Using Actor Network Theory to analyze the success of the Amsterdam Smart City

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Introduction

     50% of the world's population currently live-in cities and that is predicted to increase to 70% by 2050. Combined with the overall population growth, urbanization will add approximately another 2.5 billion people to cities over the next thirty years (World Urbanization Prospects, 2014). This rise in city population comes with serious environmental (pollution, energy consumption), social (crime), and economic sustainability concerns that result from the overexertion of city resources. Implementing a smart city infrastructure is one solution to combat these challenges. Smart cities essentially utilize a network of connected sensors and machines that run cloud-based applications to collect, analyze, and manage data to make intelligent decisions at a city scale. Using the various data sources available across a city with information and communication technologies (ICTs), smart cities help monitor, manage and control systems across its communities including, traffic, transportation systems, utilities, air quality, waste, crime detection, schools, libraries, hospitals, and other community services ("Smart Building Technologies", 2019). Amsterdam is an example of a widely successful instance of the smart city infrastructure.

     In 2009, the Netherlands Capital city of Amsterdam launched the Amsterdam Smart City Initiative; this project aimed to fight against global warming and implement innovative smart technology into the city infrastructure. An example of a smart technology in Amsterdam can be seen with the dimmable LED lights that automatically light up and dim when bikers pass over it. Amsterdam is on track to have no CO2 emissions by 2040 (Bosch, 2018). Amsterdam's success in building a smart city led to it being ranked as the third smartest city by the IESE Cities in Motion Index. The co-author of that report, Joan Ricart, said, "A truly smart city is one that has

as its goal improving the quality of life of its residents, which means ensuring economic, social and environmental sustainability." when addressing the criteria of the ranking (Smith, 2017).

One scholar has emphasized the importance of cultivating strong citizen, economic, and technological backings in their framework for developing successful smart cities (Joshi, 2016). Another scholar uses the strategic urban planning, logistical implementation, and monitoring tactics of the smart projects by Amsterdam to be key actions needed for a successful smart city (Mora & Bolici, 2016). While both of these reasons indubitably contributed to the wide success of the Amsterdam smart city, current scholars neglect the collaborative "startup" culture of Amsterdam that propelled the innovative development of smart technologies. This "startup" culture manifested due to the fact that city data sets are open source, meaning anyone can access/add to the database; this also created more opportunities for startups to form and improve the city infrastructure. This open and collaborative mindset between the public/private sectors and citizens all contributed to the success of the smart city initiative. If we continue to think that the logistical planning and execution from the government, ICT technology, and citizen participation were solely responsible for the success of the city, then we lose understanding of how the open "startup" culture greatly contributed to the project's success and will thus be less effective in building future smart cities that benefits millions of people.

Using the Amsterdam smart city as a specific case, I will use actor-network theory (ANT) to argue that the "startup" culture of Amsterdam is the dominant actor that is the main driver of success for smart city implementations through the effectiveness of the online Amsterdam Smart City (ASC) platform in bringing relevant actors together to start projects and through the actual impact on city the startups had. I will begin by identifying the actor-networks that make up this "startup" culture and then go in depth into these actor-networks to show their relative power is

dominant with respect to the other actors in the Amsterdam smart city network. I will do this through the examination of the infrastructure of the ASC platform and its effectiveness to bring together important actors as well as through quantitative and qualitative data of how startups have been successful.

Literature Review

Few scholarly sources have investigated the "startup" culture of Amsterdam and its impact. Some scholars use the case of the Amsterdam smart city to create guides on what specific action items should be focused on for other smart city initiatives. Other scholars emphasize other important qualities like economic profitability or legal compliance in studies about ideal smart cities. I will now go through two research papers that fall under these shortcomings.

In "How to Become a Smart City: Learning from Amsterdam", Mora and Bolici sets out to explain a 5-phase roadmap to implement a successful smart city strategy based on the city of Amsterdam's own initiative. Phase 1 Starting: Three organizations, the Amsterdam Innovation Motor, energy operator Liander, and the municipal administration of Amsterdam take the lead on transforming Amsterdam into a smart city, collectively called the Amsterdam Smart City Foundation. Phase 2 Planning: The long-term vision and goals along with strategic approach are defined along with a corresponding implementation team. A procedure for the execution of smart projects and a monitoring and evaluation methodology is also defined. Phase 3 Development of Projects: Amsterdam's smart city strategy is based on the development of ICT-based projects that enable the introduction of new services, applications, machines, and technological infrastructures within the city. To select and implement projects, the foundation uses the procedure defined during the planning phase. Each potential project starts with a concept

development phase during. Ideas can be developed by the Amsterdam Smart City Foundation or initiated by outside actors (citizens, startups). If approved, the foundation identifies the most appropriate project partners and invites them to participate. Once the working team is in place, the execution of the project begins. Phase 4 Monitoring and Evaluation: The progress and results of the projects are evaluated which in turn adjusts the overall strategy if needed. Phase 5 Communication: Results and knowledge gained from the projects are communicated to the public so that more support can be garnered from citizens and potential partners for future projects. While this paper does a good job setting a roadmap with specific actions that emphasize the importance of strategic planning, it misses the mark on any discussion of how startup actors can collaborate or communicate.

In another study, "Developing Smart Cities: An Integrated Framework", Joshi describes important factors and attributes that affect a smart city initiative's success. Joshi argues that, "cities that are smart only with respect to their economy are not smart at all if they disregard the social conditions of their citizenry" (Joshi, 2016). Smart cities initiatives should be sensitive in balancing the need of various communities and should foster more aware, educated and informed citizens. Smart city initiatives should allow the citizens to participate in the governance and management of the city and become active users. This ties to the importance of governmental management, that includes attributes such as, leadership, communication, and accountability. Economic prosperity is another factor, "What truly makes a city intelligent is its capability to innovate and capitalize economically. The smart city, like all models used for economic development, supports the maximization of profits." Lastly the paper states that the underlying technology must be implemented and be on the cutting edge; for an ordinary city to transform into a "smart" city, developing cutting edge technology (notably ICT technologies) is critical.

This study does well to advance the idea of creating smart citizens, however this is only a single piece of the "startup" culture.

Mora, Bolici, and Joshi all emphasize leadership, the importance of citizen participation, and developing new ICT technology infrastructures. Mora and Bolici focus more on the strategic urban planning dimensions while Joshi touches on the economic and citizen governance factors that is absent from the first study. However, both arguments miss the value of cultivating a "startup" culture among the private, public, research, and citizens of the city in an open and collaborative way. This paper will set out to show the effectiveness of the ASC platform in organizing partners, not just citizens, to advance the city infrastructure with logistical credence. The actual startups and the resources available to them created from this culture will also be examined as those actors are responsible for many projects citizens enjoy.

Conceptual Framework

I will use Michel Callon's actor-network theory (ANT) to argue that it was the "startup" culture actor-network, fostered in Amsterdam that led the way to Amsterdam's success. Actor-network theory analyzes the relationships among human and non-human actors, which themselves are complex networks, that form a network designed to accomplish a particular goal; in this case the goal is building a successful smart city (Callon, 1987). ANT will be effective in supporting my claim due to its ability to separate and analyze the diverse heterogeneous actor-networks and their connections to the smart city and the "startup" culture. Engineers in ANT have the responsibility to recruit all the relevant actors in order for the project to succeed; this means selecting the correct non-technical actors as well. Power relations and purpose in a network is also based solely by the associations that relevant actors have with each other. Actors by themselves do not amount to much as it is the interconnection among all the relevant actors

that supports the network. To support my argument, I will first construct the actor-networks involved with the "startup" culture. Then I will analyze each using of these networks in isolation and their power relations with other important actors to show the impact the success of the city. Namely I will analyze how effective the online platform is at bringing together various diverse actors together by examining the internals of the platform and the projects created by it. I will also be looking at the success of smart startups in Amsterdam through the way they are supported and through the social and economic effects of startups.

Analysis

The success of the Amsterdam smart city network was made possible through the "startup" culture that manifested. First, I will identify the two main actor-networks that makeup this "startup" culture, the online Amsterdam Smart City platform and the startups themselves. I will then analyze each of these to show their significant impact on the city. Additionally, I will highlight how these actors form powerful associations with other relevant actors of the Amsterdam smart city including citizens, government, industry partners, ICT technology, and data.

Amsterdam Smart City Platform

A crucial actor that is associated with this culture that has helped make Amsterdam a world-leading smart city is the Amsterdam Smart City (ASC) online platform and its ability to effectively bring together many actors to facilitate efficient collaboration. The ASC brings together citizens, startups, academic institutions and government and consists of public-private partnerships that shares expertise and collaborates to come up with innovative solutions for urbanization issues (Amsterdam Smart City, 2020). One key aspect of the ASC is that it offers an open-source database of various city data sources with respect to, topographical data, traffic,

healthcare records, environment and much more. This database is easily accessible through the online portal. Often times the data produced by users of the ASC has greater value than the service offered. By making Amsterdam's city data open source, the data that is usually reserved for corporations is given back to the citizens to reinvest in new and innovative solutions to the city's problems. An impressive application made with this data is the Energy Atlas, containing all information that is required for making district-related energy plans, including energy usage and supply metrics (Pater, 2016).

Since its conception in 2009, the platform has grown a community of 400 organizations and more than 5000 individuals, including many startups; the ASC has also facilitated over 80 pilot projects aimed at improving smart infrastructure. Community members have initiated many projects including ones like Circular Amsterdam, a project aimed to reduce material waste, and City-zen, a CO2 reduction project (Bosch, 2018). Another form of collaboration through the ASC is with the collaboration between Delft University of Technology, Wageningen University, and MIT, called the Amsterdam Institute for Advanced Metropolitan Solutions (AMS). The institute consists of an intensive collaboration between the academic partners mentioned above along with various private industry partners (IBM, CISCO, Liander, KPN and Shell) (Kuyper, 2019). AMS was formed in response to requests from the city to develop smart city solutions to practical urban issues. It has various ongoing projects, analyzing how the available data for various city functions can be put to use. Wyzer is one such project that research ways to produce large-scale, geosocial data. This data is obtained from sensors, GPS devices and mobile phones. This information is more human-oriented that benefits from previously untapped forms of community information gathered from social media and open data (Leeuw, 2017).

Through the Amsterdam Smart City platform, a large number of high-quality actors can come together and collaborate on projects to support the city, with the open database facilitating application development. Amsterdam's approach to Smart Cities is clear and focused. It follows an open and collaborative approach, connecting stakeholders through their highly effective Amsterdam Smart City Platform, with the purpose of developing and implementing shared ideas and solution for the city. Amsterdam stimulates the collaboration of public and private companies, research institutions and citizens, and we have seen the projects that have resulted from this.

I will now look at a study aimed at examining digital urban innovation systems in which it uses the ASC as a case (Putra & Van der Knaap, 2018). The results of this study showed that ASC can be considered an example of a new type of urban innovation system. The results of this study on the ASC revealed that there are nine actor categories (large companies, startups, government, etc.) involved with either a one-sided or a bi-directional relationship between them in the ASC. The actors dynamically interact with each other based on their interests and resources. The use of an open web-based platform to connect actors and to exchange information in the ASC makes it such that "the information can be distributed fairly and transparently among actors." Additionally, it can reach a broad group of actors to join the innovation system through its comprehensive online portals and communication channels. With that, it seems that geographical limitations between actors to collaborate and to innovate on a specific idea do not exist and is not limited to just the Amsterdam urban area. Putra concludes, "All in all, dynamic interaction between actors facilitated by an open web-based platform can be a new way to develop innovation systems in urban areas."

Research has even indicated the innovative approach Amsterdam has taken with the infrastructure of the ASC in efficient communication and project execution. In this section, I have shown how effective the ASC platform is at cultivating cooperation among various actors resulting in each individual actor-network in the ASC obtaining much more power through these associations. I then demonstrated how some of these actors, through the power of the ASC, accomplishes wide goals for Amsterdam. The next section will go into detail about a specific actor-network that also utilizes the ASC platform.

Startups in Amsterdam

I will now proceed to analyze the impact of the startup actor-networks that have spawned from the "startup" culture of Amsterdam which I argue is the main actor for the success of the smart city initiative. I will show that the startup actor-network effectively leverages the resources available to startups to create innovative solutions. A notable actor within the "startup" network is StartupAmsterdam, which began in 2015 as a collaboration between the City of Amsterdam and 250 stakeholders (startups, large companies, incubators, accelerators, researchers) in the tech sector. The aim was to unify the startup ecosystem in Amsterdam and was to be a hub for startups, connecting them to key players like mentors, investors, tech talent, incubators, and potential customers. On the StartupAmsterdam website, you can search for jobs at startups, connect with smart city planners, find tech talent, and many activities to get you connected to the startup community. In 2016, startups in Amsterdam raised 194 million euros, which was 76% of the total funding for startups in the whole of the Netherlands (Macpherson, 2017).

Another important actor within the "startup" actor-network is Startup in Residence, a governmental incubator. Every year since its inception in 2015, the incubator evaluates the concerns of the people and creates a set of social challenges for startups to solve using city data.

With around 4000 startups in the Netherlands in 2019, collaboration between talented software developers and startups speeds up the innovation and development process considerably (Number of startups in the Netherlands in 2019, 2020). It also means that citizens can be directly involved in the future of their city giving the citizen actor-network considerably more power in relation to the city and its goals. If the solutions show a successful proof of concept, the City of Amsterdam will invest in the company or become their launching customers. Working with the government of Amsterdam then presents a unique opportunity for a startup to additionally access the support of city experts and their network.

One startup that resulted from Startup in Residence is Wyzer (mentioned above). Wyzer is a tourist centered application that aims to provide information to tourists about lesser-known spots in Amsterdam, improving their experience. The app is devoid of a map and only provides directional information so different tourists can possibly take different routes to the destination. The app uses map, GPS and tourism data, then relies on a bit of community collaboration to suggest the best places to recommend to users. The app highlights 'hidden gems' for you to discover along the way. Tourists then get a more unique experience this way and locals enjoy overall less congestion as a result.

I have provided evidence for the vast support for startups in Amsterdam that contribute to the overall infrastructure of the Amsterdam network. Support networks like StartupAmsterdam gives more power accelerators, incubators, investors, and citizens. A good example of the social good startups in Amsterdam is the Wyzer startup.

Conclusion

In this paper, I have used actor-network theory to analyze the Amsterdam smart city actor-network in order to find the dominate actor responsible for the success of the project. I

argued that it was the "startup" culture of the city that was the main driver of success as it spawned the highly effective Amsterdam Smart City online platform to enable collaboration and communication among various actors (private/public sector, industry, governmental). This culture also allowed many startups to flourish and thus add value to the city's smart infrastructure. This paper offers a newfound understanding of the importance of cultivating actors apart of this "startup" culture. Without this insight, ensuring the success of building other smart city projects would be very difficult leading to failures that are costly and prevent the benefits of smart technology from reaching the general population. Many cities can learn from the findings of this paper so they can tackle future urbanization challenges through their own smart city initiatives.

Word Count: 3159

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