

Critical Success Factors for a Smart City Strategy

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ABSTRACT

Urbanisation is forcing local governments to be more efficient with their resources. By using technology, cities can become smarter and therefore become more liveable and sustainable. Only if local governments, businesses, knowledge institutes and citizens cooperate this can be achieved. Local governments can define a smart city strategy to accomplish this. However, since all cities are unique and have their own goals, a one size fits all strategy is not an option. This paper proposes six critical success factors (CSFs) that can be used when developing a smart city strategy. These CSFs were identified by reviewing current literature on smart cities strategies and interviews with policy advisers of three smart cities within the Netherlands.

Keywords

smart city, governance, strategy, critical success factors

1. INTRODUCTION

Urbanisation is increasing as more people move towards cities. In 2014, 53 percent of the global population lived in cities and it is expected that this number will grow to 66 per cent by 2050 [27]. This creates extra demands impacting on both city resources and the environment [17]. Local governments have the task to manage these demands. Developing a smart city strategy can help cities cope with this.

Smart city is an emerging domain that is studied from different perspectives [5]. The meaning of smart city is multi-faceted [1], which makes that there is not an absolute definition of a smart city. Most literature studies give an overview of the different topics related to smart cities. Maccani, Donnellan and Helfert combined the key elements from existing literature to come to a single definition: "An urban area that leverages its technological and social infrastructure implementing people-private-public partnerships supported by an innovative governance in terms of policies, leadership and proper ongoing management principles, to enable smart information services, aiming at improving its critical capabilities." [23]. Since this definition is compatible with most literature, it will be

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An example of innovation related to smart city is the use of modern information and communication technology to monitor and control the energy production and consumption of a city [19]. This so called smart grid can help to optimise the production and use of energy. Furthermore, citizens are stimulated to think about their energy consumption.

The literature is full of frameworks by which smart cities are analysed and benchmarked. Two examples are the European Smart City Model [14] and the index of the Intelligent Community Forum [18]. These can be used by cities that are already a smart city to compare them with other smart cities. What is missing, is literature on forming and shaping a smarter city. This makes it difficult for local governments to define a smart city strategy. This paper proposes six critical success factors (CSFs) related to the process of forming a smart city strategy. By reviewing existing literature on smart city strategies and conducting interviews with Dutch Municipality officials, these CSFs are determined and validated. Local governments can in their turn use these CSFs to create a smart city strategy that fits their needs.

1.1 Problem statement

Smart cities are an opportunity for local governments to cope with the demands of urbanisation. For example, resources can be shared to create innovating ecosystems [32] and new technology can be used to monitor critical infrastructure [16]. Cities need a strategy for becoming a smarter city. However, a one size fits all strategy is not an option, since all cities differ in size, available resources and goals [26]. Cities should therefore create their own strategy based on their own needs. A list of CSFs for developing a smart city strategy can help with this. For determining these CSFs, it is important to clearly define what a smart city strategy is. The factors that form the strategy can then be explored and evaluated on importance. Another main aspect is who should be involved in creating a smarter city. The information on key stakeholder can be used as input for developing a smart city strategy.

This translates into the following research question:

What are the critical success factors for cities in determining and forming a smart city strategy?

And the following sub questions:

1. What is a smart city strategy?
2. Which key stakeholders should be involved?

Table 1. Selected smart cities

Medium sized cities	Larger cities
Eindhoven	Amsterdam
Groningen	Rotterdam
Nijmegen	the Hague
Enschede	

This paper is divided in different sections. section 2 explains the details of the research method. Section 3 shows the results of the literature review. The results of this are used as input for the interviews, which are discussed in section 4. Section 5 compares the results of the interviews with the literature review. Finally, in section 6 the results are discussed and the identified CSFs are presented.

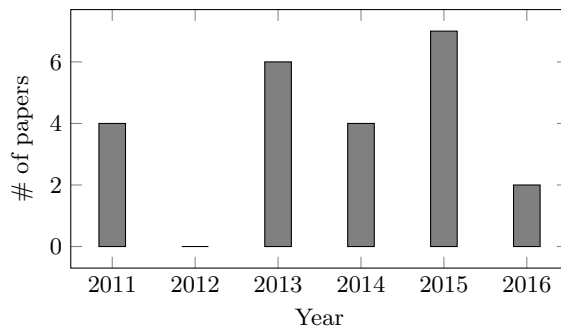
2. RESEARCH METHOD

A literature review was conducted to determine what a smart city strategy is and to explore the factors of a smart city strategy. Based on the research questions, five keywords were identified related to the topic: *smart city, governance, government, strategy* and *success factors*. These keywords were then combined into the following search key: TITLE-ABS-KEY(“smart city” AND (governance OR government OR strategy OR “success factors”)). The database Scopus was used to find relevant publications. Since this research is focussing on scientific peer-reviewed publications, the results were limited to conference papers and articles. 420 Papers were found with these criteria. The titles, abstracts and keywords of these papers were manually scanned to determine their relevance towards the research questions. This was done multiple times so that no important paper was overlooked. 21 Publications were found to be relevant for answering the research questions. Table 2 lists these papers. The publications were divided into two categories: strategy and stakeholders, depending on the topic discussed. These papers were then used for describing the relevant factors of a smart city strategy.

After the literature review, interviews were held with members of Dutch municipalities. This was done to validate if the factors described in the literature are actually used in smart cities. Therefore, it was important to conduct interviews with cities that are recognised as smart cities. Therefore, the benchmark of European Smart cities [14] was used. This benchmark is based on the model of Giffinger et al. [13] and ranks smart cities within Europe. Different versions exist of the benchmark, based on different selection criteria. These criteria are: a population size within a specific range, at least one university and a limited catchment area. For this paper version 3.0 (2014) on cities between 100 000 and 500 000 habitants and version 4.0 (2015) on cities between 300 000 and 1 million habitant were used. The Dutch smart cities found in this benchmark are listed in table 1. Three policy advisers from Enschede, Groningen and Rotterdam were willing to participate. The other cities could not be contacted within the timeframe of the research. All three policy advisers are involved in the smart city strategy of the government they work for. The interviews were semi-structured so that more in-depth knowledge could be gathered. An interview guide was made based on the factors identified during the literature review. All interviews were recorded with the permission of the interviewee. To review the interviews, full transcripts were made. These transcripts were then made publicly available online, see appendix A for the links. The interviews were then analysed and compared to each other based on the discussed topics. Direct quotes

Table 2. Selected publications

Strategy	[4] [7] [8] [10] [21]
	[22] [23] [25] [26] [29]
	[30] [33] [35]
Stakeholders	[3] [6] [15] [20] [24]
	[28] [31] [34]

**Figure 1. selected publications published each year**

were used to support the views of the policy advisers.

After analysing the interviews, the results were compared to the already identified factors from the literature review. Important factors that were mentioned in the literature as well recognised by at least two, but preferably all three interviewees were listed. These were then used answer the main research question.

3. LITERATURE REVIEW

The relevant publications are listed in table 2 . All papers are published after 2011 (see figure 1). This shows that the topic of smart city strategies has only been studied for the past few years. This makes that it is still much of an unknown field [4]. For 2016, the number of papers indicates how many papers were published before the start of this literature research. The papers are used to discuss and analyse smart city strategies and key stakeholders. The results are listed below.

3.1 Strategy

None of the papers gives a clear definition of a smart city strategy. Maccani, Donnellan and Helfert [23] describe strategy in terms of a smart city as: “With the proper technological and social infrastructure through the right organization and appropriate management, partnerships between governments, businesses and people can be enabled, and they are needed to overcome the existing gap for the actual delivery of smart services to the city’s community, and so achieve the smart city mission”. This relates to the description of Ben Letaifa [8] on strategy: “Designing and steering a common vision of the city”. To complement these two descriptions, the definition on strategy of Boddy and Paton [9] is used: “How people decide to organise major resources to enhance performance of an enterprise.” By adjusting the definition towards smart cities instead of enterprises this definition can also be used.

Angelidou [4] studied and compared the strategic choices of different local governments on the topic of smart city. The advantages and disadvantages of the identified choices were discussed and recommendations were made based on this. One recommendation is that cities should first look at what is already in place and find ways to improve this. This view is supported by Wiig [33], who states that the smart city concept should be used as an extension of

past policy-making. Lekame and Marasinghe [22] also describe optimising the utilisation of existing resources as key point in developing a smart city. The other recommendations are that cities should begin with selecting few areas that are in need of improvement and integrated project that combine digital changes with physical and institutional ones can be used to create economies of scope. Finally, some recommendation related to the stakeholders of smart cities were made as well. These are discussed in the section on stakeholders.

3.1.1 frameworks

Battle-montserrat, Blat and Abadal [7] describe the bench-learning methodology that can be used to by smart cities to evaluate themselves and identify areas that can be improved. Different benchmarks on smart cities already exist, but these are only offering the option to compare cities with each other [14, 18]. With the Bench-learning methodology, cities can learn from each other and compare their strengths and weaknesses.

Chourabi et al. [10] describe an integrative framework based on eight critical factors: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure and natural environment. The integrative framework shows the relationships between these factors. This framework can be used to examine smart city initiatives and describe the relations between the different factors.

The framework of Nam and Pardo [26] shows the process of smart city innovation. Four dimensions are identified: Technology, organisation, policy and context. Technology is described as a tool for innovation. The organisation dimension describes how innovation can be managed so that technological tools and conditions are used effectively. Policies create the enabling environment to use the tools in a smart way. The context dimension points out the uniqueness of each city and therefore the need for a unique strategy. Parts of the context are: the physical dimension, the larger environmental context and the level of interaction. This framework gives an overview for local governments to the dimensions of smart city innovation.

Zygiaris [35] describes the smart city reference model. This holistic framework has seven layers. Layer 0 is the city layer which focusses on the readiness of the city. Layer 1 or the green city layer focusses on the sustainable future of a city. Layer 2 or the interconnection layer recognises the importance of broadband connections and other forms of telecomm infrastructure. The instrumentation layer or layer 3 connects the physical world to the information world. The data from the sensors of layer 3 can then be used for the open integration layer or layer 4. Layer 5 or the application layer builds further on this to enable intelligently responsive operations. The last layer, the innovation layer Which enables for innovation and new business models. The model can be used by smart city planners for defining a conceptual layout of a smart city.

The framework of Lee, Phaal and Lee [21] shows the design for developing a smart city roadmap. The eight phases of this roadmap can be found in figure 2. The researchers identified that the strategy should be based on market demands instead of technology capabilities. This is also supported by other scholars, For instance by Nam and Pardo in the paper mentioned before, describing the technology factor as the means of a smart city instead of a end [25] or, in other words, as a tool for innovation [26]. According to Perboli et al. [30], using a technology driving approach could lead to loss of effectiveness of the used methods.

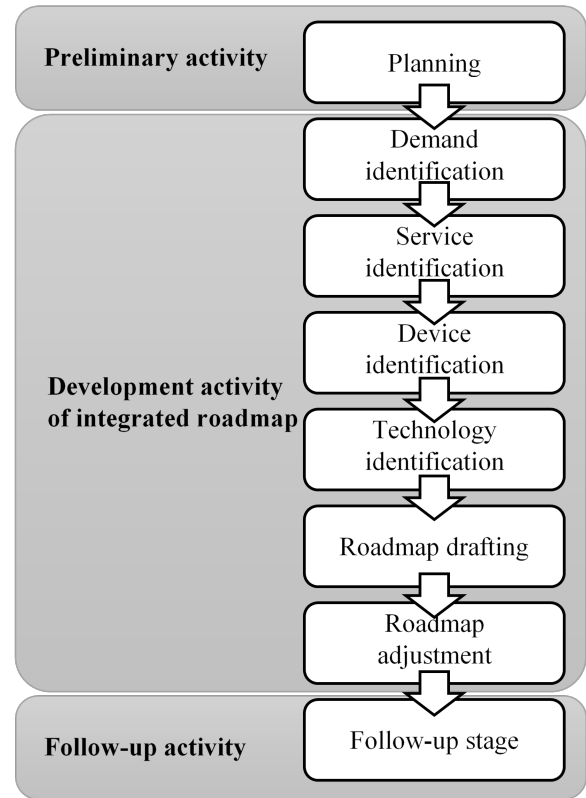


Figure 2. Technology roadmapping process for smart city development. Adapted from Lee, Phaal and lee [21]

Still most studies on smart cities focus on the technology factor [29]. Some frameworks focus on the human factor [28]. This will be further discussed in the next section on stakeholders.

Ben Letaifa [8] introduces the SMART model for strategizing smart cities. In this case, SMART stands for: Strategy, Multidisciplinarity, Appropriation, Roadmap and Technology, which are according to Ben Letaifa [8] the five main phases for city smartization. Figure 3 shows the five steps and the corresponding strategic level (Macro, Mezzo or Micro). The last step is the identification of the required technology. This framework can be used by local governments to transform their city into a smarter city.

3.2 Stakeholders

According to Marsal-Llacuna [24], A smart city can be seen as: “a participatory arena for local governments and all interested stakeholders (including citizens) to co-create communities”. The definition of Maccani, Donnellan and Helfert [23] describes people-private-public partnerships and an innovative government as important factors of a smart city. Schaffers et al. [31] describe a smart city as: “environments of open and user-driven innovation for experimenting Future Internet-enabled services”. Oliveira and Campolargo [28] also recognise the importance of humans in smart cities: “people rather than technology are the true actors of the urban ‘smartness’”.

The relations between different stakeholders in a traditional cities is often described as the triple helix [12]. In this model university, industry and government are mentioned as key stakeholders. For smart cities, this model is missing the citizen as important stakeholder. Alizadeh [2]

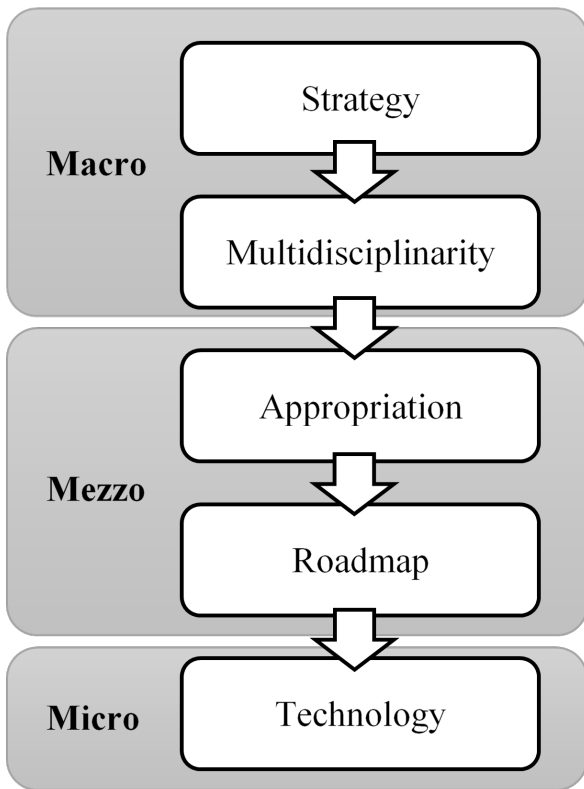


Figure 3. The SMART Model. Adapted from Ben Letaifa [8]

therefore included the citizen, forming the quadruple helix model. This model has been used by the same author and Sipe to describe the stakeholders in the case of smart city Brisbane [3].

In smart cities, living labs can be used to connect the different stakeholders. For example, in the case of Barcelona [6] different living labs were used for user innovation and research on new technologies and services of organisations. Zurita, Pino and Baloian [34] describe the use of a smart community application in which citizens can discuss issues relevant to the community. According to Chourabi et al., citizens should also be referred to as communities and groups, not only as individuals.

Governments have a key role in smart city initiatives by bringing resources and stakeholders together [20]. According to Lekame and Marasinghe [22], smart cities should include government-led initiatives in collaboration with the private sector. Angelidou [4] describe the engagement with stakeholders as crucial. small pilot project can be used to encourage citizens participation and create awareness. These projects should however be part of a strategic plan to create synergies among the projects. Granier and Kudo [15] Studied the involvement of citizens in the case of Japanese cities. In a project on smart grids Japanese government officials were pushing citizens to engage in a smart grid project. The smart community was not used to involve citizens but rather to have them participate for the co-production of energy. Governments should avoid this.

4. RESULTS

This section shows the results of the interviews held with three policy advisers of the cities: Enschede, Groningen

and Rotterdam. The results are ordered based on the topics that were identified from the literature review and used as input for the interview: The definition of a smart city, smart city projects, stakeholders, strategy and vision.

4.1 Definition of a smart city

All three municipalities identify themselves as smart cities. However, there are some differences in their definition of a smart city.

Enschede describes being a smart city as: “making the city smarter, with smart people and doing things smarter as a government”. The key questions on the topic for this municipality are: “How can we make better use of the already available data?” and “How can we use technology better?”. The answers to the questions can be used for monitoring, improving the smart city experience of the citizens, and creating policies.

The policy adviser of Groningen describes a smart city as: “a city that is focussing on making the living environment smarter, safer or more fun”. According to the policy adviser, this basically the development of the infrastructure, something that is an ongoing process which started in the past. Creating a modern city with modern technology could be seen as smart, but “if no one wants to live there since it it feels cold and inhumane, should that be regarded as a smart city?”. According to the interviewee; “There are many dimensions [to a smart city].”

Rotterdam is looking for ways to make the city future proof, focussing on the resilience of the city. “A smart city is forward-looking, ready for the future and can move with the already ongoing developments.” However, the city does not have a single definition for smart city. “Smart city does not necessarily have a digital nature. It could also be about citizens’ initiatives, often with the use of technology”.

4.2 Smart city projects

The municipalities all have their own focus area. First of all, Enschede is focussing on the use of big data. They describe their challenge as: “How can we use the already available data in a better, more smarter way for creating policies?”. Another project is focusing on the city center that is used as a living lab in cooperation with a local knowledge institute.

Groningen is interested in the field of energy, specifically smart grids. One pilot study called PowerMatching city involved 42 households that were connected to a smart grid. In this living lab setting, citizens, government, researchers and businesses cooperated. This project did not only focus on the use of technology, but also on laws and regulations involving smart grids. For example, currently, it is not permitted to sell your extra energy to a neighbour. Therefore, questions like: “What is needed in terms of laws and regulations to make it possible to sell energy to your neighbours?” were also discussed. With these kind of projects, the city of Groningen is trying to become a host for lighthouse projects on smart grids within Europe. Other smaller project in Groningen are focussing on using technology to improve the infrastructure. An example of this are the traffic lights in the city that give preference to cyclists when it rains. Thus, allowing cyclist to get to their destination faster when it rains.

Rotterdam is more focussed on creating a future proof and liveable city in terms of living, recreation and work. According to the interviewee, their main focus is resilience: “A city is nothing more than a meeting place for residents, businesses, visitors and knowledge institutes who

found each other. The city should facilitate this now and in the future. With the help of technology this can only be done better.” Examples of this are present in the form of innovative projects. A part of the harbour that is no longer used as docking area is now designated as innovation district. Businesses can use this area to develop new business models. Companies that use new technologies like 3d printing and drones, but also smaller community based projects are settled here. Rotterdam also has some smaller projects like solving parking problems by directing visitors to an empty indoor parking place.

4.3 Stakeholders

Local government, knowledge institutes, businesses and citizens are all recognised as stakeholders of the smart city projects. Most projects are developed with a top-down approach, meaning that the municipality establishes and governs the project. Local knowledge institutes are involved most of the times. Local businesses help to develop the projects.

In Enschede, working together with large companies is mostly avoided, since this could lead to a vendor lock-in. Instead, local businesses are approached. According to the interviewee, the municipality is now working on shifting towards a bottom-up approach, starting with small projects from the community. “There are entrepreneurs and citizens working on this. Our quest is: how can we make the transition in means of communication to activate these people?”

Smart city projects in Groningen start from the municipality itself. Businesses that are able to contribute to the project are asked to join. For example, within the smart grid project, a company that specialised in the technology side of smart grids, the grid operator and other small parties like ICT companies joined. “Every company delivers a building block that together completes the project.” Knowledge institutes are not yet fully involved in these projects, but this is something the municipality is currently looking into. Organisations like Energy Academy Europe and the local universities are already dedicating parts of their education towards the topic of energy transition. Citizens are mostly involved in a later stage of the project, but the innovation is still user centred: “As a local government you should look at where your innovation strength lies and which project you can start with that. However, these projects should be of use for the end user and he or she should be sitting at the controls.”

The city of Rotterdam also collaborates with businesses and knowledge institutes. Citizens are involved but harder to reach. “Businesses and knowledge institutes are obviously better organised [than citizens], so it is easier to work together with them.” Citizens are mostly reached on neighbourhood level as a group, instead of individually.

4.4 Strategy

Enschede is profiling itself as a smart city. “We are focussing on this topic and we recognise the importance. We make room for it and act on this topic. We are by any means planning on providing more open data.” An example of this is the cooperation with the German city Heidelberg and the American city Palo Alto. Furthermore, the municipality is part of different platforms on smart city strategies like the open & agile smart cities initiative. The interviewee did explore the subject of smart city and what it can do for the city. However, a smart city strategy is not defined in the policies. Also, the budget for smart cities is relatively small. Instead, investments are made as part of

the ongoing maintenance and replacement programs: “Investments are always needed within cities, Whether these are new street lights, asphalt or traffic lights, this is needed at a certain point in time. If you think smartly on those moments about what you want and what is possible, you can invest in new technology that might not be needed now, but that can be uses in the near future.”

Groningen does have a formal strategy on smart cities, however this is not documented or used by the whole municipality. “We do not have a department of smart city. [...] Our smart city policy is part of the policy of the department of economic affairs, in a broad sense, to stimulate innovation.” This means that the strategy is only used by the department of ‘knowledge economy & innovation’ (in Dutch: Kenniseconomie & innovatie) which is part of economic affairs. This department has an advising role and also aims at maintaining and building a strategic network in the region as well as international so that new knowledge intensive and innovative projects can be started. An example of this is the smart grid project. The smaller projects, like the smart traffic lights, are more or less part of ongoing innovation within the departments themselves. This also means that the budgets of these projects are part of the ongoing investments.

Rotterdam neither has a documented policy on smart city strategy. “Rotterdam does not have a strategy adopted by the executive board [in Dutch: college van burgemeester en wethouders], but it is more a movement for which we have a number of focus areas. Furthermore, we have a few projects in different stages of development.”

4.5 Vision

Enschede currently does not have a detailed vision on smart city. The interviewee mentioned that a something what could be called a vision was defined, but this is not really useful according to the interviewee: “from the moment you write down your vision it is obsolete”. For now they want to focus on participating citizens. Knowledge centres and businesses: “We want to give space to companies to do things, create a living lab environment. Not only for knowledge institutes, but also for businesses, to make things happen that cannot be done easily at other places.”

Groningen is working on defining a vision on smart city for the whole government. Their smart city vision as part of the innovation department is communicated to the outside world as: Groningen smart users’ city. An information folder and website [11] show information of innovation within the city of Groningen. The topics mentioned are: smart energy systems, smart healthy ageing and smart facilities. The user has a central role in the described projects.

Rotterdam is collaborating in the Metropolitan region Rotterdam-The Hague on the roadmap next economy. In this programme, 23 municipalities, businesses, knowledge institutes and social organisations from within the region work together on creating a roadmap to cope with technological developments and environmental sustainability. Rotterdam itself does not have a complete roadmap. “We have a spot on the horizon, like the roadmap next economy. There are some goals presented in this work, which lead to concrete projects. But we also realize that some developments are fast and others are slow. This means that you have to make adjustments along the way.”

5. ANALYSIS

5.1 Strategy

As with the definition of smart city, smart city strategy is also not well defined in the literature. Also none of the municipalities formally documented a strategy on smart cities.

The literature acknowledges the need for technology as a means instead of an end [8, 21, 25, 26, 30]. This also comes forward from the interviews. All the projects of the different cities are user centred. Technology is used as a tool for creating a smarter city instead of as the end goal.

Another point that stood out from the literature is the context of the smart city projects. Smart cities should build on what is already in place, building further on past policies. Smart city concepts can be used to improve those areas in need that can use improvement. This also came forward during the interviews. Each city has its own area of expertise on which they focus. By building on existing knowledge and policies these areas are improved.

There are different frameworks available that could be used within a smart city. All frameworks have their own specific capabilities. Some frameworks can be used as input for a smart city strategy [7, 10, 26, 35], while other frameworks describe the process of forming a smart city [21, 8]. None of the interviewed cities used a framework on smart city, although the city of Rotterdam is working on a roadmap for smart city.

5.2 Stakeholders

The key stakeholders already identified in the literature review also appear within the three cities. Not all stakeholders are equally involved. All cities have projects that started from a top-down approach in which businesses and knowledge institutes are involved first. In a later stage the citizens are also involved. However, there are some examples that show that a bottom-up approach is also applied. The city of Enschede is now working on activating people and the city of Groningen brings smart facilities to enable citizens to create and innovate [18]. The city of Rotterdam offers a specific area in which businesses and communities are encouraged to develop innovative solutions. Both strategies seem to be contributing towards a smarter city.

6. DISCUSSION

The first sub question asked for what a smart city strategy is. The results show that there are definitions in the literature recognised by multiple scholars. Also none of the cities have a formally defined strategy. However, the interviews show that cities are working on developing such a strategy. A smart city strategy should define how cities use their resources towards their vision [8] or in other words to achieve the smart city mission [23]. Therefore, it is important for cities to have a vision on how their smart city should look like. Therefore, the first identified CSF is:

CSF1: *Define a clear vision*

Both the literature review as well as the results of the interview show that technology should be used as a tool. The citizens or communities are the central topic in smart cities. The human factor is what makes a smart city smart. Citizens can participate in communities to make the city more liveable and more future proof with the use of technology. Hence the CSF:

CSF2: *Focus on humans instead of technology*

All three cities focus on specific areas. The literature also

clearly defines that cities should built further on what is already in place. This past knowledge can be used to innovate. Part of this is the uniqueness of each city. All cities have their own strengths and weaknesses. Identifying these will contribute to a stronger smart city strategy.

CSF3: *Focus on a specific topic*

None of the cities formally defined a smart city strategy. The projects are mostly part of a specific department of the city. Smaller project are part of the ongoing innovation and are the responsibility of the departments themselves. If a department does not see the need for smart city innovation, opportunities could be missed. All cities define themselves as smart cities, but in reality only a part the local government is working on innovative projects. A city wide smart city strategy prevents this and will make these smaller project also contribute to the central topic.

CSF4: *Develop a city wide smart strategy*

All three cities are currently working on defining a city wide smart strategy. Translating the current projects into a strategy can be difficult. Different aspects need to be taken care of and without proper guidelines this could become a tedious and long process. A framework like that of Ben Letaifa [8] help local governments to develop a strategy. Such a framework orders the steps and gives a structure to the strategy, which reinforces the strategy.

CSF5: *Make use of a smart city strategy framework*

The second sub question focussed on the stakeholders that should be involved. Both the literature and the results clearly show that Local government, businesses, knowledge institutes and citizens should work together. All stakeholders have their own role. The local governments bring resources and stakeholders together and thereby have an organising role. Businesses make the innovation possible by delivering the needed technology. Knowledge institutes have an innovative role by research and develop the needed technology. Citizens do not only give feedback, but also actively participate in smart city projects and are mostly organised in communities.

CSF6: *Bring Local government, businesses, knowledge institutes and citizens together*

Limitations

There are a few limitations to this research. First of all, only policy advisers were interviewed. Only their view on the smart city was considered. Other departments could have another interpretation on how they see the smart city. However, all three interviewees were asked if other departments were involved in the smart city process. Other than the ongoing investments this was not the case. Second, all three cities are Dutch cities and therefore the CSFs are based on how Dutch municipalities work. The results are not necessarily applicable to cities in other nations. Third, the results are limited to the situation of only three cities, two small and one large. Other cities could possibly have other approaches that also work. However, the goal of this paper was not to generalise but rather to identify CSFs.

7. CONCLUSION

This paper started with explaining the need for CSFs for local governments in developing a smart city strategy for their unique situation. In answering the sub questions, different aspects came to light. Although the literature on the topic is still in a developing stage, different success factors could be determined. Interviews with the policy advisers gave insight from the viewpoint of local govern-

ments resulting in six CSFs. The first five specifically focus on forming the strategy and the last one on the identified stakeholders. The next step for local governments is to use these CSFs in developing their own smart city strategy.

Further research on smart city strategies is needed to help local governments to define a smart city strategy. The CSFs proposed in this research could be validated against other cities and possibly more CSFs could be identified.

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9. REFERENCES

- [1] V. Albino, U. Berardi, and R. M. Dangelico. Smart Cities: Definitions, Dimensions, Performance, and Initiatives. *Journal of Urban Technology*, 22(1):3–21, 2015.
- [2] T. Alizadeh. The interaction between local and regional knowledge-based development: Towards a Quadruple Helix model. In *Knowledge-Based Development for Cities and Societies: Integrated Multi-Level approaches*, number June, pages 81–98. 2010.
- [3] T. Alizadeh and N. Sipe. Brisbane’s digital strategy: an economic strategy for the digital age? *Australian Planner*, 52(1):35–41, 2015.
- [4] M. Angelidou. Smart city policies: A spatial approach. *Cities*, 41:S3–S11, 2014.
- [5] L. G. Anthopoulos and C. G. Reddick. Understanding electronic government research and smart city: A framework and empirical evidence. *Information Polity*, 21(1):99–117, 2016.
- [6] T. Bakici, E. Almirall, and J. Wareham. A Smart City Initiative: The Case of Barcelona. *Journal of the Knowledge Economy*, 4(2):135–148, 2013.
- [7] J. Battle-montserrat, J. Blat, and E. Abadal. Local e-government Benchlearning : Impact analysis and applicability to smart cities benchmarking. *Information Polity*, 21:43–59, 2016.
- [8] S. Ben Letaifa. How to strategize smart cities: Revealing the SMART model. *Journal of Business Research*, 68(7):1414–1419, 2015.
- [9] D. Boddy and Paton;Steve. *Management An Introduction*. Pearson, 5th edition, 2011.
- [10] H. Chourabi, T. Nam, S. Walker, J. R. Gil-Garcia, S. Mellouli, K. Nahon, T. A. Pardo, and H. J. Scholl. Understanding smart cities: An integrative framework. *Proceedings of the Annual Hawaii International Conference on System Sciences*, pages 2289–2297, 2011.
- [11] City of Talent. Smart facilities - city of talent. Accessed: 10 April 2016.
- [12] H. Etzkowitz. Studies of science Etudes sur la science Innovation in innovation : the Triple Helix of university - industry - government relations. *Social Science Information*, 42(3):293–337, 2003.
- [13] R. Giffinger, C. Fertner, H. Kramar, R. Kalasek, N. Pichler-Milanović, and E. Meijers. Smart cities Ranking of European medium-sized cities. *October*, 16(October):13–18, 2007.
- [14] R. Giffinger, H. Kramar, G. Haindlmaier, and F. Strohmayer. European smart cities. <http://www.smart-cities.eu/>. Accessed: 15 June 2016.
- [15] B. Granier and H. Kudo. How are citizens involved in smart cities? Analysing citizen participation in Japanese ”Smart Communities”. *Information Polity*, Preprint(Preprint):1–16, 2016.
- [16] R. E. Hall, B. Bowerman, J. Braverman, J. Taylor, and H. Todosow. The vision of a smart city. *2nd International Life . . .*, page 7, 2000.
- [17] G. Haughton. Developing sustainable urban development models. *Cities*, 14(4):189–195, 8 1997.
- [18] Intelligent Community Forum. <http://www.intelligentcommunity.org/>. Accessed: 15 June 2016.
- [19] S. Karnouskos. Demand Side Management via prosumer interactions in a smart city energy marketplace. *IEEE PES Innovative Smart Grid Technologies Conference Europe*, pages 1–7, 2011.
- [20] S. Kraus, C. Richter, S. Papagiannidis, and S. Durst. Innovating and Exploiting Entrepreneurial Opportunities in Smart Cities: Evidence from Germany. *Creativity and Innovation Management*, 24(4):601–616, 2015.
- [21] J. H. Lee, R. Phaal, and S. H. Lee. An integrated service-device-technology roadmap for smart city development. *Technological Forecasting and Social Change*, 80(2):286–306, 2013.
- [22] S. Lekamge and A. Marasinghe. Developing a smart city model that ensures the optimum utilization of existing resources in cities of all sizes. *Proceedings - 2013 International Conference on Biometrics and Kansei Engineering, ICBAKE 2013*, pages 202–207, 2013.
- [23] G. Maccani, B. Donnellan, and M. Helfert. A Comprehensive Framework for Smart Cities. *Proceedings of the 2nd International Conference on Smart Grids and Green IT Systems*, pages 53–63, 2013.
- [24] M.-L. Marsal-Llacuna. Conceptualizing, Modeling and Simulating Sustainability as Tools to Implement Urban Smartness. In O. Gervasi, B. Murgante, S. Misra, M. L. Gavrilova, A. M. A. C. Rocha, C. Torre, D. Taniar, and B. O. Apduhan, editors, *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, volume 9157 of *Lecture Notes in Computer Science*, pages 477–494. Springer International Publishing, Cham, 2015.
- [25] T. Nam and T. a. Pardo. Conceptualizing smart city with dimensions of technology, people, and institutions. *Proceedings of the 12th Annual International Digital Government Research Conference on Digital Government Innovation in Challenging Times - dg.o ’11*, page 282, 2011.
- [26] T. Nam and T. a. Pardo. Smart city as urban innovation. *Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance - ICEGOV ’11*, page 185, 2011.
- [27] U. Nations. *World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352)*. 2014.
- [28] I. Oliveira and M. Campolargo. From smart cities to human smart cities. *Proceedings of the Annual Hawaii International Conference on System*

- Sciences*, 2015-March:2336–2344, 2015.
- [29] S. Paroutis, M. Bennett, and L. Heracleous. A strategic view on smart city technology: The case of IBM Smarter Cities during a recession. *Technological Forecasting and Social Change*, 89:262–272, 2014.
- [30] G. Perboli, A. De Marco, F. Perfetti, and M. Marone. A New Taxonomy of Smart City Projects. *Transportation Research Procedia*, 3(July):470–478, 2014.
- [31] H. Schaffers, N. Komninou, M. Pallot, B. Trousse, M. Nilsson, and A. Oliveira. Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation. volume 6656, pages 431–446. 2011.
- [32] H. Schaffers, A. Sallstrom, M. Pallot, J. M. Hernandez-Munoz, R. Santoro, B. Trousse, J. Domingue, A. Galis, A. Gavras, T. Zahariadis, D. Lambert, F. Cleary, P. Daras, S. Krco, H. Müller, M.-S. Li, and others. *The Future Internet-Future Internet Assembly 2011: Achievements and Technological Promises*. 2011.
- [33] A. Wiig. IBM’s smart city as techno-utopian policy mobility. *City*, 19(2-3):258–273, 2015.
- [34] G. Zurita, J. A. Pino, and N. Baloian. Supporting Smart Community Decision Making for Self-governance with Multiple Views. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, volume 9454, pages 134–143. 2015.
- [35] S. Zygiaris. Smart City Reference Model: Assisting Planners to Conceptualize the Building of Smart City Innovation Ecosystems. *Journal of the Knowledge Economy*, 4(2):217–231, 2013.

APPENDIX

A. TRANSCRIPTS

The transcripts of the interviews (in Dutch) are published online and can be found on the following pages:

For the interview with the policy advisor of Enschede:
<http://tinyurl.com/hscwwz8>

For the interview with the policy advisor of Groningen:
<http://tinyurl.com/hw8styx>

For the interview with the policy advisor of Rotterdam:
<http://tinyurl.com/jcj9wvp>