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Abstract:

This report present the key points of the Joint Action Plan, primarily the 14 recommendations, in order to offer political decision makers an action strategy for smart city systems specialisation that will enable cities to move towards becoming Smart Cities. We present what smart city systems specialisation means in practice, why cities should embrace this kind of smart specialisation to move forward and how they can achieve a successful transformation into a Smart City.

Keyword list: Joint action plan, strategy, Smart City, embedded systems

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Towards a smart city

- Recommendations on smart specialisation within embedded systems for smart cities

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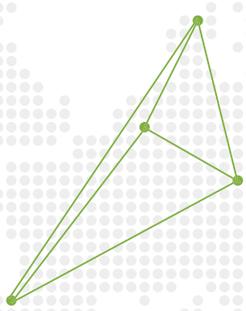
About the report

This report presents the results of the CLINES project (CLuster-based INnovation through Embedded Systems technology) in the form of recommendations for political decision makers on smart specialisation within smart city systems. The report builds on the research and innovation activities of the CLINES project whose aim – in short – was to define how research-driven embedded systems clusters can support the development of smart city solutions.

About the CLINES EU project



The CLINES project (2013-2016) was funded by the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 320043.

The CLINES consortium was formed around the idea of supporting the formation of cluster collaboration for the "Smart, Digitized Cities of tomorrow, based on Embedded Systems Technology" including Internet of Things, cyber-physical systems and smart systems technology.

The project brought together four research-driven European clusters with proven track records within the development of embedded systems: BICCnet (Germany), BrainsBusiness (Denmark), DSP Valley (Belgium) and GAIA (Spain). In addition, Aalborg University/Center for Embedded Software Systems (Denmark), IWT (Belgium) and Tecnalia (Spain) were partners in the project.

For more information, see www.clines-project.eu.

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The smart city is only a few steps away

A smart city is not just a prefab machine designed by architects or engineers, and crammed with the latest technologies; it is a city that makes optimal use of digital technologies to respond to people's actual needs. As such, it has the potential to lift quality of life to a totally new dimension.

– Pieter Ballon, Smart Cities Expert, iMinds-VUB

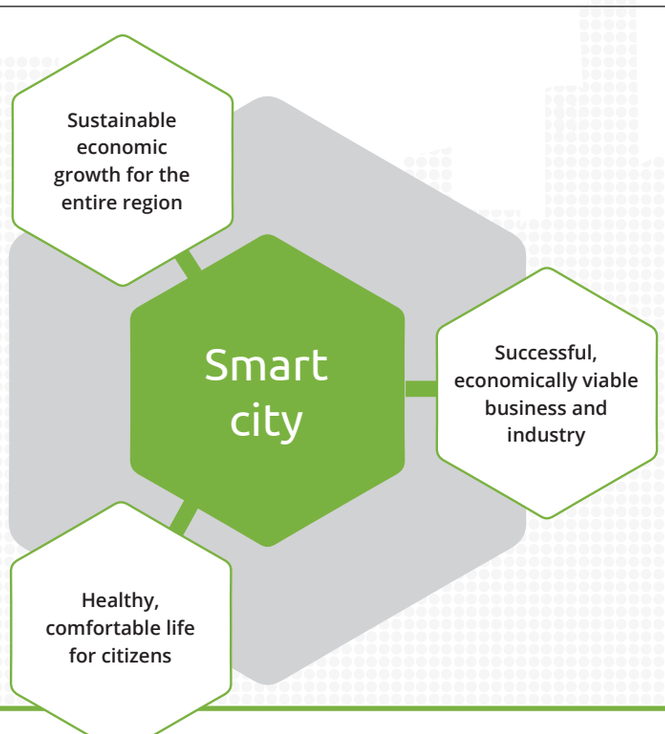
Smart cities and the ideas of smart cities are on the rise. Information and communications technology offers a multitude of new solutions to the challenges that cities and regions are facing, and citizens place increasing demands on their cities and public institutions with regards to smarter and better solutions and services that will improve their everyday lives.

In addition, the rapid development within embedded systems and smart systems technology enable almost any imaginable device, product or system to be infused with "intelligence" that allows them to monitor and communicate information as well as control systems and processes on the basis of this.

The concept of "smart city" raises a number of questions and challenges – not least in connection with how to make a city "smart" – but also a wealth of opportunities for cities, citizens, universities and businesses to jointly develop innovative new smart city solutions with global market potential that can improve the daily life of citizens in a wide range of contexts.

This report presents to political decision makers in potential or existing smart cities a series of recommendations on how to utilise smart city systems development. Such an effort will not only benefit all stakeholders in and around the smart city but also contribute to creating a strong pan-European eco-system of smart city systems development.

A smart city is attractive to both citizens and businesses. It provides:



Executive summary – Flanders, Belgium

As is the case for other densely populated urban regions, Flanders is confronted with societal challenges which cry for solutions, such as: security, ageing, social isolation, mobility, work-life balance, scarcity of natural resources, etc. Part of those solutions can be enabled by smart systems technology. However, to grab the value from those solutions cooperation between different stakeholders is needed. For this reason DSP Valley developed, in close collaboration with partners from Denmark, Spain and Germany, a Joint Action Plan which has as overall objective to push economic (and social) development by enabling innovative research and technology partnerships in the area of embedded/smart systems for smart cities.

This document elaborates on the recommendations from this action plan and its 5 main goals:

1. Improve smart specialisation in the area of embedded/smart systems for smart cities (ESSC)
2. Build a vibrant ESSC ecosystem
3. Develop innovation capability
4. Create more business
5. Mobilize funding sources for ESSC

This Joint Action Plan has been developed by stakeholders from 4 regions and offers a solid basis for joint actions, taking into account regional specialisation. However this action plan also looks beyond borders to stakeholders from other regions who collaboratively want to develop the urban regions of our future. The smart systems ecosystem has invaluable capabilities to participate actively in the development of those urban regions.

Executive summary – Basque Country, Spain

La prioridad de las RIS3 de Euskadi abarca el concepto "Territorio", dentro del cual entran las Smart Cities.

Se identifican los siguientes segmentos principales, de distinta naturaleza, alienados con el proyecto CLINES:

- La planificación y regeneración urbana del territorio (regeneración ambiental, planificación y soluciones urbanas.
- Los ecosistemas, basados en la experiencia de éxito en la regeneración medioambiental de una región minera e industrial como en el País Vasco.

Los ámbitos de oportunidad representan los grandes retos sociales y económicos mundiales recogidos en distintas estrategias europeas (Europa 2020, Horizon 2020) y en las reflexiones de los planes previos realizados en Euskadi.

En general responden a retos complejos que deben ser resueltos con soluciones basadas en conocimiento y adaptadas a las condiciones particulares de cada región.

Los ámbitos de oportunidad considerados son los siguientes:

Cambio Climático y Sostenibilidad –incorpora una perspectiva de sostenibilidad en todas las facetas de la vida, con un impacto especialmente en la gestión del medioambiente, el uso eficiente de recursos y materias primas y la producción primaria sostenible.

Urbanización y Movilidad –impulsa una transformación de las aglomeraciones urbanas hacia ciudades inteligentes (a través de medios tecnológicos, de modelos innovadores en la gestión ...), necesidad de desarrollar sistemas de transporte inteligentes, eficientes, integrados y seguros.

Executive summary – North Denmark

Nordjylland står over for en række samfundsmæssige udfordringer i de kommende år. Øgede krav om bæredygtighed og energibesparelse, forhøjet levealder i befolkningen, reducerede budgetter og et ønske fra borgerne om forbedret service og levevilkår er blot nogle af de udfordringer, man som byråds- og regionalpolitiker står med ansvaret for at løse.

I den sammenhæng byder smart city-begrebet sig til som en mulig løsning. En regional satsning inden for udvikling og anvendelse af smart city-løsninger og –systemer kan fungere som en generator for vækst og innovation – og samtidig løse en lang række udfordringer for borger, by og region.

Nordjylland rummer allerede et stort potentiale på smart city-området. Regionen er kendt for sin stærke IKT-klynge og tætte samarbejde mellem virksomheder og universitet, og Aalborg Kommune har med SmartAalborg-inititativet allerede igangsat Aalborgs udvikling mod at blive en endnu mere smart, digital og bæredygtig by.

Spørgsmålet er, hvordan disse forskellige initiativer kan koordineres og udnyttes optimalt til at bringe dette potentiale til live. I denne rapport præsenteres 14 anbefalinger på baggrund af et omfattende europæisk klyngesamarbejde, hvor AAU og BrainsBusiness har samarbejdet med klynger fra Belgien, Tyskland og Spanien. Anbefalingerne dækker områderne forskning, finansiering, innovation, smart specialisering og vidensoverførsel og kan anvendes som strategisk ramme for regionens videre udvikling mod at blive en dynamisk smart city i vækst.

Executive Summary – Germany

Für einen dicht besiedelten Staat wie Deutschland ist Smart City ein zentrales Zukunftsthema: Wie können Städte zu „intelligenten Städten“ werden, mit hoher Lebensqualität, hoher Wirtschaftskraft und geringem Ressourcenverbrauch? In Flächen-Ländern wie Bayern wird dabei auch immer Smart Region mit gedacht: Wie können nicht nur in den Metropolregionen, sondern auch den Landkreisen und im Ländlichen Raum die Qualitäten einer Intelligenten Stadt erreicht werden?

Dieser Bericht – eine Zusammenfassung der Ergebnisse des 3-jährigen CLINES-Projekts – stellt die Treiber hinter dem Trend zu Smart Cities vor (Verbesserte Dienstleistungen für Bürger und Unternehmen, Ressourcen-Effizienz), und zeichnet ein Bild der Vision von Intelligenten Städten (Intelligente Spezialisierung und hochvernetzte technische Infrastruktur-Systeme).

Als zentrale Botschaft an die Politik sind 14 Empfehlungen enthalten, wie zum Wohle aller Bürger in den Bereichen Forschung, Innovationsförderung, Intelligenter Spezialisierung, Förderinstrumente und Wissenstransfer die Evolution zu Intelligenten Städten befördert werden kann.

Für Deutschland, das über den Cluster BICCnet am Projekt beteiligt war, stehen dabei folgende Anwendungsbereiche im Fokus:

- Smart Mobility – E-Mobilität, Intermodalität
- Smart Environment – flexible Energienetze und Ressourcen-Effizienz
- Smart Living – Selbstbestimmtes Wohnen für alle

Towards a smart city – Executive summary

This report presents recommendations for an action strategy for smart city systems specialisation that will enable cities to move towards becoming smart cities – for the benefit of all stakeholders in that city. We present what smart city systems specialisation means in practice, why cities should embrace this to move forward and how they can achieve a successful transformation into a smart city.

The WHY

A choice to invest in smart city systems specialisation may be the way to solve a range of challenges that cities and regions all over Europe are facing, including:

- The need for optimisation of resources
- The demand for improved services to citizens and businesses
- The need to meet the worldwide demand for sustainable development.

In short, smart city systems will result in marked benefits for all stakeholders in an area – citizens, business and industry, public agencies and universities and other knowledge institutions alike. In overall terms, the three major benefits are:

- *Enhanced liveability* – in the sense of a better quality of life for citizens.
- *Enhanced workability* – in the sense of accelerated economic development and competitiveness in the global economy.
- *Enhanced sustainability* – in the sense of giving people access to the resources they need without compromising the resources of future generations.

The HOW

Transforming a city or region into a smart city takes a new form of collaboration that goes beyond the traditional triple-helix structure (public agencies, knowledge/research institutions and business/industry) to also include the end users of the smart city systems: Citizens and city employees. This quadruple-helix form of collaboration must be based on *active participation from all four groups of stakeholders* in order to ensure the success of the smart city solutions developed.

On the next page, we present 14 recommendations concerning *research, funding, innovation, smart specialisation* and *knowledge transfer;* recommendations that a city or regional government can apply to take the first steps towards becoming a smart city.

The WHAT

The transformation into a smart city rests on three key concetps that, when combined, form the process of *smart specialisation within smart city systems:*

Smart city

– refers to any area (city, region, cluster, county etc.) that uses networked infrastructures (IT as well as traditional) to fuel a sustainable economic growth, more efficient public government and administration and a high quality of life for its businesses and citizens.

Smart city systems

– refers to extensive, citywide systems in which objects and devices in a variety of contexts and infrastructures are infused with computerized intelligence in the form of embedded systems.

Smart specialisation

– refers to the principle of cities choosing to favour certain technologies, businesses and public endeavours and concentrate resources on the development of activities that can transform existing industrial and societal structures through R&D and innovation.

Recommendations

How to strengthen your city's smart city systems specialisation

1. Create a common vision for the development of smart city systems in your city.
2. Mediate across business sectors, public agencies, alliances and initiatives related to smart city and urban development.
3. Establish a permanent smart city roundtable in your city.
4. Communicate the common vision through showcases and case stories.

How to build a strong European eco-system for smart city systems development

5. Create joint events and specific actions across Europe.
6. Establish a smart city office to organise joint actions across Europe, for example under the CLINES brand.
7. Coordinate regional actions and impact.

How to develop innovation capability within smart city systems in your city

8. Facilitate innovation workshops and demonstrators.
9. Liaise between business and research groups.
10. Understand users and value-creating cases.

How to create more business in your city

11. Build knowledge of business models for smart city systems development.
12. Identify key industrial partners and establish matchmaking.
13. Reach for international collaboration.

How to mobilize funding sources for smart city systems development

14. Exchange knowledge of public and commercial investment.

The recommendations are presented in more detail on pages 15-19.

What makes a city ”smart”?

“Smart city” – “Smart specialisation” – “Smart systems” – These terms can be found everywhere today, but what does it really mean that a city is “smart” – and how do we develop and utilise these smart systems optimally?

On the next two pages, we present general definitions of the key terms of this report: smart city, smart specialisation and smart systems – the last in a form specifically associated with smart city development: smart city systems.

Smart city

In this report, we define “smart city” as *the use of networked infrastructures (traditional as well as information and communication technologies) to fuel a sustainable economic growth and a high quality of life in a city.*

These infrastructures should not only be *intelligent* in themselves (such as buildings automatically controlling the air conditioning and heating according to the buildings’ use) but should also be smart in that they provide citizens, businesses and city employees with selected, useful and valuable information that ease and improve their everyday lives (such as real-time traffic information enabling citizens to pick the fastest route through the city during rush hour).

Thus, in transforming into a smart city, a city becomes digitalized through the use of smart systems in an extensive range of contexts with the purpose of improving the everyday lives of its citizens; improving the conditions and competitiveness of its businesses and industries; optimising the consumption of resources (including public budgets) by public agencies and in general increasing the attractiveness of the city for both citizens and businesses.

Note:
When using the term “smart city”, we mean any area – including cities, regions, clusters of cities or towns, counties, districts and neighbourhoods – that have ventured in a joint effort to become a smart area. In this publication, we will refer to any such city, region or area as a smart city.

Smart specialisation

By “smart specialisation” we refer to the principle of *cities choosing to favour certain technologies, businesses and public endeavours and to concentrate resources on the development of activities that can transform existing industrial and societal structures through R&D and innovation.* The purpose is to link research and innovation with economic development and to adapt a policy-making strategy of a region.

This is also referred to as a smart specialisation strategy. In terms of smart city development, a smart specialisation strategy refers to the conscious choice to focus on and support research and innovation within smart city systems with the purpose of transforming cities into smart cities – and through this process, both develop the city itself and support and develop the smart city systems industry of the city.

The importance of smart specialisation is underlined by the fact that the EU has defined an overall strategy for smart specialisation in Europe: “Research and Innovation Smart Specialisation Strategy” (RIS3). Following this, developing a research and innovation strategy for smart specialisation is currently a prerequisite in order to receive funding from the European Regional Development Fund.

Smart city systems

The concept of "smart systems" – or, as we have chosen to refer to them in this publication when talking about smart systems for smart cities: "smart city systems" – refers to *extensive, city-wide systems in which objects or devices in a variety of city contexts and infrastructures are infused with computer intelligence in the form of embedded systems, including Internet of Things technology and cyber-physical systems.*

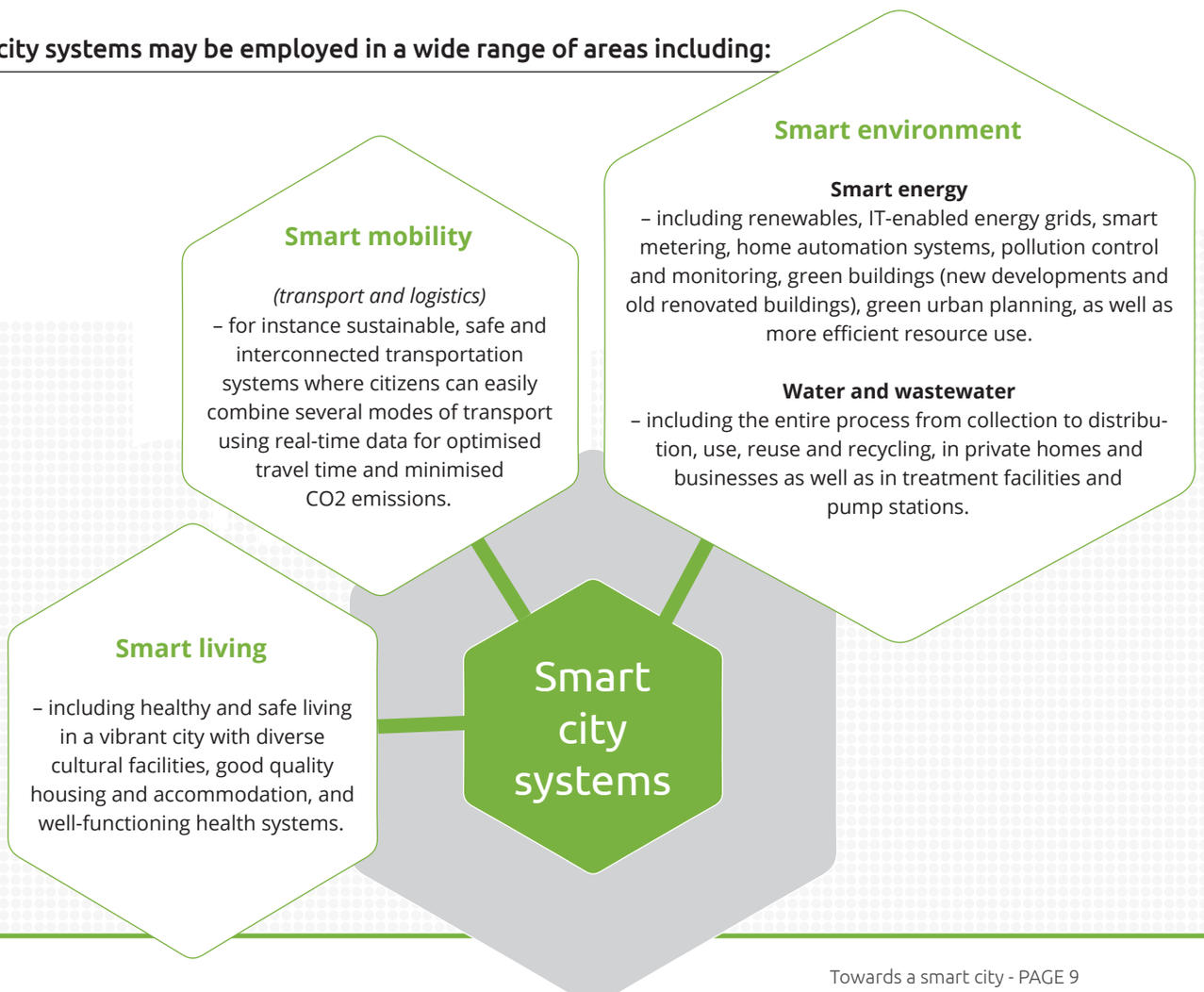
The smart systems are created by incorporating these embedded technologies into physical objects or systems of objects – for instance power grids, traffic lights, water meters, streetlights or cars. The systems monitor, store and communicate data (to citizens, businesses or public authorities) and, in some cases, analyse these data and control the system itself on the basis of these, thus becoming intelligent and autonomous.

Smart systems
are predicted to play a crucial role for the future of European economy: smart systems (micro-/nanoelectronics) are seen as a key enabling technology for solving a range of societal challenges – and as one of the technologies that will enable the EU to keep pace with its main international competitors.

When talking smart city systems, a crucial element is also the communications systems tying all the various devices together. This communications system not only consists of telecommunication networks, public Wi-Fi systems or fibre-optic networks but also LAN networks, sensor networks, Bluetooth connections – and all the other major and minor communications networks that allow any imaginable device to communicate with other devices or with central systems.

Examples of smart city systems

Smart city systems may be employed in a wide range of areas including:



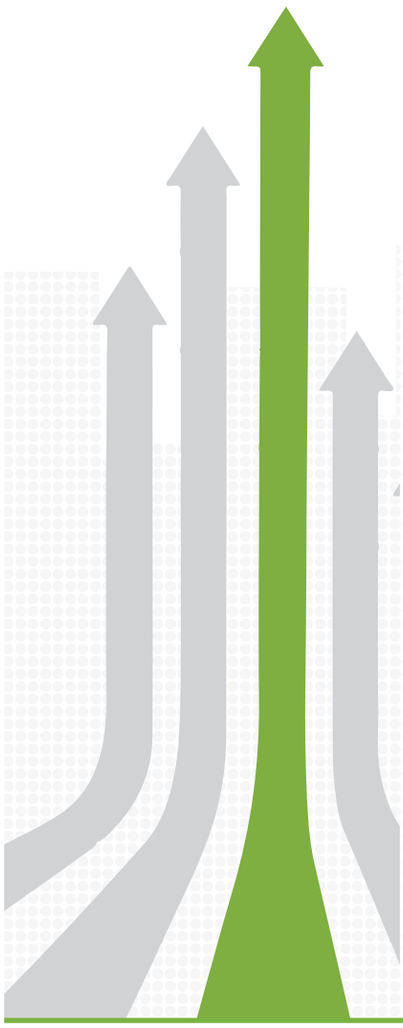
Why move towards becoming a smart city?

A choice to invest in smart city systems specialisation may be the way to solve a range of challenges that cities and regions all over Europe are facing. Growing urbanisation, growing economic competition on a global market, growing environmental challenges and growing expectations from citizens as to the quality of life and service they can expect from the city they call home are only a few of the challenges that set the agenda for political decision makers all over Europe. Although these challenges are major, **they also constitute a large potential for development if used as drivers for innovation – especially in terms of smart city systems.**

As always when talking about major societal changes connected with technological innovation, there are a number of barriers for the transformation of a city into a smart city, but if these barriers are addressed properly – as through following the recommendations presented later in this report – they are indeed surmountable. **And the benefits that citizens, cities, business and industry as well as Europe as a whole will gain are well worth the effort to get there.**

On these pages, we provide you with an overview of some of these key challenges and barriers, as well as some of the key benefits that citizens, businesses, universities and cities may gain from smart city systems specialisation.

As will be evident, the recommendations in this report will enable cities to overcome these challenges and barriers – and at the same time **fulfil the potential for innovation, growth and regional development that smart city systems specialisation offers.**



Key regional challenges that a smart city transformation may solve

Optimisation of resources

There is a growing need for optimisation of the utilisation of existing systems and processes, as well as for extensive, cross-sectorial use of any new systems that a city or region chooses to invest in. Cities all over are experiencing budget cuts while simultaneously experiencing continuous demands for (expensive) improvement of processes, living conditions, public facilities, infrastructure and health systems.

Improved services to citizens and businesses

Citizens' and businesses' expectations are growing, and technological advances are finding their ways into our daily lives. This leads to increased expectations to the services that cities offer, as well as to the communications infrastructures necessary for these various technologies and digital services to function at a high level of operational reliability, speed and data security.

Sustainable development – worldwide demand for the reduction of CO2 emissions

With the pressing demand for a reduction of CO2 emissions and shift towards sustainable fuel sources, cities are facing a major challenge of optimising public buildings, transportation systems, infrastructures, energy systems, waste management – and a wide range of other systems and contexts.

Potential barriers to a city's transformation into a smart city

Lack of a smart city vision and governance

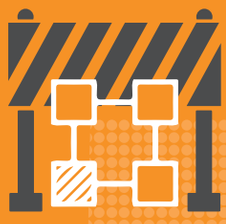
Every train needs an engine. Sometimes that driving force comes from an elected official – a mayor or council member who acts as the smart city champion, or the head of the city or regional smart city initiative. Or it may come from outside city hall altogether with involvement from business leaders, civic organizations or public-private partnerships, or through a smart city roundtable consisting of representatives from 1) city administration, 2) business and industry, 3) universities and knowledge institutions and 4) citizens. The key point is that the governance of smart city efforts should be inclusive and open to the collaboration of different stakeholders.

Lack of financing

Tax revenues are shrinking in many cities, making infrastructure projects increasingly difficult to finance. This makes it crucial to investigate new ways of funding for city projects, as well as new ways of reducing costs for maintenance through smarter use of existing infrastructures and services. Many smart city solutions have a rapid payback, enabling cities to save in the long run through investing in new smart city services.

Lack of IT know-how

Although industry has developed highly sophisticated IT skills, few city governments have had the budget or the vision to push the state of the art. Since smart cities are essentially the injection of IT into every phase of operations, this lack of IT skills puts cities at a disadvantage. This calls for the inclusion of IT experts from industry and research institutions in the planning of the development of smart systems in the city infrastructures in the future – for instance through cross-sectorial collaboration projects.



Lack of integrated services

To the extent that cities applied IT in the past, they applied it to their internal, siloed operations. Those separate IT systems need to be updated to talk to each other, and be useable beyond the city administration. This means that new systems and services need to be developed through projects involving all imaginable stakeholders to ensure cross-sectorial applicability.

Lack of citizen engagement

The smart cities movement is often held back by a lack of clarity about what a smart city is and what it can do for citizens. As a result, many stakeholders are unaware of the smart city options that have found success already. This calls for the communication of a joint vision for the improvements in daily life that a smart city may offer its citizens, as well as the business opportunities that smart city systems specialisation offers business and industry in the area.

List of barriers derives from the "Smart Cities Readiness Guide 2015", pp. 16-17, published by the Smart Cities Council. Read more at www.smartcitiescouncil.com. The list has been adapted and expanded by CLINES for the purposes of this report.

Benefits – for citizens, businesses, cities, universities – and Europe at large

While the barriers to smart city systems development may seem major, they are by far outweighed by the benefits. Transforming a city into a smart city – with the subsequent development, application and utilisation of smart city systems – will reap benefits for all stakeholders:

- **Citizens** will gain a better quality of life, including optimal health systems, improved traffic and transport conditions, a multitude of new services and solutions and decreased expenses for e.g. energy consumption.

- **Business and industry** will gain improved communications infrastructures, higher attractiveness for new employees, business opportunities within smart city services, easier access to global markets, closer ties to regional research groups and a new eco-system of smart city systems innovation.

- **Public agencies** will benefit from a better utilisation of funds, services provided more efficiently and at lower costs, optimum utilisation of existing and new infrastructures (physical as well as digital), economic growth and population growth through increased attractiveness for citizens and businesses.

- **Universities/knowledge institutions** will gain plentiful research and collaboration opportunities during the development and operation of the smart city systems.

- **Europe at large** will gain a higher level of competitiveness on a global scale through a pan-European eco-system for state-of-the-art smart city systems development.

Three general benefits of the smart city:

Enhanced **liveability** means a better quality of life for citizens. In the smart city, people have access to a comfortable, clean, engaged, healthy and safe lifestyle.

Enhanced **sustainability** means giving people access to the resources they need without compromising the ability of future generations to meet their own needs. Sustainability in this context refers not only to the environment, but also to economic realities. It isn't about investing huge sums of money into new infrastructure, it's about making infrastructure do more and last longer for less.

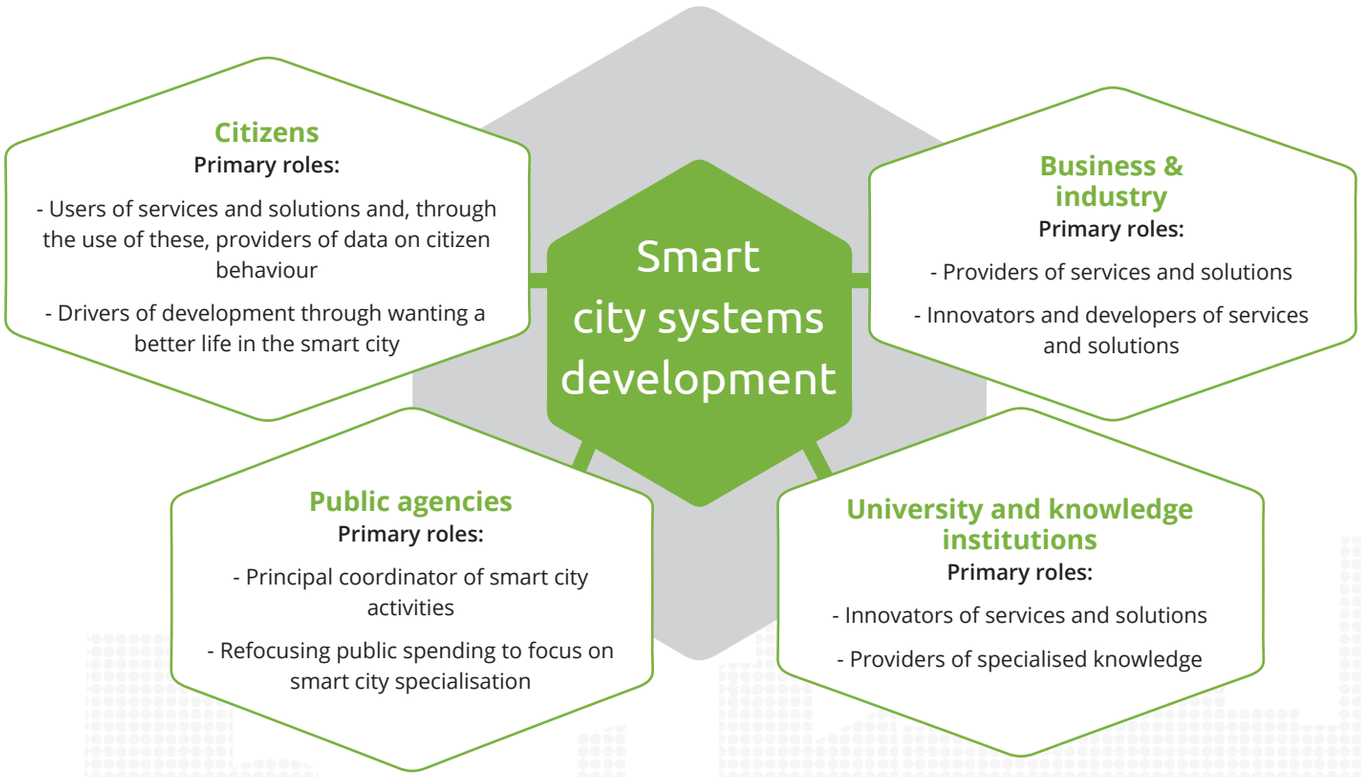
Enhanced **workability** means accelerated economic development. Put another way, it means more jobs, better jobs and increased local GDP. In the smart city, people have access to the foundations of prosperity – the fundamental infrastructure services that let them compete in the world economy.

These three benefits derive from the "Smart Cities Readiness Guide 2015", p. 19, published by the Smart Cities Council. Read more at www.smartcitiescouncil.com.

Smart city systems innovation in practice – Beyond the triple helix

As is evident from the above, citizens play a crucial role in the transformation of a city into a smart city. As end users of the smart systems – and providers of much of the data necessary for the smart systems to function and deliver the valuable knowledge that lets the systems improve a wide range of processes – it is vital that citizens, as well as the city employees who will be using and managing the smart systems from an operational standpoint, are willing to adopt and use the systems developed.

For this purpose, smart city systems development necessitates a new form of cross-sectorial and cross-regional collaboration – one that does not only entail the well-known triple-helix collaboration of university-industry-public organisations but takes into account a crucial fourth factor: Citizens and cities' employees who will be the end users of the smart systems and products in practice.



By bringing together these four groups of stakeholders, a unique synergy arises – and it is this exact quadruple-helix synergy that lets smart city systems development break through all the barriers listed earlier to not only solve technological challenges and facilitate ground-breaking innovation but also to solve the major regional challenges mentioned above.

A crucial point in this connection, however, is the necessity for political decision makers and public agencies to play a very active role. The success of smart city systems specialisation – and the fulfilment of the huge potential that this area holds – rests on the ability to facilitate collaboration across all four groups of stakeholders. For this purpose, it is necessary to have a key organisation – such as a public/private smart city partnership or a publically funded smart city office – that can be the driving force and coordinating player behind the smart city activities in the city. And, behind that, financial and administrative support from regional as well as national governmental agencies and policies.

Towards a smart city – Global development on a local scene

The smart city systems industry is a global business. Many of the businesses developing smart city systems, whether large or small enterprises, are part of global value chains. This means that competition takes place neither at a regional nor at a national level, but at a global level. In contrast to the global character of the smart city systems industry, the challenges of cities have a very local or regional character rooted in the city's ecosystems and culture.

Any effort to drive smart city systems in Europe forward must take this context into account. An approach has to be defined where global solutions meet local opportunities. Driving value development in the area of smart city systems must be rooted in local city ecosystems and at the same time has to take advantage of synergies between regions and between globally developed smart city systems solutions. Matching 'local' smart city needs with 'global' smart city systems solutions requires a joint quadruple-helix approach based on detailed analysis of local ecosystems, culture and needs and thorough knowledge of the smart city systems sector.

Recommendations for smart city systems specialisation

This is exactly the context that the CLINES Joint Action Plan – including its 14 recommended actions – presented in this report has been developed in. Through the collaboration of partners from four European regions (Spain, Germany, Belgium and Denmark) and building on detailed analyses of ecosystems, road mapping of industrial and societal trends, surveys and experiences from both local and joint activities – to name a few elements of the work done in the CLINES project – the Joint Action Plan constitutes a strategy that will work locally, regionally and internationally; for the benefit of the individual company or citizen as well as for the entire smart city in question, and for Europe as a whole.

In short, the CLINES Joint Action Plan is an action plan outlining a strategy for the future development of the involved regions and cluster organisations in the context of smart city systems development. The plan includes specific strategies for activities within *research, funding, innovation, smart specialisation* and *knowledge transfer*, ensuring the establishment of a firm basis for pushing economic development in the four regions by enabling innovative research and technology partnerships within the collaborative area of smart city systems.

The Joint Action Plan as a whole can be downloaded at www.clines-project.eu; on the following pages we will present the key points –14 specific recommendations for smart city development – with the aim of strengthening the joint effort on smart city development within each region as well as across the four regions and Europe as a whole.

The 14 recommendations are not regionally specific; the intention is that the strategy and recommendations will be applied in a wider context to help and support smart city systems specialisation initiatives in Europe as well as internationally.

How to strengthen your city's smart city systems specialisation

When initiating your efforts to strengthen your city's focus on smart city development – in other words strengthening your smart city systems specialisation activities – a crucial point is gaining public support to ensure that all stakeholders – end users (citizens and city employees), business and industry, research and knowledge institutions and governmental organisations – support the initiatives.

Recommendations:

1 Create a common vision for the development of smart city systems

In order to leverage regional strengths, potentials and opportunities, strengthen cooperation across sectors and minimise regional weaknesses and threats, a common vision for the regional smart city systems specialisation is needed. The vision must emphasise regional strengths with a focus on improving the visibility and awareness of these strengths and their potentials, as well as increase the awareness of the benefits of regional and cross-regional collaboration.

2 Mediate across business sectors, public agencies, alliances and initiatives related to smart city and urban development

At the outset, the various stakeholders in the quadruple-helix collaboration structure seem to have different interests, business domains, technology domains, cultures, languages and modes of operation, but synergies can be found and translations must be sought. This will optimise collaborative processes and the effect and success of the smart city products and solutions developed. A potential tool for achieving this is joint innovation workshops.

3 Establish a permanent smart city roundtable in your city

Over the course of the CLINES project, regional smart city interest groups have been established. To transform the regional stakeholders from being a CLINES project interest group to becoming useful for regional smart specialisation beyond the project, a permanent smart city roundtable should be established. This process includes involving a broader set of stakeholders, including businessmen and public policy-makers, and thus also serves to strengthen public support among a wide section of the city's citizens and businesses.

4 Communicate the common vision through showcases and case stories

In order to strengthen public support for the common vision and the city's smart specialisation activities, the vision and the benefits of it must be communicated broadly. For this purpose, three types of exemplary stories can be used:

- Examples and convincing stories of successful collaboration within the smart city systems vision
- The CLINES showcases
- Reports on identified and important problems concerning smart city systems.

How to build a strong European eco-system for smart city systems development

As mentioned earlier, smart city development is a matter of solving local smart city challenges and needs through global smart city systems solutions. In order to fully utilise the global potential of locally developed solutions – and, conversely, utilise solutions and competences from other European regions to avoid the expense of developing solutions that already exist – the overall European eco-system for the development of smart city systems must be cultivated.

Recommendations:

5 Create joint events and specific actions across Europe

In order to promote an overall European agenda within the development of smart city systems, joint events and matchmaking actions should be organised. Topics may include:

- Funding opportunities
- Calls
- Smart city projects
- Knowledge and research on smart city systems.

The events will be open to European as well as other international interested parties and will include organised matchmaking across relevant sectors and across the participating regions.

6 Establish a smart city office to organise joint actions across Europe, for instance under the CLINES brand

In order to strengthen the regional cluster organisations and cross-cluster collaboration, a smart city office should be established (initially reaching out to the CLINES regions, then later branching further out). The tasks of the office should include:

- Matchmaking through joint events
- Informal matchmaking through identifying relevant partners
- Coordination between the partner regions
- Expanding knowledge of interests, competences, stakeholders etc.
- Seeking knowledge and influencing pre-competitive public procurement
- Communicating knowledge and insights in newsletters to all regions
- Branding the office as CLINES in order to build on the established consortium brand.

7 Coordinate regional actions and impact

In order to heighten the impact both regionally and jointly, the local actions of each region should be coordinated. In particular, it is crucial to facilitate the exchange of experiences and results in order to facilitate joint learning from past experiences.

As part of this action, closer ties should be formed with the city administrations of each region as well as to the cities' smart city initiatives.

How to develop innovation capability within smart city systems in your city

Innovation within smart city systems is difficult, and capabilities need to be developed and nurtured both regionally and jointly across Europe. In this respect, a crucial action is to ensure the linking between research and technology on the one hand and application and value creation on the other – in other words, to establish the quadruple-helix collaboration between research, business, cities and citizens.

Recommendations:

8 Facilitate innovation workshops and demonstrators

To build the various stakeholders' – research, industry, cities and citizens – capability for innovation, it is necessary to build their competences in innovation and in creative thinking. This can be done through facilitating innovation workshops aiming to:

- transfer methods and processes
- communicate exemplary innovation through demonstrators and showcases.

The workshops will revolve around a particular challenge within smart city systems (designed in detail beforehand) and will invite the most relevant stakeholders, who will be guided through the innovative and creative processes over the course of the workshops.

9 Liaise between business and research groups in your city

In order to optimise collaboration, it is necessary to build bridges between business/industry and research groups, research labs, test beds and technical infrastructure for smart city systems. This involves the cluster organisations having insight in the on-going research in their region within smart city systems and helping to open doors to these activities for businesses in and across the regions.

10 Understand users and value-creating cases

In order to develop successful smart city solutions that are adopted and used by the end users, it is necessary to build an understanding of the users (including citizens and cities' employees) and consumers of smart city systems. This may be done through use cases, through business cases and by exchanging user analyses. The purpose is to ensure that the systems developed create value for customers and citizens, as understanding the users of smart applications and their visions for the future will be crucial in meeting their needs for smart city solutions.

How to create more business in your city

A particular challenge within the development of smart city systems is to increase the volume and quality of business within the eco-system of smart city systems development. This needs to be supported by new and improved business models and entrepreneurial capabilities, including a particular focus on start-ups and SMEs, as well as linking with international partners and unleashing new opportunities through alliances and networks or close collaboration.

11 Build knowledge of business models for smart city systems development

To create more business in a new domain such as smart city systems, it is necessary to develop and disseminate new business models fitting this domain. The business models need to explain how to create value across previously closed borders between sectors and between public agencies and private businesses, and how to utilise radically new configurations such as value networks, quadruple-helix cooperation and alliances.

Part of the establishment of these business models will be matchmaking across sectors and across regions in relation to specific topics within the development of smart city systems. Connected to these matchmaking activities, activities of open development with an eye towards learning from joint experience for future collaboration (rather than, say, specific product development) should be organised.

12 Identify key industrial partners and establish matchmaking

In order to root the smart specialisation vision and development activities in the city, key industrial partners that are already operating on a global market should be identified and invited to participate in the activities, including in the regional smart city roundtables, events and matchmaking activities. Through these partners – who have considerable influence and momentum both regionally and internationally – the eco system can be extended beyond the initial partners, and through matchmaking with (other) SMEs, the partners themselves may become more agile through collaboration.

13 Reach for international collaboration

An important part of creating more business is connected to the facilitation of international outreach for SMEs through international matchmaking. Through being less known by potential international collaborators, SMEs may experience obstacles for their international activities. This can be amended by activities that:

- attend to the specific needs of SMEs seeking international collaborators
- support the internationalisation efforts of these SMEs
- facilitate the exchange of key information and knowledge among SMEs
- activate SMEs from different regions and clusters.

How to mobilize funding sources for smart city systems development

In order to facilitate smart specialisation and the development of smart city systems, a variety of funding sources are needed to underpin the various steps in the transformation of a city into a smart city. Therefore, it is necessary to identify, understand, apply, gain, and report on all funding sources relevant to promoting these efforts, both jointly on a European scale and regionally in each cluster.

This involves both public funding for research, cluster organisations and SMEs, and commercial investment, such as venture capital and crowd funding. This may also involve informing political decision makers and funding agencies of the attractiveness of funding activities within the development of smart city systems.

14 Exchange knowledge of public and commercial investment

To mobilize more explicit and relevant funding for activities within the development of smart city systems, there is a need to facilitate the exchange of knowledge between the regions on the structure and availability of both public and commercial investments.

Part of this action will be to establish and maintain an overview of investment structures and availability in the regional cluster organisations, as well as facilitating public-private partnerships.

Smart city systems in action

Smart city systems can be a diffuse concept, as it may cover a very extensive range of city systems. On these pages, we present three showcases from the CLINES partners, illustrating three types of smart city systems, namely solutions under the three headings smart mobility, smart living and smart energy.

Smart mobility: The Bike Cruzer

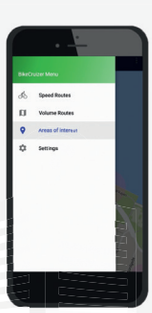
The Bike Cruzer is a mobility service for tourists in the form of a smartphone app offering information of the biking patterns of other tourists. The tourist can choose between three types of maps: areas of interest, routes where other tourists have ridden their bikes, and information on how fast other tourists have ridden where.

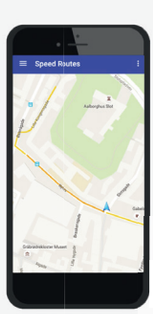
The aim is to provide tourists who want to explore a city on bikes with information on where other tourists have ridden and where they have stopped, as this indicates particular areas of interest that the tourists might want to explore.

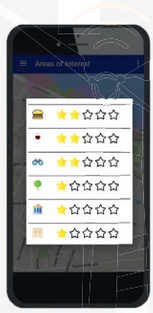
The data is generated by the behaviour of tourists riding around on bikes and can potentially be combined with other data from municipalities, such as data on safe bike routes and locations of cycle tracks, to generate useful information for municipalities.

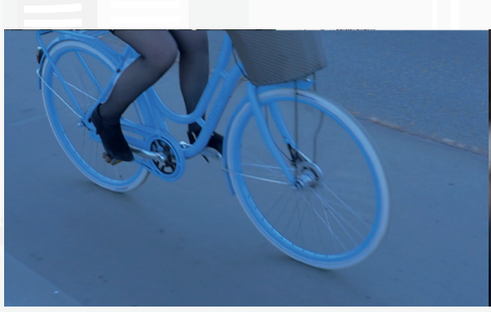
Another potential application of the Bike Cruzer solution is adding in tourist information to increase the value the app will give the tourist user.

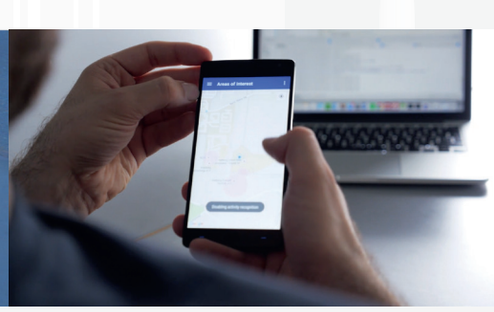
The prototype of the Bike Cruzer app is developed by researchers at Aalborg University.











Smart living: Intelligent Lighting in Donastia-San Sebastian

As part of the large SmartKalea project of Donostia, San Sebastian – a project promoting sustainability and energy saving among the merchandisers, restaurateurs and residents of Downtown San Sebastian – an intelligent lighting system has been installed in the Calle Mayor, one of the main streets in the old city centre.

The system allows control of consumption and light intensity by adjusting the extent and intensity of the lighting to the amount of traffic and number of people in the street at all times.

The new LED-based lighting system will be adjustable and remotely manageable, and it will function on the basis of a system of detection and analysis of the way pedestrians move in the area.

The lighting system is one of a range of systems in the Smart Kalea project. This project constitutes a comprehensive smart city platform that allows real-time monitoring – and subsequent control – of a number of systems across more than 23 premises and 67 houses. The project incorporates private citizens and retailers as well as technology businesses and city management.

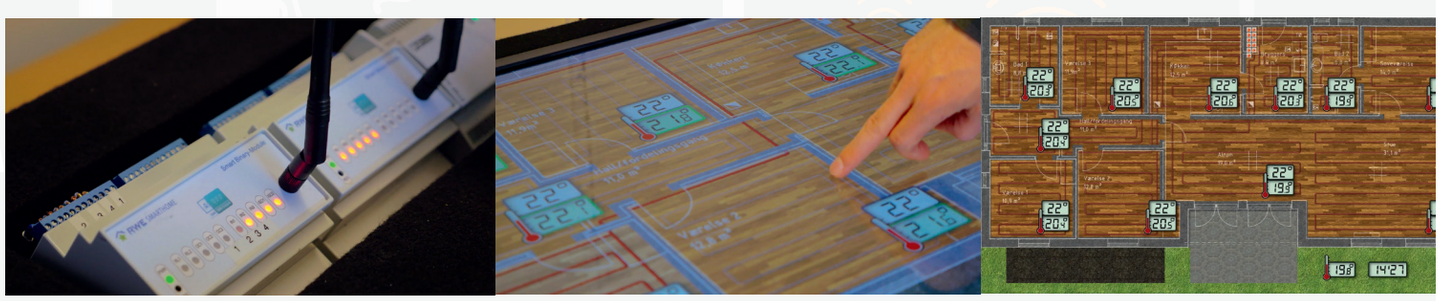
Smart energy: Floor heating system

In Aalborg, the company Seluxit and researchers at Aalborg University have developed a home automation system for intelligent control of floor heating in houses.

The system incorporates data on the usage of the house – gained by monitoring the use of the different rooms – with data on real-time outside temperatures and weather forecasts. This enables an optimisation of the heating system, taking into account both the comfort of the users of the building and the importance of saving energy.

By incorporating weather data into the controlling algorithm of the system, the system will adjust the amount and level of heating to the predicted outside temperature – for instance not turning on the heating if the forecast says hot and sunny; a feature that will be increasingly important in the future where we will see fluctuating energy prices depending on the time of day.

The plan now is to commercialise the system and expand it to a scalable model incorporating several houses, enabling optimised energy consumption – and consequent energy saving at a major scale.



The work continues

– Examples of smart city specialisation activities from the four CLINES regions

As a continuation of (and, in some cases, parallel to) the work carried out in the CLINES project, a number of smart city initiatives have already been set in motion in the four participating regions. Below, we present highlights of the smart city initiatives of the four regions.

Flanders, Belgium

To drive economic development in the area of 'smart systems for smart cities' in Flanders a phased approach will be followed which will implement a number of the recommendations from the CLINES Joint Action Plan:

Phase 1 will focus on mobilizing Flemish smart city stakeholders around the CLINES vision and develop a list of priorities. This phase will include:

- Developing a holistic vision on smart cities and creating awareness amongst stakeholders on the challenges of modern cities and the added value of smart systems to overcome those challenges.
- Developing (international) partnerships with key stakeholders.
- Organising and attending smart city events: By actively participating and organising smart systems for smart city events to smart city related events the objective is to build a vibrant ecosystem in this domain.
- Developing a Fast Track to Innovation program on smart city systems. The idea is to define a range of challenges and to mobilise stakeholders to develop solutions for those challenges.

Phase 2 will focus on proactively developing smart city opportunities together with smart city stakeholders.

Basque Country, Spain

The Basque Government is using smart specialisation as a focal point to review how they are doing things, and to try to make improvements to governance so that the innovation investments of firms, universities and government can be better aligned.

The smart city niche was the first to formally establish a steering group. Companies, in collaboration with different clusters, have identified unique innovative opportunity areas for service or product delivery within this niche, which have the potential to respond to the latest global and regional trends (housing efficiency, digital transformation, urban growth and rural development, mobility and improving people's quality of life).

This work has led to the identification of a range of challenges:

- Both economic and research activities are distributed across departments, necessitating a high degree of inter-departmental coordination.
- Integration of civil society concerns is crucial.
- Companies working within the smart city niche need to understand and respond to the complexity and diversity of issues, technologies and business models involved.

However, the potential of the niche, and the opportunities provided if the abovementioned challenges are met, are highlighted by the enthusiasm with which many diverse stakeholders have embraced the initial outreach of the steering group, thus emphasising the general interest in the area from both citizens and businesses.

North Denmark, Denmark

The public/private cluster organisation BrainsBusiness will work to create a strong vision for smart city in collaboration with, among others, the City of Aalborg and Aalborg University, and link this vision to specific competences within BrainsBusiness' member companies and relevant research groups at the university.

The purpose is to create awareness amongst stakeholders on the challenges of modern cities and the added value of smart systems to overcome those challenges, and to utilize this awareness in matchmaking and consortia building events for Horizon 2020 applications focusing on smart city systems development.

Among the activities carried out will be:

- Establishing a permanent smart city roundtable
- Communicating the smart city vision to citizens, industries, public organisations
- Liaising between businesses, research groups and end users
- Building and disseminating knowledge on smart city business models
- Identifying key industrial partners and SMEs.

Bavaria, Germany

Numerous Bavarian policies exist that roadmap the development of (technology) fields that are instrumental to smart cities. For instance, the central policy documents for Digital change and hence smart cities is the Gesamtkonzept für die Forschungs-, Technologie- und Innovationspolitik der Bayerischen Staatsregierung, Beschluss der Bayerischen Staatsregierung of May 3rd, 2011 and the "Zukunftsstrategie Bayern Digital" – Strategy for a Digital Bavaria (published July 2015). One of the cornerstones of implementing the strategy is the creation of the Zentrum Digitalisierung.Bayern (ZD.B) – Centre for Digitisation of Bavaria, of which the cluster BICCnet is a partner. Among the topics that are researched and disseminated within Bavaria are:
Networked Mobility · Health · Energy · IT –Security · Industrie 4.0

The three first topics are of course the centre of the CLINES smart city technology focus. It is thus perfect that the cluster BICCnet has been a part of the ZD.B since its inception, as it can continue to pursue the smart city topics within the politically very well-recognised ZD.B.

In addition, the city of Munich is currently drafting their strategic plan for the town's (smart) development in the next decade.

Smart city – highlights in Bavaria:

- "Smarter Together". A pilot project that aims at developing IT solutions for the energy transition in urban areas, including residential housing renovation, production and consumption of renewable energy and mobility. (EU H2020, together with Lyon and Vienna).
- "Open Data Warehouse": Plans are developed to create a central database that can hold all the data that is created by the city (infrastructure).
- The Virtual Innovation Forum, Ingolstadt, aims at constructing a virtual model of the region. It wants to digitally represent all activities in the region, such as for instance modelling the traffic patterns, and providing real-time data, including on exhaust pollution. In addition, the Federal Minister of Transport and Digital Infrastructure, Alexander Dobrindt, has announced plans to turn parts of the Autobahn A9 near Ingolstadt into a testbed for autonomous driving, which would be a boost for the regional model.

Smart cities and the ideas of smart cities are on the rise. Information and communications technology offers a multitude of new solutions to the challenges that cities and regions are facing, and citizens place increasing demands on their cities and public institutions with regards to smarter and better solutions and services that will improve their everyday lives.

This report present recommendations for an action strategy for smart city systems specialisation that will enable cities to move towards becoming smart cities – for the benefit of all stakeholders in that city.

We present what smart city systems specialisation means in practice, why cities should embrace this kind of smart specialisation to move forward and how they can achieve a successful transformation into a smart city.

Learn more about how to become a smart city:

CLINES resources
- Full Joint Action Plan
- Catalogue of the technological challenges facing the potential smart city
- Catalogue of showcases, demonstrators and demo videos of smart city solutions
- Smart city information paper – A guide to the main concepts of the smart city

Available at
www.clines-project.eu/downloads

Other resources
- Smart City Readiness Guide

Avialable at
www.smartcitiescouncil.com

Partner websites
www.brainsbusiness.dk
www.biccnet.de
www.dspvalley.com
www.gaia.es
www.tecnalia.com

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