

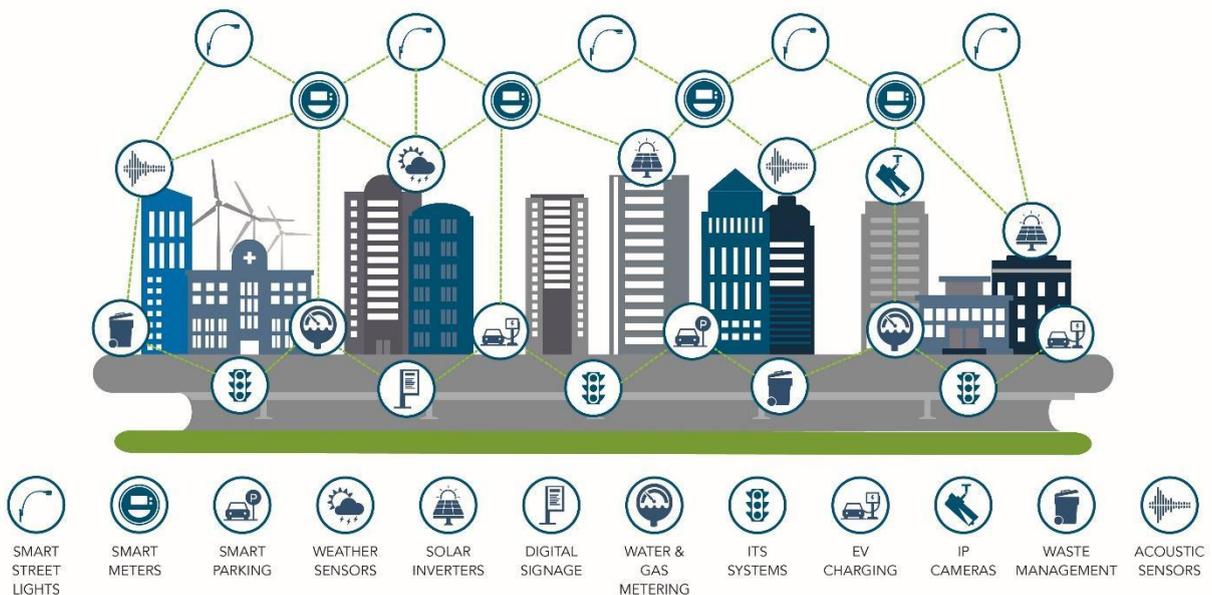


Co-funded by the
Erasmus+ Programme
of the European Union



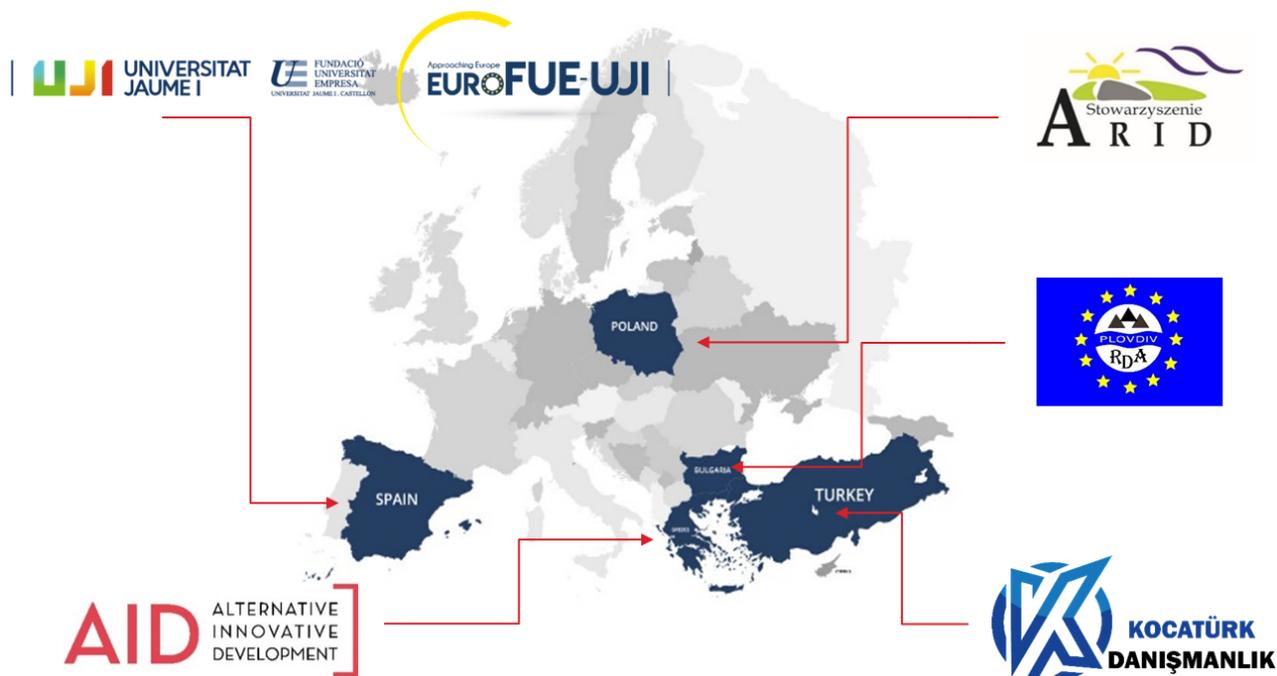
MODULE 1

INTRODUCTION





Co-funded by the
Erasmus+ Programme
of the European Union



[HTTPS://STARTUPERASMUS.EU](https://startuperasmus.eu)

PRODUCED BY: START-UP PROJECT PARTNERSHIP

APPLICANT COORDINATOR: FUNDACIÓ UNIVERSITAT JAUME I-EMPRESA (ES)

PROJECT PARTNERS:

Kocatürk Danismanlik Özel Eğitim Hizmetleri Turizm ve Proje Hizmetleri Ticaret Sanayi Limited Sirketi (TR)

STOWARZYSZENIE ARID (PL)

Regional Development Agency with Business Support Centre for Small and Medium-sized Enterprises (BG)

ENALLAKTIKI KAINOTOMA ANAPTYXI ASTIKI MI KERGOSKOPIKI ETAIREIA (GR)

Project Code: 2020-1-ES01-KA204-082611

This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.



Co-funded by the
Erasmus+ Programme
of the European Union



CONTENT MAP:

UNIT 1. Introduction of the concept of smart cities	6
1.1. Some definitions	8
UNIT 2. Benefits of a smarter city	13
UNIT 3. Standards and standardization	15
3.1. ISO 37101: Sustainable development & resilience of communities – Management systems General principles & requirements	16
3.2. ISO 37120 Sustainable development of communities. Indicators for city services and quality of life	17
UNIT 4. Open data and big data	20
UNIT 5. Smart citizens	23
5.1. Different approaches	24



Co-funded by the
Erasmus+ Programme
of the European Union



ANNOTATION AND LEARNING GOALS:

This module is focusing on introduction of the concept of smart cities/villages and the understanding of this concept by the municipalities who are the ones implementing smart solutions in their environment. It is based on a premise that the understanding of the concept of smart cities/villages by municipalities is on a low level due to the fact that the problem is too wide, solutions even wider and there is also the lack of experts offering comprehensive solutions for municipalities. Especially those small municipalities that cannot afford to have such experts in their employment.

It is an adult education (online and offline) module focused on smart cities/villages. The concept of smart cities/villages is in principle too wide, making it difficult for the municipalities and wider public to understand and start implementing. The idea is to create a training module to train the trainers who would then work with municipalities promoting the smart cities/villages solutions and their understanding.

The main goal of the module is to form introductory knowledge, skills and professional competencies in the field of smart cities.

EXPECTED LEARNING OUTCOMES:

After studying the module, the trainees are expected to acquire introductory theoretical knowledge, cognitive and practical skills in the field of smart cities, as follows:

Knowledge:

- of the concept of smart cities
- of some basic definitions related to for smart cities
- of benefits of smarter city
- of some standards and standardization
- different approaches related to smart cities

Skills:

- recognise the challenges and opportunities cities face
- discuss smart city definitions and what they have in common
- skills for independent work



Co-funded by the
Erasmus+ Programme
of the European Union



Competences:

- Competences for learning (for comprehension, understanding and critical interpretation of the acquired theoretical knowledge; for clear and understandable formulation of ideas and solutions to problems; for practical application of theoretical concepts; for logical, analytical and creative thinking);
- Professional competences (in the field of training and development related to smart cities);
- Independence and responsibility (related to the skills for independent work);

FORMS AND METHODS OF WORK

The methods used in the work are appropriately selected to address all levels of the taxonomy of learning, namely – perception, understanding, application, analysis, synthesis and evaluation.

Mode of study: online, physical, blended

The main forms and methods of work are:

- lecture with discussion (online/offline)
- training seminars (online/offline)
- self-study (online/offline)

Study materials: books, readers, online and offline training materials, PPP



Co-funded by the
Erasmus+ Programme
of the European Union



UNIT 1. Introduction of the concept of smart cities

Cities are a place where people live and work together. And different people look at this living and working together from different perspectives. So, there are people who look at cities as an economic system. The generation of wealth, the generation of jobs, the economic interactions, the economic conditions for the workings of a city as an economic system. Typically, economists look at cities as an economic system. Sociologists rather look at cities as a social system, it's a way of life of cultural life, of social life, of activities, of inequities and all these kinds of things. Then there are people who look at cities as a political system, how the different actors interact with each other, who decides about what, who has power over what. So, it is also possible to look at cities as such political systems. Our approach is to look in particular at cities as a technological system. Typically, the infrastructures constitute the technological system of a city. And of course, all these things are interrelated which exactly makes the city a socio-technical system. The way the technology works effects the economy, the way the economy works effects whether you have money to invest in technology the same for the social and political dimensions. So, this is the very systemic view of a city. Now more precisely, as we said, the city is a place where people live and work together. The urban infrastructures enable such collective living and working. And this is typically done in a systemic fashion. The infrastructures enable the way that people work, the way that people live, the way that people decide. You can easily imagine how the infrastructures are built those effects social life. Is it easy to reach the city centre or not? Is the traffic flowing, is it not flowing? Is water available? All this effects the quality of life, of social life and of economic life of a city. But also, the other way around the economic and social and political life determines how the infrastructures are maintained, built, invested in, developed. So, it is easily understandable that depending on the political decision-making processes, investments are done in certain parts of the cities and not done in other parts of the cities. Business parks are created here, not there. So typically, the city is such a complex socio-technical system that decides upon the infrastructure which in turn decide upon the social life of a city. Now, at the same time, one can look a little bit more in detail. To look at the infrastructures themselves as a socio-technical system. And so, we have infrastructures, such typical infrastructures, such as transport, housing, buildings, energy, water and other things you can add. Waste water, waste. And the way these infrastructures are laid out effect the way that the social and political and economic life of a city is happening. Inversely, the decisions made at these levels will effect where housing is going to be, whether transport is developed here or there whether energy is renewable or not renewable whether water is cleaned or not cleaned. So, one can really look at urban infrastructure systems as a socio-technical system in itself as part of a larger urban system. Now this systemic view of cities clearly has implications on the management and the governance of cities. The most important concept here is the concept of feedback loops. So, all



Co-funded by the
Erasmus+ Programme
of the European Union



these elements of the system, of course, interact with each other and create feedback. The social dimensions interact with the technical dimensions. The technical dimensions interact with the economic dimensions and all this creates feedback loops. This makes cities very, very complex and the outcomes of what happens in the city is never attributable to one single cause. All these elements are related to each other. And of course, all these things are also path dependent. So, decisions that have been made at some point in the past deploy their effects later in the future. What happens today, may be caused by an array of complex interactions and feedback loops that come from the past. Let us illustrate that in the context of cities. So, the city is in its environment. And as we said, the city and especially its infrastructure are a complex socio-technical system interacting with each other. So, there are feedback loops on both sides. There are technical feedback loops. The way housing works effects transport. Transport effects energy. All these technical feedback loops are going on inside a city. Similarly, there are social feedback loops. The different actors interact with each other. What is done economically has an impact on the social life. What happens socially has an impact on finances, on the economic life. And then, of course, even more so there are interactions, between the social dimensions and the technical dimensions themselves. So how the technology is laid out effects the social life, effects the way people work, whether they get to work or not, whether they have water or not and the other way around, of course, also. Now all this, and this is our particular approach to the city, all this leads to certain types of performance of a city. We have classified performance in terms of efficiency, resilience and sustainability of cities but it is easily understandable that all these feedback loops, the complexity, the path dependency makes the management and the governance of these cities extremely complex, unpredictable and we need to take that fact into account when we manage and govern cities.



Introduction to Smart Cities: <https://youtu.be/pXSJmZcC2J8>



Co-funded by the
Erasmus+ Programme
of the European Union



1.1. Some definitions

Smart cities and communities are helping to tackle urban challenges, foster local economies, and meet targets set in the European Green Deal.

The concept of smart city was first used in 1994.¹ Since 2011 the number of publications referring to this subject has distinctly grown. This is associated with the emergence of smart city projects and endorsement by the European Union.

“Smart cities” is a term used to describe the use of smart technologies and data as the means to solve cities’ sustainability challenges. Many cities are in the process of making themselves smart, using data and technology to improve transport, energy use, health and air quality or to drive economic growth. Others are being built to be smart from the start. So, this is a term that relates to the present and to the future.

Other definition: A Smart City is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership.²

What are smart cities according EC?

A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business.

A smart city goes beyond the use of digital technologies for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population.

The construction of intelligent cities is a long and systematic process, as well as a process of continuous exploration.

The point of becoming a smart city is that it will increase resilience and improve the lives of citizens. So, should the vision of a smart city be to implement more technology or to explore how technology might enable the city and citizens to solve the challenges they face?

Cities are centres of innovation and creativity, but they also face great challenges such as rapid urbanisation, climate change and increased pressure on city services like transport and healthcare. To address the challenges and capitalise on the opportunities, cities are encouraged to become “smart cities”. However, the term

¹ Porter 2003 ; Lombardi et al.2012 ; Dameri, Cocchia 2013

² The European Network of Living Labs and World Bank, „A Guidebook for City Mayors and Public Administrators”, 2015



Co-funded by the
Erasmus+ Programme
of the European Union



“smart city” is broad and ambiguous, with no agreed definition or consensus on how cities should approach the agenda.

A number of smart city definitions exist; some have a broad focus while others focus on technology and data or citizens. For example:

- The British Standards Institute (BSI) defines smart cities as “the effective integration of physical, digital and human systems in the built environment to deliver sustainable, prosperous and inclusive future for its citizens” (BSI, 2014).
- Cisco defines the term as those cities that adopt “scalable solutions that take advantage of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life” (Falconer and Mitchell, 2012).

What most smart city definitions have in common is that they consider the use of smart technologies and data as the means to solve cities’ sustainability challenges – economic, social and environmental issues. Smart technologies can be classified, broadly, as ICT solutions. They range from expensive hardware solutions such as city control centres, smart grids and autonomous vehicles, through to much lower cost solutions such as smartphone apps, online platforms that crowdsource citizens’ ideas and low-cost environmental sensors. Data is also central to smart cities, in particular the use of big data and open data.

The approaches to smart city initiatives can be classified into two main approaches: “top-down” and “bottom-up” (Centre for Cities, 2014). Top-down approaches focus on technology, efficiency and master planning, integrating data from different systems into a central operations centre. Bottom-up approaches focus on citizens and how they can use innovative technologies, such as social media, mobile applications and open data to create solutions to issues that matter to them and enable behaviour change.

So, do smart cities already exist or are they a future aspiration? Smart cities are created, they don’t simply exist or emerge, but there is no end point. Rather, becoming a smart city is a process by which cities use smart technologies and innovative approaches to address the challenges they face, helping them to become more resilient and liveable.

Today, more than half of the world’s population, 3.5 billion people, live in urban areas, and by 2030 this will rise to 60%. Over the next decades there will be significant changes in the size and distribution of the world’s population.

According to the United Nations (UN) close to half of the urban population live in cities of less than 500,000 people, but one in eight of us live in 28 mega cities – cities



Co-funded by the
Erasmus+ Programme
of the European Union



that have more than 10 million inhabitants, such as Tokyo, Delhi, Shanghai, Sao Paulo and London. The fastest growing cities have 500,000 to 1 million inhabitants and are located in Asia and Africa (UN, 2014).

Rapid urbanisation and unplanned growth pose significant challenges – greater demand for natural resources such as water and energy, increased pollution and impacts on biodiversity. The world's cities occupy just 2% of the Earth's land, but account for up to 80% of energy consumption and 75% of carbon dioxide emissions (UN, 2014).

Cities are major contributors to climate change but they're also heavily vulnerable to it: they're affected by rising sea levels, more frequent and stronger storms and cyclones, and more frequent extremes in heat and cold. These then impact on urban infrastructure and quality of life.

In many cities there's also a shortage of housing, pressure on healthcare systems, and issues with poverty and crime.

Cities in the developing world face the toughest challenges, and it is here that 95% of future urban growth is predicted to take place by 2050. These cities will experience great change but have the lowest levels of resources and institutional capabilities to deal with that change. Already, 828 million people live in slums and the number keeps rising (UN, 2015).

As urban populations continue to grow, the demand for services and pressure on resources will increase. This will put a strain on energy, water, waste, mobility and other utilities essential for prosperity and sustainability in cities. Smart cities can help us combat these pressures and work towards sustainability through projects such as smarter urban transport networks, upgraded water supply and waste disposal facilities. They also look for more efficient ways to light and heat buildings. Smart cities also mean a more interactive and responsive city administration, safer public spaces, and an ability to react to the needs of ageing populations.

The European Commission is working towards smart cities in a number of ways, including achieving a smart city digital ecosystem, maximising efficiency and flexibility, building consensus, connecting Europe, and looking towards climate neutral and smart cities.

However, the concentration of people in cities can also bring benefits: if managed well population density allows increased access to jobs and cultural activities as well as to services such as healthcare, education and mobility, which could lead to longer life expectancy and poverty reduction.

Cities are dynamic places. They rely on the flow of people, ideas, resources and global connections. To thrive, cities need to meet the economic and social



Co-funded by the
Erasmus+ Programme
of the European Union



aspirations of the people who live there. They also need to manage their impacts on the environment in order to ensure that their growth is sustainable and that benefits are accessible to all.

Cities face complex challenges but they also offer a setting where people and organisations together can find solutions and opportunities. In smart cities, creativity, innovation and enterprise combine with technology and data to develop innovative solutions to urban challenges and citizens' needs.

But becoming a smart city doesn't necessarily mean being a resilient or sustainable city. Some smart city initiatives are driven by a vision of technology for the sake of technology. They fill their cities with smart technologies but they are not clear what problem these will solve and have little understanding of the needs of the citizens. These projects are often shaped by large technology companies who want to sell their smart city solutions. Amid the heavy marketing of smart city products and services it is hard to find evidence of impacts in the real world.

Other's cities have set out with a belief that smart technology such as smart meters, electric vehicles, a smart grid or city control centre will solve their city challenges but concern themselves with working out where to deploy the smart technology rather than first being clear about its purpose, identifying the problem and then considering whether smart technology is the right solution.

An integrated approach to planning and management is needed if smart cities are to become more sustainable and resilient.

It could be describing city resilience through four dimensions:

- Health and wellbeing – everyone living and working in the city has access to what they need to survive and thrive
- Economy and society – the social and financial systems that enable urban populations to live peacefully and act collectively
- Leadership and strategy – the processes that promote effective leadership, inclusive decision making, empowered stakeholders and integrated planning
- Infrastructure and environment – the man-made and natural systems that provide critical services, and that protect and connect urban assets, enabling the flow of goods, services and knowledge.

The smart city is a complex ecosystem of people, processes, policies, technology and other enablers working together to deliver a set of outcomes. If smart cities want to solve city challenges, their best first step is to bring together city stakeholders (government, business, universities, community organisations, public services and citizens) to explore the complexity of the issues they face, and involve them in



Co-funded by the
Erasmus+ Programme
of the European Union



collaborative decision making and future planning of their city. This will be the start of a journey in which the city understands its issues and explores solutions which might include smart technology solutions.

The problems different city sectors face are interconnected and an integrated approach has clear benefits.

“Systems thinking” is a discipline that provides skills and tools designed to address situations of complexity and uncertainty – situations that are difficult to grasp and to manage, and to which there are no simple answers.

How does systems thinking work? A system can be defined as a set of components that are interconnected for a purpose – a purpose that is identified as being of interest.

In dealing with the challenges that cities face, it is often changing to the structure and organisation of society that are needed, rather than quick ‘technology fixes. Changing behaviour – the way we live, work and play – will be critical for cities if they are to become smart. However, technology can play an important role in facilitating behaviour change, for example in helping to reduce energy demand or change travel patterns.

Cities are well placed to operate as laboratories where, with the active participation of their citizens, they can explore problems and develop smart technologies, services and business models.



Co-funded by the
Erasmus+ Programme
of the European Union



UNIT 2. Benefits of a smarter city

Individual city systems, i.e. the set of organizations, community facilities, technical systems and infrastructures that deliver a specific city function such as health or energy, are becoming smarter. Technology is increasingly being used as a tool to support better integration within the individual city systems, to enable them to work more effectively. Increasingly, for example, we are talking about smart mobility, smart grid and smart healthcare.

A smarter city takes this integration one step further. It is a city where these individual city systems are better integrated, not just within themselves but together, in order to seamlessly deliver on the city purposes. This increased connectivity allows cities to be managed more holistically and effectively.

For the citizen, the benefits of this integration of city systems include the following:

- Personalized services. The ability to have the services they use integrated around their needs, rather than around the convenience of individual service providers.
- Access to information. Better access to contextual information to support decisions relating to life in the city, helping them to navigate around the city and achieve their goals more easily.
- Greater transparency in public sector decision-making processes, making it easier to feed in informed ideas and opinions within consultation processes and to hold public sector organizations to account, leading to an increased sense of democratic participation.
- Support in helping each other more effectively. Citizens can use open data to develop and use new applications to manage their lives more effectively and to collaborate to tackle joint challenges together.

These benefits can result in a better run and more attractive place to live and work for the citizen, as well as providing them with improved services at lower cost.

For local business leaders, the benefits include the following:

- More efficient management by providing them with easier access to more accurate and detailed real-time data about city life and services. This could benefit their business in a variety of ways, for instance enabling more efficient logistics, more insight into customer needs, and more opportunities for collaboration.



Co-funded by the
Erasmus+ Programme
of the European Union



- New business opportunities, to allow them to develop new and profitable services in the city using the widespread availability of usable data.

For service providers, the benefits include the following:

- Greater synergies. Closer integration with other service providers can enable potential synergies to be more easily exploited, leading to greater efficiency and control of the outcomes they aim to deliver.
- Individualized service offerings. Increased availability of data about the needs and circumstances of their customers can enable them to provide more tailored services, leading to greater efficiency and customer satisfaction.
- New ways to meet customer needs by providing them with opportunities to develop new services that deliver the outcomes they are responsible for in a way that better suits their customers, including self-service and peer-to-peer service options.

For city leaders, the benefits include the following:

- More informed decision-making by providing them with better evidence, enabling them to be more confident in their decision-making and to manage the city more effectively.
- The facilitation of wider service provision. The opening up of more useful data to the public can enable other agencies and businesses to develop a range of useful services for the citizen and enable citizens to provide effective peer support to each other.
- Better collaborative processes, enabling more efficient and integrated working between city stakeholders.
- Better citizen engagement. More transparent processes can enable stronger and more positive engagement with citizens and businesses.
- More positive relationships with other cities. The ability of the city to compare itself to other cities on a global stage can enable it to identify opportunities for collaboration with other cities, while maintaining a competitive edge.

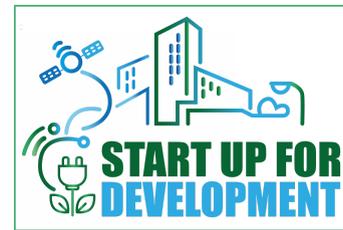
In other words, increased connectivity can lead to the achievement of better results at lower costs for city leaders.



SMART CITIES: WHO BENEFITS: <https://youtu.be/92wg2eqgkM8>



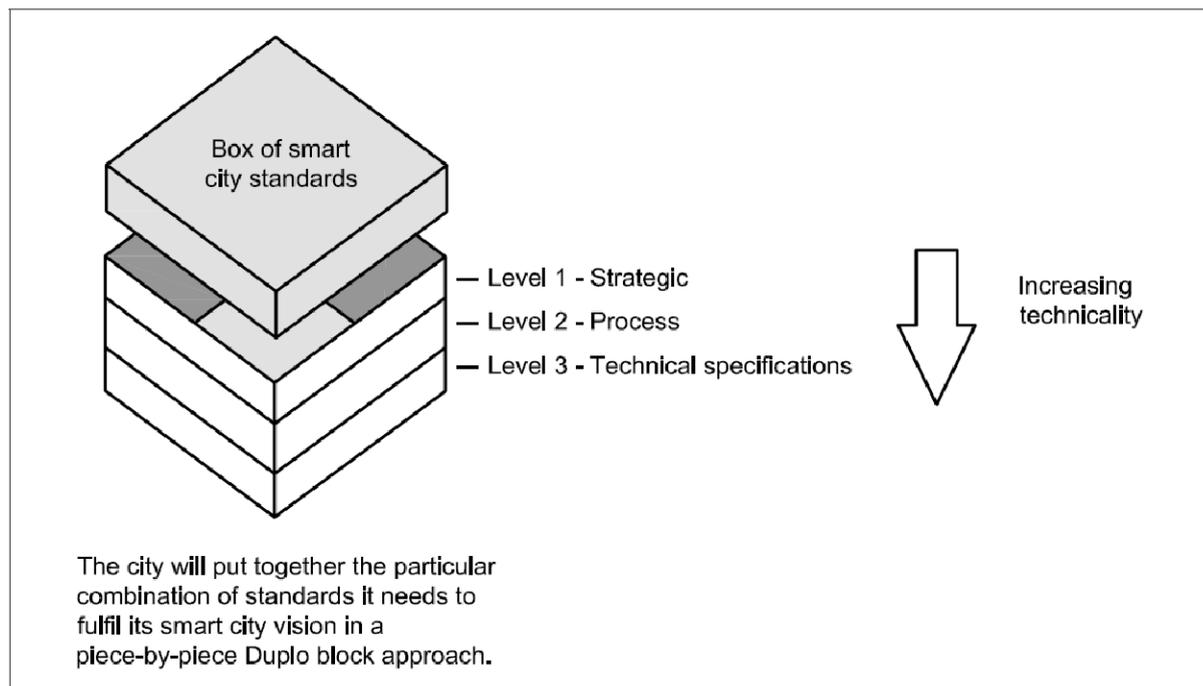
Co-funded by the
Erasmus+ Programme
of the European Union



UNIT 3. Standards and standardization

Standards and guidance documents can describe good practice in a way that makes it easy to know exactly what needs to be done to comply with it and, just as importantly, to know what to specify in procurements in order to be sure that what is supplied is fit for purpose. Standards are developed by experts in a particular area of interest, using a transparent consensus-building process that allows a variety of stakeholders to provide input.

Levels of smart city standards



Strategic-level smart city standards provide guidance to city leadership on the process of developing a clear and effective overall smart city strategy, identifying priorities, and developing a practical implementation roadmap and an effective approach to monitoring and evaluating progress.

Process-level standards cover good practice in procuring and managing cross-organizational and cross-sectorial smart city projects, including guidance on putting together appropriate financing packages.



Co-funded by the
Erasmus+ Programme
of the European Union



Technical specifications cover the practical requirements for smart city products and services to ensure that they achieve the results needed.

Strategic-level standards are of most relevance to city leadership and process-level standards to people in management posts. However, even technical specifications are relevant to people in management posts as they need to know which standards they need to refer to when procuring technical products and services.

Some standards at strategic level:

- ISO 37101: Sustainable development & resilience of communities – Management systems General principles & requirements
- ISO 37120: Sustainable development of communities – Indicators for city services and quality of life.
- ISO 37102: Sustainable development & resilience of communities –Vocabulary
- ISO 37123: Indicators for resilient cities



Download: [The Role of Standards in Smart Cities](#)

3.1. ISO 37101: Sustainable development & resilience of communities – Management systems General principles & requirements

ISO 37101:2016 establishes requirements for a management system for sustainable development in communities, including cities, using a holistic approach, with a view to ensuring consistency with the sustainable development policy of communities.

The intended outcomes of a management system for sustainable development in communities include:

- managing sustainability and fostering smartness and resilience in communities, while taking into account the territorial boundaries to which it applies;
- improving the contribution of communities to sustainable development outcomes;
- assessing the performance of communities in progressing towards sustainable development outcomes and the level of smartness and of resilience that they have achieved;
- fulfilling compliance obligations.



Co-funded by the
Erasmus+ Programme
of the European Union



ISO 37101:2016 is intended to help communities become more resilient, smart and sustainable, through the implementation of strategies, programmes, projects, plans and services, and demonstrate and communicate their achievements.

ISO 37101:2016 is intended to be implemented by an organization designated by a community to establish the organizational framework and to provide the resources necessary to support the management of environmental, economic and social performance outcomes. A community that chooses to establish the organizational framework by itself is considered to constitute an organization as defined in ISO 37101:2016.

ISO 37101:2016 is applicable to communities of all sizes, structures and types, in developed or developing countries, at local, regional or national levels, and in defined urban or rural areas, at their respective level of responsibility.

ISO 37101:2016 can be used in whole or in part to improve the management of sustainable development in communities. Claims of conformity to ISO 37101:2016, however, are not acceptable unless all its requirements are incorporated into an organization's management system for sustainable development in communities and fulfilled without exclusion.

3.2. ISO 37120 Sustainable development of communities. Indicators for city services and quality of life

ISO 37120 establishes definitions and methodologies for a set of city indicators to steer and measure delivery of city services and quality of life. As part of a new series of International Standards being developed for a holistic and integrated approach to sustainable development and resilience, this set of standardized indicators provides a uniform approach to what is measured, and how that measurement is to be undertaken.

The requirements contained in this International Standard are applicable to any city, municipality or local government that undertakes to measure its performance in a comparable and verifiable manner, irrespective of size and location.

The indicators can be used to track and monitor a city's progress on city service performance and quality of life and assist cities in setting targets and monitoring achievements. In order to achieve sustainable development, the whole city system needs to be taken into consideration. Planning for future needs must take into consideration current use and efficiency of resources in order to better plan for tomorrow.

Indicators are across follow themes:



Co-funded by the
Erasmus+ Programme
of the European Union



- Economy
- Education
- Energy
- Environment and climate change
- Finance
- Governance
- Health
- Housing
- Population and social condition
- Recreation
- Safety
- Solid waste
- Sport and culture
- Telecommunication
- Transportation
- Urban/local agriculture and food security
- Urban planning
- Waster and wastewater

Theme	Core Indicator	Supporting Indicator
Economy	<ul style="list-style-type: none"> • City's unemployment rate; • Assessed value of commercial and industrial properties as a % of total assessed value of all properties; • % of city population living in poverty. 	<ul style="list-style-type: none"> • % of persons in full-time employment; • Youth unemployment rate; • Number of business per 100 000 population; • Number of new patents per 100 000 population per year
Education	<ul style="list-style-type: none"> • % of female school-aged enrolled in school; • % of students completing primary education; survival rate; • % of students completing secondary education; survival rate; • Primary education students/teachers ratio 	<ul style="list-style-type: none"> • % of male school-aged enrolled in school; • % of school-aged population enrolled in school; • Number of higher education degree per 100 000 population
Energy	<ul style="list-style-type: none"> • Total residential electrical energy use per capita (kWh/year); • % of city population with authorized electrical service; • Energy consumption of public buildings per year (kWh/m³); • % of total energy derived from renewable sources, as a share of the city's total energy consumption 	<ul style="list-style-type: none"> • Total electrical energy use per capita (kWh/year); • Average number of electrical interruption per customer per year; • Average length of electrical interruptions



Co-funded by the
Erasmus+ Programme
of the European Union



Environment	<ul style="list-style-type: none"> • Fine particulate (PM 2.5) concentration; • Particulate (PM 10) concentration; • Greenhouse gas emission measured in tonnes per capita 	<ul style="list-style-type: none"> • Nitrogen dioxide (NO₂) concentration; • Sulphur dioxide (SO₂) concentration; • Ozone (O₃) concentration; • Noise pollution; • % change in number of native species
Finance	<ul style="list-style-type: none"> • Debt service ratio (debt service expenditure as a % of a municipality's own-source revenue) 	<ul style="list-style-type: none"> • Capital spending as a % of total expenditure; • Own-source revenue as a % of total revenues; • Tax collected as a % of tax billed
Fire and Emergency Response	<ul style="list-style-type: none"> • Number of firefighters per 100 000 population; • Number of the fire related deaths per 100 000 population; • Number of disaster related deaths per 100 000 population 	<ul style="list-style-type: none"> • Number of volunteer and part-time firefighters per 100 000 population; • Response time for emergency response services from initial call • Response time for fire department initial calls
Governance	<ul style="list-style-type: none"> • Voter participation in last municipal election (as % of eligible voters); • Women as a % of total elected to city-level office 	<ul style="list-style-type: none"> • % of women employed in the city government workforce; • Number of convictions for corruption and/or bribery by city officials per 100 000 population; • Citizen's representation: number of local officials elected to office per 100 000 population; • Number of registered votes as a % of the voting age population
Health	<ul style="list-style-type: none"> • Average life expectancy; • Number of in-patient hospital beds per 100 000 population; • Number of physicians per 100 000 population; • Under age five mortality 100 000 live births 	<ul style="list-style-type: none"> • Number of nursing and midwifery personnel per 100 000 population; • Number of mental health practitioners per 100 000 population; • Suicide rate per 100 000 population



Co-funded by the
Erasmus+ Programme
of the European Union



UNIT 4. Open data and big data

A key factor in a city becoming smarter is its ability to exploit the power of data. The provision of accurate, timely and comprehensive information about what is happening in the city to those who need it can enable city leadership, planners and managers, as well as individual citizens and businesses, to make decisions that better meet their own needs, as well as supporting the overall functioning of the city.

Data is generated from a growing amount of sources. Cameras, sensors, RFIDs, GPS, including what we call self-generation, that is the smart phones that we are using are constantly generating and transmitting data and all this data is generated at an ever-lower cost and by ever smaller devices, and also the storage capacity where this data can be stored is increasing exponentially. Basically, all this leads to the fact that there is an unprecedented ever-growing amount of data that is being generated. So that's the first element of digitization. The second element is what we call communication and networks and that has 3 different dimensions that all relate to each other. On the most basic level we have the telecommunications infrastructures. Traditionally these are the wired infrastructures, the cables, the fibre but increasingly we have wireless infrastructures also where the capacity is increasing 1-5G, WiMax, WiFi, satellites. All this makes up for the telecommunications infrastructures through which data is transmitted. The 2nd dimension is the networks, that is the different devices that are being used need to be connected to each other through the telecommunications infrastructure and this is done by so called protocols, physically connecting the different data storing devices to each other and the 3rd dimension of this is the identification and exchange of this data. What is typically being called the World Wide Web, that is the location of this data by way of unique record locators inside the different devices, inside the different computers. So, adding to the data generation, this second dimension, the communication dimension, connects all the data to each other. So, we have basically 4 things, we have a telecommunications infrastructure, we have the network, that is the devices connected to each other through the internet, and then we have the identification and exchange of the different data of the devices connected to each other thanks to the World Wide Web and, as we have seen in the very beginning, we have the data generation and storage. Now all this has a growing capacity, there are more and more things that can be stored, generated, transmitted, it has increasing speed, data is transmitted ever more rapidly, there are reduced power needs, even to the point that some of the devices do not need power anymore such as RFID's, all this at every lower cost and in an ever-smaller format, miniaturized. Today you can have, for example, RFID's directly in each letter in a cost-effective manner. Now all this together leads to what is currently being called the Internet of Things. That is the different devices connected to each other, thanks to the Internet and the World Wide Web and this has 3 main dimensions. So, we have exponentially connected devices, people say that in about 5



Co-funded by the
Erasmus+ Programme
of the European Union



years, the amount of devices that will be connected to each other through the internet will double then we have exponentially generated and transmitted data. Again, for example, people say that in a house in 5 years, the bandwidth that will be used by these devices connected to each other through the internet will take up 50% of all the bandwidth and then we have increasingly real time exchange of data. Already today, you can supervise your house remotely through your smart phone in real time, all this together is leading to this phenomenon we call the Internet of Things today. Now there is an additional element that we need to talk about and this is analytics. All this data needs to be analysed and also here, there is a rapid development in the ability and the capacity to analyse and also to visualise these. The visualisation is necessary because analytics often cannot really show what the outcome is so the things here that are important are what we all artificial intelligence, machine learning, deep learning tools that basically allow for the intelligent analysis of all these huge amounts of data. This has also been called today Big Data.

Open data is data that is made available by governments, organisations, businesses and individuals for anyone to access.

It's there for anyone to use and share, and it's making massive differences to people's lives. It's a core component of smart cities that's helping to create a better future across the world.

Smart technologies can enable cities to tackle their sustainability challenges. However, technology itself can also be a threat to global sustainability if its impacts are not managed well. It impacts on the environment across the life cycle of a product or service – in manufacturing, distribution, consumer use and disposal.

Energy use is the single largest contributor to the carbon footprint of the ICT sector. Some of the electricity is used when the ICT equipment is in standby, which means when it is not fully closed down or performing its main function. Electrical or electronic goods are a significant source of hazardous waste as they can contain lead, cadmium and brominated flame retardants. There is a huge opportunity to ensure that smart technologies are designed to minimise their impact on the environment and on wider sustainability. The key is to ensure that the benefits of smart technology as an enabler outweigh technology's own sustainability impacts.

The mass proliferation of connected devices, systems and services in the smart city inevitably raises questions about privacy. Who is monitoring and controlling the sensors on buildings, lamp-posts and pipes in the city? What happens if someone hacks into the city control centre? How secure is my information? Will they get access to my home energy use, travel habits and social care records?

Smart systems are rich sources of data that help cities to plan better services and businesses to create new products. But careful management of the data is crucial. Considerations of security, data ownership, access and ethics are all important.



Co-funded by the
Erasmus+ Programme
of the European Union



Considerations of security, data ownership, access and ethics are all important. Cities need to be thinking about questions such as:

- How can a city government ensure that personal data is secure?
- Can a citizen opt in or out of smart data collection?
- How can a city ensure that the data being collected to design a city service is inclusive?

Better regulation on privacy, data ownership and security must balance the rights of individuals without stifling innovation. Smart cities must rely not only on data collected from tech-savvy users, as this could lead to the creation of services that exclude certain groups. All of this smart data collection will be a complex process. By involving citizens in the co-creation of smart city projects, cities can start to debate these issues. Citizens who are empowered to understand the value of their data are enabled to make better choices about who they share it with. There are certainly great opportunities for cities to benefit from smart technologies but the trust of citizens and their acceptance of initiatives will be crucial to the success of smart cities.



Big Data: What it is and why it matters | SAS:

https://www.sas.com/en_us/insights/big-data/what-is-big-data.html



What is Big Data and Why is it Important?: <https://youtu.be/jH44SfUNpWw>



Big Data In 5 Minutes | What Is Big Data?: <https://youtu.be/bAyrObI7TYE>



Co-funded by the
Erasmus+ Programme
of the European Union



UNIT 5. Smart citizens

The key challenge around smart cities is not technological but about people.

The performance of a city is the aggregate outcome of the daily lives of its citizens and workers. Currently, this bottom-up activity is not working sufficiently. City leaders therefore need to develop strategies and management processes that can help to coordinate the activities of everyone in the city around common goals, leading to effective transformational solutions.

A key opportunity is to harness the knowledge and energy of the citizen by providing win-win opportunities to gain their active participation in city transformation.

Progress towards making a city smarter comes when city leadership and institutions use the new tools provided by technology and data to put in place better policies, services and infrastructures (including, but not limited to, digital) that are sustainable and resilient, that provide opportunities and resources to people, communities and businesses more equally, and that enable their city to be more successful.

It is equally important to ensure that the technologies used within a smart city strategy are accessible to, and usable by, the people they are intended to benefit.

Forward-thinking cities and businesses recognise the need to review their approach to smart city design and planning, to move away from a technology-led approach and towards a design approach that is people-centred. In this vision, the city will reflect the needs of citizens and the challenges they face. Technology will play an enabling role and smart city plans will be bespoke to the needs of individual cities.

Successful smart cities are making the most of the technologies that enable greater collaboration between urban communities, and between citizens and city governments. The success of smart cities relies on citizens engaging with technology solutions, but citizens must also take a leading role in their design, creation and maintenance. Professional disciplines will be required to work together with citizens to co-create solutions; designers, engineers, social scientists, technologists, psychologists, planners, artists and many more must collaborate to make our cities better places in which to live, work and play.



Smart Citizen - Institute for Advanced Architecture of Catalonia:
<https://youtu.be/pAUvh1aY-oY>



Co-funded by the
Erasmus+ Programme
of the European Union



5.1. Different approaches

Smart city solutions (products or services) can be designed using a variety of design approaches.

- Supplier-centred design – a designer creates a solution they think cities or citizens need.
- User-centred design – a designer shapes a solution to the user’s point of view.
- Co-design – a designer works with stakeholders to help them design a solution for themselves.
- Co-production – a designer works with stakeholders to produce a solution.
- Co-creation – this is where co-design and co-production are brought together. Citizens work in partnership with a designer to co-create solutions.

The European Network of Living Labs (ENoLL), for example, was established as an independent association of living labs in 2010. It’s a not-for-profit organisation and has 3,454 international members spanning six continents. The living labs cover a broad range of issues from cultural heritage to healthcare.

ENoLL defines living labs as ‘real-life test and experimentation environments where users and producers co-create innovations. They’re a form of public–private–people partnership and employ four main activities:

- co-creation – co-design by users and producers
- exploration – discovering emerging usages, behaviours and market opportunities
- experimentation – implementing live scenarios within communities of users
- evaluation – assessment of concepts, products and services according to various criteria.



Smart City: An Anixter Case Study: <https://www.youtube.com/watch?v=pnRh0J7AauY>



Smart cities Case studies - Singapore, Netherlands and the UK:
<https://www.youtube.com/watch?v=YU9f1nVAnFY>



Co-funded by the
Erasmus+ Programme
of the European Union



BIBLIOGRAPHY:

- Porter 2003 ; Lombardi et al.2012 ; Dameri, Cocchia 2013
- The European Network of Living Labs and World Bank (2015). "A Guidebook for City Mayors and Public Administrators"
- BSI (2014), "Smart cities framework – Guide to establishing strategies for smart cities and communities", PAS 181:2014
- Falconer, G., & Mitchell, S. (2012), "Smart City Framework A Systematic Process for Enabling Smart + Connected Communities", CISCO
- Centre for Cities (2014) Smart Cities [online]. Available at <http://www.centreforcities.org/publication/smart-cities>
- United Nations (2014) World Urbanization Prospects: The 2014 Revision, New York, United Nations. <http://esa.un.org/unpd/wup/Highlights/WUP2014-Highlights.pdf>
- Introduction to Smart Cities (YouTube video): <https://youtu.be/pXSJmZcC2J8>
- SMART CITIES: WHO BENEFITS? (YouTube video): <https://youtu.be/92wg2eqgkM8>
- BSI(June 2013), The Role of the Standards in Smart Cities, Issue 1
- Big Data: What it is and why it matters | SAS (video): https://www.sas.com/en_us/insights/big-data/what-is-big-data.html
- What is Big Data and Why is it Important?(YouTube video): <https://youtu.be/jH44SfUNpWw>
- Big Data In 5 Minutes | What Is Big Data? (YouTube video): <https://youtu.be/bAyrObl7TYE>
- Smart Citizen - Institute for Advanced Architecture of Catalonia (YouTube video): <https://youtu.be/pAUvh1aY-oY>
- Smart City: An Anixter Case Study (YouTube video): <https://www.youtube.com/watch?v=pnRh0J7AauY>
- Smart cities Case studies - Singapore, Netherlands and the UK (YouTube video): <https://www.youtube.com/watch?v=YU9f1nVAnFY>