SMART CITY

GUIDE TO THE IMPLEMENTATION OF SMART CITY INITIATIVES IN SWITZERLAND

swiss energy
Our commitment: our future.

(Source: Tollkirsch/ELEKTRON AG, Wädenswil)

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ABBREVIATIONS

- AI: Artificial intelligence
- CDO: Chief digital officer
- CHF: Swiss francs
- ICT: Information and communication technology
- IoT: Internet of Things
- ITU: International Telecommunication Union
- LoRa: Long Range
- NGO: Non-governmental organisation
- PPP: Public-private partnership
- SCI: Smart City initiative
- SFOE: Swiss Federal Office of Energy
- SWOT: Strengths, weaknesses, opportunities, threats
- ZHAW: Zurich University of Applied Sciences

FOREWORD

ON THE WAY TO THE SMART CITY

Two thirds of the population in Switzerland now live in urban areas, and this proportion is growing. Cities are booming, and the urbanisation of society continues to advance. The diverse education, leisure, and work opportunities offered in big cities are the dynamic drivers of social and economic innovation

Some of Switzerland's challenges are manifesting themselves faster and more strongly in the cities, which are pioneering solutions to these challenges for the rest of Switzerland. Climate change calls for measures to be taken; electricity, cooling and heating requirements are to be met exclusively by renewable energies in the foreseeable future, with the aim of zero CO_2 emissions by 2050. Mobility is a constant source of conflict and new forms of mobility must be integrated into urban life. Other challenges are the scarcity of space due to constant population growth, the handling of digitalisation and the restructuring of the economy, to name a few.

How should cities deal with these challenges? With a certain delay, the Smart City concept with its holistic approach to innovative, resource-saving and liveable cities has also gained momentum in Switzerland in recent years. A Smart City is based on the networking of the various subject areas, bringing together different players, involving residents in processes and positioning itself as a driver of urban innovation. Its ultimate goal is to make cities and municipalities more liveable, sustainable and attractive.

The majority of large cities have launched initiatives and developed strategies that have put them on their way to becoming Smart Cities. While numerous medium-sized cities want to follow this path, their limited human and financial resources make this particularly difficult.

This guide is not only aimed at these smaller cities, but also at interested persons from politics, administration and civil society. It is intended to facilitate their introduction to the topic of Smart Cities and serve as an orientation guide. It summarises previous findings, provides information, makes suggestions for action and aims to help people approach the topic efficiently and successfully by guiding the first concrete steps.

For SwissEnergy, the cities and municipalities are important drivers for achieving the goals of the Energy Strategy 2050. Smart Cities make a significant contribution to the promotion of renewable energies and energy efficiency in conjunction with other issues and through cooperation between civil society, companies and the administration.

This guide is intended to make a significant contribution to this.

Patrick Kutschera
Managing Director SwissEnergy

Source: *LG Öffentlichkeitsarbeit*, City of Uster

1 EXECUTIVE SUMMARY

Challenges such as the digitalisation of public administration, the impact of urbanisation on towns and cities, climate change and the remodelling of energy and mobility infrastructure systems require us to rethink the current approach to urban development. Thanks to the Smart City concept, cities can address these challenges using an integrated and inter-departmental development approach, in a network of partners and with the support of digital technologies. In Switzerland, the Smart City concept is understood as being much more than internal e-government and digitalisation strategies. The overarching goal is to develop efficient and resource-friendly solutions while enhancing quality of life and site attractiveness. Overall, the aim is to build an innovative urban environment that integrates residents and businesses and allows for new design possibilities.

For most small and mid-sized cities and municipalities in Switzerland, the introduction to the Smart City theme proves to be challenging. While pioneer cities have gained some experience of Smart City implementation in the past few years, most small and mid-sized towns need proper support. This guide was produced in cooperation with an advisory group at the request of the Swiss Federal Office of Energy (SFOE) and SwissEnergy to serve this purpose precisely. The guide presents and discusses various steps, tools, options and practical examples for the implementation of Smart Cities, from which interested towns can choose according to their needs. It does not only summarise the literature on pioneering cities and the lessons learned, it also enables cities and municipalities to develop their own understanding of what it means to be "smart" – and corresponding measures of Smart City implementation.

The anticipated challenges and the steps, tools and measures introduced in this guide are based on a three-phase development model consisting of a pilot project, an institutionalisation and a consolidation phase. During the pilot project phase, the various departments gain experience by carrying out Smart City projects. This guide helps cities develop, select and implement project ideas. After having gone through the pilot project phase, many cities move on to institutionalisation, during which they seek to implement the Smart City concept by developing an overarching strategy and setting up a corresponding organisational structure. For this phase, the guide presents steps, options and tools for the development of a prioritised project portfolio, a Smart City organisation and strategy.

Consolidation, which is usually gradual, is characterised by an operational organisation. The Smart City concept is actively incorporated into the administrative procedures and user routines of municipal services and embedded in all fields of action. Investments are made in digital infrastructure. Further measures are implemented in fields such as communication, (continuing) education/training and data security. The guide presents long-term implementation strategies and distinguishes between a technological and a project-oriented approach. The former is high-risk and results in fast, radical change. The latter tends to be longer-term and changes the city by means of many individual projects.

The three development phases also differ in terms of the management skills required to carry out the Smart City process. While at the outset it is above all project management and organisational development skills that are important, over the long-term the process will also require change management competencies in order to consolidate the Smart City approach successfully.

Source: City of Zug

2 THE SMART CITY – AN INTRODUCTION

2.1 REASONS FOR THIS SMART CITY GUIDE

To date, only a few, mostly larger Swiss cities, have implemented a Smart City concept. However, other interested cities and municipalities should be able to join them by starting projects and initiating a suitable process for the transition to a Smart City. Digital transformations will affect how city administrations are organised and will create space for new opportunities (eg. implementing apps, the Internet of Things (IoT), sensors and artificial intelligence (AI) to facilitate processes).

The aim of this guide is to give cities and municipalities a tool that: (a) enables them to enter the various phases of the Smart City process quickly; (b) provides an overview of steps, methods, strategies and options; and (c) illustrates the transformation process through a comprehensive collection of material and examples. The guide is thus intended for the following target groups:

- politicians seeking a gateway to the Smart City world;
- municipal administrations seeking to implement Smart City projects or having been given a remit to develop a Smart City strategy;
- municipal enterprises and institutions, such as municipal utilities, public transport companies and retirement homes, seeking to digitalise;
- consultants and the interested general public wishing to be part of and understand the Smart City process.

This guide is based on the existing literature on Smart Cities and urban development. It draws on an analysis of various case studies in Europe, in particular Switzerland, Germany and Austria, to develop possible steps and processes.

2.2 THE SMART CITY CONCEPT

Numerous definitions already exist for Smart Cities. Many are fundamentally similar but focus on different areas.[1] Every city has to develop its own understanding and define its own Smart City fields of action.[2] This guide, therefore, does not provide a conclusive definition; instead, it focuses on the thought and other processes related to the development of a Smart City.

In a Smart City,

- … all stakeholders are involved in the development process so that the solutions found meet genuine needs and are shared by all.
- … interdisciplinary and inter-departmental cooperation to reshape processes and services are promoted, and existing departmental and management structures (the so-called administrative silos) are broken down, with a view to developing the most integrated and synergetic solutions possible.
- … digital technologies are used effectively for the purpose of performing municipal tasks and responding to residents' concerns and needs.
- … innovation is promoted through cooperation with external partners and a culture that uses open communication and constructive criticism to deal with errors.

[1] Neumann, O. & Portmann, E. (2017). Smart Cities: Lösungsansätze für die Städte der Zukunft. Innovative Verwaltung. 39(5). 8–12.
[2] Carabias, V. et al. (2016). Treiber und Barrieren auf dem Weg zu einer Smart City. Erkenntnisse aus Theorie und Praxis. Energy Governance Working Paper Nr. 7. Retrieved on 4. July 2019 from: https://doi.org/10.21256/zhaw-1052.

Urban challenges and modern technological possibilities engender the following fields of action typical for Smart Cities, as shown in Boyd Cohen's Smart City Wheel (and adapted in SwissEnergy (2019)[3]; see Figure 1):

Smart Energy and Environment: resource- and environmentally friendly development of urban areas (buildings, public spaces, infrastructure systems), promotion of renewable energies and exploitation of potential synergies

Smart Economy: development of an innovative, resource-friendly and open business system in which the emphasis is on networks, cooperation, the circular economy and flexible working arrangements

Smart Living: provision of a collaborative, safe and healthy living built on accessibility and equality of opportunity

Smart Mobility: introduction of clean mobility and logistics, promotion of efficient means of transport, intermodality and sharing concepts

Smart People: use and promotion of residents' resources and development of "lifelong learning", participation, community integration and openness to creativity

Smart Government: intelligent, needs-oriented and transparent steering of municipal administrative processes and infrastructure.

While it is an advantage if the Smart City (core) team has a shared understanding of the Smart City concept, it is even more important to select and prioritise fields of action.

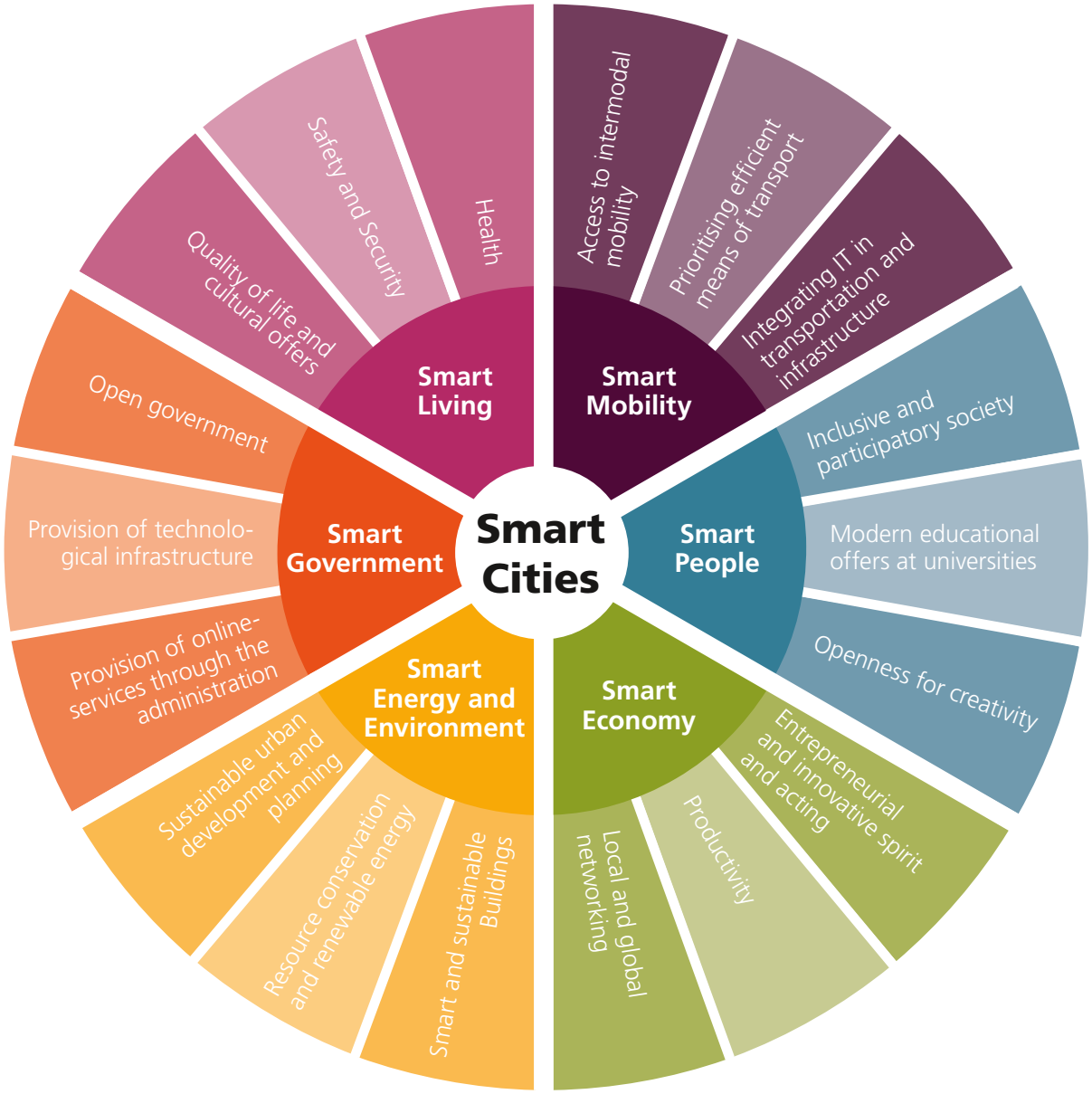

Figure 1. The SFOE's Smart City wheel (SwissEnergy, 2019)[4]

[3 and 4] EnergieSchweiz (2018). Smart City Wheel taken from Merkblatt für Projektanten Smart City Innovation Award 2019. Retrieved on 4. July 2019 von: www.local-energy.swiss/programme/smart-city.html.

2.3 SMART CITY DEVELOPMENT PHASES

Path to a Smart City can vary widely from one town to another. The Smart City development model depicted in Figure 2 consists of three phases and enables cities to position themselves in the Smart City process.

- **Pilot project phase:** During this phase, the city carries out initial pilot projects that are not coordinated. These pilot projects are often implemented by different administrative entities (e.g., the municipal utilities, IT unit or environmental authority). While provisions for a coordinating group for Smart City projects may have been made, such a body does not usually exist at this point.
- **Institutionalisation phase:** During this phase, Smart City activities are coordinated and institutionalised. In addition to adopting various steering tools, such as a Smart City strategy or vision, the city will create new vacancies and establish some form of organisation.
- **Consolidation phase:** During this phase, the Smart City organisation becomes operational, and the Smart City concept is mainstreamed into administrative processes and culture, and embedded in all sectors of municipal activity. In addition to engaging in project management, the city invests in digital infrastructure and implements accompanying measures in the areas of communication, (continuing) education/training and data security. In order to anchor the Smart City approach in the city, broader change and transition management is required (Description of change and transition management).

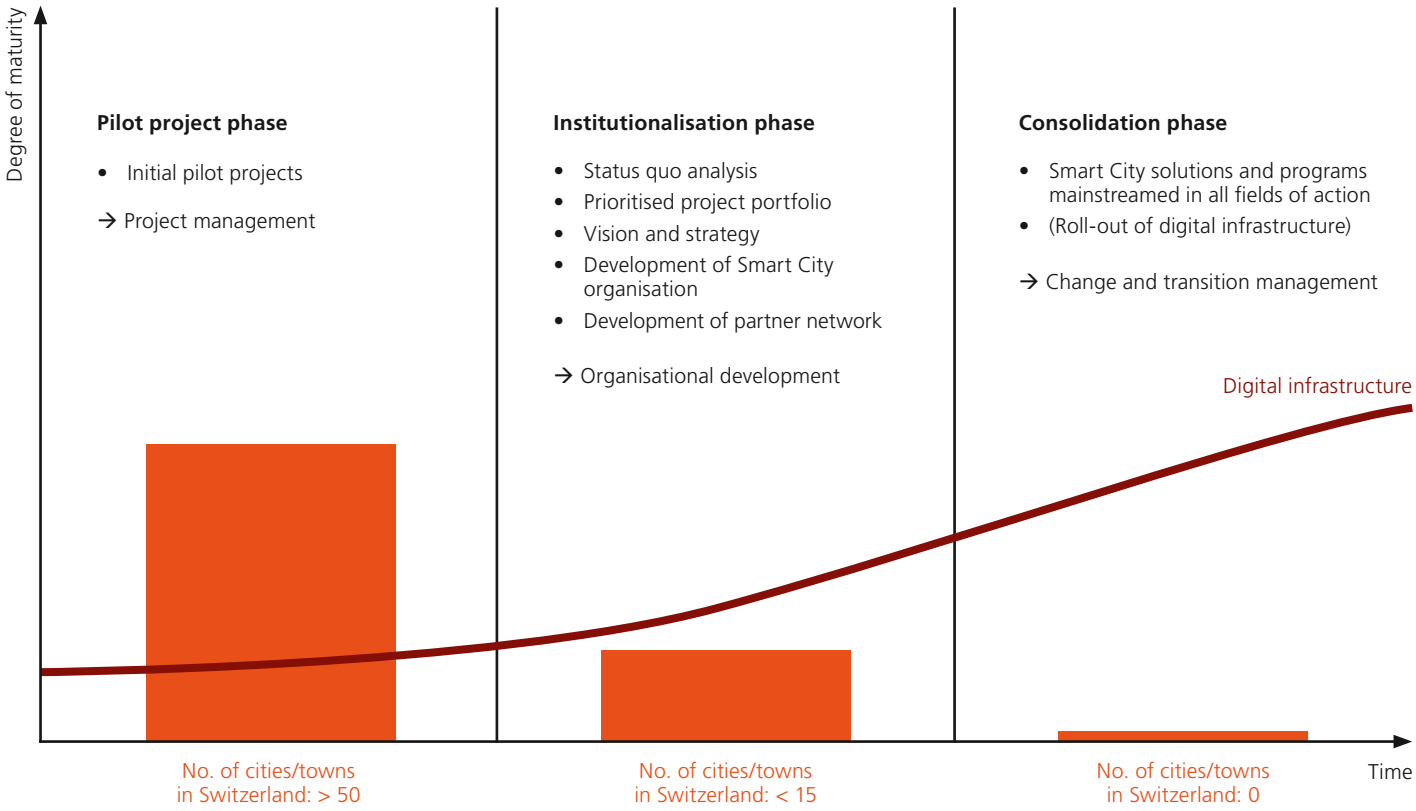

Figure 2. Simplified Smart City development model (source: authors' representation, 2019)

2.4 WHY BECOME A SMART CITY?

Today's urban challenges are complex and multi-layered. In addition, the digital transformation is a reality and is being pushed in many fields by major platforms such as Google and Uber. A city that tackles those challenges using the Smart City approach and that seeks, tests and implements its own solutions can:

- position itself as an innovative, forward-looking and sustainable city;
- contribute to better quality of life and more efficient use of resources;
- act on current developments and challenges holistically;
- exploit the possibilities afforded by digitalisation and modern information and communication technologies (ICTs);
- help design the Smart City process and develop tailored solutions with local partners;
- contribute to the long-term development of new competencies (digital skills, participative approaches, internal and external cooperation) and a new way of working together in the administration and in the population;
- create the possibility to use data in a transparent process for public solutions; and
- gain experience for future procurement decisions and for tenders promoting digitalisation.

2.5 FURTHER READING

Bee Smart City (www.beesmart.city) (Smart City concept presentations).

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ITU (n.d.). Focus Group on Smart Sustainable Cities. Retrieved on 4 July 2019 from https://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx (various reports and documents).

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Wiederkehr, S., Kronawitter, A. and Geissbühler, P. (2019). Stakeholderanalyse Smart City Switzerland – die wichtigsten Erkenntnisse. Retrieved on 4 July 2019 from https://asut.ch/asut/media/id/1549/type/document/20190627_Bericht_Stakeholderanalyse_Smart_City_Switzerland.pdf.

Source: *Infrastruktur Zürichsee AG*

3 USING THE GUIDE

This guide is intended to present various options and possibilities for action, on the basis of which interested cities can develop individual solutions. It contains five elements that divide the contents along clear and practical lines:

- **Flow charts** showing the steps in the different phases of the Smart City process
- **Options** in the form of various solutions and implementing paths and their advantages and disadvantages
- **Tools** with detailed instructions for the instruments and methods presented
- **Descriptions** with examples and fact sheets from different cities and projects, and recommended reading
- **Tips** for practical implementation

ONLINE CONTENT

For reasons of space, and in order to be as current as possible, additional content can be found on a website:

- Case studies of Swiss Smart City initiatives (SCIs)
- Implementing instructions for individual design elements (e.g., tools)
- Introduction to digital technologies
- Overview of developments in Swiss Smart Cities
- Fact sheets on Smart City use cases (e.g., Smart Parking Pilot)
- Information on vendors and links to helpful websites

In this guide, online content is underlined and can be retrieved by using this Symbol ( ) or by visiting this website (www.zhaw.ch/en/engineering/institutes-centres/ine/smart-city-guide-main-page).

This guide is structured along the lines of the three phases in the Smart City development model (see Figure 2). Sections 4 to 6 contain information, tools and case studies for each phase. Section 7 contains a number of concluding considerations and an outlook.

Start with Section 4, pilot project phase, if you:

- are looking for ideas for initial pilot projects and applications or want to know how to develop them;
- want to know how to prepare, carry out, evaluate and perhaps even scale Smart City projects;
- are interested in funding opportunities for your projects or public-private partnerships (PPPs); or
- are looking for case studies to generate ideas.

Read Section 5, institutionalisation phase, if you:

- are looking for information on how to go about putting together a SCI;
- want to conduct a status quo analysis;
- need to draw up a prioritised Smart City project portfolio;
- intend to draw up and publish a Smart City strategy that is acceptable to a majority; or
- want to read case studies on establishing SCIs.

Start with Section 6, consolidation phase, if you:

- already have a Smart City strategy in your town;
- have to decide between technology- or project-oriented implementation;
- are looking for information on the long-term challenges of the digital transformation of cities.

Consult Section 7, concluding considerations, if you:

- would like to read a short synopsis of Smart City implementation.

4 PILOT PROJECT PHASE

Pilot projects lead to new partnerships, the development of new solutions and applications and the acquisition of expert knowledge within an administration. This section looks at what pilot projects involve, from idea to implementation, and answers the following questions:

- What are Smart City pilot projects and what challenges do they present?
- How can ideas be developed for pilot projects?
- How are pilot projects implemented?
- What has to be done at the completion of a project?

Smart City projects use modern technologies to generate economic, social and ecological added value, are carried out by several organisations in partnership, and are innovative and experimental in nature.[5] In addition to the usual challenges of any IT project, Smart City projects also have to deal with the following difficulties:

- **Technology and financing:** In addition to developing applications and services, Smart City projects often involve the construction of new infrastructure (e.g., transmission technology). In many cases, interaction between infrastructure, data and software is in its infancy, and security and data protection mechanisms remain to be defined. In addition, the costs of installing,

Source: City of Wil

operating and maintaining infrastructure, and of training and recruiting IT specialists are in some cases hard to estimate.

- **Cooperation and governance:** Smart City projects require cooperation between politicians, administrators, scientists, businesses, non-governmental organisations (NGOs) and residents, and are therefore rather complex. It is key to include the public in order to show people what they stand to gain and motivate them to back proposals for new solutions. Other challenges are communication and coordination between the partners, the absence of standards (e.g., on open data), a potential lack of support from politicians and city administration, unclear roles, conflicting goals, and breaking down the silo mentality in the departments concerned.

It is important to adopt a project management approach that recognizes the challenges and actively addresses them. These challenges will be addressed in the subsequent discussion of the steps in the pilot project phase.

Cities have to decide early if they would rather develop their own pilot projects (i.e., specific local solutions) or draw on existing solutions applied in other cities. Experiences can be exchanged within stakeholder groups such as the "Digitalisation" working group of the Swiss Union of Cities or the "IG Smart City Switzerland".

4.1 DEVELOPING AND SELECTING PROJECT IDEAS

Pilot projects start with innovative project ideas, from which a number of projects are then selected and launched. Project ideas can

- emerge from the administration's concrete presentation of a problem (e.g., Pully case study);
- be submitted to cities by businesses or university faculties;
- be suggested by residents or other stakeholders via idea platforms or similar participative processes, such as workshops;
- result from an analysis of potential/needs (see Section 5); or
- be developed at internal workshops using innovation management tools (e.g., Idea Generation Tool).

It often makes sense to test solutions already implemented by other cities and to (adapt and) replicate them. The Smart City community has presented application examples and data banks (Description of reports and data banks). Figure 3 depicts various Smart City ideas for initial brainstorming. They are described in detailed fact sheets on the website.

[5] van Winden, W. (2016). Smart city pilot projects, scaling up or fading out? Experiences from Amsterdam. Paper presented at Regional Studies Association Annual Conference, Graz. Retrieved on 4. July 2019 from: https://pure.hva.nl/ws/files/811939/RSA_paper_upscaling_RG.pdf.


FABRIK
ENERGIE
CBIKYE
14%
SOS
HOTEL
TAUSCHBÖRSE
OPEN
Menü
PREMIUM


BIOENERGIE
SOS
98%
42%
COWORKING
OLD SCHOOL
FRESH
1. Smart Parking
2. Smart Waste
3. Smart Lighting
4. Innovation Network/Platform
5. City Information App
6. Low Power Wide Area Network (LPWan)
7. Vehicle to Grid (V2G)
8. Circular Economy
9. Combined Mobility
10. Emergency Response System
11. Air Pollution Monitoring
12. Smart Metering
13. E-Governance
14. Local Networking Platforms
15. Bicycle Highways
16. Digital Participation
17. Co-Working Space
18. Urban Gardening
19. Overview

When implementing actual projects or investing in infrastructure, take the digital possibilities into account. Smart City projects often arise directly from ongoing projects of the administration.

When selecting project ideas (from a portfolio of ideas), feasibility and the city's possible objectives are paramount. Pilot projects often aim to

- test and develop new technologies and applications;
- market the Smart City concept and enhance its acceptance;
- build knowledge and skills within the administration;
- solve a tangible problem;
- increase the efficiency of existing infrastructure or services;
- launch new services for the administration or the public;
- break down administrative silos and create networks in the administration; or
- build a SCI (see Section 5).

Projects intended to meet the first three objectives listed above can be carried out with technology providers using standard solutions (Description of technology providers). They enable relatively risk-free implementation of simple Smart City applications.

4.2 PROJECT PREPARATION

4.2.1 PORTFOLIO OF SOLUTIONS AND CHOICE OF PROJECT PARTNERS

While preparing the project, the project consortium can choose among various solutions and ways of proceeding. When solving tangible problems or developing new services, the above-mentioned project data banks should be used in order to identify already implemented (technological) solutions and the corresponding partners (Description of reports and data banks). The following steps should also be taken at this point:

- Search for and assess various technological options (technology principle and properties, compatibility with existing and possible future technologies, scope and cost per inhabitant)
- Select and assess different vendors or development partners (existing relationships, quality, service, availability, risk of vendor lock-in)
- Set the framework conditions and specifications for public tenders and vendor contracts

The outcome of these steps will be a short list of possible solutions and corresponding partners/vendors for the project idea. The next step is to consult political and administrative decision-makers with a view to making the final choice of partners and solutions, because there are important political considerations next to the stated project goals. Those considerations include the following:

- The existence of local technological vendors, start-ups and research facilities (promotion of local added value)
- The needs of and acceptance by the administration and the public

Once the project partners have been selected, the tangible project requirements can be defined in an exchange between city, businesses and any other partners (see also Section 5).

When developing new products, it is important to involve the end users in the process at an early stage. This requires identifying pilot customers and taking account of the needs of potential users (see text on "Citizen participation" in Section 5).

Solutions calling for the use of IoT or AI require multiple technologies to be combined and the corresponding vendors to be evaluated (e.g., producers of sensors or suppliers of gateways or Long Range (LoRa) networks). Specifications must also be developed that take account of the use of these technologies in the public sphere (e.g., protection against vandalism). The website lists appropriate technology vendors (Description of technology vendors; also provides information on relevant terms and concepts).

In addition, the project proposal should have a local connection and be needs-based and relevant for the sustainable development of the place of implementation. See Table 1 below for the evaluation criteria of Smart City projects being applied in Winterthur (City of Winterthur, 2018).

Innovation	The project is highly innovative. It integrates and involves physical/digital infrastructure, relevant stakeholder groups and several municipal functions. Generally speaking, Smart City projects address at least two of the fields of action as identified by Smart City Winterthur.
Sustainability	The project enhances the quality of life of Winterthur's residents and/or spares resources.
Economic efficiency	The project's costs and risks are proportionate.
Relevance	The project has a clear link to Winterthur and/or the region and offers a needs-driven added value.

Table 1. Evaluation criteria for Smart City projects in Winterthur[6]

[6] Stadt Winterthur (2018). Strategie Smart City Winterthur. 18–19. Retrieved on 4. July 2019 from: https://stadt.winterthur.ch/gemeinde/verwaltung/stadtkanzlei/kommunikation-stadt-winterthur/medienmitteilungen-stadt-winterthur/winterthur-lanciert-smart-city-programm/beilage/strategie-smart-city-winterthur.pdf/view.

4.2.2 FINANCING OF PILOT PROJECTS

Project financing and organisation depend on the project goals. The more specific the benefits for the city administration, the more the administration should act as the initiator and project leader. In such cases, project financing and organisation stem essentially from the administration itself or from municipal concerns. The city can also promote corporate projects by making pilot customers, infrastructure, financial means or helpful framework conditions available. Generally speaking, pilot projects tend to be development projects in which cities and businesses do not build a simple customer-vendor relationship but instead develop a new solution together. PPPs are an example of such financing and organisational models. A PPP is a form of contractual cooperation in which the public purse and private-sector businesses form a special-purpose entity. This may consist of anything from a simple contract to a joint venture or even an operator/license model (see Table 2).

There are countless other possibilities for encouraging the implementation and/or financing of Smart City projects (for an overview, see Description of Financial model).

NAME	DESCRIPTION	EXAMPLE
PPP project (joint venture)	Public and private partners start, finance and run a project together.	**Vienna Aspern project** Cooperation between the city of Vienna and Siemens: establishment of Aspern Smart City Research (ASCR) as the project organisation for the development of a smart neighbourhood.
PPP initiatives	Public and private partners together initiate and finance an office for the implementation and coordination of a SCI.	**SCI in Amsterdam** with an office comprising eight partners.
Operator/license PPP	The private partner takes provisional charge of investments and the operation of services. The public partner ensures, through tender guidelines and operator oversight, that the specifications are met.	In **Santander**, tenders were awarded for projects to digitalise waste removal, water supply and lighting, and to develop a digital city management platform. the projects were financed by businesses via tenders.

Table 2. Forms of PPP (source: authors' representation)

4.2.3 PROJECT DECISION

The decision to implement the project marks the end of the preparatory stage. The following points should then be discussed:

- The relationship of trust between the project partners and the likelihood that the project will be aborted by one of the partners should a problem arise
- The likelihood of finding financing for the project and of ensuring continuity after it ends
- Political/administrative support for the project
- The chances that the project will be viewed in a negative light in terms of technology/infrastructure security and data protection
- User acceptance
- The likelihood that local, regional or national regulations (or their absence) will derail the project
- The likelihood that the necessary exemptions will be granted for pilot projects

High-risk ideas should be scrutinised in feasibility studies and stakeholder analyses before a decision is taken (see Further reading, Section 4.6).

4.3 IMPLEMENTATION

Smart City projects tend to be high-risk, involve many complications yet hold great potential for innovation. Classical project management, which is based on milestones and contractually defined outputs, is of limited use here because

- projects cannot be defined from A–Z and set out in contracts respectively;
- implementation often proceeds on a trial-and-error basis that requires trust and flexibility
- the eventual benefits of implementation may be unclear at the outset or hard to quantify.

Pilot project goals and milestones should not be too strictly or too narrowly defined, so that the project can evolve in ways that cannot be anticipated at the start.

Since there are often no standardised approaches for Smart City pilot projects, Table 3 lists the fundamental challenges they face and the conditions for successful implementation.

PILOT PROJECT CHALLENGES	PILOT PROJECT SUCCESS FACTORS
Administrative structures	
• Administrative processes are formalised and often part of long-term planning processes • Absence of a culture of risk and innovation • Smart City projects are carried out on top of ongoing activities and therefore require additional resources and funding • Shortage of qualified personnel	• Training or new attitudes in order to close competence gaps • Mixed funding, use of public support programs • Use of existing infrastructure, costs of using technology/ infrastructure should be split between various projects • Holistic implementation strategies can clearly boost a project's chances of success
Project implementation	
• Lack of experience in innovation management • Trial and error, no standardised approach • Benefits not immediately apparent • No common project understanding • Risk of being overwhelmed by technical difficulties	• High level of trust and very flexible partners • Allocation of responsibilities, provision of resources, living labs • Highly sophisticated technology, infrastructure used and compatibility with existing systems • Consideration of social, economic and cultural aspects
Project acceptance	
• Fear and resistance among the public as well as administrative staff • Danger of digital exclusion • Data protection, data security, critical infrastructure	• Build trust in one's own data protection • Ensure that stakeholders understand the benefits of Smart City solutions • Involvement of regional vendors/service providers to enhance acceptance • During a transition phase, offer analogue as well as digital solutions and means of participating

Table 3. Challenges to and conditions for successful implementation of pilot projects (source: authors' representation based on expert interviews)

4.4 PROJECT CONCLUSION

The end of a project coincides with tasks such as the evaluation of results and a decision as to whether to continue the project or even scale it up. In addition, the results as well as the lessons learned have to be communicated.

4.4.1 PROJECT EVALUATION

There are various methods for evaluating projects. A complex monitoring system with various quantitative indicators can be developed (see Section 6), or the project outcomes can be evaluated qualitatively via surveys and workshops. In the Spanish city of Santander, for example, three questions were discussed with the stakeholders after the project had ended:

- Was the project successful from a technical point of view?
- Did the city's population or other stakeholders benefit from it?
- What are the views of municipal staff on the project?

If the answers to those questions are positive, it may be possible to scale up the pilot project.

4.4.2 PROJECT SCALING

Smart City solutions are ideally tested on a small scale and then, if successful, scaled up to encompass a larger circle of users or other buildings, an entire neighbourhood or city, or other cities. In this way, the initial challenges, costs and risks are minimised and promising business or operating models can be developed on the basis of initial experiences. As a rule, there are also various options for scaling:

- A city or a private enterprise develops a solution for a small circle of beneficiaries and subsequently extends the pilot project to a wide circle
- A city develops a solution on a small scale and replicates it in other buildings, neighbourhoods or the entire city
- A city develops a solution in the pilot project and subsequently awards a licence to a private enterprise, following a call for tenders, to implement the solution citywide (Santander case study)
- A solution is developed jointly by a private enterprise and a city and subsequently offered nation- or worldwide as a product or service

4.4.3 OPERATOR MODELS

Many Smart City projects do not initially have any provisions for how to run the solution nor do they determine in advance what the operator model should be. In the long-term, operations may be taken over by administrative entities, a private operator or local initiatives with a tangible interest in pursuing the solution. Completely new financing possibilities and business models may also emerge at this point. What is important is that the operators are familiar with general conditions in the municipality and receive support from the administration. The project may be continued by (a) city enterprises or institutes, (b) associations, (c) cooperatives, (d) NGOs, (e) private individuals or (f) companies (via licences).

In order to facilitate closer ties between potential operators and projects, operator involvement should start at the project planning stage.

4.4.4 KNOWLEDGE TRANSFER

When carrying out pilot projects, cities can benefit from each other's experience. To that end, it is vital to record pilot project results and insights in detail and make them accessible. There are various means of doing this:

- Prepare project reports and publish them on the city's website or in public databases (Description of Reports and data banks)
- Share experiences in the Digitalisation Working Group and the interest group Smart City Switzerland
- Share experiences between departments within the administration and with other cities
- Write a scientific article or other contribution
- Publish media releases and communicate at public events

4.5 TO-DO LIST PILOT PROJECT PHASE

The list below sums up the activities in the pilot project phase:

- ☐ seek, develop and select project ideas (Section 4.1);
- ☐ develop a portfolio of solutions for project ideas, select solutions and partners, identify the project goals (Section 4.2.1);
- ☐ clarify financing and define project roles (Section 4.2.2);
- ☐ weigh the decision to implement the project (Section 4.2.3);
- ☐ consider special challenges to implementation (Section 4.3);
- ☐ end the project: organise evaluation, scaling, operating, knowledge transfer (Section 4.4).

4.6 FURTHER READING

Bitkom (2019). Smart-City-Atlas: Die kommunale digitale Transformation in Deutschland. Berlin: Bitkom e.V. Retrieved on 4 July 2019 from https://www.bitkom.org/sites/default/files/2019-03/190318-Smart-City-Atlas.pdf.

Gassmann, O., Böhm, J. and Palmié, M. (2018). Smart City: Innovationen für die vernetzte Stadt – Geschäftsmodelle und Management. Munich: Hanser. (Tips for simple risk, feasibility and stakeholder analyses)

ITU (n.d.). Focus Group on Smart Sustainable Cities. Retrieved on 4 July 2019 from https://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx. (Various reports on monitoring)

Pfaeffli, M.P., Rollier, R., Vonlanthen, B. and Wade, M. (2017). Smart City: Sechs Schritte zur erfolgreichen Transformation Ihrer Stadt. IMD International Institute for Management Development/Swisscom AG.

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5 INSTITUTIONALISATION PHASE

In this section, we look at how cities can move from initial pilot projects to an institutionalised SCI. A SCI is established when overarching organisational structures, processes or instruments have been introduced with a view to embedding the Smart City in the city administration. The section answers the following questions:

- How is a Smart City strategy developed?
- How is a prioritised project portfolio put together?
- How is a SCI organised and financed?

Swiss pioneering cities have taken different paths in establishing a SCI and attained different stages of institutionalisation (see Table 4). Some base their activities on strategy papers and implement new innovation-promoting instruments (supporting SCI); others use project portfolios or roadmaps to steer the content of the SCI (roadmap SCI); others again focus on agility and solutions to concrete problems (agile SCI).

Agile and roadmap SCIs use diametrically opposed approaches. Both have their advantages and disadvantages. Depending on the situation, it makes sense to "keep it simple" to, for example, solve specific problems. Careful planning, on the other hand, requires time and resources but results in a framework to which all those involved can look for guidance. The middle road – steering using project promotion instruments – links decentralised agility and structure but has the disadvantage that integration and the long-term compatibility of different projects and technologies may not necessarily be guaranteed.

Digitalisation is a long-term process leading to the transformation of an administration and city system. A strategy should be available at the latest when major investment or reorganisation is called for. In institutionalizing the SCI, every city must find its own path and decide on one of these three options.

TYPE (LABEL)	AGILE SCI	SUPPORTING SCI	ROADMAP SCI
Description	Focuses on the speedy implementation of projects and solutions (no formal strategy established)	The Smart City strategy sets the framework, projects are not specified, project development is decentralised and takes place in different departments	The Smart City strategy sets the framework and contains project-level priorities and a roadmap
Steering	By a board (e.g. conference of directors)	Using innovation tools, e.g. tools to promote internal project ideas	Using tangible project portfolios, fields of action or roadmaps
Motto	"Keep it simple"	"Making innovation possible"	"Set the Smart City direction and coordinate"
Example	Pully	Winterthur	(to some extent Lucerne)

Table 4. Overarching SCI options (source: authors' representation)

5.1 STEPS TOWARDS A SCI

The starting point for any SCI is support from the political authorities and senior management of the administration. It is hard to indicate the return on investment for Smart City projects and investments, and a relationship of trust between the political authorities and the operational level in the administration is therefore fundamental. That relationship can be built up before the SCI is established by various means, such as:

- publicly effective and successful pilot projects (e.g., Pully);
- parliamentary motions, questions on the subject of Smart Cities (e.g., Lucerne);
- raising public awareness of Smart City issues (e.g., Wil); and
- information events with Smart City experts or excursions by city councillors to Smart City precursor cities and/or events (e.g., Winterthur).

These lobbying activities, as they are known, are carried out by individuals or a network of Smart City supporters. They are an important means of familiarizing decision-makers with Smart City issues and of obtaining a political mandate, for example to draw up a strategy.

When it comes to drawing up the SCI, it is important to have people and activities at the operational level. Properly networked people with special skill sets and a doer mentality must be given the space, resources and political backing needed to carry out those activities

Promising steps on the way to a SCI are the implementation of pilot projects and political influence obtained through various lobbying activities. If the interest of decision-makers has been sparked, the political discussion often shifts to the bundling and structure of Smart City activities. Ideally, the result is a mandate to develop a concept and thus to set up an operational core team (see Figure 4). The initial core team then organises and carries out a status quo analysis or strategy development processes. These usually lead to the establishment of a strategy proposal that ideally is approved by the corresponding political authorities. This ideal path to the launch of a SCI is followed by a few pioneering cities in Switzerland (see Table 5).

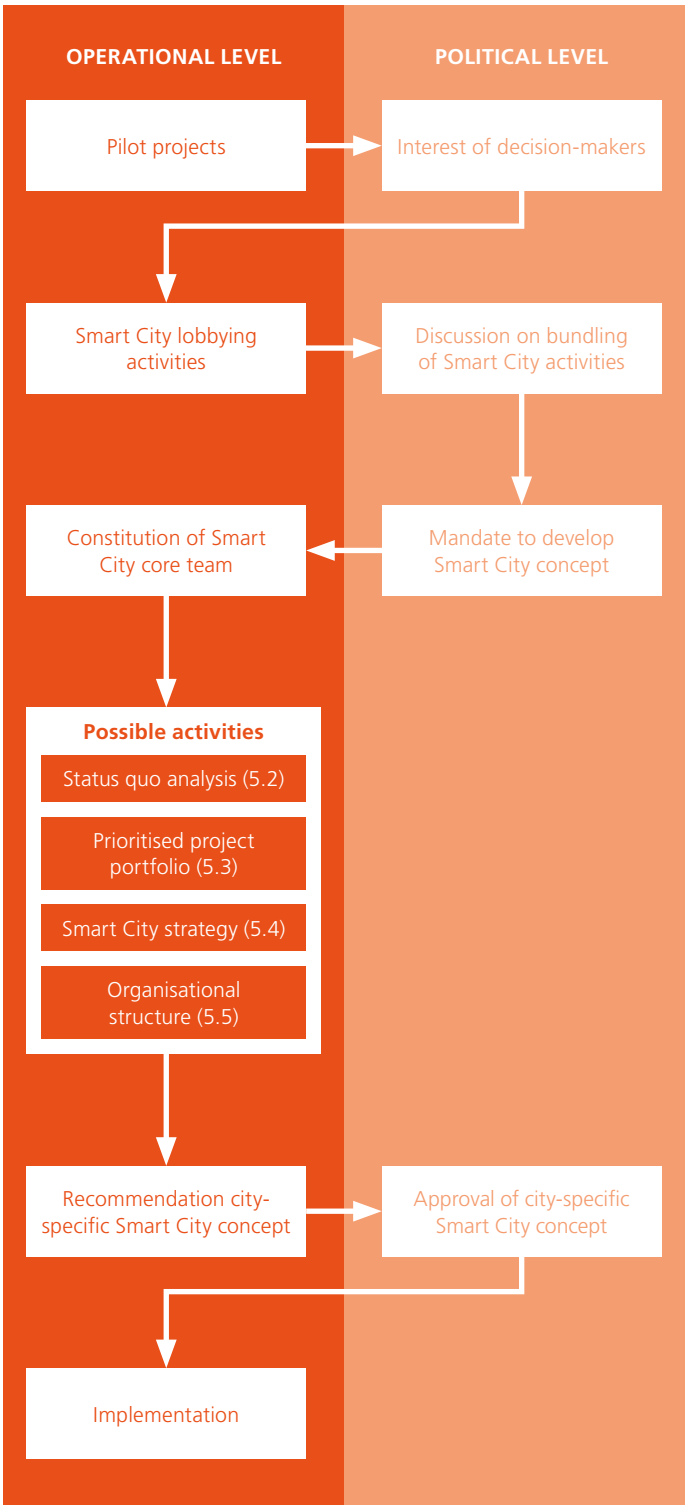

Figure 4. The ideal step-by-step approach to establishing a SCI (source: authors' representation)

Especially when financial needs are high, not only the political executive but also the parliament must be involved in the Smart City process early, in order to obtain its support for the Smart City concept.

	PULLY	ZUG	WINTERTHUR
Milestones	• 2013: Project "digitalisation of building permits" • 2015: Project with Swisscom • 2017: Various surveys and workshops on Smart City issues • 2018: Decision not to develop a formal Smart City strategy, to work with guidelines • 2018: Launch of smart.pully.ch	• 2015: City vision is developed • 2015: Executive initiates digital ID and Crypto Valley • 2016: Bitcoin experiment • 2017: Digitalisation strategy • 2018: Prioritisation of Smart City projects and decision to implement	• 2014: SFOE pilot projects launched • 2016: Executive decision to develop Smart City strategy • 2016–2017: Smart City strategy developed with Zurich University of Applied Sciences (ZHAW) and innovation team • 2018: City council approves Smart City strategy • 2018: Approval of innovation credit • 2019: Staffing of Smart City office
Organisation	(no new smart-city-specific organisation) Directors' conference, various coordinating groups, project teams	City council, Smart City coordinating group (one representative per department), Smart City project leader	Smart City steering committee, innovation team (one representative per department and ZHAW), Smart City office (staff unit of mayor's office)
Organisation tasks	• Directors' conference = strategic leadership and portfolio management • Project team = operational implementation	• City council = strategic leadership • Coordinating group = internal networking • Smart City project leader = administration support, digital technologies	• Steering committee = strategic leadership • Innovation team = internal networking • Office = operational implementation, coordinates network
Project portfolio/ Roadmap	Portfolio management, ad hoc additions from idea list, annual brainstorming for new ideas in workshops	List of priority Smart City projects	Bottom-up development of project ideas, annual funding decision
Strategy concept	Steered using values and guidelines	Being developed	Drafted and approved
SCI and project financing	City procurement and replacement budget, co-funding with partners	Internal means, external fund for project promotion	Internal innovation credit of CHF 200'000.– per year, additional third-party funding for projects
Website	smart.pully.ch	n.a.	smartcitywinterthur.ch

Table 5. Examples of SCI development processes in Switzerland (source: authors' representation)

Subsequent implementation is contingent on a contract for the development of a Smart City concept. The core team has multiple potential activities, selected on the basis of the city's framework conditions and goals. This guide provides the building blocks for the steps and methods involved in the following core team activities:

- Analysis of the status quo
- Development of a prioritised project portfolio
- Development of a city-specific Smart City strategy concept

5.2 STATUS QUO ANALYSIS

In a status quo analysis, the city's current situation is analysed from the point of view of existing and planned Smart City solutions, problems, needs and the framework conditions for the Smart City process. The analysis consists of simple surveys of the population and a potential and needs analysis (see Figure 5).

5.2.1 SURVEYS AND ANALYSES

Every city already implements smart solutions, but often not under the "Smart City" label. Given the way administrations are typically structured, with departments, divisions, sections, etc., there is a fundamental need to exchange information on existing and planned Smart City solutions. The status quo analysis includes a systematic survey of all the city's implemented and planned solutions. The aim here is to …

- ensure internal and external transparency about existing solutions (e.g., project outlines with the relevant economic and technical information, partners, etc.);
- uncover possibilities for cooperation and joint procurement;
- identify experts and supporters and integrate them; and
- stimulate exchange and understanding in respect of the Smart City concept.

In the event that there is as yet no political mandate to develop a Smart City strategy, the status quo analysis can be initiated/financed by, for example, the city utilities.

There are also various options for implementing a status quo analysis. Some Swiss SCIs conducted simple internal surveys using an Excel spreadsheet containing structured questions. The spreadsheet was made available to all administrative units on a shared drive and completed by them. The survey data were subsequently collated, providing detailed insight into the most important information for every Smart City solution.[7]

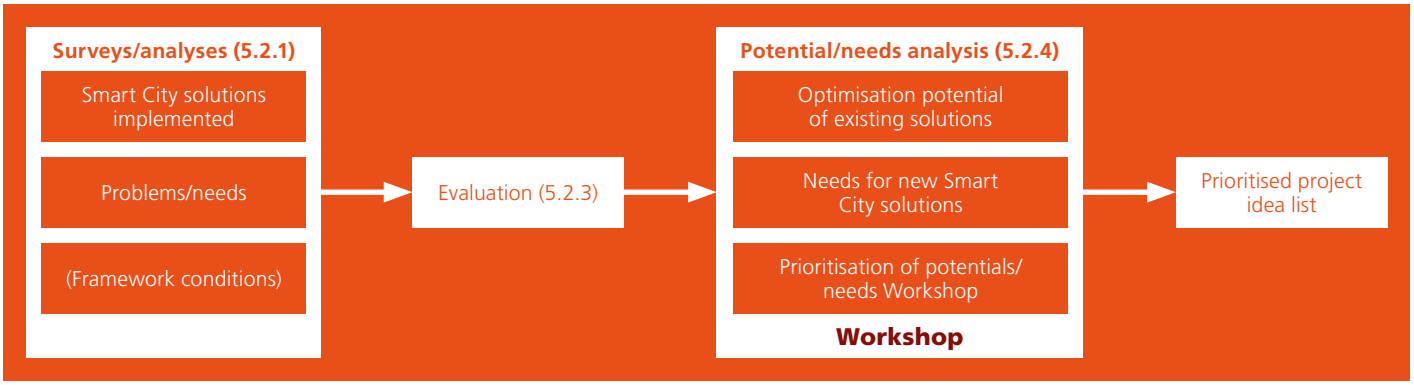

Figure 5. Ideal process for implementation of a status quo analysis (source: authors' representation)

[7] In addition to these low-threshold, internal tools, software solutions exist for implementing programme-based surveys in the administration.

The challenge here is to distinguish between IT system adaptations and true Smart City projects. It is therefore important to clearly define beforehand what is meant by a Smart City solution. Basically, the quality of the survey depends on the following factors:

- Comprehensible and clear questions that are applicable to the Smart City solutions implemented in a city
- Accessibility and identification of the right survey respondents, and their motivation
- Existing concept for the assessment, presentation and use of the results for further planning steps

Before being sent out, the survey should be tested by one or two administrative units (pre-test), and the question categories reviewed accordingly. A ready-made Excel spreadsheet may be found on the guide's website (Smart City solutions survey tool).

5.2.2 OPTIONS OF SURVEYS AND ANALYSES

In most Swiss examples, the focus is on an internal administrative survey for existing Smart City solutions. This can be combined with a survey of needs or ideas for new solutions, or with a comprehensive analysis of the framework conditions, for example for a later analysis of its strengths, weaknesses, opportunities and threats (Description of SWOT analysis).

- In Zug, in addition to implemented Smart City solutions, ideas/proposals for new approaches were collected in an Excel-based survey, assessed and later selected for funding by the city council.
- In Winterthur, the Smart City strategy development process was closely coordinated by ZHAW and linked to a comprehensive analysis of stakeholders and framework conditions in Winterthur (Innovation system analysis tool).
- In Wil, the population participated in an "energy games" campaign that led to the development of a Smart City vision and the identification of needs (Wil case study).

5.2.3 SURVEY INTERPRETATION

As soon as the Smart City solutions have been summarised (e.g., in the form of fact sheets), they can be assessed by categories. One practical way of proceeding is to group them according to the six fields of action depicted in the Smart City Wheel (see Figure 1).

Solutions should be classified according to their main contribution. A distinction can be made between implemented and planned solutions. In addition, the identified needs can be further broken down by the stakeholder groups administration, population, and economy (Assessment matrix tool).

By taking this step, the city can identify priorities and gaps in its Smart City portfolio and use them to identify optimisation potential and new needs.

5.2.4 POTENTIAL AND NEEDS ANALYSIS[8]

In a potential and needs analysis, the results of the survey are considered in greater depth. This is where the workshop format comes into play. The aim is to bring Smart City experts and supporters together in a working group to discuss the Smart City concept, obtain an overview of the status quo and prioritise projects for the city. As a rule, the following tasks are assigned to a Smart City core team of urban development, computer services or city utility representatives (potentially backed up with external support from universities or consultants):

- Preparation and organisation of a kick-off workshop
- Conducting a workshop and a potential and needs analysis
- Post-processing and reconciliation of the workshop findings

When it comes to administrations with very strong departments or management structures and conflicting interests, it is best to involve external facilitators. They can organise the working formats or reflect the findings, while the administration provides the content (Workshop organisation tool).

Preparing and organizing the kick-off workshop

Key aspects the kick-off workshop are selecting the participants and preparing the content, the work formats and the goals. All administration departments and Smart City-related fields of action should be represented, also in order to avoid later misunderstandings or resistance. Potential participants are professionals and field leaders from departments, city councils and other political decision-making bodies.

In terms of content, the discussion of the Smart City concept and the findings of the status quo analysis must be prepared. In addition to existing Smart City standard presentations (Description of Introduction to Smart City), workshop organisers can use the fact sheets and short presentations on existing Smart City solutions drawn up by the corresponding project leaders. During the preparatory phase, clear workshop goals should be defined and the corresponding working formats planned (Description of Workshop formats).

The promoter model is useful for identifying and bringing together workshop participants. The workshop will be particularly successful if all qualified process and power promoters work together (Description of Promoter model).

Conducting the workshop and the potential and needs analysis

The workshop design depends very much on the goals. If the goal is above all to prioritise Smart City solutions and identify further needs and project ideas, it may consist of a mix of specialist talks, short presentations and work in small groups. During the first part of the workshop, the Smart City concept is introduced and the results of the status quo analysis are presented in talks. During the second part, existing Smart City solutions – and any suggestions for improvement – are presented by the invited project managers. Prioritisation can be based on selected criteria (see Table 1) or supported by an in-depth benefit analysis (e.g., CO_2 emissions saved per Swiss franc invested).

Experiences show that the workshop moderator should adhere strictly to the schedule and procedures. The best option would appear to be a five-minute presentation on each existing Smart City solution and a subsequent evaluation of its potential according to the categories "discontinue, continue or optimise" (Zug case study).

The third part of the workshop comprises a needs analysis and the development of ideas for new Smart City solutions. The needs analysis can be carried out entirely within the workshop, although in-house surveys of ideas/needs can also be conducted beforehand (Zug case study). In order to structure the exercise, workshop participants should be divided into small, cross-departmental groups on the six Smart City fields of action. The small groups identify, discuss and write down the needs based on the city's current problems in each field of action.

[8] This section is based on the findings of Gorynski and Mikolajczyk (2019), but the steps, methods and examples have been adapted to general conditions in Switzerland.

At the end of the workshop, the optimisation potential of existing solutions and needs for new approaches identified are weighted by the workshop participants according to their importance and urgency. Web-based tools exist for this purpose, but analogue methods can also be used. The workshop ends with the presentation and discussion of a ranked list of the optimisation potential and needs identified.

Another possibility is brainstorming for new innovative ideas using the Idea generating tool or a checklist to evaluate the technological maturity of existing urban services (Santander case study).

Post-processing and external comparison of the workshop results

Post-processing of the kick-off workshop implies verifying, visualizing and validating the results. The optimisation potential and needs weighted in the workshop are also verified by external stakeholders. In particular, they should be evaluated by end users such as residents and businesses, who may add new needs or ideas. Here, too, a wide range of web-based tools exists alongside analogue participation processes. The consolidated potential and needs can then be entered, for visualisation and further discussion, in an urgent important matrix.[9]

Swiss cities have so far been relatively cautious about using resident participation formats for Smart City processes, often out of fear of creating expectations they may not be able to meet. Clear and open communication can prevent this. The procedure for public participation and various digital and analogue methods are described in the inset on citizen participation.

CITIZEN PARTICIPATION

The goal of citizen participation is to ensure that procedures, projects and task implementation have public support and are in line with the public's needs. In Smart City projects, data protection and security of new technologies are particularly relevant issues for the population and must be addressed accordingly. In addition, it is of great interest to include the future users and their suggestions when developing the new technologies and processes used.

In principle, participation can take place at three different levels:

- The public is informed: Information is the basis for every form of participation, but it does not involve the tangible possibility of public participation.
- The public is consulted: The public takes a stand on and assesses the city's proposals.
- Cooperation takes place with the public and other city stakeholders (businesses, institutions, associations): Solutions are developed and decided on jointly (participative decision-making) or developed and implemented cooperatively (integrative participation).

[9] Gorynski, B. & Mikolajczyk, P. (2019). Smart City/Smart Region: Handlungsleitfaden für Praktiker*innen. (S. 34). Mülheim an der Ruhr: bee smart city GmbH. Retrieved from 4. July 2019 from: https://hub.beesmart.city/de/handlungsleitfaden-smart-city-smart-region.

The decision as to the extent of participation in a specific context depends on the goals of participation and its starting point. In reality, participation is often mixed; the city of Wil, for example, informs and consults the public on Smart City topics and goals. It involved the population at a very early stage in the development phase, namely when it came to defining the most important issues of their project. It is important to obtain political support for the project before starting citizen participation.

Regardless of the level of participation, citizen participation should follow the following procedure:

- Obtain political support for citizen participation
- Plan participation with the help of the "Description of Resident participation plan"
- Establish a communication and participation concept using the methods suggested in Table 6
- Implement the measures and evaluate the results
- Incorporate the results into the corresponding processes, projects and orders
- In the case of consultation and cooperation: Communicate the results and inputs/outputs of the participation process to the public and, if necessary, continue the participation process

METHODS FOR CITIZEN PARTICIPATION

Citizen participation can be implemented using a wide variety of methods and tools, and many handbooks exist on the topic (see Further reading, Section 5.7). The most common digital and analogue methods are shown by level of participation in Table 6, which is followed by a brief discussion of the advantages and suitability of using digital or analogue processes, or a combination of both.

	COOPERATION		CONSULTATION	INFORMATION
analogue	**Participative decision-making (political dimension)** • Future workshop	**Integrative participation (social dimension)** • Future workshop, future conference • REPLY Method • Planning for real	• Political approval • Survey • World-Café • Possible future workshop (with no subsequent citizen commitment)	• Newspapers, publications • Letter • Information events
digital	• Municipal app for participation • Innovation network/ platform and crowd-sourcing • Crowd-funding • Co-creation platform	• Innovation network/ platform and crowd-sourcing • Co-creation platform	• Innovation network/ platform and crowd-sourcing • Voting/rating • Participatory budgeting, public budget discussion • City info app	• City info app • 3D visualization, virtual reality, augmented reality • Websites

Table 6. Varieties of analogue and digital participation tools (source: authors' representation)

Digital participation tools

- Advantages: Can be used anywhere, anytime; potentially able to reach a larger, more diverse group of participants
- Suitable: For the longer term, location-non-specific urban issues in order to generate many ideas

Analogue participation processes

- Advantages: Foster trust and responsibility
- Suitable: For smaller groups of people (e.g., people living near a park) or for a launch event in a longer participation process

Combination of analogue and digital participation

- Offline and online possibilities can be combined depending on the project phase and target group.
- Videos, live chats and voting/rating via mobile devices enable people who are not physically present to take part in a workshop.
- Collating the results of online and offline participation requires an extra effort.

5.3 DEVELOPING A PROJECT PORTFOLIO [10]

The project portfolio specifies which activities are carried out as a priority in a SCI and, if necessary, when which technologies are being implemented. It can be integrated into the Smart City strategy and be taken on board for implementation when the strategy is approved. The procedure for developing a project portfolio is shown in Figure 6 and consists of the following steps:

- Potential and needs analysis, along with prioritisation of project ideas (see Section 5.2.4)
- Development of portfolios of solutions for prioritised projects (see Section 5.3.1)
- Selection of Smart City solutions and possible approval of the project portfolio by the executive power (Section 5.3.2)

Few Swiss SCIs have coordinated project portfolios. This gives them a measure of flexibility when testing solutions. It has the disadvantage, however, of undermining future technological compatibility (see Section 6). As markets develop and standard solutions become available, cities should increasingly think about project portfolio management.

After potential and needs have been identified and prioritised, (a) portfolios of solutions are put together for the prioritised potential and needs, (b) concrete solutions are selected from a portfolio of solutions based on policy requirements and, lastly, (c) an agreed project portfolio is established.

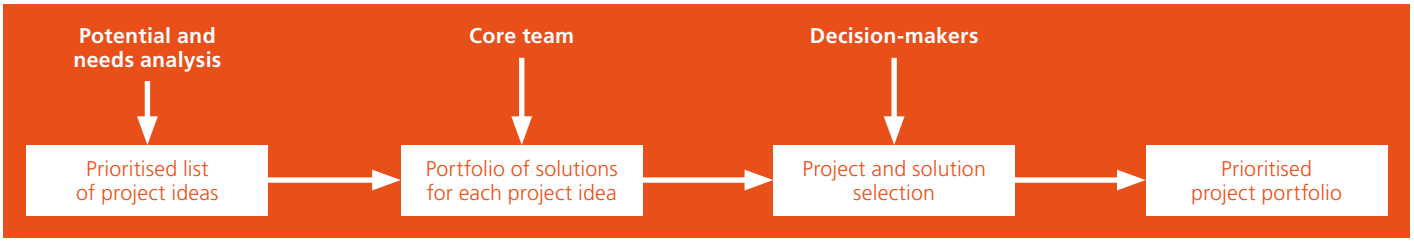

Figure 6. Ideal procedure for the development of a project portfolio (source: authors' representation)

[10] This section is based on the findings of Gorynski and Mikolajczyk (2019), but the steps, methods and examples have been adapted to general conditions in Switzerland.

5.3.1 DEVELOPING PROJECT IDEAS

Putting together the project portfolio involves further processing of the results of the status quo analysis (ranking of potential and needs). To rank the list of project ideas, specific solutions are identified and listed in a portfolio of solutions for each project idea. In addition to identifying adaptable solutions that have already been implemented in other cities, the core team may focus on the following tasks:

- Research and evaluation of various solutions (technological principle and properties, compatibility with other technologies, range and costs per inhabitant, energy/CO_2 savings potential)
- Framework conditions and specifications for public tenders and vendor contracts
- Selection and evaluation of vendors or development partners (existing relations, quality, service, availability, risk of supplier lock-in)
- Possible comparison with existing technologies or the planned technological architecture

As a result, there will be a list with possible solutions for each project idea, collated as an Excel sheet.

Putting together portfolios of solutions is a complex and time-consuming task. It can be helpful to consult existing databases and catalogues, visit trade fairs or work with local start-ups and companies with expertise in technology scouting.

5.3.2 SELECTING SPECIFIC SMART CITY SOLUTIONS

Since the next steps entail project implementation and financing, the city's decision-makers must be involved. Decision-makers can stop or delegitimise the Smart City process. It may be appropriate to organise an extended city council meeting or an additional workshop. The aim is to identify possible resistance, find compromises and, above all, spell out the policy requirements for Smart City solutions. These are city-specific and reflect the city's structural, economic, social and political dimensions. The following political considerations are usually involved:

- Climate and energy policy requirements (e.g., CO_2 emissions reduction targets)
- E-government goals and guidelines (service quality and costs)
- Scope and quality of the solution (number of users)
- Budget framework and conditions
- Implementation time, probability of success and visibility of activities

Based on the concrete city-specific requirements, the ranked list of project ideas will be re-processed in the meeting and a specific solution (i.e., technology, provider, financing, etc.) selected from the portfolio of solutions for each activity. The administration, politicians and other stakeholders thus put together a prioritised project portfolio with specific Smart City solutions. This portfolio can be incorporated into the Smart City strategy or adopted by the executive power without a "strategic superstructure".

The results of the status quo analysis or the workshops can be summarised in an interim report and perhaps combined with press releases and other communication activities to inform the public.

Source: ELEKTRON AG, Au/Wädenswil

5.4 SMART CITY STRATEGIES

The Smart City strategy is drawn up by a core team and approved by politicians. It describes the SCI's goals, organisation, funding and initial implementation. It precedes implementation, provides a reference frame for action by those involved and forms the basis for any budget application required.

Smart City strategies go by a variety of terms – Smart City concept, digital master plan or digital mission statement. A cross-sectional analysis of 50 German pioneering cities showed that 29 were in the process of formulating a strategy and 19 had already drawn up and adopted a strategy document.[11] In Switzerland, Winterthur, Basel, Zurich and Lucerne are among the pioneering cities to have published Smart City strategy documents. Other cities, such as Wil and Zug, are in the process of developing a strategy.

Smaller cities in particular tend to find it easier to engage in the requisite cross-silo networking and cooperation between different players, even without a formal Smart City strategy. Cities of the agile type have come up with other forms of shared terms of reference, for example, establishing values and models for the selection of projects, instead of drawing up a Smart City strategy document.

For smaller, agile cities, the formulation of Smart City principles or a mission statement is an alternative to the strategy development process (Pully case study).

5.4.1 TYPES OF SMART CITY STRATEGIES

Smart City strategies differ in terms of control and implementation. When it comes to governance, the focus is on the role of the city administration and the choice of partner (i.e., "with whom" and "how" you want to manage, implement and finance the SCI). The approach may be top-down (the city and its partners set the strategic and substantive direction) or bottom-up (the administration develops and implements the Smart City with a network of businesses, associations and, above all, residents). Smart City strategies can involve PPPs or adopt a city elite, city society or innovation network approach (see Table 7).[12]

In selecting a type of strategy, it is important to think about the implementation strategy beyond project direction and choice of partner. For this, the type of intervention must be decided:

- Technology push: The Smart City strategy is guided by the available technology
- Citizen pull: The Smart City strategy is guided by the needs of people, businesses, etc.
- Individual prioritised areas: Individual Smart City fields of action are digitalised and optimised (e.g., mobility)
- Integration of various fields: The Smart City strategy integrates various fields of action

Cities have to decide whether they prefer to pursue a technology- or a project-oriented implementation strategy (see Section 6).

[11] Bitkom (2019). Smart-City-Atlas: Die kommunale digitale Transformation in Deutschland. Berlin: Bitkom e.V. Retrieved on 4. July 2019 from: www.bitkom.org/sites/default/files/2019-03/190318-Smart-City-Atlas.pdf.
[12] Kaczorowski, W. & Swarat, G. (2018). Smartes Land: Von der Smart City zur Digitalen Region. Impulse für die Digitalisierung ländlicher Regionen. Schriftenreihe des Innovators Club – Deutschlandforum Verwaltungsmodernisierung, 8. Glückstadt: Werner Hülsbusch.

APPROACH	PPP	City elite	City society	Innovation network
FEATURES	• Technological partnership with ICT firm • Memorandum of understanding • Focus on implementation and solutions	• Experts from politics, economy, science and administration • Closed circle, usually based on existing network/relations	• Involves representatives of the public • Open to all interested parties • Usually developed gradually from the city elite approach	• Smart City projects are chosen through the network, projected on a selected city and, if positively evaluated, implemented in other cities
ADVANTAGES	• Transfer of know-how • Investment by ICT firms • Professional project management	• Based on functioning working relations • Facilitates consensus building	• Greater acceptance of outcomes • Draws on the city's knowledge and creative potential	• Shared learning, exchange of know-how • Funding synergies • Shared risks
DISADVANTAGES	• Often a technology-driven approach • Dependence on ICT firms and their products • Non-disclosure agreements • Low public acceptance	• Often a technology-driven approach • Absence of scaling • Ivory tower attitude • Low public acceptance • Elites are not digital natives	• Gap between online activists and mainstream policy • Longer consensus/feedback loops • Financing difficulties	• Establishing the network takes time and resources • Public procurement law restrictions
EXAMPLE	Rio de Janeiro, Brazil	Winterthur, Zug, St Gallen	(to some extent Wil in Canton St Gallen)	Smart City Hub Switzerland

Table 7. Types of Smart City strategy (source: authors' representation)

5.4.2 DEVELOPING A SMART CITY STRATEGY

Which of the overarching Smart City strategy types the city chooses is usually the outcome of a strategy development process. This process can be initiated by partners such as ICT companies but is often carried out by the city elite or can also involve city society (e.g., the development of a framework strategy in Vienna). Strategy development processes mostly build on simple status quo analyses or the city's project portfolio activities, are carried out in a workshop format and culminate in a draft strategy document. Here, too, different models exist (see Table 8). How the strategy development process is organised has a major impact on the content of the strategy document. Important steps are described below.

- **Steering and organisation:** It is key to establish a project group (Smart City core team) to prepare the entire process, carry it out and develop it into a draft Smart City strategy. Tasks include setting a schedule, organizing the involvement of policymakers and other administrative tasks.
- **Choice of format and group of participants:** It must be clear who participates or is involved in the strategy development process and thus contributes to the content of the draft strategy.
- **Preparatory work and creation of the strategy's content:** It is crucial to create an overview of existing Smart City projects; to develop a common understanding of "Smart City"; to compare with other reference cities at home and abroad (benchmarking); to conduct a SWOT analysis (cf. description SWOT analysis) with a view to deriving the relevant overarching goals; and to create further content such as focus areas and project portfolios, instruments and measures or ideas with a view to anchoring the process in the organisation.
- **Development and communication of the draft Smart City strategy:** Given the importance of the strategy document, the reasoning and structure are central. A Smart City strategy document usually consists of the following: an understanding of the Smart City concept and mission statement; the city's starting point and current position; the situation in reference cities and drivers of digitalisation; strategic goals and topics; cost-benefit considerations, risks, organisational design and financing; and a roadmap, action plan or first implementation steps.

The status quo analysis and activities to create the project portfolio should be part of the strategy development preparatory process and contribute to the development of a Smart City position or a city vision (Description of City vision). A SWOT analysis is one of the tools that can be useful here (cf. Description of SWOT analysis).

	VARIETIES	COMMENTS
Steering and organisation	• External partners (e.g. universities, consultants) • Internal units (i.e. existing coordination group) • Mixed core team (external and internal)	The advantage of including external partners is that they organise the process while the city representatives concentrate on the content; in addition, conflicts between departments can be mitigated.
Choice of format and participants	• Workshops with internal department participants or with an existing coordination group (Winterthur) • Workshops with internal department participants and validation of the outcome by a sounding board (Zurich) • Forums with many participants (experts, residents, businesses and administration) (Vienna)	The participants' tasks vary from specialist input to the introduction of an outside perspective and active participation. Forums are complex to organise but have the advantage that the Smart City strategy is more broadly based and more widely accepted. Option: Divide participants into thematic subgroups, e.g. as per the Smart City wheel.
Preparatory work and creation of the strategy's content	• Status quo analyses/innovation system analysis • Establishment of a prioritised project portfolio • Benchmark study of reference cities • Cost/benefit analyses • Risk analysis • SWOT analysis • Development of a city vision • Development of a roadmap	Each city has to decide which steps to combine.
Development and communication of the draft Smart City strategy	• The functional structure is very much based on the strategy development process. • The timeline is long-term, broken down stepwise into short-term measures, e.g., vision (to 2050) – scenarios and strategic roadmap (to 2030) – action fields (to 2024).	Smart City strategy documents are often structured in a way that focuses on the big issues first. Thus, they start by presenting the framework conditions and the general understanding of "Smart City" before moving on to the overarching goals, which are then fleshed out and underpinned by implementing measures.

Table 8. Types of strategy development process (source: authors' representation)

5.5 ORGANISATIONAL STRUCTURE OF A SCI

The organisational structure encompasses the structural and operational anchoring of the SCI in the administration. It performs the following tasks:

- Identification of new tasks and assigning of responsibilities
- Allocation of financial and human resources for new tasks
- Incorporation of new knowledge and competencies
- Creation of smart-city-specific decision-making structures (e.g., decisions on project choice and financing)
- Development of standardised processes and procedural plans (e.g., project management in pilot projects, procurement procedures)

Here, too, the approach varies widely – and this guide can only show types and variations. In principle, responsibilities and structures should be created for the following core tasks: strategic steering, internal networking of departments and operational implementation.[13]

In some cities, SCI are integrated within existing departments (such as IT, urban development). Other cities create new organisational structures. In either case, cities can either hire new personnel or work with existing staff. For newly created organsiational structures, three models are identified:

- The first is centred on the chief digital officer (CDO) and thus explicitly considers Smart City concerns a newly created, person-specific task.
- The second involves the creation of a special office or staff position inside or outside the administration.
- The cross-sectional model is made up of employees from various specialised departments within the administration.

A model commonly found in Swiss pioneering cities comprises a cross-sectional organisation (e.g., steering committee) linked to a newly created position of CDO or a department head. This ensures that departments are networked internally, communicate, and serve to introduce new knowledge and skills.

FOCUS ON COMMUNICATION AND COORDINATION	FOCUS ON TECHNOLOGY (DIGITAL PILOTS)
• Management of the city's Smart City strategy • Coordination of all activities and cooperation between different fields • Management of Smart City committees (steering committee, businesses) • Management of individual projects or a project portfolio • Establishment and maintenance of a partner network at local, national and international level, representation in national working groups (e.g., association of cities) • Initiation and coordination of Smart City projects in cooperation with external partners • Communication and organisation of events and training • Focal point for Smart City related questions from the public, businesses or academia	• Analysis of the effects of IoT and Smart City trends, identification of IT strategies • Technology scouting and technical support for individual Smart City projects and procurement • Knowledge-building in the field of IoT and Smart City platforms and services, transmission technologies (5G, LoRa, WLAN, etc.), IoT sensors and other devices • Knowledge-building in machine learning and AI
Example: CDO in St Gallen or Smart City Office in Winterthur	Example: Smart City Zug project management

Table 9. Types of Smart City organisation

[13] In addition to the structures mentioned, other, mostly virtual organisational structures – open data platforms, platforms for generating ideas or for public participation – are often established.

Smart City affin people (interested in technologies, open to new ideas, assertive, and well-connected) from individual departments should be appointed to steering committees. For new positions (e.g., CDO), training of current staff is also a possibility.

New positions can be differentiated according to either their communication/coordination-oriented tasks or technology-oriented tasks. In the process, new Smart City tasks are often identified and assigned (see Table 9).

It is crucial to establish and coordinate a Smart City partner network. Cities should choose a structured approach and roughly define, for example, the decision-making process for external project inquiries, how to institutionalise the exchange of information and which topics are city-specific and which are overarching and should, for example, be tackled in partnership with other cities or in the Smart City Hub Switzerland.

The advantages of creating a new organisational structure within the administration are that Smart City activities are embedded in administrative processes, can build directly on existing projects and programmes, and are free of political bias. On the other hand, silo mentalities and complex organisational processes can hinder Smart City activities. Additionally, the private sector may find it difficult to participate or provide funding (see Table 2: PPP initiatives).

External organisational structures, such as the Smart City office in Amsterdam, can be run by various entities (companies, universities, consultants commissioned for that purpose or associations) and can also be co-financed with regard to human resources. Offices outside the administration commissioned to deal with Smart City issues enjoy greater freedom to develop pilot projects and may find it less difficult to engage with other private partners for financing and implementation. The downsides are the complexity of cooperating with the administration and the possibility that dependencies and conflicts of interest will arise.

Smart City organisational structures are context-specific and depend on the general conditions in a city. The process by which the organisation is developed is often closely linked to project portfolio creation or strategy development. This is why the corresponding working group meetings and workshops, for example, institutionalise steering committees or innovation teams. In contrast, newly created positions are often the outcome of the strategy development process. Organisational development workshops can also be useful in larger cities. The following checklist may be of assistance in the organisational development process:

- What digital competencies in which fields does the administration already have?
- Which committees or offices are currently addressing overarching issues of urban development or digitalisation?
- What operational experience exists for the introduction of new tasks and positions?
- What is the attitude and motivation of administrative staff in respect to new tasks and topics?
- What supra-regional issues and problems are relevant for the city?
- What direction is the city pursuing with its Smart City strategy? What requirements for an organisational structure can be derived from this (financial resources, focus on content)?

The Smart City does not stop at the city's borders. In particular, the Smart City fields of mobility, and environment and energy require new, cross-community approaches. It can make sense to break new ground with regards to financing and organisation or to use established structures such as special-purpose associations or other supra-regional bodies.

5.6 TO-DO LIST INSTITUTIONALISATION PHASE

Table 10 summarises the most important steps for institutionalising SCIs. It distinguishes between small towns and mid-sized (and large) cities, which, owing to their differences in size and resources, have different possibilities.

5.7 FURTHER READING

ESTABLISHING A SCI

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SMART VILLAGES

Entwicklungsagentur Rheinland-Pfalz e.V. Land – Leben – Digital. Retrieved on 4 July 2019 from https://landleben-digital.de.

SELF-EVALUATION

Some companies offer tools for investigating and benchmarking the implementation of digitalisation by cities in the individual Smart City fields of action. See, for example:

Roland Berger GmbH. Smart City Strategy Index – Self-Assessment. Retrieved on 4 July 2019 from https://survey.rolandberger.com/cgi-bin/s.app?A=hkuEfKLL.

SMALL TOWNS	MID-SIZED (AND LARGE) CITIES
☐ Build up and legitimise the core team (personnel/financing) (Sections 5.1 and 5.2) ☐ Define the city's goals together with the executive (Section 5.4) ☐ Launch projects together with partners (city and private sector enterprises) (Section 5.3) ☐ Build a Smart City partner network, involve local businesses/research institutes (Section 5.5) ☐ Enable public participation (see Citizen participation in section 5.2.4)	☐ Build political support for a SCI (Section 5.1) ☐ Carry out a status quo analysis (Section 5.2) ☐ Draw up a prioritised project portfolio (Section 5.3) ☐ Publish the strategy or vision (Section 5.4) ☐ Create a Smart City organisational structure (Section 5.5) ☐ Build a Smart City partner network, involve local businesses/research institutes (Section 5.5) ☐ Inform the public about ongoing and new projects and plan any public involvement (see Citizen participation in section 5.2.4)

Table 10. Institutionalisation to-do list (source: authors' representation)

CITIZEN PARTICIPATION

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Source: City of Zug

6 CONSOLIDATION PHASE

In the consolidation phase, the focus is on the long-term transition of a Smart City. This phase can be carried out using different approaches and at different speeds. It encompasses the following aspects:

- Establishment of a Smart City partner network
- Implementation and integration of new technologies, infrastructure, various datasets and services
- Introduction of new planning, governance and management methods
- Change in culture and behaviour in the administration and the public

For this purpose, administrative silos have to be broken down and synergies released between different fields of action, applications and datasets. This section therefore answers the following questions:

- What challenges arise in the long-term transition of a city system to a Smart City?
- What approaches exist to long-term Smart City transformation? What are their advantages and disadvantages?

New understandings of cities are already taking shape through emerging technological trends such as IoT, big data, and the use of AI. For a better understanding of the associated risks and opportunities of these developments, further critical reading is suggested at the end of this section.

6.1 CHALLENGES IN THE CONSOLIDATION PHASE

The challenges in this phase lie in the management and long-term development of the project portfolio, the implementation of digital technologies and infrastructure, and the application of supporting measures.

- **Management and long-term development of the project portfolio:** During the long-term implementation of the project portfolio, new project ideas are added, or the technologies and (legal) frameworks change. In addition, the focus of measures in individual Smart City fields of action or city districts shifts to the city-wide level across all fields of action. This requires constant review and coordination of the project portfolio.
- **Implementation of digital technologies and infrastructure:** Decisions on technology investments become more important on the way to the Smart City since infrastructure such as transmission technologies or Smart City platforms are linked to implementation of new services or solutions. As a result, cities face the great uncertainty of making investment decisions in an environment in which no standard solutions exist. The risk is that certain technologies and vendors will be prematurely decided on, resulting in dependencies (supplier lock-in) and incompatible technological (island) solutions in the various Smart City fields of action.
- **Implementation of supporting activities:** Those responsible for the implementation of the SCI find themselves with new responsibilities. While it is crucial in the beginning to coordinate stakeholders and to launch and implement projects, the cultural change in the administration, data security and the design of other framework conditions, such as social acceptance, subsequently take on greater importance. It is crucial to develop a culture of cooperation base on society's needs, establish a Smart City partner network, develop administrative competencies in digitalisation, put in place a uniform procurement system and formulate guidelines for the transparent handling of data and for infrastructure and data security (e.g., processing of personal data).

6.2 DIFFERENT APPROACHES TO THE TRANSITION TOWARDS A SMART CITY

In Europe, pioneering cities such as Santander, Vienna and Amsterdam have been implementing the Smart City concept for more than 10 years. Using them as examples, and in the context of the above-mentioned challenges, a distinction can be made between the project-driven and the technology-driven approach to the long-term transition to a Smart City (see Table 11).

	PROJECT-DRIVEN APPROACH	TECHNOLOGY-DRIVEN APPROACH
Description	The city focuses on practical experience and learning, citizen participation, implementation of pilot projects without a final plan for long-term operational integration and infrastructural coordination to a new systems architecture.	The city focuses on building up technology and infrastructure and on integrating various datasets with a view of making available a broad range of smart applications and services.
Steps	• Establishment of a city-specific Smart City strategy and monitoring system • Development and selection of projects in light of the strategy • Project implementation • Evaluation of project outcomes and possible adaptation of the strategy	• Digitalisation of individual priority Smart City areas • Integration of technologies between fields of action • Introduction of a Smart City data and management platform for the integration of all fields
Path to the Smart City	Stepwise, project by project, making cumulative, small-scale changes	Disruptive, through the implementation of a new technological systems architecture
Implementing logic	Rolling planning, management cycle (plan, do, check, act)	Implemented by means of systems architecture or roadmap
Advantages	• Citizen participation • Easy to involve start-ups and small and medium-sized enterprises • Possibility to test and use many different tools • Speedy results, quick wins	• Synergies can be found between applications • Simplest way to integrate different datasets, services and applications
Disadvantages	• Hard to go beyond pilot projects (implementation in administrative processes, scaling) • Hard to integrate different services and applications • No clear focus	• Risk of supplier dependency • Lack of standards complicates technology selection • Early investment with no clear returns
Example	Vienna, Amsterdam	Santander

Table 11. Different approaches to the Smart City transition (source: authors' representation)

Few cities follow a pure form of either of these approaches. Many SCIs are characterised by a combination of the two or are in the process of changing from one approach to the other. An appropriate monitoring system is important for evaluating implementation of the SCI.[14]

6.2.1 PROJECT-DRIVEN APPROACH

This approach is based on the assumption that Smart Cities are not implemented by following a master plan but step by step, through projects and by making small changes. The SCI is therefore designed to initiate Smart City projects and thus manage the long-term transition to a Smart City. This approach allows for a high degree of freedom to test new technologies and services and to involve the public. Different applications and vendors can be tested without a final plan for long-term integration and infrastructural integration to a new systems architecture. This approach is also known as the beta strategy, since the beta version of technologies – considered provisional – is used. This is why scaling to the entire urban area or implementation using existing administrative processes is deferred. There are two variations of the project-driven approach: The agile type and the supportive type.

- **Agile type:** Innovative projects are proactively initiated and implemented by a network of stakeholders. There is no overarching strategy or control in the project selection and also no long-term monitoring of Smart City implementation. The focus is on learning and exchange about the implementation of Smart City projects. Freedom, agility and the ability to innovate are more important than coordination and integration. Cities of this type can therefore be leaders in individual applications or fields of action (Amsterdam case study).
- **Supporting type:** This type introduces a comprehensive Smart City strategy, a programme that encourages innovation and possibly a monitoring system to control the long-term transition to a Smart City. Projects are selected, funded and implemented according to the strategy. Using the monitoring system, the success of the entire Smart City initiative is then assessed and the strategy adjusted if necessary (rolling planning) (Vienna case study).

Overall, both variations of the project-driven approach have the same follower advantages. Cities of this type want to gain experiences in digitalisation, but do not yet want to make risky city-wide investments in technologies and infrastructures. They can nevertheless market themselves as innovative locations and will have already acquired the skills and experiences they will need subsequently to scale up the solutions.

6.2.2 TECHNOLOGY-DRIVEN APPROACH

This approach is based on the assumption that technologies are driving the long-term transition to a Smart City. The focus here is on combining and integrating various fields of action, types of infrastructure, applications and datasets to form a functional systems architecture. Those responsible for the Smart City will therefore use their solid technological know-how to select, procure and integrate different technologies with a view to long-term Smart City implementation. Long-term compatibility, the use of synergies and the creation of a functional systems architecture are important. There are two types of technology-driven approach: the anchor strategy and the platform strategy.

- **Anchor strategy:** Cities develop a technological solution for a specific Smart City field of action, usually in response to an urgent need for which there is a digital solution. This digital solution "anchors" all subsequent investments in technology in other fields of action. Implementation of the initial technology is therefore driven by the use case. If the technology works for the use case, it can be expanded for other purposes too.
- **Platform strategy:** Cities start by investing in infrastructure and in a comprehensive Smart City platform encompassing existing datasets, applications and services. New solutions can be developed by combining datasets. This means that the platform's performance and benefits depend on coordination and the design skills of those responsible for the Smart City and that investment decisions have to be made despite the lack of technological standardisation.

[14] International Telecommunication Union (ITU). Various reports on monitoring. Retrieved on 4 July 2019 from: www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx.

The goal of the technology-oriented approach is usually to implement a Smart City management platform on which different datasets are combined in real time and evaluated and visualised for various planning and management purposes. The anchor strategy, with its digitalisation of individual priority applications and the subsequent integration of further applications, is the risk-free way to achieve the goal of an integrative Smart City management platform. Overall, technology-oriented approaches are characterised by first-mover advantages (technological leadership, marketing) but entail very high risks and uncertainties (Santander case study).

There is not one right approach to long-term Smart City implementation. Cities have to be guided by their resources, challenges and framework conditions and, if necessary, adapt their strategies during implementation (rolling planning).

6.3 TO-DO LIST CONSOLIDATION PHASE

- ☐ Promote awareness of challenges in the consolidation phase
- ☐ Anchor integration across different fields of action and from the city-wide perspective
- ☐ Promote the establishment of a Smart City partner network
- ☐ Initiate supporting measures (digital competence capacity building, public involvement and information, development of data-processing guidelines)
- ☐ Gauge risks and decide on a more project- or technology-oriented approach
- ☐ Develop a city-specific approach for the long-term transition to a Smart City

6.4 FURTHER READING

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7 CONCLUSIONS

The transition to a Smart City is a long-term and complex process involving numerous technological, legal and organisational changes and activities. Figure 7 summarises the sequence of the main activities in the three phases of the development model (see also Figure 2). The starting point for change is leadership in the administration and the deliberate launch of Smart City projects. Starting with the development of pilot project ideas and continuing with their implementation and scaling, the activities of the pilot project phase help politicians support the Smart City process. A core team then analyses the initial situation, needs and potential, and develops the Smart City strategy and organisation. If the strategy and the proposed budget are adopted, the Smart City organisation can become operational in the consolidation phase. A partner network is established and a city-specific approach, accompanied by supporting measures, is chosen for the long-term transformation of the city.

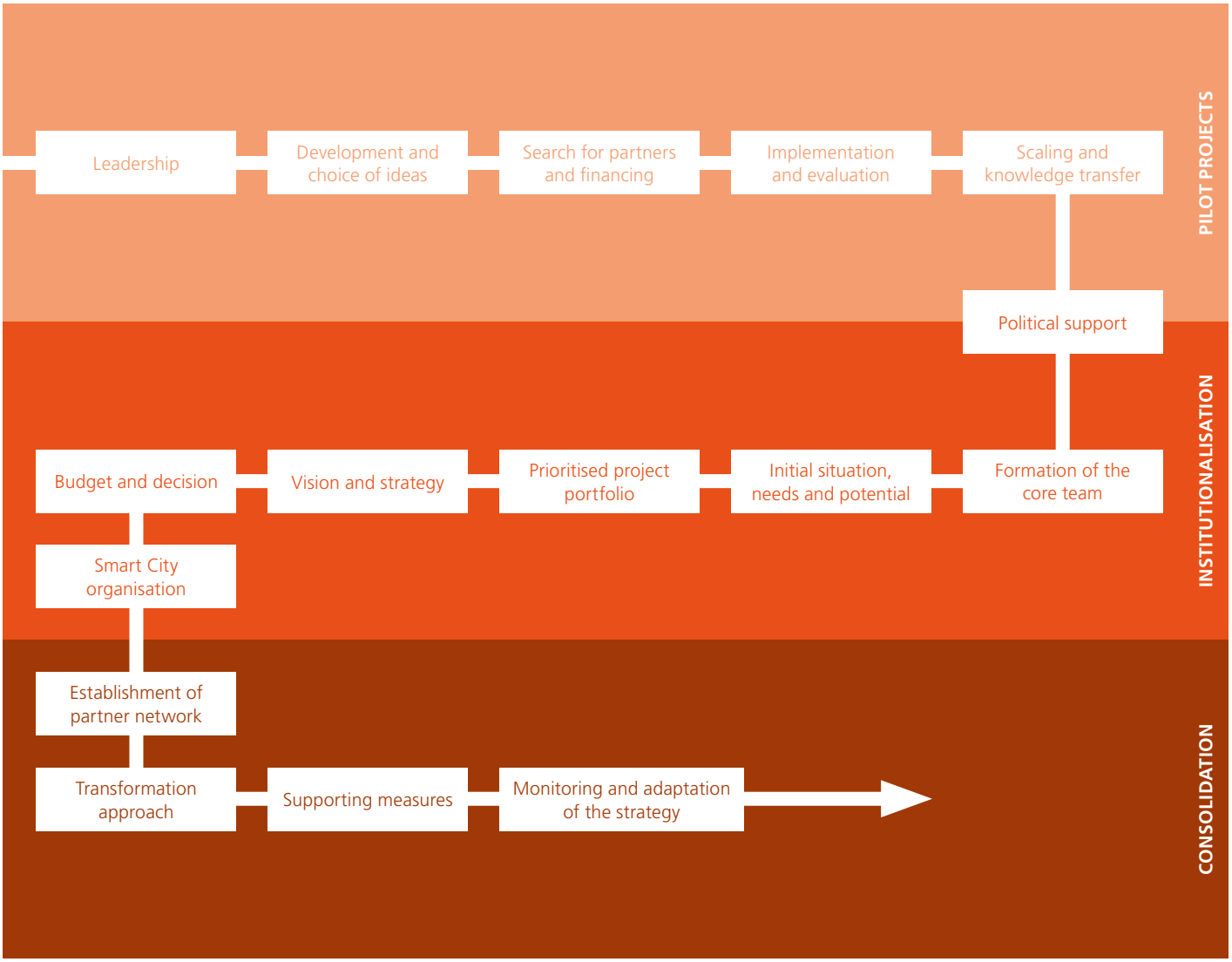

Figure 7. Roadmap to a Smart City (source: authors' representation)

Successful implementation of this roadmap requires leadership and coordinated action by all those concerned: elected officials and administration, businesses, households, NGOs and research institutions. Hard (laws, regulation) and soft (values, norms) framework conditions that support the corresponding developments are equally important. Other factors of success are an advanced vision or strategy, enthusiastic players and good digital infrastructure. They serve to execute existing processes more efficiently, to trigger innovation and to offer new processes and services.

Some researches have highlighted the potentially disruptive effect that digitalisation will have on cities. The Smart City concept is, therefore, not just about implementing individual projects or establishing a Smart City partner network. Ultimately, it is about managing the transition to more sustainable and attractive urban systems. To deal with these challenges, to take advantage of the opportunities and to find appropriate solutions is a complex, but also rewarding and future-oriented task for every city.

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