Being Smarter in the Pursuit of a Smart City

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Abstract

The purpose of this keynote paper is to stimulate new ideas and collaborative discussions. It explores ideas of what a city is before looking at lessons we can learn from the effort of others. It argues there are two dominant strategies that need to combine. These are examples of top-down and bottom-up strategies. The paper also looks at examples that argue a Dynamic Capability perspective which seems to hold promise, especially for agile development. However, all of these examples have issues and so the paper concludes a blended approach is most likely to succeed. This requires the establishment of shared services agenda between a number of cities and the partitioning of key issues in a smart city. Each municipality should target one theme before encouraging proof-of-concepts. There is also a call for municipalities to move from a reactive-transactional to a proactive-relational relationship with citizens that uses the idea of co-creation during a pilot project. This approach reduces the R&D cost for cities to become Smart Cities and is part of a transformation that will also unlock other potentialities.

Key words: Smart City, Co-Creation, Citizens, Municipality, Shared Services.

Introduction

Thank you for inviting me to be a keynote speaker at this prestigious conference.

What I plan to do in this paper is outline ideas and thoughts I believe are needed to better manage the evolution of a Smart City. Its aim is to be visionary from within a pragmatic realist stance and hopefully stimulate interesting discussions amongst conference attendees.

First we need to agree what a city is and why we see it as we do before thinking of a smart version. One only has to compare a city to a rural area to recognise an urban concentration of people in a

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geographical area is a key aspect of what a city is. This has efficiency advantages due to things like the cost of infrastructure being reduced because of close proximities (e.g. the length and cost of pipe carrying water per home). With the density of people being larger in a city it also enables new possibilities as it reduces business risks for companies bringing new solutions such as 5G. More importantly is the role a city plays in bringing new cultural memes into existence that later disperse over wider geographies; that is the city sets expectations for the wider country.

It is also important to see a city through a temporal lens with a history, its contemporary state and where it could evolve to. Here we are in St Petersburg and have an ideal case in point. Brook (2013) explained that Peter the Great influenced the design of this very city in an attempt to recreate the cutting-edge Amsterdam of its day. There was another motivation which was to use an advanced St. Petersburg to pull a then technologically backward Russia into modernization. This shows how the city has a role for the nation and is happening in various smart city attempts around the world. Furthermore, by 2050 we expect 68% of all humans will live in a city (UN, 2018), and so the challenges we see today are likely to become more pressing.

Learning from others

Attempts to provide technological solutions that make a city smarter are too many to mention but a simple Google Search of "IEEE Smart City" found over 30 million pages (search made on 28/05/2021), and that is a search from one professional society only. When we look more closely we see developments in the smart city space are typically point solutions (Woodhead et al, 2018) that target a single benefit. We argue this is because a lack of strategic guidance means an organic 'bottom up' approach is the current mode of development; companies specialising then look for cities that might buy their solution.

A key problem to better coordination of a collection of point solutions is a lack of transcending architectural standards and so synergies are inevitably harder to achieve. Koch (2018) puts forward an approach to the structuring of requirements that seem plausible but also reveals a weakness in a purely top-down logic that will inevitably end up missing some aspects. What comprises a city is simply too complex for classical top-down approaches.

There have been challenges in attempts to realise the idea of a smart city. Toronto's "Sidewalk Labs" is a great example that failed to deliver its vision primarily because of citizens' data privacy concerns

(Gray, 2018). This shows how trust between the municipality's solutions, and the citizens it purports to represent, is key to the evolution of a success smart city.

Another challenge is a static vision of what a city is can quickly become out of date. Chonga et al (2018) explore the contemporary city through the lens of Dynamic Capabilities (Teece, Pisano, & Shuen, 1997) and see three key capabilities as sense, seize and transform as they explain, "*A smart city is an urban organization with dynamic capabilities*." This fits well with agile development as opposed to the waterfall methods.

Chonga et al (ibid) also cite Dameri and Ricciardi (2015) for a more 'smart city' focused view of key capabilities as being:

> "(i) sustainability, or the ability to avoid over-exploitation of resources, (ii) robustness, or the ability to return to equilibrium after a crisis, and (iii) agility, or the ability to evolve and adapt."

This view excludes more granular requirements such as the happiness and mental health of citizens (Kamel Boulos et al, 2015). It shows how attempts to define requirements for smart city solutions will struggle to be anything other than targeting one subset of problems amongst many.

Bakici et al. (2013) argue yet another perspective and that a smart city rests on three main pillars: infrastructure, human capital, and information. This seems more relevant to technological solutions than the human needs of citizens.

We can characterise many challenges as less about technology and more about alignment, motivational and trust.

I. Some developers create point solutions but are often disconnected from a wider coordinated effort because singular goals fit the idea of what a project is, a means to achieve an outcome.
II. The motivation of unpaid developers obviously exists but needs better coordination so that duplicated effort is minimised and the way a solution works also provides potentiality for other as yet imagined solutions.
III. There is a need for coordination, but the big question is how this can be done to be motivational and promote greater levels of trust.
IV. There needs to be standards and a shared infrastructure to unlock synergies.

Potential next steps

The way forward seems to be around creating a cloud-based platform in which developers can target agreed requirements and so solution in a coordinated way. At the same time they can make data available to other developers in compliance with GDPR regulations.

The obvious beneficiary of a smarter approach to a smart city, would be the municipality. These have historically tended towards bureaucracies and with a reactive relationship to the citizens it is supposed to serve (Goldsmith and Crawford, 2014). Furthermore, this is based on transactional thinking as the citizens contribute to the cost of the municipality from forms of localised tax and grants from Central Government. With Austerity, the idea of 'value for money' meant the municipality tried to deliver services from a reduced budget and this could not be achieved. Given the cost consequences of the Covid pandemic it looks likely a new form of Austerity will emerge. We know the old model did not work in many communities, so what can we do differently and how can technology help?

The first thing to challenge is the reactive relationship the municipality has with the citizens it serves. If a citizen phones to complain their rubbish has not been removed then a job ticket is created, a council worker dispatched, the rubbish removed, and the ticket closed. Some services provided by the municipality are not well known such as providing secure housing for people suffering severe disability. How can a municipality move from reactive-transactions to proactive-relationships?

There may be a request for feedback after a service has been delivered but most times such comments do not really change a service so much as give a view of how hard those delivering the services are working. This reinforces the reactive-transactional thinking and in so doing disconnects 'processes' from 'people'.

The new possibility is a move from transactional thinking to relational thinking. Goldsmith and Crawford (2014) sum up this possibility calling for "empowered, engaged and enabled" citizens. This requires a search for new ways of working and a rethink of how the municipality and citizens get the necessary work done. Things like rubbish removal could be seen as a community issue requiring a community response. Why does rubbish only get collected on every other Wednesday? Because that is the most efficient way of organising for the municipality. The bins are left for a planned period of time to ensure they will be full. This is not really about a great service for citizens, it is about efficiency for the council trying to deliver outcomes from within constrained budgets.

Could a new approach be more efficient such as an Internet of Things solution with predictive analytics linked to a route-planning-optimisation app, so rubbish collection is linked to bins actually needing to be emptied. Could robots be tasked with emptying rubbish bins daily and taking it to a collection point so a big lorry can quickly pick up the rubbish and move it to a rubbish dump? Could the rubbish bin itself be a robot? Rather than a single solution deployed city wide, perhaps a number of solutions that help deal with the different nuances involved in rubbish collection, could be established, and a model for other services.

Collaborating Cities

In the UK, many cities are fairly close together. Could they collaborate in coordinated efforts to increase value for citizens and reduce cost? Perhaps different cities could target one issue they all face and develop a proof-of-concept project, a pilot project, and then deployment to all the municipalities. The collection of cities should agree the criteria to recognise a winning proof-of-concept as later they will be expected to accept the production version of a solution after successful completion of a pilot project; a similar model happens in the Oil Industry where one oil major becomes the lead operator and other companies become part of the decision approval process which could be adapted to fit with a single theme in a city taking the lead. Key to this is shared infrastructure and standards to enable wider deployment later.

Most of the technology to create a layered platform that addresses the needs of a city exists today. Technologies that could help include Cloud services, 4G & 5G, Blockchain, web apps, open data and so on. These technologies could innovate the way the municipality works today but that seems not to happen as part of a collaborative strategy that combines different cities. So there is a mindset that needs to be challenged and a way of coordinating efforts to be devised.

The way forward seems to be about unifying disparate parties and building a creative and shared vision of a layered model that coordinates the efforts of individual developers and companies delivering services linked to data repositories that are open to all. Immonen et al (2016) look at how requirements are defined and break the challenge into three ecosystems: business, digital and software. They then outline the process for the elicitation of requirements as:

i. Identifying responsibilities
ii. Identifying ecosystem assets
iii. Identifying requirements sources

iv. Analysing stakeholders
v. Introducing the approach and tools
vi. Eliciting the requirements

Given the scale of a city and the variance amongst types of citizen, this kind of approach is unlikely to be viable on a city-wide agenda. There is a need to break the challenge into smaller bite sized chunks but in ways that later integrate. Furthermore, rather than enter into a formal procurement process it might be wiser to allow solutions to emerge from self-organising developers within a framework of standards.

Financial incentives need to be thought through to make it easy for companies to invest in proof-of-concept solutions (i.e. Minimum Viable Products) and a process where one or more move to become a funded pilot project. This idea requires standards, so every developer brings forward projects that unlock further synergies such as making their data available to other developers. These standards could be adapted from OPC UA (https://opcfoundation.org/about/opc-technologies/opc-ua/) as is common in many Industry 4.0 ecosystems and other standards needed for each service such as a standard rubbish bin.

This is not an easy challenge given the complexity of multiple perspectives as well as the role dynamic context play in shaping requirements. Rather than a top-down approach perhaps we should learn from Nature and encourage multiple experiments so winning ideas can emerge victorious through a Darwinian selection process. An argument for bottom-up emergent solutions is also argued for by Dameri (2013). However, without some top-down logic the resultant variety of organically grown solutions will hinder other synergies, thus making the strategy sub-optimal.

The usual way for the IT Industry to model is via a multi-layered ontology, a view of things and how they connect to an analytics engine. This will quickly become too complex unless the idea of a smart city is partitioned in some way and agenda designed for such partitions that avoid a silo mentality. The complexity of trying to build a single ontology is simply because there are so many things that need to happen in a city from the level of an individual citizen in a given context to the whole city itself as a functioning entity.

So it seems obvious that we need to make explicit the design rules and standards for a longer-term grand vision of a city-wide ecosystem; a guiding star for the digital creatives to navigate towards. Furthermore, this can be broken down into partitions and a collection of collaborating cities take ownership of the delivery of the best solutions that can easily be configured for other cities. This

approach could also help the municipality to benefit from a shared services model such as all agreeing to be part of a cloud services offered by a single provider. It would also benefit from closer alignment with the open-source community as their values reduce the risk of being held hostage by a large technology company that blindly seeks only profit maximisation.

Conclusions

For a city to pursue the idea of a smart city on its own increases R&D costs and risks. A wiser strategy is to break the challenge into smaller parcels and collaborate with other cities.

To advance towards a smarter 'smart city' we need to step back and think about how we think as individuals looking at the very idea of what makes a great city. The city is a very complex phenomena with many socio-technical layers each of which interacts dynamically. To attempt a static representation is unlikely to be successful for long due to the dynamic issues each causing the need for adaptive dynamic capabilities.

What is needed is a transcending high level functional view of what work must be done to make a city great for its citizens. This high-level view then needs to become part of a smart city agenda that helps developers in a bottom-up strategy within a standardised technology framework. That is, the outcomes to be achieved are defined at a high level and solutions encouraged in an open-source approach that encourages collaboration.

This high-level view of the needed functionality (e.g. provide drinking water to all citizens or provide solutions to remove household waste etc) should be shared amongst a collection of cities so that the endeavour can be broken into more manageable chunks. This also encourages a shared services strategy amongst different municipalities where a proof-of-concept is eventually piloted and if successful deployed to collaborating cities.

The pilot project, and possibly the proof-of-concept, must include a participative co-creation approach between the municipality and its citizens to build a compelling vision for investors and inhabitants as well as identify undesirable aspects that can be mitigated in the pilot.

The move from the municipality being committed to reactive transactions to more relational actions require the distribution of power and authority through a more democratic government with open and shared information symmetry among all citizens. This also requires technological solution providers to devise ways collected data can be shared whilst complying with GDPR regulations.

Finally, we must recognise that a city is incredibly complex and abandon one dimensional strategies that are not part of a wider multi-dimensional strategy. That is, enable an "up and down" approach rather than only a top-down or only a bottom-up approach.

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