



Handbook for cities

on performance
measurement

JANUARY 2017

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Foreword

The present handbook gathers material from the whole CITYkeys project and its deliverables and aspires to be the entry point to the work and the more technical deliverables of CITYkeys. It will: explain why a city should have a performance measurement framework and process in place; describe how such a framework can be built and used; give recommendations on policy and decision making issues; identify business models related to performance measurement; and explain how indices and benchmarking work.

The aim of the CITYkeys project was to develop and validate, **with the aid of cities**, a performance measurement framework for the common and transparent monitoring and comparability of smart city solutions across European cities. The framework includes: key performance indicators (KPIs); the data collection procedure; the methods to calculate indicators; as well as policy and business model recommendations for the use of these indicators.

The project builds on existing performance measurement frameworks and proposes the use of open standards and interfaces. It also aspires to be the first framework that has a specific **European** and **holistic** approach to smart city objectives and smart city projects.

The CITYkeys project ran from February 2015 to January 2017, and this handbook, along with the 'CITYkeys experience: recommendations from cities to cities' guidebook¹, aims to help urban practitioners and experts create and run a performance measurement system. The present handbook gathers material from the whole project and its deliverables and aspires to be the entry point to the work and the more technical deliverables of CITYkeys. It will: explain why a city should have a performance measurement framework and process in place; describe how such a framework can be built and used; give recommendations on policy and decision making issues; identify business models related to performance measurement; and explain how indices and benchmarking work.

1. Both documents are available at <http://citykeys-project.eu/>

How to use this guidebook

Building and using a performance measurement framework or system usually entails a number of steps that will help a city assess its progress in carrying out its strategy and identify opportunities for improvement.

CITYkeys has developed all the required deliverables and can guide a city through this process. Moreover, it has done so in a non-explicit way: CITYkeys offers an open framework based on open standards and formats. Accordingly, cities can fully or partially apply the CITYkeys KPIs and architecture, augment an existing performance measurement system with some of the CITYkeys elements, or even start the development of a new system based on the CITYkeys principles.

During its lifetime, CITYkeys offered guidance documents on how performance measurement can be implemented or can contribute to the relevant steps of the process. We encourage the reader to skip sections of no interest and go directly to the ones he or she deems relevant. This guidebook aims to answer a number of questions that city practitioners and experts pose:

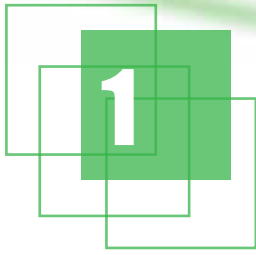
- **Why** should we implement a performance measurement system?
- **How can we build** such a system?
- **How can we use** it afterwards?
- **What is the business case** for using such a system?
- What about **benchmarking** and **indices**?

The last page of this guidebook contains references to relevant CITYkeys documents and to other works of interest.

WHY READ THIS GUIDEBOOK?

This guidebook is meant to serve as a reference document, which looks at performance measurement through the eyes of cities' experts. It aims to explain:

- **What** performance measurement means
- **Why** a city needs such a framework
- **How** to build and use a performance measurement framework, based on CITYkeys results
- Identify the framework's strengths, shortcomings, as well as the steps needed to unlock the full potential of performance measurement;
- Lay out key recommendations for the application of the performance measurement framework
- Promote the sharing of approaches, information and experience among cities and experts interested in performance measurement



Why measure performance?



In general, performance measurement has four objectives:

- demonstrate the **accountability** of projects and operations implemented and performed with public money
- support **informed decision making** for both strategies and projects
- inform the **public** about a city's activities
- promote the **continuous improvement** of city-funded activities and of the administration of the city itself

In the current context of the local governments' operation, performance measurement can help address a number of specific performance-related challenges:

- focus on results that are important for the citizens and other stakeholders active in the city
- improve these results in an environment of resource constraints
- engage all employees of the administration in designing and delivering better services and results
- gain and keep the public's trust and confidence

Two different user groups can be identified, each with different needs:

- **external users**, such as clients of city services and citizens, might use performance information to better understand the city's accomplishments thereby to become more involved in the democratic processes
- **internal users**, such as politicians and the city administration, might use performance information to continuously improve their activities, strategies, and resource allocation-related decisions

CITYkeys attempted to identify the potential beneficiaries among the internal users. These are:

- mayors' offices
- high-level city managers
- organisations supporting and consulting cities in shaping local policies
- municipal departments in charge of smart city management
- smart city managers
- municipal programme managers
- knowledge management departments and units
- civil servants and experts working for or developing projects
- managers of public buildings and institutions
- project managers

CITYkeys also asked which decision making processes could such a performance measurement framework support. Most respondents identified *decision making at project level* as being the most likely to benefit from the application of this framework. Also, *support for strategic decisions* surfaced as a priority. In general, the following decision making processes were identified:

- strategic decisions
- performance-based budgeting
- translating strategic goals into actionable initiatives
- checking the performance of individual projects against district-level development plans
- linking sectoral 'silos'

Finally, CITYkeys asked the internal users what purpose could such a performance measurement framework serve in cities. According to the replies, the framework can be used:

- as a support system during the agenda setting process and to focus discussions
- for comparison and motivation purposes
- for identifying tasks that could be performed better and more efficiently
- for benchmarking differences and similarities
- for sharing information and data between cities in order to help them learn from each other
- as a reference framework during the operational management of different projects
- for measuring performance during ex ante and ex post evaluations
- at operational level, in the context of district development
- for establishing a stronger connection between district development and individual projects

- for assessing the level to which projects meet the goals set at the beginning
- to support stakeholder collaboration
- to facilitate and inspire the learning process
- for cities' internal self-assessment
- for independent (external) assessment/evaluation
- as a flexible tool on social networks such as LinkedIn, even via smartphones
- to promote a change in mind-set
- to support the development of new approaches to city services by making data accessible and usable

The following table summarises the possibilities related to performance measurement:

| | City administration and internal stakeholders | Citizens and external stakeholders |
|---------------------------------|---|--|
| Accountability | <ul style="list-style-type: none"> • Have a better tool for internal accountability and reporting processes • Enable performance-based budgeting | <ul style="list-style-type: none"> • Understand what the city thinks is important • See how public money is spent and the results this brings |
| Informed decision-making | <ul style="list-style-type: none"> • Better evaluate objectives, results and relevant gaps • Assess strategies, and the activities and operations connected to them • Evaluate the performance of departments and teams • Design and deliver better projects and services | |
| Public reporting | <ul style="list-style-type: none"> • Get evidence about the performance of their department or team and its relation to the performance of the whole administration • Guide managerial or individual decisions at all levels of city administration | <ul style="list-style-type: none"> • Evaluate the performance of the city and its administration • Understand how the city uses data and indicators in decision making • Better understand city data, indicators, performance measurement, and how they can ask questions or evaluate results |
| Continuous improvement | <ul style="list-style-type: none"> • Identify opportunities for continuous improvement • Adapt activities and delivery of services to the changing needs of users • Better align activities with strategies • Adapt structures, break down sectoral 'silos' | <ul style="list-style-type: none"> • Improve the city's democratic functions (checks and balances) |

Table 1: Uses of performance measurement in a city

Potential application of CITYkeys framework at EU level

The CITYkeys framework is a valuable tool for cities interested in networking and exchanging best practices across national borders. Experience shows that the availability of an open and transparent framework significantly increases the efficiency of urban decision making processes across Europe.

Knowledge sharing: A performance measurement framework can provide a snapshot of a city. It can highlight the areas where the city is doing better than the average, and can equally flag unsolved problems. Such a snapshot can help municipal leaders identify other cities facing similar problems. The CITYkeys framework is an efficient enhancer of knowledge sharing.

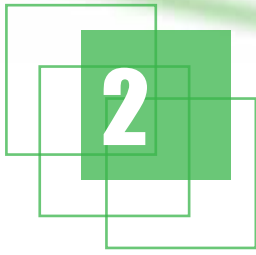


Replication of projects: A holistic framework of key performance indicators (KPIs) can provide a quick, visual overview of the project results and can help identify the areas where the project will be most beneficial for the city (environment, mobility, economic development, etc.). KPIs are a great tool for presenting and comparing projects across borders. The CITYkeys framework enables the replication of projects, as well as the comparison of approaches and results.

Project finance: In an era of increasingly complex challenges, when 'integrated' projects have an impact on multiple functions of a city, project financing needs new tools to compare and select the best-suited solutions. This is true both in the local context, when a single city has to choose from a number of alternatives, and in the European context, when an international organisation or financing institution has to select projects that meet its objectives or matches its potential.

Joint procurement: Based on the legislative efforts by the European Commission and the member states, several cities are experimenting with 'joint procurement' or participating in joint innovation procurement schemes. CITYkeys can offer valuable help when a common solution or product that might produce different results in each participating city is selected and procured.

Smart city index: The CITYkeys proposals for building a smart city index can help cities across Europe identify other cities that are close to their level of smart development or focus on the same areas of development. Decisions on collaboration, participation in project consortia and experimentation can be greatly enhanced if such tools are made available to cities.



Performance measurement at work: performance management

Performance management is a systematic approach to improving results through evidence-based decision making, continuous organisational learning, and a focus on accountability for performance. Performance management is integrated into all aspects of an organisation's management and policy making processes, focusing practices on achieving better results for the public.

Performance measurement and performance management are often used interchangeably. However, they are distinctly different. For decades, many public entities have measured outputs and inputs and, less commonly, efficiency and effectiveness. Performance measurement helps organisations monitor performance. Many of them have tracked and reported key statistics at regular intervals and communicated them to stakeholders.

Although measurement is a critical component of performance management, measuring and reporting alone have rarely led to organisational learning and improved outcomes. Performance management, on the other hand, encompasses an array of practices designed to improve performance. Performance management systematically uses measurement and data analysis as well as other tools to facilitate learning and improvement and to strengthen focus on results.

As illustrated in Figure 1, the performance measurement cycle starts with shaping the city mission and strategy and includes four plus one phases of activity.

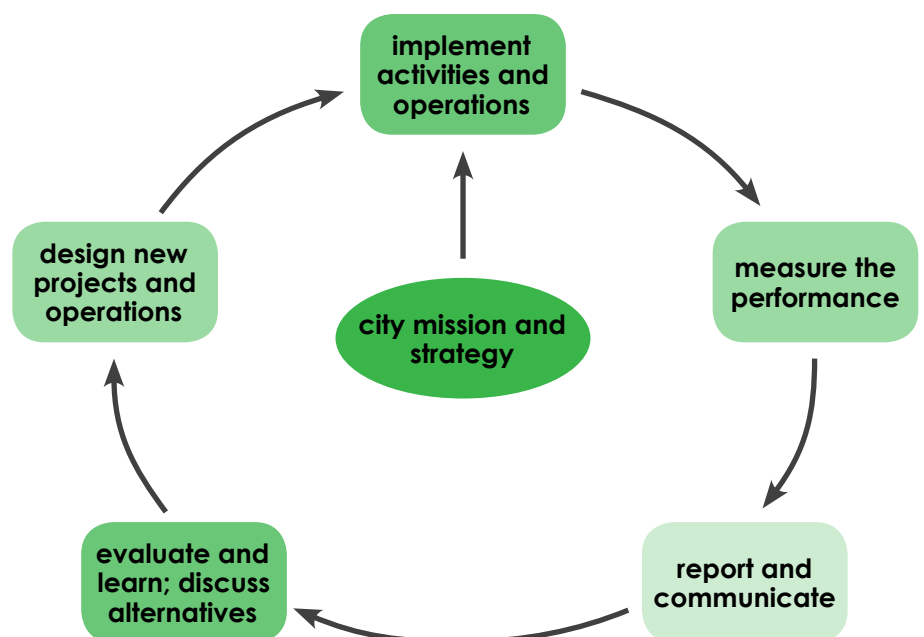


Figure 1: Using performance measurement in a city

City mission and strategy

The mission articulates the city's (administration) goals and how the public (citizens and other stakeholders) will be better served by them. Although it may seem obvious why a city exists, the city mission needs to be spelled out and communicated. This mission then needs to be translated into strategic objectives, targets, and actions that will eventually enable the realisation of the mission.

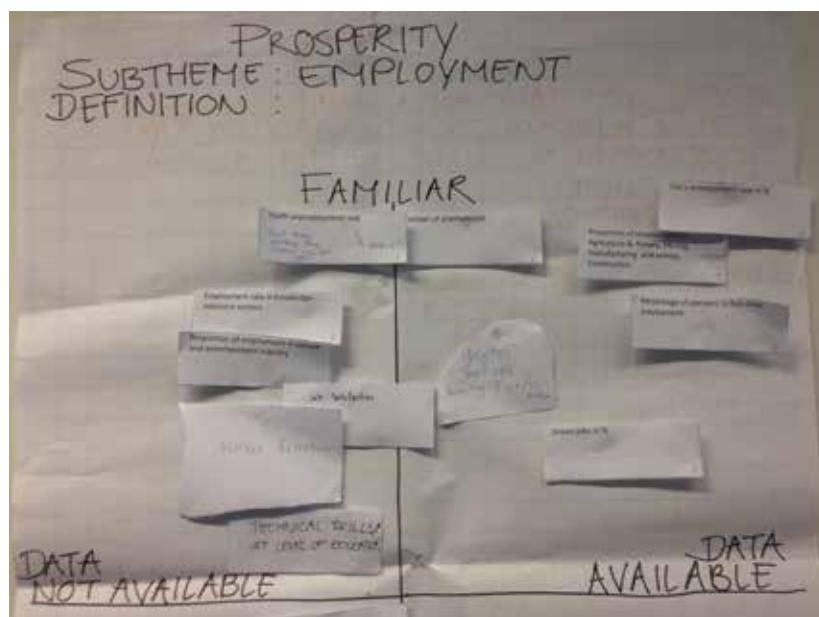
Activities and operations

Activities are programmes, services, projects, and initiatives implemented and run by a city. Operations refer to the infrastructure that supports these activities, including human resources, technology, and financial management. Together, activities and operations constitute everything the city does to carry out its strategy and realise its mission. The performance measurement cycle starts and ends with an organisation's activities and operations, as it continually moves through the following phases:

Measure: The city uses (key) performance indicators that are tracked regularly to assess its activities and supporting operations.

Report and communicate: To present performance measurement data in an easy-to-analyse format, cities can use any reporting tool they prefer. Dashboards - online tools that enable the customised and attractive presentation of results – are becoming increasingly popular.

A **dashboard** presents a focused selection of indicators to provide periodic snapshots of the city's overall progress in relation to past results and future goals. Performance measurement systems can include various types of dashboards, for example management dashboards, which enable the city's leaders to track overall organisational performance; programme-level dashboards to track individual programmes or internal areas, such as marketing or human resources, in further detail; or district or neighbourhood-level dashboards to track progress or challenges in specific areas.



Evaluate and learn: Using the reporting tools, the city's leaders and other key staff members review and interpret performance data in order to make well-informed decisions and identify opportunities for improvement and necessary course corrections.

Improve and redesign: The city implements its decisions to improve its activities and operations. From there, the performance measurement cycle begins again.

In the context of a performance management scheme, CITYkeys asked the cities' experts to identify the city-level decision making processes that could be supported by the information generated within the CITYkeys framework. The respondents raised a wide range of options. These included:

- **High-level decision making processes and smart city development**
 - processes of identifying strategic measures based on data and information
 - smart city planning decisions
 - city-level decision making concerning future smart city projects
 - city strategy framework development
 - define and prioritise smart projects and budget allocations
 - decision making in the fields of planning, mobility, and energy
 - decision making in the context of implementation of new city vision
 - supporting informed decisions on strategic development and urban improvement
 - decision making in urban planning processes
 - ensuring that urban regeneration embraces the advantages of smart city thinking and technological applications
 - strategic decision making in the field of waste management

- **Budgetary and human resource-related decisions**
 - decisions concerning budget planning
 - decisions and measurement of HR effort per undertaken project
 - decisions about future investments

- **Processes of negotiation, communication, and participation**
 - in the process of negotiation and communication with different stakeholders, also serving as an instrument of persuasion
 - supporting the management of citizen participation in public consultations
 - supporting decision making in urban planning and participation processes
 - in the process of awareness raising in relation to sustainable development

- **Specific sectoral and measure-related decision making processes**
 - application of the CITYkeys framework can enable the measurement of effects that certain measures would have (e.g. policy, technological investments). This pre-assessment could also allow for cities to take into account, in a timely manner, the effects on the market (supply), while considering further procurement procedures
 - in selection processes of adapted projects / considering technological solutions that ensure alignment with the KPIs chosen by the city / region
 - decisions on energy consumption (e.g. electricity and waste fleet fuels)
 - framework can serve as a general background for decisions and as a tool for comparison purposes

Similarly, CITYkeys asked the cities' experts to identify the district-level decision making processes that could be supported by the application of the CITYkeys framework. The decision making processes at district level entail a variety of views that overlap with the same processes at city level (e.g. support for budgetary planning, mobility and energy-related decision making processes):

- **Budgetary and human resource-related decisions**
 - Budget planning
 - for the timely and accurate involvement of suitable personnel in project management, and for the quantification of the expected results in smart city projects
 - for decisions on individual policies and investments
 - identification of new opportunities (business, energy transition, etc.)

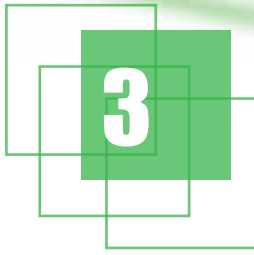
- **Impact assessment**
 - measuring the impact of different scenarios
 - measuring the quality of the results in energy efficiency, environment, etc.

- **Communication and engagement**
 - supporting the awareness raising process about the importance of citizen engagement
 - supporting interventions in social programmes

- **Policy and urban planning-related decisions**
 - setting (policy) boundary conditions - minimum sustainability performance – for real estate development
 - evaluation of aspects not yet integrated in planning processes
 - all district development projects/processes that require accountability
 - district planning processes for energy efficiency and environmental sustainability
 - in the process of urban district development
 - informed decision making processes on service delivery and development

- **Selection and comparison of smart city projects**
 - decisions about future smart city projects at district level

- **Sectoral and technological decision making processes**
 - selection of technologies and implementation plans
 - supporting mobility and energy-related district planning processes
 - supporting the validation of district heating KPIs



Building and using a performance measurement framework

There are many different paths a city can follow to initiate and use a performance measurement framework. It can also take considerable time before all processes are in place or – even more important - before a real change in the management culture and processes allows for the benefits of performance measurement to be fully seen.

Simply put, performance measurement consists of five main steps. These steps are identified in Figure 2, along with the relevance of CITYkeys' outcomes and potential contribution to each of these steps.

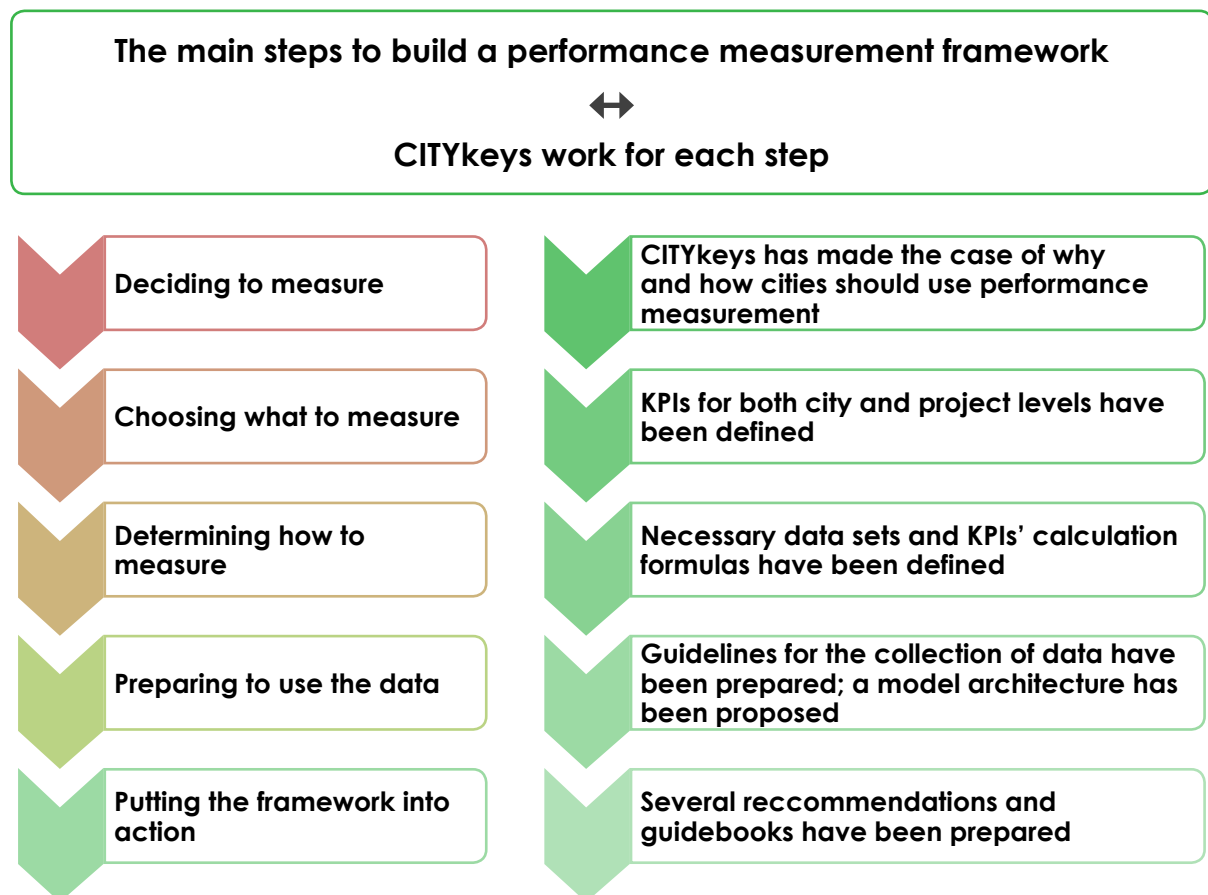


Figure 2: Main steps to build a performance measurement framework

Deciding to measure

The first step in building a performance measurement framework includes all the decisions and commitments that will define the shape of the framework, as well as its eventual success and usefulness. Regardless of the specific approach chosen, the first step is to answer a number of questions and identify the challenges that will shape the whole framework:

- Does the city already have strategic priorities and/or a leader who is willing to set them?
- Has the city articulated precisely its goals and strategic priorities?
- Are the politicians and the leading members of the local administration ready and willing to talk about performance and establish their own priorities?
- Have related efforts been grouped into strategic themes and their desired results summarised for all stakeholders?
- Have required resources and activities been linked to intended outcomes?
- What does measurable success look like?
- Have all stakeholders identified how they can contribute to the achievement of the agreed goals?
- Has an action plan been defined for each strategic area?
- Has a programme been set to manage performance in achieving the strategic priorities and desired outcomes?

Choosing what to measure

The CITYkeys framework supports smart cities in strengthening their strategic planning processes and measuring their progress. The indicators are thus primarily performance oriented. An important feature of this framework is that it focuses on the city as well as the project level. The CITYkeys evaluation framework can:

- evaluate the impact of a smart city project by comparing the 'before' and 'after' situations, or comparing the expected impact with a reference situation. As such, it can also serve to benchmark projects against each other
- monitor the progress of the city as a whole towards its smart city goals. The time component – 'development over the years' - is an important feature. The city indicators may be used to show the extent to which the overall policy goals have been reached. In addition, city-level indicators may be used to compare cities with each other, although such a comparison should be done with care

The CITYkeys method and the indicators are to be used to evaluate the success of smart city projects and the possibility to replicate the (successful) projects in other contexts. Following the CITYkeys project's definition of a smart city, success is determined by the transition across the entire ecological footprint of urban areas, simultaneously promoting economic prosperity, social aims, resilience to climate change, and other external disturbances. The concept of sustainability - split up in the triple bottom line of social sustainability (**people**), environmental sustainability (**planet**) and economic sustainability (**prosperity**) - has become generally accepted in the development of indicator systems for national and regional urban development.

However, this is not enough to determine the success of a smart city project. Success is also determined by how projects have been - or will be - realised in various contexts. The **governance** of developing and implementing smart city projects is a determining

factor, since governance has been established as one of the four pillars of sustainable development. Finally, the ability of individual smart city projects to be replicated in other cities and contexts determines their ultimate impact on the European-level goals. Under the **propagation** theme, smart city projects are evaluated to determine their potential for up-scaling and for application in other contexts.

| People | Planet | Prosperity | Governance | Propagation |
|--|---|---|---|--|
| <ul style="list-style-type: none"> • Health • Safety • Access to (other) services • Education • Diversity and social cohesion • Quality of housing and the built environment | <ul style="list-style-type: none"> • Energy and mitigation • Materials, water and land • Climate resilience • Pollution and waste • Ecosystems | <ul style="list-style-type: none"> • Employment • Equity • Green economy • Economic performance • Innovation • Attractiveness and competitiveness | <ul style="list-style-type: none"> • Organisation • Community involvement • Multi-level governance | <ul style="list-style-type: none"> • Scalability • Replicability |

Figure 3: Classification of CITYkeys KPIs in themes and sub-themes

Under these subthemes, 99 project indicators and 76 city indicators have been selected. Not all indicators are equally suited for evaluating all types of smart city projects. Although there is a considerable body of common indicators, for specific sectoral projects a relevant subset of these may be used (some indicators are specifically suited for transport projects, others for building-related projects, etc.).

The selection was based on an inventory of 43 existing indicator frameworks for (sustainable) cities and projects. Most of the indicators in the CITYkeys selection have been derived from existing indicator frameworks. New indicators have been suggested to fill gaps in existing frameworks, mostly related to the specific characteristics of smart city projects.

Determining how to measure

The CITYkeys set of indicators consists of a mixture of quantitative and semi-quantitative indicators. The semi-quantitative indicators, for example, provide an assessment of the way smart city projects are executed and the way the city government stimulates smart city development; and of the potential of smart city projects to be taken up by other cities. For the semi-quantitative indicators, data need to be collected using interviews or an analysis of policy documents.

Project and city indicators require different data collection processes. Project indicators are meant for assessing the success of smart city projects. In individual project assessments, data need to be collected from the project office, the project leader, and/or others closely involved in the project. Cities might want to streamline the data collection process for all their smart city projects by creating a reporting system and specific databases, but even then a number of project indicators will require (qualitative) information that can only be gathered by consulting persons involved in the project (e.g. through interviews, questionnaires).

Data for the majority of city indicators can be retrieved from statistical sources available within the city administration. Some are accessible in open source formats. However, certain governance indicators also require a person to gather the information. The share between these different data sources varies according to cities and administrations. Eventually, it is recommended that the cities automate data collection and framework feeding as much as possible.

It is important to note that data for all indicators will obviously not be immediately available in all cities. A city that engages in smart city indicators starts a process. The CITYkeys framework is a methodology for such a process. Cities will need to continuously develop the indicators as well as the data collection mechanisms.

Moreover, the quality of data obviously varies within countries, between cities, and between city departments. The quality of the overall assessment depends on the quality of the indicators, which in turn depends on the underlying data. Managing data quality throughout the process is thus crucial.

Additional issues that a city has to reflect upon include:

- whether the data collection, processing, and storage processes comply with the privacy legislation
- the place where the data and the performance measurement results will be stored
- security and integrity of the data and the performance measurement results

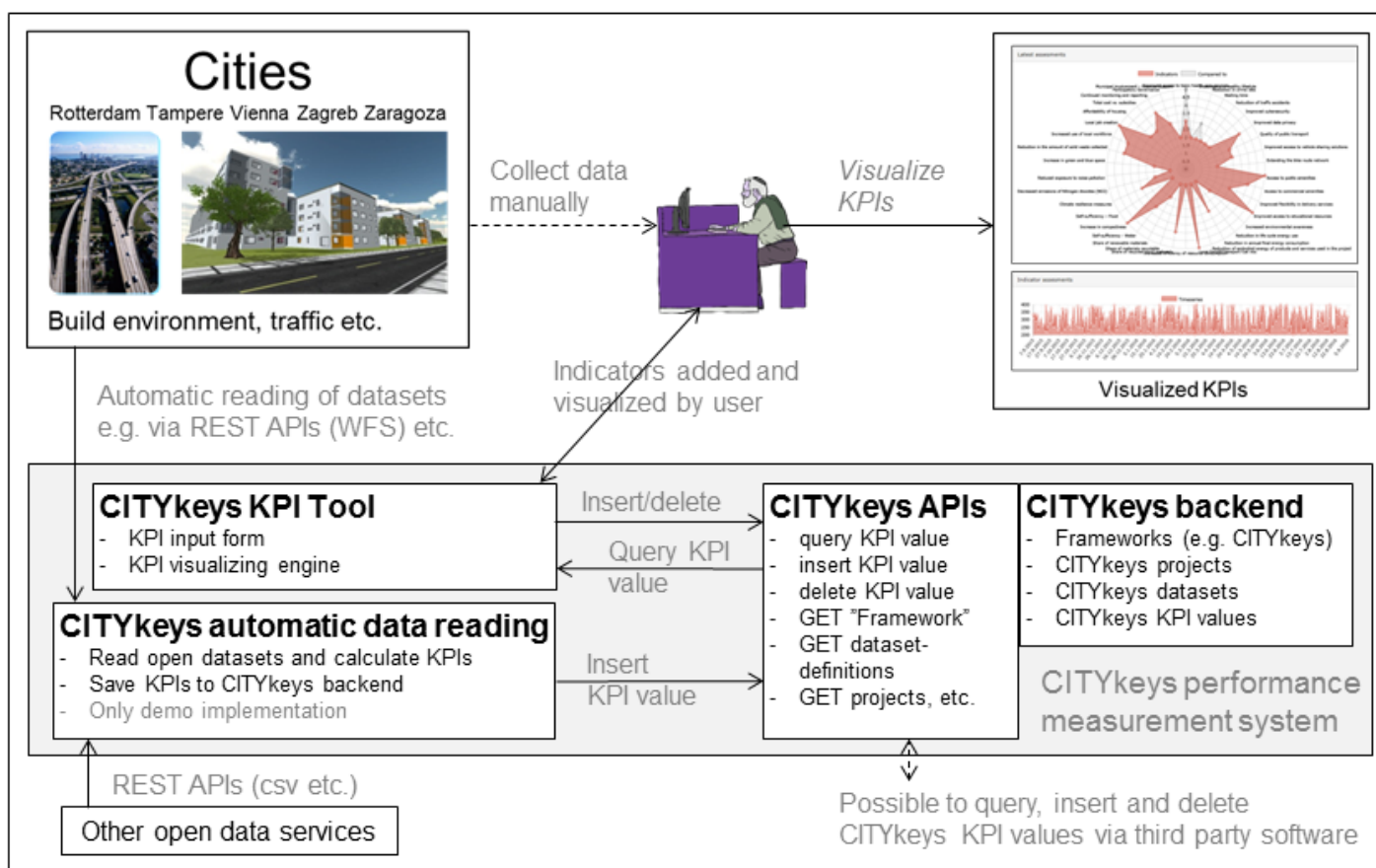


Figure 4: CITYkeys prototype architecture and platform

Preparing to use the data

Raw data is about as useful as no data at all. Thus, this step is about preparing a city to make use of the data it collects. This includes:

- creating the suitable reporting tools
- setting up the team that will be responsible for the performance measurement framework
- establishing a schedule for reviewing the performance measurement results

Regarding the first task, CITYkeys has developed a demo tool client, which is available at <https://ba.vtt.fi/keystone/kpitol/>. The architecture of the demo tool is shown in Figure 4.

As an example of visualisation, the CITYkeys KPI tool includes two different types of indicator visualisation: the 'spider' diagram-based visualisation for KPIs assessed on a uniform 1-5 performance scale to illustrate the overall assessment results (Figure 5), and the trend graph-based visualisation for individual KPI analysis (Figure 6).

It needs to be mentioned that CITYkeys has shown that cities' involvement in the development of smart city KPIs and tools is crucial. Without engaging the end-users in all stages of development, the results will likely not be used at the end. Such developer–end-user collaboration requires the latter to: 1) identify the requirements at the beginning; 2) comment on the various intermediate versions; and 3) validate the final version and ensure that the proper format of communication is used.

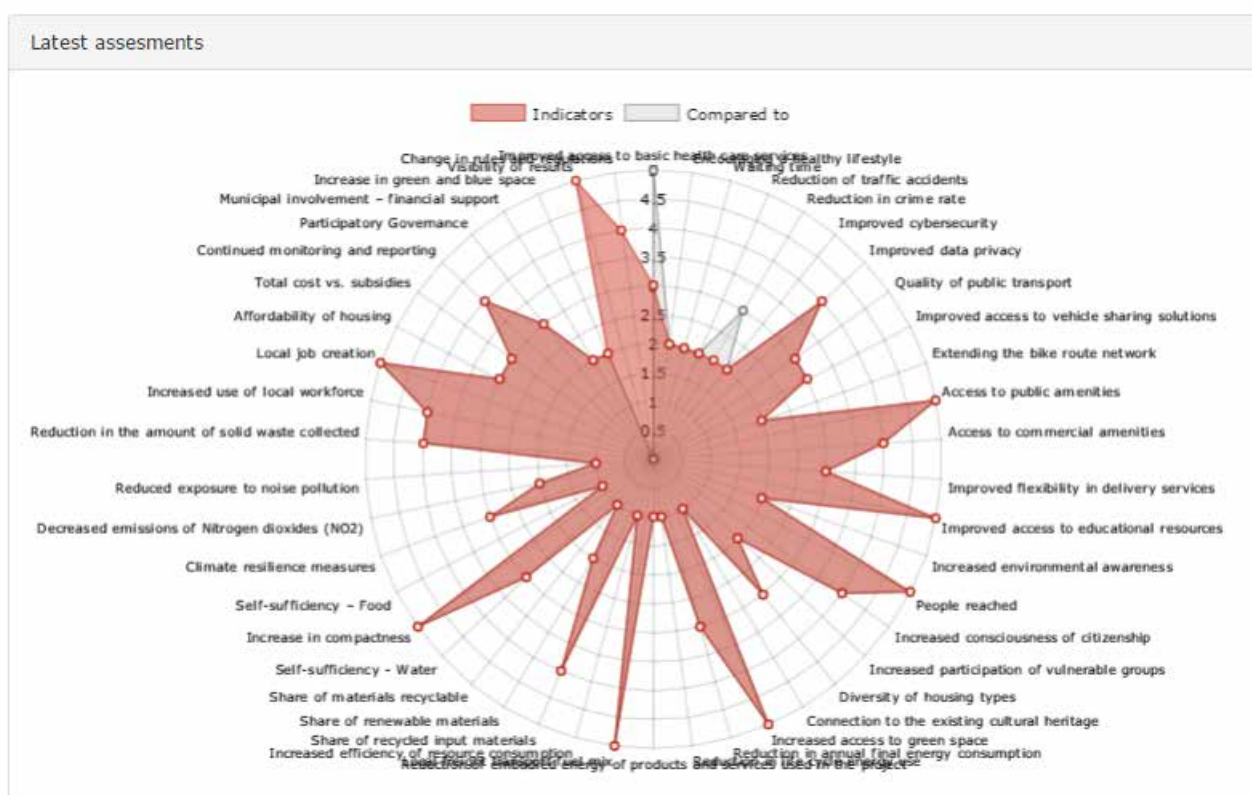


Figure 5: Spider diagram

Water consumption

Total water consumption per capita per day

| | |
|--|---|
| Related city | Test city 1 |
| Assesment method | Calculated annually with data from the water supply companies |
| Tags | City, Planet, Materials water and land |
| Calculation Formula | $(\text{City's total water consumption in litres per day}) / (\text{total population})$ |
| Unit | litres/cap/day |
| Performance level 1 description | |
| Performance level 2 description | |
| Performance level 3 description | |
| Performance level 4 description | |
| Performance level 5 description | |

Water consumption must be in harmony with water resources to be sustainable (ISO/DIS 37120, 2013). This harmony may be achieved through improvements in water supply systems and changes in water consumption patterns. The main driver for water consumption indicator is the increased concern of water scarcity and decreased water quality. Water management and supply of safe drinking water have become a global issue. Due to changes in the climate, there has been an increase of either extreme dry and warm seasons in some countries or rainy seasons connected with floods in other areas. Water scarcity varies greatly between countries, even between regions inside the country. This indicator will need to be measured in terms of changes from year to year within a city within a range of rates due to the variability among cities.

Indicator assesments

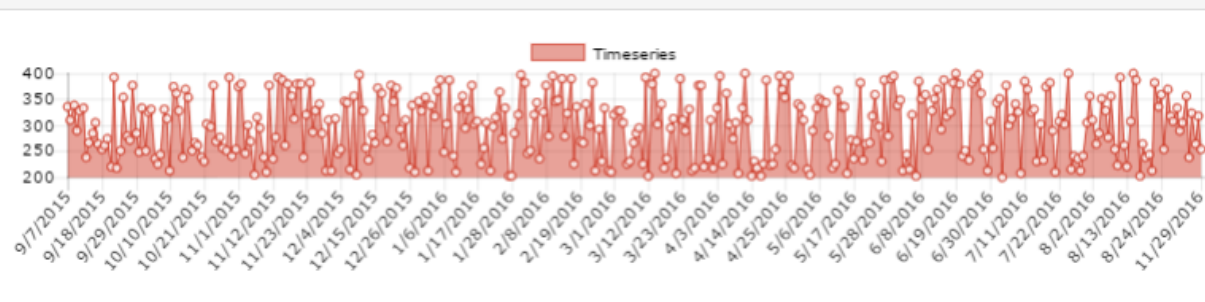


Figure 6: Trend graph

Putting the framework into action

Putting the framework into action means launching the performance measurement system and observing the associated commitments throughout the process (Figure 1 on page 9).

It is important to launch the performance measurement system only after the actions and resources for all the steps have been designed, even if there are gaps or missing data for the KPIs. The first performance measurement cycle will inevitably have some gaps that will be filled in future cycles. For the first cycle, a city needs to focus on what is available:

- begin measuring the indicators that the system prepared to track at this point
- report the available data via the management dashboard and programme-level dashboards as determined by the established review schedule
- conduct the initial performance reviews to begin interpreting and analysing the reported data, paying particular attention to how the review process itself works
- make decisions regarding the activities and operations based on the data review
- update the existing measurement tools and processes or develop new ones as needed

Guidelines for reporting KPIs

Reporting on performance based on KPIs should be coherent and consistent, and should enable recipients of the report to be on the same page with regard to the performance measurement system. To this end, the following guidelines should be observed:

- **Link to strategy:** KPIs presented in isolation from strategies and objectives, or vice versa, will fail to provide the readers with the level of understanding they need.
- **Specific targets:** Some performance indicators are best suited to the quantification of future targets. Expectations and aims for other indicators may be better explained in commentary.
- **Definition and explanation:** In absence of standards for the measurement of many indicators, and with many companies also applying their own indicators, an explanation of the components of a metric and how it is calculated is vital.
- **Purpose of indicators:** It is important to explain why a performance indicator is relevant. In many instances this will be because it measures progress towards achieving a specific objective.
- **Sources, assumptions and limitations:** To enable readers to make their own assessment of the reliability of the information, it is important to identify the sources of the data used in calculating performance indicators and any limitations on that data.
- **Relation to standards:** Where the indicators follow a standard definition or a definition used in other well-known systems, it is good practice to mention this.
- **Trends:** Measurement of performance in isolation over a single period does not provide the reader with very useful information. An indication of how performance has improved or worsened over time is much more valuable.
- **Changes in KPIs:** It is recognised that KPIs may evolve over time as strategies change or more information becomes available. When such changes are made to the KPIs being monitored, either in terms of the KPIs used or how they are calculated, these changes need to be explained.
- **Benchmarking:** Performance benchmarked against a relevant internal or external peer, with an explanation of why these peers were chosen, can be valuable to the users of the system.

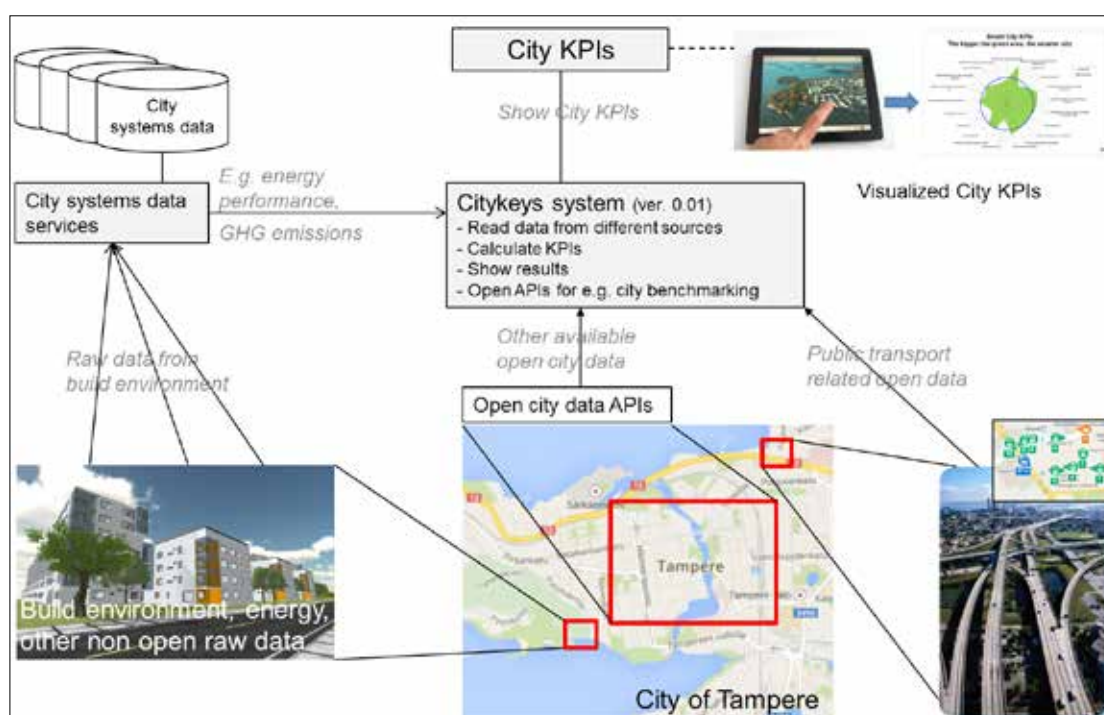


Figure 7:
CITYkeys
framework

Delivering added value through the application of the CITYkeys framework

As part of the process of asking European cities for feedback, CITYkeys asked cities' experts to specify the added value they expect to see from the application of the CITYkeys framework. The respondents identified the following:

- **Performance measurement and impact assessment**
 - a new holistic tool for the assessment of the city's performance (provided data is available)
 - it serves the purpose of inspiration and overview
 - it enables a better understanding of the city's needs and performance
 - the framework application can enable evidence-based policy setting and assessment
 - it can be a structured performance management tool to increase public understanding and encourage participation
 - it enables the measurement of the impact that specific policies and projects have
 - it enables the monitoring and measurement of the success of smart city strategic plans
 - a tool that allows the comparison of already existing strategies
 - it enhances stakeholder support and improves planning due to provision of information
 - it supports evidence-based policy development and the evaluation of processes and projects
 - the framework provides KPIs that can be shared
 - it enables better planning, and facilitates the assessment of the status quo for different purposes. It opens up a new understanding of urban problems, new ways to coordinate urban technologies, supporting new forms of urban governance and organisation
- **Learning from other cities**
 - keeping track of own performance while benchmarking with other cities
 - if standardised, it could be used for benchmarking
 - enables comparison with other major cities
 - supports learning from other cities and enables the setting of priorities for new initiatives
 - enables comparison with other evaluation frameworks
- **Support to develop new business models**
 - it could provide a key tool for identifying and agreeing upon new (potential) business models
 - it helps cities identify potential business opportunities, and supports the ongoing development of smart city programmes
 - it supports the development of data for use

- **Based on sound methodology**
 - the CITYkeys framework is a complete and precise tool based on sound methodology. It is flexible and allows stakeholders to choose diverse indicators based on individual city specifications and data availability
 - the framework can be applied in order to adopt rules and measurements that have proven their validity across European cities, which can result in comparable values and identification of measures that need improvement

Using the CITYkeys performance measurement system

Cities' experts were asked what a city needs to be able to use the CITYkeys performance measurement system. Based on their replies, cities are advised to meet the following conditions/have the following measures and procedures in place:

- strong political support to enable true capacity-building and cross-sectoral collaboration
- a clear overall vision of what they want to achieve
- decision by the smart city manager(s) to employ the framework
- determination to work together on interdisciplinary, cross-sectoral issues
- presence of organised 'back-ends' that ensure efficient communication and information flow
- availability and accessibility of data
- narrowing down complex sets of indicators to key indicators, which can be easily integrated and used in daily life
- good coordination between the different offices and presence of a central IT hub
- sorting out competition between the tools that are already in place and new tools
- ability to interpret and address the growing flows of data
- ability to translate data into 'useful' information
- ownership of the CITYkeys performance measurement framework from day one
- willingness and ability to co-create

Similarly, the respondents identified the following barriers to the application of the CITYkeys performance measurement framework:

- **Complexity and time**
 - complex and time-consuming to use
 - the framework is too 'heavy' to be applied in full. It offers a sufficient set of KPIs, but contains too many checkboxes. Useful as a planning support tool and for stimulating dialogue (and decision making) between stakeholders
 - the length of decision making processes and the time needed for data updates
 - complexity of the framework (and its presentation) can complicate alignment processes
- **Local contextual and cultural resistance**
 - knowledge of it, internal cultural resistance
 - adoption by stakeholders of a single methodology
 - resistance to change and to acceptance of the framework
 - lack of awareness
 - not a priority for local councils to implement it

- **Organisational**
 - lack of coordination
 - cross-sectoral input required (from different departments)

- **Data availability**
 - lack of complete sets of data in certain cases
 - provision of resources to collect data
 - availability of data

- **Competing frameworks**
 - one of many KPI systems, but the first for smart cities
 - knowing and understanding the framework in light of the existence of several similar frameworks
 - ongoing use of other types of indicators

- **Motivation, funding, and human resources**
 - access to funding for such applications
 - political decisions driven by other motives
 - resources, especially human resources

- **Conflicting interests and views**
 - different viewpoints of various stakeholders

- **Key opportunities are seen in the following areas**
 - enabling interaction with other tools, such as sustainability indicators, to find the right - accurate and up-to-date - information, is needed to communicate about smart city projects and project results
 - keeping the focus on what we really want to achieve
 - it is a great opportunity for co-analysing CITYkeys data in a network of cities
 - framework application can provide visibility to smart projects
 - application of the CITYkeys framework can help stakeholders to close knowledge gaps and to receive informed support
 - this framework could add value to the delivery of regional programmes, providing insight and analysis to aid decision making and monitoring
 - this framework could increase the quality of already existing indicators used for measuring city projects and urban pilots

3

Business models and opportunities in performance measurement and citykeys

The expected impact of a framework for data collection and performance measurement includes the stimulation of market for data-enabled services and solutions, thus supporting entrepreneurship. This is why the CITYkeys consortium has tried to identify new business opportunities for service and technology providers. The underlying assumption is that the creation of such a framework provides opportunities for existing or new businesses that make use of gaps in the implementation of smart city development.

To find out what is the best way to use the CITYkeys framework, three factors are analysed:

- the needs of cities
- the use of existing performance measurement frameworks
- the features and characteristics of the CITYkeys framework

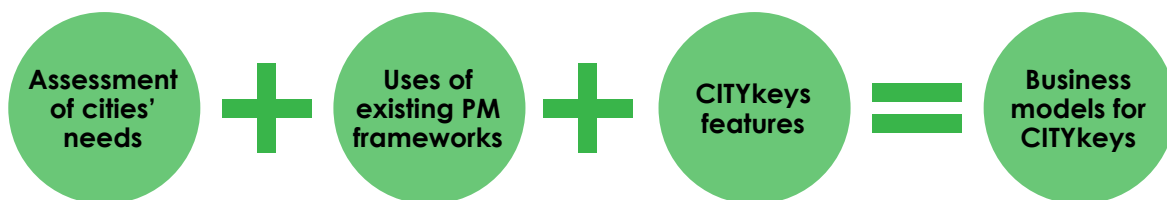


Figure 8: Identifying new business opportunities for CITYkeys

Starting with the assessment of the cities' needs, CITYkeys approached the European cities, and their responses revealed that they use performance measurement on city level for:

- the development of strategies and policies, and for evaluating progress in implementing them
- supporting decision making
- promotion and encouragement
- identification and dissemination of successes

The reasons for the use of performance measurement on project level are of a different kind:

- assessment of contributions to the municipal strategy and evaluation adaptation (interaction between city and project levels)
- assessment of project success
- upscaling and progress from experimental projects towards large-scale implementation
- management of resources



The requirements for a performance measurement framework and platform include:

- integration of several functions in one system
- compatibility with existing systems
- user-friendliness

The market for performance measurement in smart cities on project as well as on city level is already established to a certain extent. Following the CITYkeys analysis, existing services and frameworks support the process of smart city development in the following ways:

- **Neighbourhood and city certification schemes:** Neighbourhood certification schemes evolved from established certification systems for buildings to proof a certain quality level. They are targeting project developers or municipalities. Advantages include the high profile that most of these frameworks have (e.g. from building certification activities); the simplicity of an established system that comes along with clear guidelines; and the involvement of small and medium-sized enterprises (SMEs, usually consultancies perform the assessment). The main disadvantage is the fixed framework, which is not always flexible enough to consider different environments and situations that occur on local level.
- **Standardisation services:** The establishment of different frameworks for indicator systems leads to standardisation processes for the assessment as well as for the underlying indicators. The main aim is to find a unified methodology and a common set of KPIs that allow the results to be comparable. Standards can either be directly applied or serve as a basis for initiatives and projects using an own system. All standards are subject to regular updates.
- **International indices and other frameworks:** This category consists of commercial and non-commercial services and can also include services that offered by commercial institutions free of charge. The advantages of city indices are their simplicity and that they compare different environments. These advantages can also turn out to be disadvantages, since a deeper assessment is necessary to determine the state of development of a municipality, and comparison is often dependent on the composition and aggregation of the methods used.

- **Data platforms and interfaces:** Open data platforms meet the needs of a public policy that requires the release of certain sets of data for public use. The value of this data lies in the combination of data from different sources. In case the data can be found easily and is in a common machine readable format, the value can be even higher since that way third parties (e.g. service providers) can analyse the performance of smart city areas.
- **KPI development in publicly-funded research and demonstration projects:** Many KPI frameworks were established within publicly-funded research projects or coordination and support actions (CSAs). The need for impact assessment and performance proof makes the use of KPIs in projects necessary. The reasons for this need include the obligation to report the impact of public funding. This information can then be used for the replication and upscaling of the demonstrated measure. The main challenge in this regard is the existence of several parallel frameworks that are not always aligned to each other.
- **National frameworks:** The results of the national frameworks are similar to those of the international or European research projects. If such frameworks exist and have a suitable scope for application, they can be recommended for use. The advantage is that these frameworks consider differences in national legislation or national standards (e.g. area definitions differ in Europe, and this requires the additional step of converting the data). Also, these frameworks are more suitable for small and medium-sized cities.

The identification of gaps was performed based on the assessment of needs, and on a survey of the existing frameworks. Additionally, the direct feedback of city representatives was used to identify gaps that could be used by existing or new businesses. This was an especially valuable source of information. Urban planners working in municipalities play a central role in smart city development and implementation. Due to their role as coordinators, they have an overview on missing links and services in smart city development. Based on these inputs, the following business opportunities have been identified:

- performance measurement platform – used for supporting business development, local market alignment, and procurement procedures
- assessment and consulting services – considering data and targets on project and city level
- IT services based on open data solutions – utilising the CITYkeys performance measurement system

Overall performance measurement system

The main business opportunity arising from CITYkeys is the implementation of an overall performance measurement system. Such system requires the combination of several approaches (data collection and maintenance, calculation, and provision via visualisation) and technologies (IT). Since the effort and the requirements on expertise are quite high, it can be applied in a project or by a consortium of several SMEs. The system can be used for services described below (assessment, basis for the development of new application), but it also brings a variety of additional services:

- **Support of business development:** Municipalities receive numerous queries from companies offering services or solutions. A publicly accessible performance measurement system would allow companies to see what is required in a city and better align their offer.

- **Local market alignment:** Stakeholders involved in smart city development come from different fields and their level of expertise also varies. Not all of them have technical skills to understand the impact certain measures will have or what the status quo in the city is. A performance measurement system can be used as an application to establish a common language between stakeholders.
- **Support of procurement procedures:** A performance measurement system can be used by municipalities to provide requirements for procurement procedures based on the actual situation and the need to meet city targets.

Assessment and consulting services

Many new opportunities that arise from the application of the CITYkeys performance measurement system are related to assessment and consulting. New services can occur on city level to support the development and evaluation of strategies and support decision making. On project level, new services should be developed to allow for the assessment of project success, support planning, allow upscaling, and show the project's contribution to the city's specific strategies and targets. A large amount of data and extensive assessments are necessary before a proper development process for a site can start. This includes data from the municipality that can already be available in a platform, but also project specific data for the given site. Municipalities often lack resources to perform detailed assessments of this kind. This role can be taken over by a consultancy. The CITYkeys performance measurement system can be used as developed solution, and adapted to the assessment needs. The target group of such a service depends on the particular setup of the project or on the stakeholders involved in the development process. The customer can be the municipal administration; a group of stakeholders led by the municipality; or a private enterprise, such as a project developer. This setup can be institutionalised by establishing an umbrella association.

IT services based on open data solutions

Open data solutions can be applied directly by the municipal department responsible for IT issues or via an IT provider. Both alternatives enable SMEs to take over part of this development process. Outsourcing IT implementation can solve resource problems and stimulate the creation of economic value locally. CITYkeys provides data set definitions and KPIs that can be used for the visualisation of the outcome in an open data platform. The requirements on the development of data platforms and information management systems include compatibility, stability, safety, and user-friendliness.

Another possibility for services to enter the game occurs after the implementation of the platform. An open system provides the possibility for SMEs specialised in software development to develop applications that make use of the data in the platform. By docking applications to APIs, new solutions can be created on top of the existing system, thus, offering new services to citizens, businesses or the municipal administration. For this purpose, the CITYkeys performance measurement system with its KPIs can also be used as basis for developing applications. The involvement of SMEs creates or increases local economic value. SMEs take care of the development and operation of the platform, can contribute to its further development, or give feedback on how best to improve data sources.



Benchmarking and smart city indices

What is benchmarking?

Benchmarking is the process of continuously comparing and measuring a city against its own performance in the past (internal benchmarking), or comparing its performance to that of another comparable city (external benchmarking). Benchmarking provides information that will help the city take action to improve its own performance. Unfortunately, there is no such thing as a 'twin' – or fully comparable - city. Many cities and organisations are searching for meaningful ways to perform such comparisons, but this can turn out to be a frustrating task. Rather than trying to find an exact match, one should strive to find a 'cousin' that bears a strong resemblance in a specific activity or challenge.

What is a smart city index?

A smart city index aggregates the 'smartness' of a city into one number. An 'index' is a quantitative aggregation of many indicators, and aims to provide a simplified, coherent, and multidimensional view of a system. Indices usually give a static overview of a system, but when calculated periodically, they can indicate whether the system is becoming more or less smart, and can highlight the factors most responsible for driving the system.

How are they/should they be used?

Indices can be powerful tools to influence policy in a competitive environment as they make it possible to compile rankings. On the other hand, to really understand the factors influencing the index, it is necessary to know the underlying indicators and data. In many cases, there is no transparency with regard to this underlying information. Indicators and composite indices are gaining a lot of importance and are increasingly recognised as a powerful tool for policy making and public communication by providing information on countries and corporate performance. Four major purposes in assessment are identified:

- decision making and management
- advocacy
- participation and consensus building
- research and analysis

Ideally, the goal of city indices is to help city stakeholders better understand their specific challenges. They provide insights into effective policies and best practices and support decision making.

What are indices made up of?

Indices are made up of indicators. Just like during the development of a set of indicators, a policy goal has to be clearly defined for constructing a composite index. The components and sub-components then need to be determined based on theory, empirical analysis, pragmatism, or intuitive appeal - or some combination of these methods. With regard to the selection of indicators to be included, depending on how the index is to be used, one could think of, for example:

- including only the indicators that are applicable in all contexts (overall smartness) or only using the indicators that apply to a certain sector (e.g. smart mobility)
- striking a balance between output and impact indicators
- a well-thought-out approach to qualitative and quantitative indicators (i.e. if the index is used to promote competition, the standards for comparability will have to be high)

Transparency is the key to generating a good index. The index needs to be easy to understand, yet scientifically sound.

Towards a city index?

Based on the conclusions of the CITYkeys workshops and on interactions with cities, it appears that cities do not see many advantages in comparisons with other cities, and they are not keen about rankings either. Their differences in geographic location, history, economic structure, institutional arrangements, etc., make each city unique and incomparable to others.

Although the publication of a certain city index may get some initial attention, it is quickly forgotten and seldom leads to any policy reaction. At best, some questions are asked in the city council, which prompt responses from the civil servants, but there are no examples of the use of a city index in actual city policy making.

Cities are well aware that quite a number of city indices are published by companies, which are suspected of using these to create a market for their services. One of the big disadvantages of several of the existing indices is the relative ranking lists they produce. For the city at the top, there is no incentive (and no guidance) to improve further. For cities at the bottom, it looks frustrating or impossible to reach the ones at the top. Moreover, it is unclear what the ranked cities' absolute position is. For example, in a sustainability index many of the cities (in absolute numbers) may actually be unsustainable, without the (relative) index indicating such a status.



CITYkeys smart city project indices

The CITYkeys assessment methodology contains KPIs for both project and city-scale assessment of smart cities. The framework is structured in a hierarchy of themes and sub-themes. Both qualitative and quantitative indicators are used, and in many cases there is a city KPI corresponding to an associated project KPI. All the project KPIs have a uniform five-level assessment scale (ranging from 1 = worst to 5 = best performance level). This makes the KPIs comparable between each other, which also enables the easy scoring of KPIs throughout the framework on the same scale. One could imagine a CITYkeys smart city index for project scale consisting of one overall index and sub-indices for each CITYkeys main themes (people, planet, prosperity, governance, propagation). The indices can be aggregated by using simple averages as follows:

- The sub-indices for each main CITYkeys theme are calculated as an average of the scores of each assessed KPI under that theme. The index is thus a number between 1 (worst score) and 5 (best score).
- The overall index is an average of all the five sub-indices.

Many certification schemes and indices use weighting methods to indicate the mutual importance of KPIs and/or categories in a framework. Weights are then taken into account in the calculation of the overall score. The importance of various aspects in a framework depends on the stakeholder that uses the framework and on the context where the indicators are applied. Another option for a city is to develop the CITYkeys assessment scheme as full-fledged, multi-criteria, multi-stakeholder decision support system, whereby each of the stakeholders will be able to attach his or her own weightings to indicators or policy themes. These weightings then become an explicit element in the decision making process.

Partial use of the framework?

Since the beginning of CITYkeys project, it has become clear that there is a wide range of smart city projects having very different characteristics and focusing on various aspects. Therefore, the consortium ended up with a KPI framework consisting of 101 KPIs available for the assessment of various types of smart city projects. It is clear that not all of those available KPIs are relevant in a specific smart city project, and the flexible methodology allows for selecting and assessing only those KPIs that are relevant in that specific project. However, it has to be kept in mind that, stemming from the CITYkeys definition, a smart city project is an integrated project combining multiple sectors and having a significant impact in supporting a city to become a smart city along the four axes (people, planet, prosperity, governance). It is clear that a project that has been assessed with only a very small number of KPIs probably does not comply very well with the former requirement. Furthermore, two projects are not comparable as such with the above defined indices if their indices are based on scores of very different amounts of assessed KPIs. Someone could even misuse the indices by calculating them deliberately for a small number of KPIs in which a project is performing particularly well.

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Authors

- Nikolaos KONTINAKIS, EUROCITIES
 - Rebeca PORTAIL, EUROCITIES
 - Wilma DRAGONETTI, EUROCITIES
-
- Miimu AIRAKSINEN, VTT Technical Research Centre of Finland
 - Peter BOSCH, TNO
 - Ina HOMEIER, city of Vienna
 - Aapo HUOVILA, VTT Technical Research Centre of Finland
 - Branislav IGLAR, AIT Austrian Institute of Technology
 - Daiva JAKUTYTE-WALANGITANG, AIT Austrian Institute of Technology
 - Ana JIMENEZ, city of Zaragoza
 - Sophie JONGENEEL, TNO
 - Elli KATAKORPI, city of Tampere
 - Sanja MALNAR NERALIC, city of Zagreb
 - Hans-Martin NEUMANN, AIT Austrian Institute of Technology
 - Eva PANGERL, city of Vienna
 - Kalevi PIIRA, VTT Technical Research Centre of Finland
 - Isabel PINTO-SEPPE, VTT Technical Research Centre of Finland
 - Daniel SARASA FUNES, city of Zaragoza
 - Roland VAN DER HEIJDEN, city of Rotterdam

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