challenge is also relevant for SMM. Many crowdsourcing projects have developed domain-specific applications, supporting different tasks such as idea evolution or idea generation. A problem here is that inadequate design of the digital platform can lead to poor results in terms of participation as mentioned above. Within information systems research there are extensive studies in design theory that reveal constraints and affordances between artifacts and human actions. The sociotechnical design of these platforms has to take into account aspects such as

if the functional properties are appropriate for participation and collaboration, ease of use, popularity, visual appeal, etc. [37]. In addition, to accomplish a high level of use of domain-specific applications the owner needs implementation and adoption strategies directed to the different stakeholders in the crowd. An alternative solution is to utilize already widely used platforms, such as Facebook, Snapchat and Instagram, where large parts of the population already are familiar with their features for exchanging comments, ideas and opinions.

Finally, Picazo-Vela, et al [42] point out that despite the high hopes that social media may transform public administration to become more citizen oriented, empirical evidence from research suggests that up until now social media mostly has contributed only to a gradual process of transformation inside public administration, mainly serving as just another channel for pushing information to citizens. And, that does scarcely bring any participation and collaboration. The empirical case study of local governments in Sweden and Norway presented in the next section, corroborates Picazo-Vela, et al's observation, and also demonstrates that at least in some countries and some public agencies, we are yet quite far from meeting the expectations on social media use in public sector.

4 A CASE STUDY - SOCIAL MEDIA USE IN LOCAL GOVERNMENTS

As social media offers possibilities for interaction and dialogue with citizens, social media sites have become important channels for communication between local government agencies and citizens around the world [19, 28]. The Scandinavian countries are no exception. In Sweden, for example, almost all local governments are present on Facebook [45], and in Norway, Johnsen, et al [26] report that many local governments are sophisticated users of social media. This section reports from an empirical case study of how social media is used by local governments in the northern parts of Sweden and Norway.

4.1 A study of seven government agencies in Sweden and Norway

To gain a deeper understanding of how government agencies use social media, an interview study was carried out during the time period November 2016 - March 2017. Empirical data was gathered through interview sessions at seven different government agencies in the northern parts of Sweden and Norway. The seven agencies are situated at six separate locations and vary in size and resources, as they represent different geographical areas and populations. Also, five of them are local governments, while the remaining two are national government agencies. This heterogeneous context is well in line with the recommendation that have been proposed by de Vries, et al [10] as important for future research on public sector innovation, namely to employ multi-method studies that cross countries or sectors.

Face to face interviews with representatives from the agencies were conducted at local visits, and informants included web editors, communication personnel and information managers. At some of the agencies, an additional interview was conducted in order to get a more comprehensive understanding of their diverse use of social media, resulting in ten interviews in total (table 1). The interviews

were semi-structured [21], guided by thematic, open-ended questions, concerning their use of social media, existing social media strategies, and views on citizen engagement. The recorded interviews lasted for 45-70 minutes, and were transcribed before analysis. This section summarizes some of the common themes emerging from the empirical data, highlighting key aspects of how the agencies studied use social media. Annotation A-E will be used when quoting some of the informants. It should also be noted that all quotes are translated from Swedish or Norwegian by the authors.

4.2 Social media presence without long-term strategies

All government agencies included in the study are present in social media, at least to some extent. Among the seven participating organizations, their presence in social media corresponds quite well with their relative size, with the largest agency being most active in various social media channels followed by the second largest agency, and so on. However, since the main web site presenting the organization and available services is considered their main priority for all participants, their social media activities are not typically prioritized. Furthermore, the purpose of using social media is generally quite unclear:

"We have no communication strategy. [...] Why are we on Facebook? What are the consequences of not being there?" (A). (Nov 1, 2016)

"We need to be on Facebook. Why? Because everybody is there!" (B). (Nov 22, 2016)

A representative from one of the local governments admits that they actually made a decision a couple of years ago, not to engage with social media at all, mainly due to lack of personnel resources. But since then they gradually have begun entering Facebook, now having a couple of accounts representing different operational areas. The reason for this turnabout seems to be a perceived pressure of having to be present in social media no matter the reason:

"It is constantly mentioned that we need to get into social media, that it is needed [...] But we have no structure or any plans." (C). (Nov 2, 2016)

Thus, since citizens use social media, the local government agencies feel a need to have a social media presence as well. Having the notion that it can probably develop into a valuable arena for interaction with citizens, most of the agencies in the study still have no strategic ideas of what they want to achieve with their social media presence. Accordingly, notions of crowdsourcing or social media monitoring as methods for citizen input to innovation and business development, have not had any impact on current social media activities.

In a review of social media use in e-government, Magro [31] concluded that there seemed to be a lack of long-term goals for the interaction that government agencies seek to establish with citizens, through the use of social media. The empirical material in this present study, similarly shows that although the government agencies are present on different social media arenas, the purpose and strategy of their social media activities, remain to be specified or communicated throughout the organization.

Table 1: Government agencies included in the case study

Organisation	Country	Population	Main social media channels	Interviews/respondents
Local government	Sweden	2800	Facebook	1 interview/1 respondent
Local government	Sweden	4100	Facebook, Twitter, Instagram	1 interview/1 respondent
Local government	Norway	4500	Facebook	1 interview/1 respondent
Local government	Norway	51000	Facebook, Twitter, Instagram, YouTube	1 interview/4 respondents
Local government	Sweden	125000	Facebook, Twitter, Instagram	2 interviews/3 respondents
National Agency	Sweden	220000	Facebook, Instagram	2 interviews/2 respondents
National Agency	Norway	National population	Facebook	2 interviews/2 respondents

Without a coherent and anchored social media strategy, it is often up to individual social media enthusiasts, to take initiatives. Especially among some of the municipalities, social media activities are not always centrally organized but rather the result of initiatives from individuals who want to promote a specific operational area:

"Now, those that are the most interested, publish things on their own [on Instagram]" (D). (Jan 19, 2017)

Some of these initiatives are quite successful in terms of engagement and public appreciation, others not so much. Typically, someone decides to create a new, business related Facebook account, presenting news related to a specific area without considering how this new account should relate to other existing accounts belonging to the agency, or what value it brings to the citizens. Again, the potential of using social media channels as tools for citizen sourcing or co-production of public value seems to be lost when spontaneous individual initiatives rather than coordinated efforts, guide the social media activities.

4.3 Using social media as a channel for broadcasting

While some of the participating organizations have tried using Instagram, YouTube and Twitter, Facebook is the predominant social media platform. It is however mainly used for pushing news, often already posted earlier to the main web site. Some of the participants describe how they actually prefer not to have conversations on Facebook, but rather want to forward any comments or questions to their ordinary support channels available via their main web sites. They do not want to have extensive discussions on Facebook, being afraid of losing control and not being able to monitor all postings:

"We never engage in discussions on Facebook.[...] We do not have resources to participate in dialogues." (A). (Nov 1, 2016)

There are indeed some examples of extended dialogue, as well as attempts on asking citizens for their opinions related to specific municipal decisions:

"I wrote a question on Facebook, asking our citizens for their opinions. [...] I think the politicians thought it was a bit of fun." (E). (Jan 11, 2017)

But in terms of crowdsourcing, these existing attempts are small scale, ad hoc activities, rather than long-term intentional strategies.

Having studied the adoption of social media strategies in government agencies, Mergel [35] presents a framework for categorizing different social media strategies. The different strategies, also

valid as levels of maturity, are labelled *representation of the agency*, *engagement of citizens*, and *networking with the public*, with its corresponding tactics *push*, *pull* and *networking*.

At the first level, the main focus is to be present in the same social media channels as the citizens, to build identity and good reputation. The easiest and most straight-forward way to achieve this would be through a push tactic, considering all social media channels to be more or less similar to each other, using the same message everywhere with small or no effort of tailoring channel specific content. Thus, the push tactic is based on a broadcasting one-way communication, with no great interest in bidirectional conversations with citizens.

The next strategy and maturity level is characterized by engagement and dialogue. Instead of just pushing out news messages, this strategy involves a pull tactic where citizens are invited to respond and co-produce content [35]. The third and final strategy could be labelled as networking or collaboration [35, 36]. Moving beyond the notion of local agencies having conversations with citizens, this level is more about facilitating conversations among citizens and stakeholders, being a curator rather than playing the main role. In this way, local governments can gain valuable insight about current issues and important local topics being discussed online.

In relation to the framework presented by Mergel [35] all organizations in this study are still mainly using push tactics, focusing on being present in social media, rather than having dialogues or curating networking activities. Thus, the government agencies are mostly using social media as a channel for broadcasting news about public services and local events.

The empirical material further indicates that the government agencies, in their approach to social media, to some extent have adopted a marketing view, aiming for reaching as many viewers as possible and measuring their social media success in "likes" and "followers". Because of this, they risk missing out on the perhaps most prominent feature of social media; its support for user-generated content [27]. Also, the citizens are not being invited as active co-producers of public value.

5 AN INTERNET OF THINGS APPROACH TO CITIZEN SOURCING

The empirical material shows that the local governments studied, so far have a very limited interaction with citizens through social media platforms. Due to lack of both resources and capability, the conditions for successful adoption of social media monitoring or crowdsourcing methods are weak. In addition, there seems to be an

uncertainty when it comes to reaching the right population through social media. When looking for input about specific municipal services, how can they through social media reach the very citizens that are actually using those services and filter out opinions from citizens that not to the same extent possess relevant knowledge or experience? How can they make sure they receive valid data when using citizen sourcing methods?

To this endeavor, an IoT approach to citizen sourcing was launched at one of the local governments participating in the study. Thus, aiming for improved conditions for data-driven business development, and innovative citizen sourcing, the initial interview study was followed-up by providing a local government with a LoRa network, consisting of two gateways and different kinds of sensors. The LoRa network was installed during September 2017, with around 20 sensors to test the equipment and its performance.

We use the term citizen sourcing to describe this IoT setting although we could also have used the term citizen (or sensor) monitoring. In one sense what we are doing could be described as similar to the passive setting of SMM. That is, we use the sensors to collect data of citizens' real-world actions, but we have not actively presented them a problem that we need help solving. On the other hand, what we are doing could also be described as similar to the active setting of citizen sourcing. The sensors are not put out by chance, rather they are placed at locations where the local government feel that they have a problem that they need help from citizens to solve. Hence, we decided to use the term citizen sourcing as we judge it to be more accurate.

5.1 Collecting data with sensors in a LoRa network

LoRa is a *Low Power Wide Area Network* specifically designed for wireless battery-operated sensors in a regional network. The infrastructure can be described as a star topology with gateways as bridges between sensors and a central server [2]. LoRa was chosen since that it is an open and widely spread platform, including an open, non-profit association sharing their experiences.

By placing two gateways in central locations, the network covers a large part of the central city area. Each gateway is expected to cover a radius of three kilometers (figure 1). The reason for also including the outskirts of the town is to cover leisure areas such as cross-country skiing trails, cross-training tracks, barbecue areas, and areas for swimming and hiking.

The technical implementation of the network was initially a success. Both the gateways and the sensors communicated with the server. But after 2 months, the server started to have problems with receiving data from the sensors. The cause of the problem was connected to our choice of using a SIM-card and mobile communication between the gateway and the server. The mobile company had during this period problems with their tele mast in the area, and the solution for the project was to connect the gateway to an Ethernet network governed by the local government. After this shift of communication method, the LoRa network has been running without any disturbances.

Adjacent to the technical implementation, the project has developed a simple test lab together with the business development team at the local government, where they can deploy IoT sensors

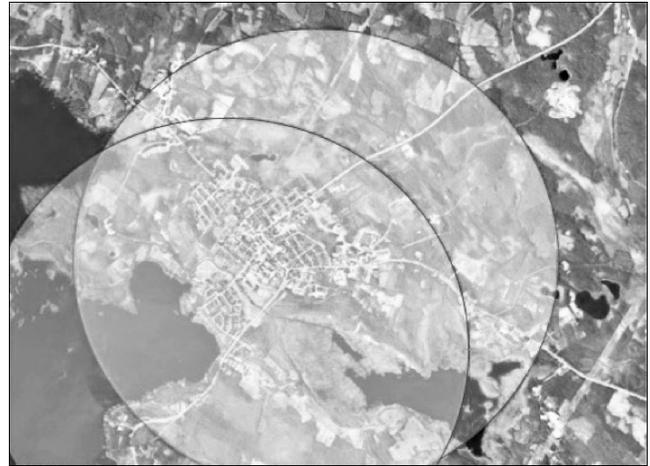


Figure 1: Two LoRa gateways covering the central city.

and measure different kinds of data. The signals are captured by the gateways and sent to a server at the back-end, that saves the data.

In the initial phase, the placement of sensors is based on some of the current challenges the development team has on their desk. Example of issues are; a) the city has too many pedestrian crossings, and other attempts on deciding which crossings that should be eliminated has failed. Questionnaires and focus group interviews have not given any clear answers regarding the citizens' use of these crossings, b) the city would like to know more about when and how much their outdoor multi-sport arena is used, and c) how often cleaners should clean public toilets and empty trash cans/baskets.

To further explore what kind of sensors that could be implemented, the development team have performed focus group interviews with different target groups during fall 2017. Target groups can either be by a specific category, e.g. non-profit organizations or property owners, or by age. The aim of these meetings has been to investigate what information/service the citizens would like to have from the local government and discuss which channels they would prefer for interaction. These meetings have uncovered requests as for instance 'knowing how many people that have joined different public areas such as the gym or the public bath', or 'knowing snow and air temperature for preparing cross-country skis in an appropriate way'.

Initial investigation shows that citizens' need of information is much bigger than what the local government is currently providing. Much of the suggestions are opposite of what we can find in large cities that have adopted the smart city concept, where much of the information is about avoiding queuing, traffic jams and crowds. In our case with a sparsely populated setting, the citizens would like to know where other people are at the moment, especially the young population. Even if they can use social media to interact, some of the population such as young immigrants and asylum seekers has not yet been incorporated and gotten access to these local digital communities.

Further, the case also shows that different target groups are familiar with different social media platforms. For the young population

the majority use Snapchat in their communication. They would never enter Facebook or any other channels. On the other hand, middle aged and older people prefer Facebook or Instagram when communicating through social media.

5.2 Initial responses on sensor data

The first sensors were deployed during the first quarter of 2018, based on current challenges of the development team and input from focus group interviews. The choice emanates mainly from citizens' interest of sport and health, with the purpose of delivering data to enhance service. Two sensors have therefore been placed at a cross-country skiing trail, one at the start/finish and the second one on the opposite side of the track, a couple of kilometers from the start. Both sensors are measuring the snow temperature and humidity, which are of importance when the skiers select appropriate ski wax based on current weather conditions.

The local ski club arranged a cross-country ski competition during the same time period and wanted to use the sensor data at once. Accordingly, they received a link to the server where sensor data were presented. As a consequence, the ski club put the link to the raw data from the sensors on their website, without any re-configuration or reflections on interface design.

As shown in figure 2, data was received every 20 minutes, and beside temperature and humidity it also included lots of irrelevant and internal information, such as identifier number of the sensor, temperature inside the sensor, signal strength, etc.

After the deployment of these two sensors, the following responses from the citizens have been sent to the local government by SMS or through social media posts:

"Great! Thanks for thinking about us." (Respondent 1). (Mar 19, 2018)

"Some parents of the competitors had noted and praised, in particular, that you could follow the temperature log, for the whole day." (Respondent 2). (Mar 19, 2018)

"Great fun that we got to test in connection with the skiing event!" (Respondent 3). (Mar 19, 2018)

"To me it was a big difference; I usually get up at 5.30 am to read the temperature, and then update about once every half hour. I didn't need to do that. Also, people usually call me and ask for the temperature, but during this weekend no one called me." (Respondent 4). (Mar 19, 2018)

Despite the lack of an appropriate interface, people interested in the snow temperature apparently did not have any problems to interpret the data tables offered by the ski club, and also found the available data to be very useful.

Another case showing the sensors ability to be a key driver for business development, was discovered when the local government placed sensors on toilet doors in schools. The purpose was to measure how often the cleaner had to clean each toilet in a specific school building, based on how frequently the toilets were used. However, they discovered that the toilets in the building were almost not used at all. Instead, the school children went to the next building, where they used the toilets. In an interview with the children, they explained that outside the toilets in the main building,

there was an open space where children spent their time during breaks, playing table tennis, etc. This space was too disturbing, with people kicking on the doors etc. which forced them to avoid the toilets. With these data at hand, the school management could discuss changes in the school environment to improve the current situation and make the facilities more available.

5.3 Citizen sourcing through IoT

To this point, the LoRa network seems to offer favorable ways for effective data collection, that is, as a citizen sourcing approach. Instead of analyzing opinions through social media monitoring, government can get direct and actual feedback on citizens movements, behavior and actions from the sensors.

In this present study, this is beneficial for several reasons. Firstly, the local government included in the study is situated in a scarcely populated area, and has limited resources both in terms of money and people to perform social media monitoring. At best, they have people responsible for business development, but they usually have very little knowledge about social media and how to use it for analyses that can lead to business development. Secondly, this local government is already quite familiar with sensor technology and has already developed practices around IoT. Sensors measuring weather, humidity, traffic data, temperature, oxygen, etc., have already been installed in many cities, mostly to help manage infrastructure, that is, in buildings, roads, etc. Together with other kinds of sensor-rich devices, smart phones and other artifacts, IoT generates an enormous amount of data that can provide bases for new services to the citizen.

Thirdly, a local government is an extensive organization with thousands of services that can be improved and enhanced. The difficulties of prioritizing can therefore be a challenge when business developers only have opinions and attitudes to rely on. Actions captured from sensors can in some circumstances be a better solution since they count and register what the citizens actually do. Fourthly, visualizing sensor data and establishing citizen participation based on such data can also be a way to make government more open and accountable [25]. The gathered sensor data can, for instance, easily be visualized and published in social media. The feedback received, will then contribute to improving the services of the local government.

Currently, the project is deploying sensors based on the inputs received from the focus group interviews with citizens, and from the challenges the business team is facing. One of the coming key issues for the project is to experiment with visualizations of the data received from the sensors. The aim is to find ways of creating value-added information and services to the citizens, but also to create a platform for discussing business development and improvements of public service. A future challenge is therefore how to integrate different communication channels, such as social media, mobile apps and web sites, in the dialogue and how these can be integrated in the methods and tools used for innovation and business development in public sector.

6 CONCLUSIONS

In this study we have seen that an IoT technology, in comparison to social media, seems to be easier to incorporate into the activities

#	Time	Temp	Humidity	Vdd	Extemp	RSSI	SNR	SF	GW	NO
1140	2018-03-18 10:17:26	3.1	13	3.408	3.4	-108	7	7	C49300FFFF0EDD88	1290
1141	2018-03-18 09:57:26	2.7	13	3.403	3.5	-112	-2.5	7	C49300FFFF0EDD88	1289
1142	2018-03-18 09:37:26	1.7	13	3.396	2.8	-114	1.5	7	C49300FFFF0EDD88	1288
1143	2018-03-18 09:17:27	1.3	13	3.392	1.6	-105	7.3	7	C49300FFFF0EDD88	1287
1144	2018-03-18 08:57:27	1	13	3.387	1.5	-107	7.3	7	C49300FFFF0EDD88	1286
#	Time	Temp	Humidity	Vdd	Extemp	RSSI	SNR	SF	GW	NO
1143	2018-03-18 11:08:36	2.6	14	3.4	3	-77	8.8	7	C49300FFFF0EDD88	1289
1144	2018-03-18 10:28:36	2.1	14	3.395	2.8	-81	10.8	7	C49300FFFF0EDD88	1287
1145	2018-03-18 10:08:36	1.8	14	3.391	2.6	-76	8.5	7	C49300FFFF0EDD88	1286
1146	2018-03-18 09:48:36	1.3	14	3.386	2.2	-78	9.3	7	C49300FFFF0EDD88	1285
1147	2018-03-18 09:28:36	1	14	3.384	1.6	-78	8	7	C49300FFFF0EDD88	1284

Figure 2: Sensor data from two positions at the cross-country skiing trail.

performed by a public sector business development team. Early findings show that sensor data can be of importance for generating value-added services or business development in a local government. In that sense our initial research question already shows promising progress.

One reason for this result might be that IoT already is a mature technology among the core businesses in the public sector. It is currently in use to enhance service and performance with the aim to increase efficiency and implement the "smart city" concept. Therefore, IoT appears to be on its way to become a natural tool for the business development teams to use for both incremental and disruptive innovation. In our case the business development team has adopted an active citizen- or crowdsourcing perspective. They have a challenge or a problem stated by citizens as their starting point. Then they install sensors in locations where data relevant to the problem can be collected, that is, data that describe citizens' movements and behavior. The next step is to analyze the data from sensors, and thereafter visualize data and publish it in different social media to get input and suggestions from the citizens. The belief of the development team is that they first need to receive data from those who actually is affected by a problem and not only opinions from the whole crowd, and then publish visualizations of it in appropriate channels for further interactions with citizens.

This is on-going research so no data is yet collected in the second stage which involves the interaction with citizens through different social media channels. The project is still in an initial stage, where we test sensors and install them in different locations in the city. However, results so far are promising and combining IoT and social media may be one way of creating co-production of public sector services.

Our empirical study of local governments' use of social media, also shows that the communication department usually is solely responsible for the use of social media, and that they use it mainly for communication and broadcasting purposes. Using social media as a vehicle for business development or innovation is lacking among

all of our observed agencies. In a sense this is not so strange. People working in communication departments are normally communication experts working with communication. Hence, we believe that if public sector wants to go beyond broadcasting information they need to make organizational changes. Currently the communication departments are not involved either in innovation or other activities conducted in business development.

Earlier research has drawn similar conclusions, and also emphasizes the necessity of organizational changes [19, 31]. Some even propose that the public sector needs to develop new organizational roles to manage social media effectively [42]. To enhance business development units to also involve communication departments in their work or to assign new tasks to communication staff requires leadership and support from politicians and other departments in the agency [19]. It will also require comprehensive competence development for all involved actors. Communication staff in general have little knowledge about innovation and business development. Business development teams, on the other hand, are facing challenges with old-fashioned practices and legacy systems and needs to develop and adopt new practices and methods, that helps them manage the requests that comes along with the evolution and adoption of new emergent technologies, such as social media, among both citizens and employees [7].

A final remark concerns the social context in which we are using IoT and social media to create better services. A user centric or citizen centric approach to co-produce or co-create new and better services requires a holistic perspective. User-centered methods originally came from research within information systems and informatics where participatory design is one common methodology to involve the users/professionals within an organization in the design of new information systems. However, methods for co-production of public value also have to take into account the customer/citizen in the design process. A holistic approach is also necessary since the co-production approach is not a normative good [41]. We already know that too much focus on IoT sensors in the

pursuit of efficiency creates side effects that can cause safety problems, uneven distribution of work, difficulties in getting a smooth workflow, etc. An example from our initial study revealed that sensors measuring waste in dust-bins and baskets can create heavy garbage sacks which may result in repetitive strain injuries (RSI) for the cleaners.

The co-production approach also implies that the innovation process is incremental, that is, it tends to improve existing services rather than creating new, innovative services. Continuous improvements can be beneficial, but if public sector wants to create greater impact they also have to take into account radical innovation and this perspective is much less covered by user-centric design methods [38].

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