Reality Sensing, Mining and Augmentation
for Mobile Citizen–Government Dialogue

FP7-288815

D2.3

Visualization on data injection from mobile sensing

Dissemination level:	Public
Contractual date of delivery:	Month 24, January 31st, 2014
Actual date of delivery:	Month 24, January 31st, 2014
Workpackage:	WP2 Policy Modelling and Visualization for Mobile-aware Dialogue
Task:	Model informal structures of decision-making
Type:	Report
Approval Status:	Final
Version:	4
Number of pages:	102
Filename:	20140130-deliverable_D2.3_eusoc_v4.docx

Abstract

Deliverable D2.3 fulfils two central purposes. It presents first a summary of methods how data from the mobile applications as developed in the Live+Gov project can be visualised. Citizens and authorities should be enabled to analyse the data and retrieve valuable information quickly and easily. These methods cover basic conceptual recommendations how such visualisations should look like in principle as well as practical applications and examples. Second, the deliverable presents a methodology how informal structures of decision-making can be tackled. Live+Gov understands informal structures of decision-making as those outside the political organs of a representative state. Institutionalising this area of political decision-making safeguards the democratic participation of the individual citizen bypassing established political organisations like parties. This corresponds to the societal demand of citizens in modern representative democracies.

This work was supported by the EU 7th Framework Programme under grant number IST-FP7-288815 in project Live+Gov (www.liveandgov.eu)

Copyright

History

Version	Date	Reason	Revised by
1	07.10.2013	Outline document	Harald Keuchel, Matthias Thimm
2	10.12.2013	Alpha-Version	Matthias Thimm, Pieter Minnigh
3	13.01.2014	Beta-Version	Pieter Minnigh, Spiros Nikolopoulos, Harald Keuchel
4	29.01.2014	Final Version	Matthias Thimm

Author list

Organization	Name	Contact Information
EuSoc	Laszlo Kovats	laszlo.kovats@eurosoc.de
EuSoc	Harald Keuchel	Harald.keuchel@eurosoc.de
EuSoc	Dr. Mathias Lorenz	Mathias.lorenz@eurosoc.de
YUCAT	Marjolein Terpstra	M.Terpstra@yucat.com
YUCAT	Jens Steensma	J.Steensma@yucat.com
YUCAT	Pieter Minnigh	P.a.Minnigh@yucat.com

Executive Summary

Deliverable D2.3 contains a summary of methods showing how the data from situational mobile sensing can be processed and presented. This makes hidden information visible for the citizens and the authorities and allows for analyses that have not been possible before or only for much higher costs.

Due to the vast substantial field of visualisation possibilities and visual analytics we need to approach this task systematically in order to not getting lost in methods that are not expedient for the Live+Gov project. Therefore, we depart from the principal functionalities of the Live+Gov project, which should be supported by appealing visualisations. This is limiting the scope of the area, which needs to be covered. Accordingly, we automatically focus on the type of data that can be obtained through mobile devices and on the type of information that can be extracted from it.

However, these functionalities have specific purposes and are therefore embedded in a comprehensive model of Citizen Participation. Therefore, deliverable D2.3 also puts a great emphasis on the task description T2.3, which asks for a methodology how to tackle informal structures of decision-making. We interpret informal structures of decision-making as those processes in the political discourse outside the formal political arenas (e.g. the City Council, administration, etc.), which are highly influential for the outcome of the policy-making process and are important for the decision-making of the political actors. In a representative democracy this realm is deliberately left to the free flow of the political forces and is not regulated by laws or rules of procedure. However, it favours big organisations like parties and powerful associations, which have the power of impacting on the policy-making process. Small groups or even individuals do not have such a direct impact on policy-making because they are dominated by the big players. This turns into a societal issue because less people are feeling represented by these large organisations and loose touch to them. Accordingly, they can impact on the policy-making process only through their vote, which is increasingly viewed as insufficient.[1] As a matter of fact, the aim of this methodology is to create communication and impact channels between the individual citizens and the authorities. These need to be institutionalised and regulated by rules determining how the citizen input has to be handled by the authorities.

We interpret this as a concise continuation of the first two deliverables in WP2, which have laid the conceptual foundations of Live+Gov. Therefore, deliverable D2.3 represents one step further in creating a comprehensive strategy for more Citizen Participation. This strategy is comprehensive because it is embedding technical solutions in the organisational circumstances. In other words, it is combining and aligning the technical components as developed in the Live+Gov project with organisational rules of procedure. In our view this is the only possibility to develop sustainable forms of Citizen Participation that last independently from research projects or individuals promoting it.

[1] This is explained in detail in deliverable D2.1.

The methodology as presented here has a general approach. This means that it refers on the one hand to the Live+Gov Use-Cases as well as to municipalities outside the project which may be interested in introducing advanced forms of Citizen Participation. Therefore, the methodology is deliberatively formulating general guidelines that need to be implemented in the concrete case. In other words, they define the basic tasks that need to be accomplished by the authorities if they want to introduce participatory or collaborative policies. This methodology is leading the municipality in its quest for creating such an organisational backup for the technical solutions.

However, D2.3 applies this methodology to the Live+Gov use-cases as well. The document shows explicitly how they implement it (and which parts). Due to the fact that this process is still evolving, the presentation is necessarily incomplete. The Urban Planning Use-Case for example will need to implement a new consultation process around the Live+Gov application. However, the application will first be tested in a controlled environment before the organisational setup will be decided upon. Nevertheless, the plan for such a process is presented in D2.3. Therefore, this deliverable is also paving the way for the following deliverable D2.4, which will deal with the concrete implementation of the technical solutions in a real-world context. The broad guidelines of D2.3 will be further developed to a clear training package for civil servants explaining how they could improve their Citizen Participation. This training package will implement the guidelines, which are presented here.

From a broader, project perspective, D2.3 fulfils similar purposes: it is working out basic guidelines helping the other project partners to implement their tasks. On the one hand it shows how the technical components can be embedded in a comprehensive strategy for improving Citizens Participation. Outlining the interaction between the concept and the technical solutions helps defining the technical requirements and refining the technical solutions. On the other hand it specifies a number of visualisations, which could help to process the new data that are gained by the Live+Gov applications. Some of these examples are already implemented. In fact, the presentation here recalls the discussion process within the Live+Gov project about the best visualisations techniques in the project. Therefore, it also needs to be viewed as a summary of the Live+Gov project work.

Table of Contents

List of Figures

List of Tables

1 Introduction

Liberal, representative democracies have the distinguished feature that they are based on a set of formalised and constitutionalised democratic rules of procedure. These rules, which are legally binding and enforced by the authorities guarantee on the one hand the principal power distribution between central decision-making bodies like the Members of Parliament, the government and the judicial system. On the other hand they determine that the citizens remain the core sovereign of the state by having the central power to choose and elect the central decision-making organs of the state. This right is executed through elections on various state levels.

In contrast to these formalised decision-making structures, the free flow of political forces is not or very little formalised. This means that the manner in which policies are initiated, debated, communicated, how immediately citizens are participated in direct policy-making is hardly regulated. In general, politically active groups like parties and associations are initiating and preparing policies. How the citizens are participated remains unspecific. The state guarantees every citizen the possibility to form a party, to issue opinions, and to initiate political discussions. However, they are subject to the free flow of political discussion and the everyday political business, which means that they will only succeed with their initiative if they can convince representatives or parties fight for their right. In this respect, citizens are not having a codified and formalised right to participate directly in policy-making – their rights concerning policy-making remains indirect. Accordingly, the state does not provide the necessary communication channels for this either.

It is the aim of the Live+Gov project in general and this document in particular, to propose a methodology how these informal decision-making processes can be tackled and how the citizens can be provided institutional, direct access to the policy-making process: the individual should be enabled to participate directly in the various political and executive decision-making processes. As it has been discussed and argued in deliverable [1] such an offer is necessary because citizens are decreasingly well represented by the political forces like parties, which are dominating the political process. Accordingly, they have decreasing political power when it comes to concrete political decisions. Therefore, citizens are reckoning state action as increasingly illegitimate.

This deliverable presents a methodology, which introduces direct political power for the individual citizen in municipal decision-making. If implemented consequently, it overcomes the principal dichotomy between the state and the citizens and establishes citizen participation in the everyday decision-making processes of the public authorities in a municipality: it formalises something that is currently informal. This methodology outlines the cornerstones of a four-step process beginning with the principal decision which form of Citizen Participation to choose and which policy areas to cover. Second, it describes organisational aspects that need to be accounted for if the chosen aims and purposes of the Citizen Participation should indeed be fulfilled. Third, it includes technical tasks that need to be accomplished assuming that meaningful Citizen Participation of the 21st century is imperatively including advanced IT solutions. These technical components are developed in the Live+Gov project and are here integrated in a comprehensive concept of Citizen Participation. The last step is to introduce a consequent communication strategy in which

the authorities are actively reaching out for Citizen Participation. This corresponds to a fundamental change of the mind-set of authorities, which are currently still viewing Citizen Participation as tedious. After having presented the methodology, this document illustrates how it has been applied in the single Live+Gov use-cases. They are focusing on different aspects of the methodology and are providing valuable insights about its feasibility.

After having described the overall methodology and concept, the document addresses the important aspect of how presentation and visualisation methods are helping to support decision-making both in the formal and informal arena. In this respect, authorities can profit from newly generated mobile data (e.g. through the Live+Gov applications) by improving their oversight capacities, their maintenance procedures, and future planning. Citizens on the other hand can learn about the processes in the administrative and political bodies and how their fellow citizens act and think. However, these data need to be presented and visualised for enabling the spectators to extract the necessary information that they want to have. Therefore, visualisations need to incorporate principles suggesting how visualisations should be structured. They are also accounted for and represent the basis for all further action. Furthermore, these principles need to be transposed into concrete recommendations and guidance leading to successful visualisations, which are helping the user to quickly analyse and understand the data at hand. Therefore, four principle objectives are formulated that are guiding the visualisation process. These objectives are first, to formulate a clear aim for the visualisation; second, to consider the context of the visualisation; third, to specify the targeted audience of the visualisation (and adapt the level of abstraction); and fourth, to identify the data that are available for the visualisation. Optimising these four objectives and aligning visualisation accordingly will most likely lead to powerful analytical and descriptive tools. The core aim, in this context, is to enable human analysts to understand patterns in data that have not been known before and are allowing for conclusions that are improving real-world services as well as individual action. Therefore, sophisticated visualisations and data-analysis methods improve descriptive and analytical abilities of authorities and citizens.

Deliverable D2.3 is structured as follows. Section two opens with a discussion about the term “informal structures of decision-making” and provides a definition that is used in the Live+Gov project. It argues why these informal structures need to be tackled and presents the methodology, which is describing how these structures could be tackled. Additionally, it outlines implementation measures that need to be taken in this context. Section three describes how this methodology or its components are applied in the Live+Gov use-cases. Section four shifts the core attention to the visualisation aspects of the project and presents a summary of how visualisations should/could be conceptualised and implemented. Elements of this discussion are already used in the Urban Maintenance and Urban Mobility Use-Cases. Section five concludes.

2 Tackling Informal Structures of decision-making

After having discussed the principal connection between the concept of the Live+Gov methodology and its technical implementation in the previous deliverables of Work Package (WP) 2, deliverable D2.3 now shifts attention to visualisation aspects of the project (deliverable description) and informal structures of decision-making (task description). Accordingly, section 2 focuses on task description T2.3, which calls for a methodology for "tackling informal structures of decision-making" ([2], p.8) as well as showing how the input from citizens' mobile devices contributes to the decision-making capacity of public authorities and how/where this input can be integrated in the current organisational structures of the state. In the following, this section first defines the terminology (informal structures of decision-making) and explains its background. Then, the section presents the Live+Gov methodology for bringing structure to unstructured citizen and stakeholder input and making it exploitable for the public authorities as well as empowering individual citizens in the process of municipal decision-making. More specifically, the Live+Gov methodology for tackling informal structures of decision-making is setting up a four step-process that is guiding authorities in their intention to introduce Citizen Participation. Due to the fact that the steps are partly dependent on the type of Citizen Participation, the four steps will be described separately in the context of the three pillars of Citizen Participation Transparency, Participation, and Collaboration.

2.1 Definition: informal structures of decision-making

A traditional representative democracy sets clear rules how decision-making has to take place between the representatives. Elected legislators are negotiating and bargaining among each other along clearly defined legislative rules; the executive on the other hand has the role of executing the legislative decisions according to their own laws, rules of procedure and guidelines. These rules are fully formalised and included in state laws and constitutional laws or explicit rules of procedure of the different institutions. Accordingly, they apply generally, must be obeyed and safeguard the individual rights of the representatives.

A second set of formal rights refers to the act of selecting and appointing state representatives and executives. The political elite is chosen in general elections, which are clearly define, regulated and supervised by the judicial system. This secures the individual rights of the citizens; violations of these rights are sanctioned.

Every other aspect of political decision-making in a representative state is partly or not regulated at all. The process of forming and developing policies and legislative initiatives are mostly left to political parties that have the explicit mandate to collect the interest of the citizens, condense them into policies and nominate candidates, which are running for a legislative office.[2] However, decision-making processes that are outside of political parties are mostly unregulated. Communication processes between societal actors and stakeholders, lobbies, parties, elected representatives are not formalised in any kind of clear procedure or detailed legislation. Therefore, participatory rights of citizens outside the

[2] In some countries like Germany political parties must conform to democratic principles and formulate concrete demands for the act of decision-making.

politically active groups like parties and associations are not secured. This means that the only way of influencing concrete political decisions and individual policies is by being part of such a group.

This representative setup is not chosen by chance but on purpose. As it is argued in deliverable D2.1, the liberal representative state is capable of producing legislation that is to the benefit of the majority of the people because the elections exert a sufficient pressure to discipline the representatives. As described by [3], the competitive electoral logic of a pluralistic representative democracy guarantees that legislators and politics in general by and large follows the majoritarian will because the representatives seek power and re-election and therefore satisfy the median voter. In other words, knowing that the majority of voters decide about who is governing and legislating, the legislators act in their interest – even without a clear set of formalised rules and procedures.

However, as argued by [4] representatives are not bound to concrete needs and demands of their voters: they are not part of a complete but an incomplete principal-agent relationship. Their (re-) election is dependent on how the voters estimate their work in general. In other words, they form an average over all policies and grant their voice accordingly. This implies that the representatives may well depart from the individual needs and demands of their voters in particular political settings. This is explicitly possible and is reflected in the fact that the mutual exchange between the society and political representatives on a daily and direct legislative basis is unregulated and due to individual communication tactics by the representatives themselves, lobbying by special lobby groups and the like. As argued in [1], citizens increasingly view this circumstance as unjust and illegitimate. Decreasing party membership- and attachment as well as the tendency to short-term political action calls for institutionalised citizen participation on the level of individual decision-making. Thus, citizens call for more direct participation in public decision-making and action.

Live+Gov Definition of informal structures of decision-making

Political communication in the context of direct political decision-making between non-political bodies like citizens/societal stakeholders and political organs like elected representatives, which are influencing the policy-making process but not are compelling it.

At present such direct involvement in policy-making and decision-making is not regulated and left to the free flow of political forces. This results in two distinct problems: first, if the political landscape is distorted in terms of small, financially potent and well organised groups exerting a stronger influence on politics as compared to large and diffuse interests, certain legislation may also be distorted.[3] Second, capturing the central argument of deliverable [1], those societal forces not represented in societal pressure groups or political parties have no voice in the concrete decision-making process: they have no chance to include their particular interest in the concrete policy that is being decided. They have no formal right that grants them this possibility: they have no political power – neither representative nor direct Against the background of an individualising society, which has its implications to the political discourse, this results in increasing discontent among the citizens. They are decreasingly ready to accept this lack of direct political power, which should be just as

[3] This is a general problem discussed in the context of lobbying.

institutionalised as their right to vote or the state representative's right to act. This is slowly but steadily growing to a societal issue - if not to say problem - because it is concerning an increasingly large proportion of the society. In our view, citizens demand generally applicable rules and state legislation that safeguard a more direct citizen participation in concrete decision-making processes and a more institutionalised way of communicating between the state authorities and the citizens.

As a matter of fact, we understand the task of "tackling informal structures of decision-making" as structuring, formalising and institutionalising these communication processes around concrete policy-making processes, which should grant every individual citizens at least the possibility to contribute substantially in the policy-making process. Accordingly, we focus on three components of the Citizen Participation concept: first, citizens should be actively informed about actual decision-making processes (transparency), second, be granted direct decision-making power (participation), and third, be offered opportunities for collaborative action (collaboration). We argue that formalising this informal aspect of the representative state is an imperative component of effective citizen participation. Without having them explicitly codified as legal rights, citizen participation remains sporadic and due to chance.

2.2 Live+Gov method of tackling informal structures of decision-making

Having said this, institutionalising Citizen Participation and making it the norm of public decision-making is the aim of this method. However, this is not trivial as it is combining organisational tasks internal to the administration, communication tasks between the public authorities and the citizens and technical tasks when adapting new technologies to the existing ones. Moreover, different conceptual decisions have their own dependencies and come with distinct consequences. For example, the organisational and technical tasks needed for implementing transparency measures are differing largely from those of introducing direct participation. Therefore, the public authorities have to have a concise imagination of what kind of Citizen Participation they would like to introduce: their initial decisions have important implications for the decisions to be taken in the following process. The Live+Gov project provides solutions for many variants and opportunities of advanced Citizen Participation most importantly from a technical perspective.

This section is presents a methodology how these informal structures of decision-making could be tackled. According to the definition from the previous sub-section this means nothing less than proposing guidelines, which are changing the principle perspective of the authorities on Citizen Participation: if they are implemented public policy-making becomes participatory "per default" – they become the standard operating procedure. Therefore, it appears to be necessary to extend the state influence on the informal decision-making processes prevalent in the society – something, which is not the case at present: the authorities need getting involved in these processes and opening up for citizen participation. The following Table 1 summarises the methodology, which is composed of a four-step process combining conceptual, organisational, and technical tasks. Its content is described at length in the remainder of the section.

Table 1: Four-step methodology

Step 1 A: Choosing the Form of Participation	
Transparency	Types of Transparency
	Type 1: Simple – Uncommunicative Type 2 Simple – Communicative Type 3 Advanced – Involving Type 4 Advanced - Engaging
Participation	Variants of Participation
	Variant 1a) Consulting early Variant 1b) Consulting late Variant 2) Co-deciding / co-governing
Collaboration	Types of Collaboration
	Type 1 Collaboration a) Active data-delivery Type 1 Collaboration b) Passive data-delivery Type 2 Collaboration
Step 1 B: Choosing the Policy-field and the sub-field	
Recommendation: Maintenance and investment in public infrastructure	
Step 2: Organisational Implementation	
Transparency	Decisions about transparency policy
	Which data to publish (organisational (individual), procedural, internal)? Which data to open? How to present? Who is responsible?
Participation	Guidelines
	Early participation, questions of legitimacy, executing bodies (responsibility), online support, offline support
Collaboration	Organisational arrangements
	Type 1: Improving the planning process, improving the maintenance process Type 2: installing the collaborative process
Step 3: Technical Implementation	
Transparency	Mostly organisational tasks
Participation	Tasks to implement: Reality Mining, Visualisation, Communication (technical)
Collaboration	Tasks to implement: Reality Mining, Activity Recognition, Visualisation, Communication (technical)
Step 4: Communication Strategy **Overcoming the dichotomy between the state and the citizens: authorities are actively inviting the citizens to participate**	

2.2.1 Step 1 A: Aims and targets - Form of Citizen Participation

The first and foremost decision that has to be taken by the public authorities is which kind of Citizen Participation they would like to introduce. Are they willing to collaborate with citizens in public maintenance or budgeting (collaboration), are they ready to let citizens participating in decision-making but keeping full control about execution of the decisions (participation), are they willing to provide extensive internal and external information to the citizens by informing them in detail about their processes and opening up internal data (transparency)? It may also be the case that the authorities are willing to introduce all the three forms of Citizen Participation and develop a comprehensive participatory policy. However, all these different forms of Citizen Participation demand different organisational and technical facilities for harvesting their full potential. In the following, we define a number of different aims and targets that could be implemented in the three different domains of the concept. Obviously, we concentrate on the special contribution of mobile technology; however, we see mobile devices as an additional, very helpful but not the single instrument of effective Citizen Participation.

2.2.1.1 Transparency

When introducing increased transparency a municipality has several options depending on what level and detail the additional information should have that is communicated to the people. Table 2 summarises the different forms of Transparency in the Live+Gov methodology:

Table 2: Forms of Transparency

Simple Uncommunicative	Simple Communicative	Advanced Involving	Advanced Engaging
Information			
Organisational setup: Acting bodies, personnel (position, powers, duties)	Organisational setup: Acting bodies, personnel (position, powers, duties), contact information, communication possibilities	Organisational setup: Acting bodies, personnel (position, powers, duties), contact information, communication possibilities Decision-making procedures, background information (reports, evaluations, budgets, etc.)	Organisational setup: Acting bodies, personnel (position, powers, duties), contact information, communication possibilities Decision-making procedures, background information (reports, evaluations, budgets, etc.) Open data for own analyses

Simple / Uncommunicative

The first and most basic level of transparency is providing online and offline information about the setup of the public administration and the political decision-making bodies. These can be published on websites or in brochures and contain information about the organisational structure of the organisation, the acting personnel, their position, their powers and duties. This basic form of transparency is already often implemented in any kind of organisation (public and private) and is giving the citizens an impression how the organisation works and how it looks like. However, one can doubt the effective usefulness of such unspecific information if they do not give the spectator the possibility to interact with the organisation and the people that are working in it.

Simple / Communicative

Therefore, **the second** level of transparency is to creating communication facilities for the citizens. The first variant here is to publish the contact details of civil servants and public employees. Citizens can then address them directly if they have questions or recommendations. This, however, bears the danger that the public employees are overwhelmed with a high number of unspecific and/or inadequate questions that they can possibly not even answer because they are not responsible. Even if this is not the case and the questions are to the point, they might be overburdened with citizen communication and be kept away from their business. On the other hand if they refuse to answer the questions by the citizens they might be annoyed and discouraged from future participation as they are not provided the transparency service that they are promised to get. One remedy for this is to install a central institution being solely responsible for citizen communication and having the job of responding to citizens' queries. If they cannot answer specific questions right away, they can forward the question to the right administrative units, obtain the information and send it back to the citizens. They can also ask for specialised documents and may share internal information with the citizens explaining the issues that they are concerned with.

Introducing such "Citizens Contact Centres" is a widespread method for creating better communication with the citizens while controlling the organisational burden for the authorities (see e.g. the Citizen Contact Centre in Eindhoven (use-case partner) or information units of the European institutions, which are also working according to this principle. However, while this is indeed a step forward in terms of transparency, direct information possibilities for the citizens are still limited. There is still an actor and stakeholder between them and the information that they would like to have, they are still dependent on the good will of this institution and can not judge upfront what rights and possibilities they have. Therefore, they need to invest time and resources to acquire this specific knowledge, which is increasing the threshold for effective participation.

Advanced / Involving

Therefore, the **third level** of increased transparency in public decision-making is to providing more direct internal information about the administrative and political processes. In this respect, we consider simple organigrams as they can be found in many organisational

descriptions not sufficient. In general, they are too abstract and not easy to understand for outsiders like citizens. More importantly, they hardly allow for conclusions about concrete decision-making procedures and particular cases. Accordingly, their usefulness for the citizens is limited. Therefore, we propose textual descriptions underlined by graphic illustrations of actual decision-making processes in the public administration displaying how the administrative units cooperate, how they interact with the political bodies, how the responsibilities are distributed and how the various stakeholders are involved in the process. Adequate examples for this are the legislative information sites of the European Institutions like EUR-Lex, the Legislative Observatory, and PreLex to name the three main ones. They are showing the process of different decision-making procedures on one webpage and linking all the relevant documents to the different decision-making steps. As this form of information could also quickly become quite complex, this transparency measure should be accompanied by extensive explanations about the different decision-making domains.[4]

However, before such a system could be introduced and installed, the municipality is required to agree on a transparency policy defining about which policy fields they would like to inform the citizens and which documents they are willing and able to publish. These decisions are partly political and need a formal decision in the political bodies of a municipality. However, the big advantage is that the daily business of an administration as well as their working procedures are made explicit showing the citizens which (often difficult) tasks an administration has to master. On the other hand this also shows the weaknesses of a political and administrative decision-making system and may provoke an impetus for administrative change. In any case, such a measure improves the political education of the citizens and serves as a basis for more meaningful and effective communication with the public authorities.

Advanced - Engaging

The **fourth level** of transparency goes one step further in the process of opening up internal documentation by opening up internal data that are collected by the public authorities and that are used for their policy-making. These are for example demographic data about the inhabitants of the municipality allowing for conclusions about their needs and demands and the planning of the public infrastructure. Furthermore, the municipality could also open up financial data informing the public about the revenues and the possibilities for public investments, respectively. These two data sources alone allow stakeholders to judge about the dependencies of the public authorities and draw conclusions about the future development of the municipality.

Nevertheless, opening up such internal data is not a trivial task. Many of them are highly sensitive and contain private information about the citizens and need to be anonymised. Accordingly, before opening up internal data the public authorities have to sort out a number of legal issues not only about privacy but also about the property of the data and the respective complications when making any use of it including potential commercial use by professional stakeholders.

[4] PreLex is presented and discussed as a method of visualisation in the next section.

Furthermore, the municipality needs to pay great attention to the format in which the data are published. This refers first to the technical format e.g. the type of documents containing the data, second to the particular way they are processed and presented and third, the possibility how to obtain the documents. The authorities need to pay particular attention to the problem of not drowning the citizens in the masses of data that they are publishing. This may easily confuse the citizens and fail to have the intended transparency effects.

2.2.1.2 Participation

According to the discussion in [1], there are four fundamental aims and objectives of public participation in public decision-making. When municipalities involve the citizens in important decision-making processes they can aim at first, developing and enhancing personal competences of the citizens, second at an impact or an influence on the society by raising awareness about particular societal problems, third at consulting the citizens about particular issues and projects and gather their opinion about them, and fourth at letting the citizens co-decide and co-govern and therefore increase the legitimacy of state decisions ([1], p. 36, Box 3).

In the Live+Gov context, however, we concentrate, in particular, on the third and the fourth aim: on the one hand citizens get the opportunity to issue their opinion about specific decision-making processes e.g. an actual public investment program. On the other hand Live+Gov aims at providing all the requirements for letting the citizens co-decide about decision-making processes and have a real influence on their outcome.

Accordingly, the **first variant** of public participation is to consulting the citizens about actual developments and explaining the background of the municipal decisions. These consultation processes supply the citizens with all the necessary information for understanding why the public authorities have acted the way they have and how their plans look like. While being close to standard transparency measures, the core difference to transparency is that consultation processes include deliberative elements establishing discussion and debate between citizens and state authorities. Furthermore, citizens are having the opportunity to issue their demands and formulate requirements or suggestions that are directly reaching the administration. Due to the fact that consultations take place in public and are monitored by a larger community, the public authorities will not be able to deny knowledge about certain societal demands. Accordingly, they are compelled by their word to a much higher extent than in a less responsive transparency context.

The feedback component is the central asset of a consultation process and its greatest difficulty at the same time. An audience has to be formed and substantial information need to be shared on demand, which puts a high burden on those giving the feedback. These people also have to be skilled communication experts who are ready to deal with dissenting opinions and controversies during the consultation process. Fact of the matter is that the decisions that are presented in such consultation processes are usually not subject to change; this means that they will be executed regardless of the opinion or the attitude of the people. Therefore, traditional consultation could be understood as a communication instrument of a representative state because it is not providing the citizens with direct decision-making power. Their sole benefit is that they can better draw their individual

conclusions about the work of the government and vote for alternatives in the next elections if they are unhappy with political and executive outcomes.

Therefore, Live+Gov envisages a second variant of consultation procedures, which are taking place before and final political and administrative decisions have been taken. Then, the authorities can take up the input coming from the citizens and incorporate them into their planning. As a matter of fact, this complicates the planning of the respective project but satisfies the citizens to a greater extent: they see that their voice is heard and has a real effect on the projects that are presented. Nevertheless, this second consultation variant does not provide the citizens with mandatory decision-making power - the representatives and the public authorities are not bound by their opinion. Accordingly, they can incorporate the suggestions and proposals by the citizens but they are not compelled to do so.

The difficulty of this second variant of consultation is to find the optimal moment for citizen participation. On the one hand the respective plans have to be mature enough for having the citizens something to comment on. On the other hand they have still to be in a preliminary stage and need to offer substantial changes if the public decides accordingly. However, regardless of how this second variant is implemented, it will most probably prolong the decision-making and the implementation process, as the suggestions first have to be matched with the underlying plans, which then might change and affect the implementation process. On the other hand such consultation processes may increase the legitimacy of the public decision-making and reduce opposition against the plans. This may clarify controversies early in the process and avoid judicial conflicts, which are prolonging the implementation on their part. Furthermore, public authorities should realise the financial benefit of an open consultation process: if understood as a kind of market analysis studying the take-up of the planned investment the plans can be adapted according to the real needs in the society or the community and achieve a better return on the invested capital. For example, if a consultation has the result that a planned infrastructure will not be used as planned, the authorities can change its features and secure the average utilization, which possibly results in increased income as well.

Nevertheless, it needs to be stressed that consultation is an incomplete form of participation. Although citizens are granted the possibility to issue their opinion their voice has no direct mandatory power over the outcome of the decision-making process. Therefore, the **second** variant of public participation, which is envisaged in the Live+Gov context refers to co-governing and co-deciding in public decision-making. This means that citizens are provided with the possibility to issue a mandatory opinion about a concrete decision-making process and to compel the public authorities. The core question in this context is where the initiative for such action should come from: if the citizens can introduce their demands and issues and let them be voted upon they are required to overcome quite extensive organisational thresholds. If, however the municipality is granting access to its decision-making and opening up the decision of certain questions, this certainly eases the burden of participation for the citizens. Accordingly, Live+Gov envisages that the public authorities explicitly involve the citizens in their decision-making processes and define specific areas and questions where this is possible. Additionally, the citizens should have the possibilities to formulate their own opinions and let them be voted upon. However, if municipalities agree to such far-reaching political participation they are giving up a great

deal of decision-making power for the benefit of their citizens. This comes with organisational issues that have to be satisfied: concrete questions and alternatives need to be formulated that could be voted upon, thresholds for the validity and legitimacy of participatory decisions need to be defined and the decision-making processes have to be made more flexible and allowing for direct citizen input.

Table 3: Forms of Political Participation

Consultation		**Co-deciding / Co-governing**
Variant 1	Variant 2	
Late in the process – more a communication tool for ex-post legitimization	Early in the process – not binding for the authorities but hard to neglect – might prolong the process but increases legitimacy of the policy.	Early in the process – plans need be there but are still flexible to be changed. Alternatives need to be formulated. Greatly increases the legitimacy of policies.

Collaboration

The Live+Gov project aims at establishing advanced forms of interaction between the public authorities and the citizens. According to its underlying CPMT approach (Citizen Participation with Mobile Technology), collaboration is the most advanced form of such public – private interaction. Live+Gov promotes, however, a form of collaboration which is offside the scientific and public discussion but already has real-world examples. Accordingly, collaboration is understood as citizens and public authorities jointly executing tasks that have traditionally been under the full responsibility of the state. In other words, citizens are actively supporting the authorities in executing their tasks. The literature has traditionally seen experts from the private sector in this role granting the authorities their expert knowledge for solving "wicked" problems. The Live+Gov understanding of collaboration is, however, that the citizens are actively involved in the everyday business of the authorities. Such collaboration is rare in the real world and not fully grasped in the scientific discussion. This may partly be explained by the fact that mobile technology and the availability of advanced mobile communication is the crucial facilitator for the concept of collaboration. These possibilities only make collaboration effective and harvest its full potential.

In principle, Live+Gov differentiates two basic types of collaboration. Type 1 collaboration is utilising data in order to improve their services, which are gathered by the help of the citizens. Here, Live+Gov differentiates between citizens giving their input actively by making photographs or writing messages or allowing the Live+Gov system to collect data about them. In return of the data the authorities can then either take better care of the public infrastructure or offer additional services e.g. in the traffic domain.

Type 2 collaboration goes one step further and hands over responsibility to the citizens for certain public tasks, e.g. in the context of maintenance or gardening. They are given the possibility to "apply" for or to "announce" certain tasks in the context of public maintenance via their mobile devices and obtain information how they can become active. Both types of collaboration are discussed at length in [1].

Table 4: Forms of Collaboration

Collaboration Type 1		**Collaboration Type 2**
Passive	Active	
Data collected automatically and quietly by the Live+Gov application	Citizens are actively giving their input through pictures, text messages and sensor data	Citizens "apply" for taking responsibility in maintaining the public infrastructure.

2.2.2 Step 1 B: Aims and targets - Policy Field

The second fundamental initial decision is which policy field the public authorities would like to open up for Citizen Participation in general and for Citizen Participation via mobile devices in particular. In general, the Live+Gov recommendation for the public authorities is to compile an overview of the responsibilities and the powers of the municipality in which the participatory approach is about being installed and reflect about possibilities how citizens could contribute to the respective decision-making. This will depend on the concrete case as municipalities have different powers and competences depending on their size, their legal status, the region, state, and nation. Additionally, the authorities can engage in a participatory approach by involving the citizens already in the planning phase. This is currently being done in the Live+Gov Use-Case of Utrecht where the authorities have asked the citizens in which policy areas they wish to be involved and which possibilities should be safeguarded. Accordingly, the City of Utrecht is taking participation seriously and is involving their citizens when setting up these new forms of Citizen Participation.

The default approach by Live+Gov is involving the citizens in all policy areas that affect the everyday lives of the people. These are usually the policy-fields dealing with public infrastructure, services, and maintenance. Accordingly, whenever the authorities are planning to invest in new public infrastructure or to change existing infrastructure, the respective decision-making procedures should be opened up for citizen participation. This can touch all three forms of Citizens Participation and can range from advanced information and concrete participation regarding the shape of the new infrastructure or budgeting, as well as survey approaches about the take-up and the usability of the new infrastructure.[5] As

[5] Here, the differences between participation and collaboration are blurry. On the one hand this survey method could be interpreted as consultation or participation as citizens are asked for their opinion, which is having a certain effect on the decision-making. On the other hand citizens are delivering data that is improving the service of the municipality (planning and realising new infrastructure).

it is demonstrated in the use-case examples, collaboration is particularly well suited for improving the traffic infrastructure and for maintaining the public infrastructure in general.

2.2.3 Step 2: Organisational implementation

It has been mentioned several times that the concrete implementation and institutionalisation of participatory policies depends greatly on the actual circumstances of the municipalities and their particular forms of organisation and the legal circumstances. This concerns both the policy-field in which citizens should be participated as well as the organisational solution for making participation work. There are, however, certain fundamental guidelines that should be taken into account in every actual case. These are, again, specific to the form of Citizen Participation.

2.2.3.1 Transparency

The organisational tasks of a transparency policy depend on the intended level of transparency. In general, the main issue is to decide about the type of data that should be published and how this should take place. The main questions in this context are concerning

- **Organisational information**

It needs to be decided which kind of organisational information should be given and how the organisational units should be represented? Furthermore, the organisation needs to agree on how much personal information about the administrative personnel should be published. Should this include personal contact information?

- **Procedural information**

Which working processes should be presented? In general, the authorities should inform about their standard operating procedures explaining how decisions are taken. However, one could argue that not all administrative areas need to be covered. Live+Gov recommends illustrating and presenting those decision-making processes in which citizens are participated. In a later stage, new decision-making processes could be added.

- **Internal information**

The authorities need to decide about which internal documents they would like to publish. Live+Gov recommends that the authorities share their internal knowledge and publish internal documentation about the planning and the execution of political and administrative tasks. This involves feasibility studies, communication between stakeholders, reports and evaluations by experts, budgets and budget lines, bills and general financial calculations.

- **Open data**

Authorities need to engage in a broader debate about which of the data could be made public that are at their disposal. This relates to data from the registration office, from public service providers (water supply, electricity supply, transportation companies). Publishing this kind of data often comes with legal restrictions and need a respective legislative decision.

- **Presentation**

Authorities need to agree on a coherent presentation of the internal information. This refers to the general form e.g. on a special website and – very importantly – to the format of the published documents.

- **Responsibilities**

Authorities need to agree on the principle responsibilities of the transparency policy. The default Live+Gov recommendation is to install a special transparency and communication centre that is implementing the transparency policy. Organisationally, such a "Citizen Contact Centre" – as it is called in the Live+Gov Use-Case city of Eindhoven – is an own department of the municipality, is well connected to all other departments and organisational units of the city administration and therefore well informed about all procedures and processes. Accordingly, if a citizen has a question, a recommendation or wants to address the authorities in any way, the CCC is the central hub ready to be contacted either by mail, telephone or email. If the CCC has no answer right away, it can acquire the necessary information in the administrative organisation and share the knowledge with the interested citizen. Such a CCC can also organise special communication and participation events involving the citizens in decision-making and public affairs. In general, such a contact centre needs to have the powers of a traditional communications' office having the ability to demand and access internal information and documents and having the power to engage the political as well as the administrative units of a city in active citizen communication.

One central Live+Gov recommendation, which is not implemented in Eindhoven but in the other use-case city of Utrecht, is to develop an own website and web-application specially dedicated for citizens communication. This plays an important role in the Live+Gov methodology assuming that the amount of information that is given to the citizens reaches levels and extents that are hardly manageable in the context of the cities' usual websites. Therefore, a communication centre should have an own website and web-application where it publishes all the relevant information and which serves as a platform for the citizen to obtain all the information that they would like to have.

Principally, transparency information on such a web-application should be structured according to the policy-fields that should be presented to the public. Citizens should have the possibility to choose a general topic they are interested in and find all information about the ongoing decision-making processes including the involved and responsible administrative units (and personnel) underlying political decisions and the legal background, the budget and the financial conditions, as well as internal documentation.

2.2.3.2 Participation

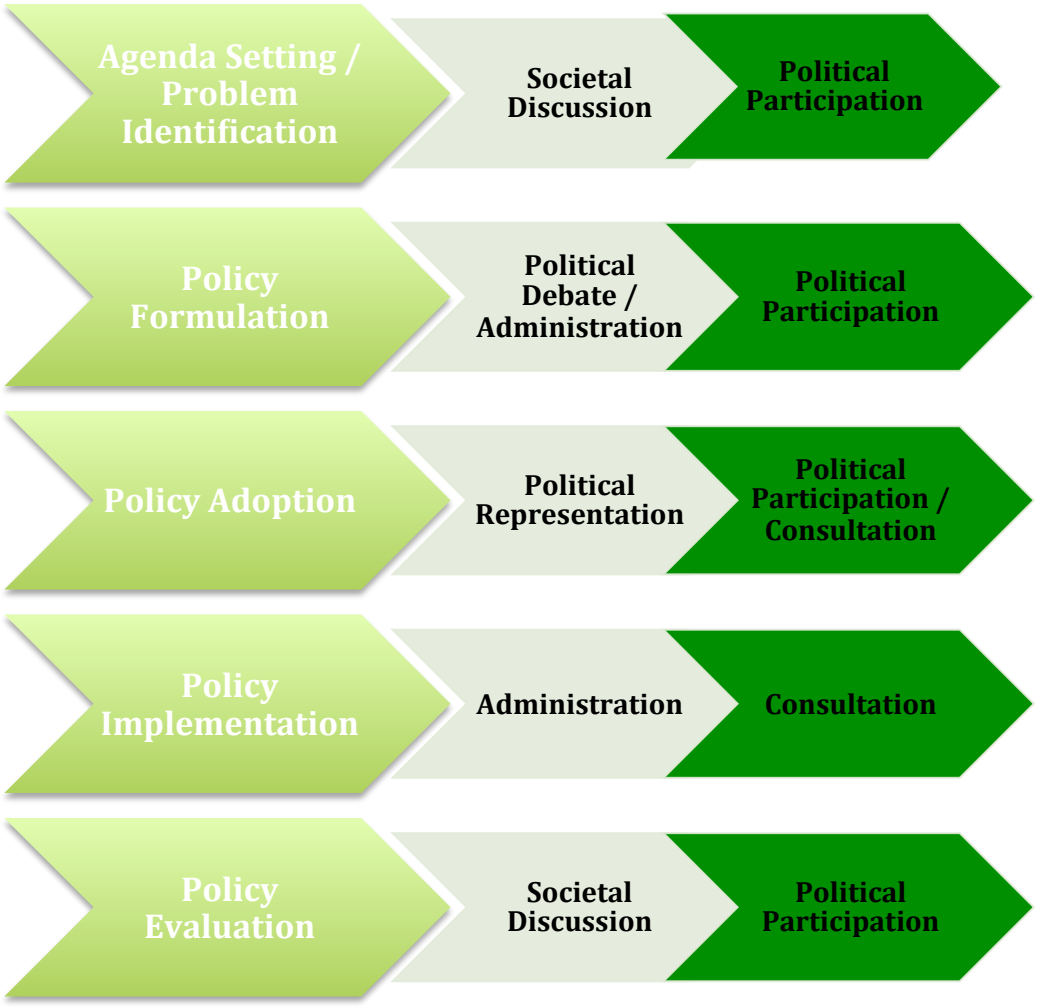
The Live+Gov method considers a specific participation policy as the basis of sustainable political participation. Just as a transparency policy, a participation policy defines the terms and conditions of the participatory process. In cases in which public participation in municipal decision-making is already installed the respective rules and procedures can be extended to the mobile context with the mobile participation becoming a complement to the existing processes. In those cases in which public participation is new, introducing participation via mobile devices is an ideal occasion to introduce participatory policies in general including and combining mobile, online, and offline components. Regardless of the concrete case, Live+Gov proposes the following organisational guidelines:

- **Early participation**

Once the policy-fields are defined that should be opened up for citizen participation, their processes need to be analysed to find the optimal stage for the citizen input. In general, Live+Gov is recommending political participation of citizens early in the decision-making process. From a Live+Gov perspective we recommend as well to keep the participatory process intact until the final decisions have been taken and the policy in respect is implemented and evaluated. Accordingly, assuming a five stage policy-making process starting with the "Problem Identification and the Agenda Setting" leading to the "Policy Formulation" and the Policy Adoption and ending with the "Policy Implementation" and "Policy Evaluation" we suggest to involve the citizens from the beginning [5].

An ideal policy-making process with extensive citizen participation is presented in Figure 1.

Figure 1: Ideal policy-making process



This above sketch illustrates that citizens should participate as early as a societal problem is identified and the policy-agenda is set. Here, the distinction between participation and collaboration is blurred: citizens can either debate the proposals made by the authorities or can make proposals themselves. The latter solution is currently practiced in the Live+Gov Use-Case in Utrecht where the authorities explicitly ask the citizens for their suggestions concerning the type of collaboration. In contrast, participation on the policy formulation stage is clearer: citizens should have the power to comment and influence the different proposals that are discussed in the political arena and that are developed in the public administration. They should have the power to give a proposal a certain substantial direction. After the concrete policy proposals have been elaborated and the details are further discussed in the political bodies (e.g. the City Council) citizens can also be participated meaningfully. Early in this bargaining and negotiating process the citizens can be equipped with the power to make the policy-proposal change in important aspects. Once the policy is adopted and implemented the citizens can still be consulted about the latest developments concerning the policy. There, however, the form of participation should change from concrete participation to consultation. This changes again on the policy evaluation stage on which the citizens can take a more active role in the discussions about the effects of a policy.

- **Legitimacy of direct democratic decisions**

In case the municipality opts for real co-decision and co-governance by the citizens handing them over real decision-making power, the participation policy has to define the thresholds that have to be reached for claiming that a decision has been legitimate.

- **Executive body**

Initiating a participatory process comes with an organisational burden to the public administration and the public authorities in general. This means that the administrative body may not be able to cope with this burden. Therefore, Live+Gov recommends to creating an external body that is explicitly dealing with citizen communication and could organise the participatory process. This communication body needs to be connected to the decision-making bodies of the municipality and organise the exchange of information between the citizens and the political decision-making bodies. Just like in the transparency context, this organisational unit has to be embedded into the administrative system in a way that it is automatically receiving all the necessary information by the administration that it needs to initiate the participatory process. In fact, it needs to have the same information powers as the political decision-makers. Accordingly, it is of highest importance to find an adequate solution for the necessary information flows. Furthermore, and in particular in the Live+Gov context, this executive body has to have sufficient technical knowledge for implementing and adjusting the Live+Gov applications e.g. when it comes to installing the Augmented Reality functionality.

- **Online support**

Just like in the transparency context, Live+Gov recommends the creation of a special web-application and a website serving as a hub which is summarising and aggregating all participatory processes and is backing the participatory process. It would seem appropriate to embed participatory processes in the general communication platform as it has been

described in the transparency context and which is serving the participation unit to communicate with the citizens that are not using the Live+Gov mobile applications.

- **Offline support**

In the context of public participation in particular, it appears highly important to complement the mobile and online solutions by real-world participation events. This is due to the fact that a political decision can only be fully legitimate if the whole population that is concerned by the decision has the possibility to participate. Therefore, the participatory process needs to consider those citizens that are not using the internet and are not equipped by mobile communication devices. Accordingly, the participatory process needs to involve the traditional participation tools like consultations, non-electronic voting and campaigning.

2.2.3.3 Collaboration

Type 1 Collaboration is often referred to in the literature as a form of modern complaint management. However, the basis of its novel Live+Gov understanding is that by sharing a report about damaged public infrastructure citizens are providing the authorities with valuable data which can be used to improved the public service – e.g. to deal with the damage more rapidly. This new perspective paves the way for a range of new possibilities how the authorities can profit from the engagement of the citizens. However, in order to harvest the full potential of this form of collaboration the administration has to become receptive to the citizen input organisationally and has to have the technical facilities for analysing the incoming data. Before turning to the technical elements some basic organisational guidelines are outlined here. They should be part of a corresponding collaboration policy.

Collaboration Type 1:

- **Planning Processes**:

Citizens sharing important information either actively or passively bears great potential for improving authorities' oversight of the municipality. Therefore, the policy-fields of public maintenance and traffic are ideal for making use of the natural movements of the inhabitants and visitors through the municipality. This is not limited to the short-term improvement of the actual situations (e.g. quickly recognising damages that can quickly be repaired) but refers very importantly to the long-term planning of respective infrastructural investments. Direct citizen data represent a new form of information that has hardly been accessible until now. Therefore, with adequate analysers and data mining mechanisms the planning processes can either be refined or even replaced.

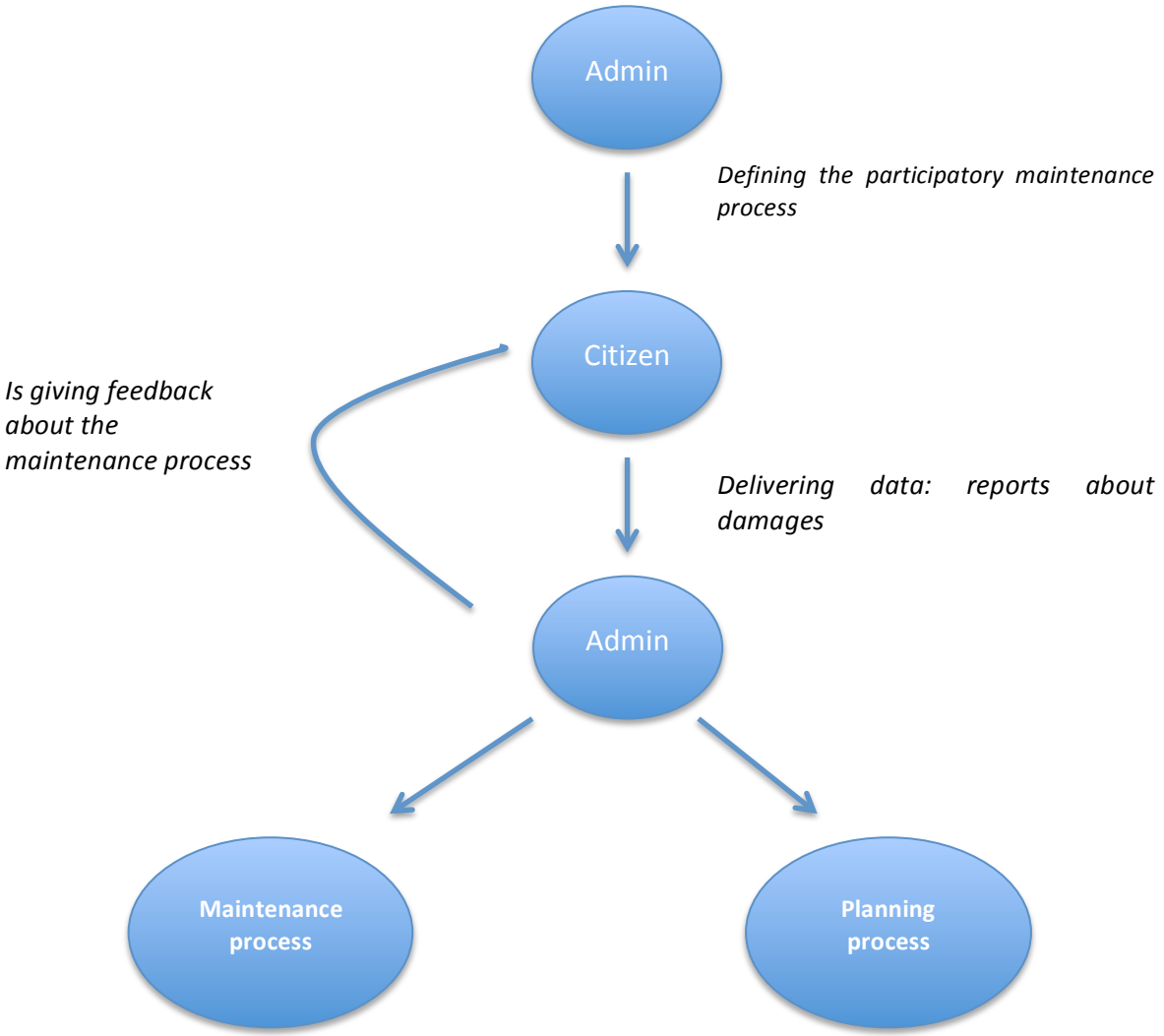
- **Maintenance Processes**

As the municipality of Eindhoven has shown, Collaboration Type 1 bears great potential for improving the maintenance procedures. This is basically due to the fact that citizen reports via mobile devices contain are more accurate and contain enough information enabling the authorities to initiate a repairing process directly (as compared to telephone or text). Accordingly, they can save time by a lower control burden. However, the municipality needs to introduce a new working procedure that is ready to digest the citizen input. The positions of an "Area Managers" needs to be created, which can almost autonomously decide about

all aspects of a maintenance process. This includes the negotiations with the service providers, control mechanisms, communication with the reporting citizens, billing, etc. Furthermore, the Area Manager needs to be connected to other departments that can assist when the reported damages are more severe than originally thought.

Figure 2 sketches an ideal collaborative process: once the administration has created the organisational foundations for a participatory maintenance process, it can resort on the citizens' oversight capacities: they are actively reporting damages and annoyances in the municipality and therefore engage in the maintenance process. The administration is working with this information: it is initiating the maintenance process, is giving feedback to the citizens about how the maintenance process proceeds, and includes the citizen data to the long-term planning process.

Figure 2: The ideal collaborative process is presented



Collaboration Type 2:

- **Active maintenance**

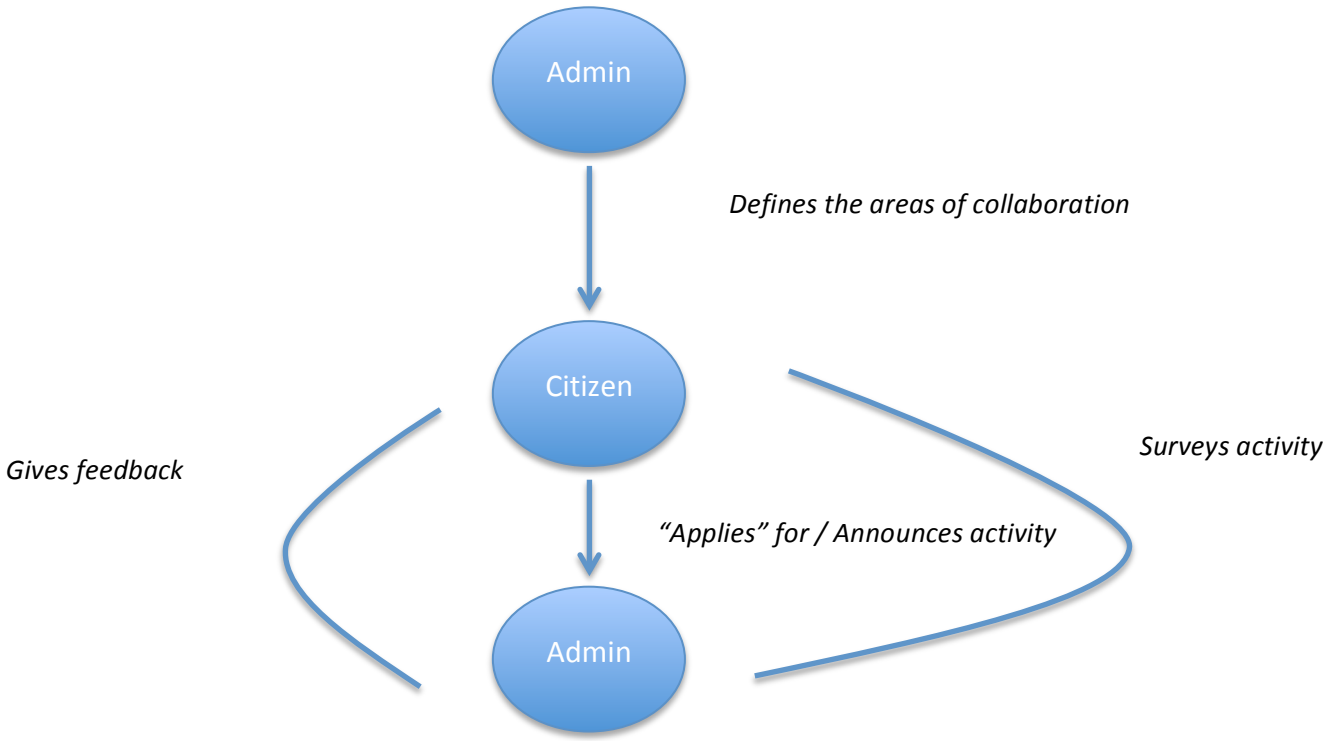
Once the maintenance processes are installed with a mobile component working as the main data supplier it is only a short technical step for allowing the citizens to engage even more actively in the maintenance of their municipality. Organisationally, however, this is not an easy task. In particular, the concrete field of citizens' collaboration needs to be defined. Many maintenance issues need to be executed by experts and cannot be handed over to non-expert citizens. Therefore, the municipality needs to pay great attention which responsibilities it grants to the citizens. Live+Gov recommends for allowing limited makeovers like gardening projects or paintwork in certain areas that need to be dedicated as well.

- **Process Management**

The collaborative process needs to be set up. Therefore, Live+Gov proposes to mark areas in a municipality open for citizens' collaborative project on a map, which can be accessed via the maintenance application and the corresponding web-applications. Citizens should then be enabled to mark their interest for their activity briefly indicating what they would like to do. This can all take place via the maintenance application. The area manager receives this input and takes the decision whether the proposed action can be accepted or not. The citizens receive the answer and are provided with further information regarding their activity (e.g. supportive resources). The area manager can then supervise the process and check the quality of the action as well as its progress. In general, such a collaborative process needs to entail a detailed supervision and quality control mechanism.

The ideal collaborative process (type 2) is presented in Figure 3.

Figure 3: The ideal collaborative process



2.2.4 Step 3: Technical Implementation

The special approach of the Live+Gov project is to use mobile technology for improving Citizen Participation in local municipalities. This does, however not mean that Citizen Participation has to take place exclusively via mobile devices. The new possibilities that are introduced by mobile technology rather need to be seen as a complement and a crucial facilitator for Citizen Participation. Accordingly, one should neither overestimate nor underestimate the role of mobile technology: it provides powerful instruments that make participatory processes more effective, appealing, and easier for the citizens. Therefore, their usage may motivate citizens and stakeholders to participate more in public decision-making; from a collaboration point of view it is even a crucial facilitator for new interactions between the public authorities and the citizens. However, the introduction of mobile technology does not change the fundamental purpose and aim of Citizen Participation.

Therefore, in order to make Citizen Participation more effective via mobile technology the Live+Gov project develops a number of technical components, which are bringing participatory possibilities to the mobile devices of citizens. These components range from smart phone applications, over analytical tools on web-servers, to web-applications. Three core functionalities are provided: first, reality mining functionalities are collecting and interpreting individual data about the context of the citizens; second, visualisation functionalities are presenting the collected and processed data to the users; and third, communication functionalities are establishing internal communication between the different Live+Gov components and external communication establishing communication between the Live+Gov system and external data sources and computer systems e.g. administrative back-end systems.

The following pages will illustrate which technical components implement the different functionalities and outline briefly how they can be assembled in order to implement the three concepts of Citizen Participation. The technical denominations of the software components refer to those of the software architecture as developed in WP 4. The following description is partly adopted from the latest deliverables of WP 4 (D4.2) and WP5 (D5.2). They are, however, important for the comprehensive representation of the methodology. Please note also that the technical description covers participation and collaboration but not transparency. Creating Transparency requires mainly organisational decisions and do not necessarily involve new IT infrastructure. This, however, is beyond the scope of the Live+Gov project. Functionalities like feedback loops and other communication between the citizens and the authorities are covered in the other two pillars.

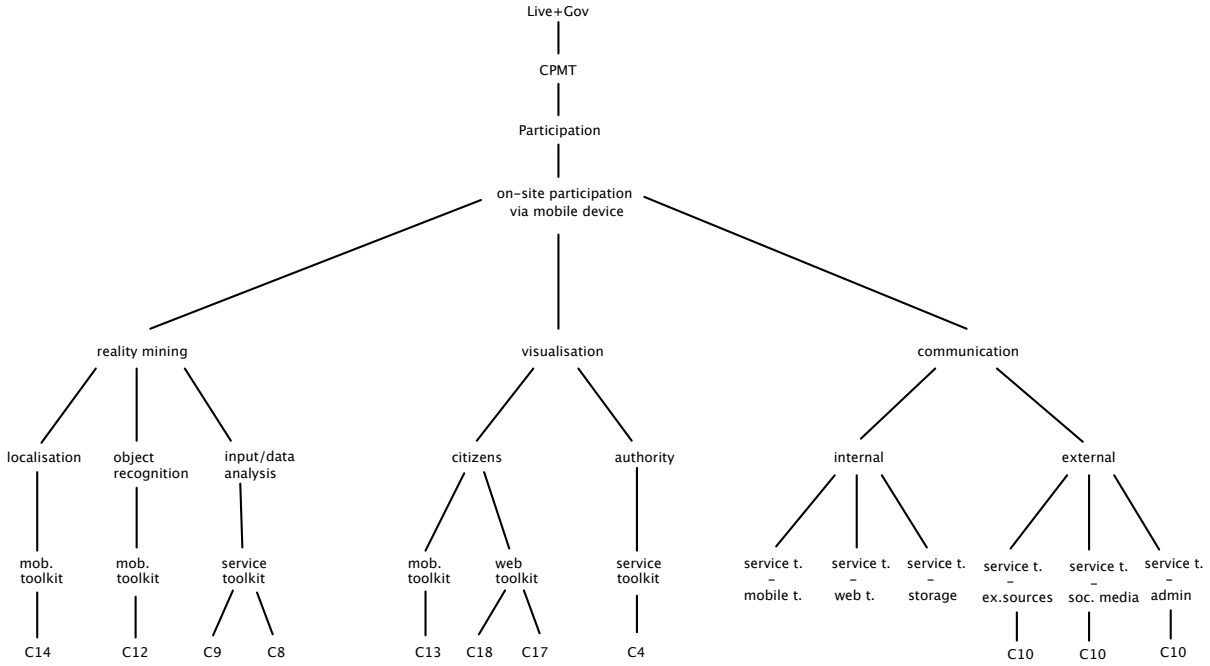
2.2.4.1 Participation

The CPMT approach of the Live+Gov project understands the pillar of participation as direct citizen participation in administrative and political decision-making. Accordingly, citizens should have institutionalised access to decision-making about fundamental issues in a municipality or a city. The scope and the content of these issues needs to be defined and agreed upon as well as the principle way of how citizens can make their contribution or give their input. In this respect, the Live+Gov project focuses on decision-making about public infrastructure: if new buildings or public facilities are planned the citizens should have the possibility to provide their opinion about the principal direction of the public investment, should be able to rate the usefulness of the new infrastructure, and take basic decisions about its final design.

Again, the particularity of the CPMT approach is that it is taking this participatory offer to the mobile device: citizens are enabled to making their contributions on site in the moment that they are confronted with the construction site or an empty space, which is about to being built on. Due to the fact that participation via mobile devices requires careful design to cope with the limited format in terms of both space and content that can be delivered, the Live+Gov solutions rely on “Augmented Reality” (AR) visualising the plans and therefore transmitting a maximum of information in a restricted (mobile) environment. Additionally, the AR presentation is complemented by simple polls and questions that are related to the planning. However, the limited scope of the mobile device itself as well as the fact that citizens are easily overburdened with participatory action when confronted with it on site, the Live+Gov project understands such mobile participation as an initial offer to the citizens to participate in the respective decision-making in a more profound way later. If they find the AR offer and the initial poll appealing and if their interest has been aroused, they will probably be motivated to find more information about the municipal planning and possibly in further consultations.

Again, the core technical functionalities that need to be supported are “reality mining”, “presentation”, and “communication”. Except of “reality mining” they are largely congruent to the functional dimensions of the pillar of “transparency”. This means effectively that they are implemented by the same toolkits and in some cases by the same components of the toolkits. They have, however, their own specificities and functionalities that need to be accounted for separately. Nevertheless, this also shows the generic setup of the Live+Gov project: single components are designed in order to fulfil a variety of functionalities. This approach safeguards the widest application of the Live+Gov solutions possible and safes costs both in terms of development and implementation effort. They will be discussed in the following.

Figure 4: Technical Live+Gov components providing Public Participation



Reality Mining

The reality-mining dimension intends to capture and recognise the actual context of the citizens in the moment in which they wish to participate in a decision-making process concerning an infrastructural plan. Therefore, the Live+Gov system needs to identify the location of the citizen, needs to recognise the object, the building or the open space, respectively, which is the subject of the infrastructural plan and project the plans onto the screen of the mobile device. Furthermore, the Live+Gov system needs to interpret the textual input that is given by the citizen and analyse the data that is acquired in the mobile participation process. These three sub-dimensions of "reality-mining" capture the actual context of the citizen sufficiently in order to make further conclusions concerning their attitude and opinion about the concrete planning. The localisation and object recognition functionality are both covered by the mobile toolkit. The Mobile Sensor Collection Component (mobile toolkit, C14) collects GPS and compass sensor data and therewith identifies the exact location. Components in the "Augmented Reality" service (C12, C4, C16) capture the object (or the site) that is of interest for the citizen. The data analysis functionality is implemented in the service toolkit: The Server Side Mining Service (server toolkit, C9) executes the analysis and the Sensor Data Storage Service stores the data.

Visualisation

The dimension of visualisation concerns basically two sub-dimensions. Citizens are presented the participatory elements first on their mobile device and second on the screen of a web-application serving as a backup or a "hub" for various citizen participation elements. The web-application serves the purpose of providing the citizens with more detailed information about their participation possibilities. Citizens are expected to visit the corresponding web-application after they have acquired first knowledge and initial

information about participatory possibilities via their mobile devices. Accordingly, the Mobile eGovernment Dialogue and Visualization client (mobile toolkit, C13) visualises the communication on the citizen's mobile device. The Web application for eGovernment Dialogue and Visualization (web toolkit, C18) visualises the communication on the central web-hub whereas components of the web application for Augmented Reality Configuration (web toolkit, C17) provides the mean to configure the 3D presentation models.

The second sub-dimension in the context of presentation and visualisation refers to the communication with the public authorities. This is also implemented by the Web application for eGovernment Dialogue and Visualization (web toolkit, C18), supported by the corresponding back-end service (C4).

Communication

The third functional dimension refers to the internal and external communication of the system components. Internal communication relates to the communication between the different system components. External communication relates to the communication of the different system components with external sources.

Internal communication

Internal communication between the software components is essential for meeting the general project aim, which is to provide personalised information to citizens depending on their actual context. Accordingly, the mobile toolkit has to communicate with the service toolkit linking collected movement data with pre-defined movement patterns. Hence, a connection needs to be established between the data-collection components and the data analysis components. Furthermore, the Mobile Sensor Collection (mobile toolkit, C14) and Mining (mobile toolkit, C15) components need to exchange information in a similar way. Furthermore, a connection and communication needs to be established between the service toolkit and the storage facilities for making the retrieved data available for future data analysis and usage. Eventually, supplementing web toolkits, which are backing up the mobile components need to communicate with service toolkit. The information that are retrieved by the mobile components in the mobile toolkit, are analysed in the service toolkit, and stored in the storage are communicated to the web toolkit. Information can then be presented respectively.

External communication

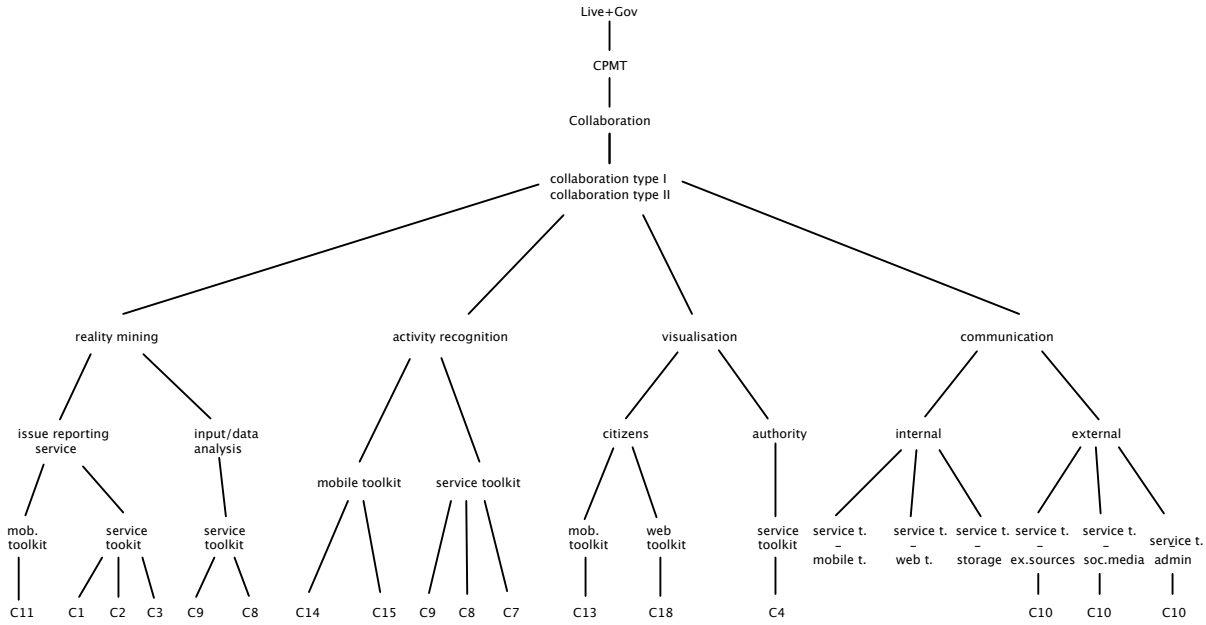
External communication is equally essential for the running system. Specific information about decision-making processes with public administrations or in politics is retrieved from pre-defined sources on external servers of the public administration and the like. Accordingly, the service toolkit of the Live+Gov system has to communicate with the relevant government systems and provide this information to the mobile toolkit. Additional connection and communication is established between the service toolkit and social media in order to reaching out for the citizens in this prominent way. Furthermore, the service toolkit retrieves information from other external service providers (e.g. map providers). These external connectors are developed in the service toolkit.

2.2.4.2 Collaboration

Mobile technology crucially facilitates both types of collaboration. Citizen either provide data actively by reporting damages utilising the sensors on their mobile device (e.g. camera GPS, and compass) or passively by granting the mobile device to logging their movement through the municipality. However, they can also use their mobile device for announcing or applying for individual action. Furthermore, integrating mobile solutions in the maintenance process comprehensively and organising the repairing processes via mobile solutions (e.g. through PDAs) promises further economies for the administration.

In contrast to the pillar of participation, the CPMT approach of the Live+Gov project defines here four functional dimensions that need to be implemented by technical components. They are partly congruent to the functionalities and components of the participation pillar.

Figure 5: Technical Live+Gov components providing Collaboration



Reality Mining

As in the participation context, the "reality-mining" dimension in the pillar of collaboration requires the activity of the citizens. However, citizen activity is not restricted to using the Live+Gov application for acquiring information and issuing their opinion. They are rather asked for their cooperation in terms of either type one or two (or both) collaboration: they can report damages and issues of the public infrastructure as soon as they come across or can announce a collaborative project. Both can be done via the Live+Gov application on their mobile device where they can add text giving even more information if they wish to do so. Accordingly, the Live+Gov application mines the reality by the activity of the citizens applying the in-built sensors like compass and GPS as well as the camera and by citizens giving their textual input.

These functionalities are facilitated by an issue reporting (an announcing) service as part of the application as such and supported by server side computing power. The Mobile Issue Reporting Client (mobile toolkit, C11) provides the functionalities on the mobile device. The Issue Reporting Service Components (service toolkit, C1, C2, C3) represent the server side reporting and announcing functionalities. Additional data-mining (service toolkit, C9) and storage components (service toolkit, C8) provide data-analysis guaranteeing the further application of the user-generated data.

Activity Recognition

The core innovation of the Live+Gov solutions is that they are providing the citizens with relevant information, which are fitting their actual needs in their actual context. Therefore, the Live+Gov applications have to recognise the location and the activity of the citizens. The concrete functionalities that should be supported are the following: first, they should capture how people are moving through the urban area and recognise their movement as well as their mode of transportation. Accordingly, the system should detect whether the citizen is walking, biking, or using public transportation. If the citizen is using public transportation the system should identify the correct bus – or tramline. Second, the Live+Gov system should also recognise the current activity of the people in terms of whether they are commuting to or from their workplace or are pursuing a free time activity. Third, from a policy support perspective, the collected data are analysed for relevant information concerning the planning of the traffic infrastructure. Therefore, data mining algorithms are portraying how the citizens are using the public (traffic) infrastructure allowing for conclusions how it could be improved. The core technical components in the architecture recognising the activity of the citizens are located in the mobile toolkit and the service toolkit. The Mobile Sensor Collection Component (mobile toolkit, C14) collects the data by GPS tracking and by making use of other internal sensors like the gyroscope, accelerometer and magnetometer. The Mobile Sensor Mining Component (mobile toolkit, C15) performs first and immediate analyses, mining the captured data for specific patterns, which are revealing the citizens' location and movement. The Server Side Ming Service (service toolkit, C9) performs additional and more sophisticated analyses about the data structure revealing more fundamental patterns that are useful for the municipality's or city's planning authorities. The Sensor Data Storage Service (service toolkit, C8) stores the data on the server and prepares it for a periodic search in the aggregated data. The Personalized Content

Delivery Service (service toolkit, C7) has the essential role of linking the retrieved information to citizen characteristics as they have been specified before. Hence, C7 components safeguard that the information communicated to the citizen fits their actual context.

Visualisation

Visualisation issues in the collaboration context are basically similar to the participation context. Visualisations are provided for the citizens through the Mobile eGovernment Dialogue and Visualization Client (mobile toolkit, C13) and the web application for eGovernment Dialogue and Visualization (web toolkit, C18). Again, the web-application and visualisation serves as a central hub providing extended background information that cannot be communicated via the mobile device. Next to the citizens' side, the back-end namely the administrative interface enabling the public authorities to communicate through the system via the web application for eGovernment Dialogue and Visualization (web toolkit, C18), supported by eGovernment Dialogue and Visualization (back-end) service (C4).

Communication

Communication demands are equally high in the collaboration context as compared to the participation context. Internal communication between the different components of the Live+Gov system needs to be established. This refers, in particular to the communication between the service toolkit and the mobile toolkit, the web toolkit, and the storage, respectively. External communication needs to be established between the various Live+Gov components and external sources providing additional information to the system (administrative documents, social media, and map providers). The latter are implemented by the external system connectors.

2.2.5 Step 4: Communication Strategy

Even our liberal representative democracies in Europe are based on a paternalistic relationship between the citizens and the state: the state is dictating and the citizens have to follow. One of the fundamental innovations of the liberal state is, however, that the citizens have the right and the possibilities to intervene and engage in the policy-making by forming parties, pressure groups and influencing the public opinion in one form or the other. Nevertheless, the manners in which public policies are decided and executed are still based on a dichotomy between the state and the citizens. Even more than this: the policy-making process is creating this dichotomy by the fact that the citizens do not have the right to participate in the concrete process. This is also visible in the communication strategy of many authorities. Even if participatory policies are in place, the political or administrative authorities are hesitating to fully include the citizens in the policy-process and are trying to withhold rights, or conceal the respective citizens' rights.

Accordingly, we argue that a fundamental change of the mind-set of politicians and civil servants relates to the fact that they need to realise the value of citizen participation and need to develop an interest in it. Accordingly, if a participatory process is about to take place, the authorities need to actively motivate and invite the citizens to participate; they

need to fight for citizen participation and take measures to achieve participation quotas that are sufficiently high. State authorities need to actively dismantling the artificial separation between the state and its citizens.

Therefore, Live+Gov proposes to develop a communication strategy as part of the participatory process in order to motivate citizens to take action, to issue their opinion, to take part in the public debate. Hence, if a new participatory process is introduced, authorities should use online and offline media communication channels (local newspapers, radio ads, websites, email messages, social media, telephone calls, mail) for advertising the new possibilities. Furthermore, they can organise and invite to public participation days where the new possibilities are presented and discussed. There, citizens can learn how the new processes are functioning, how new technical features are working, and can issue their opinion and attitude already in the development phase of the participatory process as such. This shows the citizens that the authorities have a genuine interest in the opinion of the people and that it has understood that its core role is to make policies for the benefit of the citizens and is not an end to its own.

3 Implementation in the Live+Gov use-cases

The four-step process, which has been presented in section two depicts the different possibilities that are at the disposal of the authorities, shows which fundamental decisions they have to take in order to implement participatory policies and the frame of the implementation measures. This frame is still rather abstract and high level and has to be newly applied in every real-world context for reacting to the specificities and the great diversity of public administrations and political circumstances. The general Live+Gov recommendation is to aim at the highest and most ambitious form of Citizen Participation by introducing all three pillars in the highest number of policy-fields. However, the various solutions are modular both organisationally and technically meaning that municipalities can choose which form of participation makes most sense to their circumstances. The following section presents the use-cases of the Live+Gov project and shows how they implement the four steps of the methodology. It should also be noted that the respective processes are still in flux and not finalised yet. All the three use-cases have an explorative character meaning that at the time of writing the organisational setup of the respective participatory processes are not settled yet.

3.1 Use-case 1: Mobility – Helsinki – HSL

3.1.1 Step 1 (A+B): Defining Aims and Targets

The focus of the Mobility Use-Case is to open up policies and decision-making concerning the traffic infrastructure to citizen participation. More concretely, citizens are asked for their collaboration by providing their individual data via their mobile devices. These data are collected actively and passively. On the one hand the citizens are having the possibility to report damages to the traffic infrastructure and issue their opinions or make some recommendations for improving it. On the other hand they are allowing their mobile devices to record how they are moving through the traffic system. This individual user-perspective provides the planning authorities with a much higher level of accuracy when supervising and analysing the traffic infrastructure. This reveals in particular, how the different modes of transportation could be better aligned to each other. Furthermore, the planning authorities can profit economically because such an automatic system could reduce their expenses for costly and resource-intensive research projects observing the traffic flows with traditional survey methods. Adequate automated analytical tools are enabling the decision-makers to draw their conclusions directly and make their decisions without being required to hire expensive consultancies.

In return of their collaboration, the citizens are provided with an improved traffic infrastructure as well as with an additional service on their mobile device easing the usage of the different modes of transportation. Additionally, the citizens can profit from a new level of transparency by improved feedback through the reporting mechanism and improved oversight of the maintenance and planning processes.

Box: the Helsinki Transport System Plan 2011 - 2015

The Live+Gov Mobility Use-Case fits neatly into the Helsinki Transport System Plan 2011 – 2015 [3]. Out of the five defined development levels, the Live+Gov functionalities tackle or touch four:

Development Level 1 foresees the creation of a more sustainable urban infrastructure and land use. In this context, the traffic infrastructure is key in the "integration ad the development of coherent urban structures". Live+Gov contributes by showing in detail and on one sight where citizens suffer from large delays and inadequate facilities.

Development Level 2 considers the connectedness of public transport, walking and cycling. The Live+Gov solutions explicitly recognise and differentiate between these modes of transportation and therefore grasp how the citizens move through the public transportation system.

Development Level 3 charged with mobility management pricing and regulations. In this context new and "real-time information systems and journey planners" (quote) should be researched and developed. Live+Gov is responding to this by supplying the citizens with real-time information about the bus-or tramline they are actually travelling on.

Development Level 4 names the operation and the maintenance of the transport system as a core development aim. Live+Gov introduces the new maintenance application, which can be used by the citizens to report damages of the traffic infrastructure via their mobile applications and inform the authorities more quickly and accurately than in the past.

According to the project plan, Live+Gov foresees the creation of advanced collaboration of the type 1 including improved maintenance procedures and planning processes. In the context of the maintenance procedure it would, however, be advisable to introduce extensive transparency offers, which are informing the citizens about the state of their report and the ongoing maintenance process. This would then correspond to Advanced/Involving transparency and could be combined with other online features like web-applications or other web-based services. At the present stage of the project this is not accounted for, yet. Accordingly, the focus is clearly on type 1 collaboration in terms of improved maintenance procedures and better or more accurate long-term planning of the traffic infrastructure.

3.1.2 Step 2: Organisational Implementation

Concentrating on Collaboration type 1, the Mobility Use-Case will assist the authorities in the maintenance of the traffic infrastructure and in the long-term planning.

Improving Maintenance Procedures

For improving the maintenance procedures Live+Gov proposes a process, which is similar to the Eindhoven maintenance procedure. In general, both the Eindhoven area managers and the maintenance department of HSL are having similar tasks: they have to survey a large area, identify damages that have to be taken care of and have to initiate the maintenance process. Citizens can add further accuracy to this oversight task and therefore add valuable information: the maintenance process can be identified more quickly and, as a matter of fact, can be started more quickly as well.

The origin of the improved maintenance procedure is the maintenance department of HSL. It needs to be receptive for the incoming input by the citizens both technically as well as personally. Coming in via mobile devices, the citizens' input needs to be received by an electronic content management system displaying the report together with all the data obtained (picture, text, sensor data). Maintenance officers need to be able to assess the input and initiate the maintenance process executed either by external service providers or the own maintenance department. Regardless of the executing body, it is advisable to equip them with electronic devices as well or make them work with the Live+Gov application for organising the maintenance process, agreeing on the needed investment and the pricing. In general, the maintenance procedures can be equipped with a highly valuable data-source, which is the citizen using the infrastructure. The maintenance department can therefore reduce its surveillance tasks and shift its focus on quality control and on more complicated issues.

Improving the Planning Process

The planning process of the traffic infrastructure in the Helsinki metropolitan area is based on the "Helsinki Transport System Plan (HLJ)" [6]. This is a strategic, long-term plan that aligns the regional transport policy. HLJ is prepared as a joint project of the Helsinki region consisting of 14 municipalities. It has to be approved first by the HLJ committee, the executive board of HSL as well as by KUUMA (Keski-Uusima) region in Southern Finland. Further cooperation is taking place with the Helsinki Region Land Use, Housing, and Transport Program (MAL), which is the core political planning authority in Helsinki.

The HJL is based on empirical evaluations of the actual system and a number of projections, which are calculated through a number of statistical demand and supply models. The database for the calculations stems from an extensive Travel Behaviour Survey of round about 20 000 users of the traffic infrastructure. They are either contacted and interviewed by telephone or cooperate by filling out explicit travel diaries accounting for their travel behaviour. This survey is conducted by two large consultancies – TNS Gallup Ltd. and WSP Finland Ltd. The obtained data are then combined with distinct traffic databases maintained by state authorities themselves: The Finnish Transport Agency provides the "Digiroad" and "VALLU" databases – both accounting for the entire road and street infrastructure in Finland. The Helsinki Regional Transport authority provides the "JORE" database, which is the basic registry of public transport; it is including all up-to-date timetables, lines, stops, specific departure times and GIS information [7]. All three datasets are combined and serve as the basis for the describing and forecasting models.

Live+Gov's core contribution to the planning process is that it is dramatically reducing the cost for the Travel Behaviour Survey, which is currently done by external consultancies. The Live+Gov method is quicker and easier, requires fewer resources both in terms of effort and money, and is more accurate.

Survey Results quicker and easier

Live+Gov provides a largely automated system that is constantly collecting the movement profiles of the citizens / passengers. As the system is running and is therefore delivering data permanently the authorities can easily produce up-to-date statistics about the functioning of the transport infrastructure. There is no need to conduct a large survey as it is currently done.

Survey Results more accurate

Due to the fact that the survey can be done more easily and quickly its results can be obtained more often. Therefore, in contrast to the current interval of 5 years, the authorities can perform such an automated Live+Gov survey – which corresponds basically to a periodic analysis of the running system – more frequently. This increases the accuracy of the data forming the basis of the HLJ. Furthermore, an automated system as the Live+Gov is much less prone to error as compared to traditional surveys. Those contain errors due to faulty coding, misinterpreted questions and instructions and simply wrong answers (due to a lack of memory of the interviewees or their unwillingness to give the correct answers). The automatically collected data do not contain significant errors and can be interpreted as direct empirical data just as the data from the Digiroad, VALLU, or JORE databases.

Live+Gov survey requiring less resources

The Live+Gov solutions are developed for permanent usage in the organisation. Therefore, inhouse expertise is sufficient to produce the respective survey results. In fact, Live+Gov produces a new database and provides the required analytical tools for enabling the staff in the maintenance department to compile their own statistics. Shifting responsibility from external service providers to inhouse experts saves costs. This relates not only to the objective movement profiles but also to subjective opinions and attitudes that are delivered by Live+Gov's maintenance and feedback mechanism. Hence, in fact the planning process can spare one big and resource intensive component, which is the survey with 20 000 participants.

3.1.3 **Step 3: Technical Implementation**

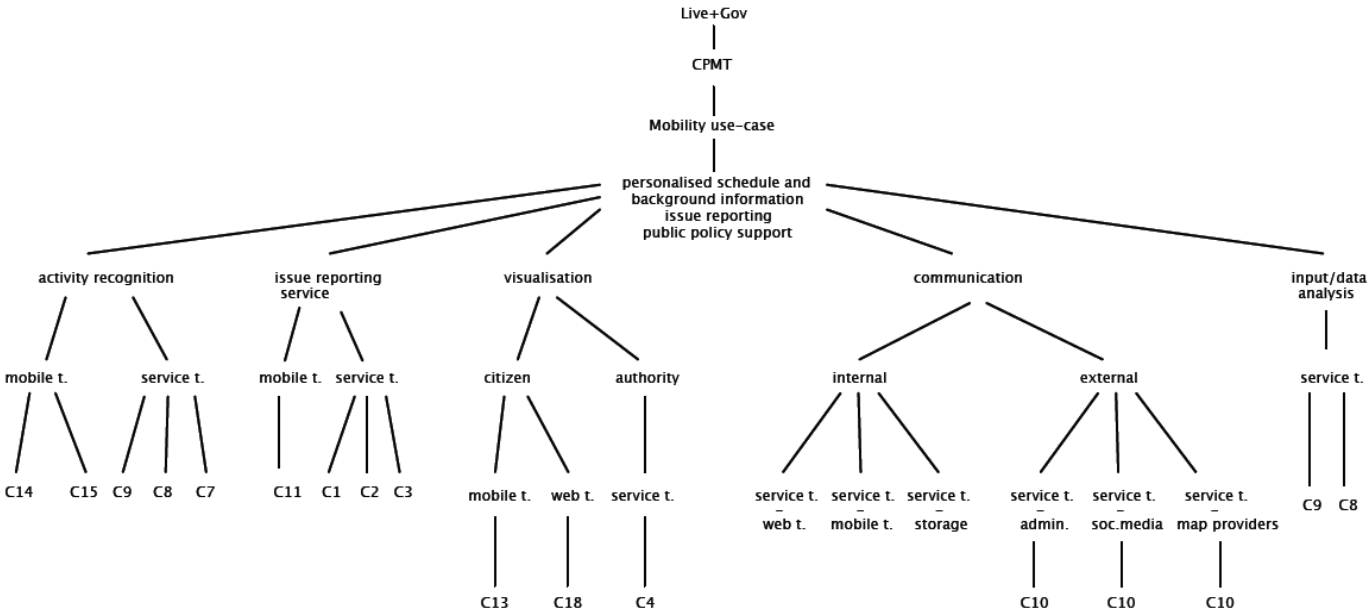
The four main functionalities of the Mobility Use Case are:

- Citizens get immediate information about the state of the public transportation system. The information fits to the actual demand of the citizen, meaning that they should get information about blockages and traffic jams on the line they are travelling on and fitting to the activity that they are pursuing.
- Citizens get access to specific information about the traffic infrastructure e.g. about actual developments and future planning, the respective decision-making processes, the acting bodies, and the possibilities to participate in this decision-making process.
- Citizens get the possibility to report damages in the traffic infrastructure and get the respective feedback about the repairing process.
- The authorities obtain an additional policy support feature by making use of the user-data that is generated by the Live+Gov system.

Therefore, the Urban Mobility Use-Case is combining elements of the conceptual pillars of transparency/service and collaboration. Accordingly, their technical components need to be

combined for making the Use Case work. Therefore, we have defined five functional dimensions that need to be accounted for technically:[6]

Figure 6: Live+Gov concepts and technical implementation for the Mobility Use Case



The technical dimensions that need to be covered by the Live+Gov application for performing the functions of the mobility Use Case are depicted in Figure 6. The connecting lines between the dimensions and the concepts depict that they are contained in each other. So, for example the dimension of activity recognition is performed by components of the mobile toolkit and components of the service toolkit. Therefore, activity recognition contains elements of the mobile toolkit and the service toolkit. The denominations of the components are taken from the architectural plan of deliverable D4.1.

Activity Recognition

The whole Urban Mobility Use-Case is based on the core Live+Gov feature of identifying the actual activity of the citizen: the detected activities are whether the citizen is walking, biking or taking the public transport facilities. If the citizen is using public transport facilities the system also identifies the correct bus- or tramlines. Depending on the actual activity of the citizens the system provides customised information about the traffic conditions and provides additional information about respective decision-making processes.

[6] Just as before in the general description how to implement the conceptual pillars technically, we resort to the denominations from the general software architecture having been defined in work package 4. They are described and illustrated there in great detail.

For the activity recognition functionality components of the mobility toolkit and the service toolkit work together:

Mobile toolkit:

Component C14 (Mobile Sensor Collection Component) collects the necessary sensor data that is containing information about the movement of the citizen. The sensors that are being applied are: Accelerometer, Gravity, Rotation Vector, Gyroscope, Magnetic field, GPS, WLAN, Bluetooth and GSM. Components of C15 (Mobile Sensor Mining Component) mine the retrieved data and identify the initial activity patterns of the citizens.

Service toolkit:

In order to backing up and extending data-analyses in the mobile toolkit more extensive data mining is performed on the Live+Gov server. Here, the system identifies more fundamental activity patterns like free-time activity or commuting (work-related). The active components for this task are C9 (Server Side Mining Component) providing the mining capacity, C8 (Sensor Data Storage) controlling the storage and primary content delivery functions that in the later versions are included in C7 (Personalised Content Delivery) organising the personalised content delivery.

Issue Reporting Service

The issue reporting service should enable the citizens to collaborate directly with the providers of public transport in terms of reporting damages and issues they come across and by giving textual input and so informing the authorities about their individual opinions. Reporting is taking place via the Live+Gov application by taking a picture of the identified damage and sending it directly to the authorities. Those receive the citizen input and can take care of the reported damage. Accordingly, the issue reporting service covers only collaboration of the type 1 and is not allowing the citizens to announce own initiatives (collaboration type 2).

The technical components implementing the issue reporting service are again located in both the mobile toolkit and the service toolkit.

Mobile toolkit:

Component C11 (Mobile Issue Reporting Client) organises the reporting process: citizens can take a picture, write a comment, and send both directly to the authorities. Component C11 adds further information to the message, which are the GPS localisation and the compass orientation.

Service toolkit:

Corresponding issue reporting components are part of the service toolkit. Components of C1 (Issue Reporting Service) receive the reports; components of C2 (Issue Distribution Service) distribute the reports to the correct addressees; and components of C3 (Issue Updating Service) organises the feedback to the citizen.

Input/Data Analyses

Essential to the Live+Gov solution is the policy-support feature. The retrieved sensor data should portray the flow of the traffic from a user perspective and cover areas that have not been covered by the traditional survey tools. The Live+Gov system will be able to observe what happens outside and between the public transport facilities. Aggregated over a longer period of time and enriched by personal information of the users the provider of the public transportation in Helsinki, Helsinki Region Transport (HSL), can use this additional information for adapting their traffic infrastructure and improve their planning process.

The technical components, which are executing this functionality, are located in the service toolkit. Components of C8 (Sensor Data Storage) store the retrieved data and prepare it for further usage. Components of C9 (Server Side Mining) analyse the stored data and mine them for substantial information.

Visualisation

The functionalities as well as the respective inputs and outputs of the running Live+Gov system need to be visualised. This applies for the mobile device as such as well as the web-application that is backing up the mobile components and is providing more extensive information. Furthermore, the authority's interface of the Live+Gov system needs to be visualised as well.

Accordingly, the citizens' side will be covered by component C13 (Mobile eGovernment Dialogue and Visualisation) in the mobile toolkit and by component C18 (Web Application for eGovernment Dialogue and Visualisation). The authority's side will be covered by component C4 (eGovernment Dialogue and Visualisation) in the service toolkit.

Communication (technical)

In order to implement these functionalities these components need to communicate with each other, which has to be safeguarded by a number of APIs. According to the architectural setup of the technical requirements communication internal to the system needs to be established between the service toolkit and the web toolkit, between the service toolkit and the mobile toolkit and the service toolkit and the storage. Furthermore, external communication needs to be established between the Live+Gov service toolkit and the servers of HSL. Components C10 of the service toolkit are providing internal and external communications.

3.1.4 Step 4: Communication Strategy

HSL is in permanent contact with the passengers that are using the public transport system. The basic form of communication is via the large passenger survey, which is conducted periodically. It asks the passengers explicitly for their opinion about the traffic infrastructure as well as for issues and annoyances when using it. Feedback possibilities are also given through the traditional media like the contact interface on the HSL website as well as more traditional contact possibilities via telephone and mail. In order to extend communication with the passengers, HSL is using the Live+Gov system to establish a constant flow of information between the people using the public transport and the authorities providing them.

3.2 Use-case 2: Maintenance – Eindhoven - Utrecht

3.2.1 Step 1: Aims and Targets

The year 2002 has brought important changes to political decision-making in the Netherlands. In this year, the national legislator has passed a number of acts, which are reforming the local level decision-making processes. The central aim was to bring politics closer to the citizens by giving the local authorities more power and, in particular, by strengthening those political forces that are closest to the citizens, which are the municipal councils. The core of the reforms consisted first of a clearer separation of powers between the local legislative and executives by not allowing the Aldermen (who have the positions of minsters responsible for executing policies in certain policy-areas) to hold council seats and therefore giving the Councils more effective supervising power.[7] The political role of the Council has also been strengthened by now having more extensive agenda-setting powers and an own secretariat, which is supporting the Council administratively and substantially.

For many Dutch municipalities this was the optimal opportunity to expand their participatory and involving approach when it comes to public decision-making. Hence, one could say that these municipalities have shared their new powers with their citizens and aim at giving them more direct democratic powers.

The Live+Gov use-case municipalities Eindhoven and Utrecht (Utrecht in particular) have decided not to restrict Citizen Participation to decision-making but to engage the citizens in concrete action, e.g. in maintaining the city and the municipality. The city of Utrecht, in particular, is currently developing an extensive participatory approach with transparency and collaboration measures implemented through a central web-application, with mobile applications facilitating citizen-government communication, and offline participatory events establishing personal relationships between Council members, civil servants, and the citizens being engaged in jointly forming the new participatory processes.

Accordingly, the Live+Gov solutions in the Urban Maintenance Use-Case concentrate on Advanced / Engaging Transparency and Collaboration Type 1 and Type 2 and on effectuating political participation.[8]

3.2.2 Step 2: Organisational Implementation

Advanced / Engaging Transparency supporting Political Participation

Citizen Participation has a long tradition in the Netherlands. This is also reflected in the fact that the citizens are well represented in the public decision-making process on the local

[7] In case of political or professional misconduct the Council can now dismiss one or several Aldermen more easily. Formally, the Council had already had this power but practically, the fact that it had to dismiss a member of its own institution proved to be difficult.

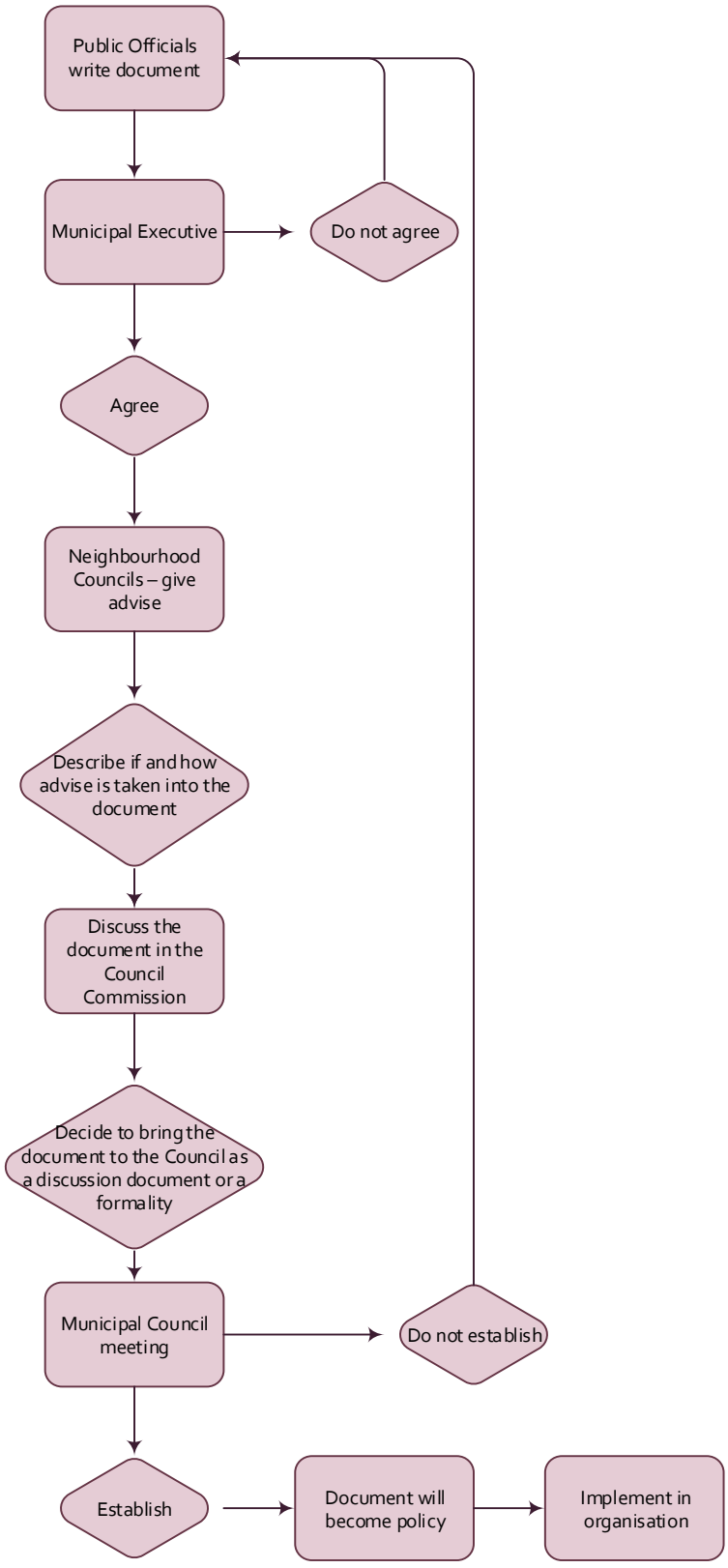
[8] Political participation is already institutionalised in municipal decision-making.

level. Citizens are represented in the policy formulation before the proposals are introduced to the Council for political debate as well as in the adoption stage when the Council debates the completed proposal in its respective specialised committees. In the policy formulation stage the citizens are taking part first, through “Neighbourhood Councils” and second, the “Council Commission”. On the policy adoption stage the citizens have the opportunity to appear and speak in front of the Council committees dealing with a proposal and working on the final legislative text.

Figure 7 illustrates this: The three governmental bodies are all involved in making a policy. Public Officals write the document (by order of the Municipal Executive, which handles in order of the Municipal Council). More explicitly, an Alderman will serve as a principal for initiating a certain policy. This Alderman is the first ‘check’ for the Public Officials for the document. After this, the document is discussed in the entire Municipal Executive for agreement. If not agreed, public officals should improve the document. If the Municipal Executive agrees, the next step is the advise of the Neighbourhood Councils. The Neighbourhood Council consists of an (independent) group of citizens, entrepreneurs and representatives of organisations that are active in that specific neighbourhood. The municipality of Utrecht for example has a Neighbourhood Council of each of the 10 neighbourhoods of the city. The Neighbourhood Council can give advise to the Municipal Executive about neighbourhood matters.

Before actually being put on the agenda in a Council meeting, the document has also been discussed in a Council Commission. This Commission exists of Council members as well as citizens and can be seen as the ‘discussion’ meeting about the policy document. From this meeting, it is decided to bring the document to the Council as a discussion document or a formality. If it is a formality, the Council only votes to establish or not. If it is a discussion document, the Council discusses about the document in the Council meeting. Finally, if the Council establishes the document, it will become policy and thus be implemented in the municipal organisation. Public Officials will comply to this policy.

Figure 7: Standard decision-making process in Dutch municipalities



Accordingly, the participation pillar of Live+Gov's Citizen Participation approach is already well established. However, improvements can be made in the publication of the divers participation possibilities, the announcement procedures when people can speak in front of the Council and how they can apply for this, the type of decision-making procedures are taking place and at which point in the respective procedure they are. Therefore, Live+Gov pool all the relevant information on a newly developed web-application presenting all of this information on one sight.[9] Hence, the existing participatory processes are supported by Advanced / Engaging Transparency.

Collaboration Type 1 and 2

The City of Utrecht is following the City of Eindhoven in introducing collaborative Citizen Participation. However, while the City of Eindhoven focuses on collaboration type 1 in the policy-field of maintenance, the City of Utrecht is pursuing an even more advanced approach by introducing collaboration type 2 meaning that the citizens can announce a specific activity for improving or embellishing the municipality. This can either be by gardening and planting brownfields in the city, by organising events and festivities in the neighbourhood, or by renewing and renovating certain buildings or public areas in the neighbourhood. Live+Gov proposes a procedure for implementing this form of collaboration as shown in Figure 6 of the previous section.[10] The process demands a number of organisational and technical components already being in place: organisationally, the municipality has to agree on the principle range of collaborative measures meaning that it needs to define which activities the citizens can engage in; technically, there needs to be a mobile communication component installed that is enabling the communication.

[9] The visualisation and the functionalities of this web-application are presented in the last section of this document.

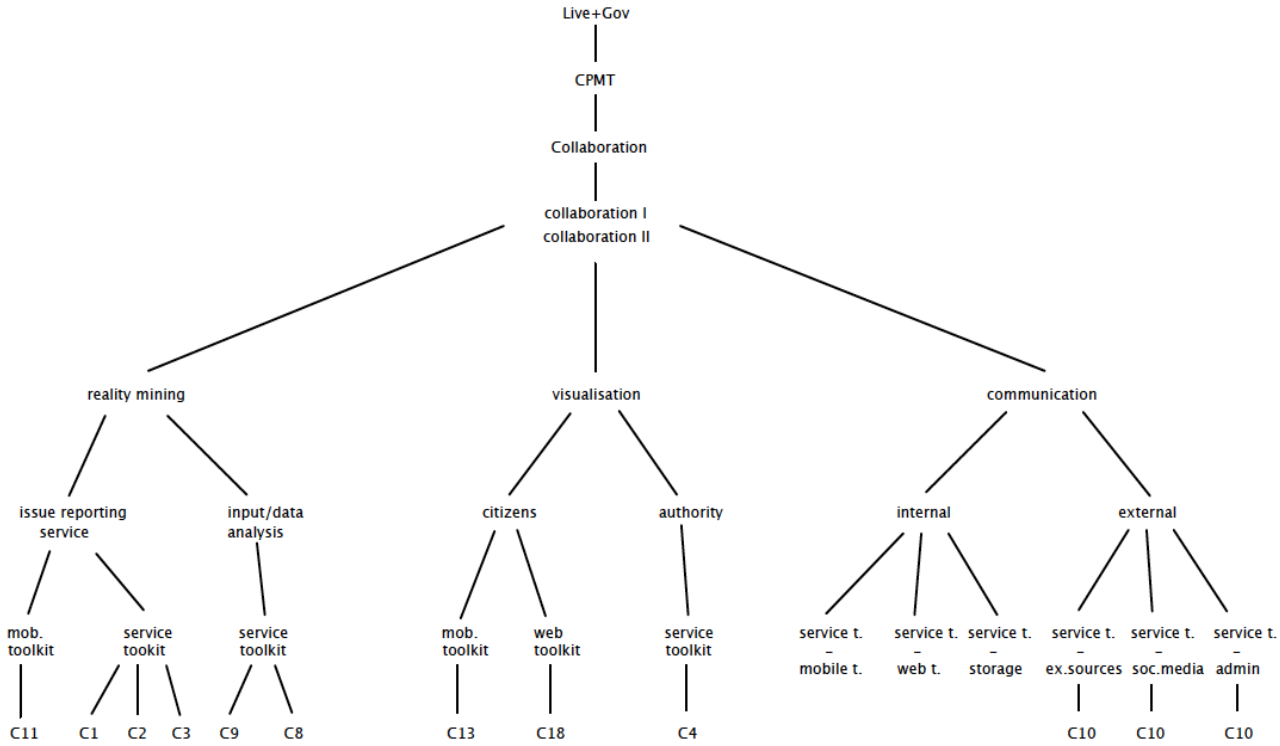
[10] It should be noted, however, that the deliberation about how to implement this collaboration process is not finished, yet.

3.2.3 Step 3: Technical Implementation

The Urban Maintenance Use-Case is implementing a comprehensive approach of Citizen Participation. Accordingly, the mobile component is only one of several components that are introduced. Effectively, this means that the already existing mobile application "BuitenBeter" is complemented and backed up by a web application giving extensive information to the citizens and the public authorities about possibilities of public participation and collaboration in the city. The data, which are presented on the web application are either supplied by the authorities themselves or delivered by the citizens through their mobile devices. Reports, announcements, opinions and feedback are displayed on the web application pages. Citizens and authorities can both use the web application for informing themselves about the actual proceedings in the context of Citizen Participation. Another innovation, which is implemented in the Live+Gov project, is an advanced feedback mechanism running through the mobile application BuitenBeter. New elements are introduced, which inform the citizens about maintenance standards and more and better direct responses and reactions by the authorities to the citizens.

Figure 8 visualises the connection between the Live+Gov concepts and their technical implementation for the entire Urban Maintenance Use Case. For a better understanding, the connecting lines between the different concepts denominate the different dimensions and components that are part of a concept. Accordingly, in order to implement type one and type two collaboration, three functional dimensions have to be differentiated that need specific consideration. These are the dimensions of "reality mining", "visualisation", and "communication".

Figure 8: Live+Gov concepts and technical implementation for the Urban Maintenance Use Case



Reality Mining

The Urban Maintenance Use-Case grasps and recognises the reality by two functionalities. On the one hand the users are asked to give their input about issues and damages they come across in their everyday lives. The corresponding issue-reporting-service of the Live+Gov application is installed through the Live+Gov application on the mobile device of the user and is backed up by server side functionalities executing the aggregated analyses of the retrieved data that usually need more computing power. In a collaboration type 1 setting, the application enables the citizens to take a picture of the damage that they want to report, add a short explanation (if they wish) and send the picture directly to the respective maintenance department of the municipality. The message does not only contain the picture and the textual input but is augmented by additional sensor data like the GPS location and the compass orientation. In a collaboration type 2 setting, the citizen can additionally choose and announce what kind of action they would like to take. This service is executed by components of C11 (Mobile Issue Reporting Client) of the mobile toolkit. Technical denominations refer to the architectural plan as developed in D4.1. The server side functionalities of the service toolkit store and mine the data and prepare them for further usage (for presentation on the web-application and for policy-support and for communication purposes on the mobile device). The active technical components of the sever side functionalities are C1 (Issue reporting service), C2 (Issue Distribution Service), and C3 (Issue Updating Service) in the service toolkit.

On the other hand the data that are acquired by the Live+Gov application should be used for policy support action. This includes a better account about the state of the municipality from a maintenance perspective. The system should enable the public authorities to better plan and execute their maintenance procedures and therefore improve their service to the citizens. Components of C9 (Server Side Mining) and C8 (Sensor Data Storage) in the service toolkit execute these functionalities.

Visualisation

The functional dimension of "visualisation" refers to bot the citizens and the authorities as well as to the presentation of the functionalities on the screen of the mobile device and to the fashion in which the retrieved data are presented to the users. Visualisation functionalities for the citizen concern the screen of the mobile device and the web-application that is offering further information about the actual developments in the city/municipality. Visualisations on the mobile device will be implemented by components C13 of the mobile toolkit and C18 of the web-toolkit. Both will be presented in greater detail in the remainder of this document.

Communication

Communication is understood here as communication between the different system components. In this context, internal and external communication has to be differentiated.

Internal communication between the different system components of the Live+Gov system needs to be established. This refers, in particular, to the communication between the service toolkit and the mobile toolkit, the web toolkit, and the storage, respectively. External communication needs to be established between the various Live+Gov components and external sources providing additional services to the system (administrative documents, social media, and map providers). External communication is implemented by components of C10 (SaaS Service Centre) in the service toolkit.

3.2.4 Step 4 - Communication Strategy

The City of Utrecht is showing how a successful communication strategy for improving Citizen Participation can be implemented. The city is, in particular consequently connecting mobile, online, and offline components for getting in touch with their citizens. The most convincing part of Utrecht's communication strategy is the fact that it is a participatory approach from the beginning of the process: after the authorities have decided to introduce more Citizen Participation they have opened the agenda-setting process to the public. This means that the city has informed the citizens about this determination but has immediately asked them what they think about it and where they would like to be participated. Citizens could issue their opinion about future participation online and, in particular on real-world events. There, they could learn about the new offer of a web-application serving as a central hub for all kinds of Citizen Participation and make suggestions how this portal as well as its

functionalities (technically and organisationally) could be improved. Accordingly, the citizens themselves could choose how tightly they would like to be involved in public decision-making and where they would like to collaborate with the authorities. To our knowledge, this is one of the most advanced forms – if not the most advanced form - of Citizen Participation in a municipality in Europe.

3.3 Use-case 3: Urban Planning

3.3.1 Step 1: Aims and Targets

The basic legal foundation of any form of Citizen Participation in Spain is the basic law LEY 7/1985 (from the April 8th). This law regulates the power distribution between the state entities and defines the role allocation between the Federal Stage and its provinces, municipalities and islands: it determines the obligations of the different entities and constitutes the financial and organisational preconditions, which are necessary for their execution. Accordingly, municipalities and provinces are given important regulatory and self-organising powers for accomplishing their tasks. If compared to other European countries these powers are far-reaching giving the municipalities and provinces high autonomy. This applies equally to the role of the citizens in municipal decision-making processes. In principle, they should be involved but the concrete modus operandi is left to the local authorities themselves. Consequently, the participatory rules of procedure are highly divers. One general observation that has been made in the project and elsewhere is that there are extensive possibilities for Citizen Participation in the Basque Country, in particular. They refer to

- Civil society participation in decision-making procedures of the city council (singular event)
- Civil society representation in various decision-making bodies of the city on a permanent bases
- Citizens' initiatives (requiring a certain quorum)
- Neighbourhood organisations

However, as it has already been outlined in [1] citizen participation in Spain (like e.g. neighbourhood initiatives) has been criticised as merely symbolic acts. As Rafael Ruiz de Zàrate, leader of the neighbourhood community of Victoria [8] for El País says, "citizen and neighbourhood participation today is symbolical. Everything the town hall does is a camouflage. They feign to take into account the citizen, but the real decisions are taken by them."[11] This indicates the fundamental problem that the thresholds for participation are very high and enable mostly established pressure groups and parties to influence decision-making. Direct and immediate policy-related political decision-making or individual collaboration is rarely possible.

[11] See other critical comments by Javier Muñoz, president of the neighbourhood association federation, quoted by [8] for El País and Eva Salaberría, expert on citizen participation in San Sebastián, quoted by Larrea (2008) for El País.

The municipality of Gorexola has currently no explicit participation processes in place: neither direct and individual nor group participation are currently institutionalised. Due to its small size communication about the municipality's development and the respective investments is done on a personal basis and on public hearings that are, however, only taking place very rarely [9]. Accordingly, Live+Gov is taking the opportunity to make suggestions for how to introduce a participatory process even in a small community using modern mobile technology. The core aim is to enable citizens to have their say in the decision-making about important infrastructural investments. Accordingly, Live+Gov enables political participation in the context of the question whether or not to build a bridge in the municipality. In a first step, Live+Gov envisages a consultative process of variant 2 meaning that the citizens should be asked for their opinion before the political decision is taken. Depending on the success of the trials and the way the citizen perceive these solutions they are institutionalised on a more permanent basis and on a larger scale. Therefore, the Urban Planning Use-Case has a highly explorative character.

3.3.2 **Step 2: Organisational implementation**

The political system of Spain, which provides decisive context factors for the participatory means applied, is characterized by a pronounced federalism, in which the different political and administrative levels have important and independent competences. In the aftermath of the promulgation of the Spanish constitution in 1978, 17 Autonomous Communities were progressively created. Their competences are fixed in the Statutes of Autonomy, which are laws in the function of regional constitutions. In the area of urban planning, the relevant administrative level is the Basque Autonomous Community, the federal state being concerned only indirectly, for instance when it comes to land ownership and the general criteria and principles of policy-making[12].

On the administrative level of the regional government, the *Diputaciones forales* have exceptionally extensive competences, due to their traditional self-government following the Foral System, which is particular to the Basque Country. They are the authority in charge of taxes and the Internal Revenue Service, which are distributed between the Basque government, the regional governments and the local entities[13] as well as to the central government following a regularly negotiated quota system (*cupo*). Just as the government of the Basque autonomous community, the foral level has its own legislative and executive institutions: the unicameral parliament *Juntas Generales* and the *Diputación Foral de Vizcaya*.

The relevant regional government for the use case, Bizkaia, is one of the three regions of the Basque country and includes the city of Bilbao, which is the capital of the region, and a

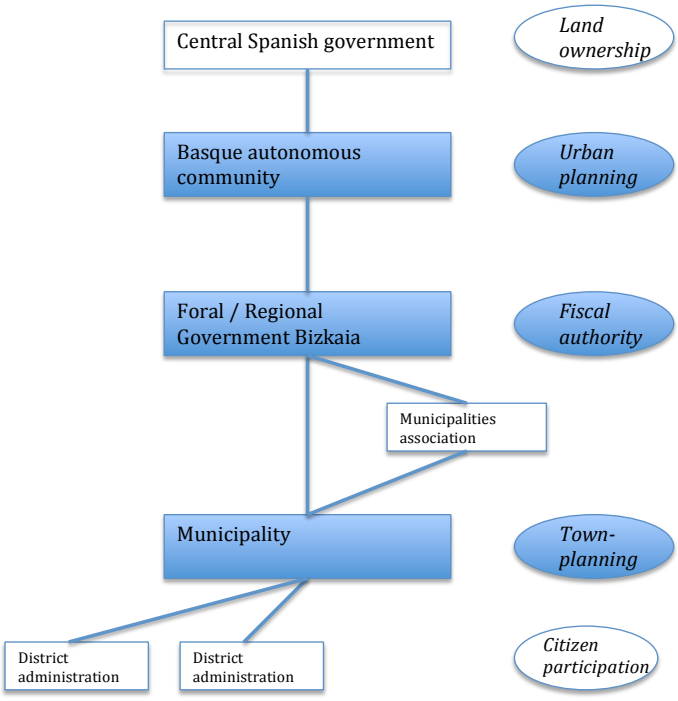
[12] For more information, see Ley Orgánica 3/1979, de 18 de diciembre, Estatuto de Autonomía del País Vasco.

[13] Regulated by the *Ley de Aportaciones*, the new law for the period 2012-2016 is currently being negotiated.

diversity of small and middle-sized municipalities. Due to the strong decentralization of the country and own historically grown administrative structures, the municipalities have different organizational structures and the legal autonomy to organize them. However, all of them are equipped with an *Equipo de Gobierno*, in charge of the everyday decision- making and a *Pleno*, the full meeting of the municipal corporation or council. According to the regulation of competences of local governments, urban planning is, broadly speaking, a competence of the municipalities (including urban development, housing, parks and landscapes, public roads in the urban area and the conservation of rural paths and ways).[14]

Apart from these three major administrative levels, whose autonomy and competences are legally guaranteed, small municipalities have the possibility to confederate with others in order to unify administrative capacity and offer services commonly in a pragmatic approach as a municipalities association (*mancomunidad*). This, for example, is the case for the municipality of Derio, which belongs with five other municipalities to the *Mancomunidad del Txorierri*. This administrative level does not have relevant competences in the area of urban planning. Moreover, bigger municipalities have administrative structures below the town-hall administration. Bilbao delegates duties and responsibilites to its districts (*distritos*), especially in the field of citizen participation. Coordinated by a department of the municipal administration, the *Servicio de Relaciones con la Ciudadanía*, they consist again of a plenary (*Consejo de Distrito/Pleno*) and an executive organ (*Comisión de Gobierno*).

Figure 9: The standard organisational setup



[14] Ley 7/1985, de 2 de abril, Reguladora de las Bases del Régimen Local.

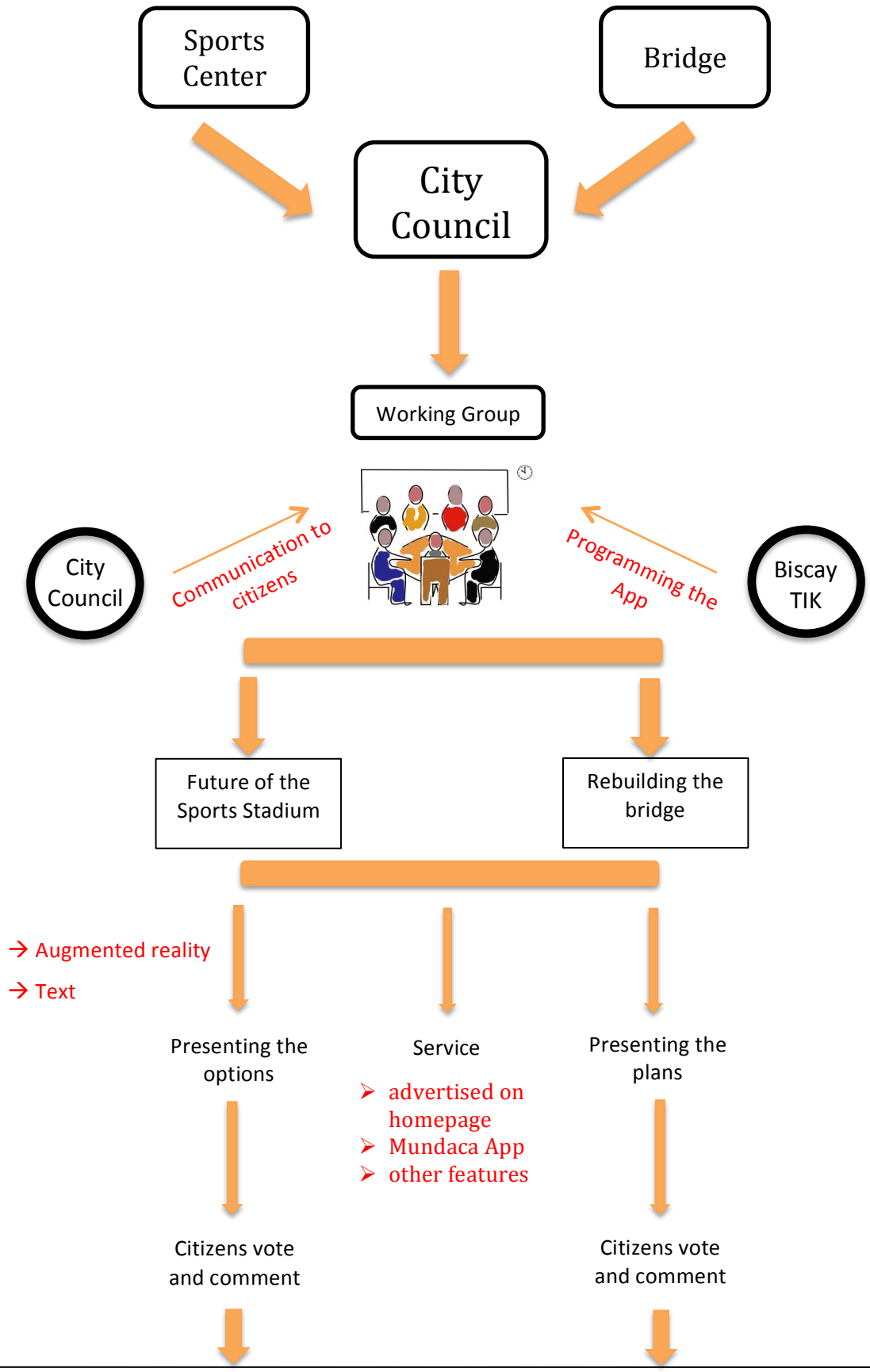
For any kind of Citizen Participation in the public infrastructure domain this results in a distinct problem: planning such infrastructure requires the cooperation of a number of administrative stakeholders, which are all represented in the decision-making process. Involving the citizens in this process is difficult as the respective decisions quickly become very complicated. For example, negotiating the budget of infrastructural project and determining the exact share of the different state entities as well as inferring the consequences for the general budget easily exceeds the capacity of the citizens.

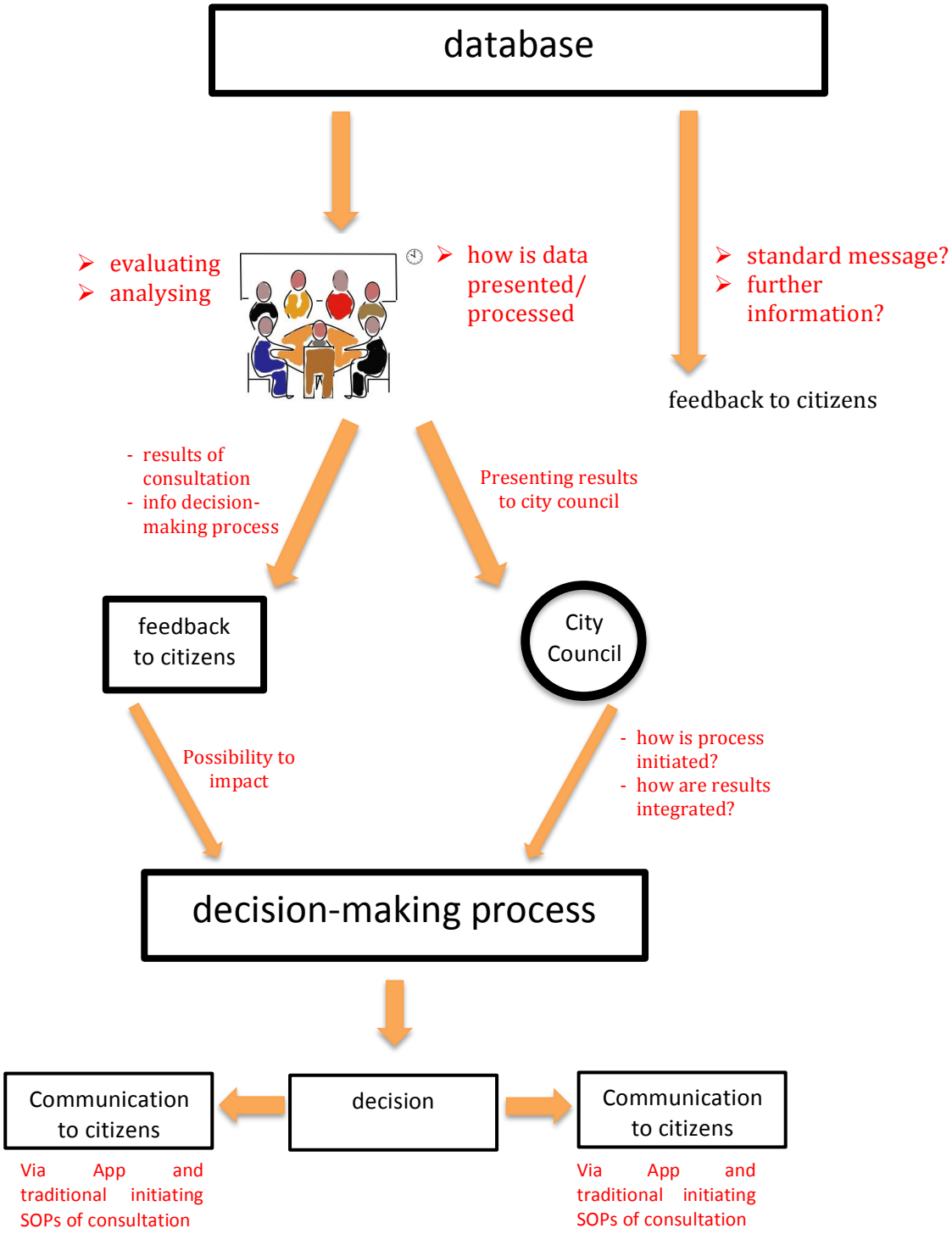
Therefore, public participation has to be granted when the most fundamental decisions are taken. This can take place at the lowest levels of the decision-making process, which is at the municipal level or the district level, respectively. Here, the citizens can be involved in the fundamental deliberations about future plans without being overburdened by the complexity of the following processes. Therefore, they become part of the policy formulation process and do not only obtain decision-making power but agenda-setting power as well: citizens initiate and decide about the municipality's policies.

Accordingly, Live+Gov is proposing the following procedure:

1. Once the Citiy Council has initiated a political debate this should immediately be opened up for the citizens. Public debate should be going on in parallel in the City Council and among the Citizens with online, offline, and mobile solutions (Live+Gov). Clear alternatives and choices need to be formulated.
2. The communication process is organised by a special working group consisting of experts implementing the communication plan (e.g. BiscayTIK providing the technical expertise in programming the AR application and producing the background reports about the participatory process, also managing the feedback processes)
3. Results of the participation process are prepared by experts and Council Members of the working group and presented to the Council
4. Council takes the respective decisions and communicates this to the citizens
5. The Council starts the technical decision-making process
6. The Working Group keeps the citizens updated about the decision-making process through the mobile AR application.

Figure 10: Use Case, BiscayTIK




database
evaluating
analysing
how is data presented/ processed
standard message?
further information?
feedback to citizens
- results of consultation
- info decision-making process
Presenting results to city council
feedback to citizens
City Council
Possibility to impact
- how is process initiated?
- how are results integrated?
decision-making process
Communication to citizens
decision
Communication to citizens
Via App and traditional initiating SOPs of consultation
Via App and traditional initiating SOPs of consultation

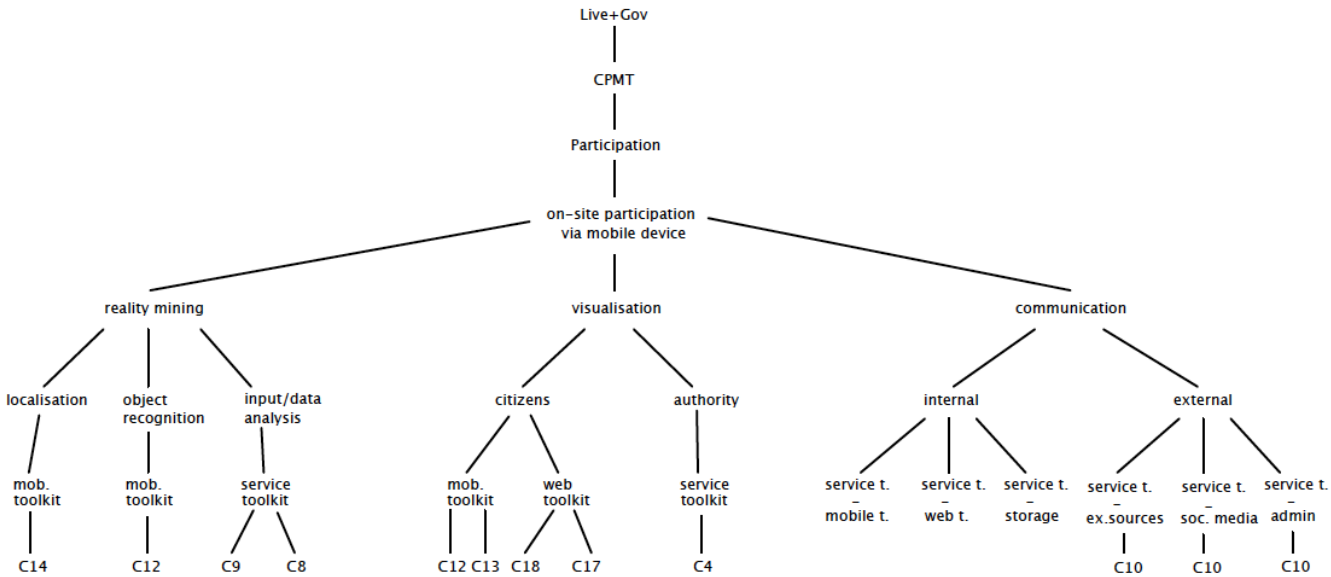
3.3.3 Step 3: Technical Implementation

In contrast to the other two Use Cases, the Urban Planning Use Case has a specific emphasis on a clear participation functionality enabling citizens to take part in a poll where they can express their opinion and attitude towards a specific infrastructural plan of the municipality. They should be enabled to view the plan via "Augmented Reality" and make a choice concerning the configuration of the plans. In a later stage of the Live+Gov system should provide clear statistics about the extent of citizen participation enabling the public authorities to base their decisions on the participatory process.

The first prototype of the mobile application as well as the respective participatory process will be set up in the municipality of Gordexola. The results of this system will provide important insights for how establishing similar processes in other municipalities.

Figure 11 visualises the connection between the Live+Gov concepts and their technical implementation. For a better understanding, the connecting lines between the different concepts denominate the different dimensions and components that are part of a concept. Accordingly, three functional dimensions have to be differentiated that need specific consideration in the Planning Use Case. These are the dimensions of "reality mining", "visualisation", and "communication". They are presented in the following Figure 11:

Figure 11: Live+Gov concepts and technical implementation for the Urban Planning Use Case



Reality Mining

The functional dimension of "reality mining" consists of three separate sub-dimensions. In order to enable on-site participation the Live+Gov system has first to recognise the actual location of the user and connect the location with the concrete participation functionality. This localisation is executed by components of C14 (Mobile Sensor Collection) in the mobile toolkit and is done with the help of internal sensors like GPS and compass. Second, the object or the open space, respectively need to be recognised by the system. Once this is done, the plan of the building or the respective infrastructural is projected onto the screen of the mobile device. This is done by the components of C12 (Mobile Augmented Reality Client) of the mobile toolkit. Third, in order to enabling the public authorities to base a decision on the participatory process, the input provided by the citizens needs to be recorded, aggregated, and summarised. Statistical calculations need to identify the socio-demographic characteristics of the citizens that have participated. This adds further information for the public authorities about the sentiments of different parts of the concerned population. The concrete features that will be recorded are the number of participants, their age, their gender, the area of their neighbourhood. The results of these calculations are included in a report about the mobile participation process that is then fed into the decision-making procedure about the infrastructural plan. Eventually, the data that is passively recorded by the system can be augmented by additional textual input by the citizens themselves. Their comments and suggestions will then be added to the final report about the participatory process.

Visualisation

The functionalities as well as the respective in-and-outputs of the running Live+Gov system need to be visualised. On the one hand the citizens need to be presented the infrastructural plan, be guided through the participatory process and be presented additional information about the complete participatory process on the mobile device. This applies as well to the web-application that is backing up the mobile system. Eventually, the service to the authorities needs to be visualised. Visualisations on the mobile device are implemented by components C13 (Mobile eGovernment Dialogue) in the mobile toolkit. The augmented reality functionality is additionally implemented by components of C12 (Mobile Augmented Reality Client) of the mobile toolkit.

The corresponding web-application is fulfilling the same functionalities as the mobile application but has a much broader scope. Whereas the further is meant to grant the citizens an initial access to the participatory process, the web-application is designed to give deeper information about these processes and other consultative and participatory offers made by the municipality. It also offers a much greater informational basis about the infrastructural plan and provides background information about the planning process and the respective personnel dealing with it. The web-application is implemented by components C18 (Web Application for eGovernment Dialogue and Visualisation) and C17 (Web-Application for Augmented Reality Configuration) in the web toolkit.

Please note that a web application is not envisaged in the testing phase of the Live+Gov project. The first focus is to demonstrate the functioning of the system and the usefulness to the municipality. Once public officials declare their interest, existent web services can be utilised to implement the web application. The same refers to the visualisation for the public authorities, which will be implemented by components of C4 in the service toolkit.

Communication

As in the other two Use Cases, internal communication needs to be established between the different system components. External communication needs to be established between servers and systems of the administration and other external resources. The communication requirements are similar to the other Use Cases. A more extensive explanation can be found in the respective chapters.

3.3.4 Step 4: Communication Strategy

At the time of writing there is no explicit communication strategy adopted in the Urban Planning Use-Case. However, it is envisaged to organise consultation events during the lifetime of the Live+Gov project, which are informing the citizens of Gordexola how to use the Live+Gov application. There, the citizens will also have the possibility to discuss and evaluate the usefulness of the application giving important hints about how to proceed with follow-up projects in the region.

4 Visualizations in the Live+Gov project

Presenting information on computers and communicating via the Internet or mobile phones comes with distinct opportunities for improving our everyday lives. Transforming any kind of information into a machine readable format delivers huge amounts of data enabling us either to capture the actual state of the world around us in real-time and adapt our behaviour and/or is allowing us to store the data and use it for more profound descriptions of this world recognising developments that have not been known to us before. This explosion of digital communication and the corresponding deluge of huge amounts of data is also a great challenge for those who want to draw their conclusions from the data: how finding the right and the interesting information in this universe? Which data contain the right information and which methods could one apply to extract it? Humans are generally not able to sufficiently capture computer readable data. Therefore, one has to find presentation and analysis techniques, which can be handled by humans and are providing analytical possibilities that can be executed by non-experts as well. Basic numerical presentations and statistical calculations are the basic form of this kind of analysis; however, they are mostly too abstract as well and mostly manageable by experts in data-analysis.

Accordingly, the last years have witnessed the emergence of data-mining and visualisation techniques. Apparently, data mining and data-analysis are tightly interconnected with the methods that are visualising the derived information. Therefore, [10] call this discipline visual analytics, which “is a multidisciplinary field that includes the following focus areas:

- Analytical reasoning techniques that enable users to obtain deep insights that directly support assessment, planning, and decision making.
- Visual presentation and interaction technique that take advantage of he human eye’s broad bandwidth pathway into the mind to allow users to see, explore, and understand large amounts of information at once
- Data representations and transformations that concert all types of conflicting and dynamic data in ways that support visualization and analysis
- Techniques to support production, presentation, and disseminations of the results of an analysis to communicate information in the appropriate context to a variety of audiences” ([10]: p.4).

This section outlines the basic trajectories of visualisations and the presentation of information in the Live+Gov context. More specifically, it relates the Live+Gov functionalities and the corresponding data that are collected by the Live+Gov applications to analytical techniques that are assisting the citizen and the authorities. The former is profiting by obtaining valuable information fitting to their actual demand. The latter is profiting by optimising their policy-planning e.g. in the domain of the public (traffic) infrastructure. Due to large quantities of the incoming data they need special analytical tools that allow the analyst to extract the necessary information quickly and accurately. This section presents

basic visualisation methods allowing for this. It is organised as follows: it summarises first some fundamental principals, which are guiding potent visualisations. This discussion is located on a very abstract and aggregated level and needs to be broken down to an implementation level. Therefore, the section presents concrete questions guiding the implementation of analytical and descriptive visualisations and presents solutions for the specific Live+Gov context. In other words, the visualisations, which are shown here are aligned to the Live+Gov concept and fit the project's purpose. The concrete implementation will, however, deviate to some extent. This section will also refer to the Live+Gov use-cases if visualisations are already in place as for example in the Urban Maintenance Use-Case.

4.1 Principles for developing visual representations

Visualisations of information and visual analytics have one principle purpose: they shall enable machine-human interaction while easing the life of an analyst. It shall facilitate high quality human judgement about human activities and interaction based on digitalised data delivered by machines while minimising the investment of the analyst's time [10]. Although tabular presentations of acquired data are the first starting point of extracting information from them, even the simplest ones are too abstract for immediately understanding correlations, interactions and dependencies in their structure. Statistical calculations are a means for their better understanding provided that the analyst copes with statistical models and the interpretation of statistical figures. Accordingly, in order to saving the analyst from acquiring this knowledge, adequate visual presentations allow for rapid conclusions and quick reactions.[15]

[10] name six basic ways in which information visualization amplifies human cognitive capabilities: 1) by increasing cognitive resources, such as by using a visual resource to expand human working memory, 2) by reducing search, such as by representing a large amount of data in a small space, 3) by enhancing the recognition of patterns, such as when information is organized in space by its time relationships, 4) by supporting the easy perceptual interface of relationships that are otherwise more difficult to induce, 5) by perceptual monitoring of a large number of potential events, and 6) by providing a manipulable medium that, unlike static diagrams, enables the exploration of a space of parameter values. The following Table 5 summarises them and is giving further explanations.[16]

[15] An appealing example is presented [11], p. 13-14.

[16] Taken from [10], p.48

Table 5: How information visualisation amplifies cognition

1. Increased resources	
High-bandwidth hierarchical interaction	The human moving gaze system partitions limited channel capacity so that it combines high spatial resolution and wide aperture in sensing the visual environments.
Parallel perceptual processing	Some attributes of visualizations can be processed in parallel compared to text, which is serial.
Offload work from cognitive to perceptual system	Some cognitive inferences done symbolically can be recoded into inferences done with simple perceptual operations.
Expanded working memory	Visualizations can expand the working memory available for solving a problem.
Expanded storage of information	Visualizations can be used to store massive amounts of information in a quickly accessible form (e.g. maps).
2. Reduced search	
Locality of processing	Visualizations group information used together, reducing search.
High data density	Visualizations can often represent a large amount of data in small space.
Spatially-indexed addressing	By grouping data about an object, visualizations can avoid symbolic labels.
3. Enhanced recognition of patterns	
Recognition instead of recall	Recognition information generated by visualization is easier than recalling that information by the user.
Abstraction and aggregation	Visualizations simplify and organize information, supplying higher centers with aggregated forms of information through abstraction an selective omission.
Visual schemata for organization	Visually organizing data by structural relationships (e.g. by time) enhances patterns.
Value, relationship, trend	Visualizations can be constructed to enhance patterns at all three levels.
4. Perceptual influence	
Visual representations make some problems obvious	Visualizations can support a large number of perceptual inferences that are extremely easy for humans
	Visualizations can enable complex, specialized graphical computations
5. Perceptual monitoring	
	Visualizations can allow for the monitoring of a large number of potential events if the display is organized so that these stand our by appearance or motion.
6. Manipulable medium	
	Unlike static diagrams, visualizations can allow explorations of a space of parameter values and can amplify user operations.

In order to facilitate and support human cognition, visual representation needs to follow some basic principles. Although the discipline has amplified its knowledge in the last decade,

there is still the need for further research and better, more suitable as well as more easily understandable visualisation methods. Very basic and largely heuristic principles were proposed for example by [11] and demand that "graphical displays (of data) should

- show the data,
- induce the viewer to think about the substance rather than about methodology, graphic design, the technology of graphic production, or something else;
- avoid distorting what the data have to say;
- present many numbers in a small space;
- make large data sets coherent;
- encourage the eye to compare different pieces of data;
- reveal the data at several levels of detail, from a broad overview to the fine structure;
- serve a reasonably clear purpose: description, exploration, tabulation, or decoration;
- be closely integrated with the statistical and verbal descriptions of a data set" [11], p.13).

More fundamental principles have been proposed by [12] and are discussed by [10]. They root their approach in the question how visual representations enable cognition and therefore adapt to the principles of human thinking. These are the

- "**Appropriateness Principle** – the visual representation should provide neither more nor less information than that needed for the task at hand. Additional information may be distracting and makes the task more difficult.
- **Naturalness Principle** – experimental cognition is most effective when the properties of the visual representation most closely match the information being represented. This principle supports the idea that new visual metaphors are only useful for representing information when they match the user's cognitive model of the information. Purely artificial visual metaphors can actually hinder understanding.
- **Matching Principle** – representations of information are most effective when they match the task to be performed by the user. Effective visual representations should present affordances suggestive of the appropriate action" [10]: p. 71).

[10] add two principles from another prominent cognitive scientist Barbara Tversky [13], which are the

- **Principle of Congruence** – the structure and content of a visualization should correspond to the structure and content of the desired mental representation. In other words, the visual representation should represent the important concepts in the domain of interest.
- **Principle of Apprehension** – the structure and content of visualization should be readily and accurately perceived and comprehended.

While being rather abstract and generic, these principles provide orientation when creating project-specific guidelines for visual representation. In the specific Live+Gov context these principles are:

- **The Appropriateness Principle in the Live+Gov context**

Information is provided in a mobile context meaning that the visual representation needs to take into account that the citizen/user is confronted with a number of distorting factors capturing some of their attention. Accordingly, the "Appropriateness Principle" has high relevance here as it says that the "Live+Gov" citizen should not be overwhelmed with a large extent of information, which are not necessarily in relation with the task, which is performed. It is challenging, however, to determine the amount of information that could be conveyed. According to the conceptual approach of Live+Gov, transparency of decision-making procedures as well as background information concerning certain policies is key for closing the gap between the citizens and their state. Nevertheless, it is recommended here that the amount of information communicated on the mobile device should be limited. Accordingly, it is highly advisable to have parallel web-sites and web-applications providing more extensive information with more extensive and elaborate visualisations as a backup. Hence, applications as well as their visual representations should be restricted to participatory and collaborative processes and restrict the background information e.g. by providing links and hints to where more profound information could be obtained.

- **The Matching Principle and the Principle of Congruence in theLive+Gov context**

Once the citizen leaves the mobile context, the **"Matching Principle"** and the **"Principle of Congruence"** become more important. The information still needs to be presented appropriately but they need to be subject-specific. In other words, the information conveyed and communicated should be clearly separated by thematic dimensions. In the Live+Gov context, two distinct approaches can be chosen: first, one could distinguish the three concepts of Citizen Participation combining and aggregating information about participatory processes distinct from collaborative ones. One drawback of this is that much information is doubled as for example fundamental decision-making procedures or similar developments in different cases. Such repetition of information may fatigue the users lowering their motivation for obtaining more information.

A second possibility could be to distinguishing between substantial policies and distinct decision-making processes and giving all the relevant and available information to the citizens about these substantial issues. Accordingly, the citizens can choose a specific policy and obtain all available information about it. The problem here is that the citizen is easily overburdened by too much information in complex decision-making procedures. Therefore, this type of visualisation could be used in a kind of "expert mode" or "advanced search".

A possible combination of both variants is creating a common, policy-specific presentation capturing the whole decision-making process and offering all relevant information that are necessary for understanding participating. Furthermore, linking the information to specific environments can be implemented for the different forms of Citizen Participation.

Therefore, the policy-specific information representation serves as the background for further visualisations filtering the specific information that should be communicated. A combination of both setups is flexible enough for responding to the actual demand of the citizens – whether they are interested in specific information about a decision-making process or want broader information about how and in which context to participate.

Clearly, most of these principles in the Live+Gov context aim at the citizens trying to facilitate their access to a rather abstract domain. However, Live+Gov is also considering the policy-making side in terms of supplying the public authorities – the political sphere as well as the executive (administration) - with better information and improving their policy-making capacities. Here, Live+Gov assumes the addressees for these policy-support services are experts in their domains. Therefore, we assume further that the demands for the visualisation and the information representation are different. Live+Gov uses the **Principles of Apprehension** and the **Principle of Congruence** as the main points of orientation. This means that one should focus on more advanced visual representations, which are being based in theoretical reasoning and explorative data-analyses. In other words, the experts dealing with the Live+Gov tool should be able to test certain hypotheses they are having about their domain and answer certain questions. Accordingly, they should be able to define variables for correlating them and answering certain hypotheses.[17] This would enable them to detect anomalies in their municipality and guide them in their pursuit to improve the state of the municipality. Thus, developing visualisations and visual representations for the public authorities should focus on presenting data analysis and enabling simple statistical correlations for obtaining advanced descriptions of the municipality. Nonetheless, these applications could also be made available for citizens inviting them to participate in analysing their environment. Such tools are available and have been presented previously. Examples are Protovis [14] or CommentSpace [15] enabling the user to produce own graphs and statistics. “ReVision” introduces more flexibility for the user in designing visualisations for their own purpose [16]. In contrast to these visualisation tools, the “framework and class library (GAV-Flash) implemented in Adobe’s ActionScript” is providing a solution web-enabled applications for geo-visual analytics” [17]. Other examples are the “ManyEyes”, Sens.us, and “e-local” platforms [18].

4.2 Implementing the Principles

While these principles are indicating the broad directions for adequate visualisations they are not detailed enough for guiding their concrete implementation. Accordingly, Live+Gov formulates four questions, which should guide the process of setting up visualisations. The

[17] One example would be to define the variables “reports about maintenance issues” and “municipal districts” and obtain a statistic where citizens report most or least damages. This allows inferences about the reasons of these circumstances.

questions correspond to the guidelines for visualisations as they are proposed in the literature (e.g. [19]). These questions are:

1. What is the aim and the purpose of the visualisation?
2. What is the visualisation-context?
3. Who is the targeted audience?
4. Which data should be visualised?

In the following, this section identifies four basic aims and purposes corresponding to the pillars of Citizen Participation, which are being aimed at in the Live+Gov use-cases, specifies particular contexts, infers the targeted audience and describes the data that is to be visualised. Based on the combination of these four factors the section presents powerful and popular visualisation techniques serving as a baseline for visualisations in the Live+Gov use-cases and, in particular further applications outside the project.

4.2.1 **Visualising Transparency: concept**

- *Aim and purpose: Providing substantial and procedural background information*

Information is the fundament for any meaningful participatory and collaborative process. Citizens need to be informed about the internal decision-making processes and tasks of the legislative and the executive for being able to form an own opinion and participate in these processes. Accordingly, he first aim and purpose is to establish an adequate information system for the citizen, which is capable of providing both substantial and procedural information. The citizen should be able to learn about the motives and the reasons for certain policies and political decision as well as how such a formal decision-making process is performed, which actors and stakeholders are involved and which powers they have. They should get access to formerly internal documents and reports as well as to public data. This would enable the citizens and professional stakeholders to conduct own research about policy processes in order to articulate their interests publicly. Above all, such a transparency system should show possibilities how the individual citizen can participate in the process by announcing consulting and participatory events and describing the modalities of the respective participation. Furthermore, it should also enable the citizens to contribute substantially, e.g. if they have additional information to share.

- *The visualisation context*

Such an information platform visualises all the available information for communicating with the public. Therefore, on the one hand it is directly connected to the basic data-sources in the administration of the municipality. On the other hand it serves as the source for all other participatory services. In other words, all subsequent participatory or collaborative services utilise data from this platform and present them in their specific context.

- *The targeted audience*

The targeted audience is the general public including individual citizens as well as professional stakeholders like journalists, researchers or lobby groups who are interested in the decision-making of the municipality.

- *The data base*

Visualisation in this context refers to presenting two distinct forms of data: first, procedural information is providing basic but abstract knowledge of how the administration is working in utilising organigrams and decision-trees. Second, the information portal should grant easy access to substantial documents like policy-studies, reports, expert hearings, financial calculations, budgets etc. Furthermore, it should provide access to internal data-sets enabling interested stakeholders to run own calculations and do their own research.

4.2.2 **Visualising Transparency: Implementation**

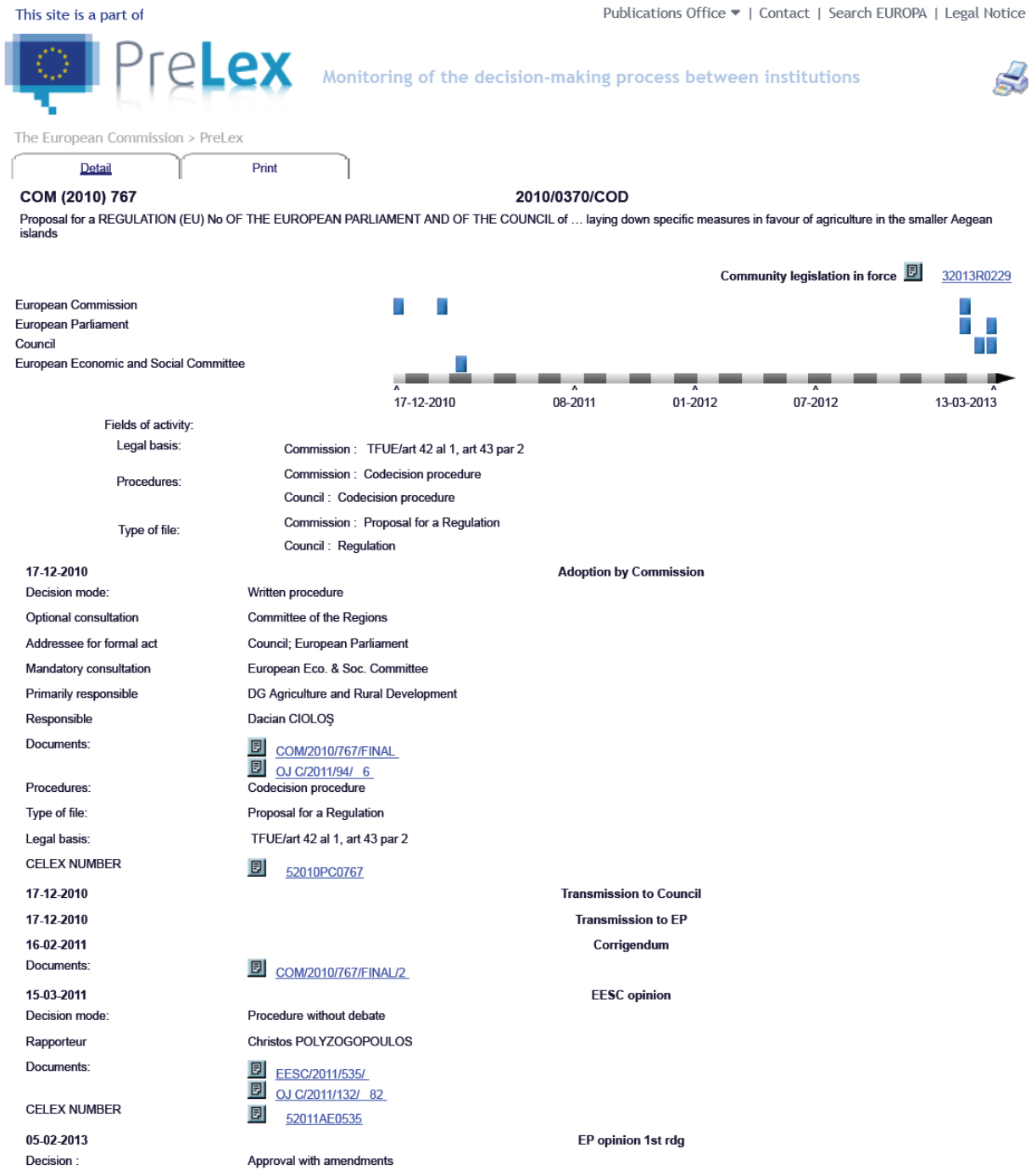
Possible models for such a transparency platform are the various legislative information platforms by the European institutions.[18] The most established ones are the Official Journal and its online presentation "EUR-Lex", the Legislative Observatory OEIL by the European Parliament, and PreLex the central decision-making information system of the European Commission. EUR-Lex is summarizing and aggregating the complete secondary legislation of the European Union and containing all concluded regulations, directives, decisions, recommendations, and opinions. Additionally, EUR-Lex includes "the Treaties, legislation in force, the document series of the European Commission, the case-law of the Court of Justice and the Court of First Instance and the collection of consolidated legislation" [20]. OEIL contains all pending and concluded legislative, non-legislative, and budgetary processes involving the European Parliament since the beginning of the fourth legislature in 1994. It also publishes documents related to all decision-making processes referring to the European Parliament itself. As a matter of fact, OEIL is having a greater emphasis on parliamentary discussions and therefore covering committee discussions in greater detail. PreLex keeps record of all legislative and non-legislative proposals initiated by the Commission and submitted to the other institutions for final decision. It is documenting each stage of these decision-making processes, showing when they are taken, and is informing about the particularities of the different stages of decision-making, e.g. the decision modality. All three databases provide easy access to internal documentation of the processes and showing in detail how the decision-making procedures work simply by documenting when which

[18] Nation states are having similar services in place, of course

decision has been taken, on which legal basis the decision is grounded as well as how the decisions are motivated substantially.

We consider the Prelex database as the best suitable example to be matched to the Live+Gov purposes (a screenshot is presented below). A presentation like this captures the whole decision-making process at one sight and provides simultaneously substantial background information like policy recommendations, acting and responsible institutions and personnel. Knowing which policy-process they are interested in, citizens and stakeholders can easily collect all the necessary information and react accordingly.

Figure 11: Prelex excerpt



This site is a part of

Publications Office | Contact | Search EUROPA | Legal Notice

PreLex

Monitoring of the decision-making process between institutions

The European Commission > PreLex

Detail | Print

COM (2010) 767 **2010/0370/COD**

Proposal for a REGULATION (EU) No OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of ... laying down specific measures in favour of agriculture in the smaller Aegean islands

Community legislation in force 32013R0229

European Commission
European Parliament
Council
European Economic and Social Committee

17-12-2010 08-2011 01-2012 07-2012 13-03-2013

Fields of activity:

Legal basis:	Commission : TFUE/art 42 al 1, art 43 par 2
Procedures:	Commission : Codecision procedure Council : Codecision procedure
Type of file:	Commission : Proposal for a Regulation Council : Regulation

17-12-2010 **Adoption by Commission**

Decision mode:	Written procedure
Optional consultation	Committee of the Regions
Addressee for formal act	Council; European Parliament
Mandatory consultation	European Eco. & Soc. Committee
Primarily responsible	DG Agriculture and Rural Development
Responsible	Dacian CIOLOŞ
Documents:	COM/2010/767/FINAL OJ C/2011/94/ 6
Procedures:	Codecision procedure
Type of file:	Proposal for a Regulation
Legal basis:	TFUE/art 42 al 1, art 43 par 2
CELEX NUMBER	52010PC0767

17-12-2010 **Transmission to Council**

17-12-2010 **Transmission to EP**

16-02-2011 **Corrigendum**

Documents: COM/2010/767/FINAL/2

15-03-2011 **EESC opinion**

Decision mode:	Procedure without debate
Rapporteur	Christos POLYZOGOPOULOS
Documents:	EESC/2011/535/ OJ C/2011/132/ 82
CELEX NUMBER	52011AE0535

05-02-2013 **EP opinion 1st rdg**

Decision : Approval with amendments

4.2.3 Visualising Participation: concept

- *Aim and purpose: enabling participation in decision-making*

In the Live+Gov context, the participation in decision-making procedures is taking place via consultation (possibly co-governing) functionalities. In the Urban Planning use-case the citizens should be given the possibility to either co-decide about large infrastructural projects that have a significant impact on their municipality both in terms of budget and intrusion or at least to issue their reasoned opinion. In both the Urban Maintenance and Urban Mobility Use-Case citizens should have extensive feedback and commenting possibilities. Accordingly, the citizens as well as the authorities should learn about the participation process and its results as well as different characteristics of the voters and the extent of the interest among them. For the authorities this information is valuable for knowing about the acceptance rate concerning a project or certain issues in the public (traffic) infrastructure. Accordingly, they and can possibly adapt their policies. In any case, if governments are involving the citizens in their planning and are asking for their participation thy can claim increased legitimacy for their actions. However, information about the participatory process is equally important for the citizens who realize on which basis the administration is working: is their opinion shared by a majority? If this is the case and they realize that politics is not in line with the majority of the population they can draw their consequences for the next elections. Hence, the major purpose of visualisations in the context of political participation is to present the results by the participation process.

- *The visualisation context*

Political Participation in the Live+Gov project should be facilitated and supported by mobile technology. Accordingly, the crucial technology and visualisation technique is “Augmented Reality” (AR), which is projecting the infrastructural plan onto the screen of a mobile device. This presentation method is described and discussed in the deliverables of WP3. However, the AR visualisation needs to be embedded in a context that allows first for voting and second for viewing the voting results. This has to be enabled on both the mobile device as well as on a corresponding web application. Therefore, next to the AR view, both applications (mobile and web) should support first, geo-location presentations for identifying the spot of the project in the municipality; second, a numerical presentation of the voting process, and third, a visual presentation of the commenting functions of the applications.

- *The targeted audience*

Both the AR and the map view are targeted specifically at the citizens who should be supplied with easily understandable information about the respective infrastructural project. The presentation of the statistical data is crucial for both the citizens as well as the authorities. Therefore, the presentation techniques should contain analytical functionalities displaying correlations between different characteristics (variables) of the voting population. Therefore, the visualisation should enable the authorities to view different combinations of

variables for learning if there are patterns in the voting behaviour e.g. whether certain citizens have a particular concerns.

- *The data-base*

The data-base which is being used for the statistical presentations consist of sensor-data collected by the mobile devices: on the one hand the application saves the voting results, which are related to a specific infrastructural project and specific questions. On the other hand the application collects the comments that are given by the citizens. Both are combined with personal information about the users, which are their age, gender, and residence. These data serve as the basis for statistical correlations and subsequent visual analytics.

4.2.4 Visualising Participation: Implementation

Following the concept, two distinct visualisations are suggested: first, the results of the poll should be represented with the possibility of showing different voting rates according to different characteristics of the participants (age, gender). Second, votes and comments should be presented on a map for helping to understand the spatial distribution of votes or comments. This shows, whether citizens of a certain region or neighbourhood are particularly affected by certain issues that they either vote for or comment on. Third, citizens' comments should be visualised.

Discrete quantities of participation in bar-charts

The basic method of presenting the results of a poll is in simple tables showing how certain people have voted or how many people have commented on issues. However, these tables quickly become confusing when they are growing. Furthermore, they hamper the comparison between different values of interest. Therefore, simple visual representations are advisable. For the Live+Gov purposes, we consider bar-charts as the most promising method. Bar-charts as presented in Figure 12 are appropriate for illustrating small numbers of discrete quantities as it is depicted in Figure 12 but also e.g. voting results in polls. They become confusing, however, if too many quantities are to be presented. One possibility for integrating more information is by stacking the bar charts as presented in Figure 13. One application for this method is to defining certain sub-categories of variables of interest and showing their internal distribution. If, for example we are interested in the age-distribution of voters we can visualise this distribution within the single bars of the variables.

Figure 12: Bar-charts taken from the Helsinki Region Transport System Plan (HLJ) 2011 [6]

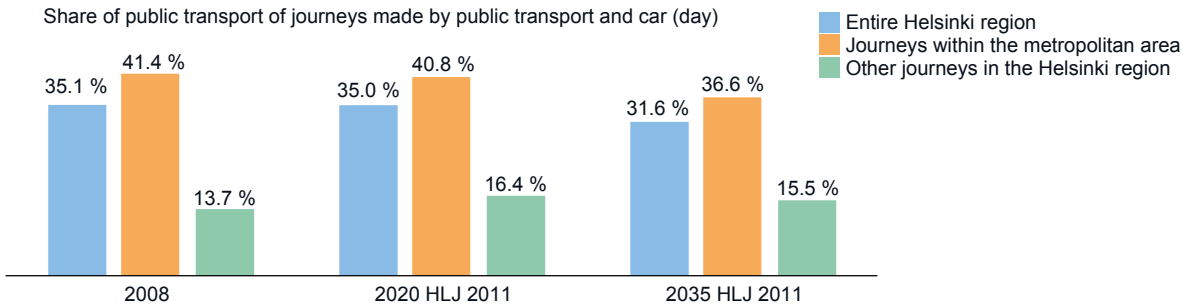
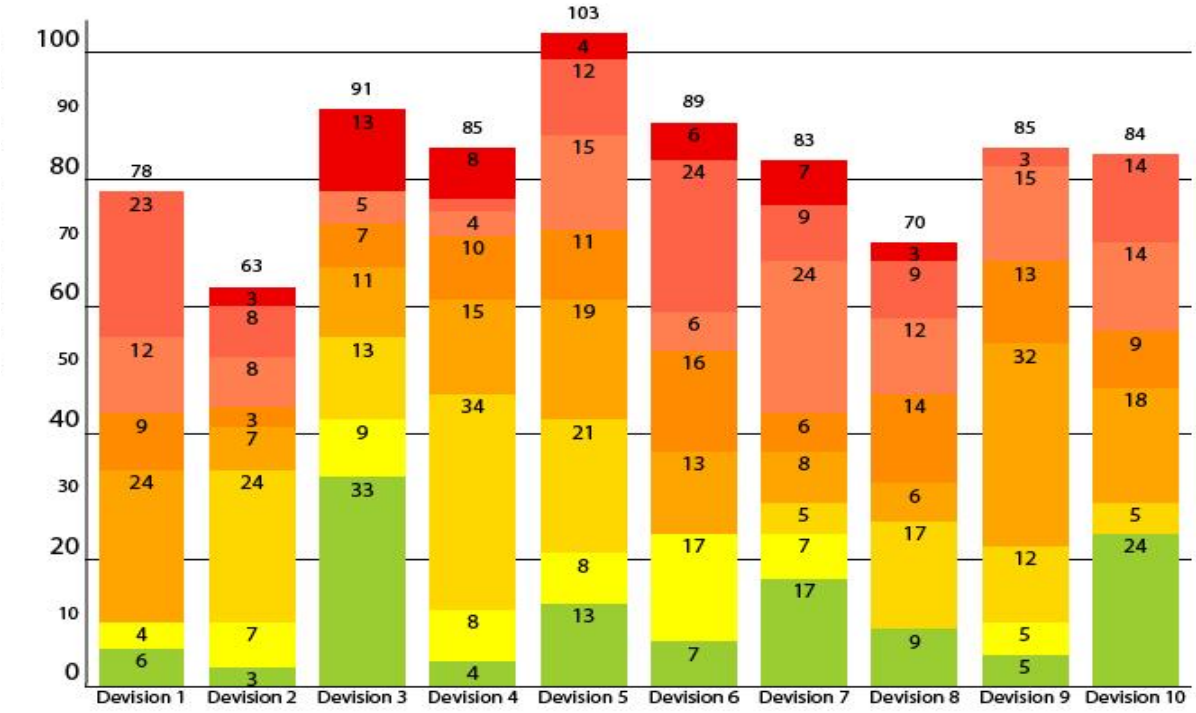
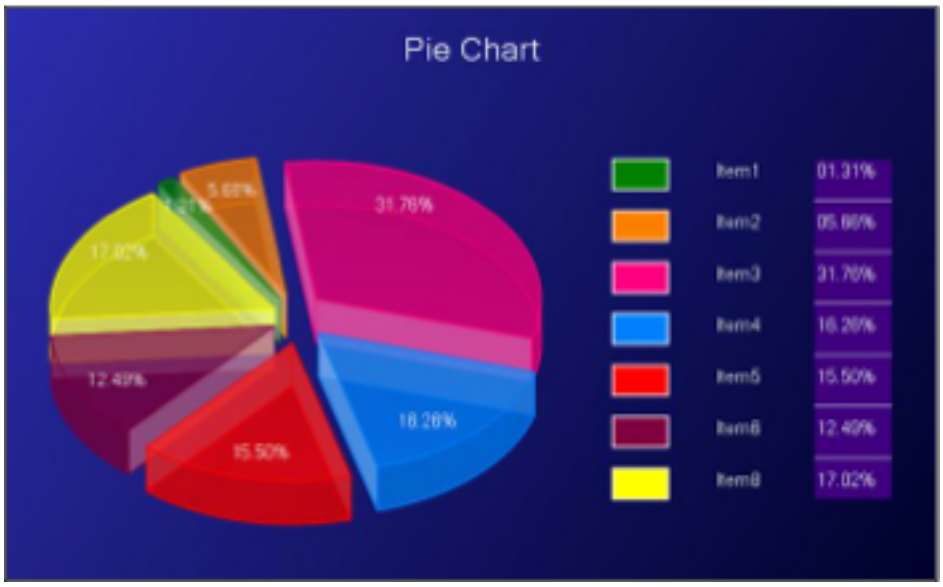


Figure 13: Example for a "Stacked Bar-Chart" [21]



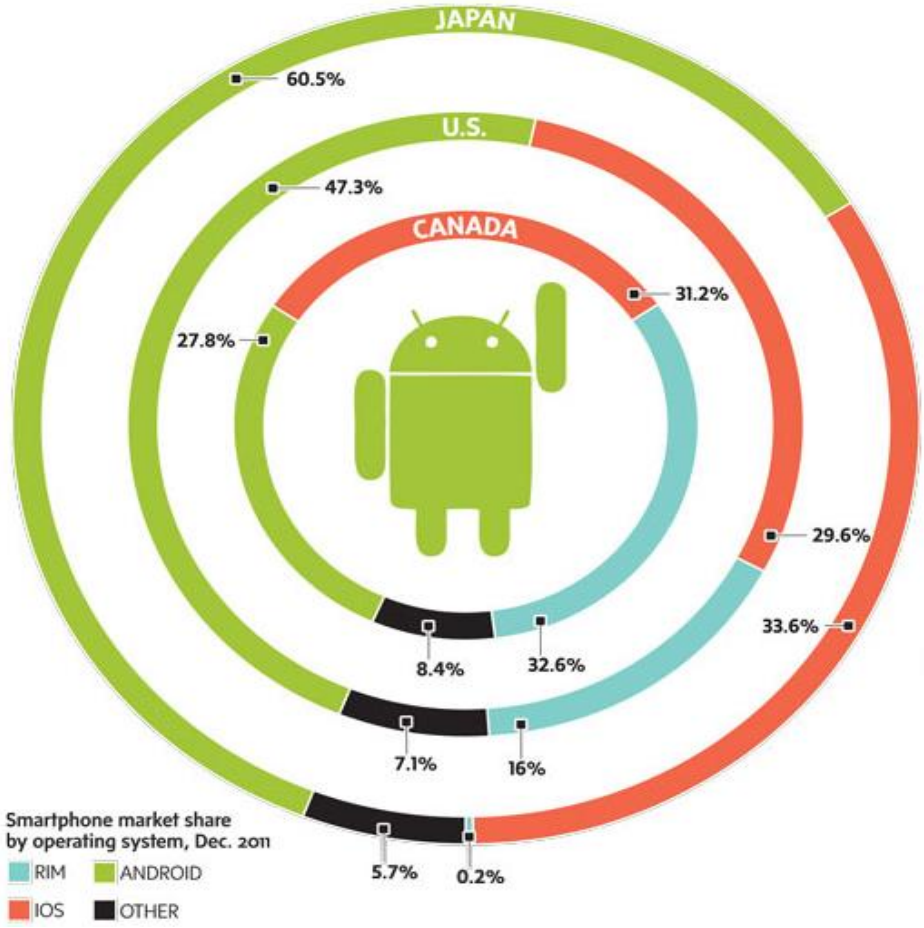
Another popular method for displaying discrete quantities is via “Pie-Charts”.

Figure 14: Example of a Pie-Chart [22]



Pie-Charts can basically be applied in a similar way as bar-charts although they are even less suitable for presenting many variables and provide less appealing in terms of comparability of the single variables. Therefore, a more appealing variant of the Pie-Chart is the “Ring-Chart” as displayed in Figure 15.

Figure 15: Ring Chart [22]

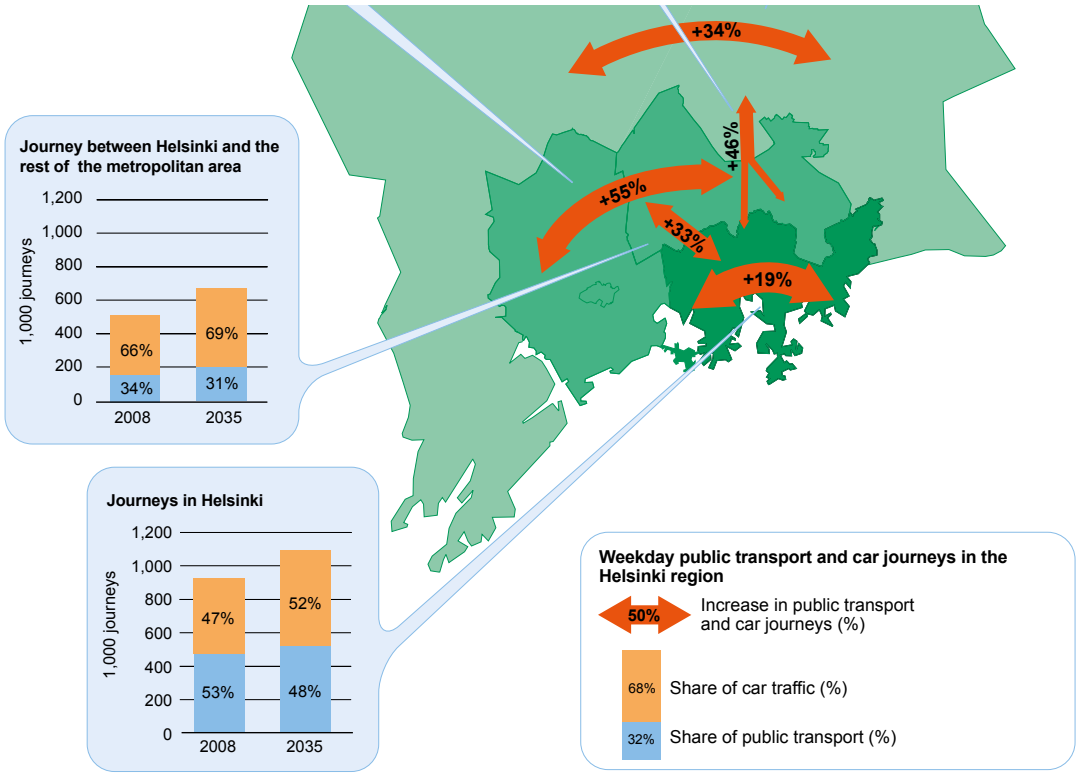


Ring-Charts are equivalents to “Stacked bar-charts”. The rings represent the single variables and the segments of the rings the sub-categories.

Identifying the geo-location of voters or commentators

While bar – and pie charts are enabling easy comparison of abstract variables it is important, in the Live+Gov context in particular, to show how people vote or comment per neighbourhood of the municipality. Accordingly, it is appropriate to combine the voting distribution with maps of the area in respect. One possibility is shown in Figure 16 where abstract figures are related to a certain area on a map.

Figure 16: Commuting Statistic from the HLI 2011 [6]



Another possibility is to colourise a map according to a defined colour-code. A simple example of a clear colour-code is presented in Figure 17 depicting the voting results in the 2004 U.S. presidential elections showing quickly how the majority of the voters have voted per state.

Figure 17: Example for a colour-coded map [22]

The informative content of these maps can be further increased by adding abstract charts. This is shown in Figure 18. [23] calls this a “Graduated Symbols”-map.

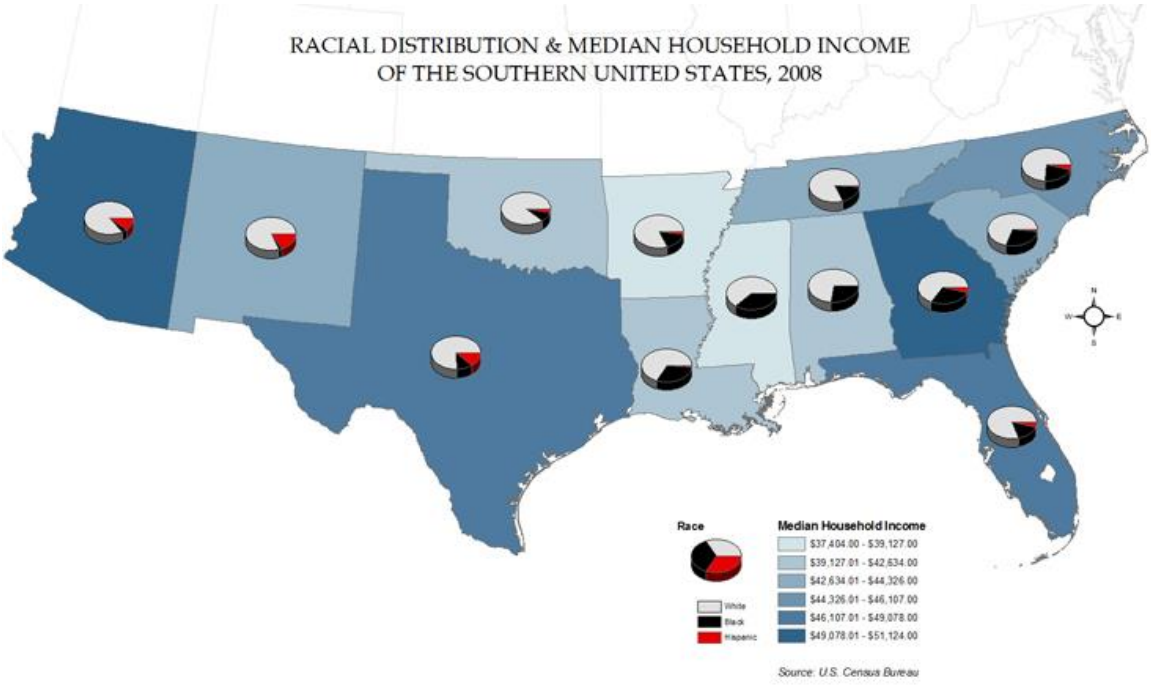


Figure 18: Colour-coded map including pie-charts containing further informative details (source: internal document)

A highly valuable method of visualisation is to combine abstract, purely numerical accounts of data like the bar – chart with more vivid visualisations like map views in different windows dealing with the same subject but taking different perspectives. This reduces the complexity per window and allows the spectator to concentrate on certain aspects of the visualisation. Adequate examples are shown in [24] and are accounted for in the Figures 19 and 20.

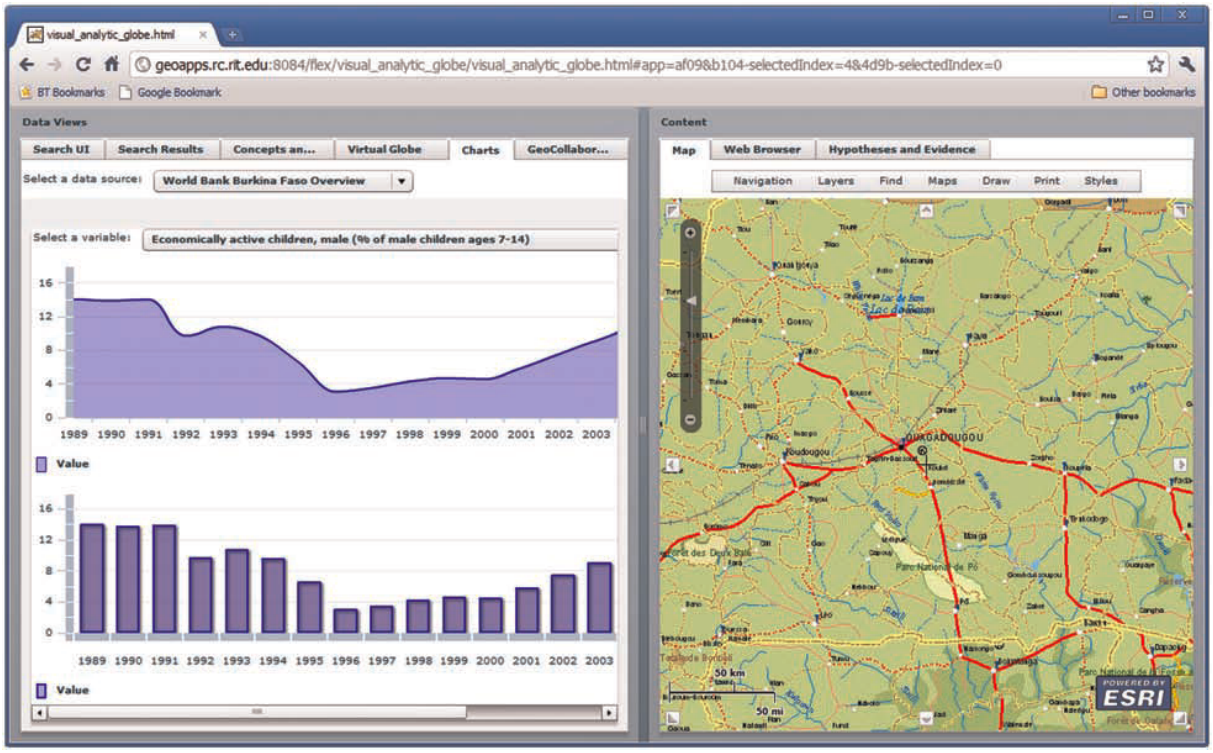


Figure 19: Integrated quantitative data representation

Figure 19 is an "integrated quantitative data representation of World Bank data related to economically active children in Burkina Faso". The left hand side allows abstract comparison of collected data while the right hand side of the visualisation provides a map view showing the region on a map. The analyst can so relate the abstract data to actual conditions more easily. Having more options to filter data and choose different map views further increases the analytical capability of the spectator.

Figure 20 shows the "Graduated Symbols" presentation method in a more advanced way juxtaposing different views about the same region and allowing for a better comparison of the data.[19]

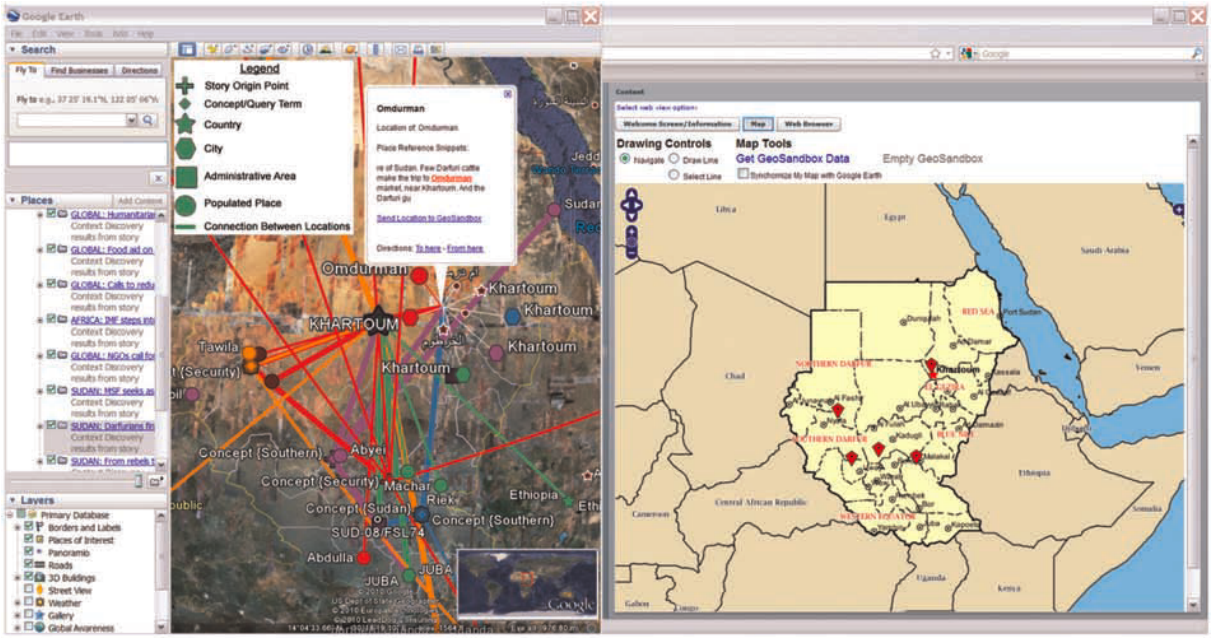


Figure 20: Graduated symbols

Visualising textual data

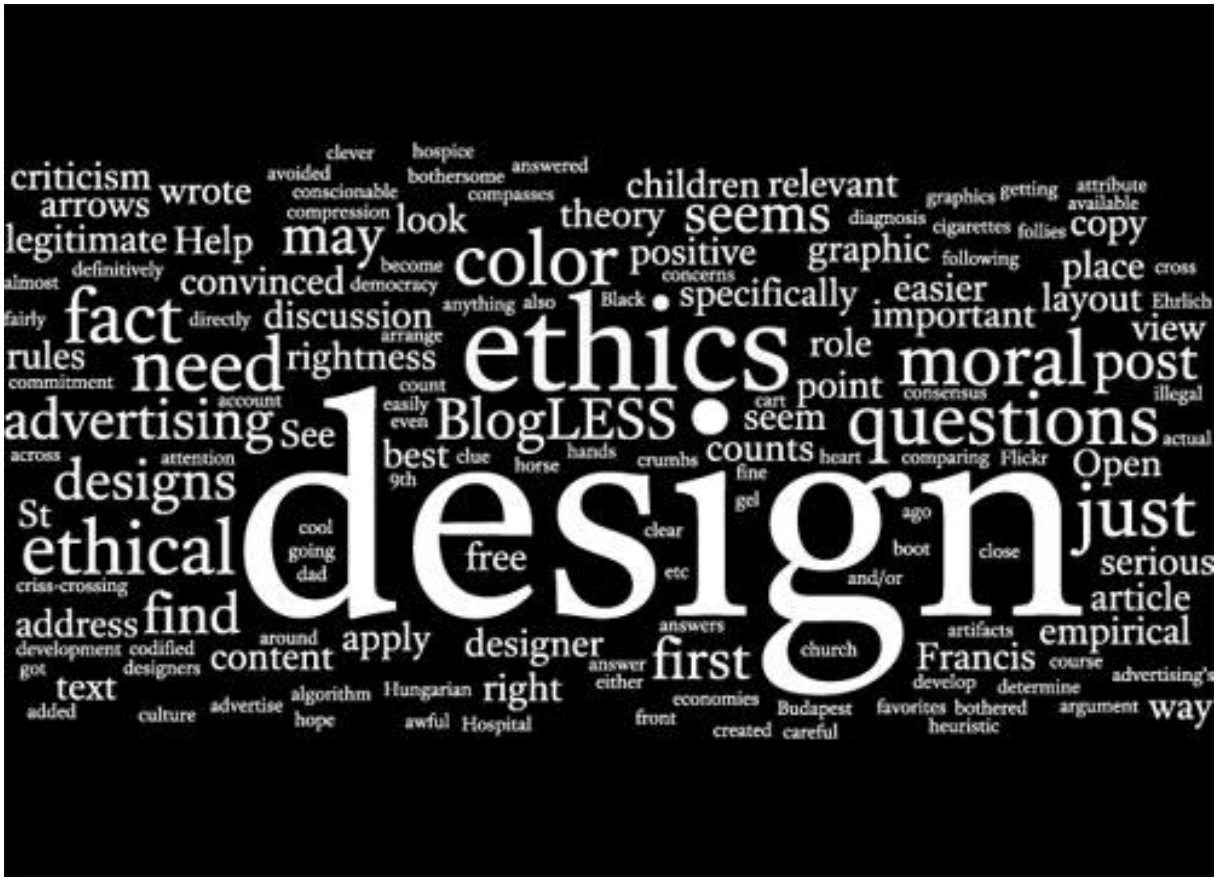
The third participatory data source that should be visualised is text, which is given by users of the Live+Gov application. In all three use-cases citizens are having the possibility to communicate opinions, sentiments, and comments either concerning a participatory processes, a maintenance issue, or any other information they would like to share with the public authorities or other users. While being highly valuable, these text messages are hard to handle by the authorities if they occur in high numbers: they are hardly structured, touch different topics, convey sentiments, are often erroneous, or simply nonsense. Accordingly, opinion mining and sentiment analysis methods are increasingly relevant for public authorities that are receiving and processing text messages. With the rise of social media and extensive communication and the deluge of input via communication facilities like facebook and twitter these methods are highly important for making good use of the data and harvesting them for the purpose of good communication between the citizens and the authorities.

[19] Figure 20 is taken from [24] and is a screenshot of a GeoSandbox view linked to google Earth.

Before resorting to some types of presenting and visualising the content of text it should be noted, however that this "research theme is based in long established computer science disciplines, such as Natural Language Processing, Text Mining, Machine Learning and Artificial Intelligence, Automated Content Analysis, and Voting Advise Applications" [25]. These subjects are not covered in this document and are only touched remotely in the Live+Gov project.

An easy but appealing visual method for distinguishing the main trends within a large corpus of textual information is to calculating the occurrence of certain words heuristically and presenting them in an adequate format. The resulting "wordclouds" could look like the one in Figure 21:

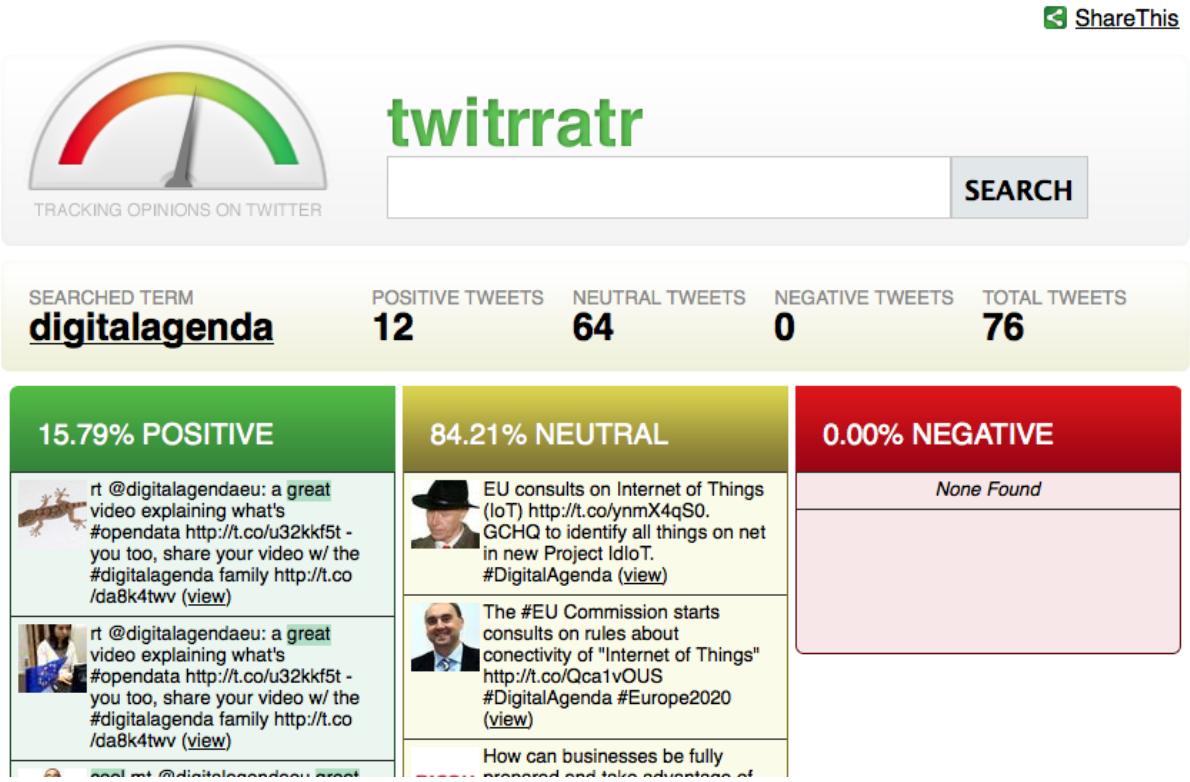
Figure 21: Example of a "Word Cloud" [25]



This wordcloud is produced with the "wordle.net" web-application, which is depicting the single words according to their heuristic occurrence and aligns them in a single picture. Clearly, the amount of information of these visualisations is extremely reduced and hardly useful for more sophisticated analyses. However, they represent an appealing first step in approaching the data and starting a more fine-grained analysis.

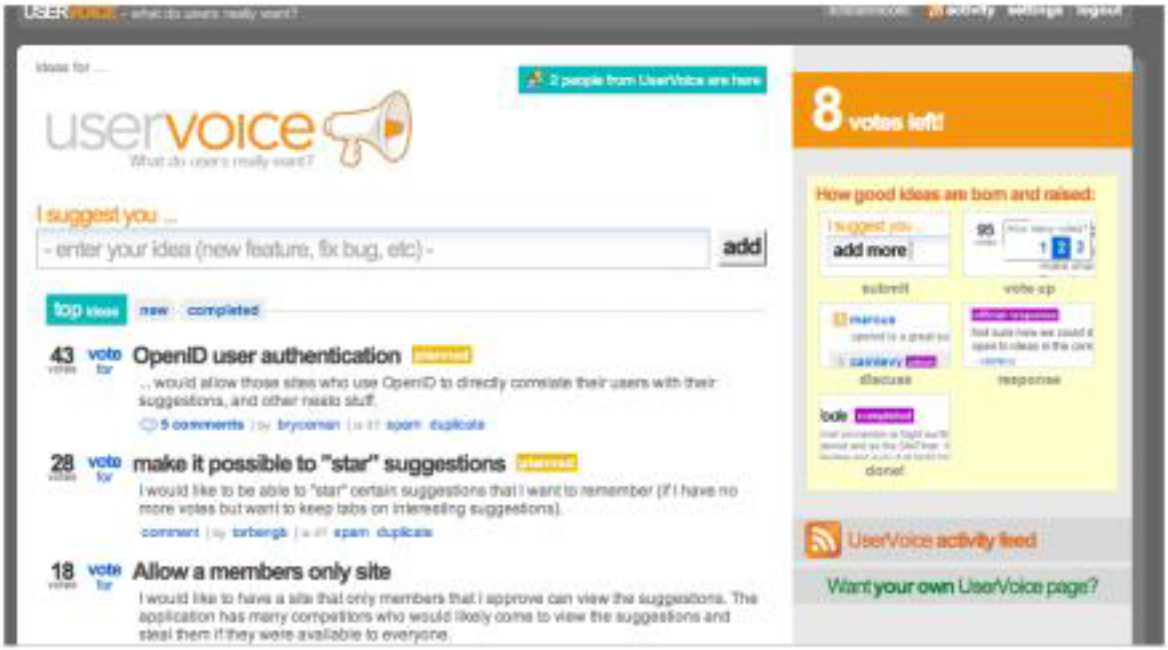
Another easy example for analysing textual input is by classifying their content according to a pre-defined glossary of words. They should recognise if comments are, for example, positive or negative in respect to a certain question or a vote. Such an application is, e.g. “twitrratr.com”, which produces a visualisation as presented in Figure 22:

Figure 22: Screenshot of a "twitrratr" [25]



Eventually, if the necessary algorithms are not available, an adequate way of classifying and rating textual messages is “by relying on human effort, by crowdsourcing and collective intelligence: people are not only submitting their opinions, but actually filtering them by signalling the most important ones. Tools such as “uservoice.com” allow customers to submit feedback and to rank other people ideas, thereby allowing the emergence of the most popular ideas” [25]. A screenshot is presented in Figure 23.

Figure 23: A screenshot of "uservoice.com" [25]



4.2.5 Visualising active Collaboration: concept

- *Aim and Purpose: Establishing Collaboration in maintaining the public infrastructure*

The first collaboration concept (of two) in the Live+Gov context refers to mobilising citizens for maintaining their public infrastructure. This can be implemented in two different ways: first, Type 1 Collaboration foresees a reporting infrastructure enabling the citizen to report damages to the public infrastructure. Except of taking pictures and sending them to the public authorities, the citizens are provided with a sophisticated feedback possibility showing them a comparison between desired states of the public infrastructure and the actual ones. Furthermore, the authorities are providing personal feedback to their comments and questions. Second, Type 2 Collaboration is enabling citizens to become active by proposing own maintenance projects (e.g. gardening)

- *The visualisation context*

In the Live+Gov use-cases this sophisticated maintenance tool as well as the respective organisational procedures inside the administration itself are part of a comprehensive strategy for establishing Citizen Participation per default in public decision-making. One of the Live+Gov use-cases – the City of Utrecht – aims at including the citizens into their decision-making from the beginning and making them an integral part of the respective organisational procedures. Therefore, Citizen Participation is understood holistically implementing all three pillars, Transparency, Participation, and Collaboration.

- *The targeted audience*

Active collaboration is addressing the individual citizen. Therefore, visualisation techniques and information representation need to aim at informing the citizens about collaborative projects, showing them where fellow citizens have reported issues and where they could become active with own projects. At the same time, the authorities can use the visualisation tools to manage Type 2 Collaboration projects representing them on a map and including status updates about their state.

- *The data-base*

According to these descriptions, the data being used for the visualisations are composed of sensor data from the mobile devices sent to the authorities when a maintenance issue is reported. Furthermore, the citizens can provide textual comments.

4.2.6 Visualising active collaboration: implementation

As it has been noted earlier, the Urban Maintenance Use-Case taking place in the City of Utrecht is implementing a comprehensive strategy of Citizen Participation with a heavy focus on Type 1 and Type 2 Collaboration. These functionalities are enabled by various visualisations that can serve as a role model for similar projects in the future. According to the visualisation concepts, the implementation focuses, in particular on providing the citizens with the necessary information enabling them to become active either by a report or by an own maintenance proposal. Visualisation of the textual information is also on the agenda of the use-case and has been presented in the previous section. Therefore, the presentation here focuses on visualisations enabling interaction between the citizen and the municipality.[20]

Facilitating citizen-government interaction: Citizens' corner

The collaboration platform in the municipality of Utrecht provides three specific views on collaborative projects and reports:

1. A global view accounting for all initiatives in the municipality
2. A local view filtering specific types of initiatives, accounting for their number and their location in the neighbourhood, and
3. A detailed view accounting for the complete information regarding an initiative,

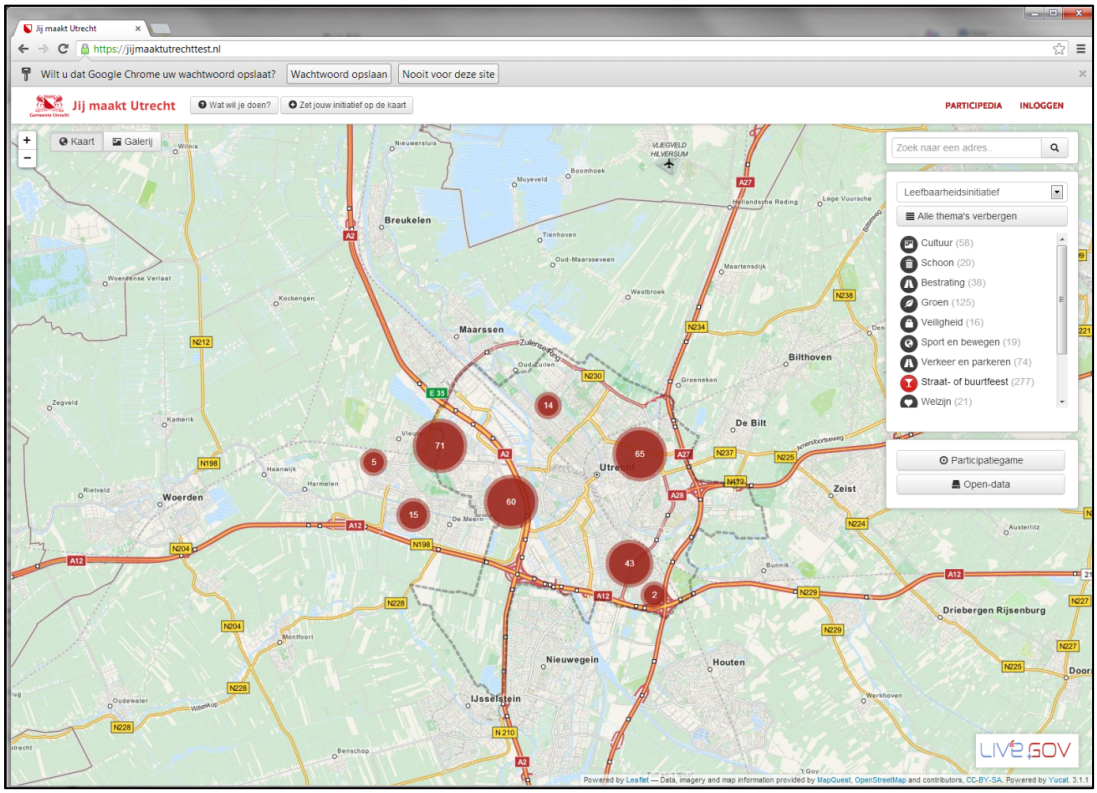
[20] The following descriptions are mainly taken from the deliverables of WP5 describing the Urban Maintenance Use-Case and their internal preparatory documents as for example [26].

Map view – Global View

The web- application is using a map presentation showing where initiatives are located in the municipality. Therefore, the application is optimised to make use of the entire screen as much as possible. A clear example of one of the design choices: the map is entirely screen-filling and the menus are 'floating' to make as much as possible use of screen-space for the map.

To keep the view well arranged within every zoom level, clusters of initiatives are visualised as disc shaped markers, labelled with the number of initiatives that are clustered. Also the size of the cluster is dependent on the number of initiatives within an area, which makes instant overview possible as visible in Figure 24.

Figure 24: Clusters and numeric total initiatives in a map view [26]



Map view – Local overview

It is made intuitive to zoom in and out on the map, which makes an overview of the entire municipality to a detailed view of the neighbourhood possible. This complies with the need to give users easy access to gather the information, for example 'what is going on in my neighbourhood'. Colour coded markers signal the type of collaborative project.

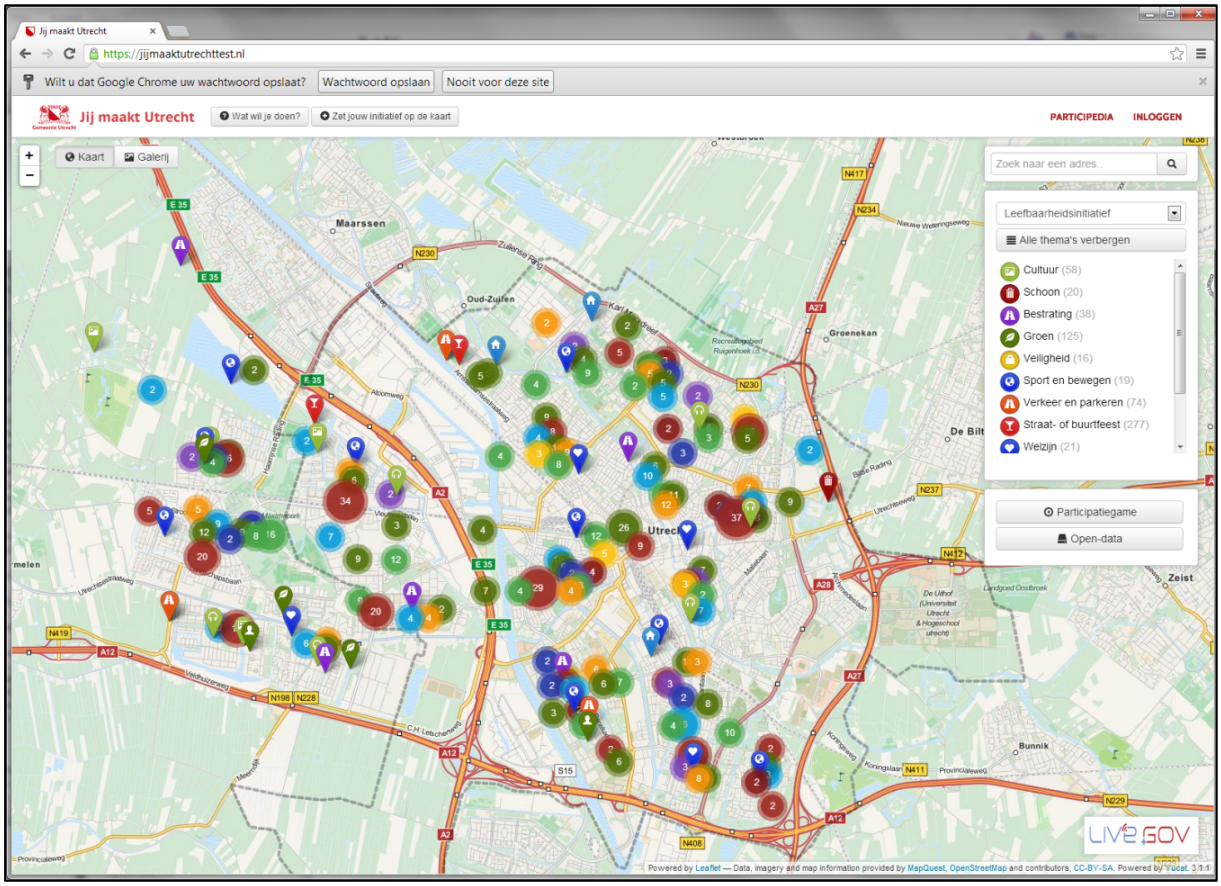


Figure 25: Jij Maakt Utrecht: Map view of initiatives [26]

Map view – Detailed overview

Once the user of the application has chosen an initiative for taking a closer look, they can click on the marker and open a new window containing the details of the initiative.

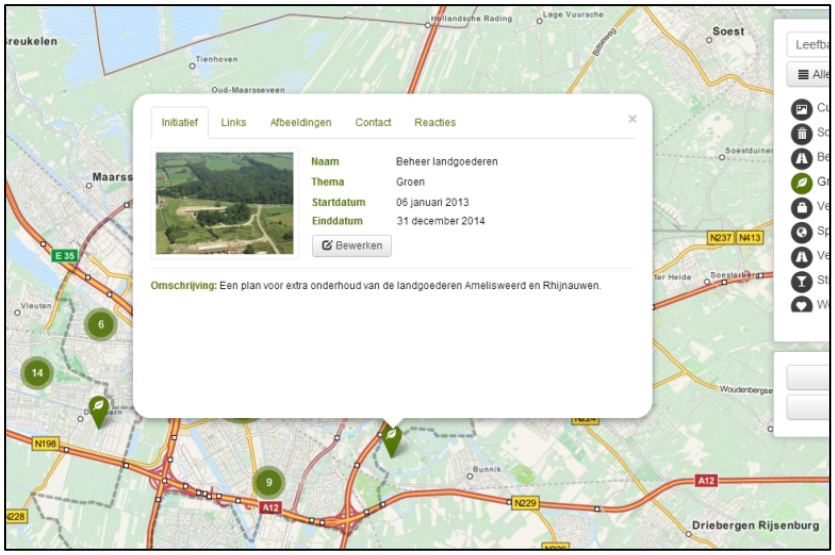


Figure 26: Detail view of an initiative: short summary of an initiative tab "Initiatief" [26]

The initiatives are categorised by their type, which are defined in advance. These types are:

1. Citizen initiatives – type for citizens to place their own initiative without an explicit role for the municipality
2. Co-maintenance – this includes public space that is maintained by a citizen, or a group of citizens. Support from the government is possible, but not necessary
3. Liveability initiatives – initiatives of citizens where the government provides financial support out of Liveability Budgets
4. Participation Projects – projects initiated by the government, where citizen can add influence in a certain way at a certain moment in time.

It also contains all necessary information for the user either to become active or to learn more about the ongoing projet. Each initiative has, in principle, an owner. This can be a municipality official in the case of participation projects, as well as a citizen or an employee of any other organisation. The owner manages the 'content' of his/her Initiative and is the contact person of that particular initiative (see 6). In the 'Management module' of the Webapplication, management functions are available to create, read, update and delete initiatives. This connects to the idea of 'user-generated content' in *Jij Maakt Utrecht*. Citizens can create and manage their own data. This can be compared to eBay, where the supplier is shaping his/her own advertisement, by giving it an appealing title, description and/or photos.

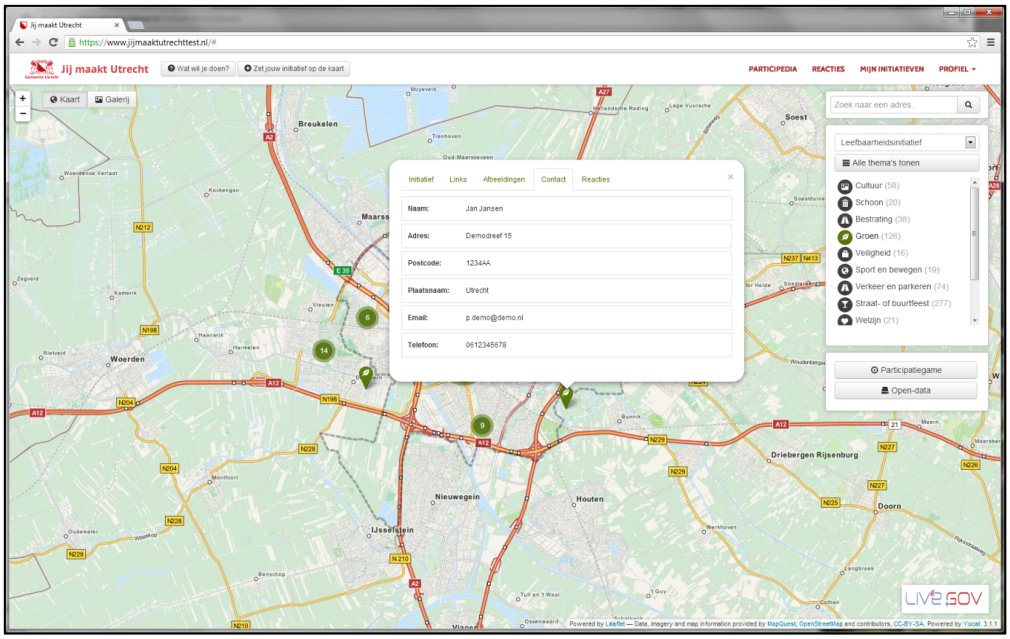


Figure 27: Detail view of an initiative: contact on an initiative in the tab "Contact" [26]

In order to facilitate eGovernment dialogue, engagement and interactivity, it is possible for anyone to give response to initiatives (see Figure 28 below). For this dialogue functionality the threshold is low on purpose: it is not necessary to register for the Webapplication to be able to give a response.

This is where interactivity between citizens, and between citizens and government is totally open and publicly visible. Citizens can comment on other citizen's initiatives, but it is also possible for the government to comment on citizen's initiatives and vice versa. In return, the government can explain their efforts and invite the citizen to add influence in this project. *Jij Maakt Utrecht* facilitates collaboration and participation between government and citizen.

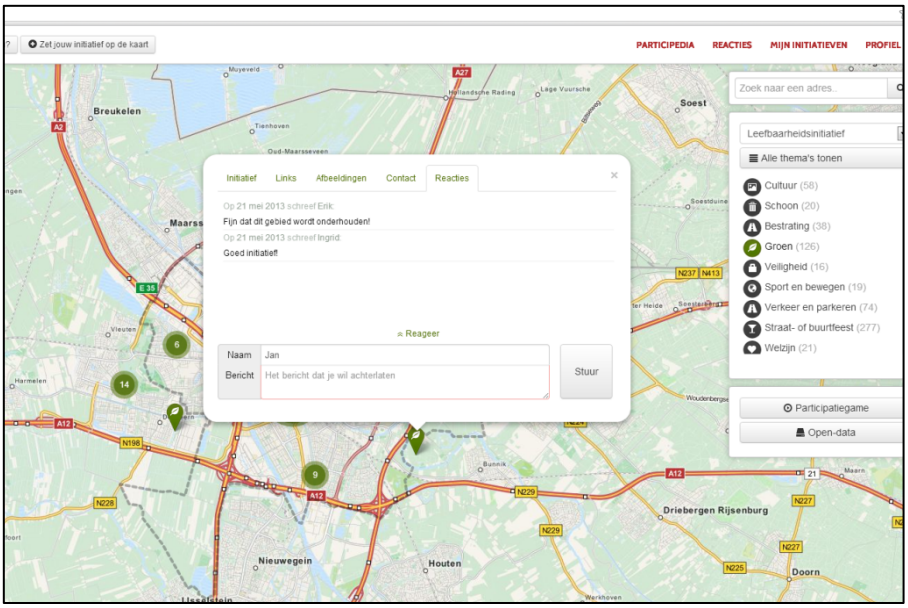


Figure 28: Detail view of an initiative: responses in the tab "Reacties" [26]

Next to location, images are crucial. Images directly make clear what the initiative is about and well-chosen images are able to bring enthusiasm and can motivate to participate. In the Gallery view, Initiatives are shown as a matrix with pictures (see Figure 29: Jij Maakt Utrecht: Gallery view of initiatives

). This gives an instant visual overview of Initiatives.

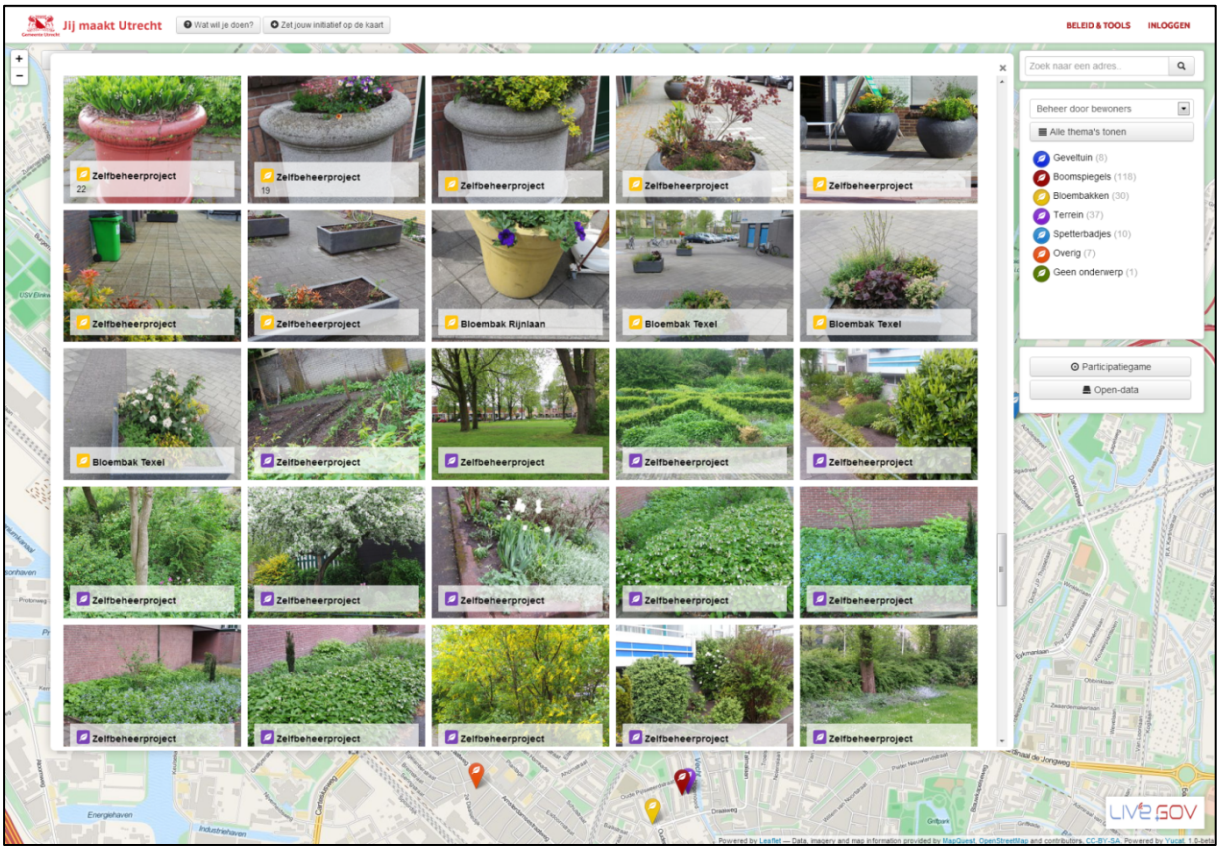


Figure 29: Jij Maakt Utrecht: Gallery view of initiatives

Facilitating citizen-government interaction: Administrators' corner

Key aspect for *Jij Maakt Utrecht* is that it facilitates free and direct communication. However, the public administration can access all information in the system and change it accordingly: a) access and changing (editing, deletion) of a reaction and b) the content of a initiative, including the deletion of it. The functionalities are handled as it is done in standard content management systems.

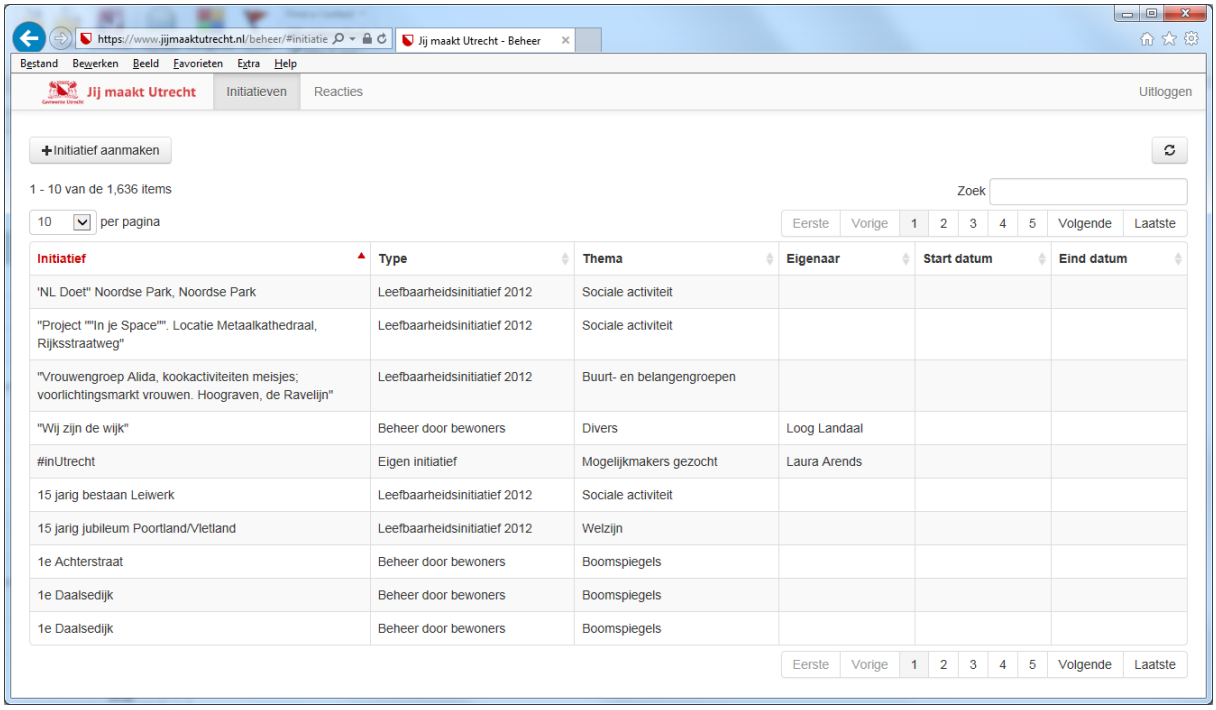


Figure 30: interface for moderating by municipality officials of citizen reactions [26]

This interface is purely designed on functionality and not on visual-attractiveness as *Jij Maakt Utrecht* itself. Apart from the moderation of reactions, also moderation of initiatives is possible for municipality officials, as can be seen in 31:

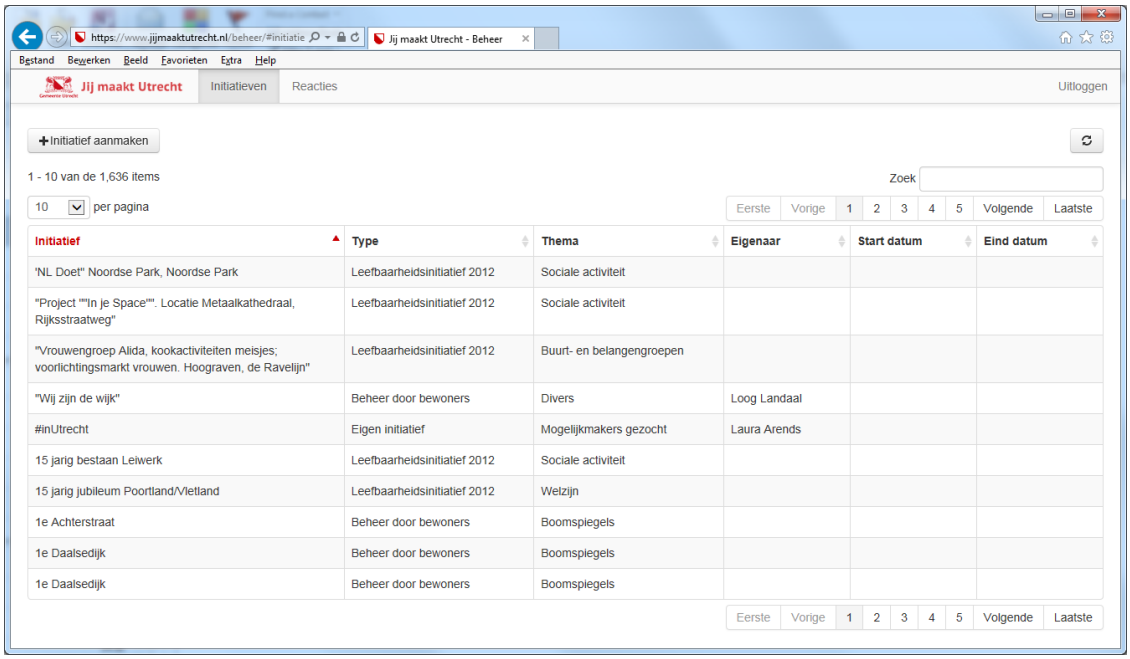


Figure 31: Interface for moderating by municipality officials of initiatives [26]

Thus, the Urban Maintenance Use-Case in the City of Utrecht is a highly elaborated example how government-citizen dialogue via modern communication tools can be organised and implemented. This includes the aspect of visualisation, which is, in the Live+Gov context, held simple, clear and lucid. They enable the spectator and the user to focus on what they intend to achieve when consulting the respective pages: finding ways how to collaborate with the municipality and contributing to the wellbeing of the whole community. In this respect, we consider the visualisations on the web-application as well as on the mobile application being solutions, which are fulfilling all five fundamental principles for successful visualisations and information representations: the Appropriateness Principle, the Naturalness Principle, the Matching Principle, the Principle of Congruence, and the Principle of Apprehension.

4.2.7 **Visualising passive collaboration: concept**

- *Aim and Purpose: improving infrastructural planning*

The second collaboration concept, which is conceptualised and implemented in the Live+Gov context aims at improving public authorities' capacity for planning the public traffic infrastructure. Therefore, citizens' mobile devices are used for collecting more and more detailed data about their movement through the municipality. The main advantage of this method as compared to more traditional survey methods is that the movement profile is automatically detected in real-time and from an individual passenger's perspective. This means that the Live+Gov system is covering changes between different means of transportation. This represents a level of detail, which has not been achieved with traditional, vehicle based tracking methods. Accordingly, visualisations and information representation needs to focus on showing the usage of the different means of transportation and on presenting statistical analyses of movement data collected over a longer period of time. Furthermore, Live+Gov aims at implementing a reporting function similar to the Urban Maintenance Use-Case. This section will however, refer to the previous sections in this context.

- *The visualisation context*

This system is enhancing current analytical methods of describing passengers' usage of the traffic infrastructure. Therefore, the statistical calculations that are to be presented should correspond to the visualisations in these traditional reports.

- *The targeted audience*

These visualisations are aimed at assisting the planning authorities. Therefore, they are developed for experts who are used to dealing with abstract data representations and panel data. Nevertheless, with a running system depending greatly on the collaboration of the citizens there is no need to withholding the newly gained knowledge. Therefore, Live+Gov recommends to make the visual analytics tools available to the public.

- *The data – base*

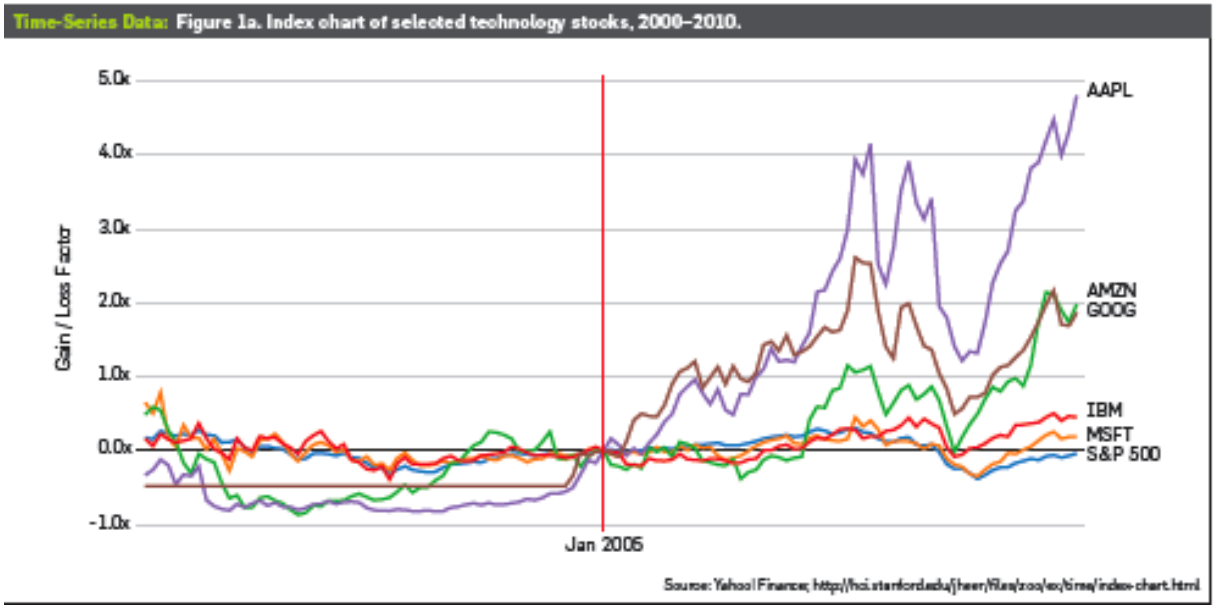
The data are provided by the Live+Gov mobile application, which is installed on the citizens' mobile device. Once activated it tracks the movement of the user by a combination of various sensor data. This sensor-record contains a high number of variables that can be extrapolated. These range from personal data about the users, data from their movement on a certain means of transportation, data about transfer times between different vehicles of the same transportation facility or between different modes of transportation. Additionally, these data are available as panel-data covering certain periods of time.

4.2.8 Visualising passive collaboration: implementation

These sensor data can be used for mere descriptive purposes showing for example the usage of certain bus- or tramlines per day or per a defined period. However, the richness of the sensor record is providing a range of analytical possibilities. Therefore, the analyst has to have certain questions in mind when analysing and visualising them. They have to ask specific questions by correlating specific data present in the data - base. Such a question could be, for example: which is the average utilization of trams or buses, which of those are burdened too heavily and which are not used enough. Accordingly, the analyst can infer that in some cases buses or trams need to be added and in others be saved.

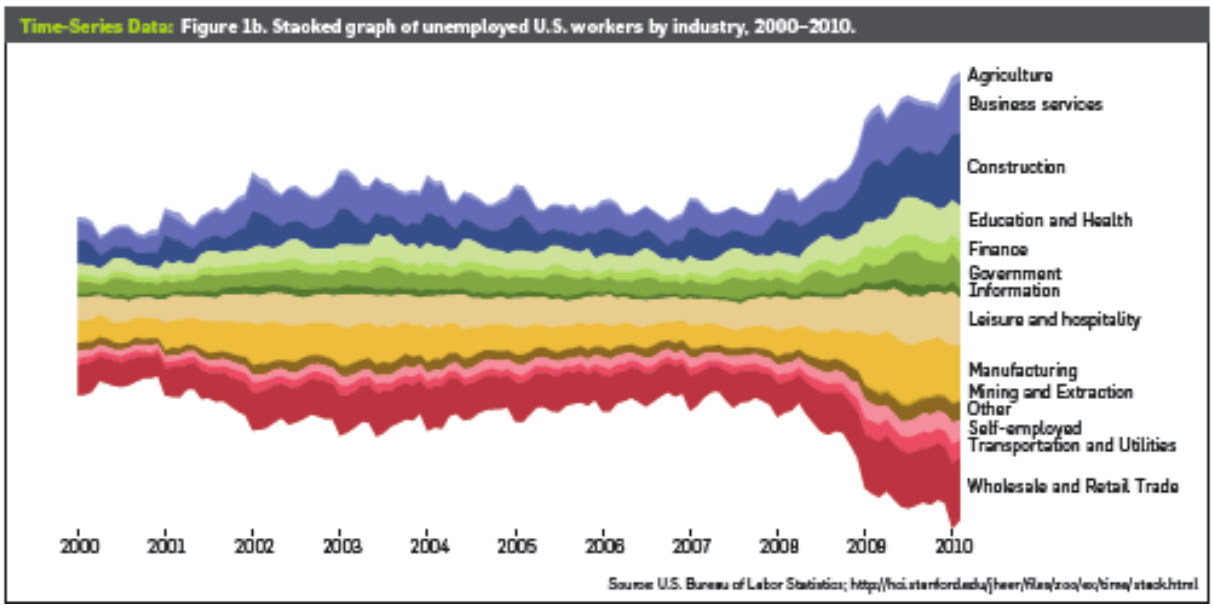
For descriptive purposes time-series visualisations of continuous data are appropriate. Figure 32 presents an index-chart showing peaks and lows of specified variables. This example is about financial data but the principle can easily be applied to means of transportation (e.g. number of passengers per bus-line per day).

Figure 32: Example of an index-chart [23]



While such index-graphs are adequately illustrating absolute changes to their values relative changes between variables may be less easily detectable. Therefore, one could opt for "stacked graphs" (also called: "stream graph"), which "depicts aggregate patterns and often supports drill-down into a subset of individual series" ([23], p. 61). The chart in Figure 33 shows the number of unemployed workers in the U.S. over the past decade, subdivided by industry.

Figure 33: Example of a Stream-Chart [23]



Limitations to "stacked graphs" are, however, that they are meaningless for data, which should not or cannot be summed. They also have their limitations when it comes to individual trends that often cannot be detected accurately. Therefore, they can either be presented as "Small Multiples" (Figure 34 – same data as in Figure 33) or "Horizon Graphs" (Figure 35 – same data as in Figure 33 and 34).

Figure 34: Example of a Small Multiple [23]

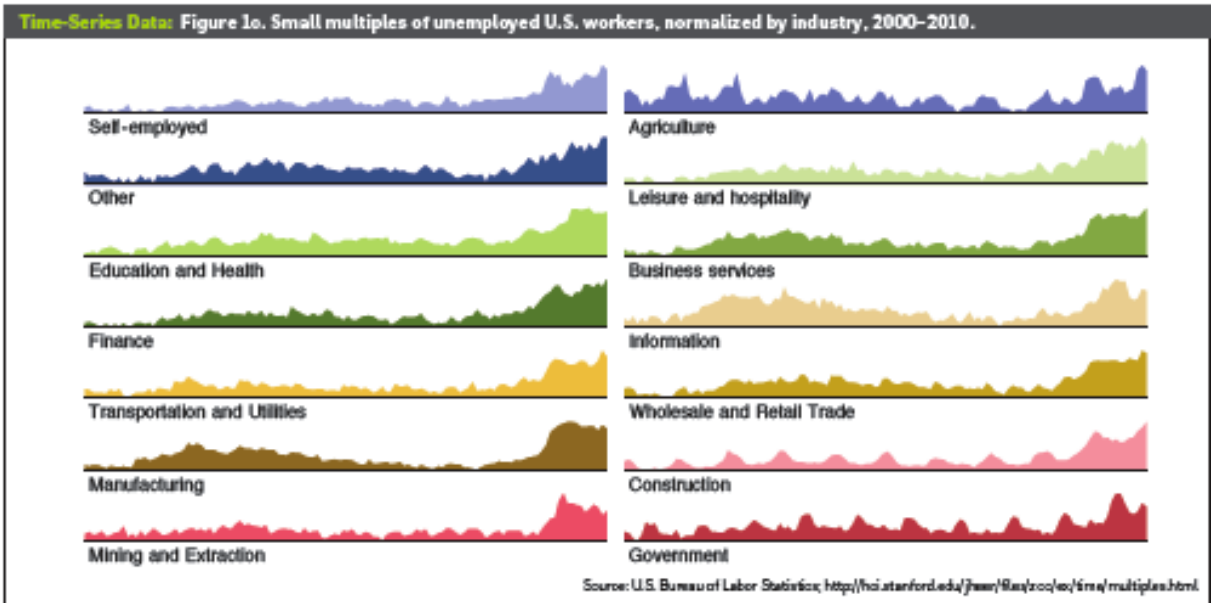
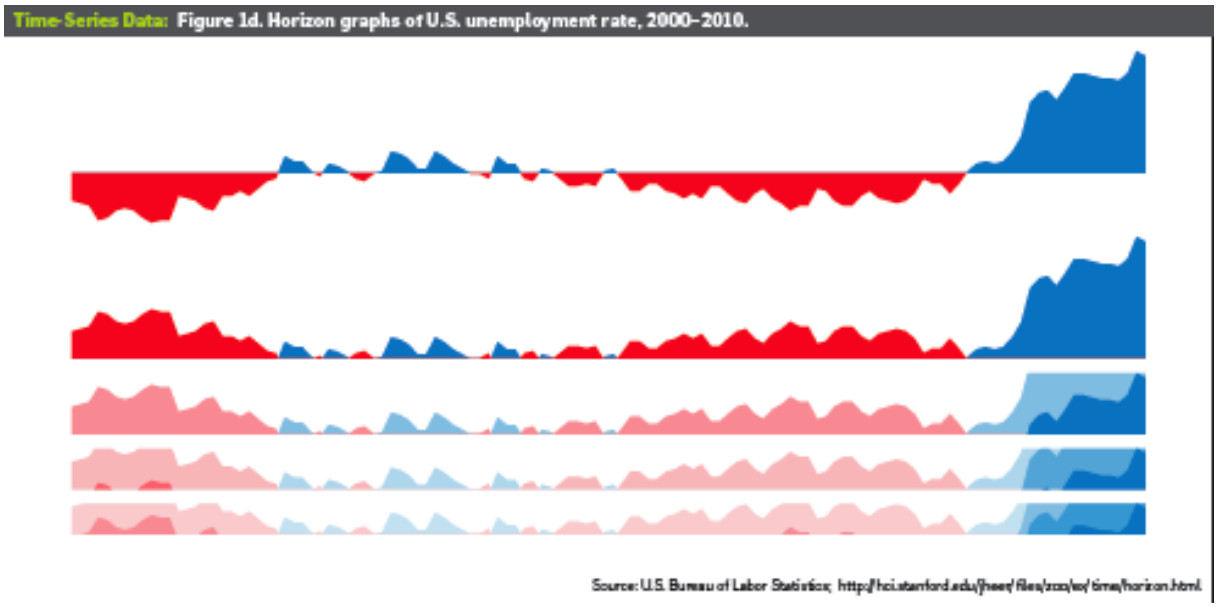


Figure 35: Example of a Horizon-Graph [26]

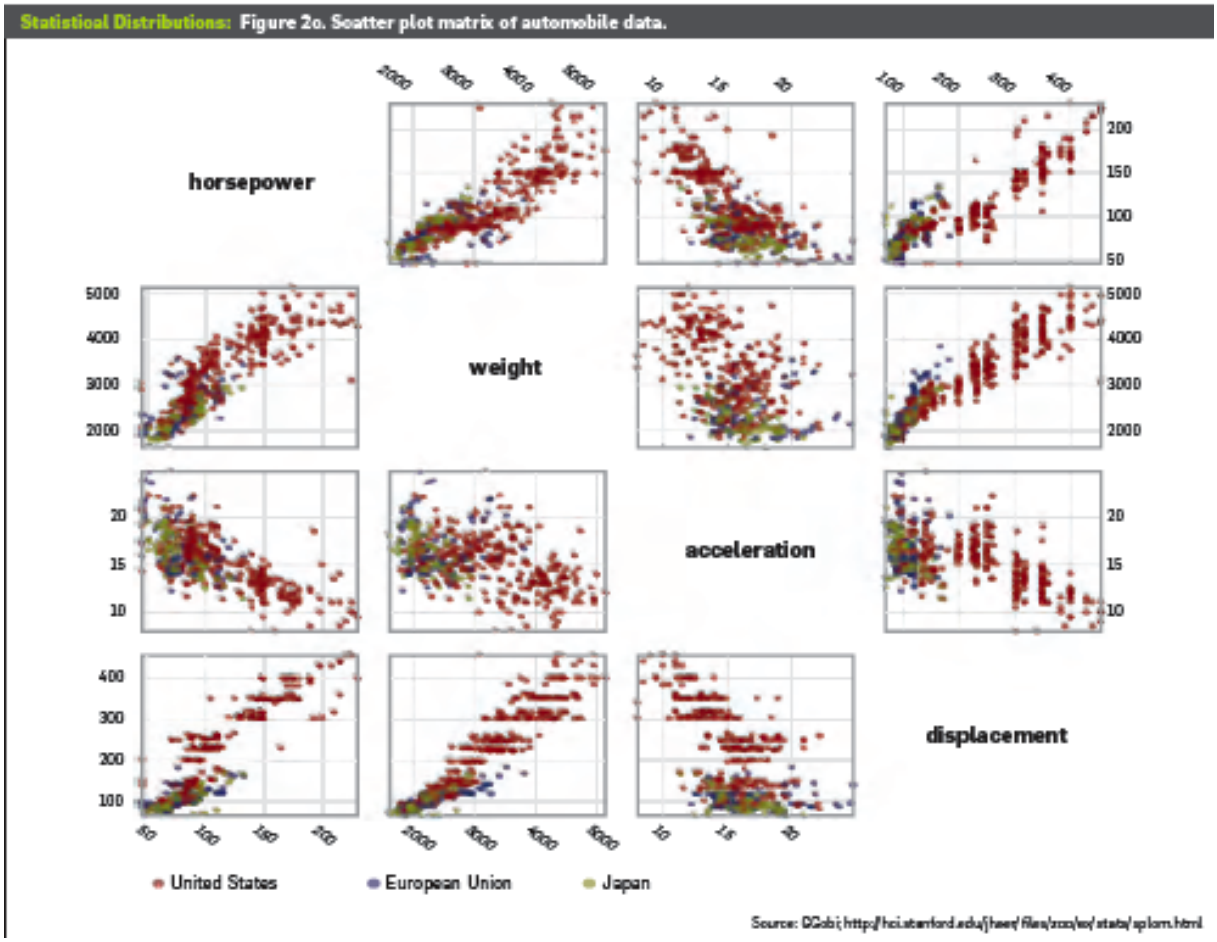


For analytical purposes such summaries and aggregations of the available data are concealing too much detail and variation between the single data points. Therefore, they have to be accounted for in specific statistical distributions. As it has been described earlier,

the analyst needs to have a rather exact question in mind and needs to correlate the available variables accordingly.

A very useful visualisation for the purposes of the Live+Gov project is the scatterplot matrix depicting the correlation between two variables. Collected for the different subjects of the basic population, such matrices show outliers in the system and can lead the analyst to problems in the traffic infrastructure. Colour-coded data-points / values depict the data-categories. Resorting to the example from before, analysing the average utilisation of vehicles per line the traffic planner can infer where to add more vehicles and to save some. In the example of Figure 36, automobile data are shown:

Figure 36: Example of scatterplot matrices [23]



Eventually, such statistics can also be combined with maps of the traffic infrastructure. Figure 37 shows a first account of the first pre-trial of the Live+Gov tracking system in Helsinki:

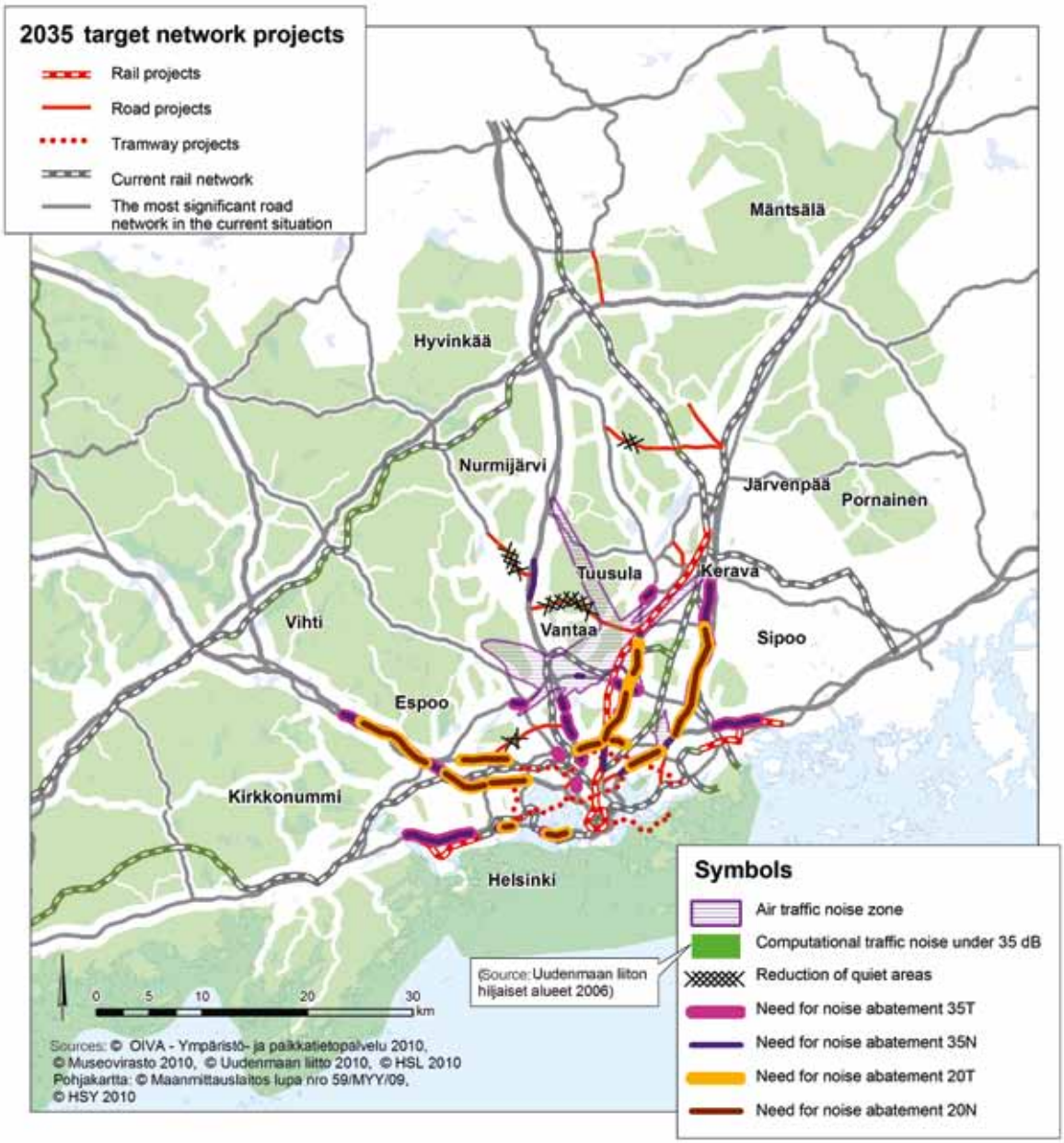
Figure 37: Annotated movement profile from the Urban-Maintenance Use-Case

This maps shows how the test personnel is moving through the city and which means of transportation they are using (including walking, biking, and public transport). Colour coding supports the understanding of the data. Remaining with the example from before, such colour coding can also be used for comparing different bus-or tramlines with the colours showing the average utilization. Clearly, the analytical detail is lower here as compared to the presentation in a scatterplot matrix. Nevertheless, it is providing an appealing overview.

Not only bus-or tramlines could be presented like this. It is also possible to colour the areas of a city or a municipality, which need specific consideration as it is shown in Figure 38. This maps accounts for the targeted network projects in the Helsinki metropolitan area as they

are planned until the year 2035. These plans have been developed in response of the survey results and the statistical analyses that are taking place periodically every five years.

Figure 38: Targeted Network Projects [6]



5 Conclusion

This deliverable fulfils two central purposes: first, it is presenting a methodology how "to tackle informal structures of decision-making". In this respect, it begins with defining ambiguous terminology. Live+Gov understands informal structures of decision-making as those areas of the political process that are not regulated by laws or rules of procedure. In a representative state the influence of societal groups, parties, and associations on concrete and direct policy-making is not particularly regulated and subject of the free flow of societal and political forces. This can become a societal issue if this free flow of political forces does not lead to just policies – just in terms of according to the majoritarian will or disregarding certain parts of the population.

The document continues by presenting a methodology how these structures could be tackled. Live+Gov understands this task as bringing structure to the unstructured free flow of the political discussion and countering the respective distortions. Hence, Live+Gov aims at creating institutionalised communication and impact channels between the individual citizen and the authorities, which are making the policies. These institutionalised channels bypass the societal and political groups, which are traditionally organising the political process and aggregate political currents. As argued in [1], this is necessary for reacting to actual developments in the societies of established representative democracies.

This methodology establishes direct forms of communication between the authorities and the citizens and grants the people extensive possibilities for issuing their opinions, for making (direct) policy-recommendations, and for engaging citizens in their municipality in general. It opens the policy-making process to the citizens and introduces measures, which are safeguarding citizens' impact. Even if the proposed measures are not compelling to the authorities and are not implemented, they nevertheless bring publicity to the policy-making process and strengthen the representative power of the people: they will be much better able to evaluate the performance of the elected representatives and draw their personal conclusions in the upcoming elections.

A highly important component of this methodology is the visual representation of the newly gathered and/or published data. The Live+Gov applications that are crucially facilitating the presented methodology are generating a large quantity of new data that can be used for retrieving new information about the municipality and its citizens. The authorities can use this new information for improving their services on the short- and the long-term. Besides the improved services, citizens profit by learning more about the various decision-making processes in their municipality. However, it is not trivial to retrieve the information from the raw data. Therefore, the new research discipline of "visual analytics" and "visual information representation" has come up with appealing visualisations, which are allowing both the citizens and the experts to extrapolate the interesting information from the data easily and quickly. This happens through sophisticated descriptions over several variables and/or time or statistical correlations between specific variables of interest. In order to fulfil the task of

easily understandable data-analysis, visual representations need to consider four characteristics of analytical framework, which they need to optimise. First, they need to consider the aim and the purpose of the visualisation, the visualisation context, the target group, and the data-base. Having a clear imagination of these four issues will most probably lead to adequate visualisations.

Eventually, this deliverable fulfils a bridging purpose within the Live+Gov project. On the one hand it continues the conceptual base from the first two deliverables of WP2 and develops them further to a general methodology that can be used inside and outside the project. Please note, however, that it represents an ideal concept that will possibly not fully implemented within the Live+Gov project's life-time. Nevertheless, due to its modular approach interested municipalities can opt for implementing different parts of the methodology. On the other hand it serves as the basis for the last deliverable in WP2, which is the training package for public administrations. This training package will implement this methodology and show the public authorities how it can be introduced in their municipality and how the different technical components need to be combined for making the new solutions work.

From a general, Live+Gov perspective this deliverable first gives important impetus to the work packages 1 and 5 showing how the newly generated data can be exploited. Furthermore, an even more importantly, it contextualises the technical developments and integrates them in a comprehensive approach combining organisational and technical innovation. In our view, this is core for sustainable and realistic Citizen Participation.

6 References

[1] Live+Gov deliverable D2.1

[2] Live+Gov project “Description of Work”

[3] Ferejohn, J. and Rosenbluth, F. (2009): “Electoral Representation and the Aristocratic Thesis”, in: Shapiro, Ian et al. (eds.) Political Representation, Cambridge: Cambridge University Press Reference 2

[4] Alonso, S. (2011): “The Future of Representative Democracy”, Cambridge: Cambridge University Press

[5] Burkhardt, D. et al. (2013): “Interactive Visualisations in the process of policy-modelling. Forthcoming.

[6] Helsinki Region Transport (2011): “Helsinki Region Transport System Plan HLJ 2011: Abstract”

[7] Interview with Kerkko Vanhanenen on the “Superhub-homepage”: http://www.superhub-project.eu/media-centre/93-interview-smart-mobility-the-finnish-model-of-public-transport-.htmlm (January 24th, 2014)

[8] Larrea, Unai (2008) "El movimiento vecinal vuelve a la calle", *El País*, 08.06.2008, http://elpais.com/diario/2008/06/08/paisvasco/1212953999_850215.html

[9] Interview with Inigo Gomez on … Date?

[10] Thomas, James and Cook, Kristin (2005): “Illuminating the Path. The Research and Development Agenda for Visual Analytics”, Los Alamos, California: IEEE Computer Society

[11] Tufte, E. R. (2001): “The Visual Display of Quantitative Information”, Connecticut: Graphics Press

[12] Card, S.K. et al. (1999): “Readings in Information Visualization: Using Vision to Think.” Morgan Kaufman

[13] Tversky, B. et al. (2002): “Animation: Can It Facilitate?” International Journal of Human-Computer Studies 57: 247-242

[14] Heer, J. and Agrawala, M. (2007): “Design Considerations for Collaborative Visual Analytics”, IEEE Symposium on Visual Analytics Science and Technology (VAST)

[15] Willet, W. et al. (2011): “ CommentSpace: Structured Support for Collaborative Visual Analysis”, Proceedings of the SIGHI Conference on Human Factors in Computing Systems, p. 3131-3140

[16] Savaa, M. et al. (2011): “ReVision: An Automated Classification, Analysis and Redesign of Chart Images”, UIST, p. 393-402

[17] Ho, Q.V. et al. (2011): “A web-enabled visualization toolkit for geovisual analytics”, Information Visualization 11 (1): p. 22-42

[18] Novak, J. and Preuße, S. (2008): “Designing Visual Systems for Social Data Analysis in Open Government Applications”, Working Paper, European Institute for Participatory Media

[19] Lange, S. (2006): “Visualisierungsdesign – ein systematischer Überblick”, SimVis, p. 113-128

[20] Website of the European Union Publications Office: http://publications.europa.eu/eur_lex/index_en.htm, consulted January 25th, 2014.

[21] http://thelivecycle.blogspot.de/ (consulted, December, 2013)

[22] Terpstra, M. et al. (2013): Information visualisation to represent statistical data and complex information. Working paper.

[23] Heer, J. et al. (2010): “A Tour Trough the Visualization Zoo”, Communications of the ACM, Vol. 53, No. 6

[24] Tomaszewski, B. and MacEachren A.M. (2012): “Geovisual analytics to support crisis management: information foraging for geo-historical contexts.”, Information Visualization 11 (4): p. 339-359

[25] Osimo, D. and Mureddu, F. (2010): The Crossroads Project.

[26] Steensma, J. et al. (2013): “Webapplication for eGovernment Dialogue and Visualization . Public Beta, Functional Sketch. Live+Gov Working Paper

[27] Norman, D.A. (1999): “Things that Make Us Smart”, Reading, Massachusetts: Addison-Wesley