Real-Time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications

Collaborative Project

Overall Evaluation Report

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Executive Summary

The CityPulse project provides a framework for large-scale data analytics in smart cities. The CityPulse components provide information in real-time, transforming raw data into actionable information and thus enable the creation of novel smart city applications that rely on the underlying IoT architectures and networks. The CityPulse framework components can be divided in three main categories: large-scale data stream processing modules; reliable information processing modules; and adaptive decision support modules. The components, which are generic and reusable in different application domains, are provided as open-source (https://github.com/CityPulse).

This report presents the overall evaluation of the Smart City Demonstrator that has been carried out in the scope of Activity 6.4 in the project. The evaluation is performed on a set of application scenarios and prototypes that have been built based on the components in the CityPulse framework. The application prototypes have been presented to different stakeholders and city partners during a set of events in the form of face-to-face meetings or demos. Finally, the feedback has been collected and processed, and a set of conclusions have been also included in the report.

Overall, our evaluation and demos showed that even though many cities have open data portals and/or offer mechanisms to share data, the data is not used up to their its full potential unless it is provided with the right set of metadata and with suitable interfaces. Our applications also showed that in some cases there are gaps in the way the data is collected and shared. For the latter, we used the data stream annotation and stream processing components in the CityPulse to transform the raw data into richer information sets that could be used directly by end-user applications. The evaluations also provided interesting insights into the city ecosystems. For example, in Aarhus and by using the quality explorer, we noticed that the quality of data in some parts of the city decreases during the day. By further investigation the city of Aarhus team noticed that some of the sensors have re-chargeable batteries that use the power on lampposts. However, during Scandinavian summer time lampposts have power only for a short period of time during the day and this did not provide enough time for the batteries to re-charge fully. Information such as this are very helpful in designing and extending the city information services. The CityPulse applications and demos also are designed for end-users and were presented and evaluated based on different feedback and insights that were collected from the users and city authorities.

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1. Introduction

The CityPulse project provides a framework for large-scale data analytics. It provides components t allow publishing information in real-time, transforming raw data into actionable information and thus enabling the creation of different smart city applications that rely on the underlying layers. The CityPulse framework components can be divided in three main categories: large scale data stream processing modules; reliable information processing modules; and adaptive decision support modules. The components, which are generic and reusable in different application domains, are provided as open-source (https://github.com/CityPulse).

This report presents the overall evaluation of the Smart City Demonstrator that has been carried out in the scope of Activity 6.4. The Smart City Demonstrator relates to the cities of Arhus, Brasov and Stockholm. We have performed workshops in all the three cities evaluating all or parts of the application scenarios and prototypes developed using components from the CityPulse framework. The application scenarios and prototypes have been shown to different stakeholders, city partners or citizens during a set of events using two different methodologies, one for the city of Aarhus and Brasov, and another one for the city of Stockholm. In the following we present the two methodologies, as well as the feedback collected and processed from the performed workshops, and the set of conclusions that have been drawn.

In the scope of this activity the following applications have been evaluated:

- In the city of Aarhus:
    - **3D Map** –provides a 3D visualisation of cities and different geo-located events provided by the platform;
    - **Social Media Analyser** – the users can visualise events extracted from social media streams (Twitter);
    - **City Dashboard** –supports visual analytics for the different relevant datasets registered in the platform;
    - **Quality of Information (QoI) Explorer** – a web-based tool to get detailed insight about the quality of information that the deployed sensors provide.
- In the city of Brasov:
    - **Travel Planner** (aka Brasov Travel Planner) – an Android application for citizens, that can be used for obtaining user centric travel and parking recommendations;
- In the city of Stockholm:
    - **CityPulse Tourism Planner** – provides citizens relevant information of tourism-related points of interest and optimal routes according to the user's location, transportation information and users' preferences;
    - **CityPulse Pick-up Planner** – provides optimal planning and routing for a fleet management company;
    - **CityPulse Dynamic Bus Scheduler** – provides optimal bus transportation schedule based on user demands and real-time traffic in the city.

The following sections present the applications evaluation grouped by the city where the evaluation has been performed and the methodology that has been used in the evaluation.

2. Evaluations performed in the city of Stockholm

In the City of Stockholm, we have evaluated the following applications: CityPulse Dynamic Bus Scheduler, CityPulse Tourism Planner and CityPulse Pick-up Planner. In the next sections, we present the methodology used to evaluate these applications. We also discuss the results gathered from the workshop.

2.1   Methodology

In order to evaluate the Stockholm applications/use cases a questionnaire was given to a number of participants attending the Kista Mobility Week event[1] at Ericsson. The participants of this event were private users, academics, public sector, representatives from the telecom industry, as well as transportation companies.   During this event, the applications were presented to the end users and their feedback was collected.   The participants did not have any previous knowledge about the CityPulse project and the developed applications i.e. Dynamic Bus Scheduler, Tourism Planner and Pick-up Planner. We started by giving a short presentation of the CityPulse project, the partners involved and listed the number of prototypes that have been developed during the project.   Then we moved to presenting the applications, and we gave each participant a questionnaire to fill in. The participants had the choice to give short answers (no opinion, strongly disagree, disagree, neutral, agree, strongly agree), or to provide more descriptive feedback.

2.2   Questionnaire

The questionnaire was composed of the following questions in order to collect some useful information on improvements of the presented service. A total of 40 end users attended the event providing their feedback on each of the applications/use cases. Note that some questions are only applicable to certain applications.

UC1: CityPulse Dynamic Bus Scheduler

UC2: CityPulse Tourism Planner

UC3: CityPulse Pick-up Planner

The questionnaire taken by the participants contained the following questions:

1. Do you think the application is useful in your daily life? Why? (applicable to: UC1, UC2, UC3)

2. Do you think the application is useful for improving your business? Why? (applicable to: Fleet management companies, UC1 and UC3)

3. What is good about the concept of this application/service? (applicable to: UC1, UC2, UC3)

4. What is bad about the concept of this application/service? (applicable to: UC1, UC2, UC3)

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[1] https://www.ericsson.com/thecompany/events/kista-mobility-week-2016_957590553_c

5. Do you think this is an interesting application for the city?

    a. From an economic perspective, e.g. saves costs or increases productivity?
(applicable to: fleet management companies, UC1, UC3)
(no opinion/strongly disagree/disagree/neutral/agree/strongly agree)

    b. From an economic perspective, e.g. saves time for you or for your costumers?
(applicable to: UC1, UC2,UC3)
(no opinion/strongly disagree/disagree/neutral/agree/strongly agree)

    c. From an environmental perspective does the application directly or indirectly helps in saving the environment e.g. reduces fuel consumption? (applicable to: UC1, UC2,UC3)
(no opinion/strongly disagree/disagree/neutral/agree/strongly agree)

    d. From a societal perspective, e.g. helps people? (applicable to: UC1, UC2,UC3)
(no opinion/strongly disagree/disagree/neutral/agree/strongly agree)

2.3 Conclusion of the Questionnaire

The following results and conclusion were gathered from the questionnaire:

1. Do you think the application is useful in your daily life? Why? (UC1, UC2, UC3)

Usefulness of the UC1 application in daily life
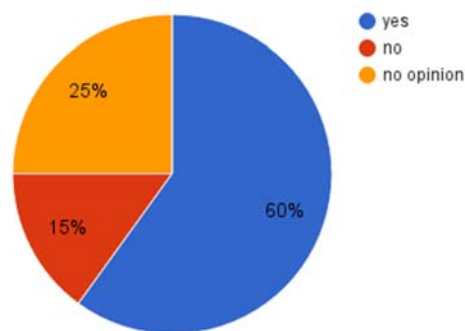- yes
- no
- no opinion

25%
15%
60%

Figure 1 Feedback about usefulness of the CityPulse Dynamic Bus Scheduler (UC1) in daily life.

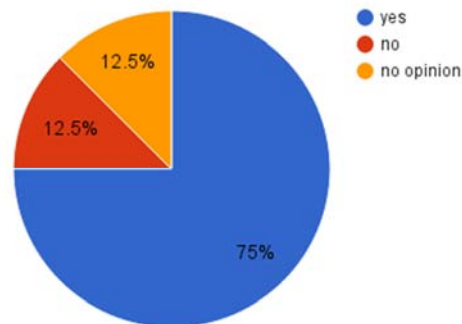Usefulness of the UC2 application in daily life

Figure 2 Feedback about usefulness of the CityPulse Tourism Planner (UC2) in daily life
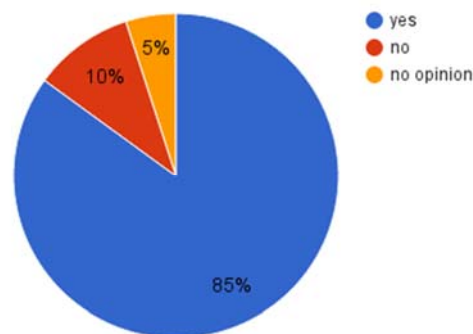

Usefulness of the UC3 application in daily life

Figure 3 Feedback about usefulness of the CityPulse Pick-up Planner (UC3) in daily life

UC1: Based on the answers the majority of the participants found the application useful in their daily life (60%) and thought that it could improve the bus arrival time and decrease the passengers' waiting time. There was also a minority (15%) that thought the application would not be realistic in real life.

UC2: According to the performed survey the majority of the participants found this application useful in their daily life (75%) and thought that it could save a lot of time for the tourists when visiting a new city, since it simplifies planning. This survey also showed that some participants (12.5%) would prefer not to use this application, as they would prefer not to plan ahead about their trip.

UC3: Based on the responses of this survey, the majority of the participants found the application useful in their daily lives (85%). The participants appreciated the fact that the Pick-up planner can be personalized to the users' needs, e.g. having a wheelchair. From the environmental perspective the transportation companies' participants found this use case in line with their strategy regarding fuel consumption reduction, as it will optimize the number and size of the vehicles as well as their routes. Still there were a few users (10%) who believed such a system is not necessary as long as there is an available good, affordable and reliable public transportations system.

2. Do you think the application is useful for improving your business? Why? (applicable to: Fleet management companies, UC1 and UC3)

Overall the fleet management participants thought that these applications will help out decreasing the fuel consumption and do a better planning.

It worth to mention that there were participants from other industries who found these applications useful to their business.

3. What is good about the concept of this application/service? (Applicable to: UC1, UC2, UC3)

12 participants out of 40 stated why these applications are useful. All these use cases help with saving time and money for the potential users.

In particular for UC1, the fact that the timetables and routes are dynamic was well embraced. In addition, the bus transportation system does not get affected by having interruption on the road.

As for UC2, many users found this application very customer centric. They thought it helps with planning for users in new cities.

Regarding UC3, those users who have special needs (e.g. are with wheel-chair) thought that this service could serve them better than public transportation. In addition, it eases up life for the customers who can afford it.

4. What is not good about the concept of this application/service? (Applicable to: UC1, UC2, UC3)

There were some concerns about the affordability of UC3, i.e. how much such a service would cost compared to the price of the public transportation? However, this is out of the scope for this project and it is more related to a company that would like to implement the idea.

Another concern was related to the processing time of the planning/scheduling algorithms. However, for most of the use cases (UC2 and UC3) the system will plan ahead, which means it is not a real-time system. As for UC1, the timetable generation is performed once (or a few times) per day by the genetic algorithm and is fast enough.

5. Do you think these are interesting applications for the city?

 a. *From an economic perspective, e.g. save costs or increase productivity? (applicable to: fleet management companies, UC1, UC3)*
 (no opinion/strongly disagree/disagree/neutral/agree/strongly agree)

Out of 40 participants, there were 12 participants from the fleet management companies. The figure below reflects the opinion of these 12 participants.

Economical perspective

disagree
neutral
agree
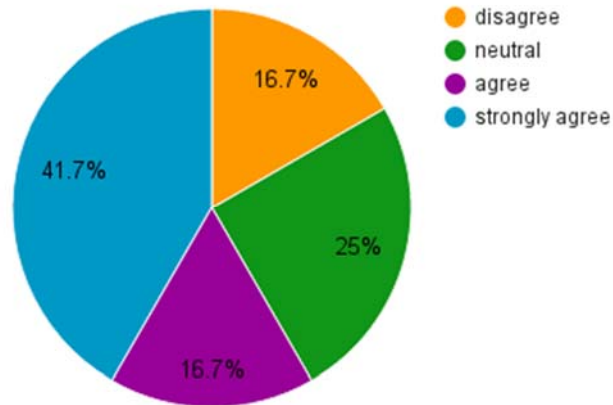strongly agree

16.7%

41.7%

25%

16.7%

Figure 4. Combined value of UC1 and UC3 from the economical perspective

From economical perspective, 58.4 % (41.7%+16.7%) of participants agreed that these are interesting applications for the city and the business of the fleet management companies. The following results are gathered:

- 16.7 % of the participants did not agree to this subject. Some participants thought that there are already such solutions available. Others thought (for UC1) that it would be costly to educate the bus drivers to interact with such a system that will constantly update the routes and timetables.
- 25 % of the participants are neutral on this subject.
- 16.7 % of the participants agreed that the applications bring a value for the city from economical perspective.
  41.7 % of the participants strongly agree that the applications bring a value for the city from economical perspective.

b.   *Do these applications save time for the users? (applicable to: UC1, UC2,UC3)*
     (no opinion/strongly disagree/disagree/neutral/agree/strongly agree)
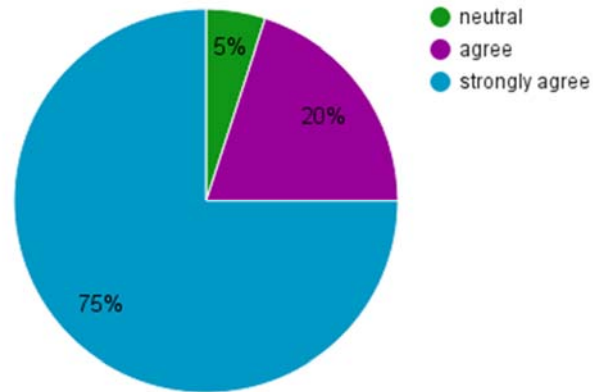
Saving-time perspective

Figure 5. Combined value of the use cases from a time-saving perspective

75 % of the participants strongly agreed that these applications would save time to their users, 20 % agreed with that, and 5 % were neutral.

c. *From an environmental perspective do the applications directly or indirectly help in saving the environment e.g. reduce fuel consumption? (applicable to: UC1, UC2,UC3)*
   (no opinion/strongly disagree/disagree/neutral/agree/strongly agree)
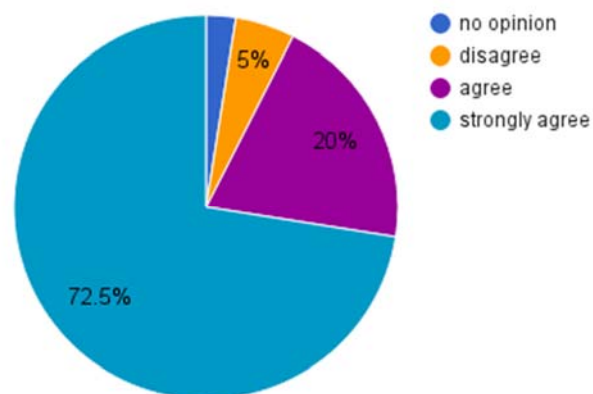
Environmental perspective

Figure 6. Combined value of the use cases from the environmental perspective

- 2.5 % of the participants had no opinion in this regard.

- 5 % of the participants disagreed that these applications would bring value for the city from an environmental perspective. Regarding UC3 they were concerned with the fact that this pick-up service would cause people not use public transportation and therefore there will be more vehicles in the city, resulting in more pollution.
- 20 % of the participants agreed that the applications bring a value for the city from environmental perspective.
- 72.5 % of the participants strongly agree that the applications bring a value for the city from environmental perspective.

  d. *From a societal perspective, e.g. help people? (applicable to: UC1, UC2,UC3)*
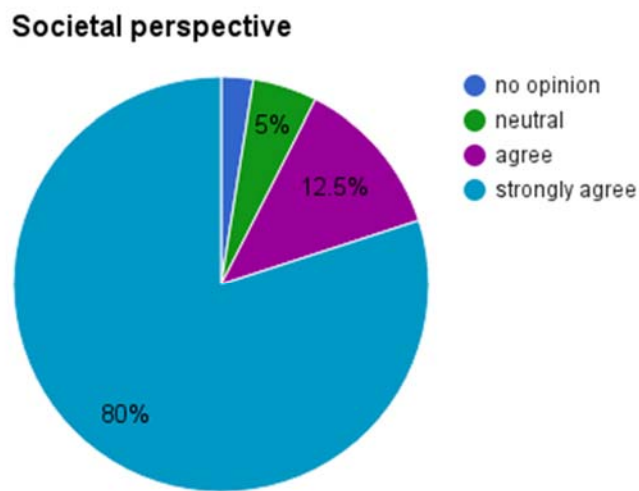   *(no opinion/strongly disagree/disagree/neutral/agree/strongly agree)*

Societal perspective

Figure 7. Combined value of the use cases from a societal perspective

From societal perspective, 92.5 % (80%+12.5%) of participants agreed that these are interesting applications for the city. The following results are gathered:

- 2.5 % of the participants had no opinion on this subject.
- 5 % of the participants were neutral on this subject. They were mostly concerned about the cost of using these applications
- 12.5 % of the participants agreed that the applications bring a value for the city from societal perspective.
  - 80 % of the participants strongly agree that the applications bring a value for the city from societal perspective.

3. Evaluations performed in Aarhus and Brasov

In the City of Aarhus, we have evaluated the 3D Map, Social Media Analyser, City Dashboard, QoI Explorer and in the City of Brasov we have evaluated the Brasov Travel Planner application. In the next sections, we present the methodology used in both Aarhus and Brasov workshops to evaluate these applications, as well as the gathered results.

3.1 Methodology

We aimed for a qualitative approach since this makes it possible to analyse peculiar relationships that can be expressed through in-depth interviews and observations (Alvesson and Skoldberg, 2000). The greater depth in the qualitative method makes it possible to produce more nuanced data, and create an overall understanding of a phenomenon than with the quantitative method that creates more general images (Kvale, 1996). It would be correct to note that our workshops were structured as a qualitative evaluation and not a usability evaluation per se. (Spencer *et al*, 2003). Our goal was to get as close to the users' point of view as possible and allow for more descriptive stories about the perceived value and use.

Why did we choose this approach?

Classic usability evaluation (Spencer *et al*, 2003) requires a lot of preparation time. We would have needed to set up test environments for testing of a few functionalities at a time at an individual level. Specific functionalities would have been singled out by the working group and questions prepared. This test-setup would need to be conducted until we had a full picture of whether an assumed failure or success was a valid concern and changes would have to be made. This approach however suitable for evaluation within the field of UX was not realistic given the timing of the project as well as the scope of Work Package 6.4 It would be correct to note that our workshops were structured as a qualitative evaluation and not a usability evaluation per se. (Spencer *et al*, 2003)

In both Aarhus and Brasov, we aimed to both have a citizens' workshop and city stakeholder workshop. Below is a description of how Aarhus and Brasov structured the workshops.

3.2 The Aarhus workshop

The workshop in Aarhus was conducted in three phases:

1) Exploration of meaningful smart city solutions – inspiration and warm-up;

2) CityPulse prototypes + use case presentation and demo;

3) Taking CityPulse to the next level - Evaluation and improvements.

In the following two sections we present separately the gathered input from the citizens workshop, as well as the city stakeholder workshop, and we draw a conclusion from both of the workshops.

3.3 Input from the citizens' workshop

A workshop on Wednesday 14th September 2016 attended by participants with various technical backgrounds such as Computer Science and Multimedia Design.

	Reactions to the Demo	User journey	Quotes
CityPulse 3D Map	The participants wanted to know on which platform the service could be viewed. All participants favoured the idea of viewing the service in an app on a smartphone. The participants asked for the possibility of communicating with the service, and not just have information from a single source. In their opinion the map could be viewed as a platform where the users would be able to apply data or place reports of specific incidents, e.g the user could report a location where there are big trash items requested to be removed. All agreed that the possibility of predefining what data were of interest in a much more seamless way was required. Also how it was displayed was crucial. The "balloons" and "sticks" were not palatable. They adviced to make the visuals different depending on the target group i.e. the visuals for professional users and citizens would be very different. It was not transparent to most what the purpose of the 3D map was and it didn't make much sense that the 3D effect was simply a visual effect. What does 3D do that could not be done with 2D alone?	3D Tinder 3D is dependant on really good hardware which would exclude those who doesn't have a great computer or smartphone. In other words if you have to have 3D it must have a purpose. Perhaps it could be used with VR glasses to walk around and explore cities of the world? What sort of data is so interesting that I would actually walk inside a 3D map to explore it? We chose to interpret this completely openly. What value would it have if the map was combined with the Twitter service and Tinder. Lisa is going on a date and she is really nervous, on Tinder 3D she is able to find the restaurant where she will meet her date. She knows what public transportation will take her there so she will not be late. She puts on a set of VR glasses and with an avatar she has an imaginary first date to settle her nerves. She explores the tweets in the area and she finds a great place for coffee after the date.	"It is not very useful for most people. It seems like it is useful for visualisations and presentations, and not at all like a service in it's own respect. Perhaps this would change if it contained different data?"
QoI	QoI Explorer The participants struggled to see the use from a citizen's point of view at first. They	One girl in the group who worked with this use case was an intern in the	

	themselves did not have the need to assess the quality of data; they did however see how it might be a great tool for a person, who work with data sets.

Furthermore, they felt that they needed a way to tell the different types of data apart. Since both traffic data and parking data are green or red, you have to click on each source to find out what they are, which seems unnecessary.

The participants found the explorer relevant to whoever develops applications using the data, but not so much to citizens. | department of city design and infrastructure, and she provided their possible use case.

The imaginary city planner Steve used the QoI Explorer on a website. He opens it start navigating.

Steve is currently working with a new neighbourhood in the harbour-front, they will soon start to map the streets in this area.

He would like to know if the data is up to date, so he chooses "age" he can see that they are.

Steve would now like to know when and where there is a lot of traffic in the surrounding area. He can see that there are a lot of traffic three times a day, within a half hour. (The extremes should be highlighted in some way)

He finds out that the data include all possible sources by clicking "completeness".

He finally realizes that the crowded times are due to the ferry boat arriving from Sealand - so this is an important information.

He decides that extra measures have to be considered for this area, which should be included in the scope of the project. He saves the data in a pdf and includes it in his recommendations to his closest leader. | |
| Twitter Service | The participants agreed that they found the service less interesting because of the security measure that clustered the tweets. | Emil is 26 years old, he has just moved to Aarhus to study physical education. | The learning service seems very smart, but the clustering robs the service of much value. |

	It would have been a lot more interesting to see more precisely, where the tweet came from. If this was possible it would be possible to make an experience based guide or sight-seing map. They were also missing the filtering option, where you could choose only to see the tweet categories that were of interest and if this were an app, it would remember your last input, and show only your personal preferences. It was unclear whether this service showed the complete map or a display of randomly selected tweets.	He is looking for an apartment and he has now narrowed his search down to three options. Emil uses the Twitter service to learn more about his new potential neighbourhood. He chooses the searches: Social events Sports Food Crime The recent tweets gives Emil an interesting view into the areas in question. He also views an added feature, which is a timeline of tweets containing each subject. The twitter service remembers Emils preferences so he can repeat the same searches in each neighbourhood. Emil has his learnings in the back of his mind when he visits the apartments.	The interface that meets you in a first time visit should allow for the helpful filtering we are missing.
CityPulse Dashboard	When the participants assessed the program as citizens, they found the interface unnecessarily advanced. 1 A more basic visualisation of the data would go a long way to satisfy any viewer and the benefit would be a much less confusing service. In other words, there were too much up front information that was not of any apparent relevance, whereas the overview in itself would contain the real value.	The group made an app called CityPulse app built on City Dash Board. The story was centered on a user (Torben) going to a rock concert outside Aarhus. Torben really wants to find out if he should bring his car. Is it likely that there will be a parking space available close by? Would he be able to park it over night? Torben opens his new awesome City Pulse app. He finds Skejby on the map (The concert is in Skejby). He can see that there are a big area of temporary parking lots in the area.	"You should consider why Facebook at some point went from showing a long timeline of events to showing instead what just happened." "It should be more like IKEA's web service that shows when the store is crowded; basically I just want to know when to go there and when not to go there."

		(Unclear: How can Torben see that they are temporary? How long will they be there?) From the dots Torben can see that a lot of people are parking in a specific area, so he plans to park near another entrance to the venue. Torben lives in the harbour front. He wonders if the ferry boat traffic might get in the way, when he plans to leave. He finds Aarhus Ø on the map and he can see that the traffic along the main road is bad, so he plans to take a short detour to save time. Torben is happy and well-informed. (Unclear: Would Torben be able to load a travel plan)	

3.4 Input from the stakeholders workshop

We held a smaller workshop with city stakeholders Thursday the 15th of September. Here three persons participated - two persons from Smart City related SMEs and one person from The City of Aarhus.

	Demo	Quotes
CityPulse 3D Map	The participants wanted a type of visualisation that was more related to the 3D model, instead of the balloons and bars that pop up in the map. The participants suggested that the visualisation could show the flow of e.g. traffic or pollution throughout a day or a week. It would be nice to have better data filtration options. According to the participants, there needed to be a clarification on who the target user for the application would be.	"I am missing an intelligent filtering up-front or a feeling of intent with the displayed information if you will."

QoI	The particants suggested that the quality explorer was integrated in other applications e.g. City Dashboard. This way, a city planner could be notified only if the data quality was bad, not when everything works. In the QOI the users would inquire about the accuracy and possibilities – it was just not of use to them. It told us that they were more interested in results and less interested in an analysis.	
Twitter Service	The participants found the overview a bit confusing. There was too much information at once. Maybe a search or filtration option would help. They were not sure what knowledge they could create from using the application. Why is the link between location and content in tweets relevant?	
CityPulse City Dashboard	One of the participants had professional contacts within city planning and she saw a potential in gathering all city related data to be viewed in one dashboard. That would mean that one city planner would not need to conduct their own data survey, but could rely on the data provided by existing sensors. There was some confusion as to why the traffic data was visualised as points/circles instead of per road or the orientation of the traffic. The participants saw some opportunities in using City Dashboard for city planning and optimisation. They would need more explanation of the data in order to analyse and create value from the data visualisation.	Why are these divided into different solutions? They envisioned a service that were really a combination of the use-cases – The city dashboard with more flow and not points without an apparent connection. The direction of the traffic should also figure.

3.5   Overall conclusion from the workshops in Aarhus

In both workshops there were a lot of questions regarding the end value of the products. What value could this potentially hold for me? And what value does the service represent for other perceived target groups? The presentation of the information and the amount of information was also a major topic.

The key Insights from the citizens' workshop are:

- The users were definitely interested in the use cases.
- The subject is of interest to the students we found, but note that they all work with either data or conceptual design in some form.
- After having viewed the demos, there was a generally high level of enthusiasm and the discussion reflected a detailed understanding of what the CityPulse Smart City apps were at this moment in time – show cases of what can be built on the smart city data we have available mostly for professional use. The participants were impressed with the quality of the backbone technology and development altogether and the talk among the participants reflected that the prototypes they were presented with were assessed to be the results of a high level of technical skill.
- The overall discussions were centered on the fact that all types of data were presented all at once.
- As end users they were interested in being allowed to choose specific events and specific details. An unusual situation calls for an explanation, e.g. where do I park my car at a concert?
- The presentation of these filtered results should appear up front, with focus on visualization and without all the unnecessary information.
- The level of simplicity depends on the user group. Professionals were more back-end oriented and the students very preoccupied with the just-right amount of information.

- They were in doubt of whether the services in themselves is new or newsworthy, the quality of the visualization and a more thoughtful presentation of the dataset is what matters if this should present a value other than what Google maps already does.

The key insights from the city stakeholder workshop:

- Data in itself is not that interesting. The real value is the knowledge the data provides that you are then able to act upon.
- A data source is a resource that has to be translated. The intent with which it is presented to the envisioned target group is really what determines the value.
- The change of target groups created a better discussion:
- What if the target group was estate agents and house buyers?
- When are specific spaces used the most during the day (traffic planning).
- Knowledge about parking hours.
- Potential exploitation of dead spaces.

One of the key insights from discussions and evaluating the results with the stakeholders was gaining information and finding better knowledge in terms of the design and implementation of smart services in the cities. For example, during the evaluations and discussions we noticed that the quality of data in the centre of Aarhus decreases over time during the day (this was obtained by using and evaluating the QoI explorer). Figure 8 shows a picture of variation of quality of data in Aarhus (red/purple circles show lower quality and green circles show higher quality data). After further investigations we noticed that some of these sensors are charged by using the power from lampposts and during the summer because the lampposts are powered only for a very short period of time, the sensor boards do not charge fully and during the day they lose their power. The latter affects the overall quality of the data that is collected from those areas. This is shown in Figure 8.

Overall, the CityPulse experience and using the applications and services in the CityPulse showed a very good indication of effectives of user-led and co-design and planning in smart city applications and services.
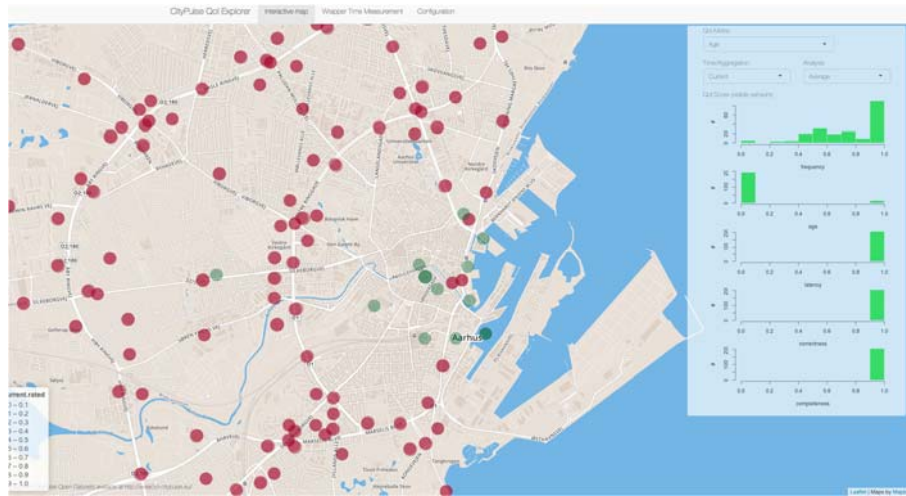
Figure 8. Quality of data in central Aarhus using QoI Explorer software

3.6   Brasov workshop

The citizens, the local business environment, the authorities and the city of Brasov are the direct beneficiaries of the City Pulse results. This is the reason why these target groups were directly involved in the overall evaluation of the project's outputs and in the definition of an exploitation road map needed to further valorize and use the City Pulse outcomes.

The overall evaluation and planning of exploitation was an open consultation process with the local stakeholders and citizens, closely correlated with the implementation of the urban development strategy of Brasov between 2016-2023.

3.7   Input from the stakeholder workshop

The main event of this process was the stakeholder workshop organized by BMA in Brasov on the 25th of August 2016. The workshop's main purpose was to present and evaluate the demo app directly developed for the city – *Brasov bus travel planner*. The event involved also the presentation of the City Pulse framework and components; the demos developed Aarhus and the CKAN platform to be made available on the City Hall servers.

The attendance was made of 12 participants, representing the main city stakeholders:

- Representatives of the local public transport company
- Representatives of the IT, road safety and transport departments of the city hall
- Local SME's, members of the local IT cluster

The workshop aimed to get a direct feedback from the stakeholders' part regarding the following aspects:

- The potential to transform the bus travel planner in a fully functioning app
- The potential to transfer and adapt the Aarhus demos to Brasov
- Other possible tools and endeavors for the exploitation and valorization of the project's results

The representatives of Siemens Romania presented a short description of the project, its aims and results, followed by a practical presentation of the Brasov bus travel planner. The moderator then launched an open discussion regarding the overall functionality and usefulness of the application aimed also to identify further potential developments and improvements. The overall consensus was that the demo has a real potential to be transformed in a fully functional app, to be used directly by the citizens, but some adjustments and improvements are still needed.

The following observations and proposals were made:

● The public transport company – a firm commitment was made to further develop the Brasov bus travel planner and to transform it in a fully functional app by connecting it to more real time data flows and making it available to the citizens
● The city hall representatives - a proposal was made to develop the Brasov bus travel planner into a new app for the cable car transport systems operating the ski slops of Brasov
● The local SME's – a real interest was shown for the City Pulse framework and components used to build the demo. The local SME's requested and received full access to the developed components and documentation available on Github and the project's website.
● The second part of the workshop involved the presentation of the Aarhus demos and a more technical overview of the City Pulse framework and the CKAN platform installed on the City Hall servers.

The following ideas and proposals were promoted by the participants after the presentation:

● To further develop the hardware infrastructure (mainly sensors) needed to further valorize the City Pulse framework
● To transfer and adapt the Aarhus demos (travel planner and parking spaces availability) to Brasov where a couple of projects which will provide the sensors' infrastructure are in preparation – a proposal of the city hall IT department
● To develop and include some of the 101 City Pulse scenarios (intelligent waste management system, smart city dashboard) as project ideas in the local development strategy to be implemented during 2016-2023 through the EU structural funds. This action plan was already accomplished after the workshop, relevant projects inspired by the City Pulse outcomes being included on the strategy's list of priority projects
● To promote the access to and to continue the dissemination of the 101 scenarios at the level of local IT SME's for further development and integration in smart city type apps
● To ensure the technical sustainability and increase the usage of the CKAN platform available on the City hall servers, were new sets of relevant urban environment data will be made available and access will be offered to the interested parties; to combine the ideas of the 101 scenarios with the available data through "hackathons" to be organized starting with the spring of 2017.

3.8   Overall conclusion from the workshop in Brasov

Based on the inputs from the performed workshop, the main conclusion is that the City Pulse project delivered the results expected by the local stakeholders, its outputs can sustain the local endeavors aimed to transform Brasov in a real smart city and the proposed exploitation road map will support this process.

4. Conclusions

This document presents a report on the overall evaluations of the Smart City Demonstrators performed in the scope of Activity 6.4. The evaluations were performed on a set of application scenarios and prototypes that have been built using the open-source components from the CityPulse framework. The application prototypes have been presented to different stakeholders, city partners and citizens during a set of events/workshops in the form of face-to-face meetings or demos.

Overall, the feedback that we received has been positive. The participants were impressed by the quality of the backbone technology and development altogether and the conversations among the participants reflected that the prototypes they were presented were assessed to be the results of a high level of technical skill.

The CityPulse applications, developed for three cities of Aarhus, Brasov and Stockholm demonstrate and showcase the potential of the CityPulse platform. The evaluations focused on the usability and applicability of the developed applications. We also discussed issues and areas to improve. Overall it was clear that the data annotation and stream processing has a significant impact on making the data more interoperable and available to various applications. Combination of citizen sensing and cyber-physical (i.e. IoT) data is also an interesting aspect that has been considered in the project.

The applications have also shown to be beneficial to citizens and also the city authorities and city planners. For example, the services such as Quality explorer and the 3D map provides an effective way for the city authorities to view and analyse the information that are gathered and analysed from the city in (near-) real-time. The applications such as journey planners and social data analysis among other application also present an effective way to collect and analyse the information and present live updates on events and occurrences in the city. The evaluations and discussion with citizens and different stakeholders has shown that accessing to actionable information generated by CityPulse components and applications enhances the user experience in the smart city frameworks. The open-source components also provide new opportunities and will inspire new developments and innovations in utilising the smart data and transforming the raw observations and measurements to information that will enhance the experience of citizens and/or will contribute to providing better planning and enhanced services in the cities.

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