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1 Executive Summary

This document is the *D8.3 Proof of Concept Results* deliverable of the EPIC project which presents the evaluation and validation outcomes of the project elements undertaken as integral elements of the "proof of concept" scenario. In EPIC WP8, in addition to the typical validation task for end-user testing of the pilot applications and the test cases for the platform features and capabilities (as presented in the *D8.2 Evaluation Report*) the project teams defined and implemented a proof of concept application that fulfilled the needs of a potential city customer of the EPIC platform, in this case the "virgin" city of Tirgu Mures in Romania. The needs of the city council and citizens for intelligent services were identified through the systematic application of the roadmap and new applications were developed by reuse of the EPIC services and platform to realise the "smartness" vision of the city.

The experiences during the technical work of developing and adapting the application elements, supplemented by comprehensive feedback from the end-users, was very positive and confirmed the added-value delivered by the project. These successful outcomes validated the EPIC platform and associated services as the first choice service innovation and delivery platform to empower "smarter working" in cities across Europe.

In addition to the results of the proof of concept experimentation, the EPIC consortium emphasised aspects of the project outcomes that could further enhanced to increase their effectiveness. This exercise identified a number of lessons learned and recommended best practices that could be applied post-project to create a commercially viable form of EPIC and produced an implementation plan for future applications to enhancing acceptance and sustainability for pan-European level application.

2 Introduction

The EPIC project has created an innovative ecosystem of services, tools and policies, to support cities in their quest to become "smart(er)" and to implement their digital agenda. By exploiting the EPIC platform capabilities and the roadmap, cities can provide "intelligent" applications with an advanced set of technical, functional and business capabilities, based on the particular requirements of the city council, citizens and participating SMEs. These applications support partnerships between the public and private sectors and collaboration across, and potentially between, cities. The applications deployed on the EPIC platform take the advantage of the platform services for scalability, sustainability and low operational cost and which could readily be made available to a pan-European (and possible worldwide) market. In addition, the EPIC Roadmap has simplified the process of extending existing applications or of defining and developing new 'smart' services for cities, leveraging the involvement of enterprises and SMEs to create new business models and value networks.

In WP8 the project focused on the evaluation and validation of the aforementioned project outcomes by following well-established methodologies that involved various stakeholders participating throughout the overall lifecycle of a service and end-users participation through the Living Labs approaches. Whilst the emphasis of *D8.2 Evaluation Report* is on the testing of the platform and pilot elements with detailed test cases and internal surveys, D8.3focuses mainly on the proof of concept-related activities in Tirgu Mures and on the reporting of the overall EPIC project outcomes, as shown schematically in Figure 1.

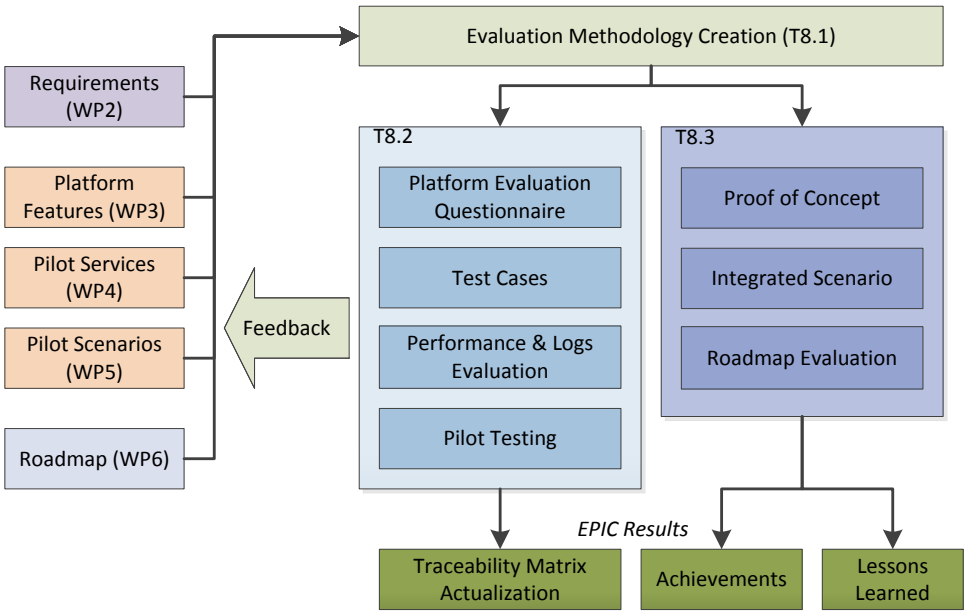


Figure 1: EPIC Project Evaluation and Validation Strategy

The greatest effort was dedicated to the adaptation of the pilot applications to suit the environment of the "virgin" city, and through this approach to validate the related project

requirements for re-use of services; interoperability; cross-border customisation and pan-European delivery. In addition, an integrated scenario was developed to further highlight the added value of the project through the demonstrable re-use web-services. The adaptation processes were guided by the EPIC Roadmap, which based on the received feedback, was also validated successfully.

More specifically, the Proof of Concept (PoC) phase of EPIC was an essential part of the project to verify that the EPIC platform approach developed initially for Pilots in Brussels, Issy-les-Moulineaux and Manchester could be readily implemented in a different city, in this case the city of Tirgu Mures, Romania. The main trigger for initiating the EPIC project in Tirgu Mures was the city's desire to become "smarter", in accordance with their Digital Strategy. The user experience and acceptance of the Tirgu Mures services were tested by alignment with the pilot framework developed and deployed in *D7.3: Evaluation of the Pilots*. Both quantitative and qualitative feedback was gathered through user questionnaires and interviews. Quantitative insights revealed relevant relationships and the strength of user experiences and the qualitative data yielded insight into the rationale and evaluation underlying the experiences of user acceptance of the EPIC solutions developed.

Following completion of user-testing of the PoC solution on a pilot-by-pilot basis, the project entered the integrated scenario phase. This was designed to demonstrate how the energy-data web-services created for use within one pilot could be readily consumed by and demonstrate added value to, the other pilots. This had already been demonstrated in part during the PoC phase, where the Tirgu Mures PoI web-service was used by both the Tirgu Mures Relocation and Tirgu Mures Urban Planning during the PoC phase. The integrated scenario demonstrated the potential for wider web-service re-use through sharing of the energy-data web-services across the three pilots.

The EPIC roadmap descriptions and the detailed templates were used in the collaboration with the city of Tirgu Mures to apply and test the concepts in a real deployment environment and from this to implement the EPIC pilot services in a form customised to the needs of Tirgu Mures. Testing of the roadmap in this way, from initial concept exploration to final service delivery and with the full involvement of Tirgu Mures citizens allowed true end-to-end testing with full participation of the city at all stages using the templates provided in the roadmap. This approach provided a real-life case-study in a realistic deployment environment rather than a simulated testing methodology in an artificial environment. The feedback, results and experiences from application of the roadmap descriptions through completion of the detailed templates delivered a real measure of user acceptance and value contribution of the roadmap methodology in smart-city service definition, development and implementation.

One of the final tasks in WP8 was a survey conducted with the EPIC consortium to capture the lessons learned during the project lifecycle, from the definition of the project vision and the identification of the requirements to the implementation of the project elements and the testing of the outcomes. The survey was conducted in May 2013 and provided very valuable input for defining the best practices required to realize fully the vision of the EPIC project and similar smart-city journeys.

As part of the EPIC achievement analysis, WP8 examined the project vision to help stakeholders across the public service delivery chain kick-start innovation and work smarter, to confirm whether and to what extent these ambitions had been fulfilled. The aspects that were analysed included: the ability to provide more innovative, efficient and effective services at reduced cost; new business models and working relationships with other cities; access to more innovative, efficient and effective services; enhanced ability to help improve public services; greater access to local and international markets and the ability to work more cost-effectively via the EPIC Cloud platform.

The document is structured as follows:

- Chapter 3 yields insights into the developments of the proof of concept, which focused on the technical aspects of the three adapted pilot applications and the integrated scenario.
- Chapter 4 presents the outcomes of the experimentation in Tirgu Mures, describing the platform elements and the roadmap with consideration of the feedback received from the end-users.
- Chapter 5 presents and overview of the lessons learned concerning the realisation of the project vision for transitioning to a "smart" city and summarises the project achievements from the perspectives of the cities, the citizens and SMEs.
- Chapter 6 draws together the different aspects of this deliverable and provides the overall conclusions of the project.

Supporting material including the Questionnaires and a List of Stakeholders in Tirgu Mures can be found in the Appendix.

3 Report on Proof of Concept

EPIC had as a primary objective the stimulation of innovation in cities across Europe through greater leverage of ICT to deliver an enabling platform for the delivery of smart-city services. A key requirement was therefore to verify that the pilots developed and evaluated separately in the initial stages of the project in Brussels, Issy-les-Moulineaux and Manchester cities could be replicated in a "virgin" city, to ensure that their multi-stakeholder benefits could be assessed in a live deployment environment following application of the roadmap methodology developed in EPIC and subsequent technical implementation of the location-specific pilots as follows:

- The Tirgu Mures "proof of concept" repurposed the original pilots and created a new customised integrated application to address the specific needs of the city; deployed these on the EPIC platform and tested the applications with the citizens of Tirgu Mures.
- The proof of concept was implemented in accordance with the strategy and guidelines indicated by the application of the process in Tirgu Mures.
- The service-oriented architectural design of the EPIC platform played a key role in simplifying the pilot conversion process and subsequent integration, enabling a relatively smooth repurposing of the pilot elements and the seamless connection of the pilots to the available local data resources of Tirgu Mures to ensure local relevance.

The components and the process of the proof of concept trajectory are drawn out in this Chapter, while the experimentation results and the received feedback – overall, considered rather positive, underpinning the value of EPIC as an effective "smart" city solution – are presented in Chapter 4.

3.1 The Role of Web-services for the EPIC Solution

The EPIC platform architecture is designed to provide: a flexible and extensible environment for the development and hosting of smart-city services commissioned by city administrations; an access portal for citizens wishing to access data-rich smart city services and to provide a resource of data-rich services which SMES software developers can incorporate into the next generation of smart city services. To future-proof the platform, ensure reproducibility without undue reliance on vendor-specific software and to ensure the widest accessibility to developers and users, the platform embraces fully the use of open standards.

A key element of the smart-city philosophy is the exposure of public and third-party owned data in a form that can be consumed readily by other smart-city services independent of the platform or implementation language. To ensure re-usability of data, it is essential that standard methods are used to expose data to the applications that consume it. The provision of data is very different to the display of data and user-interfaces can be highly application and device specific. In the EPIC philosophy, data is provided through standard SOAP or REST web-services and the user interfaces are either delivered as standard JSR-268 portlets which can be viewed in any browser or have been

developed in the native environment for mobile devices such as iPhones and Android smartphones where this is required. In either case the same web-services are consumed to deliver the data to the user-interface. This approach of separating how and in what context data is used from the mechanism by which data is delivered and visualised by end-users maximises the potential for re-use of data to create exciting and engaging data-rich smart city applications which delivered to a standard web-browser browser to maximise uptake.

3.1.1 About Web-Services

Web services are a category of software components that provide functionality across a network and more widely across the world-wide web. Communication via web-services uses standard and well-documented Internet protocols including TCP/IP, HTTP and XML. By using web-services, a client computer can use the functionality provided remotely by another computer as a software component in a larger solution. Web-services expose their functionality through well-defined programming interfaces, documented in the form of a WSDL file, which allow automated discovery of web-services. Web-services are most commonly used to provide programme-level access to real-time information such as share prices, exchange rates, train and plane arrival times, etc. Once the data owner exposes their data as a web-service, it can be readily used by other software developers to integrate this live data into web pages and software applications. The ability to access data programmatically through web-services in a manner which is location and platform independent opens up extensive opportunities for the creation of new and compelling software services derived from the data feeds carried by the web-services. Consuming data through web-services allows the programmers to concentrate their efforts on developing programme functionality and user-interfaces without worrying about the behind the scenes complexities of the data sources.

3.1.2 Use of Web-Services by EPIC Pilots

The three EPIC pilots, namely Relocation, Urban Planning and Smart Environment, each focused on the delivery of a meaningful user experience through the careful design of functionality and user interface (see e.g. *D7.3. Pilot Evaluation Report*). Each pilot was reliant on a number of external data sources to provide the information needed by the user. For example, Relocation for Brussels used data on properties for sale/rent provided by ImmoWeb and points of interest (PoI) open data provided by CIBG and Google maps. The use of web-services to expose data allowed the interfaces for property data, PoI etc to be standardised. The Brussels property data was made available to the EPIC project by ImmoWeb through access to an existing ImmoWeb web-service running on ImmoWeb servers. An EPIC Brussels Property web-service was created on the EPIC servers which consumed the ImmoWeb web-service, exposing the Brussels property data to the EPIC portlets. This meant that EPIC was able to reuse the existing third-party property web-service without requiring ImmoWeb to make any changes specific to the usage in EPIC, but EPIC kept control of the way the property data provided by ImmoWeb was exposed to EPIC clients by the web-service running on the EPIC platform (see *D5.3 Adaptation Rules & Criteria for EPIC Scenarios*). This approach was used throughout EPIC, namely

creating an EPIC platform web-service which consumed an existing third-party web-service and exposed data in a standard EPIC format, to allow simple re-use.

When Relocation was implemented in Tirgu Mures it was therefore a simple matter for the data providers in Tirgu Mures to expose their property and PoI data as web-services and for these to be accessed by the EPIC platform web-services. The EPIC web-services for Tirgu Mures presented data in the same format as the EPIC property and PoI web-services used in Brussels. Therefore Tirgu Mures was not required to create web-services that exposed data in the same way as ImmoWeb or CIBG, as any differences in the third-party web-services were accommodated by the EPIC platform web-services, to ensure standardised presentation of data. In theory this allows any application consuming the EPIC Brussels data web-service to consume the Tirgu Mures data web-services without any changes. This approach is illustrated schematically in Figure 2.

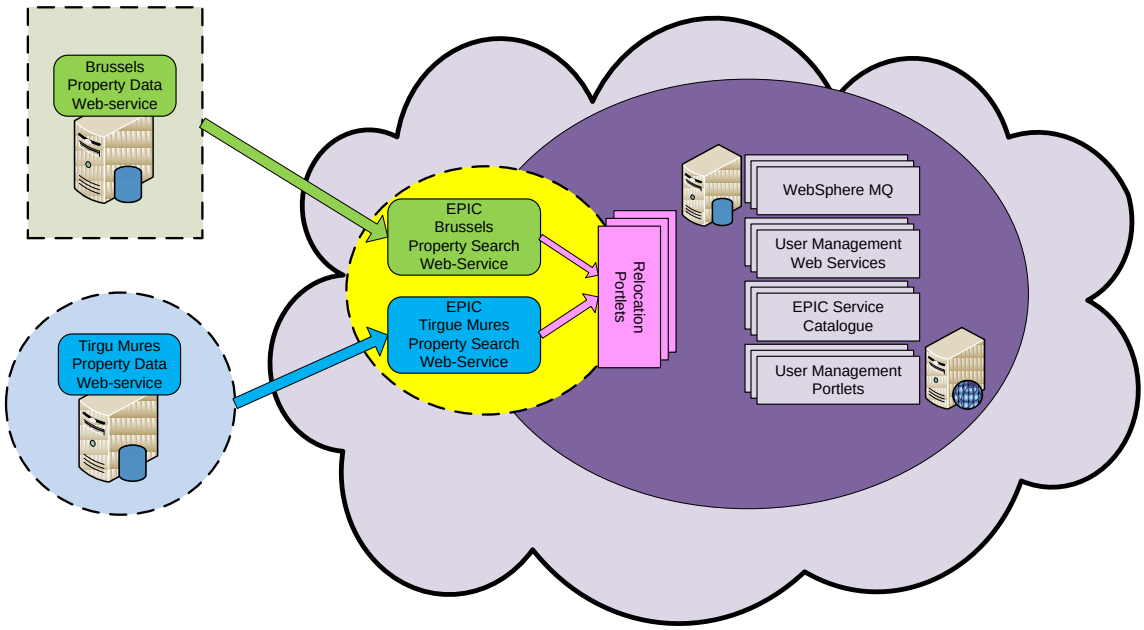


Figure 2: From a Brussels to Tirgu Mures property web service

The flexibility of web-services was further underlined by the Smart Environment pilot, which collected energy data and stored this in the off-platform generic monitoring framework (GMF). Smart Environment then exposed domestic energy data and public-buildings energy data as separate web-services to feed the energy dashboards. These web-services were subsequently, consumed by relocation to add energy data to domestic properties in Tirgu Mures and by urban Planning to add energy-data to public buildings in Tirgu Mures during the integrated scenario.

3.2 Commercial Exploitation of Data Services via the EPIC Platform

The approach wrapping third-party web-services for controlled access via the EPIC platform is a critical part of the potential downstream commercial exploitation of EPIC in a Smart City Services context. Data sources owned by third parties would be licensed to EPIC and exposed via EPIC web-services, with usage controlled and monitored by the

EPIC platform. EPIC could then license or offer on a "pay-to-use" basis access to these services for developers of big screen and mobile applications. Alternatively, EPIC could host commercially, on behalf of the data owners, EPIC web-services that expose the third-party owned data, with revenue generation and revenue sharing controlled by the EPIC platform.

This could be established using the operational model for EPIC as described in more detail in *D6.3 Functional and Business Roadmap*. Based on this operational model, the EPIC platform can play a mediator role in making data available from external suppliers or service providers. The specific smart city service that would be established on the EPIC platform would indeed be such a data mediator service. The added value of this approach would be the consistent and controlled ways of making smart city data (from various sources) available to potential integrators, businesses or even citizens and the insulation of end-users from any differences in the underlying third-party web-services from different cities.

3.3 Technical Implementation of Pilots in Tirgu Mures

For the adaptation and implementation of the "Relocation Proof of Concept" the following tasks have been performed:

1. Data on properties in Tirgu Mures was exposed through a web-service created by the city, to replace the ImmoWeb-owned web-service used in Brussels.
2. An EPIC platform web-service was created to wrap the Tirgu Mures property web-service and present data to EPIC users in the same way as the Brussels property wrapper web-service.
3. A point of interest (PoI) web-service was created by the city to replace the Brussels PoI service provided in Brussels by CIBG.
4. An EPIC platform web-service was created to wrap the Tirgu Mures PoI web-service and present data to EPIC users in the same way as the Brussels PoI wrapper web-service
5. A Google map of Tirgu Mures city was used as the baseline map over which Tirgu Mures specific data from the Tirgu Mures property and PoIs web-services were overlaid in the Tirgu Mures Relocation portlets.

The necessary steps are described more precisely in the following.

The Relocation application for Brussels is based on a modular service-oriented J2EE architecture and it makes heavy use of the concept of a web-service. The Relocation application consists of web-services and of Portlets. The Portlets are visual components that for instance provide the user interface and that also provide suitable forms of presenting the data of the web-services to the user like for instance on a map.

The adaptation of the relocation service of Brussels to Tirgu Mures was a straightforward process. In order to adapt the Relocation Application to another city only minimal changes are needed for the Portlets. More important, Tirgu Mures was requested to provide equivalences for the two web-services used by the Relocation Application,

namely a Real Estate web-service and a PoI web-service, as shown in the lower portion of Figure 3.

In order to provide a Real Estate web-service the City relied on Indecosoft, a company for software solutions in Romania. Indecosoft created a JSON-based web-service that is almost equivalent to the Estate Service which has been provided by Immoweb for usage in the Brussels Relocation Service. After a few developmental iterations and a further requirement concretization, the Estate web-service of Tirgu Mures provided about one thousand apartments that are offered for rent via the City's Town Hall.

In order to provide a PoI web-service the City relied on service applications that were already at disposal through their IT infrastructure. The City also provided access to a server offering geospatial data of Tirgu Mures, namely their GeoServer. This is an open-source server written in Java which allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards. GeoServer functions as the reference implementation of the Open Geospatial Consortium Web Feature Service standard, and also implements the Web Map Service and Web Coverage Service specifications (see http://en.wikipedia.org/wiki/GeoServer). GeoServer provides the required web-service capabilities as standard, so no additional software development efforts were needed to expose the PoI web-service for Tirgu Mures.

Due to a different cultural landscape of Tirgu Mures compared with Brussels, it was not possible to use a direct one-to-one equivalence mapping of Brussels's categories for PoIs to those for Tirgu Mures. Therefore some additional PoI types were introduced, for example "Monument" and some Brussels specific types were discarded, e.g., "Dutch Language library". Finally, the GeoServer web-service provided a few thousand PoIs of the categories "Transport facilities", "Educational facilities", "Security and Healthcare", and others.

Because the data services for PoIs and Real Estates of Tirgu Mures were not entirely equivalent to those used in the Brussels Relocation, mediating web-services were created that performed the necessary conversions. This again demonstrated how the EPIC web-services, acting as mediators, could present a standardised interface to "insulate" developers from differences in the third-party web-services exposed by the data owners. Figure 3 presents a schematic of the elements different involved.

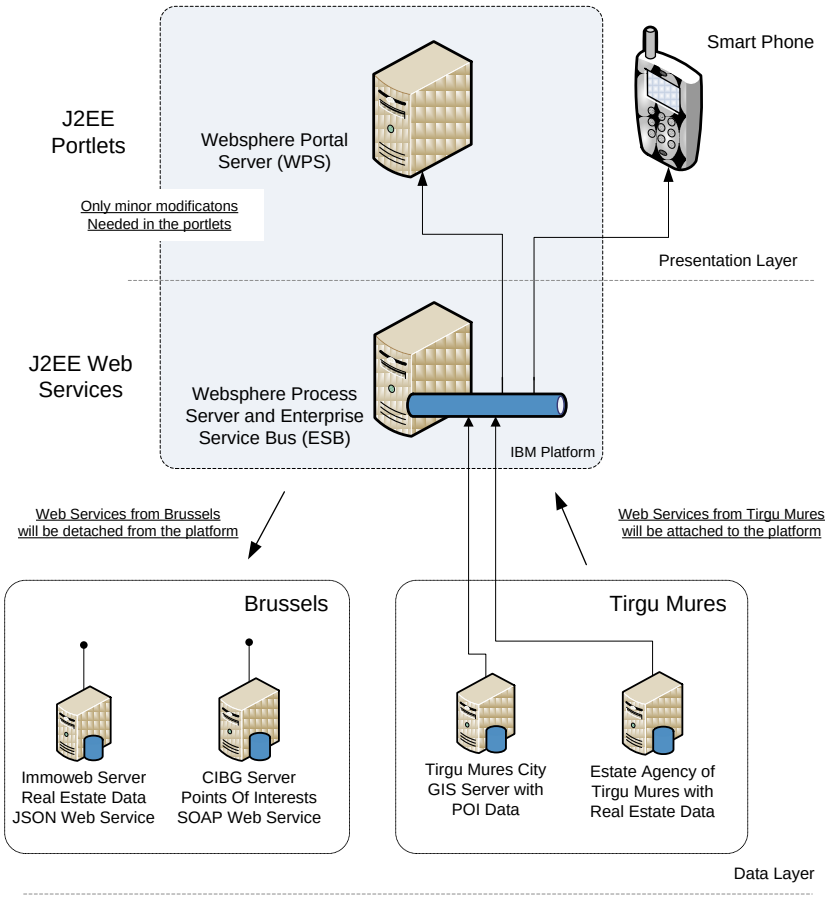


Figure 3: Data web services in the Relocation application Architecture were replugged and an adaptation to Tirgu Mures had been accomplished

3.3.1 Urban Planning Proof of Concept

For the adaptation and implementation of the "Urban Planning Proof of Concept" the following tasks have been performed:

1. A simplified 3D model was created for a selected area of Tirgu Mures city from a digital map and selected elevation data for key buildings.
2. The EPIC Tirgu Mures PoI service was consumed by the Tirgu Mures Urban Planning portlets, further demonstrating re-use of a common Tirgu Mures web-service by both Relocation and Urban Planning pilots in Tirgu Mures.

3.3.2 Smart Environment Proof of Concept

For the adaptation and implementation of the "Smart Environment Proof of Concept" the following tasks have been performed:

1. Energy monitoring hardware was installed in 2 domestic properties in Tirgu Mures. This hardware and the firmware in the web-interface box was unchanged from that installed in Manchester homes
2. Two additional inductive clamps were provided to allow the domestic hardware to ensure the 3-phase electrical supplies for commercial premises, as smart-meter data was not available for public buildings in Tirgu Mures.
3. Three Schools had the 3-phase electrical monitoring installed.
4. Data from the houses and schools was transferred into the back-end GMF database using the same re-flashed routers, MQTT protocol and message broker as used for the Manchester domestic energy data, but with the energy data from schools marked as public buildings to differentiate it from the houses.
5. Smart Environment had two different dashboards, one for domestic energy and one for public buildings. Each required a different web-service as the domestic energy data was collected as power measurements at six second intervals from the Current-Cost sensors and the public-building data in Manchester was collected as 30-minute readings of energy consumed.
6. For Tirgu Mures the same energy dashboards were re-used but the public buildings data web-service was significantly enhanced to create a "pseudo smart-meter" 30 minute energy reading from the Tirgu Mures schools by processing the 6-second 3-phase power data into energy consumed in 30-minute time slots, to match the way data was presented by the Manchester smart meters. This again demonstrated how the public-buildings energy web-service presented data in consistent 30-minute KWh consumed figures, irrespective of whether the original data was received from smart-meters and stored in the GMF as 30-minute energy readings, or was received from the Tirgu Mures schools as 6-second 3-phase power readings. The web-service processed the data appropriately to ensure that the same data format was presented to the application calling the web-service.

3.4 Integrated Scenario

Following completion of user testing of the PoC solution on a pilot by pilot basis, the project entered the integrated scenario phase, which was designed to demonstrate how readily web-services created by one pilot could be consumed usefully by other pilots (see for timing explanation, *D7.2 Reports of 3 Pilots*). In essence, part of the integrated scenario had already been demonstrated in the PoC phase, where the Tirgu Mures PoI web-service was used by both Tirgu Mures Relocation (i.e. "Find a House" application) and Tirgu Mures Urban Planning (i.e. "Discover Tirgu Mures" application).

Therefore, the integrated scenario focused primarily on how the Smart Environment web-services from domestic energy and public building energy could be usefully included in the Relocation and Urban Planning PoCs in Tirgu Mures.

The first scenario encompasses a combination of relocation with domestic energy and the second scenario is a blending together of urban planning with public building energy.

'Find a House' Scenario

The Domestic Energy web-service used in Smart Environment to feed the domestic energy dashboard was used by the Relocation portlet to add live and historic energy data to the property data for the two houses in Tirgu Mures which had been fitted with energy monitoring hardware. This demonstrated how richer data could augment the experience of the user when reviewing potential properties for sale or rent. An understanding of the potential utility bills for a given property could aid the user in selecting a property appropriate to their needs, lifestyle and values.

'Discover Tirgu Mures' Scenario

Urban Planning was already reusing the Tirgu Mures PoI web-service developed by Relocation. To further demonstrate integration, the public building energy data web-service used by Smart Environment to feed the public buildings energy dashboard was used by Tirgu Mures Urban Planning to add an energy usage timeline to the schools for which data was available. Urban Planning therefore re-used the web-service that created the pseudo 30-minute energy consumed measurements from the 6 second 3-phase power data stored in the GMF.

3.4.1 Significance of the Integrated Scenario

Whilst this demonstration may not appear particularly significant in the context of the two pilots, it demonstrates an important principle for the potential further exploitation of EPIC, namely that by *using third-party web-services and wrapping these with an EPIC web-service, these data sources can be readily reused by third-party developers, utilising the standard interface provided by a web-service*.

Integration of web-services into software applications is a relatively simple task, given the standards in place and in particular the comprehensive description of the web-service provided by the WSDL file. Consider, for example, the situation where a city has an obligation to provide under an open data agreement, information on PoIs such as public transport, schools, parks, etc. It is quite likely that this information might be held in different repositories owned by different parts of the City Administration. Whilst web-services could be made available to expose these individual data layers, the proximity of, for example, schools to parks might not be readily available if parks data is held separately from schools data, as the data may fall into a different administrative department.

One role that EPIC could have in the wider smart city context is that of a *data aggregator*, where in the above example, an EPIC platform web-service could consume both the parks data and schools data and output a composite data stream, allowing for example the distances between parks and schools to be calculated, to understand access to green space by school children. In this case, the EPIC Schools-Parks web-service would consume both the third-party off-platform web-services that exposed the Parks and Schools data streams and combine these in a meaningful way, providing a well-documented and standardized interface for any third-party developer who wished to consume the EPIC web-service in their big screen or mobile application.

3.5 Roadmap Evaluation for Proof of Concept

The other important component of the EPIC Proof of Concept is the EPIC roadmap for smart cities. This roadmap has been developed throughout the entire lifecycle of the EPIC project and now offers cities *a sustainable solution for transfer of eGovernment services and applications to shared European web-based services and cloud computing platform*. The development of the roadmap was performed in parallel to the pilot developments and PoC applications. It also was tested for the city of Tirgu Mures. The results of this test are presented in Section 4.4.

Throughout the development process several feedback moments were organized to support to learn about the best possible features to include. So, during the interim evaluation it became clear that the roadmap methodology seemed rather complex and was hard to understand for small and medium-sized cities. As such, the methodology was simplified and improved in terms of the descriptions and details of the roadmap phases. Most of the details were transferred into the templates for the different roadmap phases, which provide concrete methods, tools and descriptions for the specific activities. The development of these roadmap templates was performed in parallel with the development of the three pilots, and resulted in a minimum alignment and feedback from these pilots and user testing phases. However, the testing of the roadmap in Tirgu Mures provided more rounded feedback and resulted in clear guidelines for the use of the roadmap by city administrations and SMEs (as part of *D6.3 Functional and Business Roadmap*).

For evaluating and completing the full EPIC roadmap for smart cities, a number of interviews were organized with specific consortium members and related partners. The technical implementation (including the mobile app for the Relocation pilot) was discussed with the technical team from iMinds. The platform implementation was discussed in more detail with the team from IBM Germany. The needs and requirements of cities were discussed with ENoLL, and feedback was provided on the structure and complexity of the roadmap descriptions. In addition, the specific aspects of the three pilots (including the user testing) were discussed with the respective pilot leaders, including Navidis, iMinds and MCC/BCU.

From the developments, interviews and evaluations during the PoC phase, the following feedback was taken into account for the EPIC roadmap descriptions and templates:

- Roadmap descriptions and templates should take into account more details of the technical developments and platform components (for example, the service catalogue) as being developed in the three EPIC pilots.
- Roadmap descriptions (and to a lesser extend the templates) should focus on helping cities and city administrations in understanding the visions and directions towards a smart city.
- The roles and responsibilities of the different stakeholders involved in establishing smart city services on the EPIC platform should be clearly defined. The typical project organisation should highlight the responsibilities from the city and external providers in relation to the EPIC platform and governance organisation. In addition, the roles and responsibilities for the maintenance and

governance of the EPIC platform (and service catalogue) should be clearly defined in order to market and communicate clearly to cities or SMEs.

- The potential business models and financial structure to be used for providing the smart city services on the EPIC platform should be clear and simple towards consumers (such as city administrations, SMEs, etc.), and help in the establishment of relevant business cases.

At the conclusion of the roadmap evaluation for the PoC phase, the roadmap descriptions and templates should provide the elements necessary for city administrations and SMEs to establish smart city services on the EPIC platform. The general roadmap description should be sufficiently clear and simple to help city administrations to understand the different phases necessary in the journey towards becoming a smart city. The detailed templates should help city administrations and SMEs to define and set-up the specific smart city projects and initiatives required. Finally, the proposed operational model for EPIC, including the description and set-up of an EPIC service catalogue (see deliverable D6.3 and the technical deliverables in WP4), should help the EPIC partners and governing body to further develop and commercialise the value of smart city services on the EPIC platform.

4 Proof of Concept Results

This Chapter reports the results from the Proof of Concept (PoC) phase of the project, which involved the transfer of the three individual pilots, located originally in Brussels, Issy-les-Moulineaux and Manchester, to the common location of the City of Tirgu Mures in Romania. The aim of the PoC was to undertaken an end-to-end test of all elements of the EPIC philosophy including the application of the Roadmap by the city administration; the technical implementations of the three Pilots using Tirgu Mures data and the involvement of users through the user-centric Living Labs philosophy. The focus on user evaluation was explored through three scenarios, namely "Find a House", "Discover Tirgu Mures", and "Smart Energy". The individual testing of the pilots in the context of Tirgu Mures was subsequently extended to the integrated scenario. The Chapter concludes with the presentation of the findings from the application of the Roadmap in the Tirgu Mures context.

4.1 Tirgu Mures

With a population of about 130.000 inhabitants, Tirgu Mures municipality is the capital of Mures County. Mures County is part of the "Center" Regional Development, together with Alba, Brasov, Covasna, Harghita and Sibiu. The "Center" Development Region in central Romania is approximately equidistant from the border crossing points into neighboring countries.

Tirgu Mures is well positioned with excellent access to the existing transport infrastructure. The central geo-strategic positioning provides access to the European highway E60, to an extensive railway network, to the international Transilvania Airport. And close to the planned highways - Transilvania and Tirgu Mures - Iasi highway.

Tirgu Mures is a city which embraces novelty and innovation and understands fully the potential benefits that investment in technology, ICT, medicine, medical technologies and other high-tech businesses can deliver to the citizens and how this can act as a catalyst for economic growth. The local administration is fully aware that in an age of innovation only those cities/companies/people who innovate will prosper to deliver benefits in terms of economic growth and quality of life, with Tirgu Mures becoming a better place in which to live, work and start a business. Tirgu Mures is already on the way of becoming a "Smart" city through the implementation of a number of projects that promote intelligent services for the citizens and for the businesses, so involvement in EPIC was a logical decision for the city. These characteristics of Tirgu Mures, particularly the ready acceptance of technology by the city administration and the citizens of Tirgu Mures also made the city a natural choice for the EPIC consortium, which needed to find a receptive "green-field site" for the implementation of the Proof of Concept. This would ensue that the entire life-cycle of EPIC represented within the roadmap could be fully tested in an environment representative of that of many cities who were actively embarking on the journey to becoming a smart city to deliver enhanced socio-economic benefits to the city, businesses and the citizens alike.

4.1.1 Objectives

The main trigger for Tirgu Mures to participate in the EPIC project was the desire to become "smarter", in accordance with the Digital Strategy of the city. Tirgu Mures city has pioneered the development of ICT projects; implemented a smarter way to administer the city, to reach the citizens, to reach local/national business, to promote the city, and to create a better place for people and business to live and grow.

Through the adoption and use of a series of smart-city Pilot applications, the EPIC project provided to Tirgu Mures the opportunity to implement and evaluate better ways to:

1) communicate with its citizens and local/national businesses;
2) enable people and businesses to relocate in (or to) the city;
3) help those relocating to Tirgu Mures to find the best way ('quality') to live in the city;
4) provide people/businesses with easy access, using technology, to the information necessary to support them in moving around and living in the city;
5) have easy access to all sorts of local PoIs, whether they are interested in businesses, lifestyle, leisure, work or other things.

These requirements have emerged naturally over the last years as the enabling technologies have evolved and been taken up actively. Every citizen or business now has greater access to information, is more connected to the online environment, and all want and need easier access to relevant information, and particularly information that I personally relevant to their needs and lifestyles. In fact, according to the Tirgu Mures city admin "*these are general trends in Tirgu Mures society and they can be seen to evolve very fast and this means that our society can evolve and develop itself through the use of new technological discoveries*".[1]

In this context, Tirgu Mures was interested in adapting all the three of the smart-city Pilots developed by the EPIC project. What follows next is a short description of these applications:

Relocation proof of concept: "Find a House" Application

[1] A quick glimpse at the digital Romanian background may stress the fact that the EPIC solutions are really welcomed here. According to FoXnoMad – a worldwide technical travel guide - Romania has "the world's second fastest Internet at about 15 megabits per second (Mbps), second behind only South Korea. To put that in perspective, that's nearly 5 times the average connection an American has in their home." And that is so not only because Romania is a late newcomer to the digital revolution and therefore had the benefit of installing the latest equipment. The presences of well-trained engineers who organize the online connections efficiently are important as well in providing fast internet connections. Romania has a tradition of mathematics and science-heavy curriculum in the education process beginning early on. This may explain why "Romania has the most certified information technology (IT) specialists in the European Union (EU) and are 6th worldwide." (Source: http://foxnomad.com/2012/03/15/why-is-the-internet-in-romania-so-damn-fast/).

The "Find a House" application, like its Brussels counterpart, is designed to help citizens to look for a suitable property in Tirgu Mures. The application provides citizens with the opportunity to find in the 'Find a Place' tab potential interesting property in Tirgu Mures. They can combine a selection of desired property criteria (such as number of rooms, price, rent or buy, flat or house) with the selection of certain PoIs (i.e. transport, everyday utilities and educational facilities) within a certain preferred distance (from 0.5km to 5km) from the property. The property results are then displayed on a map and each property can be further explored using the Selected House Detail tab. This provides more detailed information about the property and allows the neighbourhood around the selected property to be explored in more details through the PoIs displayed on a detailed map of the city). Properties of interest can be saved as a "favourites" so the details of these properties can be retrieved later without repeating the search.

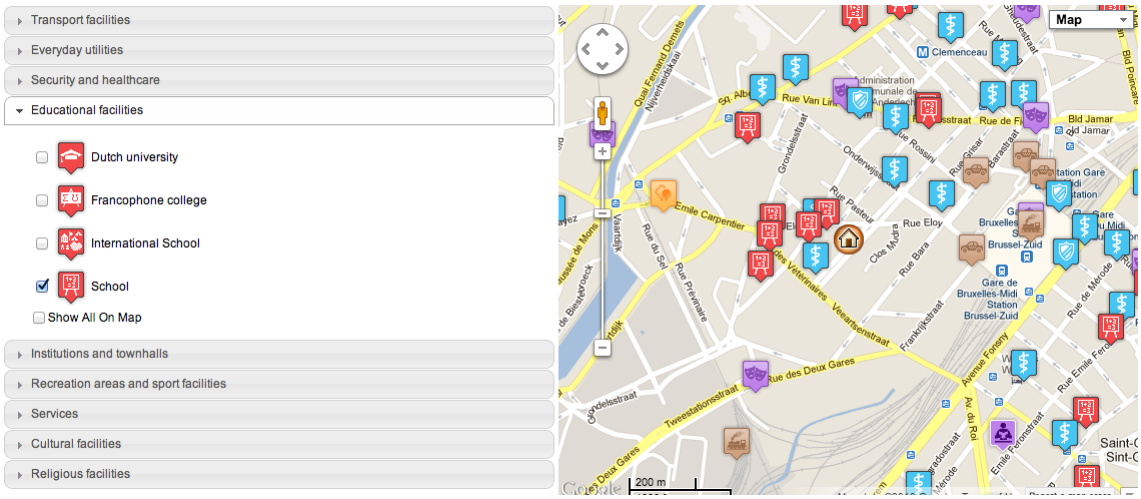


Figure 4: Points of interest around an available property in Tirgu Mures

Lastly, for those new to the city, the application provides basic information about how to register with the City Administration using the 'Living in Tirgu Mures' tab.

Urban Planning proof of concept: "Discover Tirgu Mures" Application

The "Discover Tirgu Mures" application was derived from the "Urban Planning" application developed originally by Navidis for Issy-les-Moulineaux, a suburb of Paris. This pilot helps citizens discover the city by exploring a 3D virtual space representing the city of Tirgu Mures. The 3D environment displays, among others, different categories of PoIs and commercial entities including:

- "Discoveries" such as monuments and historic buildings
- "Leisure Time and Culture" such as bars, restaurants, hotels
- "Health Services" such as hospitals and pharmacies
- "Educational facilities" such as schools, day care centres and orphanages;
- "Transport facilities" such as taxi stops, railway station.

By clicking a certain category of PoIs such as Transport, subcategories are such as taxi stops, railway station, etc are displayed on the 3D map.

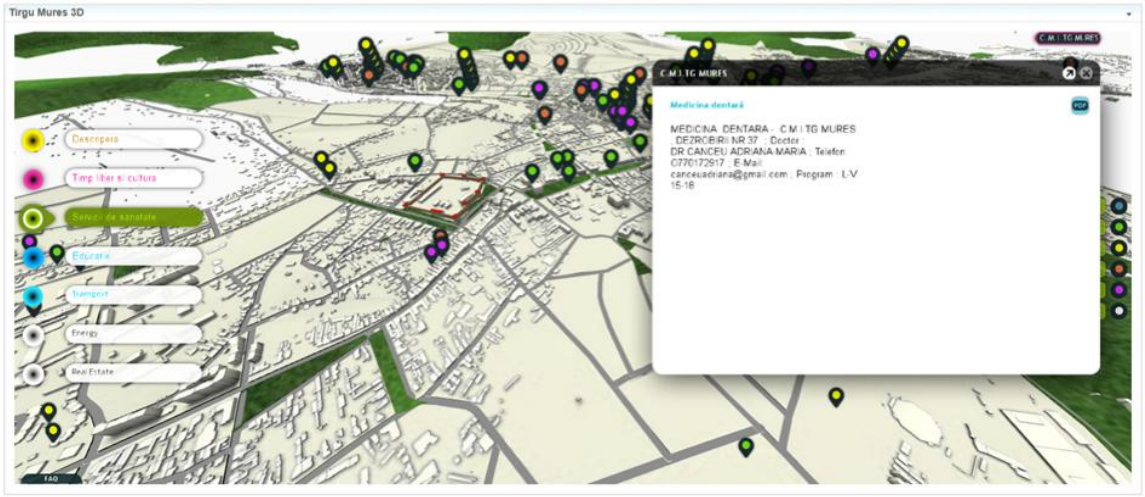


Figure 5: Exploring Tirgu Mures through the 3D model of the city

Clicking on the POI offers practical information such as location, opening hours, timetables, telephone numbers and so forth. (Note that in the future, the service may also provide information on municipal projects.)

Smart Environment proof of concept: "Smart Energy"

This application was initially designed for Manchester city and was adapted to accommodate also the information on energy consumption of different buildings in Tirgu Mures. It helps domestic houses and public buildings monitor their energy consumption and in this way, provides the future possibility of changing behaviour to reduce energy use, reducing carbon emissions and utility bills. Citizens could see both their own energy consumption if they had monitoring equipment installed and compare this with the anonymous aggregated energy consumption of properties like theirs. Citizens could also view energy consumption of each public building monitored using the public building dashboards, to see the energy used by the city in building operations.



Figure 6: Energy use of a school building in Tirgu Mures

The pilot management structure developed and deployed in Brussels, Issy-les-Moulineaux and Manchester was adapted and replicated in Tirgu Mures for the PoC phase. The local management of the Proof of Concept is explained in the following sections.

4.1.2 Pilot Management

One key objective of EPIC is to have the deployment of the PoC tested and validated by end-users, building on the experiences of the three individual pilots of Brussels, Issy-les-Moulineaux and Manchester (presented in *D7.2 Report of 3 pilots*, Chapter 5 'Common lessons learned from the 3 Pilots', pp. 59-61).

This section, therefore, presents the daily management of the Tirgu Mures 'Living Lab' during the PoC deployment and the execution of necessary activities to ensure the set objectives would be achieved. The outline expands on the presentation of the Tirgu Mures onsite management as presented in D7.2 (pp. 64-69).

4.1.2.1 General planning and execution of test phases

The user tests of the PoC was planned (see *D7.1 Pilot Operations Plan*) between M27 and M34 of the EPIC project and was guided by the same testing structure as the pilot tests conducted in Brussels, Issy-les-Moulineaux and Manchester:

- A *closed phase* with a small test group to undertake functional testing to ensure that the services were working correctly.
- An *open phase*, starting with the launch of the three PoC applications in the wider community of Tirgu Mures, with a larger test group, to undertake user-acceptance testing.

- An *evaluation phase* in which stakeholders, representing private businesses and city administrations, evaluated the pilot from their point of view

The short closed group test phase was executed between 25th and 28th February 2013 and the longer, open group test phase ran from 14th to 24th March 2013, following a two-week period following closed-group testing to allow the technical teams to undertake some technical modifications stemming from the results of the initial closed-group testing. The evaluation phase took place in April 2013.

4.1.2.2 Selection criteria and requirements

Closed Group. The aim of the closed group phase was to ensure that the applications were working correctly from a technical perspective, similar to the closed-group testing undertaken for the three pilots in Brussels, Issy-les-Moulineaux and Manchester. This required skilled technical people who were comfortable with technical tests and were motivated to participate because they had an interest in helping the technical tams to improve the Tirgu Mures Pilots. The only requirement to participate was to have access to a computer with an Internet connection during the testing period. Although all testers had access to the aggregated data on the personal energy dashboard and the public buildings data, due to the limited installation of domestic energy monitoring equipment, only two users could test the personal energy-data feeds from smart-environment.

Open Group. In line with previous experience of the three pilots and the objective at this time to gather responses from citizens, the PoC open-group tests were aimed at a larger audience who had an interest in the services provided by the EPIC project. The only requirement for participation was to possess a computer with Internet connection during the test.

Evaluation Phase. Stakeholders were defined as city administrations, businesses or institutions that would likely to be interested in one or all of the PoC applications provided by EPIC. As with the previous phases, the same requirements for participation were identified.

4.1.2.3 User participation, recruitment and retention

The maximum number of PoC users was defined in *D7.1 Pilot Operations Plan*:

- Closed group and open group: total of 500 testers
- Evaluation by 15 stakeholders

It was defined by Tirgu Mures city that respondents could only participate once in the closed and open group but they needed to test all the three applications and then complete a single questionnaire. It was envisaged that this testing of all pilots rather than separate testing of each pilot, with the completion of only a single questionnaire rather than three separate questionnaires would ensure a greater participation in user testing.

User recruitment and retention was guided by the following process:

Closed phase

Recruitment. For the closed group phase some heads of the local administration departments were asked to identify a number of employees who could participate in the testing procedure of the EPIC project, in particular, those with good technical abilities. This choice was also inspired by the assumption that these employees were likely to meet the interest criteria because, as employees of the city, they were directly involved in the three pilots deployed in their city. Finally, recruiting this population also met the risk criteria, being that it is better to test EPIC services with 'internal' users rather than to test it with testers from outside the local administration.

According to the lessons learned from the other Pilots, the recruitment of the test users should be done shortly before the start of the actual testing to maximise retention. Hence, the test users in the closed group were recruited just before the start of the closed-group testing, to ensure a smooth test experience minimising the delay between recruitment and start of testing.

Retention. After the e-mail addresses were collected, retention was a matter of communicating clear instructions and dates about test periods and reminding testers of their participation. On the day of the test launch an official invitation letter was sent and then, a couple of reminders throughout the test period. Also, the Tirgu Mures teams were able to remind some of them personally or by phone.

We believe that, together with the timing of the recruitment/launch, these were the measures that assured a valid response. Over the three pilots, a minimum of 47 people tested each of the applications.

Open phase

Recruitment. For the open group test phase most of the possible invitees were collected some time before the launch of the open group test. These were contacts that were known or had collaborated with the Tirgu Mures EPIC technical team, mainly employed in public institutions and municipal departments, but were addressed and recruited in their capacity as citizens. To complete the number of the necessary test users, other 'friendly users' outside the local administration were invited to participate in the open group phase test.

Retention. As in the closed group phase, retention was a matter of ensuring good communication about the test and its objectives as well as reminding respondents. The official invitation was sent by e-mail to the open group. Also, the same principles of recruiting and retention of the test users were applied as in the closed group: a reminder after certain days and personal reminding in the case of colleagues.

Our efforts contributed to at least 107 people testing each of the three PoC applications.

The following Table summarizes the participants per test cycle across applications, those who started and completed fully the questionnaire.

Table 1: User engagement closed and open group phase

	Started	Completed	Ratio
Closed Cycle PoC applications	126	90	71%
Open Cycle PoC applications	321	267	83%
TOTAL	447	357	79%

In the case of the evaluation phase, 15 stakeholders representing private businesses, institutions and city administrations were interviewed (see Section 4.3 for the different stakeholders involved).

4.1.2.4 User training and support

The training of users gave little cause for concern because the three applications were developed to be intuitive, and any issues in understanding and using the applications would be reported via the questionnaires. Moreover, detailed instructions were provided in the invitation mail and on the Welcome screen after login and also on those of the PoC applications.

User support during the tests was organized along the successful strategy implemented in Brussels, Issy-les-Moulineaux and Manchester:

Remote support: Manual and FAQ section was present on the "Find a House" and "Discover Tirgu Mures" applications

Primary support: In case of questions, people could communicate their remarks using a specific email address: epic@tirgumures.ro. If the questions concerned the test procedure itself, they were answered by the user evaluation team in Tirgu Mures.

Secondary support: If question concerned technical problems, they were forwarded to the respective technical teams in Belgium, France and the UK. However, the response of the technical team was communicated to the testers by the user test team.

4.1.2.5 Data capture

Feedback was mainly collected by means of surveys (see Section 4.1.3). For both cycles, the online software program Qualtrics was used. Surveys were designed in the program before the test was launched. Surveys were accessible by clicking on the link in the survey tab on the Pilot interface.

Data storage was undertaken in full accordance with legal requirement. All testers were informed in the test invitation e-mail about the way their personal information would be used and stored onto the EPIC platform. Apart from an e-mail address that was necessary to communicate with testers, no other personal information was collected or stored. Demographic information or other profile information was requested anonymously in the survey. Since there was no connection between data storage on the platform and the

online software and data of the survey were stored outside the platform in Qualtrics, anonymity of testers was guaranteed.

4.1.2.6 Evaluation of proof of concept site management

The following Table summarizes the different management activities undertaken to support the open and closed groups and identifies to what extent the stated objectives were met:

Table 2: Evaluation of pilot management activities

Objective	Implementation	Target reached
3 phases (closed, open, evaluation)	3 phases	
User number: 500 closed and open testers	Invitation/recruited: closed group 64 – open group: 238 → total: 302 Started survey: closed group =42 – open group= 107 → total: 126 + 321 = 447 for 3 pilots Completed survey: closed group = 30 – open group=89 → total: 90 + 267 = 357 for 3 pilots completed	Almost, but nonetheless acquired good response base to get valid user feedback
User number stakeholder: 15 stakeholders	15	
User profile (selection and requirement)	Closed: technically skilled testers Open: wider community of citizens Stakeholders: business, city administrations, institutions	
User recruitment and retention: e-mail recruitment campaign internal and friendly networks campaign in media	e-mail campaign, networks	 Campaign in local media not deemed to be necessary because of success of other recruitment tools
User support: remote, primary, secondary	Remote: FAQ and Manual on 2 pilots Primary Secondary	Only remote failed for Smart Energy

Data capture: Survey Logs	Survey Logs	

This overview shows that the activities to obtain valid user feedback for the applications were largely successful. The PoC management operations did not reach the desired number for participation in the closed and open group. However, the number is almost reached when we look at the number of people that started the survey (447) and at the number of people who completed it and provided feedback for each of the individual PoC applications (357 total and 267 for open group alone). However, 267 completed questionnaires for the open group provides a solid base for distilling valid results. An essential lesson, however, is that Tirgu Mures has reproduced lessons similar to those from the test experiences in Brussels, Issy-les-Moulineaux and Manchester. Seeking to target a large number of people to participate in testing applications that are not end-products or which do not offer tangible direct benefits to testers is difficult, and, arguably, in the future for similar projects, 'downsizing' this objective to a more realistic number that still delivers significant and statistically valid feedback/results should be actively considered (see *D7.2 Report of 3 Pilots*).

The only element in terms of actual management operations (recruiting, support, retention activities, etc.) that was not met was the lack of remote support for the "Smart Energy" application, primarily associated with remote support for difficulties encountered in the installation of equipment and difficulties with stability of broadband connections. However, with secondary and primary support mechanism in place, it was assured that people with specific questions could be assisted to solve any issues that they may have experienced.

4.1.3 Method

The user experience and acceptance of the Tirgu Mures services were tested using the pilot framework developed and deployed in *D7.3 Evaluation of the Pilots*. User input was collected through a two-staged approach of closed and open phases. The emphasis of the closed phase was to make sure the services were working technically before launching them to a wider, open group of users.

Both quantitative and qualitative feedback was gathered through user questionnaires and interviews. Quantitative insights could reveal relevant relationships and the strength of user experiences and the qualitative data yielded insight into the rationale and evaluation underlying those experiences associated with user acceptance of the technical solution.

These two methods were selected to elicit a particular kind of data underpinning the pilot tests. The questionnaire was chosen to yield insight into the characteristics of a set of cases and variations across cases, while interviews with stakeholders offered a more in-depth understanding of the services in the context of one's (professional) everyday life (see also *D7.1 Pilot Operations Plan* and *D8.1 Strategic Evaluation Methodology*). Following a similar analytical structure as the one presented in D7.3, the sample of respondents allowed for, among others, descriptive analysis and correlation analysis

(questionnaires) and thematic analysis (interviews) to provide an analysis of the Tirgu Mures services underpinning the evaluation of the proof of concept.

Based on the literature study which was presented in the pilot operations plan and strategic evaluation methodology reports (D7.1 and D8.1), the empirical investigation focused on drawing out several aspects of user experience and acceptance research (associated with TAM and underpinned by a Living Lab approach); that is, ease of use, usefulness, content, attitude and intention (see D7.3). This framework informed the development of the parameters, guiding the main categories for which data was collected. Question templates previously drafted for the pilots now served as the input for selecting questions for the Tirgu Mures services. However, compared to the surveys for the 3 pilots, for the Proof of Concept the focus was more oriented towards intentions and attitudes in the light of the smart city potential offered by each pilot. Questions regarding ease of use and content quality were asked, but only on a general level. Since the pilots had been tested comprehensively before transfer to Romania, much user feedback has already been elicited on those aspects. It was thus felt to be more interesting and relevant to focus on the user acceptance of the Tirgu Mures scenarios that the pilots were understood to offer in the context of Tirgu Mures becoming a smarter city. The questions were therefore translated into Romanian and Hungarian (see Annex for Questionnaires Closed and Open Group and Integrated Scenario) and the data from the on-line questionnaires were collected using Qualtrics. The results are first reported for the closed group, primarily to confirm correct technical operation of the pilots, followed by those of the open group and the main findings of the stakeholder interviews.

4.1.4 Closed User Group

The objective of the closed user group test was to discover and resolve any technical problems introduced by adapting and implementing the three EPIC pilots for Tirgu Mures, respectively, “Find a House”, “Discover Tirgu Mures” and “Smart Environment” applications (see Annex II for the Questionnaire). The participants invited to test the PoC applications consisted of employees from the local administration and a couple of persons close to the local administration in Tirgu Mures. The reason for this was that their profile matched with certain technical abilities and more open attitude towards the EPIC solutions than a larger public would likely be. More specifically, the people involved consisted of employees of the municipal departments that had already been informed about the EPIC project and, in addition, already provided information for the EPIC Tirgu Mures database underpinning the applications. Moreover, these departments were also potentially interested to use the EPIC applications.

Background information

Some 58% of the respondents were women while 42% were men (N=47). The respondents’ age ranged from 22 to 57 years. Some 25% of the respondents were born and raised in Tirgu Mures, while 71% of those had moved to the city more than 10 years ago (and were born elsewhere). Based on these basic profiles, it is likely that there are sufficient respondents who know Tirgu Mures well enough so as to make informed judgments on the reliability of data used in the applications such as points of interest,

street names, geographical coordinates of different point of interest or other relevant information about the city offered by the applications.

Against this backdrop, the professional profile of the participants tended to be a technical one, in that most of them were engineers working in different areas (IT, energy supply, surveyors, cartographers), two urban planners, a web designer and office personnel. This profile was important first because as an engineer's professional training makes him/her cautious about technical details and second, the areas in which the respondents were trained were close to the type of information provided by the EPIC applications and the respondents were regular Internet users. Some 95% (N=30) used the Internet for more than two hours per day and for a variety of activities such as online shopping, and social media in addition to work-related activities.

Next, the findings from a more technical user stance are reported for the experience of the EPIC platform more generally and the three PoC applications.

Issues - EPIC platform

Almost all of the participants were able to log in onto the EPIC platform, to select the Welcome screen and to select the three applications on the Welcome screen (N=47). Only one person was unable to select the three applications on the Welcome screen; this may have been caused by periodic updates of the platform and/or applications as these were all frequently updated (and for that moment could not be accessed).

Table 3: Access to the EPIC platform

Did you manage to...?	Yes	No
manage to log in with userid and password	√	-
see the Welcome screen with the tab of the 3 pilots	√	-
select the 3 pilots on the Welcome screen?	√	-

Source: EPIC Tirgu Mures Closed Group Survey, N=40

In order to take a closer look at the three applications, the respondents were asked to execute a test scenario to help them report their experiences of using the service/ platform. The user issues identified by per application are reported below.

Issues - "Find a House" application

The Table below shows whether the test users were able to execute different actions in the "Find a House" application. Most of them were able to complete the Search criteria for properties and point of interests (75%, Mean(M)=1.26, Standard Deviation (SD)=0.44, Number (N)=42), see the selected property on a map of Tirgu Mures (80%, M=1.19, SD=0.40), click on the icon or the property in the list and see the house detail page (81%, M=1.19, SD=0.40), and Save properties in My favourites (77%, M=1.23, SD=0.43). Yet, more than half of the test users had difficulties in Selecting a property from My Favourites and, to explore it and the neighbourhood (41%, M=1.58, SD=0.50) and finding information on how to register at the municipality (32%, M=1.68, SD=0.48).

The most unsuccessful action was to explore the neighbourhood by means of selecting Point of Interests and their display on the map of Tirgu Mures (29%, M=1.97, SD=0.56).

Table 4: Technical issues – Find a House application

Having executed the test scenario, did you manage to...?	Yes	No
complete the search criteria for properties and point of interest?	√	-
see the selected property on a map of Tirgu Mures?	√	-
click on the icon or the property in the list and see the house detail page?	√	-
explore the neighbourhood by means of selecting Point of Interest and their display on the map of Tirgu Mures?	-	√
save interesting property in my favourites?	√	-
from my favourites, select a property and explore it and its neighbourhood again?	-	√
find information on how to register at the municipality?	-	√

Source: EPIC Tirgu Mures Closed Group Survey, N=42

Issues - "Discover Tirgu Mures" application

When asked about issues experienced while testing the "Discover Tirgu Mures" application, most of the respondents said they were able to complete the scenario activities. The findings reported that most could download the 3D map (73%, M=1.27, SD=0.45, N=30), explore the city in a 3D map (70%, M=1.30, SD=0.47), open the thematic layers on the screen (86%, M=1.13, SD=0.35), open the categories right on the screen and locating the point of interests (73%, M=1.27, SD=0.45), see the point of interests on the map (80%, M=1.20, SD=0.41) and, lastly, click on a point of interest and get more information about it (72%, M=1.25, SD=0.46).

Table 5: Technical issues – Discover Tirgu Mures application

Having executed the test scenario, did you manage to...?	Yes	No
download the 3D map	√	-
explore the city in a 3D map	√	-
open the thematic layers left on screen	√	-
open the categories right on the screen and locating the point of interests	√	-
see point of interests on the map	√	-
click on a point of interest and get more information about it?	√	-

Source: EPIC Tirgu Mures Closed Group Survey, N=30

Issues - "Smart Energy" application

For this application 6 meters were installed, 4 domestically and 2 in public buildings. In addition, a number of respondents took part in this test without a meter. Four respondents with a meter installed could see/access the dashboard without interruption. Using the online application, about half of the respondents (N=24) said they were able to see the energy consumption record of domestic houses and of the public buildings (44%, M=1.46, SD=0.56), and understood the information published regarding public and domestic energy consumption (49%, M=1.38, SD=0.48).

Table 6: Technical issues – Smart Environment application

Did you...?	Yes	No
see the energy consumption record of domestic houses?	√	-
see the energy consumption record of public buildings?	√	-
understand the information published regarding public and domestic energy consumption	√	-

Source: EPIC Tirgu Mures Closed Group Survey, N=24

Besides indicating whether they could execute the different steps from the test scenario successfully or not, we also provided them with the opportunity to freely write down the technical problems they encountered accessing the platform as well as testing the three applications.

Table 7 presents an overview of the reported technical problems concerning the three pilots. As one can see, testers not only took the opportunity here to report purely technical problems such as speed or not-working functionalities. They also reported content-related issues:

Table 7: Open issues – PoC applications (closed group)

	Find A House	Discover Tirgu Mures	Smart Environment
	Technical: not working all the time	***Technical:*** Navigation speed in 3D model is too slow; map not well oriented	***Technical:*** -
	Functionality: not able to compare two properties on the same page; no street view function available	***Functionality:*** -	***Functionality:*** -
	Content: some names of the street are incorrect, some locations are incorrect; no 3 or 4 roomed properties	***Content:*** location for some points of interest is incorrect; some important point of interests are missing	***Content:*** No Tirgu Mures data are available; No Romanian and Hungarian translation; info on domestic energy is not displayed

	available; no unit for the price; incomplete data		
	Interface/look and feel: -	***Interface/look and feel:*** the bullets accompanying the points of interest placed too high; downloading the Unity Web Player	***Interface/look and feel:*** -

From this Table, the following results can be distilled.

Content-related issues

A major part of the results highlighted content-related issues: the correctness and validity of the data, regarding PoIs, properties, map content and energy data provided by the three applications. Specific complaint was made about the incomplete or erroneous data of PoIs in case of property locations. Some respondents noticed that for the "Smart Environment" application the Tirgu Mures data was lacking. The lack of translation for the "Smart Energy" application was cause for concern.

These problems can be easily solved by completing and correcting and translating the data. In fact, to provide a full database for this cycle was not the aim of the technical team, rather a sample of information was offered to allow users to test if the three applications could successfully be made available in Tirgu Mures.

Technical issues

The technical issues reported in this test cycle were mostly related to a slow or lack of performance of some functions of the pilots or of the 3D model (also, a dislike to having to download the Unity Web Player). This was followed by several participants that were unable to visualize the results of some commands (particularly, to Search for properties or for different PoIs and Display of the map/Street view).

A temporary lack of performance of some functions (or the entire application for that matter) can be explained by the fact in that period updates were performed on the platform or on the application level. In general, the test users were forewarned about this inconvenience such as upon login and in the invitation letter.

Conclusion

The closed group tests gave us the opportunity to identify the technical challenges that from an end-user point of view needed to be fixed before launching the pilots in the wider community of Tirgu Mures. Secondly, it also provided valuable feedback regarding content related matters that needed attention. As said, the database we used for the closed group was limited, so completing the database and correcting the incorrect data were actions that were undertaken before starting the Open Group phase. Thirdly, this test phase learned that regarding Discover Tirgu Mures and Smart Energy, a great majority of users understood how to execute the different tasks. For the Find a House application, it learned that special attention should be given to the Favourites Function, the Living in Tirgu Mures Section and the way to explore the neighborhoods by means of Point of

Interest. The manual was thus redesigned for this issue as well as in our instructions to testers we made the description and execution of the functionality much clearer.

4.1.5 Open User Group

Background information on users

In the open group cycle that ran from mid-March to mid-April 2013 107 participants took part in testing the PoC, guided by a questionnaire (see Annex III). The respondents encompassed 44 men and 43 women (and the remaining group preferred not to disclose their gender). The respondents did not always answer all questions, hence, numbers may fluctuate.

The youngest respondent was 15 years old and the oldest participant was 61 years old. The majority of the respondents were aged between 30 and 45 years old. Some 39% of the respondents have been living in Tirgu Mures all their lives, while 51% had moved to Tirgu Mures at a later stage in their lives (N=105). Most of those who moved to the city at a later stage (60%) have been living here for more than ten years.

The professional profile of the respondents is quite extensive but distributed evenly across many sectors. It includes, among others, IT and other kind of engineers, economists, directors, journalist, public servants, project managers, architects, drivers, web designers, and others who are employed in sales and educational domains.

Digital profile respondents

In order to get a feel for the role of the Internet and usage patterns, a few questions were included about the respondents' reasons or intention to use the Internet, how much time they spend online and the kinds of devices they employ.

The findings indicate that some 53% (N=89) use the Internet for online banking, 49% for online shopping purposes, 46% to access and use social media, and lastly, 43% said to download government documents.

When looking at the time the respondents reported to spend online, more than half said to use the Internet for more than two hours per day. This is followed by some 23% who said to access the Internet from one to two hours each day. Less than 3% said to use the Internet less than one hour per day.

Of this group of respondents, some 57% said to have a laptop, 54% a computer, 30% a smartphone, and 25% a tablet.

The next set of results yield insight into, first, impressions and aspects of the EPIC platform, and which is followed by the experience and acceptance of the three proof of concept applications, respectively, 'Find a House', 'Discover Tirgu Mures', and 'Smart Environment'.

Impressions

Some 88% of the respondents found the EPIC service easy to use. More specifically, in terms of logging in, the Welcome Page and to access the pilots (M=1.78, SD=.093, N=98). The look and feel is also considered to be satisfactory as 81% of the respondents

strongly/agreed (M=2.02, SD=.098, N=98). The login procedure, while a bit tedious, 77% strongly/agreed that it provided them with a feeling of being more safe and in a trustworthy online environment (M=2.01, SD=.115, N=98). A Kendall's W test was performed to check the level of agreement between the respondents. It indicated considerable agreement among respondents (X^2 (5) = 678.652, W= .567, p<.001).

The respondents were also asked to value the overall ease of use of the three proof of concept applications. They could give a score between 0 (not sufficient at all) to 10 (excellent). The results are presented in the following Table.

Table 8: Easiness of use across PoCs

PoC #		Mean[a]	SD
1	"Find a House" Service	7.64	2.63
2	"DiscoverTirgu Mures" Service	7.04	2.68
3	"Smart Energy" Service	6.65	2.83

Source: EPIC Tirgu Mures Open Group Survey, N=97
[a]Values range from 10-0 (Statements, 10=excellent, 5=average, 0=not sufficient at all)

A closer look was then cast on aspects associated with the ease of use, that is, those pertaining to content.

First, the respondents were asked about the interface - that is, the look and feel, navigation, etc. - of the PoC applications. On a scale of 0 to 10 all services score between 7 and 8.

Table 9: Interface

#	Rate the interface (look, feel, navigation,...)	Mean[a]	SD
1	Tirgu Mures Relocation Service	7.80	2.50
2	Tirgu Mures Urban Planning	7.15	2.93
3	Tirgu Mures Smart Environment	7.05	2.89

Source: EPIC Tirgu Mures Open Group Survey, N=98
[a]Values range from 10-0 (Statements, 10=excellent, 5=average, 0=not sufficient at all)

The terminology used – e.g. words, tabs – scored also considerably well, between roughly 7.5 and 8.5 as shown in the next Table.

Table 10: Terminology

#	Rate the terminology (words, tabs, buttons) used	Mean[a]	SD
1	Tirgu Mures Relocation Service	8.49	1.96
2	Tirgu Mures Urban Planning	8.08	2.35
3	Tirgu Mures Smart Environment	7.68	2.64

Source: EPIC Tirgu Mures Open Group Survey, N=98
[a]Values range from 10-0 (Statements, 10=every clear, 5=nor clear nor unclear, 0=not clear at all)

Also, an important role for 'smart city-ness' is carried out via the PoC applications. Hence, the respondents were extensively asked to provide their opinion about the meaning of the EPIC platform and services in the context of Tirgu Mures. In so doing, seeking to tackle the smart city principles that the EPIC service and platform have sought to comply with (see also *D7.3 Pilot Evaluation Report*). The findings show that the respondents tend to agree with the idea the EPIC platform and services are 'smart' and also considered them really useful for Tirgu Mures city. The following statements and results in this context were presented below.

Table 11: Smart city

	Mean[a]	SD
It is very useful for citizens to have access to different smart city services on one platform	1.52	0.65
The 3 smart city services offered in EPIC are innovative for Tirgu Mures	1.60	0.81
The EPIC platform and pilots will certainly help Tirgu Mures citizens to organise their daily life in a more efficient way	2.03	1.11
Tirgu Mures should in the future offer such a platform to its citizens	1.71	1.02

Source: EPIC Tirgu Mures Open Group Survey, N=98
[a]Values range from 1-5 (Statements, 1=strongly agree; 2=agree; 3 neither dis/agree; 4=disagree; 5 strongly disagree)

Kendall's W tests were performed to check the level of agreement between the respondents. Overall, they indicated moderate agreement among respondents, and in particular on the last statement whether the city should offer such a platform is scored considerable (X^2 (4) = 34.652, W= .498, p<.001).

Next, a closed look is cast at the results for each PoC application.

Find a House application

For each of the applications, the participants had to follow a scenario to use and test the services so as to help them to have a (well) structured experience while ensuring they explored all its functionalities.

The *"Find a House" scenario* prompted the respondent to imagine himself/herself as newly employed in the "Science City for Research and Medical Informatics" in Tirgu Mures. S/he is currently living with his/her family (partner and two children) away from Tirgu Mures or its metropolitan and now would like to move to Tirgu Mures together with the family. Therefore, they are looking for a house that would meet all their needs. They discovered this application which promises to display the properties for rent or sale and also allows one to take a look at the surroundings of the property. The respondents were asked to look for a property in the vicinity of a bus station (because s/he wants to use the public transportation system), a green area (because the partner likes to go for a jog), and a kindergarten (for the children).

First, the respondents were asked to perform a set of searches for which the results are reported in the Table below. It shows that almost all (87%, N=94) were able to execute the first 6 test actions. It should be noted that 41.5% were not able to accomplish the last required action that is "Find information on how to register at the municipality". This may be due to the fact that not enough information of this kind was added on the page of the "Find a House" application at that time.

Table 12: Scenario 'Find a House'

	Mean[a]	**SD**
Complete the search criteria for properties and point of interest?	1.13	0.34
See the selected property on a map of Tirgu Mures?	1.13	0.34
Click on the icon or the property in the list and see the house detail page?	1.13	0.34
Explore the neighbourhood by means of selecting Point of Interest and their display on the map of Tirgu Mures?	1.14	0.35
Save interesting property in my favourites?	1.15	0.36
From my favourites, select a property and explore it and its neighbourhood again?	1.21	1.41
Find information on how to register at the municipality?	1.41	0.50

Source: EPIC Tirgu Mures Open Group Survey, N=94
Values: 1=yes, 2=no

Perceived usefulness

The "Find a House" application is considered quite useful (M=1.98, SD=1.30, N=88). When asked about specific functionalities of the application, the respondents deemed them all as useful. The most useful feature was "Save and review interesting property in

'My favourites"' (confirmed by Kendall's W, X^2 (5) = 231.343, W= .475, p<.001) and the least useful one was "Get information about registering in municipality" (X^2 (7) = 543.542, W= .231, p<.001). Yet, there are no big differences between the mean scores of the functionalities.

Table 13: Usefulness 'Find a House'

	Mean[a]	**SD**
Combined search of property and point of interest in 'Find a place'	1.98	1.30
Display of all potential interesting houses on map and in list	1.97	1.26
Discover property and its neighbourhood with POI in detail in 'Selected House Details'	1.99	1.20
Save and review interesting property in 'My favourites'	1.91	1.29
Get information about registering in municipality	2.28	1.36

Source: EPIC Tirgu Mures Open Group Survey, N=88
[a]Values range from 1-5 (Statements, 1=very useful; 2=useful; 3 neither useful or not useful; 4=not useful; 5=really not useful)

Content quality

When considering the content of the service, the respondents seemed to find the quality of the "Find a House" content to be somewhere between "good" and "fair" (M=2.58, SD=1.81, N=93, where 1=very good and 7=very bad). The content refers to the information provided on the map and the properties, on registering in municipality, and so on). The fact that the content quality of information does not seem to be considered to be "very good" may be easily explained: the EPIC technical team uploaded not the full amount of information that Tirgu Mures provided, but only sufficient for a technical and opinion test. Another reason may be that the application used a Google map where some of the street names were incorrect, which was clearly outside the control of the EPIC and Tirgu Mures teams.

Those who were less satisfied with the quality of the content were given some predefined responses to learn about possible reasons such as about the Point of interests and media inserted in the application (such as photos, videos, information about Tirgu Mures). Some 42% (N=67) agreed that more information about each PoI was needed and also that other necessary PoIs were missing. Some 67% asked for more media to be inserted, while 58% considered that more information about Tirgu Mures was needed. And several respondents offered the following, grouped reasons:

- The search buttons lying under the main menu are easy to be confused and can be hardly noticed, the links near the PoIs are inaccessible
- The Hungarian translation is 'tolerable'
- The education information is incomplete
- The description of some details is lacking

- More details are needed about the properties (age of the building, type of apartments, restored or not, balcony, nr of bathrooms etc - these are the most important details for buyers, besides the location)

Attitude towards 'smart mobility'

As mentioned earlier, it was considered how the services were considered or accepted in a smart city context. One such objective is smart mobility which, here, may be aligned with the relocation objective in that people can plan their relocation activities in a more efficient way. The respondents were asked if they would consider the "Find a House" application to help the city to achieve this objective. Some 89% can be seen to strongly/agree with the statement that this service helps people to find a possible place faster and efficient (88%, N=92). Also, respectively 81% and 84% believe that the service will inform people better about registration procedures and neighborhoods. A correlation exercise between content and smart mobility confirms these findings. The acceptable range of values is -1 to 1, with -1 indicating a strong negative correlation and 1 a strong positive correlation. The stronger the users agree on the statement of Save and Review, the higher they rank the efficiency of the application (0.587) and registration procedure (0.434). The following Table presents an overview of the results.

Table 14: Smart mobility 'Find a House'

	Mean[a]	**SD**
This service will help people relocating to Tirgu Mures to find potential places to live quicker	1.66	0.79
This service will help people relocating to Tirgu Mures to find potential places to live more efficient	1.72	0.79
This service will help people relocating to Tirgu Mures to be more informed about the procedure to register in the city and about the potential property available	1.97	1.11
This service will help people relocating to Tirgu Mures to be more informed about the neighbourhoods of the city when looking for interesting property to live	1.82	0.91

Source: EPIC Tirgu Mures Open Group Survey, N=92

[a]Values range from 1-6 (Statements, 1=strongly agree; 2=agree; 3 neither dis/agree; 4=disagree; 5 strongly disagree; 6= prefer not to say)

Lastly, the respondents were asked about their attitude towards the "Find a House" application. More specifically, they were asked whether they would consider this service to be 'very necessary' for Tirgu Mures and whether people moving to Tirgu Mures would still need traditional relocation methods as well. The respondents considered the service to be necessary for Tirgu Mures to provide (M=1.84, SD=2.30, N=92), yet they think that traditional relocation methods are still needed (M=1.13, SD=1.22, N=92). This attitude

may be explained by the fact that not all the citizens are comfortable using Internet for such an importance purpose.

Next, the results for the PoC Discover Tirgu Mures are presented.

Discover Tirgu Mures application

Perceived usefulness

The respondents were asked how useful they found the different functionalities of the "Discover Tirgu Mures" application. Generally, their responses were rather positive (M=1.98, SD= 1.29, N=90). In fact, some 39% said the application was "very useful" and 48% found it "useful". Taking a closer look at the functionalities in the context of their respective usefulness, the 3D map, thematic layers and PoIs were all valued rather similar. As is shown in the Table, exploring the city in a 3D map, exploring the city via thematic layers and discovering and locating the points of interests are very useful. Only in case of the PoIs there was some indication that the respondents only mildly agreed (X^2 (9) = 21.968, W= .204, p<.001).

Table 15: Usefulness 'Discover Tirgu Mures'

	Mean[a]	SD
Exploring the city in a 3D map	1.33	0.83
Exploring the city via thematic layers	1.31	0.67
Discovering and locating the points of interests	1.25	0.77

Source: EPIC Tirgu Mures Open Group Survey, N=90
[a]Values range from 1-5 (Statements, 1=very useful; 2=useful 3 neither useful/not useful; 4=not useful; 5 really not useful)

Content quality

The results for the content quality seem to align with those of the "Find a House" application in that the participants view also the "Discover Tirgu Mures" application somewhere between "good" and "fair" (M=2.41, SD=1.24, N=90, and where 1=very good and 7=very bad). Again, one has to keep in mind that not all information provided by Tirgu Mures was uploaded at the time of testing, and therefore, the focus was on technical feasibility.

When asked how the quality and richness of the content of the application could be improved, the findings indicate the following: Some 64% (N=45) of the respondents said that a better 3D model (design, immersion experience) should be implemented; 57% found that more media (photos, videos) are needed; 39% reported that other thematic layers and more interesting/relevant information about PoIs would be necessary; and 25% reported to welcome more integration of social media information. In addition, several respondents offered their own suggestions including the following:

- Using this service implies that one should download a graphic interface, differing from the one that used

- No means to access the platform from a smart phone
- A faster time to use the application
- The design is quite unfriendly, Google maps is preferred.

Attitude towards 'smart living'

With respect to the question if the "Discover Tirgu Mures" application is important for the city to become 'smarter on living', the respondents seemed to agree with this idea. Some 78% strongly/agreed with the application providing an essential and efficient service about the city of Tirgu Mures, while 70% believed that the proposed thematic layers were essential in this regard (N=89). The results are summarized in Table 16 below. A correlation conducted between content and smart living supports these findings. Particularly, the stronger the respondents agree on the statement of to include other thematic layers, the better they rank the essentiality of these layers to understand the city (0.503).

Table 16: Smart living 'Discover Tirgu Mures'

	Mean[a]	SD
The Urban Planning pilot is an essential tool to get information about the city of Tirgu Mures in a quick and clear way	2.10	1.19
The proposed thematic layers are essential to grasp Tirgu Mures' city life	2.17	1.13

Source: EPIC Tirgu Mures Open Group Survey, N=89
[a]Values range from 1-6 (Statements, 1=strongly agree; 2=agree; 3 neither dis/agree; 4=disagree; 5 strongly disagree; 6= prefer not to say)

Furthermore, the "Discover Tirgu Mures" application may also have or guide the potential to connect the citizens with the economic environment of the city. Therefore, the respondents were asked to give their opinion about this perspective. Some 73% strongly/agreed with the statement that this application can promote (commercial) initiatives in the city to its citizens in an effective manner. In terms of the role of the application in the promotion of smart governance, 76% of the respondents said it is valid means for the local admin to better present and communicate with its citizens about 'all things Tirgu Mures' (and moderately confirmed, $(X^2 (3) = 432.743, W= .498, p<.001)$.

Table 17: Smart governance/economy 'Discover Tirgu Mures'

	Mean[a]	SD
The Urban Planning pilot is a useful tool for TM to promote initiatives (e.g. commercial) in the city to its citizens efficiently	2.11	1.24
The Urban Planning pilot is an essential tool to better present and communicate the fabric of TM to its citizens	2.11	1.19

Source: EPIC Tirgu Mures Open Group Survey, N=89
[a]Values range from 1-6 (Statements, 1=strongly agree; 2=agree; 3 neither dis/agree; 4=disagree; 5 strongly disagree; 6= prefer not to say)

Next, the results for the final PoC application are reported. As this was a rather minimal application (see Section 3), the focus was on "usefulness" of the application itself and in relation to the city.

Smart Environment application

As can be distilled from the Table below, overall, the respondents considered that the "Smart Environment" application was a useful one (M=1.99, SD=1.54, N=89). Two participants had a clamp meter installed at their homes. They agreed that using this service helped them to understand how much energy they consume and made them more aware of how to reduce energy consumption. Further analysis was conducted to see whether answers varied between those with/out a meter installed. A correlation for those with a meter indicated that having a meter the higher they assess 'overview of previous consumption' (0.482) and 'awareness of energy consumption reduction' (0.499).

Those who did not have such a meter installed said that it is useful to have an estimation of the cost of the energy use of domestic buildings (X^2 (6) = 45.956, W= .379, p<.001). They (75%, N=85) also reported to appreciate insight into the history of the energy consumption of domestic and public buildings.

Yet, regardless of having a domestic meter installed or not, the test persons are uncertain whether using this application would positively impact on carbon reduction in Tirgu Mures.

Table 18: Usefulness 'Smart Energy'

	Mean[a]	**SD**
Publishing the estimation of cost of the energy use of domestic buildings is very useful	2.12	1.25
Giving an historical overview (24h, one day, one week, one month,...) of domestic energy consumption is useful	2.11	1.30
Giving the historical record of energy consumption of public buildings is useful	2.18	1.37
Using this service has helped me understand how much energy I use and made me aware of reducing energy consumption	2.25	0.50
By using this service, I think I will make a positive impact on carbon reduction in my city	3.25	1.89

Source: EPIC Tirgu Mures Open Group Survey, N=85

[a]Values range from 1-6 (Statements, 1=strongly agree; 2=agree; 3 neither dis/agree; 4=disagree; 5 strongly disagree; 6= prefer not to say)

One important objective of the "Smart Environment" application was to raise awareness among citizens about energy consumption. Moreover, it also aimed at providing the local administration with a database of such information on which to base policies about energy consumption reduction and to monitor the impact of these policies. The findings are presented in the following Table. Some 68% strongly/agreed that this application

offers more rounded information about energy usage among citizens (N=89). 75% of the respondents agreed with that the ability to compare the average energy consumption of the city with their own would motivate to think about ways to reduce their own consumption. Also, about 70% of the respondents thought the application - by showing energy consumption of public buildings - makes them more aware of how the city seeks to reach its carbon reduction targets. Lastly, a little more than half of the respondents believed that the application might motivate them to undertake action towards the city in case it was consuming too much energy.

Table 19: Smart energy/governance

	Mean[a]	**SD**
It will give me more accurate knowledge of the energy usage of citizens in its entirety	2.21	1.31
By being able to compare my energy use with the average of the city, I will certainly start thinking how I can reduce my domestic energy use	2.15	1.35
The view on the energy use of public buildings will make me aware how the city tries to reach carbon reduction targets	2.35	1.54
The view on the energy use of public buildings will make me take as a citizen the necessary action towards city authorities if they use too much energy	2.53	1.59

Source: EPIC Tirgu Mures Open Group Survey, N=89
[a]Values range from 1-6 (Statements, 1=strongly agree; 2=agree; 3 neither dis/agree; 4=disagree; 5 strongly disagree; 6= prefer not to say)

In addition, some qualitative data were collected from the open questions of the questionnaire which asked the respondents to tell us what they perceived as the positive and negative aspects of the pilots and which recommendations they wanted to give us to further improvements.

Table 20: Qualitative Feedback

	Find A House	**Discover Tirgu Mures**	**Smart Environment**
Positive aspects	Technical: -	Technical: -	Technical: -
	Functionalities: Point of interest	Functionalities : -	Functionalities : -
	Content: rich and good	Content: information rich	Content: energy consumption data interesting to know
	Interface/look and feel: intuitive; easy to use	Interface/look and feel: intuitive	Interface/look and feel : -

Negative aspects	Technical : -	Technical: -	Technical: -
	Functionalities: -	Functionalities: -	Functionalities: -
	Content: range of point of interest limited, information on point of interest limited	Content: media lacking, information of point of interest limited	Content; terminology not always clear; not enough information provided, more meters
	Interface/look and feel: -	Interface/look and feel: 3D map design insufficient; downloading of map;	Interface/look and feel: designed for newbies
Recommendations	Technical: -	Technical: -	Technical: -
	Functionalities: -	Functionalities: -	Functionalities: -
	Content: add information about points of interest, expand range of point of interest	Content: integrate media, more content on point of interest	Content: terminology more user friendly, translation needed
	Interface/look and feel: -	Interface/look and feel: better 3D map; no downloading of map	Interface/look and feel: more modern design

From this Table, we can distil that comments given mainly dealt with the interface/look and feel and content aspects of the pilots.

Most attractive and least attractive features

We can see that the pilots, in line with the quantitative results, were evaluated generally positively because of the different kind of data they brought together in one pilot. The pilots were described as being information rich (Find a House/Discover Tirgu Mures) or having interesting new information to offer (Smart Energy) and having an intuitive design.

Nonetheless, although there is a basic positive evaluation, critical comments were made regarding content and interface/look and feel. Points of interest in both Find a House and Discover Tirgu Mures were maybe in itself providing useful and interesting information, but this information should be extended. For the Smart Energy pilot, the terminology was evaluated as not being very user friendly and the energy data not complete for the city.

Regarding interface/look and feel, the 3D map was seen as insufficient. Downloading the Unity Player was something considered not very user friendly. For the Smart Energy pilot, the interface was described as something very basic.

Recommendations of features to be added:

In the line of the comments, we distil the following recommendations about future features to be added:

- On the level of content:
  - Enrich with information:
    - Expand the range of types of Point of interest and enrich the Points themselves with new content (e.g. complete media centres in Discover Tirgu Mures; website links to the services on the point of interest)
    - For the Smart Energy Pilot, more meters should be displayed
  - Adopt a more user friendly terminology and translation, especially for Smart Energy
- On the level of design:
  - Make the design more modern (especially for Smart Energy)
  - Make the 3D map more ergonomic and avoid downloading the Unity Player.

Recommendation to others of pilots

Lastly, against the backdrop of all the feedback that was provided during the tests, the respondents were also asked whether they would use or recommend the applications to others if they were available in Tirgu Mures. Some 67% of the respondents said Yes to the "Find a House" application (M=1.42, SD=0.74, N=90), 63% said Yes to the "Discover Tirgu Mures" application (M=1.53, SD=0.87), and 45% said Yes (vs 35% who said Probably Yes) to the "Smart Energy" application (M=1.91, SD=1.10)

Table 21: Use/recommendation PoC applications in Tirgu Mures

Use or recommend application if available in Tirgu Mures	Yes	Probably Yes	No
"Find a House" application	√		-
"Discover Tirgu Mures" application	√		-
"Smart Energy" application		√	-

Source: EPIC Tirgu Mures Open Group Survey, N=90

4.1.6 Conclusions

The Proof of Concept Open Group Phase provides us with two kinds of insights: lessons about the services a smart city should offer its citizens in general, and lessons about the individual services EPIC currently provides.

Smart city platform providing different services:

The platform itself was evaluated as rather easy to use and the login gives indeed a sense of security to the users and the feeling of being in a trustworthy online environment. The existence of the EPIC platform with its three services in the city of Tirgu Mures was

qualified as being useful and as a tool that could help people in organizing various aspects of their daily life more efficiently. Therefore, there was a moderate agreement between the testers that actually their city should offer the EPIC platform to its citizens.

Individual application assessment:

Although the presence of such a platform providing three smart city services was positively acknowledged, retrieving insights into the positive aspects and in the points that may need improvement is also important so as to enhance the relevance of the EPIC platform for the city of Tirgu Mures.

Regarding ease of use and content quality (both in terminology used as well as the type and kind of information provided) the three applications were evaluated positively. The three pilots were also validated by end users (citizens) as being useful and most of the task of the scenario could be executed by a majority of testers. Finally, testers acknowledged and confirmed the potential to realize smart city objectives for each pilot and displayed a positive attitude towards them in using them. Finally, testers also confirmed that they would recommend the use of the three applications to relatives, friends or acquaintances.

Nonetheless, a number of improvements were clearly required. Although each application received a positive score concerning attitudes and intention to use, it was identified that they did not replace current ways of finding a house, discovering the city or actually reducing energy consumption. For 'Find a House' traditional methods were still considered a necessity to complement the house search, while for 'Smart Energy' testers doubted whether this current application alone was sufficient to reduce carbon emissions.

Both the quantitative results as well as the more qualitative feedback asserted what should be further developed in order to let the pilots better reach their smart city objectives. On the one hand, look and feel aspects of the applications should be better developed: for 'Find a House' and 'Smart Energy' the design itself should look more modern, while for 'Discover Tirgu Mures' the 3D-map should be more user-friendly (from an ergonomic viewpoint, from a navigation point of view and from the installation point). On the other hand, the content quality should be enhanced. Especially the PoIs in 'Find a House' and 'Discover Tirgu Mures' were pointed out: incorporating more PoIs in the application and enriching the information about them were deemed crucial. For 'Smart Energy', the number of energy meters (both domestic and public buildings) has to be increased in order to get a clearer and more detailed picture, allowing both a better insight into the concrete energy consumption and a comparison between types of properties itself. Finally, although the option of different languages (Romanian-Hungarian) was evaluated well, further attention should be directed to that aspect as well.

The end user test results in Tirgu Mures are in line with the conclusions of user testing of the three individual pilot tests in respectively Brussels (Relocation), Manchester (Smart Environment) and Issy-les-Moulineaux (Urban Planning) (See *D7.3 Pilot Evaluation Report*).

The results of the Proof of Concept, both about the existence of such a platform with smart city services as well as the evaluation of the pilots, indicate that the EPIC solution -

by disclosing more information previously not easy accessible, combining different data streams and enabling actions regarding different aspects of daily life - is seen in Tirgu Mures as a positive tool and safe and secure technical environment that will in the future, if the necessary improvements will be done, help and assist citizens in organizing different aspects of their daily life in the city more efficiently.

4.2 Integrated Scenario Evaluation

The integrated scenario aimed to demonstrate how web services developed for the Smart Environment pilot could be repurposed and deployed with the Relocation (RS) and Urban Planning (UP) services. In its execution it could be seen to add value to the portlets developed for these two pilots by providing data about energy use of buildings for which details were available either in the 'properties data' used by RS or the public building data and map used by UP. Perhaps not such a significant development per se, yet the ability to readily consume other web services may demonstrate the potential value of a smart city platform hosting both portlets and data sources that can effectively be deployed by SME developers. Thus, the integrated scenario portrayed a realistic situation that effectively could show the added value of combining the different available services available on the platform within a specific setting. Given the very small number of meters installed, the full benefits of this could not be assessed, but the technical feasibility and ease of integration of energy data in the Relocation and Urban Planning pilots was fully demonstrated during the integration phase.

Against this backdrop, the second dimension of the open group phase in Tirgu Mures focused on the interoperability between the three pilot applications and took a broader view on the EPIC service. As outlined earlier, the integrated scenario sought to, on the one hand, show actual public properties from the city of Tirgu Mures on the 3D city application of Tirgu Mures and show their live energy data coming from the energy meters installed by Birmingham City University. On the other hand, it sought to show the average energy usage of a property in the city of Tirgu Mures as compared to other properties in the house detail page of the Tirgu Mures relocation service.

First, a developer stance is put forward which is, arguably, more valid than the user feedback as the Integrated Scenario mainly served to support the validity of the EPIC platform. This is followed by a presentation of the findings of the user tests conducted in Brussels, Issy-les-Moulineaux, Manchester and Tirgu Mures.

4.2.1 Developer Stance

Attention will first be given to the draw out the steps involved to make the 'transfer' possible from the Relocation and Urban Planning pilots, followed by their respective integration with the Smart Environment pilot (see also Section 3.2.1-3.2.3 and *D5.3 Adaptation Rules and Criteria for EPIC Scenarios*; see the Annex for Tirgu Mures stance). Each Section concludes with some reflective notes.

From Relocation to Integrative Scenario Find a House

Regarding the Tirgu Mures application, most of the basic code developed for the Brussels pilot was reused. Between the two pilots though, there were differences in respect of

some of the requirements for example multilingual support. The steps required in summary for the "transfer" were:

1. "Clone" the Brussels pilot code (portlets and web services) in order to use it as basis for the Tirgu Mures case.
2. Modify the web services in order to use the Romanian housing and PoIs services and also to accept the user language as parameter.
3. Modify the portlets in order to communicate with the portal to get the user language preferences and to use the new web services.
4. Remove the components not applied to the Tirgu Mures application, like the communities in search criteria and the area information.
5. Create UI label files in three languages (English, Romanian and Hungarian) and configure portlet to use them according to the user language preferences.
6. Create translations for welcome and manual portlet pages and configure portlets to use the appropriate one according to the user language preferences.
7. Change the data sets for the poi categories (search criteria and house details) and the UI PoI icons according to the Tirgu Mures PoI data and also for the three languages mentioned.
8. Change the data sets for "Living in Tirgu Mures".
9. Configure Google maps to point Tirgu Mures.
10. Change search criteria and result values like price in local measurements.
11. Configure the log error messages for TM pilot.
12. Fix bugs that may arise from the changes made.

The integration with the energy service was done on the portlets side. In sum:

1. In WPF create a new "model" for consuming the energy web services.
2. In the house info portlet, create a new UI section for presenting the energy data to the user.
3. In the house info portlet, if a selected house has energy data, call the energy web services.
4. Do steps 2, 3 for favourites info portlet as well.
5. Depict the houses with energy data with different icon in the Google maps and update help information.

Since the core functionalities were implemented for the Relocation pilot, adapting the application to the TM case and integrating the energy data both went smooth. During the implementation of the TM pilot, the chance was given to explore more the capabilities of the portal and the WPF tool and use different implementation techniques. Perhaps the most difficult task was to transform the data provided by Tirgu Mures for the relocation application specifications defined in the Brussels case.

From Urban Planning to Integrative Scenario Discover Tirgu Mures

In order to first adapt the Urban Planning application to Tirgu Mures, the following steps were involved:

1. Build the 3D Model:
   - Get access to the GIS of Tirgu Mures and build the map of the City based on the cadaster. It was also possible to use Open Street Map as standard solution.
   - Tirgu Mures provided the heights of the building, i.e. approximate heights based on number of level.
   - With 3DSMax and CityEngine we were able to create the 3D Model of the City in LOD1 (See D5.3 annex for the definition)
   - Added 5 famous places, building modelled in LOD2 (See D5.3 annex for the definition) as landmark in the city
2. Define the appropriate design: Interface and interaction
3. Establish the number of layers, thematic to cover and PoIs to display:
   - Discover the City
   - Leisure & Culture
   - Health
   - Education
   - Transport
   - We added Real Estate after "Relocation" implementation
     - To do this, we connect to the database of PoIs provided by the city of Tirgu Mures via a web service. For standard solution we could also use the TM PoIs of Open Street Map and Wikipedia).
     - With access to all PoIs, we analysed them to determine the structure: geo-location, category, sub-category and content for making them available in line with the interface and selection buttons.

For the integration with the energy service

1. Establish a new layer "Energy" and add a "24 hour time line"
2. Design a specific way for displaying the energy consumption as "Band Watts Meters"
3. Geolocalize the sensors on the 3D Map
4. Connect via the web service energy to the database of statement of electricity consumption
5. Take the last 24 hour information for getting it displayed when the user move along the "time line"

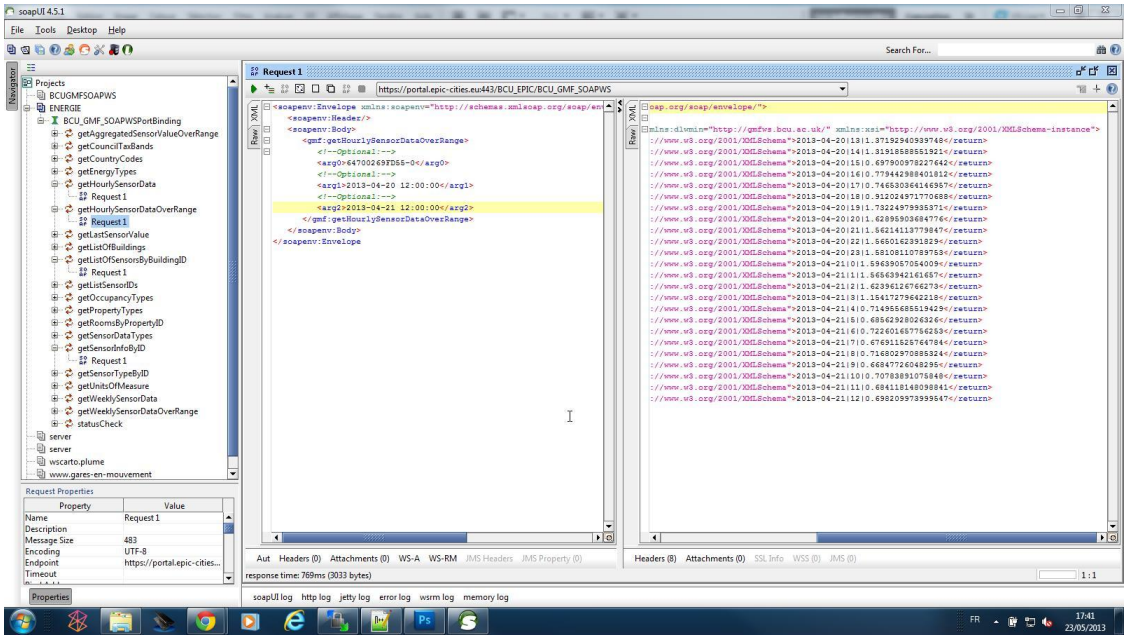


Figure 7: Integration with the energy service

In hindsight,

- The major difficulty remains producing the 3D Model when information of building heights are not available, meaning we should buy it if it is not available.
- Another potential difficulty is that we produce the 3D Model in LOD1 in standard approach, but the client can require LOD2 or LOD3 which is more expensive. And it makes also the 3D map heavier, meaning we significantly increase the loading time.
- Regarding the territory PoIs management, it would be preferable to use the PoIs from standard source like Open Street Map and Wikipedia because those ones are richer and the content is regularly updated by the community. And as secondary advantage no specific adaptation are required from one city to another one which reduces the delivery planning.
- Real Estate and any other geolocalized information should be bought to ensure that this information is complete and up to date.
- It is not too long to transfer a pilot to any other city, even if the difficulties are around data gathering, it would take max one month end to end.

From Smart Environment to Integrative Scenario

The Smart Environment pilot did not employ any location-specific information on the user-interface, so the dashboard could be used in any city. Given the purpose of Smart Environment, it did not consume data from the other Pilots but instead made energy data available to enrich the information present to users of the other Pilots. Because the BCU technical team had developed Smart Environment in a short period, it had been developed entirely in accordance with the EPIC philosophy of web services and portlets. Therefore, the other Pilots could consume the energy web-services, as this was how the Smart

Environment dashboard consumed the energy data. This furthermore demonstrated that if the web-services are developed smartly and have a correctly formed .wsdl, the services can be discovered by the Service Catalogue implemented using WSRR and offered to other developers to consume within their applications. Therefore, there is no further discussion here of the integrated scenario with respect to Smart Environment, but further details can be found in Section 3.2.3 and D5.3.

4.2.2 Testing Scenarios

The test took place in April 2013 (see for timing D7.2). As outlined in D7.1, the aim was to enlist at least 20 test users across pilot cities. The number of people to engage was set to a relative low number. The reason for this is that the applications had already been thoroughly tested in the pilot cities, thereby highlighting aspects of experience and acceptance of the offered solutions. 25 people were recruited and 21 participated; 6 participants from Brussels, 5 each from Issy-les-Moulineaux, Manchester and Tirgu Mures.

For the purpose of the evaluation, two test instruction scenarios were developed guided by a questionnaire (see Annex VI), namely, 'Find A House' and 'Discover Tirgu Mures', which are briefly explained by the following:

Test Scenario 'Find a House' This application helps people finding property for rent or for buying by displaying various points of interest in the neighbourhood of the property and energy consumption data regarding the property and the city.

Storyboard:

- Execute a property search in 'Find a place' ('housing criteria')
- Select the orange icon ('House of Keith') from the List view or press on the orange house icon showing on the map
- Click on details
- Look for energy consumption data
- Select some points of interest in 'what's nearby'
- Press on favourites to save Keith House
- Leave the pilot by clicking on the tab 'Discover Tirgu Mures'

Test Scenario 'Discover Tirgu Mures': This application allows discovering Tirgu Mures by means of a 3D-map. Different thematic layers let you discover different kinds of public buildings and points of interest. It also shows the energy consumption of a public school building in the city.

Storyboard:

- On the welcome screen, press '3D city' and let the map install itself on your screen
- Once you see the map, discover the city with your mouse and by pressing some of the thematic layers
- Press on Energy to view the historical consumption of one public building in the city

- Now click on survey tab

The results of these two test scenarios are reported next.

4.2.2.1 Results 'Find a house'

First the respondents were asked about their impression of the 'Find a House' application. Some 90% strongly/agreed with the statement that it helps to offer a combination of point of interests, property data and energy consumption to people looking for a house in a new locale (M=1.95, SD=.669, N=21). A Kendall's W test was performed to check the level of agreement between respondents. It indicated quite some agreement among respondents (X^2 (1) = 4.292, W= .508, p<.001). And, 91% of the respondents strongly/agreed on the statement that the application enables people to better plan and organize their house-hunt activities in a new city (M=1.95, SD=.865, N=21).

Table 22: Impressions 'Find a House'

Impressions	**Mean[a] N=21**
The combination of Point of interests, property data and energy consumption data helps people to find a place to live in a new (unknown) city in accordance with their various needs and demands	1.95
The service helps people to better plan and organize their property search in a new, unknown city	1.95

Source: EPIC Integrated Scenario Survey.
[a] Values range from 1-5 (Statements, 1=strongly agree; 2=agree; 3=neither dis/agree; 4=disagree; 5=strongly disagree; 6=prefer not to say).

Usefulness

The role of point of interests was examined in the context of finding a suitable property. Some 86% found the combination of PoI and property search function useful (M=2.14, SD=.793, N=21). The PoI were considered by 91% to be useful in guiding people to make a better informed decision about certain neighbourhoods in a finding a house (M=1.81, SD=.602, N=21).

Table 23: Usefulness point of interests

Usefulness POI	**Mean[a] N=21**
The ability to combine Point of interests and property criteria in the property search function, allows people to retrieve interesting property information more efficiently	2.14
Selecting and displaying Point of interests around a certain property allows people to make a more informed decision about a particular neighbourhood	1.81

Source: EPIC Integrated Scenario Survey.
[a] Values range from 1-5 (Statements, 1=strongly agree; 2=agree; 3=neither dis/agree; 4=disagree; 5=strongly disagree; 6=prefer not to say).

Furthermore, 76% of the respondents thought it was useful to compare the average energy consumption of the city and a property's energy consumption, thereby making people more aware about the consumption of energy (M=2.00, SD=.707, N=21). 81% said to believe that this combined set of information is useful in property search activities (M=1.90, SD=.700, N=21).

Table 24: Usefulness energy consumption

Usefulness energy consumption	**Mean[a] N=21**
In the exploration of an interesting property, the ability to compare the average energy consumption of the city and the property's individual energy consumption will make people more aware about energy consumption	2.00
Displaying the average energy consumption of a city and of an individual property will help people to take energy consumption into account in exploring new properties	1.90

Source: EPIC Integrated Scenario Survey.
[a] Values range from 1-5 (Statements, 1=strongly agree; 2=agree; 3=neither dis/agree; 4=disagree; 5=strongly disagree; 6=prefer not to say).

4.2.2.2 Results 'Discover Tirgu Mures'

For the second test scenario the first question focused also on the resulting impressions of the application. Less than half of the respondents (47%) reported to find the 3D-map an efficient tool to get a feel for a new city (M=2.65, SD=1.431, N=21). And, while 57% strongly/agreed that the application enables people to search, find and contact services and PoI (M=2.57, SD=1.399, N=21).

Table 25: Impressions 'Discover Tirgu Mures'

Impressions	**Mean[a] N=21**
The 3D-map existing of different layers of information is an efficient and quick tool to get an overview and feel of a new, unknown city	2.65
The 3D-map and information layers allow to search, find and contact various services and points of interests in the city in a quick and clear way	2.57

Source: EPIC Integrated Scenario Survey.
[a] Values range from 1-5 (Statements, 1=strongly agree; 2=agree; 3=neither dis/agree; 4=disagree; 5=strongly disagree; 6=prefer not to say).

Usefulness

Some 62% of the participants found the PoI and provided services useful and intelligible (M=2.57, SD=1.207, N=21).

Table 26: Usefulness point of interests

Usefulness PoI	**Mean[a]**

	N=21
The provided information about points of interest and services is useful and comprehensive	2.57

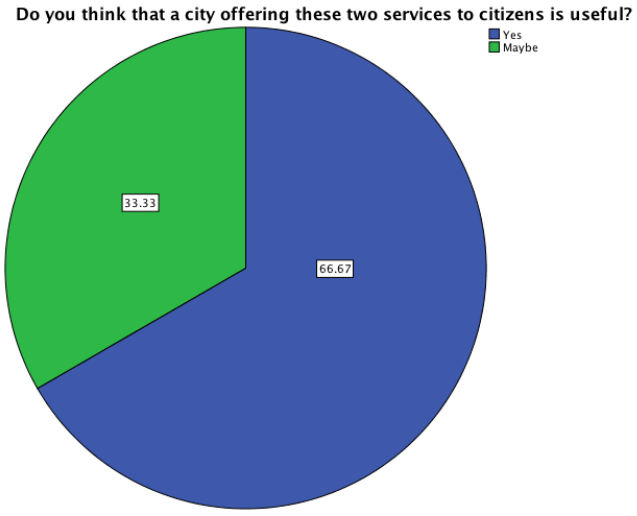
Source: EPIC Integrated Scenario Survey.
[a] Values range from 1-5 (Statements, 1=strongly agree; 2=agree; 3=neither dis/agree; 4=disagree; 5=strongly disagree; 6=prefer not to say).

Also, questions were posed about the combined feature of offering energy data and property data on the 3D-map. Respectively, 19% strongly agreed and 47% agreed when asked about the usefulness of providing information about energy data of public buildings in making people more aware about ways a city seeks to reduce its carbon footprint (M=2.33, SD=1.155, N=21). In a follow-up question, the respondents were asked about the usefulness of this kind of information/application in driving people to take action towards city authorities if they were to find that public buildings would consumer a lot of energy. These numbers do not differ a great deal from the former. Respectively, 14% and 52% strongly/agreed with this statement (M=2.38, SD=1.117, N=21).

Table 27: Usefulness energy consumption

Usefulness energy consumption	Mean[a] N=21
Providing information on the energy consumption of public buildings will make people aware how the city tries to reach carbon reduction targets	2.33
Learning about the energy consumption of public buildings may make citizens take action towards the city authorities if these buildings consume a lot of energy	2.38

Source: EPIC Integrated Scenario Survey.
[a] Values range from 1-5 (Statements, 1=strongly agree; 2=agree; 3=neither dis/agree; 4=disagree; 5=strongly disagree; 6=prefer not to say).



Lastly, the respondents overall found that it could be useful for a city to offer 'Find a House' and 'Discover Tirgu Mures' services to citizens. Some 67% found it to be useful, while 33% reported that such services could possibly be useful for a city to offer (N=21). When asked whether they would consider to paying a small fee (max. 3 euro) for such services, one-third said 'yes', while more than half declined such a service fee.

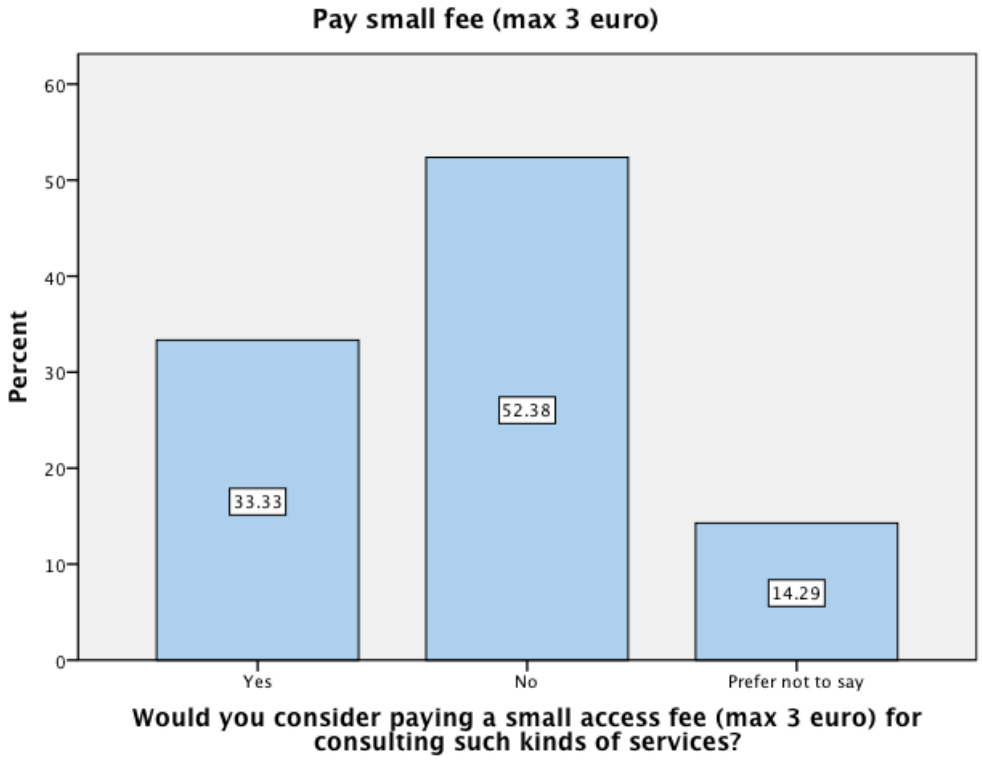


Figure 8: Access fee services

Qualitative data were also derived from the open questions of the questionnaire and which asked the respondents to provide their remarks and suggestions for improvements for the pilot. In this way, we did not of course get feedback about what testers valued as positive functionalities or content aspects and thus only got identification of the least attractive features and the potential of adding or removing some functions.

Table 28: Open responses Integrated Scenario

	Find A House		**Discover Tirgu Mures**
	Technical: the application is very slow		***Technical*****:** was not able to see the 3D maps; The system relies on 3D and was slow to load; Make moving around more easy. Responsiveness of mouse and zooming is very slow as compared to competitive tools like Google Earth; 3D view was somewhat slow to pan a and zoom around / difficult to zoom in on specific house /
	Functionalities: Allow energy usage comparison with houses or properties of same type / size; from map view		***Functionalities:*** All the energy meters (both public and domestic) should be displayed on the map.

	straight to details or favourites instead of via list, not possible to select PoI on range from property, search criteria too narrow, already clicked info not retained; not much info available for the 'energy house' such who to contact if you would like to take a look around etc;		
	Content: Because the energy consumption depends on outside temperature it would be necessary to indicate the outside temperature; would have been nice to see more energy data on all houses; I would also be interested in crime stats, not sure if these were available		***Content:*** it is quite difficult to grasp what the meter actually means in the city context; expand info regarding property
	Interface/look and feel: The interface lacks usability features and needs a more modern design; more ergonomic aspects should be taken into account		***Interface/look and feel***: Controls for 3D navigation should be on/under main screen***;*** it's not great that you have to download and install an app... and a mouse... inconvenient / Could use some keyboard or mouse hints on how to navigate interface

From this Table, the following results can be distilled.

Least attractive features: The least attractive features for both integrated scenario applications were the look and feel and their technical performance.

Look and feel: The main complaint for "Find a House" was that it looked outdated and raised ergonomic concerns. For "Discover Tirgu Mures", the complaint was that navigation with a mouse was very user-unfriendly and other controls with the keyboard should be incorporated. Secondly, the fact that one had to download the app on your computer was seen as inconvenient.

Technical: Both applications were considered rather slow and in the case of "Discover Tirgu Mures", also the rather slow responsiveness of the mouse and zooming were highlighted.

Functionalities: For the "Find a House" application, the feature of being able to go straight from a returned result on the map to the detailed page was considered as a rather undesirable feature. While in the "Discover Tirgu Mures" case, the comment was made that not all the energy meters installed in the city were displayed.

Potential of adding/removing new functionalities and implementing new content: The feedback from the testers allowed us to identify some new functionalities as well as content that should be added.

Functionalities: For the "Find a House" application, the desired functionalities were:

1. The option in the Detailed House Page to select PoIs within a certain range from a property (which is only present in the Find a place search tool);
2. The potentiality to compare energy consumption data among similar types of property (e.g. flats of the same surface);
3. To be able to contact directly the retailer of the property (advertisement);
4. To go straight from returned results on the map to the details of the house by clicking on the icon instead of going through the list first (this feature was present in the PoC pilot and pilot in Brussels); and
5. To expand search criteria.

Content: Regarding content, both pilots got the recommendation to expand them.

For the "Find a House" application, it was recommended to make the integration of smart energy data more meaningful such as by publishing data about outside temperatures to interpret changes/fluctuations in patterns. Regarding PoIs, the question was raised to incorporate crime statistics, although, as explained in D7.3, it was a principal choice not to publish those for a city if they are available because they are quite controversial (avoiding stereotyping of neighbourhoods, for example) as well as should be accurate (in the case of Brussels, the statistics were already four years old and therefore likely outdated).

Regarding the "Discover Tirgu Mures" application, the opportunity to incorporate also properties for sale/rent as an additional PoI category was recommended. Furthermore, it seemed difficult to interpret what the energy consumption data displayed referred to. As such, providing content or making this content more meaningful is a matter that should be further explored. Lastly, as not all meters were displayed at the time of testing, this can of course be interpreted as a potential feature to implement.

4.2.3 Conclusions

The integration of energy consumption data in the "Find a House" application by displaying the individual energy consumption of the property and the energy consumption of the city was evaluated positively by the testers for three reasons: 1) it provided more relevant and useful information when actually discovering potential interesting property in a city, 2) it had the potential to make them also aware of the issue of energy consumption during this process, and 3) it helped people to take the matter actually into account when exploring properties. However, from the qualitative feedback, we learned that these three potentialities can be further realised or remedied by the following:

- Displaying information about outside temperatures outside (thus, in other words, creating awareness about the climate of/in the city)
- Ability to compare energy consumption between properties of the same kind (e.g. same surface or for example same kind of energy installations). Although the Smart Environment web-services deliver the average of similar properties, this was not possible in Tirgu Mures due to a limited number of properties involved.

The integration and display of energy consumption data of public buildings on a 3D-map was evaluated positively in the context of smart environmental city objectives. Testers

acknowledge with our integrated scenario for the "Discover Tirgu Mures" application as a potential test case, that the display of energy consumption data of public buildings would make them more aware about how a city tries to achieve carbon reduction targets and that it would allow citizens to take more informed actions towards their city authorities to better monitor their energy usage behaviour. Qualitative feedback indicated that these functions should, however, be designed more meaningfully so that the real value of this data for smart environment purposes in the context of a city can be better exploited. Finally, one tester also identified as another potential relevant integration for citizens the possibility to show available property for sale or rent in the city. In other words, what seems to be desirable is to let the idea of a 3D-map be an access point to detailed property information.

Nonetheless, for the integrated "Find a House" application, some of the same lessons can be learned as identified earlier in the pilot stage in Issy-les-Moulineaux and in the "Discover Tirgu Mures" application. The 3D-map and the categories / PoI layers are seen as useful to explore and search information. AS such they represent a useful experimental application that, if further developed, could contribute more widely to smart city objectives including smart mobility; smart governance and the smart economy. However, in its current form, the tool is not sufficiently effective and warrants further development in terms of ergonomics and the controls for user navigation. To maximise the effectiveness of the media tagging facilities offered, it is also important to consider how the many potential providers of media data could be encouraged to provide content to enrich the user experience.

Taken overall, the majority of respondents found that a city should offer these tested services: 66% responded that it could be useful for a city to offer these two services, while 33% answered that it could 'possibly' be useful. However the citizens in the user test groups showed little enthusiasm for paying even a nominal fee for the use of such services and believed that they should instead be provided free of charge by the city. This view may be due to the fact that the users experienced test versions of the PoCs rather than finished end-products. The potential attractiveness of paid-for services would need to be assessed in a more representative environment with services much more representative of commercial releases.

The integrated scenario was in the main a technical exercise to demonstrate the interoperability of different data-streams accessed through reusable web-services. Despite this limitation however, user-testing of the albeit somewhat limited integrated scenario identified that the re-use and integration of different pilot data through a variety of end-user applications is technically feasible. Furthermore, such integration has the potential to deliver real benefits to citizens by providing smart city technologies that help them organise their work and daily living within the city life, with the potential for enhanced productivity and an improved quality of life.

4.3 Stakeholder Evaluation

The Tirgu Mures team recruited 15 stakeholders from 2 public institutions and 4 firms to evaluate the PoC applications delivered by the EPIC solution. Interviews were conducted between 29 April 2013 and 16 May 2013.[2]

One of the public institutions is the Tirgu Mures Municipality itself. The reason for choosing stakeholders from Tirgu Mures Municipality was that some of its departments are future potential users of EPIC services or future information providers to up-date the Tirgu Mures database or future technical service providers necessary for EPIC services maintenance. These departments are: IT department; Remuneration and Human Resources Department; Public Domain Administration and the Public Relations Department. The other public institution is Mures County Prefecture, another institution that could possibly use the EPIC services in the future.

The firms from which business stakeholders were chosen are: Intergraph Computer Services, S.C. SOBIS SOLUTIONS, S.C. INDECO SOFT S.R.L and S.C. Locativ S.A. Below there is a short description of the role of each of these enterprises (see Annex V).

SOBIS Solutions S.R.L. is the provider of the Document Management Project that manages all the documents of Tirgu Mures Public Administration. They provided the database containing some of the economic activities located in Tirgu Mures and process it in the format necessary for Intergraph Computer Services. They would update the database for the EPIC services.

S.C. INDECO SOFT S.R.L is an EPIC partner and provided the properties for rent or sell database for the Relocation Service Project. They would update the EPIC database.

Intergraph Computer Services provided GIS Database for Tirgu Mures Municipality and was asked for the EPIC Project to prepare a new DB structure to be made accessible through WFS web service to the EPIC Cloud Platform. Intergraph receives the information for DBs from SOBIS and from the Tirgu Mures Administration personnel. They would update the database for the EPIC services.

SC Locativ SA – manages the municipal properties

It should be noted that many of the stakeholders have excellent skills in programming and computer usage, with many being IT specialists and working in IT companies. This means that they are used to professionally evaluating software applications regarding their ease of use, usefulness, marketability or other relevant features.

What follows now is a presentation of stakeholder feedback.

4.3.1 Stakeholder feedback

Ease of use

When asked about the ease of use of the three EPIC pilots, all the stakeholders responded positively. Some (from S.C. SOBIS, IT Department-Tirgu Mures Municipality, S.C.

[2] Initially the stakeholder interviews were scheduled to be accomplished in one week, but due to busy agendas of the stakeholders, the interviews spanned over a period of two weeks and a half.

INDECOSOFT) added that the pilots' interfaces are user-friendly, the menus are intuitive and the applications can be easily used by individuals with average skills in applications usage. However, more than one person indicated that the 3D model of Tirgu Mures requires considerable hardware resources. Another stakeholder (GIS advisor at Intergraph Computer Services) was less pleased with the "Smart Energy" interface. One stakeholder (from the Mures County Prefecture) suggested that the order of the applications in the main menu should be switched. A couple of stakeholders appreciated the possibility of choosing ones preferred language, which offered Romanian or Hungarian to Tirgu-Mures users.

Usefulness

All the stakeholders considered the EPIC applications to be useful or very useful. One of the stakeholders (from the Municipal IT department) added that they accomplished the smart objectives of the pilots. The same person and a further tester suggested that the "Smart Energy" application should measure also the exterior temperature, as its geographical and temporal variation is an important factor that influences the energy consumption. [The technical team consider that, whilst this is a valid observation, this requirement could be best my by integrating additional meteorological data feeds provided as web-services into the energy dashboard portlets]. Another stakeholder stated that the applications are useful both for Tirgu Mures citizens and the tourists, and a municipal stakeholder noticed that they could potentially stimulate the tourism in Tirgu Mures.

Content-related aspects

All the stakeholders appreciated the quality of the applications content. One stakeholder (from municipal IT department) appreciated the wide range of information that the pilots can offer about Tirgu Mures. Another stakeholder from the IT department suggested that there should be photos attached to the properties and also that the religious category should be rearranged.

A stakeholder from Intergraph Computer Services suggested that the "3D" scroll in the "Discover Tirgu Mures" application should be improved to provide smooth navigation even after user zooms-in to maximum details level, thus avoiding the need for successive navigation commands. As a solution, he proposed to change the scroll sensitivity / use navigation commands according to the scale.

Intention to use

The stakeholder from S.C. LOCATIV S.A. that manages the municipal properties affirmed that the "Smart Energy" and "Find a House" applications are welcomed because they may contribute to improvement of the efficiency and optimisation of the services provided by their firm. A further stakeholder from the Municipal Public Space Administration department said he would be interested in the "Find a House" application and would be willing to pay for it.

A stakeholder from S.C. SOBIS Solutions said that their business has a similar product on their platform and they are not interested in buying these applications, but the EPIC pilots were not considered to compete directly with their applications. On the other hand,

a stakeholder from S.C. INDECO SOFT stated their firm would be interested in all three applications and believed that "Find a House" and "Discover Tirgu Mures" applications may compete with the services offered by their firm.

A stakeholder from Municipal ID department stated that it would be better to provide the three applications for free and financially sustain the platform through advertising.

Opportunities and impediments with the EPIC pilots

When asked if there are any legal constraints in the operation of the EPIC project, all the stakeholders considered there are no such constraints or they are not aware of the existence of such constraints. We noticed that there was a jurist among the stakeholders who stated that the EPIC pilots were conducted in concordance with the current legislation.

More than half of the stakeholders considered that the EPIC pilots may be used by a large number of users. Yet a stakeholder from the municipal IT department remarked that it is essential to have periodical information updates in order that the applications may be delivered to the large public. He also stated that some improvements especially in the economic area should be added. A stakeholder from S.C. INDECOSOFT noticed that some improvements in the information quality and quantity should be added. A stakeholder from Intergraph Computer Services stated that a more consistent real-estate database for both "Find a House" and "Discover Tirgu Mures" applications should be created.

Regarding the safety of the applications, no one of the stakeholders detected any safety issue.

All the stakeholders excepting one agreed that the applications worked technically well and were intuitive enough to be easily used by citizens. The only one who had a slightly different opinion was the stakeholder from Intergraph Computer Services who opinionated that "Discover Tirgu Mures" worked not sufficiently well but the other two applications did.

In the end, the interviewees were shown a table containing possible ways in which each of the pilots may contribute to Tirgu Mures city become a "smart" city. Almost all the stakeholders agreed to this fact, except two of them (one from Intergraph and the other from the municipal IT department) who stated that the "Smart Energy" pilot does not presently contribute in this way, but it should provide Tirgu Mures input. We may explain this remark as follows: it is possible that at the time they explored the "Smart Energy" application, Tirgu Mures data was not yet provided due to some technical issues, but this problem was resolved subsequently.

4.3.2 Conclusions

We may conclude that the evaluation by stakeholders was generally in line with the feedback from end users: the platform and the pilots were perceived as easy to use, as a safe environment, and judges as useful or very useful, as rich in content, as being of good content quality and as being multi-lingual. Also, the pilots were identified as potential

tools that could contribute to smart city objectives (only Smart Energy received some criticism due to the kind of data collected).

Similar remarks were made as the citizens that took part in the open group tests: the 3D map demanding much hardware resources, thus needed a more simplified way to access and navigate; the design of the interface of the Smart Energy pilot as being a little bit too simple; the provision of outside temperatures to make the energy data in Smart Energy more meaningful: the provision of more information (like photos) on properties or POIs in Find a House and Discover Tirgu Mures.

Stakeholders clearly expressed an interest in using one, two or all of the pilots from either their commercial sector or either their public authority mission. They acknowledged that the pilots have the potential to attract a large audience, and thus a large consumer base. However, regarding the issue of offering the services for free or allowing access in exchange for a small fee, no clear conclusion can be drawn. At least one stakeholder from the public city sector strongly preferred free access.

4.4 Roadmap Evaluation in Tirgu Mures

As part of the work for WP6, the EPIC roadmap descriptions (see *D6.3 Functional and Business Roadmap*) and the detailed templates were used in the collaboration with the city of Tirgu Mures to implement the EPIC pilot services and apply the concepts of the EPIC roadmap. The purpose of testing the EPIC roadmap in Tirgu Mures was to work together with the city on the different phases of the roadmap and to explain, complete and evaluate the different templates as provided by the roadmap. The roadmap phases were discussed in their sequential order, and for each phase the most relevant templates were selected and discussed. Subsequently the project team for Tirgu Mures provided detailed content and feedback on these templates, for example on the structure, content, methods, etc. Based on the discussions and feedback, the different templates were modified and adapted accordingly.

As a result from this roadmap testing in Tirgu Mures, the finalised deliverable D6.3 incorporates the feedback, results and experiences from using the overall roadmap descriptions and completing the detailed templates for the specific Tirgu Mures context. As such, the case of Tirgu Mures is used for describing specific guidelines towards other cities for the use of the EPIC roadmap (see chapter in D6.3).

4.4.1 EPIC roadmap test in Tirgu Mures

Different stakeholders and persons were involved in the testing of the EPIC roadmap with the city of Tirgu Mures. First, a number of technical and business representatives were involved from Tirgu Mures itself, including the coordinator of the Digital Strategy (Dana Mihet), City Hall collaborators (Coralia Goicovici), and strategy and project consultants (Razvan Ciortuz, Madalin Nicula). Secondly, the team for WP6 coordinated the different activities and organised the workshop and bi-weekly conference calls. Thirdly, the EPIC project coordinators (from ISPractice, Hugo Kerschot) were involved in the overall steering of the Tirgu Mures developments.

Specifically for the testing with Tirgu Mures, the following activities were performed in collaboration with the different stakeholders:

- organising a workshop in Tirgu Mures to discuss first steps for the EPIC roadmap, including the strategy development (for EPIC) and the assessment of the maturity of the city for adopting an EPIC platform and services,
- discussing the different templates and gathering input/feedback during the bi-weekly conference calls, with the business representatives of Tirgu Mures,
- incorporating the feedback and experiences from the testing with Tirgu Mures as a specific case and guidelines in the deliverable D6.3 – EPIC roadmap for Smart Cities,
- evaluating and updating the overall roadmap descriptions based on the experiences and collaborations with the Tirgu Mures team.

The testing of the roadmap was performed in the period from August 2012 until March 2013 (see following timeline), in parallel with the technical developments of the EPIC pilots and the user testing. During this period, a 2-day workshop was organised in Tirgu Mures together with the different technical and business teams involved in the EPIC project. Following this workshop, a bi-weekly conference call was agreed with the business team in Tirgu Mures in order to follow up and progress on the roadmap testing. Finally, at the end of the testing period, a concluding feedback was discussed with the team of Tirgu Mures on the overall roadmap description and the detailed templates provided.

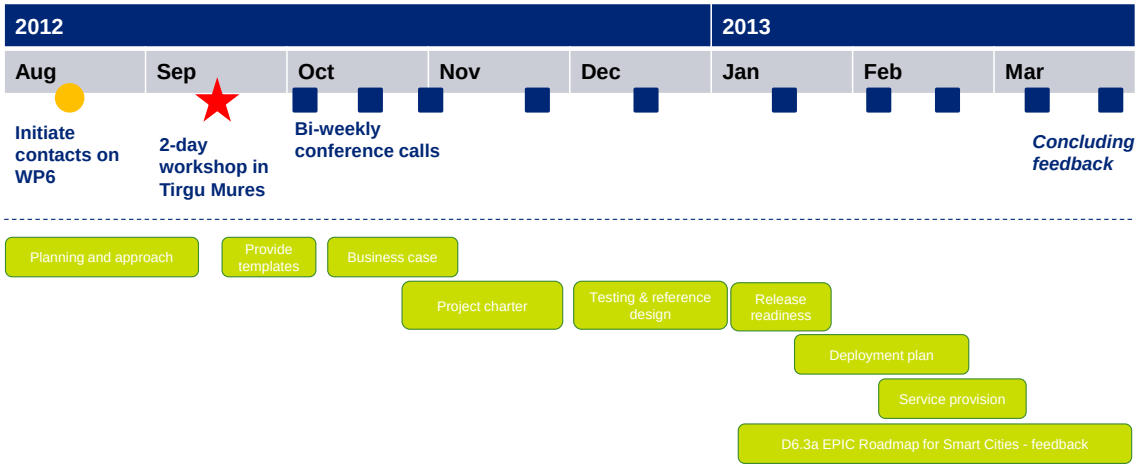


Figure 9: Timeline for Roadmap Evaluation in Tirgu Mures

The concrete scenario for the testing of the roadmap with the city of Tirgu Mures started from the defined Digital Strategy for Tirgu Mures and the developments of the pilot EPIC services (e.g. the Relocation service) on the EPIC platform.

For the Vision phase and the smart city strategy template, the EPIC project can contribute to the achievement of some objectives of the Mures Digital Strategy. During the Tirgu Mures workshop, discussions were organised around the key questions ‘What makes a

smart city?', 'How can Tirgu Mures become a smart city?' and 'How could EPIC help in becoming a smart city?'.

In the first step of the EPIC Smart City strategy exercise, the potential interests of Tirgu Mures were identified for the five focus areas of a smart city (including Governance, Economy, People, Living and Mobility). In a next step, possible (innovative) solutions were identified and discussed for the different interests. These solutions were mostly related to a possible solution on the EPIC platform (see resulting whiteboard in the following Figure).



Figure 10: Results of Smart City strategy exercise with Tirgu Mures

The second session in the T-M workshop consisted of a discussion on the business case of a specific EPIC service for the city of Tirgu Mures. In this session, we tried to find an answer to the questions 'What is needed in the city of Tirgu Mures to implement EPIC services?' and 'What is the business case for the EPIC pilots in Tirgu Mures?'. In this business case exercise, an assessment was made to evaluate the readiness of the city of Tirgu Mures for adopting an EPIC platform and implementing EPIC services. The assessment tool used for this exercise consists of four evaluation domains, including Strategic/Legal, Financial, Operational and Technical.

For each evaluation domain, four topics were investigated and scored based on the discussion with the team of Tirgu Mures (see resulting whiteboard in the next Figure). For adopting EPIC in the city of Tirgu Mures, possible conclusions from this exercise indicate that there are difficulties in terms of budgets and procurement procedures, a possible lack of skills and necessary specialists and possible issues with the ownership and security of the data and associated web services.

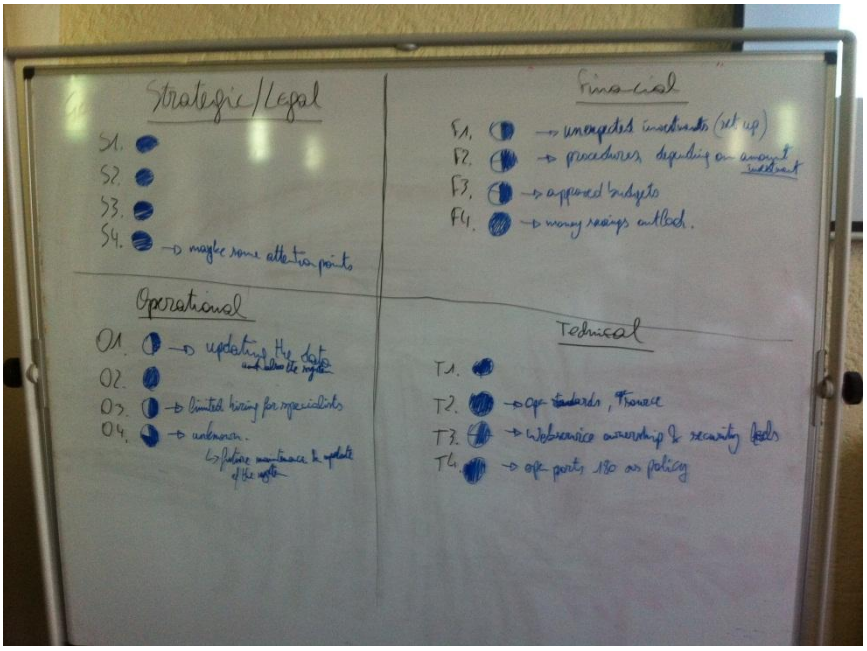


Figure 11: Results on Business Case exercise and EPIC Readiness Assessment

Next, the development of the potential operational structure for the Relocation Service was discussed for the business case. This operational structure provided insights in the concrete actors and components that are identified for operating the EPIC service. In addition, the potential financial models were discussed that could be used for the different interactions between the actors in the operational structure. For each of the actors, the potential costs were identified related to operating the EPIC service. Next, the data flows between the actors and components were used as guidance for determining possible revenue streams. Different financial models, such as pay-per-use or subscription models, were discussed and selected for the different revenue streams (see resulting whiteboard in the Figure below).

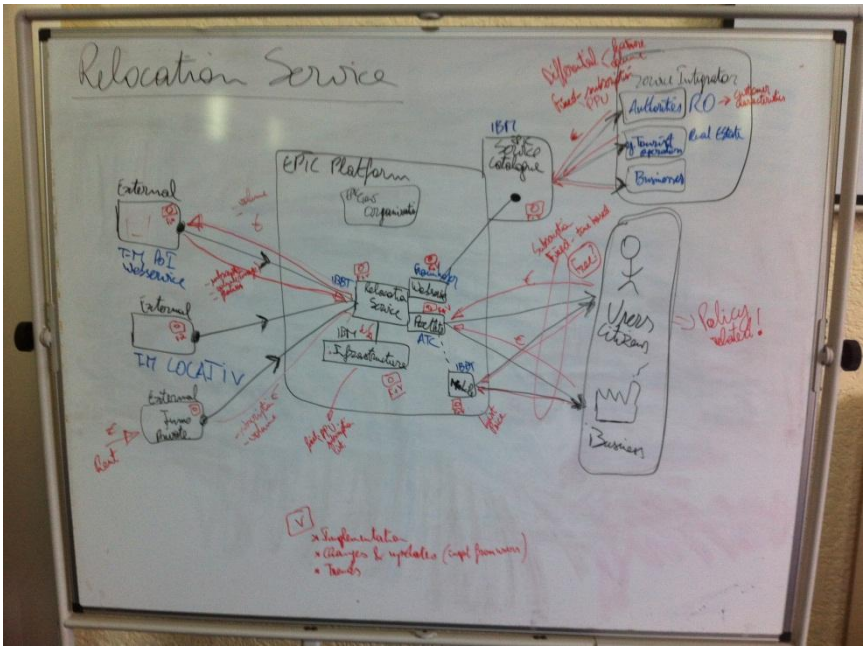


Figure 12: Results on the Operational Structure and Financial Models for EPIC Services

These exercises in the Tirgu Mures workshop led to the further adaptation of the smart city strategy material as part of the Vision phase, including more details and understanding of the different domains. Furthermore, the operational structures and possible financial models were taken into account and detailed in the different templates (for example the business case and service provisioning template) and the D6.3 deliverable (see Operational Model for EPIC).

For the Plan phase, the project structure as implemented in Tirgu Mures together with the different EPIC teams was discussed and described in more details in the project charter and project management and quality plan templates. Based on this input, the overall project organisation and roles/responsibilities of the different teams were taken into account for the project charter and project management templates, and also for the operational model for EPIC (see D6.3). In addition, the specific details on the quality standards in Tirgu Mures were taken into account for the quality plan templates. In evaluating these templates for the Plan phase in Tirgu Mures, it was decided to combine the project management and quality plan templates into a single template, separate from the project charter template.

For the Design phase, the detailed input was provided by the Tirgu Mures team (and the supporting iMinds team) on the approach and planning for the closed and open testing phases for the different pilots in Tirgu Mures. This input was taken into account for drafting the details of the EPIC overall testing approach template, including as such the closed and open testing phases.

For the Build phase, there was input provided on the technical implementation of the different pilots in Tirgu Mures that was used to evaluate the relevance of the EPIC service release readiness criteria, as were defined in the template. As a next step, the Delivery phase was discussed only in terms of this technical information with the contact

persons in Tirgu Mures, but did not have much impact on the EPIC service cutover and deployment plan template.

For the Operate phase, the main input that the Tirgu Mures team should provide were the details on the service provisioning template. As this was one of the most important templates of the roadmap, it was necessary to have as much input as possible on the different sections, including the scope of the services, the expected service levels, the expected charges for EPIC services, the identification of costs and possible pricing models. There was some general input received on the services and possible operational models (including possible price/cost structures). However, the contact persons in the Tirgu Mures team were unable to gather detailed financial information from within the city administrations. Nonetheless, based on the information received and the discussions during the conference calls, the possible service levels (such as defined in a Service Level Agreement) and financial models were evaluated and taken into account for the template.

The particular planning of the testing activities (i.e. the parallel technical and roadmap implementations) caused difficulties in the alignment between the roadmap phases and the completion of the templates with the technical implementation results. This alignment was particularly necessary for the more 'technically' oriented roadmap templates for the design, build and transition phases. However, the implementation status and results from the technical team were received only through our business representative at Tirgu Mures (being Coralia and Razvan).

4.4.2 Conclusions

The following overall considerations and conclusions for the EPIC roadmap could be made based on the roadmap testing in Tirgu Mures:

- There is an explicit need for the alignment of the roadmap phases with the technical developments of the EPIC pilots, including an improved project management at city level between the technical and business teams
- For the different phases of the roadmap, different expertise and skills are necessary to implement the actions and define the detailed results. This translates into the need for collaboration and involvement of various stakeholders at both city management and IT level.
- The development of a smart city strategy should be the main driver for implementing concrete smart city solutions and services. This smart city strategy should be fully aligned with the overall strategies of the city (e.g. the Digital Strategy in Tirgu Mures). The necessary decision-taking powers should be involved in moving from the smart city strategy to defining the concrete business cases and plans for the implementation of smart city solutions.
- More services and examples from other cities should be made available in order to indicate their usefulness and how they helped the relevant stakeholders in reaching their strategic objectives (for example in the different smart city domains).
- For using the EPIC roadmap, it could take a little more time for the city administrations and involved stakeholders to understand and to be convinced of the benefits of implementing the smart city strategy and specific solution business

cases. Some of the template descriptions should be improved in terms of the perceived ease of use and their common understanding by the different stakeholders (in particular the city administrations).

5 Realizing the EPIC Project Vision for a "Smart" City

From the beginning of the EPIC Project the Consortium believed that a truly 'Smart City' is one that is able to:

1. benefit from the innovative developments of citizens, SMEs and other actors from across Europe rather than just within their own cities,
2. leverage a service infrastructure that is capable of delivering "one stop government" through the integration of services, interoperability of systems and use of actionable intelligence in service delivery,
3. contribute to a multi-national service-oriented ecosystem by providing and sharing open business processes as services with other cities.

All partners worked on the fulfilment of the above aspects and a very important milestone for this work was to make our "smart" city vision statement a reality for Brussels, Manchester and Issy-les-Moulineaux by 2013, through the creation, use and improvement of the implementation of the EPIC Platform and Roadmap.

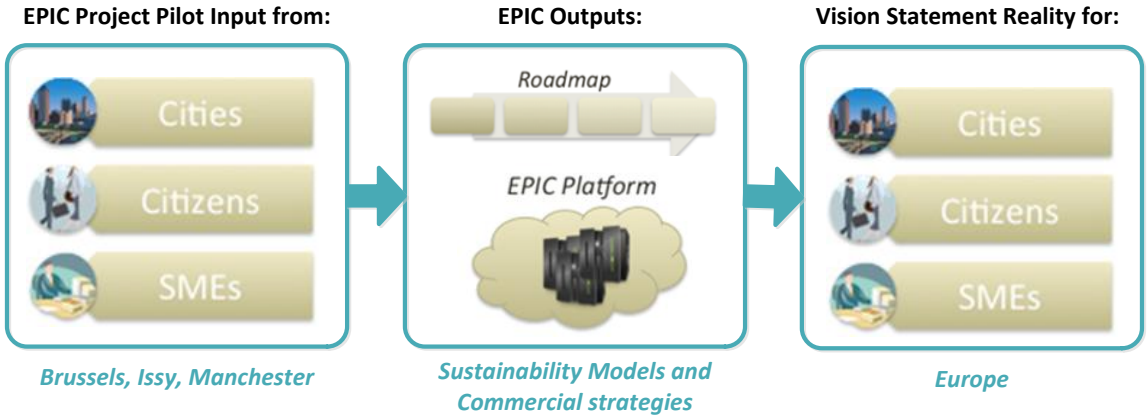


Figure 13: Making the Vision Statement a Reality

In addition, the implementation and validation of the proof of concept scenario in a "virgin" city was another key challenge for the EPIC consortium to prove that our vision statement is valid and the EPIC outputs are sustainable and applicable in a pan-European level. As described in previous sections of this document the various EPIC services have been adapted and integrated in a new application deployed and tested in Tirgu Mures city under the guidance of EPIC Roadmap. The results have been satisfying and the feedback received from all stakeholders and end-users was, overall, very positive. At the same time, the project focused on creating a strategy to deliver the EPIC vision further across Europe through the creation of sustainable commercial models that will continue offering services and benefits long after the end of the project.

5.1 Lessons Learned

In EPIC we believe that the alignment of EPIC commercial needs to those of the city is best served through creating the 'user story' with city decision makers and then ensuring capability within the city to release the full potential of the services we make available to

them; and the proof of concept highlighted that this is perfectly served by the EPIC Roadmap. During the three years of the project, EPIC consortium acquired valuable feedback, which can considerably increase the -cross border- effectiveness of the EPIC commercial solution. The findings are summarized in the lessons learned sections below.

5.1.1 Implementation EPIC Elements

From the technical perspective, the EPIC solution was based on **modern and well-established technologies and open-standards**, which is considered as a very important asset for the realisation of the project vision and post-project exploitation. Even though in the beginning of the project the use of a specific platform and tools appeared to be an issue for developers to adapt and align their work in the new environment, the continuous support and documentation from the technology providers allowed for knowledge building and implementation of advanced features in both the platform and the pilots.

In addition, the use of **web service technologies** and standards for the implementation and integration of the various components and data sources was considered very important for the wide adoption of the platform as a solution for provisioning "smart" city applications. Particularly, the **service catalogue**, as a "one-stop shop" for providers and developers, allowed for extensive reuse of services and delivery in a pan-European level such as in the proof of concept in Tirgu Mures.

An important remark though from the consortium is to have the technological baseline documented in advance (in DoW ideally) so as to help the architecture designers and developers to have a clear picture and concrete on the implementation of the capabilities of their components.

Also in order to ease the both the implementation and testing processed data providers should ensure that their data resources will be always available to avoid problems regarding their integration and the operational status of applications during testing which will affect the experiences of the end-users accessing the pilots and the platform.

It was observed that from time to time there were quite some differences between the development teams with an academic or research background and the "IT industry" development teams, which could be parallelized as **usability vs. robustness competition** on the implementation of the EPIC elements. However, with effective communication and strict processes, EPIC managed not only to fulfil the requirements of all stakeholders through common agreement and understanding but also to lay the foundation for a commercial proposition of EPIC as an integrated "smart" city solution.

5.1.1.1 EPIC Platform

At the platform level, a number of developers and users have also identified some issues. In the beginning, the platform appeared to be more complex than expected which required additional efforts for the developers to adapt to this environment. The reason for this was mainly the need to **follow strict policies and IT standards** of Reliability, Availability and Serviceability as a platform with commercial orientation, which was at first a trade-off on the platform usability and recognition that during the project phase this was still in essence a development environment rather than a commercial deployment.

For example, the fact that the registration of users the platform was carried out by the system administrators and didn't allow users to register on the system themselves and to manage their own login and passwords, consumed valuable amount of time especially during the preparation of the testing cycles. In that sense, the lack of understanding on many of the functionalities of the EPIC platform delayed sometimes the process of development however, continuous communication with workshops and web meetings in regular and ad-hoc basis ensured smooth adaptation of operational and technical aspects of the application in the EPIC platform environment.

The EPIC solution applied horizontal **open-standard based Service Oriented Architecture (SOA)** and cloud computing to provide the foundation for city service delivery to citizens, business and administrations alike. The use of open-standards has been embraced fully to maximize portability of the solutions created to a range of hosting platforms, to avoid vendor lock-in and maximize exploitation potential post-project.

A key element of the EPIC solution architecture is the **separation of data services from the visualization and user interfaces**. Web-services were created to access external data and to deliver this in a form that could be readily consumed and displayed by the portlets, which provide the user interfaces. The web-services implemented both SOAP and REST approaches for access to public and commercial data sources hosted off-platform by the data-owners but exposed to the platform through remote web-services. Each of the Pilot applications was converted from its native implementation form to use standard web-services and JSR268 compliant portlets hosted on EPIC platform. In addition, the management of services, of users, of user-data and of user-permissions was designed in a generic way to provide an extensible set of services based on a standardised data structure for "smart" city applications.

Finally, the **EPIC Service Catalogue**, as a key element of the platform, provides the cornerstone for delivering and managing "smart" city services that are currently available on the platform. The Service Catalogue will provide the starting point for any city administration, SME or other integrator to investigate the possibilities of the platform and the leveraging of already existing smart city services.

5.1.1.2 Pilot Applications

As there is a number of "smart" city applications on the market the EPIC "product" would need to establish a **unique identity**. One of the most important lessons learned in project regarding the pilot applications design and implementation is that "less is more". This adage is reflected in the user comments on the application proving the simple UIs work best.

In terms of functionality, those that were defined and developed were based on extensive user interviews and co-creative wire-framing sessions, and the outcomes were highly satisfactory. The market demands **intuitive systems** and where instructions are provided they need to be clear and not complex. To this end, single-sign on should be a must for applications targeting "smart" city services as this is the normal authentication in web and mobile applications, and definitely something that the end-users are expecting as

feature. Besides the offered functionality, development of mobile applications, as an alternative access channel, should be one of the top priorities for "smart" city services.

Mobile applications increase engagement and considerably increase the effectiveness of the services, allowing at the same time for access to advance features such as personalized delivery of information that exploits contextual data, for example location from GPS or Wi-Fi triangulation, from smartphones. In addition, the developers should target all common mobile platforms and be proactive so as to ensure timely delivery of the applications to the various app stores / marketplaces and avoid the sometimes difficult third-party software installation process.

Regarding the integration of devices and IoT, with specific reference to Smart Environment and domestic energy monitoring, it was very important to fully understand the variables introduced when working in participants own homes. End-users expect simple installation processes given that nowadays **plug and play** is the norm. Also it is vital for customer confidence and acceptance that and additional equipment necessary does not necessitate changes to the configuration of their home technology system i.e. broadband, in other words, they expect the system to be compliant with well-established and accepted standards.

The installation of energy monitoring devices for the Smart Environment pilot introduced an additional layer of complexity for users, over and above simply logging-on to the EPIC portal which was the only action required for Relocation and Urban Planning. Although users can readily install the required equipment, which is often offered free of charge to customers by energy companies, it is normally used in stand-alone mode, i.e. no internet connection is required. Users may encounter physical problems with installation, namely gaining appropriate access to the electricity meter or consumer unit to install the clamp meter, or the location of the meter, e.g. in a basement in a tall residential block, may be outside the wireless range of the transmitter. However, the use of MQTT as a lightweight publish/subscribe messaging protocol (used by Facebook Messenger, among others) appeared to be ideally suited to mobile and low-power applications. Smart Environment used the open-standard and well-accepted MQTT standard for transfer of data between the energy monitor and the EPIC platform and from the EPIC platform to the GMF.

Further issues were occasionally experienced with the user's broadband connection. When internet connectivity drops out for a short period, as is common with many non-cable broadband providers, energy data is lost. This is not considered problematic because the Smart Environment pilot is a guide to energy usage not a smart-billing application, so some degree of data loss in acceptable. However, on occasions, domestic users may need to reboot or power-cycle their router before it will reconnect. This they will do when they find themselves unable to access the internet, but they may be unaware that the energy data cannot be transferred as internet connectivity has been lost.

Finally, **additional data sources** would further enhance the added value of the pilot applications since access to information, such as contact details for real estate agents or more info about neighbourhoods such as crime rate has been a primary request from end-users.

5.1.1.3 Roadmap

Generally speaking, the smart city initiatives that are defined and implemented are often not structured, coordinated or integrated in an overall strategy and approach. The EPIC roadmap will help city management, administrations and related stakeholders to **avoid this pitfall** and improve their Smart City efforts by creating a more integrated and better managed approach for evolving towards a smart city.

During the evaluation of the project outcomes, the EPIC roadmap received the positive feedback both internally and also from the external experts and stakeholders. It is considered a very tool for cities and SMEs to realize their vision for a "smart" city based on their particular needs and priorities. Through the roadmap, the platform and the services of the Service Catalogue could be adapted to another city and decrease considerably the effort required for developing an "intelligent" application, while they can also target a wide range of potential customers in pan-European level.

However, it is considered that the roadmap would be even more useful if it will be offered as an **open solution** that cities could update themselves as they gain experience, which they can pass on to other cities. In this process, **different "flavours"** of the roadmap may be implemented from a "quick scan" approach until very detailed consultancy tracks.

5.1.2 End-user Testing

The end-user involvement in EPIC requirements definition and testing processes through the Living Labs was a very important challenge for the project. Besides their engagement and motivation in the various cycles, analysing their feedback was also very important. We realized that in many cases the end-users focused on a specific feature of the application, like some kind of missing content or on a specific element of the interface, rather than considering the entirety of the solution functionality. To this direction, it appeared to be better sometimes to **involve only experts or SMEs at the beginning** of the technical evaluation phases of the project and introduce the citizens later, since they may not have the level of awareness for digital experiences required at the start.

Another main problem we encountered in executing the user testing was the delay in technical development of the platform and the pilots, making the task of user retention and providing a good test process experience for testers difficult. Therefore leaving **more room between the iterations and tighter planning** and deadlines for the implementation of the features in collaboration with the development teams should be necessary from early start.

The end-user number should not be the first priority. Testing does not require a large number of end-user testers, but testers capable to provide feedback of **more "quality" than "quantity"**. User number targets sensible for planning purposes but should not become an absolute goal and therefore introduce potentially artificial targets.

Furthermore, to ensure the security of the platform during testing mean that users were assigned a user ID and a password. Most people were not happy with that and asked for single sign on, such as in many modern platforms. User should have **quick and smooth**

access; otherwise they don't see the value of the platform and the pilots. Also a mobile app seems that is a good engagement tool given the market penetration of tablets and smartphones.

From the start of the testing we realized that it is absolutely necessary to communicate to users clearly that this is a test environment and engage them by emphasizing that their feedback is crucial for developing the pilot into a smart user friendly application in the future. Also using the platform or installing an app, trying/using it and then providing feedback is an intensive task for end-users and a corresponding incentive is necessary to ensure adequate response rates and user retention.

Recruitment from a related cohort makes installation more efficient and easier to manage. Working with a trusted community organisation can offer confidence and opportunities to make contact with other potential users. Regarding the support of the users, "community champions" (key individuals who have training and knowledge and can provide informal support) are a useful way of providing it. Similarly, in order to ease the data capture during testing and the effective analysis of the results the project goals must be clearly defined. Users also need be confident that the observed data are protected and secure, especially when dealing with data related to people's lives and homes is paramount.

5.1.3 Proof of concept

As already discussed in the section 4.1, the long term objectives of Tirgu Mures city are the **improvement of life quality** for citizens and the **city economic growth** underpinned by innovation, technology and all other means that may increase the "smartness" of the city. The EPIC Project allows for a better communication towards citizens and businesses and facilitates ubiquitous access to information sources, which is necessary for the citizens to find the best way to live in the city. In addition, EPIC contributed to the realization of the cities strategies and planning for the next years and more specifically on:

- Tirgu Mures Development Strategy,
- Urban Development Integration Plan of Tirgu Mures,
- Sustainable Energy Development Plan of Tirgu Mures,
- Digital Mures Strategy.

The proof of concept developments in Tirgu Mures proved that the EPIC services can be adapted effectively for another city. Generally speaking proof of concepts are **very powerful tools** for demonstrating what is possible. However, it appears that too many people see a proof of concept, and think that they have a final product, which obviously is not the case and may affect user feedback responses.

The experience with EPIC proof of concept was very successful and demonstrated that the re-use of web-services and portlets is feasible and achievable in relatively short timescales and with relatively little additional effort. In this process, the lessons learned from the three pilots during the previous project period and the roadmap were useful for helping Tirgu Mures with the implementation of the proof of concept applications and the end-user testing.

Also proof of concept highlighted that for the services implemented according to well established technologies and standards, the reuse of services was actually quite easy. Reusing the services was less of an issue than making sure the data is available and accessible from all applications through the third-party owned web-services. Therefore the **use of standards is almost mandatory** if we want to be able to fully integrate services that have been developed by completely different groups and people and are to be more widely generalizable.

5.1.4 EPIC Commercialisation - Sustainability

EPIC has three core assets that could form the basis for post-project commercial sustainability, in addition to the road-mapping tools:

EPIC Platform: The EPIC platform architecture provides the technical underpinnings for delivery of data via web services through the process server; the delivery of portlets to the user's browser through the portal server. EPIC also provides the essential authentication and security, on-platform storage for user-data and a selection of platform web services and portlets through which Administrators and Pilots interact with the platform. EPIC also provides the Service Catalogue, a combined shop-window and technical resources for Cities wishing to explore available Pilots and through which developers can access web services as third-party data-sources. EPIC also contains the required back-office functions to provide, control, secure and track access to and usage of portlets and web services. The understanding developed by the EPIC team of the end-user requirements of a managed platform for Smart City applications is an important asset.

EPIC Pilots: The EPIC pilots created within the project were not developed from the outset as the most commercially attractive Pilots, but much more to demonstrate the use of the EPIC platform in a wide range of scenarios that encapsulate many of the city, citizen and business needs of a smart-city platform. However, the three pilots to date have demonstrated that they could be readily re-purposed for other cities through the proof of concept in Tirgu Mures and could therefore be readily adapted for other cities wishing to take-on these services. Therefore the three pilots represent base-line assets of the EPIC platform which could be repurposed for other cities under a commercial arrangement.

EPIC Services: The EPIC Services developed to date were developed primarily to feed the Pilots, but have demonstrated through the integrated scenario that such web services can be readily re-used by other developers, including SME developers with a city context. For example, the exposing of CIBG PoI data and Tirgu Mures PoI data via the EPIC platform demonstrates how the platform could form the basis for cities to comply with open-data obligations, by exposing their data through web services on their servers, which are accessed by "helper services" on the EPIC platform, to provide a standardise form of PoI data for developers. Therefore one key role that the EPIC platform could play downstream is that of an acting as a repository of data-provider web services that expose the data-silos common in major cities, and expose this data securely for re-use by third-party developers, without the city administration having to worry overtly about the control of access to and licensing of this data, as this would be taken care of by the EPIC platform components.

As such, EPIC has demonstrated three core technology components that could form the basis for post-project exploitation: the EPIC platform architecture; the Pilots and the data-provider web services. These could all be applied with any city that was exploring the potential to become smarter, for the development of proof-of-concept applications and for the delivery of smart-city services and smart-city data to the city administration, the citizens and the businesses within the city region.

5.2 Achievements

EPIC's vision statement outlined the ultimate aim of the project:

"*To be the first choice service innovation and delivery platform (with Roadmap) for medium sized (50,000 – 500,000 inhabitants) cities across Europe, where any city can cost effectively share, access and adapt a range of services to work smarter to meet the needs of most, if not all, their citizens".*

Following the validation of the project outcomes in the proof of concept and the lessons learned during the project duration, it is important to look at how the project envisioned it will help stakeholders across the public service delivery chain to kick start innovation and work smarter, and see how EPIC achieved these ambitions.

Table 29: EPIC Project Achievements

EPIC Vision	EPIC Achievements
Cities	
Enhance ability to provide more innovative, efficient and effective services at reduced cost	EPIC is a validated concept that has delivered a practical and flexible solution for Cities wishing to begin their Smart City journey. Cities can use the unique **EPIC Roadmap** to better understand what 'smarter' working could mean for them and help them plan a personalised strategic approach to becoming smarter. In addition to the consultancy help, the **EPIC Platform** itself has been proven through the Tirgu Mures proof of concept deployment to enable new smart services to be adopted between cities and be rapidly deployed in a cost-effective manner.
New business models and working relationships with other cities and improved relationships with citizens and businesses	A **Public-Private** business model was adopted for the development of EPIC and this model of working is to be continued for the subsequent sustainability of the solution (see Commercial Scenario in D9.4), unlike the solely Private approach of our competitors. Through the Public-Private model, the **EPIC Service Catalogue** effectively becomes a service marketplace between cities and SMEs with EPIC acting as a 'broker' of smart services and

	smart data. This feature, to-date, gives EPIC a key differentiator in the Smart City market place where the majority of solutions are proprietary to the platforms that are providing them.
City Digital Strategy enhancement	EPIC has created an opportunity for the city to experience first-hand the deployment of software as a service (SaaS) and to look at a cloud computing platform that not only contributes to the delivery of services to its citizens but also provides **a new way to develop online services** for citizens and realizes the city's **Digital, Corporate ICT and Environmental Strategies.**
Citizens	
Access to more innovative, efficient and effective services	During the project citizens in the pilot sites had access to new smarter services through the Cloud. These services are available in the **EPIC Service Catalogue** for use by cities across Europe to offer to their citizens.
Enhanced ability to help improve public services	For the pilots the EPIC Services contained a **feedback loop** for citizens to easily share their user experiences and help them be improved through an iterative testing process. In future commercial scenarios it is expected that SMEs providing services will be able to gather data and improve their products in the same manner.
SMEs	
Greater access to local and international markets	Through the Cloud based **Service Catalogue** EPIC provides the ability for SMEs to access markets outside their own network. EPIC is in close contact with other Smart City projects such as Citadel on the Move, in order to build up the existing Service Catalogue with further services, thereby increasing its value to Cities and providing benefits to more SMEs.
Ability to work more cost-effectively via the EPIC Cloud platform	The service components available on the EPIC Cloud environment provide innovation elements available for SMEs to utilise to enhance existing services and/or create new ones that can be migrated to the cloud/service catalogue. For example the Clouds privacy and security layer provides a cost-effective resource for SMEs providing their service through the cloud.

The results in this deliverable and the table above demonstrates that EPIC is on course, moving towards its future vision. The EPIC consortium believes in the commercial viability of EPIC and is currently working to secure incubation funding to enable a new legal entity to start-up that will sell the EPIC solution across Europe and ensure its benefits are far-reaching and sustainable beyond the initial scope of this project. Full details about sustainability can be found in *D9.4 Final Dissemination Report*.

6 Conclusions

The great challenge for the EPIC project was the development of an "innovation ecosystem" that offers ample opportunities for sustainable, user-driven "intelligent services" that will enable "smart" cities to realize their digital agendas. EPIC combines open innovation processes, advanced e-Government service applications and computing technologies to create a truly scalable and flexible pan-European ecosystem for effective, user-driven public service delivery.

One of the main objectives of our work was to offer public administrations an opportunity to reduce costs and to drive innovation by providing them with access to a market-leading shared infrastructure that facilitates rapid prototyping and testing as well as wide accessibility and availability. As demonstrated in the proof of concept in Tirgu Mures, EPIC accelerates the move towards "smart" cities at both the service delivery and infrastructure level by creating an open, pan-European platform for web-based 'infrastructure and software as a service' delivery that enables 'smart cities' to learn from one another and exchange practical working models in a real-life context. Information and communication sources which are currently available to the city councils and consumed by specific applications, can be adapted to the platform and offered as services in order to be exploited by any application across the cities boarders improving the business models and enhancing relationships with other cities.

In order to realize this vision in an effective and sustainable way for all involved stakeholders, EPIC followed the approach of also developing a roadmap tool, which serves as a guide and best practices to become a truly "smart" city. This significantly accelerates the business plans of cities and SMEs and overcomes the fact that the public sector is always seemingly slower to adopt these new technologies. EPIC aims to be a pioneer in this field, by taking the lessons learned so as to create a first of its kind EU-wide platform that will provide a cloud-based infrastructure for the delivery of "intelligent" services for cities. This is expected to provide more efficient, effective and lower-cost services and which will be brought to the market faster, enhancing the collaboration between citizens and businesses.

The technical developments of the proof of concept, following the roadmap guidelines, and the feedback received from the end-users prove the added value of the EPIC approach for cities, citizens and SMEs as presented in the project achievements. During this process the EPIC consortium identified valuable information that formulated the lessons learned for improving the processes for developing the various platform and application elements as well as for engaging end-users in order to realize more effectively the project vision for a "smart" city.

Annex I List of Stakeholder Interviews Tirgu Mures

Table 30: List of stakeholder interviews and numbers

Date interview	Name stakeholder	Type of stakeholder	Who
29.04.2013	S.C. INDECO SOFT S.R.L.	Business	Project Manager (Lazar Mircea)
29.04.2013	Tirgu Mures Municipality, IT Department	Local Administration	IT advisor (Mircea Emil)
29.04.2013	Tirgu Mures Municipality, Remuneration and Human Resources Department	Local Administration	Assessor (SOOS ERIKA)
30.04.2013	Tirgu Mures Municipality, IT Department	Local Administration	Head of Department (Imre)
30.04.2013	Prefecture	Governmental Institution	Head of Department (Cecan Smaranda)
07.05.2013	Tirgu Mures Municipality, Public Relations Department	Local Administration	Head of Department (SZEKELY ZOLTAN)
08.05.2013	Intergraph Computer Services	Business	GIS advisor (Mircea Voinea)
09.05.2013	SC SOBIS SOLUTIONS SIBIU, Registry Department	Business	(Florin Negoiescu)
09.05.2013	SC Locativ SA – Investments Department	Business	Investment Efficiency Expert (Tălîngă Tudorel Nicu)
09.05.2013	S.C. INDECO SOFT S.R.L.	Business	Product Responsible (Cocis Alina)
09.05.2013	S.C. INDECO SOFT S.R.L.	Business	Programmer (Gavrilescu Marius)
15.05.2013	S.C. INDECO SOFT S.R.L.	Business	System engineer (Ghete Vlad)
15.05.2013	S.C. INDECO SOFT S.R.L.	Business	Sales Assistant (Maaries Ionela)

15.05.2013	S.C. INDECO SOFT S.R.L.	Business	QA Testers (Zoicas Sebastian)
16.05.2013	Tirgu Mures Municipality, Public Domain Administration	Local Administration	Adjunct Director (Gheorghita Ioan)

Annex II: Questionnaire Closed Group Tirgu Mures

Introduction

Q1 Thank you for participating in the technical test and taking this survey! You are now going to complete a survey (max 20 minutes of your time) in which you can give us your feedback on the EPIC platform and pilots. Your responses and impressions will be very worthwhile for us. They will allow the Tirgu Mures Municipality to further develop the application.

Since this is a technical test, we will ask you for each pilot which technical problems you have encountered (e.g. slow, error messages, no display of search results,...) while executing the test scenario's.

Before you start, can you tell us with which computer (PC, Apple,...) and browser (Internet Explorer, Chrome, Safari,...) you tested the platform and applications?

Computer:

Browser:

Q3: We start this survey with the EPIC platform itself. Did you....?

	Yes (1)	No (2)
Manage to log in with userid and pasword (1)	•	•
See the welcome screen with the tab of the 3 pilots (2)	•	•
Select the 3 pilots from the welcome screen? (3)	•	•

Q4: Which technical problems did you encounter while testing the access to the EPIC platform and go to each pilot? Please specify in the form below:

Find a House

Q5: We will now ask you technical questions for each pilot individually. We start with Find a House application.

We asked you to execute a test-scenario. Having executed this test scenario, did you manage to...? *Please indicate 'yes' or 'no' to the following statements*

	yes (1)	No (2)
Complete the search criteria for properties and point of interest? (1)	•	•
See the selected property on a map of Tirgu Mures? (2)	•	•
Click on the icon or the property in the list and see the house detail page? (3)	•	•
Explore the neighborhood by means of selecting Point of Interest and their display on the map of Tirgu Mures? (4)	•	•
Save interesting property in my favorites? (5)	•	•
From my favorites, select a property and explore it and its neighbourhood again? (6)	•	•
Find information on how to register at the municipality? (7)	•	•

Q6: Which technical problems did you encounter while testing the Find a House pilot? Please specify in the fields below:

Discover Tirgu Mures

Q7: We now ask you about your experience of the Discover Tirgu Mures pilot. Did you manage to execute the tasks of the scenario?

	yes (1)	no (2)
Find point of interest 1 (1)	•	•
Find point of interest 2 (2)	•	•
Find point of interest 3 (3)	•	•
Find point of interest 4 (4)	•	•

Q8: Did you manage to...?

	Yes (1)	No (2)
Download the 3D map (1)	•	•
Explore the city in a 3D map (2)	•	•
Open the thematic layers left on screen (3)	•	•
Open the categories right on the screen and locating the points of interests (4)	•	•
See points of interests on the map (5)	•	•
Click on a point of interest and get more information about it? (6)	•	•

Q9: Which technical problems did you encounter when testing the Discover Tirgu Mures pilot? Please write them down in the fields below:

Smart Energy

Q10: We now ask some questions about the Smart Energy pilot. Did you had an EPIC-clamp meter installed when testing the pilot?

- Yes (1)
- No (2)

If Yes Is Selected, Then Skip To Q11: Did you test the domestic or public b... etc

Q11: Did you test the domestic or public buildings energy meters?

- domestic energy meter (1)
- public building energy meter (2)

Q12 Did you ...?

	Yes (1)	No (2)
Have a dashboard that displayed data about your energy consumption without interruption? (1)	•	•
See the energy consumption of other domestic buildings? (2)	•	•
See the energy consumption of other public buildings? (3)	•	•
Compare your consumption with that of others? (4)	•	•

Q13: Which technical problems did you encounter when testing the Smart Energy pilot? Please write them down in the fields below.

➔ GO TO Q16: What is your gender

Q14: Did you manage to...?

	Yes (1)	No (2)
See the energy consumption record of domestic houses? (1)	•	•
See the energy consumption record of public buildings? (2)	•	•
Understand the information published regarding public and domestic energy consumption (3)	•	•

Q15: Which technical problems did you encounter when testing the Smart Energy pilot? Please write them down in the fields below:

User Profile

You arrived at the final part of the survey. The next questions will ask you about your test user profile.

Q16: What is your gender?

- male (4)
- female (5)
- prefer not to say (6)

Q17: What is your age? Please enter a number in the box. (optional)

Age: select 1 → 100

Q18: Have you lived in Tirgu Mures since you were born?

- Yes (1)
- No (2)
- Prefer not to say (3)

If Yes is Selected, Then Skip to Q20: What is your profession…

If Prefer not to say is Selected, Then Skip to Q20: What is your profession…

If No is Selected, Then Go to Q19: Since how many years…

Q19: Since how many years are you living in Tirgu Mures now? (please select one option from list below)

- less than one year (1)
- more than one year but less than two years (2)
- more than two years but less than five years (3)
- more than five years but less than ten years (4)
- more than ten years (5)
- prefer not to say (6)

Q20 What is your profession? Please specify in the box below.

Q21: What is your internet usage profile? Please click on the appropriate box next to the three statements.

Today, I use the internet for... (1)	(1) online banking (1)	(2) online shopping (2)	(3) social media (3)	(4) downloading government documents (4)	(5) prefer not to say (5)
Today, I use the internet? (2)	(6) less than 1 hour every day (1)	(7) around 1 hour (2)	(8) between 1 and 2 hours (3)	(9) more than 2 hours (4)	(10) prefer not to say (5)
Today, I have the following ICT devices? (3)	(11) smart phone (1)	(12) tablet (2)	(13) home computer (3)	(14) laptop (4)	(15) prefer not to say (5)

End of Survey Thank you for your participation and completing this survey. Your input will be very valuable for us to further develop the prototypes of the pilots. Click on the >> below to exit the survey.

Annex III Questionnaire Open Group Tirgu Mures

Introduction

Q1 Thank you for participating in the test and taking this survey! You are now going to complete a survey (max 20 minutes of your time) in which you can give us your feedback on the EPIC platform and pilots. Your responses, reactions, opinions and impressions will be very worthwhile for us. They will allow the Tirgu Mures Municipality to further develop the application in accordance with the need of end-users. Since this is also a technical test, we will ask you at the end of the evaluation of each pilot which technical problems you have encountered (e.g. slow, error messages, no display of search results,...)Before you start, can you tell us with which computer (PC, Apple,...) and browser (Internet Explorer, Chrome, Safari,...) you tested the platform and applications?

Computer:

Browser:

General impressions about the EPIC platform

Q2 We start this survey with your general impressions about the EPIC platform.
The idea of EPIC is to develop a platform for medium scale EU-cities that offers a wide range of smart city services to its citizens. Our demo offered you access to the platform and three pilots as a demonstration of what such a platform will be like. What is your general opinion about the EPIC solution and its relevance for TM? Please indicate to what extend you agree or don't agree with the statements below.

	Strongly agree (1)	Agree (2)	Neither agree nor disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
The EPIC platform (logging, welcome page and going to pilots) is easy to use (1)	❍	❍	❍	❍	❍	❍
The look and feel of the EPIC platform is satisfactory (2)	❍	❍	❍	❍	❍	❍
The log-in procedure to enter the platform and pilots gives me the feeling of being in a safe and trustful online environment (3)	❍	❍	❍	❍	❍	❍
It is very useful for citizens to have access to different smart city services on one platform (4)	❍	❍	❍	❍	❍	❍
The 3 smart city services offered in EPIC are innovative for Tirgu Mures (5)	❍	❍	❍	❍	❍	❍

The EPIC platform and pilots will certainly help Tirgu Mures citizens to organise their daily life in a more efficient way (6)	❍	❍	❍	❍	❍	❍
Tirgu Mures should in the future offer such a platform to its citizens (7)	❍	❍	❍	❍	❍	❍

Ease of use, design interface, terminology used 3 pilots

We will now ask three questions about your impressions about each individual pilot regarding their ease of use, their design of the interface and the terminology used.

Q3: Out of ten, how many points would you give on the ease of use of each pilot? Please slide the bar to the appropriate score (10= excellent, 5=average, 0=not sufficient at all)

_____ Find a House : indicate score
_____ Discover Tirgu Mures : indicate score
_____ Smart Energy : indicate score

Q4: Out of ten, how many points would you give to the design (look and feel, navigation,...) of the interface of each pilot? Please slide the bar to the appropriate score (10=excellent, 5=average, 0= not sufficient at all)

_____ Find a House: indicate score
_____ Discover Tirgu Mures: indicate sore
_____ Smart Energy: indicate score

Q5: Out of ten, how many points would you give to the terminology (tabs, buttons) used in each of the pilots? Was it clear and understandable for you or not? Please slide the bar to the appropriate score (10=very clear, 5= nor clear nor unclear, 0= not clear at all)

_____ Find a House: indicate score
_____ Discover Tirgu Mures: indicate score
_____ Smart Energy: indicate score

Find a House

Q6: We asked you to execute a test-scenario. Having executed this test scenario, did you manage to...? Please indicate yes or no to the following statements

	yes (1)	No (2)
Complete the search criteria for properties and point of interest? (1)	❍	❍
See the selected property on a map of Tirgu Mures? (2)	❍	❍
Click on the icon or the property in the list and see the house detail page? (3)	❍	❍
Explore the neighborhood by means of selecting Point of Interest and their display on the map of Tirgu Mures? (4)	❍	❍
Save interesting property in my favorites? (5)	❍	❍
From my favorites, select a property and explore it and its neighbourhood again? (6)	❍	❍
Find information on how to register at the municipality? (7)	❍	❍

Q7 Do you consider the different functionalities of the application to be useful for people moving to Tirgu Mures? Please select one option from the list below

- ❍ Definitely yes (1)
- ❍ Probably yes (2)
- ❍ Maybe (3)
- ❍ Probably not (4)
- ❍ Definitely not (5)
- ❍ Prefer not to say (6)

Q8: Which of the different functionalities of the application do you consider to be most useful? Please give each of the following items a point from 1 to 5 (1= very useful, 5 not so useful)

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Combined search of property and point of interest in 'Find a place' (1)	❍	❍	❍	❍	❍
Display of all potential interesting houses on map and in list (2)	❍	❍	❍	❍	❍
Discover property and its neighbourhood with POI in detail in 'Selected House Details' (3)	❍	❍	❍	❍	❍
Save and review interesting property in 'My favourites' (4)	❍	❍	❍	❍	❍
Get information about registering in municipality (5)	❍	❍	❍	❍	❍

Q9 How would you rate the quality of the content of the service (the information provided on the map and the properties, the information on registering in municipality,...)? Please select one option from the list below

- ❍ Very Good (1)
- ❍ Good (2)
- ❍ Fair (3)
- ❍ Neither Good nor Bad (4)
- ❍ Poor (5)
- ❍ Bad (6)
- ❍ Very Bad (7)
- ❍ Prefer not to say (8)

If Very Good Is Selected, Then Skip to Q11: We now offer you some statements abou... etc

If Neither Good nor Bad, Poor, Bad, Very Bad is selecten, then skip to Q10

Q10 You are not satisfied with the quality of the content. Can you tell us what should be improved? Please select one or more options from the list below

- ❑ More information about each Point of Interest is needed (1)
- ❑ Other necessary Points of Interest are missing (2)
- ❑ More media inserted (foto's, video's) (3)
- ❑ More information about Tirgu Mures is needed (4)
- ❑ Other (please specify) (5) _____

Q11 We now offer you some statements about what the existence of the Find a House application means for Tirgu Mures. Please indicate whether you totally agree, agree, neither agree or disagree, disagree or totally disagree with the following statements.

	Strongly Agree (1)	Agree (2)	Neither Agree nor Disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
This service will help people relocating to Tirgu Mures to find potential places to live quicker (1)	❍	❍	❍	❍	❍	❍
This service will help people relocating to Tirgu Mures to find potential places to live more efficient (2)	❍	❍	❍	❍	❍	❍
This service will help people relocating to Tirgu Mures to be more informed about the procedure to register in the city and about the potential property available (3)	❍	❍	❍	❍	❍	❍
This service will help people relocating to Tirgu Mures to be more informed about the neighbourhoods of the city when looking for interesing property to live (4)	❍	❍	❍	❍	❍	❍
This service is very necessary for Tirgu Mures	❍	❍	❍	❍	❍	❍

(5) People moving to Tirgu Mures will still need traditional relocation methods (6)	❍	❍	❍	❍	❍	❍

Q12: Which technical problems did you encounter while testing the Find a House pilot? Please specify in the fields below.

Q13: What are your lasting impressions of this Find a House pilot? Please write down in the fields below what according to you are positive or negative aspects of the pilot and what you would recommend to improve the service.

Discover Tirgu Mures

Q14: We now ask you about your experience of the Discover Tirgu Mures pilot. Did you manage to execute the tasks of the scenario?

	yes (1)	no (2)
Point of interest 1 (1)	❍	❍
Point of interest 2 (2)	❍	❍
Point of interest 3 (3)	❍	❍
Point of interest 4 (4)	❍	❍

Q15: Do you consider that the different functionalities of the Discover Tirgu Mures pilot are useful? Please select one answer from the list below

- ❍ Very useful (1)
- ❍ Useful (2)
- ❍ Neither useful nor unuseful (3)
- ❍ Unuseful (4)
- ❍ Very unuseful (5)
- ❍ Prefer not to say (6)

If Very useful is Selected, Then Skip to Q16: Which of the functionalities… etc

Q16: Which of the functionalities of the Discover Tirgu Mures pilot are most useful? Please give each of the functionalities a score out of 5 (1= very useful, 5= not useful)

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Exploring the city in a 3D map (1)	❍	❍	❍	❍	❍
Exploring the city via thematic layers (2)	❍	❍	❍	❍	❍
Discovering and locating the points of interests (3)	❍	❍	❍	❍	❍

Q17: What do you think of the quality and richness of the content of the Tirgu Mures Urban Planning? Please select one answer from the list below.

- ❍ Excellent (1)
- ❍ Good (2)
- ❍ Fair (3)
- ❍ Poor (4)
- ❍ Prefer not to say (5)

If Excellent Is Selected, Then Skip To Q19: What would the existence of the Tirgu... etc

Q18: How should the quality and richness of the content of the Discover Tirgu Mures pilot be improved? Please select one or more options from the list below.

- ❑ A better 3D model (design, immersion experience) (1)
- ❑ Other thematic layers (2)
- ❑ More interesting information on point of interest (3)
- ❑ More media (photo's, video, …,) (4)
- ❑ More integration of social media information (5)
- ❑ Other (please specify) (6) _____

Q19: What would the existence of the Discover Tirgu Mures pilot in Tirgu Mures mean for you? Please indicate to what extent you agree or don't agree with the statements below.

	Strongly agree (1)	Agree (2)	Neither Agree nor disagree (3)	Disagree (4)	Strongly disagree (5)	Prefer not to say (6)
The Urban Planning pilot is an essential tool to get information about the city of Tirgu Mures in a quick and clear way (1)	❍	❍	❍	❍	❍	❍
The proposed thematic layers are essential to grasp Tirgu Mures' city life (2)	❍	❍	❍	❍	❍	❍
The Urban Planning pilot is a useful tool for TM to promote initiatives in the city to its citizens efficiently (3)	❍	❍	❍	❍	❍	❍
The Urban Planning pilot is an essential tool to better present and communicate the fabric of TM to its citizens (4)	❍	❍	❍	❍	❍	❍

Q20: Which technical problems did you encounter when testing the Discover Tirgu Mures pilot? Please write them down in the fields below.

Q21:What are your lasting impressions of the Discover Tirgu Mures pilot? Please write what according to you are the positive and negative aspects of the service and what you would recommend to further develop the pilot.

Smart Energy

We now ask some questions about the Smart Energy pilot.

Q22: Did you had a EPIC clamp meter installed when testing the pilot?

- ❍ Yes (1)
- ❍ No (2)

If Yes Is Selected, Then Skip To Q25: Having used the Smart Energy Ser... etc

Q23: Having seen the records of the energy consumption of domestic and public buildings, do you think that...?

Please indicate to what extent you agree or you don't agree with the following statements.

	Strongly Agree (1)	Agree (2)	Neither Agree nor Disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
It is easy to understand the information published regarding public and domestic energy consumption (1)	❍	❍	❍	❍	❍	❍
Publishing the estimation of cost of the energy use of domestic buildings is very useful (2)	❍	❍	❍	❍	❍	❍
Giving an historical overview (24h, one day, one week, one month,...) of domestic energy consumption is useful (3)	❍	❍	❍	❍	❍	❍
Giving the historical record of energy consumption of public buildings is useful (4)	❍	❍	❍	❍	❍	❍

Q24: What would the existence of the Smart Energy pilot in Tirgu Mures means for you as a citizen? Please indicate to what extent you agree or don't agree with the statements below.

	Strongly agree (1)	Agree (2)	Neither agree nor disagree (3)	Disagree (4)	Strongly disagree (5)	Prefer not to say (6)
It will give me more accurate knowledge of the whole energy use of citizens (1)	❍	❍	❍	❍	❍	❍
By being able to compare my energy use with the average of the city, i will certainly start thinking how i can reduce my domestic energy use (2)	❍	❍	❍	❍	❍	❍
The view on the energy use of public buildings will make me aware how the city tries to reach carbon reduction targets (3)	❍	❍	❍	❍	❍	❍
The view on the energy use of public buildings will make me take as a citizen the necessary action towards city authorities if they use too much energy (4)	❍	❍	❍	❍	❍	❍

➔ Go to Q29: Which technical problems…

Q25: Having used the domestic meter of the Smart Energy pilot, how useful is it for you? Please indicate to what extend you agree or don't agree with the following statements.

	Strongly agree (1)	Agree (2)	Neither Agree nor Disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
The dashboard makes it easy to understand how much energy I am using (1)	❍	❍	❍	❍	❍	❍
The dashboard makes it easy to compare my energy use with homes similar to mine (2)	❍	❍	❍	❍	❍	❍
Monitoring my energy use via the dashboard has helped me reduce my energy use (3)	❍	❍	❍	❍	❍	❍
The dashboard makes it easy to understand if the equipment in my home is sending data correctly (4)	❍	❍	❍	❍	❍	❍

Q26: Having used the domestic meter of the Smart Environment Service, what would this pilot mean for you and Tirgu Mures? Please indicate to what extent you agree or don't agree with the following statements.

	Strongly agree (1)	Agree (2)	Neither agree nor disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
Using this service has has helped me understand how much energy I use and made me aware of reducing energy consumption (1)	❍	❍	❍	❍	❍	❍
By using this service, I think I will make a positive impact on carbon reduction in my city (2)	❍	❍	❍	❍	❍	❍

Q27: Having seen the records of public buildings of the Smart Energy Pilot, how useful is it for you? Please indicate to what extent you agree or don't agree with the following statements.

	Strongly Agree (1)	Agree (2)	Neither Agree nor Disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
I feel that this is a necessary service to help my city reducing its energy consumption (1)	❍	❍	❍	❍	❍	❍

Q28: Having seen the records of public buildings of the Smart Energy Pilot, what would this service means for you and your city? Please indicate to what extend you agree or don't agree with the following statements.

	Strongly Agree (1)	Agree (2)	Neither Agree nor Disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
It helps me understanding the energy use of public buildings (school, high school,..) (1)	❍	❍	❍	❍	❍	❍
I feel using this service will make a positive impact on energy consumption reduction in my city (2)	❍	❍	❍	❍	❍	❍

Q29: Which technical problems did you encounter when testing the Smart Energy pilot? Please write them down in the fields below.

Q30: What are your lasting impressions of the Smart Energy pilot? Please write down in the fields below what according to you are the positive and negative aspects of the pilot and what your recommendations are in order to further develop it.

Recommendation to friends

Q31: If the three pilots are available in Tirgu Mures in the future, would you use them or recommend one of them to friends who might need it?

	Yes (1)	Probably yes (2)	Probably no (3)	No (4)	Prefer not to say (5)
Find a House (1)	❍	❍	❍	❍	❍
Discover Tirgu Mures (2)	❍	❍	❍	❍	❍
Smart Energy Pilot (3)	❍	❍	❍	❍	❍

User Profile Questions

Q32: You almost arrived at the end of the survey. The last questions will ask you about your profile as a test user of the platform and the pilots. What is your gender?

- ❍ Male (1)
- ❍ Female (2)
- ❍ prefer not to answer (3)

Q33: What is your age? Please enter a number in the box. (optional)

Age: select 1-→ 100

Q34: Have you lived in Tirgu Mures since you were born?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Prefer not to say (3)

If Yes Is Selected, Then Skip To Q36: What is your profession? etc

Q35: Since how many years are you living in Tirgu Mures now? (please select one option from list below)

- ❍ less than one year (1)
- ❍ more than one year but less than two years (2)
- ❍ more than two years but less than five years (3)
- ❍ more than five years but less than ten years (4)
- ❍ more than ten years (5)
- ❍ prefer not to say (6)

Q36: What is your profession? Please specify in the box below.

Complete profession…

Q37: What is your internet usage profile? Please click on the appropriate box next to the three statements.

Today, I use the internet for... (1)	❑ online banking (1)	❑ online shopping (2)	❑ social media (3)	❑ downloading government documents (4)	❑ prefer not to say (5)
Today, I use the internet? (2)	❑ less than 1 hour every day (1)	❑ around 1 hour (2)	❑ between 1 and 2 hours (3)	❑ more than 2 hours (4)	❑ prefer not to say (5)
Today, I have the following ICT devices? (3)	❑ smart phone (1)	❑ tablet (2)	❑ home computer (3)	❑ laptop (4)	❑ prefer not to say (5)

End of Survey

Thank you for your participation and completing this survey. Your input will be very valuable for us to further develop the prototypes of the pilots. Click on the >> below to exit the survey.

Annex IV Questionnaire Integrated Scenario

Hello! Thank you for taking this survey. It will take you no more than 10 minutes to complete.! We thank you in advance for your participation!

Find a House:

Q1: The first set of questions ask you about your impressions regarding the FIND A HOUSE application. What is your general impression about this application? Please indicate to what extent you agree with the statements below.

	Strongly agree (1)	Agree (2)	Neither Agree nor Disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
The combination of Points of interest, property data and energy consumption data helps people to find a place to live in a new (unknown) city in accordance with their various needs and demands (1)	❍	❍	❍	❍	❍	❍
This service helps people to better plan and organize their property search in a new, unknown city (2)	❍	❍	❍	❍	❍	❍

Q2: What is your opinion towards the provision of points of interests when searching for a property online in an unknown city? Please indicate to what extent you agree with the statements below.

	Strongly agree (1)	Agree (2)	Neither Agree nor Disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
The ability to combine Points of interest and property criteria in the property search function, allows people to retrieve interesting property information more efficiently (1)	❍	❍	❍	❍	❍	❍
Selecting and displaying Points of interest around a certain property allows people to make a more informed decision about a particular neighbourhood (2)	❍	❍	❍	❍	❍	❍

Q3: Do you think that providing data on energy consumption is useful when looking for a place to live? Please indicate to what extent you agree with the statements below.

	Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
In the exploration of an interesting property, the ability to compare the average energy consumption of the city and the property's individual energy consumption will make people more aware about energy consumption (1)	❍	❍	❍	❍	❍	❍
Displaying the average energy consumption of a city and of an individual property will help people to take energy consumption into account in exploring new properties (2)	❍	❍	❍	❍	❍	❍

Discover Tirgu Mures

Q4: This second set of questions focus on your impressions regarding the DISCOVER TIRGU MURES application. We offer some statements about what this application might mean to you. Please indicate to what extent you agree.

	Strongly Agree (1)	Agree (2)	Neither agree nor disagree (3)	Disagree (4)	Strongly disagree (5)	Prefer not to say (6)
The 3D-map existing of different layers of information is an efficient and quick tool to get an overview and feel of a new, unknown city (1)	❍	❍	❍	❍	❍	❍
The 3D-map and information layers allow to search, find and contact various services and points of interests in the city in a quick and clear way (2)	❍	❍	❍	❍	❍	❍
The provided information about points of interest and services is useful and comprehensive (3)	❍	❍	❍	❍	❍	❍

Q5: What is your opinion about the energy data and property data on the 3D-map? Please indicate to what extent you agree with the following statements

	Strongly agree (1)	Agree (2)	Neither Agree nor Disagree (3)	Disagree (4)	Strongly Disagree (5)	Prefer not to say (6)
Providing information on the energy consumption of public buildings will make people aware how the city tries to reach carbon reduction targets (1)	❍	❍	❍	❍	❍	❍
Learning about the energy consumption of public buildings may make citizens take action towards the city authorities if these buildings consume a lot of energy (2)	❍	❍	❍	❍	❍	❍

Usefulness, willingness to pay and lasting impressions

Q6: Do you think that a city offering these two services to citizens is useful?

- Yes (1)
- Maybe (2)
- Prefer not to say (3)

Q7: Would you consider paying a small access fee (max 3 euro) for consulting such kinds of services?

- Yes (1)
- No (2)
- Prefer not to say (3)

Q8: Do you have any suggestions, remarks or recommendations for one or both of the applications? Don't hesitate to let us know using the boxes below. If you don't have any recommendations or remarks, press on the >> button below.

Find a house (1)
Find a house (2)
Discover Tirgu Mures (3)
Discover Tirgu Mures (4)

User profile: origin of tester

Q9: From which country or city did you test the two applications?

- Belgium, Brussels (1)
- France, Issy-les-Moulineaux (2)
- UK, Manchester (3)
- Romania, Tirgu Mures (4)

End of Survey

You have reached the end of the survey. Just Press on >> to quit the survey. Wait a few seconds on the next screen in order to store your responses. After the confirmation of storage, you can leave the survey. We kindly thank you for your participation.

The EPIC Team

Annex V Developer Stance Tirgu Mures

The TM technical team's work:

Preparation of the POI database

One of the most voluminous work of the technical team in Tirgu Mures was to provide the points of interest database that served both for TM Relocation service and TM Urban Planning service. The following actions were taken in order to organize the POIs database:

1. finding data providers – these were providers from the local administration departments, public institutions and businesses (banks);

2. collecting info on points of interest and organising them in categories;

3. converting the POIs from the .doc/.xls files to a format compatible with the SQL Server;

4. processing the data from three other sources (DOC Manager, M2N and Cadaster);

5. finding out the POIs coordinates from GIS and making them compatible with the back-end of the Relocation and Urban Planning services; and,

These actions were undertaken mainly by the IT municipal department with the help of Intergraph and Sobis IT firms and in collaboration with the EPIC technical team.

Provisioning of Real Estate properties data

Another task of the TM technical team was to create a SOAP service necessary to access the municipal Real estate properties data. This was accomplished by INDECOSOFT.

Also, the Technical team's work in Tirgu Mures was to provide counsel on the type of energy meters fitted in the Romanian energy context, to choose the domestic and public institutions in which the EPIC energy meters to be installed and to install them.