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Deliverable 2.2

Requirements for collaborative governance tools

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Table of contents

Table of contents	3
1 Introduction	4
2 Gap-analysis and review of additional tools	5
2.1 <i>Method</i>	5
2.1.1 Gap analysis.....	5
2.1.2 Review of additional tools	6
2.2 <i>Results: gap analysis</i>	6
2.3 <i>Results: review of additional tools</i>	9
2.4 <i>Results: review of additional tools</i>	14
2.5 <i>Conclusion</i>	15
3 Requirements analysis	16
3.1 <i>Methodology</i>	16
3.1.1 Overview	16
3.1.2 Specification of first and second iteration requirements	17
3.1.3 Requirements interviews.....	18
3.1.4 Requirements workshops.....	19
3.2 <i>Results</i>	22
3.2.1 Interviews	22
3.2.2 Preliminary requirements workshop.....	25
3.2.3 Requirements workshop	25
3.3 <i>Overview of requirements</i>	26
4 Conclusions	31
5 References	33
6 Annex 1: Respondent list	34
7 Annex 2: interview format.....	36
8 Annex 3: Workshop set-up	37
9 Annex 4: Overzicht aanvullende instrumenten	40
10 Annex 5: Overview requirements	41



1 Introduction

In Samoerai a design science approach (Hevner Alan, 2007; Hevner, March, Park, & Ram, 2004) was taken to build a toolbox with collaborative governance tools to support the collaboration between stakeholders on smart city applications.

The first phase and first work package of the project comprised the relevance cycle, which has taken the shape of a multiple case study analysis on four smart city projects in Enschede, Zwolle, Amersfoort, and Rotterdam (see *D1.1 Individual case study reports*, and *D1.2 Cross-case analysis* for the results). The case studies have provided insights into the main bottlenecks and success factors for collaboration between the government, businesses, civil society, citizens, and research institutes, and as such, have enriched the body of knowledge on collaborative smart governance in the context of smart city application development. In addition, in WP2 existing collaboration instruments were systematically reviewed, drawing on both the academic and the grey literature. The resulting inventory of 118 instruments was published in *D2.1 Overview of existing instruments*.

The final step in the relevance cycle, the formulation of requirements for the collaboration tools, is the main topic of this deliverable. First, a gap analysis was carried out to identify missing instruments by comparing the results from the systematic literature review (D2.1) with the demand for instruments by stakeholders, which can be derived from the cross-case analysis (D1.2). Section 2 presents the results of this gap analysis, as well as the results of a second systematic search is reported, which sought to fill the identified gaps with additional instruments outside the smart city domain.

Finally, a round of interviews and workshops was conducted to iteratively assess stakeholder needs with regard to instruments, and next to elicit, and finally evaluate requirements for such instruments. The results of the requirements analysis can be found in Section 3.

The formulation of the requirements for collaboration instruments is the starting point for the design cycle in Samoerai. In this phase (WP3) an action research (Susman & Evered, 1978) approach is taken to plan, develop, apply, and evaluate instruments within ongoing cases of smart city application development.



2 Gap-analysis and review of additional tools

In deliverable 2.1 we already presented the results of a systematic analysis of tools in the smart city academic and grey literature. However, the tools found based on this systematic analysis were not evenly distributed among the five clusters of specific tools related to Collaborative Smart Governance identified in D2.1. Moreover, not all identified tools do really offer solutions for the bottlenecks and challenges we found. For the gap analysis, we take quantitative gaps into account as well as qualitative gaps.

With 'quantitative gap' we refer to the number of tools found and with 'qualitative gap' we analyze if the tools found can help to solve the challenges and bottlenecks mentioned by practitioners. For example, considering the component 'participation', we know that in smartcity projects, it is hard to make people enthusiastic and involved in a smartcity project. This means that instruments about 'participation' should at least partly be helpful to increase enthusiasm among citizens. If none of the tools found do cover this need, there is a qualitative gap.

This section extends the analysis presented in D2.1 in two ways. First, a gap analysis was performed to identify clusters and components for which the tools that have been identified in D2.1 do not sufficiently address practitioners' challenges. Second, based on the gap analysis an additional systematic search was performed to fill the identified gaps where possible. Whereas in D2.1 tools were sought within the academic and grey smart city literature, this additional search focused on tools outside the smart city scope, as collaborative governance is a phenomenon that is present in many different domains, including civil engineering, sustainability policy, and so on.

2.1 Method

In D2.1 we distinguished between five clusters of specific tools in relation to Collaborative Smart Governance:

1. collaborative structure tools (such as tenders, contracts & business models),
2. collaborative process tools (such as tools for leadership, collaborative culture),
3. support & participation tools (such as tools for management, political and citizens' support),
4. use of technology tools (such as tools for data skills)
5. outcome tools (such as indicators that measure the impact of the project).

The clustering formed the basis for both the gap analysis and the search for instruments presented in this section.

2.1.1 Gap analysis

The gap analysis was carried out to identify missing instruments by comparing the results from the systematic literature review (D2.1) with the demand for tools by stakeholders, which can be derived from the cross-case analysis of four case studies (D1.2). The comparison was carried out on cluster and component level with both collaborative smart governance bottlenecks (D1.2) and found tools (D2.1) assigned to their respective component(s). First, the distribution of the number of tools per component was derived from D2.1, while components for which few tools were available were identified. Second, the components that can be considered bottlenecks from practitioners' perspective were identified, drawing on the findings from D1.2. Finally, in this chapter we analyse if the components that are seen as potential bottlenecks are sufficiently covered by the tools found in D2.1 or if gaps can be identified.

2.1.2 Review of additional tools

Based on the identified gaps between the collaborative smart governance bottlenecks that were perceived by the practitioners and the available instruments in the smart city literature, a second systematic search was conducted to fill the identified gaps, where possible.

First, we conducted a preliminary search strategy in the academic database Scopus using the following search string:

("collaboration" OR "public-private collaboration" OR "helix collaboration") AND ("tool*" OR "instrument*") AND (subject tool)

By “subject tool” we filled in the name of the cluster for which we were looking for additional instruments such as “management” or “politic*”. This led to 313 hits but not to instruments that fitted with the aim of our project. Therefore, we conducted an additional search in Google in both English and Dutch. We examined the first five pages of the Google results and analysed whether the hits fit within the description of our project.

The tools were systematically described and coded, following the same coding as was used for the initial systematic search presented in D2.1. The full description of the found tools can be found in Annex 4: Overzicht aanvullende instrumenten.

2.2 Results: gap analysis

The gap analysis has revealed a need for additional tools for a number of components. Either because the tools collected in D2.1 do not (fully) satisfy practitioners’ demands within these components or few tools were found for that component. Table 1, and 2A and 2B show for which components gaps are observed and provides the rationale for why additional instruments were needed. Table 1 shows the results of the initial results in a comprehensive way (quantitative + qualitative). Table 2A shows the results of the additional search for instruments in a concise way (only quantitative). Table 2B is the final gap analysis, based on the expected response of the identified tools to the identified bottlenecks (qualitative approach).

In table 2B, we distinguish the identified tools in four different levels.

- Level 1, the lowest level, is irrelevant in this context: it is in a purely theoretical stage, so cannot be used in a project.
- Level 2: The instrument must be expanded to be deployed by any of the quadruple helix partners.
- Level 3: The instrument can be deployed by any of the quadruple helix partners, but requires modifications.
- Level 4: The instrument can be deployed without modification or with only cosmetic modifications by any of the quadruple helix partners.

Table 1: Overview of identified gaps per component (initial search)

Cluster	Components	Gaps related to number of tools found (from D2.1)	Gaps related to bottlenecks mentioned by practitioners' (from D1.2)
Collaborative Structure	<i>Budget and Contracts</i>	For <i>Budget</i> 2 tools were found and for <i>Contracts</i> 6 tools.	<p>Budget is not a problem in the development phase but can be a bottleneck in the exploitation phase. <i>"But what about after the trial period?"</i> <i>(...) In order to continue the project, the management costs must be borne by the department. The manager responsible must then have or create room in his budget"</i>.</p> <p>Contracts are not bottleneck in general, however, concerns are expressed about access to data <i>"When you sign contracts with suppliers for asset management how do you avoid that you get a contract that the data is not accessible to you"</i> Effectiveness as contracted parties may not feel bound to each other <i>"If you don't have a very strong project leader making sure that this is linked together by means of joint task performance, (...), you have a worse project running"</i> In conclusion tools are lacking that identify at an early stage the costs of exploitation and financing needs. Also, there is a lack of tools that provide insight into possible sources of finance and related conditions.</p>
		No tools were found for <i>Law & regulation</i> .	<p>Law & regulation can be a bottleneck in the development and upscaling of smart city projects. Early attention is needed for the boundary conditions that regulation may set, especially privacy. <i>"GDPR-issue", "So what we are more inclined to do is to build everything in such a way that we can be sure not to have to deal with the Personal Data Authority. While it is actually much smarter (...) to seek out the boundaries of, what (...) is possible?"</i>, Municipality own rules <i>"When I asked for permission from the municipality, there had to be an aerial platform, a certified suspension system on that lamp post (...), so all of a sudden it became very expensive (...)"</i>.</p> <p>In conclusion, tools are lacking for testing GDPR compliance or a 'privacy-by-design' development method. Also, a tool for dealing with intellectual property rights is missing.</p>
Support Tools	<i>Management Support and Political Support</i>	For <i>Management support</i> 3 tools were found and for <i>Political Support</i> 5 tools.	<p>Lack of management and/or political support. <i>"A big success factor is a mandate from the city council"</i>. Similarly, <i>"How important is support from the top of civil management, that's crucial, (...)"</i></p>

			In conclusion, tools are lacking that help to better connect smart city projects with a municipal administrative vision or policy program.
Use of Technology	<i>Technical skills</i>	For <i>Technical skills</i> 4 tools were found.	Technology and technical skills in the scaling-up and diffusion phase. <i>“Technicians who are typically educated on vocational training need to have extra training to deal with the new technology which is more college degree level”</i> In conclusion tools that provide insights in the technical knowledge and skills needed for the management phase are lacking.
Outcome	<i>Outcome</i>	For <i>Outcome</i> 4 tools were found.	Difficult to express social benefits (i.e. citizens involvement, sustainability, security) in euros or any other quantitative unit. <i>“What do you take into account? (...) What are the social benefits of influencing behaviour? How do you measure it?”</i> and <i>“(…), to what level can you express it in euros? (...) what it cost is very simple, that’s adding up all the invoices and hours. But what has SensHagen delivered?”</i> In conclusion tools that interpret, measure and can monitor (social) benefits for different stakeholders are lacking.

The total of tools identified in the initial search was 11. It was decided to conduct an additional search. In the next paragraph, the results of the additional search are presented.



2.3 Results: review of additional tools

Based on the gap analysis we concluded that specifically, for contracts & budget, rules & regulations (cluster collaborative structure), management & political support (cluster support & participation tools), for technical skills (the cluster use of technology), and outcome tools an additional search was necessary.

The search led in total to 21 additional tools. Furthermore, the researchers added two instruments that were under development at the time of the search and were known to the researchers. Hence, these two instruments did not result from the search strategy. However, because they were considered as relevant for the project, they were added as well. The full description of the tools can be found in Annex 4: Overzicht aanvullende instrumenten. In Table 2, the number of additional tools across clusters and components is presented.

Table 2A: Overview of additional tools found for each cluster

Cluster	Component	Number of Tools
Collaborative Structure	<i>Contracts</i>	3
	<i>Budget</i>	2
	<i>Rules & Regulation</i>	4
Support Tools	<i>Management Support</i>	3
	<i>Political Support</i>	1
Use of Technology	<i>Technical skills</i>	5
Outcome	<i>Outcome</i>	5
Total		23

More information about the additional tools is included in paragraph 2.4.

Together with the 11 tools identified in the initial search, the total amount of tools identified is 34.

A final gap analysis was conducted, confronting these 34 tools with the bottlenecks revealed by the case analysis (4 cases, D1.1) and the cross-case analysis (D1.2). The results of the final gap analysis are shown in table 2B.



Table 2B: Results of the final gap analysis

Components	Gaps related to the bottlenecks mentioned by practitioners (from D1.2)	Available instruments
Businessmodel	<ul style="list-style-type: none"> There is no ready-made business model for smart city applications available. In addition, it appears that a business model is not being considered at an early stage of the project. Soft values or non-monetary outcomes, such as sustainability and safety, are important in smart city applications, but are difficult to express in monetary terms. 	<ul style="list-style-type: none"> 10 instruments for component “businessmodel” This involves among others, a businessmodel development methods (level 4), a value proposition canvas (level 4), a SWOT analysis (level 4), a Business Model Canvas (level 4), an experience map (level 4), a blueprint (level 4), a businessplan (level 4), a scaling plan (level 4), the Saxion card desk (level 4), and an overview of movisie with tools to measure/evaluate effects (level 4). Gap present: No, these instruments seem helpful in developing an (innovative) business model and measure soft values. However, these tools are not specifically developed for the smart city context.
Budget	<ul style="list-style-type: none"> The budget is not so much a bottleneck in the development phase, because then an innovation budget is usually available, but it can become a bottleneck during the management phase. Solution (i.e., search direction) from interviews: looking ahead to the management phase when drawing up budget plans. 	<ul style="list-style-type: none"> 2 instruments for the component “budget”. This involves a businessmodel canvas (level 4) and a businessplan (level 4). These tools can help fill in the income and expenses of a project. Gap present: Yes, these instruments do help to visualize the financial flows, but do not help to immediately look ahead to the management phase of a project.
Procurement (tenders)	<ul style="list-style-type: none"> The cases studied have not shown that this is either a bottleneck or a success factor. 	<ul style="list-style-type: none"> 4 instruments for the component ‘procurement’ or ‘tenders’. These tools can provide support for tendering. One of the tools focuses on the inclusiveness of services through tenders (especially for the elderly and people with disabilities) (level 4). Other tools are from the governmental website PIANOo (the expertise center for innovative procurement). On their website they provide a metro map for innovation-oriented procurement (level 4), an overview of instruments for innovation-oriented procurement (level 4) and information about innovative partnerships (level 4). Gap present: Yes, because it is unclear what the real bottleneck is for this component.
Contracts	<ul style="list-style-type: none"> The cases studied have not shown that this is either a bottleneck or a success factor. 	<ul style="list-style-type: none"> 3 instruments for the component “contracts”. This mainly concerns: a format for a collaboration agreement (level 4), information about partnership agreements (level 3), and a tool explains how tendering / contracts can affect inclusiveness among the elderly and disabled (level 4). Gap present: Yes, because it is unclear what the real bottleneck is for this component. And these tools are not specifically addressing the smart city context.



Roles & Responsibilities	<ul style="list-style-type: none"> • Roles & responsibilities cannot be unambiguously identified as a bottleneck or success factor based on the available data. • What is important is the willingness and ability to shape the loose division of roles and responsibilities in a more rigorous way in the upscaling phase. 	<ul style="list-style-type: none"> • 9 instruments for the component "roles & responsibilities". • Among others, a user journey map (level 3), an overview of co-creation roles (level 3), an experience map (level 4), a blueprint (level 4) and a consolidation of different stakeholder roles (level 3). Many of these instruments are about the role of the user (user journey map, experience map, blueprint) or describe possible roles of stakeholders in a co-creation process (overview of co-creation roles, consolidation of different stakeholder roles). • Gap present: yes / no: none of these tools pays attention to the phase dependency of an innovative project and possible change in role description, but the interviews show that this component is not clearly identified as a bottleneck or success factor. Only the tool 'consolidation of different stakeholder roles', from Bullinger's article seems interesting (but in relation to business models), where roles of stakeholders are plotted with regard to value capture, value creation, value proposition. But this could also be more helpful under the component "interests"
Law & regulation	<ul style="list-style-type: none"> • Most smart city applications affect the privacy aspects of citizens. And there can be suspicion among citizens, where they are concerned about their privacy. • Solution (search direction) from interviews: paying attention to privacy at an early stage (GDPR, DPIA, privacy-by-design, etc.) and also communicating this to citizens. 	<ul style="list-style-type: none"> • 4 instruments for the component "legislation & regulations". • The Intelligent Method (II) for "smarter" urban policymaking and regulation drafting (level 4), The relevant ISOs for the smart city (level 4), the relevant accessibility standards (level 4) and insight into privacy enhancing technologies (level 3). • Gap present: no, see technology and data for applications that are really about privacy. These instruments can complement and provide insight into relevant ISOs and accessibility standards. However, many of these articles have to be converted in useful tools.
Interests	<ul style="list-style-type: none"> • Conflicting interests between various stakeholders can make cooperation more difficult (e.g., being re-elected, achieving innovative goals, entering the consumer market, creating graduation places, achieving KPIs, etc.) • Segregation within the municipal organization can hamper proper cooperation and upscaling of smart city applications. • Solution (search direction) based on interviews: identifying interests, communicating about this transparently and looking for a win-win situation. 	<ul style="list-style-type: none"> • 2 instruments for the component "interests". • This concerns a theater workshop (level 2/3) and the value mapping tool (level 4). These tools are aimed at gaining insight into the various interests of cooperation partners, inside and outside an organization. • Gap present: no, these 2 tools can help identify conflicting interests and can help partners to discuss this at an early stage.
Collaborative Culture	<ul style="list-style-type: none"> • Differences in work processes between different cooperation partners can make internal cooperation more difficult if parties are not set up to work together in an innovative way (e.g. working in an experimental environment is not compatible with a party that works with a tight project structure). • Solution (search direction) from the interviews: looking for a win-win situation, drawing up a joint vision / joint objective, designing an equal collaboration with attention to trust. 	<ul style="list-style-type: none"> • 1 instrument for the component "collaborative culture". • The tool "Intelligent Method (I)" describes a tool for smart city planning and projecting (level 4). • Gap present: yes, this tool does not help to visualize different methods and solutions for the bottleneck identified.
Leadership	<ul style="list-style-type: none"> • Leadership cannot be unambiguously identified as a bottleneck or success factor based on the available data. • The willingness and ability to switch the leadership style is important. This role can be filled in informally in the development phase but must be filled in in a 'blue' way when scaling up an innovative project. 	<ul style="list-style-type: none"> • 0 instruments (level 3 or 4) for the component "leadership". • Gap Present: Yes, these are no useful leadership tools. Paskaleva's article can help to gain insight into important leadership qualities but this is a level 2 tool.
Political Support	<ul style="list-style-type: none"> • The lack of broad interest, affinity and / or support of individual councilors or portfolio holders for the project is sometimes a bottleneck, which may arise due to the complexity of the theme and the lack of knowledge about the theme. • Lack of clarity about the theme smart city in general can contribute to a lack of interest, affinity and / or support. (1) 	<ul style="list-style-type: none"> • 6 instruments for the component "political support" • This includes among others, a citizen think tank (level 3), and an assembly set up (level 3) to combine political support with citizen support. Moreover, a digital advisor is found for municipal councilors that can help them to ask the 'right' questions around data projects (level 4) and a checklist for various stages of collaboration around data projects is found (level 4).



	<ul style="list-style-type: none"> • Solution (search direction) from the interviews: Giving examples about smart city applications and communicating about ambitions (policy goals) concerning the smart city could possibly contribute to more administrative support. Describe links with social problems or develop a shared vision) 	<ul style="list-style-type: none"> • Gap present: partly, the instruments <ul style="list-style-type: none"> - A digital advisor for municipal councilors - The checklist for different stages of collaboration around data projects <p>can help tackle complexity by providing administrators with tools for meetings and decisions concerning the smart city. But getting all/many councilors or portfolio holders interested in the smart city is still underexposed.</p>
Management Support (including civil servants)	<ul style="list-style-type: none"> • Segregation ('verkokering) within the municipal organization can hamper proper cooperation and upscaling of smart city applications. • Conflicting disciplinary backgrounds and therefore the lack of knowledge about the possibilities of the smart city can also hamper implementation and upscaling. (als 1) • Solution (search direction) from the interviews: broad embedding of the project under a policy program could possibly contribute to support from management and employees (this support is then an extension of administrative support). 	<ul style="list-style-type: none"> • 3 instruments for the component "management support". • Two times it concerns an 'action perspective' for 'limitless and sustainable collaboration' (level 3) and a checklist for collaboration around data (level 4). • Gap present: Yes, the first instrument is too extensive and aimed at central government, and the second and third fit better under other components because there is no direct attention for creating support from management and civil servants. The tool digital advisor (discussed under political support) can help to gain knowledge about question to ask about smart city projects. But no tools that can help to solve 'verkokering' are found.
Citizen Support Participation & Communication	<ul style="list-style-type: none"> • Getting and keeping citizens involved in smart city projects is proving difficult. This can be partly explained by the complexity and unfamiliarity of the theme. • Solution (search direction) from the interviews: Communicating about smart city applications to citizens can be a success factor. In this case, communication must not only focus on sending, but also on starting a discussion with citizens about possible ethical objections in relation to the usefulness of smart city applications for the residents. In addition, it is important that an application meets the needs of citizens and that co-ownership may contribute to support. • It is difficult to interest a broad group of citizens in a participation meeting and the use of an application. This may be explained by the fact that the theme does not seem to interest many citizens and is complex. • Mistrust about citizens can be a bottleneck for the implementation or upscaling of a smart city project. • Solution (search direction) from the interviews: communicating transparently about the goal, the vulnerabilities and the working method of an application, adapting communication to the target group. 	<p>The instruments for public support and participation are always discussed together in the tool overview. Therefore, the component 'citizen support' & 'participation & communication' will be discussed together below.</p> <ul style="list-style-type: none"> • 6 instruments concern the components "citizen support" and "participation & communication". • This concerns an online smart city platform (level 3) and data lab (level 3) to inform citizens with data about the city. Besides, a smart city ambassador program (level 3), a theater workshop (level 2/3) and the citizen sensing toolkit (level 4) can help to share knowledge about the smart city and to interest citizens for the smart city. Moreover, an environmental canvas is found to understand the relevant partners in the network (level 4). Lastly, the idea of a citizen think tank (level 3), a citizens assembly set up (level 3), a living lab (level 3) and a digital twin (level 2) is proposed to foster participation. However, these tools do elaborate on the method and not on the practical set up of these participation sessions. • Gap present: partly, these are different ways of involving and informing citizens about the smart city. The applicability of one of these instruments depends on the project and the participation question. In addition, we do not have any tools that specifically address how communication with citizens about the smart city should be designed.
Technology	<ul style="list-style-type: none"> • Problems with the technology appear to arise not so much in the development phase, but in the management phase. It can be a problem due to insufficient technical knowledge at municipalities, volunteers and technology companies and it can become a problem when allocating ownership and installation responsibility. 	<ul style="list-style-type: none"> • 7 instruments for the component "technology". • These include tools for digital skills among users (a citizen sensing toolkit (level 4), a critical guide (level 4) a benchmark (level 3), an assessment tool to measure skills (level 3) and a roadmap (level 3) and for governments (data sharing toolkit (level 4)). • Gap Present: Yes, we found some tools related to technical knowledge. Nevertheless, these tools are mainly about what digital skills are and how their lack can be measured. However, it is not about solving the problem of insufficient knowledge. The data sharing toolkit can, however, contribute to knowledge among governments specifically in the field of data sharing (see component 'data'). • In addition, we have also not found an instrument for the problem of ownership.



<p>Data</p>	<ul style="list-style-type: none"> The sharing of data between government and market parties is difficult (e.g., concerning ownership and standardization). 	<ul style="list-style-type: none"> 3 instruments for the component "data". It concerns the DEDA to recognize ethical problems in data projects (level 4), a checklist for sharing data (level 4) and a toolkit for data sharing (level 4). These tools provide insight into privacy, DPIA, AVG, ethical issues, formulating goals, setting up a data collaboration, etc. Gap present: No, these tools help to think about important questions about sharing and using data. In addition, the DEDA and the checklist appear to be the simplest for immediate use by partners.
<p>Outcome</p>	<ul style="list-style-type: none"> Objectives are not clearly defined in advance for this type of innovative project, which makes measuring outcomes difficult. Next to that, it is difficult to quantify social benefits such as sustainability and safety. 	<ul style="list-style-type: none"> 5 instruments for the component "outcomes" This concerns a KPI software tool from CITYkeys (level 3), the impact path, the Movision tool to measure impact with several tools to measure output/outcome (level 4), a card game to select factors to measure effects of a project (level 4), and an pointer and document by Movisie to select instruments for measuring effects (eg. SRIO, social value etc.) (level 4). Gap present: no, these instruments provide several tools that can help to measure the outcomes of a smart city project. The CITYkeys tool seems more complicated to use than other mentioned instruments.



2.4 Results: review of additional tools

As Figure 1 shows, the additional tools found can especially be used by government and by companies. For example, we found a manual that governments can use when drafting a contract with companies.

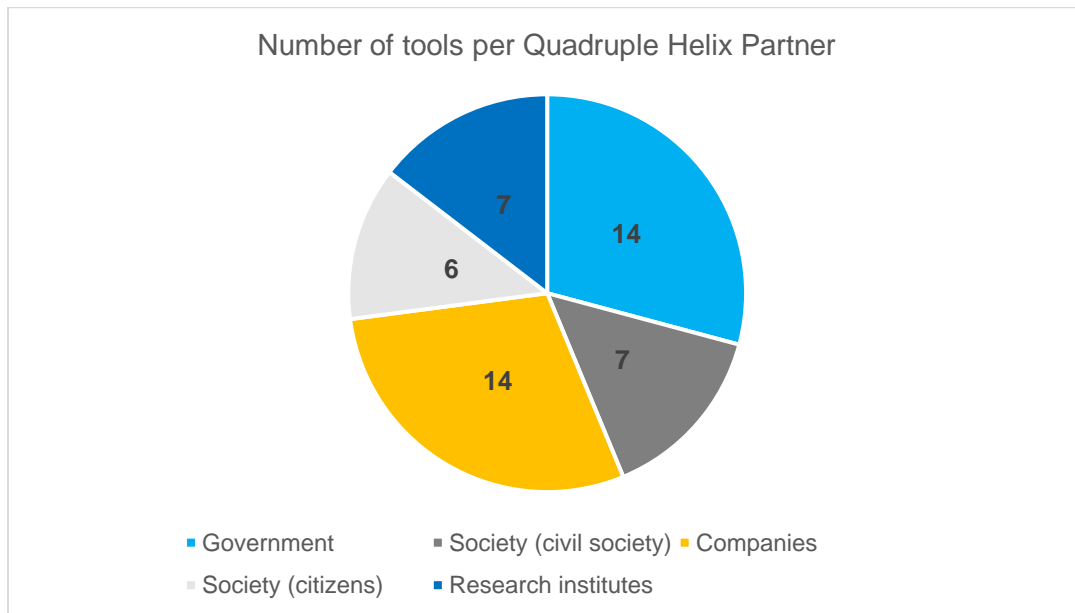


Figure 1: Number of tools found for each quadruple helix partner

Furthermore, most of the tools found can be used for Collaborative Smart Governance projects with either small (7 of 23) or no (14 of 23) adjustments. 19 of the 23 tools can be used offline. The tools found consist of broad range of formats varying from a card deck, checklist, frameworks, survey and benchmark.

For example, for rules & regulation we found a taxonomy of different types of privacy versus ways to collect data from different smart city applications. For management support we found for example the checklist “Data collaboration” provides managers in government organizations with a simple way of checking whether they have taken all the necessary actions when starting but also during collaboration with other organizations (www.dataschool.nl). In order to measure data skills, we found a self-assessment tool that assesses based on 17 key traits whether a person has a low or high proficiency in data (www.dataliteracy.com). We also found an online tool for politicians that assist them in making a decision about a data project (www.dataschool.nl). The card deck developed by Saxion (<https://businessmodellab.nl/tools/bedrijfsmodel-kaarten>) is an example of a tool that can be used to measure outcomes. The card deck consists of Business Model Metrics. Organizations can select measurable performance indicators to measure the outcome of their project.

Finally, it can be observed that the tools found in the additional search can especially be used in the scaling up/out phase of a collaborative smart governance project. For example, we found a framework that city



managers and policy makers can use to select the indicator that best corresponds to their assessment needs and goals regarding a smart city implementation project.

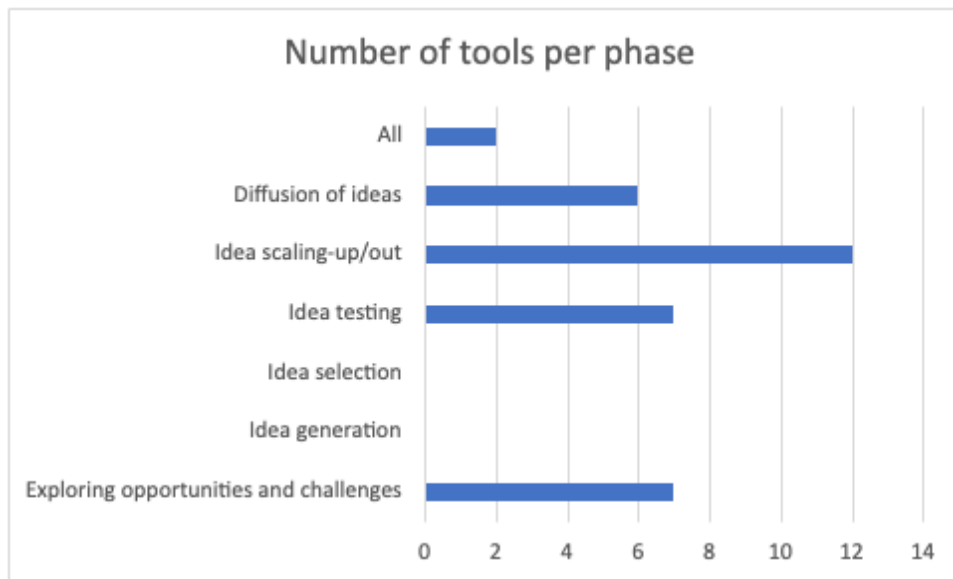


Figure 2: Number of tools for each innovation phase

2.5 Conclusion

This section reported on a gap analysis that revealed the need for additional tools for contracts & budget, rules & regulations (cluster collaborative structure), management & political support (cluster support & participation tools), for technical skills (the cluster use of technology), and outcome tools. The subsequent additional search in literature outside the smart city scope resulted in 23 additional tools. Based on this search it can however be concluded that for the collaborative components of contracts, budgets, rules & regulations, management & political support, technical skills and outcomes, the suitability of the available tools is limited, arguing for the development of additional tools to fill this gap.

The majority of the tools we found are offline tools that can be used by government without needing adjustments, suggesting that they can be added to the toolbox that is developed during the design cycle. Such tools can especially be used when governments want to scale up their project.

3 Requirements analysis

3.1 Methodology

3.1.1 Overview

The design science framework (Hevner, 2007; Hevner et al., 2004) has been introduced as the basis for the methodology in the Samoerai project. It consists of three overlapping cycles that ultimately extend the knowledge base with regard to the potential of practical tools to resolve bottlenecks in collaborative smart governance. As can be seen from Figure 3, the requirements, as part of the relevance cycle, bridge the gap between the smart city domain of practice (*in casu, the problems and opportunities with regard to collaborative smart governance*) and the design and evaluation of design artifacts (*collaboration instruments*).

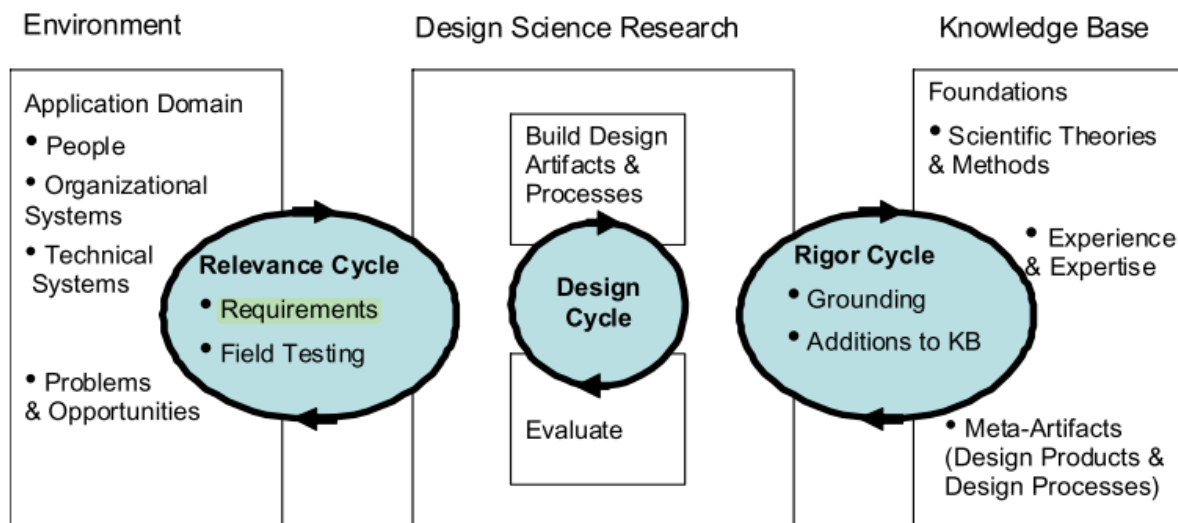


Figure 3: Design science framework (Hevner, 2007, p. 88)

The relevance cycle has been initiated by means of the multiple case study analysis, reported in D1.1 and D1.2. This section reports on the systematic approach that was taken to convert the research findings into requirements that serve as guidance for the development and evaluation of the collaboration tools.

The cyclical nature of design science research implies that requirements are developed iteratively. First-iteration requirements were elicited based on a preliminary requirements workshop (see 3.1.4 and 3.2.2), and on 11 interviews (see 3.1.3 and 3.2.1). Requirements were iteratively refined within the team of researchers. The formal second iteration was then evaluated with professionals from cities, academia, and smart city technology businesses (n=14) in a second workshop (see 3.1.4 and 3.2.3).

In Section 3.3 the current version of the requirements is presented. Requirements will continue to be refined, as evaluation results of the tools become available. Evaluation results comprise expert reviews prior to use in practice, as well as feedback collected after the actual use of the tool during a smart city application development process.



3.1.2 Specification of first and second iteration requirements

The specification of requirements was initiated by defining the actors that are involved in the use of collaborative smart governance tools during the development of smart city applications. A brainstorm session among the researchers was held to define the list of actors. The stakeholders involved in the case studies (see D1.2) and the actors involved in the quadruple helix collaboration model (Carayannis & Campbell, 2009) provided the starting point for this brainstorm. The following actors were defined:

- *Facilitator (and stakeholder)*: user of the tool who takes the lead in the application of the tool and who moderates the discussion (if applicable). The user is part of the project team.
- *Facilitator (external)*: user of the tool who takes the lead in the application of the tool and who moderates the discussion (if applicable). The user is hired by the project team.
- *Stakeholder*: member of the consortium that is involved in the development of the smart city application and that apply the tool, without taking a leading role. Facilitators may be a subset of stakeholders. Stakeholders comprise:
 - Citizens
 - Academic institutions
 - Companies
 - Civil servants (policy advisor, domain expert, communication specialist)

After the first iteration, requirements were categorized based on Verschuren & Hartog (2005) who distinguish between requirements and assumptions. Both requirements and assumptions are subdivided in three categories: user, functional, and context. Their definitions can be found in Table 3.

Table 3: Definitions of requirements and assumptions categories

	User	Functional	Context
Assumptions	Qualities the user should have in order to make a fruitful use of the artefact possible	Qualities the functions of the artefact should have in order to make a fruitful use of the artefact possible	Qualities the context should have in order to make a fruitful use of the artefact possible
Requirements	Demands of the future users of the artefact, within the frame that is defined by the goals [G]	The functions that the artefact should fulfil or enable to perform once it is realized, within the frame that is defined by the goals [G]	Prerequisites set by the political, economical, juridical and or social environment

The categorization matches the distinction that was made in the specification of the requirements and assumptions. Requirements were specified following the well-known user story template (e.g. Wautelet, Heng, Kolp, & Mirbel, 2014): as *[actor]*, I want to *[need]*, so that *[goal]*. Assumptions were specified as '*[actor]* must'. The explanation and foundation of the requirement or assumption in interview and workshop results is specified. Additionally, for each requirement the version history is logged.

A filled-out template in Dutch for an exemplary individual requirement is displayed in Figure 4.



Requirement	Type requirement	Ru: User requirement	Actor(en)	Stakeholder (alle)	ID															
Als stakeholder wil ik dat een instrument de inclusiviteit van betrokken stakeholders waarborgt, zodat iedereen de mogelijkheid heeft om inbreng te leveren.																				
Onderbouwing #W1K1, #W1G1, #W1B1 en #W2B1 wijzen erop dat het belangrijk is om alle stakeholders aan boord te hebben en dat omvat soms meer dan alleen het projectteam. #W1K1 en #R1 spreken over een proces dat meer betrokkenen bevat dan alleen de 'usual suspects' en in ieder geval de eerste en tweede ring van stakeholders moet betrekken. #Z3 geeft aan dat in relatie tot participatieprojecten ook vooral jongeren moeten worden betrokken. Volgens #Z1 is het betrekken van partijen o.a. belangrijk om te werken naar 'collectief begrip' en volgens #E2 op om te voorkomen dat je voor anderen gaat denken. #R1 vindt het belangrijk dat in ieder geval de eerste en tweede ring van stakeholders worden betrokken.																				
<table border="1"> <thead> <tr> <th>Versie</th> <th>Requirement</th> <th>Aanpassing</th> </tr> </thead> <tbody> <tr> <td>v1</td> <td>Als stakeholder wil ik dat een instrument de inclusiviteit van betrokken stakeholders waarborgt, zodat iedereen de mogelijkheid heeft om inbreng te leveren.</td> <td></td> </tr> <tr> <td>v2</td> <td></td> <td></td> </tr> <tr> <td>v3</td> <td></td> <td></td> </tr> <tr> <td>vn</td> <td></td> <td></td> </tr> </tbody> </table>						Versie	Requirement	Aanpassing	v1	Als stakeholder wil ik dat een instrument de inclusiviteit van betrokken stakeholders waarborgt, zodat iedereen de mogelijkheid heeft om inbreng te leveren.		v2			v3			vn		
Versie	Requirement	Aanpassing																		
v1	Als stakeholder wil ik dat een instrument de inclusiviteit van betrokken stakeholders waarborgt, zodat iedereen de mogelijkheid heeft om inbreng te leveren.																			
v2																				
v3																				
vn																				
Herkomst		Aggregatieniveau		Individueel instrument (cluster van c.g.-componenten)																
Bron		Respondentnummer(s)																		
Interview met (technologie)bedrijf	#Z3	#Z1																		
Minirequirementsworkshop	#W1K1	#W1B1	#W1G1																	
Interview met gemeente	#E2	#R1																		
Workshop validatie requirements	#W2B1																			

Figure 4: Requirements specification template

As can be seen from Figure 4, for each requirement the foundation in interviews and in the two workshops is systematically displayed, as well as the involved actors, and the version history of the requirement.


3.1.3 Requirements interviews

Individual interviews were conducted with a variety of stakeholders. Several stakeholders had to be interviewed to test different tools and to reveal different perspectives on the same tools. A total of 12 professionals were interviewed. See Table 4 with the overview of the respondents below.

For these semi-structured interviews, respondents from municipalities, companies and knowledge institutions were asked to participate. These respondents were selected because of their involvement in the development or implementation of the smart city application in the case studies (Zwolle, Enschede, Rotterdam and Amersfoort). The aim was to conduct at least two interviews with professionals working at the municipality. Only for the municipality of Zwolle this failed. In addition, the goal was also to interview one professional from a company and / or knowledge institution per case. No knowledge institution or company was approached for the Amersfoort case, because the project is still in the development phase and no other partners besides the municipality were involved in the project when the interviews were conducted.

Table 4: Interviewed respondents

Municipality	Organization
Amersfoort (N= 2)	2x Municipality
Rotterdam (N=3)	2x Municipality 1x Company
Zwolle (N=3)	2x Company 1x Knowledge institution



Enschede (N=3)	2x Municipality 1x Knowledge institution
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Interview set-up

The semi-structured interview consisted of two parts. The first aim of the interviews was to evaluate a range of instruments to (1) test whether certain tools offer support in resolving the bottlenecks identified in a case study (2) and to assess the type of requirements for collaborative smart governance tools in general. To test this, two tools were selected and presented to each respondent. These tools were deployable by partners with few adjustments (applicability level 3 or 4, on 4-point scale). Besides the tools were selected on several dimensions to test a variety of tools: (1) collaboration governance cluster (e.g., contract, business model, collaboration culture), (2) type of tool (e.g., workshop, app, template) and (3) the innovation phase (e.g., idea generation, idea testing, idea scaling). An overview of the presented tools is discussed in paragraph 3.1.4. Questions were asked about the tool on the basis of a topic list, for example: *“To what extent do you estimate that this tool contributes to solving the bottlenecks identified in the case?”* and *“To what extent do you intend to use the tool now or in the future?”* and *“To what extent do you consider yourself and colleagues capable of using this tool during the development or implementation of a smart city project?”*

The second aim of the interviews was to retrieve generic requirements for tools. Therefore, the interviews were concluded with general questions. For example: *“What makes a tool effective?”* And *“What makes a tool useful?”*

See Annex 2: interview format, for the topic list with interview questions.

Data analysis

Based on the interviews we created a list of 25 requirements. Three researchers developed the requirements and regularly discussed the results and issues encountered during the requirement formulation process. Besides, the requirements were tested and validated among other researchers and during two workshops. As a result, the requirements have been continuously adapted and optimized. For each requirement, the version history is logged (Annex 5: Overview requirements). The workshops are discussed below.

3.1.4 Requirements workshops

To evaluate, test, sharpen and possibly add new requirements to the list, two requirement workshops were conducted. The purpose of the first workshop was to develop requirements by showing participants possible collaboration tools (4.1.2). The aim of the second workshop was to evaluate the complete list of requirements together with a group of professionals that have experience with using collaborative tools in their line of work.

Preliminary requirements workshop

The aim of the first preliminary requirements workshop was to identify requirements for collaboration tools. Its purpose was to identify the needs of stakeholders when it comes down to requirements for tools. The results were intended to be compared against the needs and requirements that emerged from the requirements interviews (4.1.2). A limited group of professionals from municipalities and companies were invited to participate in the workshop. There were two inclusion criteria. At first it was important that the participants were not involved in the interviews explained in 4.1.2. Secondly the attendees needed to have experience with using tools.



Because the participants during the requirements interviews were all professionals from municipalities the choice was made to focus on the professionals working at companies for this workshop.

Table 5: Participants per group preliminary requirement workshop

Group	Participant
Group 1	1 (company)
	2 (company)
	3 (municipality)
Group 2	1(company)
	2 (company)
	3 (municipality)
Group 3	1(company)
	2 (company)
	3 (municipality)

To get a richer list of requirements a set-up was created where the participants needed to think of and list requirements in the context of an established tool within the smart city domain. After a brief introduction the group was separated into three subgroups with three participants per group (table 5). The group was split up to collect more and richer feedback. Every subgroup looked at two predetermined tools. The aim of the exercise was to generate requirements for a variety of tools. For this reason the tools were selected on the dimension of: (1) the collaboration governance cluster (e.g., contract, business model, collaboration culture), (2) the type of tool (e.g., workshop, app, template) and (3) the integration level (e.g., 1- many adjustments needed to make instrument usable up to 4 - minor adjustments needed to use tool)

See table 6 for the six tools that were used during the workshop.

Table 6: List of the tools used during the workshop

Tool	Tool type	collaborative smart governance domain	Integration level
Urban digital Twins	Software tool	Participation & communication and support among citizens	2
Toolkit Citizen Sensing (awareness sheet)	Workshop	Participation & communication and support among citizens	4
Business Model Canvas	Format	Business model, roles and responsibilities and budget	4
Data Ethics Decision Aid	Decision making tool	Technology & data	4
Self-Assessment Toolkit	Theoretical Framework	Leadership	2
Design Guide	Overall tool	-	3

The participants were asked to fill in the NOISE model for the two tools that were assigned to their group. The NOISE-model was used to provide insights in the needs, opportunities, improvements, strengths and exceptions of the tools. The model is based on the SWOT-model. SWOT is a simple but useful framework for analyzing strengths, weaknesses, opportunities, and threats for organizations (Gürel & Tat, 2017). For this workshop the NOISE-model has been used because it can give an overview of possible requirements.



Before filling in the NOISE model the concerned tool was explained to the participants. When the attendees were finished filling in the NOISE model a discussion was started to gain more in-depth feedback. This process was repeated for the second tool. In all the subgroups notes and recordings were made.

Data analysis

After the workshop the filled in tables were analyzed, as well as the feedback given during the discussions. The data received from this workshop was used to develop new requirements and to support the existing data about requirements. In Annex 5: Overview requirements, the history of the requirements and the additions from the workshops are included.

The complete set-up of the preliminary requirement workshop can be found in Annex 3: Workshop set-up.

Requirement workshop

The preliminary requirements workshop and the requirement interviews generated a solid base of requirements. The aim of the requirements workshop was to validate these requirements but also give the participants the chance to add new requirements. The group of participants consisted of policy advisors from municipalities involved in the consortium, experts from research institutes, the VNG and different companies.

Besides, the workshop was also used to inform the consortium about updates concerning the project and to receive more input on a topic that came to light during the preliminary workshop. During the preliminary workshop, several participants had questions about the usefulness of tools to resolve problems. A ‘Mentimeter’ question was used in the requirement workshop to obtain more opinions on the perceived usefulness and potential of tools to resolve collaborative smart governance bottlenecks. The first (brief) part of the workshop was used to handle these matters. After the update the program and the aim of the workshop were explained, and the participants were divided in three subgroups (Table 7).

Table 7: Participants per group requirement workshop

Group	Participant
Group 1	1 (municipality)
	2 (municipality)
	3 (municipality)
	4 (VNG)
	5 (research institute)
Group 2	1 (municipality)
	2 (municipality)
	3 (company)
	4 (research institute)
Group 3	1 (municipality)
	2 (municipality)
	3 (municipality)
	4 (company)
	5 (research institute)

The group discussions during the workshop consisted of two rounds. The facilitator switched to a different group at the end of the first round. Each round had two sections; the different rounds and sections are explained below.

1. First round



- a. The participants had to formulate at least one new requirement.
- b. The participants reviewed a sub-list of already drafted requirements.
- 2. Second round
 - a. The participants review the newly added requirements written down by the previous group.
 - b. The participants reviewed a different sub-list of already drafted requirements.

All the drafted requirements were separated into three clusters, following (Verschuren & Hartog, 2005): 'functional requirements', 'user requirements' and 'context requirements'. The list of requirements consists of a total of 21 requirements of which 11 functional requirements, 9 user requirements, and 1 context requirement. All the different subsets were reviewed by two groups during the workshop. The newly submitted requirements that were formulated during round 1a were reviewed once during round 2a. After every sub round a discussion followed to gain more in-depth feedback about the newly submitted requirements and also about the feedback given on the existing requirements.

During the workshop participants reviewed the requirements in an online document with a '+', '-', '+/-' or '?'. The meaning of the different symbols is displayed in Table 8. In all the subgroups notes and recordings were made.

Table 8: Meaning of symbols used during the requirement workshop

Symbol	Meaning
+	Agree with requirement
-	Disagree with requirement
+/-	Doubts about requirement
?	Requirement unclear

Data analysis

After the workshop the documents with the new requirements, the tables with symbols and the notes were examined. The data received from this workshop was used to develop three new requirements. In Dutch these requirements are: (1) als stakeholder wil ik dat een instrument goed vindbaar is, zodat het weinig moeite kost om een instrument te vinden; (2) als stakeholder wil ik dat het gebruik van een instrument leuk is, zodat stakeholders het instrument in willen zetten; (3) als stakeholder wil ik dat instrumenten stakeholders met verschillende achtergronden kan verbinden, zodat knelpunten in de samenwerking kunnen worden opgelost.

Besides, the data was used to support the existing data about requirements. In Annex 5: Overview requirements, the history of the requirements and the additions from the workshops are included. Additionally, see Table 10,11 and 12 below for the data per requirement from the requirement workshop.

The complete set-up of the requirement workshop can be found in Annex 3: Workshop set-up.

3.2 Results

3.2.1 Interviews

In order to get ample and concrete response, we selected six well described tools to present to interviewees briefly and asked them to reflect on the tools. In the section below, results per tools derived from the interviews are described. The tools are described according to the collaborative smart governance clusters. In the interviews we have presented (1) collaborative structure tools (value proposition canvas, business model canvas), (2) collaborative process tools (value mapping, thinking hats), (3) support and participation tools (digital twin, smart nation ambassador program, city assembly, citizen sensing-awareness sheet), (4)



use of technology tools (DEDA) and, (5) outcome tools (business and value case HMO). Below, tools that have been discussed with several respondents are explained.

Cluster: Collaborative Process Tools

Value Mapping

The Value Mapping tool helps to analyze and understand the interests of different stakeholders (Nesta, n.d.). Participants in the session have to fill in the value mapping tool to identify their personal values as well as their company's values. Once the values are defined, they can be shared and act as a common reference point that simplifies and speeds up decisions, whilst also ensuring consistency in the work that you do.

The tool is simple and easy to understand for all partners (R3, A2). Respondents are positive about the fact that the tool can provide insight into values and interests of stakeholders (A2). According to respondents it is important that all partners are present when using this tool and take the session seriously (E1, E2). E1, R1 and R3 emphasize that time of professionals working at companies is scarce, and that it is important to explain the output of the tool. In addition, to be able to use this tool, people with process management skills are required. People with these kinds of skills generally are available within larger municipalities (E1, R2), but not in smaller municipalities.

Cluster: Support & Participation Tools

Digital Twin

The general definition of Digital Twin is: "*a digital representation of a real-world entity or system*" (Gartner, n.d.). Digital Twins are commonly used in engineering. In smart city projects, a Digital Twin is a digital copy of the city in which different elements can be included, for example visualizations of infrastructure and of urban planning projects (Dembski, Wössner, Letzgus, Ruddat, & Yamu, 2020).

Respondents are positive about the tool (A1, R1, E3). This is mainly due to the visual aspect that could make it easier for people and partners to envision and talk about certain situations, for example in urban development (A1, R1, E3). Some reservations were also mentioned. R1 indicates that the visual image must be clear, otherwise the image can be interpreted differently. In addition, the use of the tool itself is not sufficient, the conversation with citizens about the city is also very important. This needs a tool to facilitate participation (R1).

Smart Nation Ambassador Program

The Smart Nation Ambassador Program (Smart Nation Singapore, n.d.) is essentially the development of a network of citizens that can help other citizens. The goal of this tool is to share technological knowledge within this network. On the one hand, this can enhance technical knowledge and digital skills among citizens and government institutions (Smart Nation Singapore, 2019). On the other hand, more technical knowledge and digital skills can contribute to support and participation, of citizens and professionals, for urban planning and urban management.

Respondents argued that a positive aspect of this tool is that it can help to create involvement among citizens (E1). However, various conditions have to be met to be able to use the Smart Nation Ambassador Program, especially when the tool would be applied within the municipal organization itself (E1, E2). These conditions include ambassadors with enthusiasm, with knowledge and with a positive mindset (E1, E2). In addition to an ambassador, time (E2) and guaranteed availability (G1, E2) are also important difficult to translate the concept of ambassadorship to the context of a municipal organization (E1, E2).



Citizen Assembly

'Citizens Assembly' is a citizens thinktank to contribute to a local decision-making process. (Cinnal Cimry, n.d.) It is a participation tool with a relatively high impact compared with usual participation meetings which last only a couple of hours and are completely voluntary. The aim of a citizen assembly is to randomly select people from the population to form a representative group of inhabitants. They will discuss and learn about different local issues in sessions that take one or two days. At the end of the session, a conclusion (recommendation to the municipal administration) should be reached.

The interviewees think that the Citizens Assembly is a useful tool (Z2, Z3). The strength of the tool is the selection of a random group. Although Z3 says it is important that young people are included within the target group. Z2 has some practical recommendations for the use of this tool: in order to organize the meeting properly, it is useful to set up a partnership between educational institutes, companies and the municipality; when having this meeting the communication must be well organized; the conversation should be based on equality and should be open minded (Z2). Besides, some respondents argue that it could be important for citizens to get something in return for their time (Z1, Z2).

Citizen Sensing Awareness Sheet

The Citizen Sensing-awareness sheet is part of a toolkit (Making Sense, n.d.). This toolkit contains of various tools that can contribute to citizen sensing, i.e., the participation of citizens in the collection of environmental data (e.g., air quality, climate data). This tool is intended to help community members understand the wider implications of local problems and find out which actions could be taken by different actor(s).

This tool fits well with the (climate) measurements that must be taken by residents and the municipality. In addition, it is in line with the idea of new Environment and Planning Act (Z3). Comparing the answers of the different interviewees, there are doubts about how big or how small the environmental problem can be to make use of this awareness sheet. Nuclear radiation appears to be too big a problem, and noise pollution on a square appears to be too small (E3, Z1). This suggests that a pragmatic perspective must be chosen to see whether this tool fits within the context of an issue. Z1 also wonders who will be invited to the meeting and (Z3, Z1) wonder what their motivation will be. When residents and/or partners are invited, it is important that the difficulty level of the language is not too high, and it must also be clearly explained why the tool is used (Z1). Policy can be based on the results of this tool, which can be linked to concrete and measurable goals (Z3).

Cluster: Use of technology tools

DEDA

DEDA stands for 'Data Ethics Decision Assistant' (Utrecht Data School, n.d.). DEDA helps data analysts, project managers and policy makers to recognize ethical issues in data projects, data management and data policies. Organizing a session according to the DEDA can help to detect ethical problems within a data collection project (e.g., citizens privacy issues) and help to develop a feeling for possible conflicts between values within a data collection project. It can also support the documentation of the ethical policy-making process.

Respondents see this tool as useful and clear, because it can help professionals to understand important ethical questions in relation to a data project (A1, A2). However, some respondents are also overwhelmed by the tool and describe the tool as 'too much' (A1). Besides, respondents expect to be able to use DEDA, but it requires a clear manual and a skillful moderator (A2). Hiring a moderator for the DEDA session makes the use of the tool expensive. The costs may be too high for some municipalities. That is why it would be helpful to have a light version of the tool available (A1). Another aspect that respondents mention is the



language used in the tool. The tool cannot be used with citizens, because the professional jargon that is used (A1).

General observations

Considering the results of all interviews, we came across several aspects that were mentioned in relation to more than one tool. These aspects were 'inclusion of participants to sessions', 'skills and knowledge of participants', 'presentation of the output', 'skills of facilitator', and 'cost'.

For citizens participation tools, it was often a question how to reach citizens and how to guarantee accessibility (in relation to the invitation to a session and the required skills and knowledge)? Respondents argued that a B1/B2 vocabulary is required, for tools that are used in collaboration with citizens (#Z1, #A1, #R3).

For several tools it was also emphasized by respondents that the presentation of the output of a tool is important. Results should have a concise form so that the output of the tool could easily be used (#A1, #E2, #Z1).

Many respondents also brought up facilitator skills. For example, facilitators must be able to convey enthusiasm, initiate dialogue between stakeholders and motivate respondents to think 'out of the box' (#E1, #A1, #E2, #R1, #R2, #Z3).

Lastly, sometimes the cost of a tool is discussed in relation to the perceived output (#E3, #A2).

3.2.2 Preliminary requirements workshop

The purpose of the preliminary workshop was to develop requirements by showing participants possible collaboration tools. By comparing the results against the requirements that were derived from the interviews (3.2.1), the requirements could be corroborated or refined. A couple of interesting subjects came to light during the discussions in the subgroups:

In one of the subgroups the subject 'usefulness of tools' was discussed heavily. The participants, that all worked at companies, doubted if tools could help them solve complex collaboration problems (#W1B4, #W1B5, #W1B6). A 'Mentimeter' question was used in the requirement workshop to obtain more opinions on the perceived usefulness and potential of tools to resolve collaborative smart governance bottlenecks. It was striking that during this workshop everyone assumed that tools could help them solve collaboration problems.

Besides, participants stated that a difference exists between requirements for facilitators and requirements for stakeholders. For example, requirement for facilitators can focus on process management skills and requirements for stakeholders can be about the wanted output of a collaboration tool. This thought was used to further define the requirements.

In addition, it was noticeable that some participants had trouble with understanding the difference between a tool and a requirement. The distinction of the two terms was not clear and they were sometimes confused as the same thing by a number of participants. This complicated the analysis of the results.

3.2.3 Requirements workshop

The aim of the second workshop was to develop new requirements and to validate existing requirements with the consortium and experts from outside the consortium.



During the workshop, there were a few requirements that were supported by all the participants. First of all, according to participants, the facilitator must be able to enable an open dialogue to help stakeholders express their interest. Besides, the facilitator must be able to initiate a dialogue, convey enthusiasm and motivate stakeholders to think out-of-the-box (#W2V1, #W2G1, #W2G2, #W2G3, #W2K1, #W2G4, #W2B1, #W2G5, #W2K3, #W2B2, #W2G6, #W2G7). Secondly, respondents argued that it is very important for stakeholders that an instrument matches the demands of the project and has a clear purpose (#W2K3, #W2B2, #W2G6, #W2G7, #W2G1, #W2G2, #W2G3, #W2K1, #W2G4, #W2B1, #W2G5, #W2K2). Moreover, the time that is needed to use an instrument should be proportional to the possible output of an instrument (#W2K1, #W2G4, #W2B1, #W2G5, #W2K2, #W2K3, #W2B2, #W2G6, #W2G7).

Furthermore, in the different subgroups a number of overarching topics emerged that deserve further attention. For example, many participants (#W2V1, #W2G1, #W2G2, #W2G3, #W2G4, #W2B1, #W2G5) emphasized that it is important that a tool can be used online because of the corona pandemic. Besides, some participants (#W2G1, #W2G4) stated that tools should only be used if stakeholders believe that a tool can help solve bottlenecks in the collaboration process. Informing stakeholders, before using a particular tool, about the possible outputs of a tool could generate support.

Two requirements were rejected during the workshop and were deleted from the requirements overview. One requirement stated that tools should solve manageable parts of collaboration problems. Many participants stated that it is difficult to distinguish manageable parts in a collaboration process (#W2G6, #W2G7, #W2G2, #W2G3, #W2K3, #W2B2). The other requirement stated that the tools should be used with stakeholders that have a basic level of involvement in the collaboration process. The requirement was unclear for several participants (#W2G1, #W2G3, #W2G2, #W2G5) and they stated that this requirement transcends the purpose of solving collaboration problems.

During the workshop, there were also a few requirements that weren't clear, because of the formulation. For example, one requirement was about the choice between a 'difficult' and 'light version' instrument. Respondents did not understand these concepts (#W2B1, #W2G5, #W2K2, #W2K3, #W2B2, #W2G6, #W2G7). As a result, this requirement is reformulated. For upcoming workshops, it is advised to formulate the requirements briefer and more understandable to avoid confusion and get feedback that is more reliable.

The workshop data was used to add requirements and adapt existing requirements. See an overview of the requirements in the paragraph below.

3.3 Overview of requirements

After the first iteration requirements, the full set of requirements was analyzed, resulting in two additional categories being added to the requirements and assumptions. For the specification of requirements Verschuren & Hartog (2005) recommend to limit the range of the goals the solution – in our case the collaboration tools - should try to achieve. For that reason, the wide range of goals that emerged from the first iteration requirements were classified into four main goals and four derived sub goals, using a thematic analysis (Braun & Clarke, 2012). The resulting classification is displayed in Table 9.

Table 9: Classification of goals

Short definition	Definition
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Balance between effort and contribution to the collaboration problem	Resolving a realistic portion of the collaboration problem by means of tools, balancing the effort of using tools with their contribution to the collaboration problem
Contribution to a bottleneck in the collaboration between stakeholders	Resolving a portion of a collaboration problem that has potential impact on the successfulness of a project, which can be resolved by usage of the tool
Integration of the tool into the collaboration process	Ensuring that by well-planned communication before, during, and after the usage of a tool the tool can be integrated into the process of collaboration between stakeholders
Effort	Expecting a time investment of both stakeholders and (if applicable) a facilitator that is aligned with the intended outcomes of the tool
Support	Ensuring that stakeholders are convinced of the contribution the usage of a tool can make to the collaboration process between stakeholders and of the return of their time investment.
Substantiated choice for a tool	Getting support for the choice for a tool as well as the justification for that choice
Usage in times of corona	Getting support with the collaboration process by means of tools that in spite of the corona regulations can still be used.
Adaptability of the tool	Resolving a portion of the collaboration process with tools that are adapted to the local situation, without imposing a rigid format on stakeholders.

The second categorization comprised the aggregation level of the requirement or assumption, involving two levels: tool versus toolbox as a whole, and individual collaborative smart governance component vs. generic. The following categories emerged from the first-iteration requirements:

1. Requirements or assumptions that apply to tools for a specific cluster of collaborative smart governance components.
2. Requirements or assumptions that apply to all tools, regardless of the cluster of collaborative smart governance components for which they were developed.
3. Requirements or assumptions that apply to the way in which the collection of tools is brought together in a toolbox
4. Requirements or assumptions that apply to both all individual tools and to the toolbox as a whole.

The processing of the results from the second requirements workshop, and the implementation of the resulting changes to the requirements led to the definition of the second iteration requirements, as the final outcome of this deliverable. In Tables 10,11 and12 an overview of the 23 requirements is presented. These requirements were formulated on the basis of 12 interviews and two workshops. The complete overview, and the history of every requirement, is added to appendix 6. The requirements were categorized based on Verschuren & Hartog (2005) who distinguish between requirements and assumptions. Both requirements and assumptions are subdivided in three categories: user, functional, and context. Definitions can be found in table 3.

To avoid losing the subtleties of the Dutch language, the requirements were not translated to English. The user requirements for individual tools are listed in Table 10.

Table 10: User requirements

Requirement	Doel	Requirement workshop
Als stakeholder wil ik voorbeelden zien van hoe het instrument in de praktijk (niet) heeft gewerkt, zodat ik de opbrengst van het instrument goed kan inschatten.	Draagvlak	6x bevestigd, 2x twijfel belang 1x verworpen
Als stakeholder wil ik instrumenten inzetten die passen bij het samenwerkingsprobleem van de stakeholders en de behoefte vanuit het project, zodat stakeholders het gebruik als nuttig ervaren.	Draagvlak	7x bevestigd
Als facilitator wil ik instrumenten die een open dialoog mogelijk maken gericht op het uiten van ieders belangen binnen het project, zodat knelpunten in de samenwerking kunnen worden opgelost.	Bijdrage aan het oplossen van een knelpunt in samenwerking tussen stakeholders	6x bevestigd
Als stakeholder wil ik dat instrumenten tot vervolgcacties leiden, zodat er kan worden voortbordurd op de resultaten.	Inbedding van instrument in samenwerkingsproces	4x bevestigd 2x twijfel belang 1x niet belangrijk
Als stakeholder wil ik voor mijzelf en voor stakeholders dat de tijdsinvestering voor de inzet van het instrument in verhouding staat tot de output, zodat de stakeholders bereid zijn het instrument in te zetten.	Verhouding tussen effort en bijdrage aan samenwerkingsprobleem	9x bevestigd
Als stakeholder wil ik instrumenten inzetten die de kwaliteit van het samenwerkingsproces verbeteren, zodat knelpunten in de samenwerking worden opgelost.	Bijdrage aan het oplossen van een knelpunt in samenwerking tussen stakeholders	6x bevestigd 2x twijfel belang 1x verworpen
Als stakeholder wil ik dat het instrument aan de voorkant voorziet in een uitleg over de doelen van het instrument, en achteraf voorziet in een terugkoppeling van de resultaten naar de deelnemers, zodat stakeholders de resultaten van het instrument bezien vanuit het proces in het project als geheel.	Inbedding van instrument in samenwerkingsproces	3x bevestigd 1x twijfel belang 1x verworpen 3x onduidelijk
Als stakeholder wil ik dat het gebruik van een instrument leuk is, zodat stakeholders het instrument in willen zetten.	Draagvlak	Nieuwe ontwerpeis

The functional requirements for individual instruments are listed in Table 11.

Table 11: Functional requirements

Requirement	Doel	Requirement workshop
-------------	------	----------------------



Als stakeholder wil ik instrumenten gebruiken met een duidelijk doel en nut, zodat er steun onder stakeholders ontstaat voor de inzet van het instrument.	Draagvlak	9x bevestigd
Als stakeholder wil ik dat de resultaten van een instrument compact worden weergegeven, zodat de uitkomsten in het vervolg meteen kunnen worden gebruikt.	Effort	4x bevestigd 2x twijfel belang 1x verworpen
Als facilitator wil ik een duidelijke handleiding van het instrument, zodat het instrument het beoogde effect bereikt.	Bijdrage aan het oplossen van een knelpunt in samenwerking tussen stakeholders	8x bevestigd 1x twijfel belang
Als stakeholder wil ik een instrument gedurende het proces op meerdere momenten kunnen inzetten, zodat het instrument gedurende het hele proces bij kan dragen aan de samenwerking.	Inbedding van instrument in samenwerkingsproces	4x bevestigd 3x twijfel belang
Als stakeholder wil ik een toolbox die mij ondersteunt bij het nemen van beslissingen over te gebruiken instrumenten, zodat ik eenvoudig een instrument kan kiezen en de keuze hiervoor kan onderbouwen.	Beargumenteerde keuze voor instrument	3x bevestigd 4x twijfel belang
Als facilitator wil ik dat een tool tijdens het proces duidelijk aangeeft uit welke opties ik kan kiezen, zodat het maken van keuzes binnen het instrument weinig inspanning vraagt van de gebruiker.	Effort	6x bevestigd 2x twijfel belang
Als facilitator wil ik de vrijheid hebben om te kiezen tussen een eenvoudig en een geavanceerd niveau van een instrument, zodat ikzelf of de stakeholders het geschikte complexiteitsniveau van het instrument kan selecteren.	Aanpasbaarheid van het instrument	2x bevestigd 7x onduidelijk
Als facilitator wil ik dat het instrument ook digitaal ingezet kan worden, zodat het instrument ook tijdens de coronapandemie kan worden ingezet.	Inzetbaarheid tijdens corona	7x bevestigd 1x twijfel belang
Als stakeholder wil ik dat een instrument flexibel kan worden ingezet, zodat het instrument kan worden aangepast aan de lokale situatie en context.	Aanpasbaarheid van het instrument	7x bevestigd 1x verworpen
Als stakeholder wil ik dat de naam en omschrijving van het instrument aanspreekt en de lading van het instrument dekt, zodat het instrument de juiste associaties oproept bij stakeholders.	Draagvlak	3x bevestigd 2x twijfel belang 2x verworpen
Als stakeholder wil ik dat een instrument goed vindbaar is, zodat het weinig moeite kost om een instrument te vinden.	Effort	Nieuwe ontwerpeis
Als stakeholder wil ik dat instrumenten stakeholders met verschillende achtergronden	Bijdrage aan een knelpunt in samenwerking tussen stakeholders	Nieuwe ontwerpeis



kan verbinden, zodat knelpunten in de samenwerking kunnen worden opgelost.		
Als stakeholder wil ik de vrijheid hebben om de scope van het samenwerkingsprobleem dat het instrument omvat te laten afhangen van de context, zodat ikzelf of andere stakeholders het geschikte scopingsniveau van het instrument kan selecteren.	Aanpasbaarheid van het instrument	Nieuwe ontwerpeis

The assumptions are listed in table 12.

Tabel 12: Assumptions

Type	Assumption	Requirement workshop
User	Een facilitator moet enthousiasme over kunnen brengen, dialoog tussen stakeholders op gang kunnen brengen, respondenten kunnen motiveren zich uit te spreken en out-of-the-box te denken.	8x bevestigd
Contextual	Stakeholders moeten van hun organisatie voldoende tijd krijgen om het instrument te kunnen inzetten.	6x bevestigd 1x verworpen 1x onduidelijk



4 Conclusions

This deliverable has reported on a gap analysis between collaborative smart governance bottlenecks and already identified instruments, a systematic search for additional instruments drawing on this gap analysis, an evaluation of existing tools by government professionals, and a requirements analysis that has provided an empirical basis for adaptations to existing collaborative smart governance tools, and for the development of new tools.

This deliverable marks the transition to the second stage of the project, the design cycle (Hevner Alan, 2007) that takes the shape of action research (Susman & Evered, 1978). As a first next step, the most promising subset of existing tools are evaluated against the requirements, with the purpose of identifying existing tools that will be included in the toolbox. Second, existing tools will be adapted, and new tools will be developed and evaluated, depending on a diagnosis of the collaborative smart governance problem in real-life cases of smart city application development processes. One long-term case study¹ is foreseen, in which on multiple occasions one or more tools will iteratively developed, used, and evaluated in terms of the contribution to the collaboration process. Additionally, multiple short-term case studies will be conducted, where a brief diagnosis will lead to the development, use, and evaluation of a tool in a single iteration. This set-up allows for the development and in-situ evaluation of a wider range of tools across collaborative smart governance components for which no pre-existing tools are yet available, as has become clear from the gap analysis. This is considered important, given the limited range of tools that can be applied in a single case study, as a single case study can only be used to resolve collaborative smart governance bottlenecks that stakeholders perceive as urgent within that particular smart city project. Extending the range of cases resolved this methodological problem.

Reflecting on the current state of the requirements, it should be stressed however that the requirements reported here cannot be perceived as 'final'. First, in a design-science based project requirements continue to evolve once artefacts (in our case: tools) are developed and evaluated in practice as part of the design cycle (Hevner Alan, 2007). This will yield additional insights about the user needs, the desired characteristics, and functions of the tools, as well as the opportunities and limitations the context imposes on the use of such tools. This may lead to modifications or additions across Verschuren & Hartog's (2005) categories of requirements and assumptions (user, functional, context). Additionally, the sometimes contradictory requirements may be prioritized based on insights gained while developing, using, and evaluating tools. Finally, the development and evaluation of tools in concrete cases will yield more specific requirements that capture the nuances of the smart city application context, the development phase, and the collaborative smart governance problem. These variables have not yet been taken into account in the current version of the requirements.

Second, the primary focus of the requirements analysis was on *generic* requirements and assumptions rather than those that are specific for a cluster of collaborative smart governance components, and on *individual* tools rather than the toolbox as a whole. The diagnosis and planning phase of the upcoming action research (Susman & Evered, 1978) that shapes the design cycle should resolve these omissions that result from this focus. As such, it should contribute to the requirements and assumptions that were defined at the level of the toolbox as a whole and on the level of individual collaborative smart governance components. The empirical basis for the existing toolbox-level and component-specific requirements should

¹ This approach is different from the approach described in the project plan due to a) the results of the requirements analysis itself that suggest the need for small-scale instruments that can be quickly deployed and b) Almere leaving the consortium who were scheduled to introduce a second case study.



be extended by analyzing the interview and focus group data the diagnosis and planning phase will yield, while additional requirements may also emerge from such analysis.

Third, there was a lack of consensus among participants in the workshops and interviews, regarding the scope of the collaborative smart governance problem the tool should address. On the one hand, some participants argued for a limited scope, preferring tools that each seek to resolve a small, manageable part of a collaborative smart governance problem. On the other hand, other participants prefer tools with a broader scope, to avoid losing focus on the collaborative smart governance problem at large. This scoping problem cannot be resolved without taking into account a particular context and particular collaborative smart governance component. This problem will be resolved by developing and evaluating tools in concrete cases.



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6 Annex 1: Respondent list

Refer system for anonymization:

A/R/Z/E: the municipality: Amersfoort, Rotterdam, Zwolle or Enschede

G: municipality

B: company

K: Research institutes

W1: workshop 1: mini-requirement workshop

W2: workshop 2: requirement workshop

Individual interviews

#E1	Enschede	Municipality
#E2	Enschede	Municipality
#A1	Amersfoort	Municipality
#R1	Rotterdam	Municipality
#R2	Rotterdam	Company
#V1	-	VNG
#E3	Enschede	Research institutes
#R3	Rotterdam	Municipality
#A2	Amersfoort	Municipality
#Z1	Zwolle	Company
#Z2	Zwolle	Research institutes
#Z3	Zwolle	Company

Workshop 1: mini-requirement workshop

#W1K1	-	Research institutes
#W1G1	Hoorn	Municipality
#W1B1	-	Company
#W1B2	-	Company
#W1G2	Utrecht	Municipality
#W1B3	-	Company
#W1B4	-	Company
#W1B5	-	Company
#W1B6	-	Company



Workshop 2: requirement workshop

#W2V1	-	VNG
#W2G1	Rotterdam	Municipality
#W2G2	Eindhoven	Municipality
#W2G3	Hoorn	Municipality
#W2K1	-	Research institutes
#W2G4	Rotterdam	Municipality
#W2B1	-	Company
#W2G5	Eindhoven	Municipality
#W2K2	-	Research institutes
#W2K3	-	Research institutes
#W2B2	-	Company
#W2G6	Utrecht	Municipality
#W2G7	Amersfoort	Municipality



7 Annex 2: interview format

Introductie:

- In de vorige ronde van het onderzoek hebben we stimulerende en belemmerende factoren uit de case in beeld gebracht. Vervolgens zijn we in de literatuur opzoek gegaan naar instrumenten.
- Doel van deze sessie is om een selectie van verzamelde instrumenten voor te leggen om functionele, niet-functionele en user requirements aan te scherpen.
- Het interview zal ongeveer een uur duren. We zullen in dat uur 2/3 instrumenten voorleggen en tot slot in gesprek gaan over requirements.

Vragen per instrument: (5 min uitleg, 15 minuten vragen) 2x

- Bent u bekend met tool x?
- Uitleg instrument [5 min]

Begrip

1. In hoeverre is de werking van het instrument duidelijk voor u?

Ingeschatte effectiviteit

- Hoe bruikbaar is dit instrument om de knelpunten bij [naam case] op te lossen? Zijn er aanpassingen nodig voor het instrument? Zo ja, welke?

Ingeschatte zelfeffectiviteit

- In hoeverre acht u zichzelf en collega's in staat om dit instrument in te zetten tijdens het ontwikkelproces van smart city producten?
- Wat denkt u nodig te hebben aan kennis, vaardigheden en faciliteiten om dit instrument in te kunnen zetten?

Houding en gedragsintentie

- Wat vindt u van dit instrument? Wat spreekt u aan? Wat spreekt u minder aan?
- Hoe geschikt denkt u dat dit instrument is in de ogen van de samenwerkingspartners in u project?
- In hoeverre heeft u de intentie om dit instrument, of iets vergelijkbaars, nu of in de toekomst te gebruiken?

Concluderende vragen na bevraging van de vier individuele instrumenten (20 min)

2. Heeft u ervaring met het gebruik van dit soort instrumenten en wat waren u ervaringen?
3. Nu u verschillende instrumenten kan overzien, zijn er bepaalde eisen, die altijd moeten gelden voor een instrument?
4. Wat maakt een instrument bruikbaar voor u?
5. Wat maakt een instrument onbruikbaar voor u?
6. Wat maakt een instrument effectief voor u?



8 Annex 3: Workshop set-up

Preliminary requirements workshop

Doelen:

- Tijdens workshop worden een aantal gevonden instrumenten voorgelegd aan professionals van bedrijven/ kennisinstellingen en gemeenten. Deze professionals zijn breed betrokken bij het onderzoek van Samoerai en hebben niet deelgenomen aan het WP1 (identificering van knelpunten en succesfactoren voor Zwolle, Enschede, Rotterdam en Amersfoort)
- Doel: Brede requirements inventariseren vanuit de mogelijke gebruiker.

Opzet: Twee rondes van 30 minuten in drie subgroepen:

- Groep 1: Moderator: Mark.
 - Groepsleden:** Jan-Joost (Atos), Thom (Nobralux), Sofie (Utrecht)
 - Instrument ronde 1: Urban Digital Twins/ [Drive-link](#)
 - Instrument ronde 2: Businessmodel Canvas. Zelfde link als instrument 1.
 - Teams-link: [Klik hier om deel te nemen aan de vergadering](#)
- Groep 2: Moderator: Harm-Jan.
 - Groepsleden:** Maarten (ESRI), Paul (Sorama) Karin (Almere)
 - Instrument ronde 1: Toolkit Citizen Sensing (Awareness Sheet). [Drive-link](#).
 - Instrument ronde 2: Self-Assesment Toolkit. Zelfde link als instrument 1.
 - Teams-link: [Klik hier om deel te nemen aan de vergadering](#)
- Groep 3: Moderator: Anouk.
 - Groepsleden:** Twan (Wirelab), Jasper (Hoorn), Rick (Sorama)
 - Instrument ronde 1: Data Ethics Decision Aid. [Drive-link](#).
 - Instrument ronde 2: Design Guide with tool Zelfde link als instrument 1.
 - Teams-link: [Klik hier om deel te nemen aan de vergadering](#)

Voorafgaand aan het opdelen in groepen in de plenaire ruimte (zie [workshopprogramma](#)):

- Noël deelt de groepsindeling en de Teams linkjes voor de groepen.
- X vertelt de eindtijd (als we plenair afsluiten)

Deelnemers en moderator openen Teams-link

Discussie in drie groepen

1. Vragen om toestemming voor opname. Opname starten
2. Timer zetten voor 30 minuten:
3. Eerste instrument uitleggen. Deel scherm en laat de sheets van het instrument zien [5 min]
4. Groepsleden verwijzen het NOISE-model in te vullen [5 min]
5. Discussie [20 min]
6. Herhaal de stappen 2 tot en met 5 voor instrument 2.
7. Sluit aan bij hoofdsessie voor plenaire afsluiting [5 min]

Discussies a.d.h.v. NOISE-modellen 2x20min

Open vragen:



- Vragen stellen aan de hand van de ingevulde gegevens van de deelnemers.
- Focussen op 'needs' en 'improvements'
 - Wat maakt een instrument een goed instrument?
 - Wat maakt een instrument bruikbaar?
 - Wat denkt u nodig te hebben aan kennis, vaardigheden en faciliteiten om dit instrument in te kunnen zetten?

Workshop set-up final requirements workshop

Doelen

1. Consortium informeren over de uitkomsten van fase 1:
 - knelpunten en clusters van collaborative smart governance
 - gevonden instrumenten
 - voorbeeldrequirements
2. Requirements aanvullen, aanscherpen en toetsen bij het consortium en bij experts

Welkom, introductie en voorstelrondje: (Mark) 20 minuten [10:00-10:20]

1. Welkomstwoord
2. Voorstelrondje: Naam en Functie
3. Korte projectintroductie in 2 slides
4. Metimetervraag (groep in beeld brengen)
 - a. Vraag 1: Bijdrage van instrumenten aan samenwerkingsprobleem (4-pt. -schaal)

Uitkomsten fase 1: (Anouk) 20 minuten. [10:20-10:40]

Consortium informeren over (1) knelpunten + clusters cg (2) gevonden instrumenten (3) voorbeeld requirements

Opzet: Wereldcafé: 2 rondes (totaal 45 minuten) [10:40-11:25]

- Moderatoren verplaatsen elke keer van groep en de moderatoren houden bij elke groep zijn benoemde cluster. (Zie moderatoren)
- **Opname starten!** /controleer of de opnamen blijft lopen na het wisselen.
 - Timer zetten voor 30/ 15 minuten:
 - Zet de tijd door 1, 5, 0, 0 aan te klikken. Druk op set
 - Druk op start

Ronde 1: (totaal 30 minuten)

Google Docs met deze groep te delen.

Ronde 1.1 (15 minuten)

- Google Docs-link delen via de chat
- Deelnemers één ontwerpeis laten toevoegen in Google Docs
- Per ontwerpeis deelnemer kort laten toelichten

Ronde 1.2 (15 minuten)

- Deelnemers +/- achter bestaande ontwerpeisen laten schrijven in Google Docs(+ je kunt jezelf vinden in de eis, - je kunt jezelf niet vinden in de eis)
- Per eis paar mensen aan het woord laten om mening te achterhalen.



Ronde 2: (totaal 15 minuten)

Google Docs met deze groep te delen.

Ronde 2.1 (5 minuten)

- Deelnemers +/- achter ontwerpeisen van vorige groep laten schrijven, ontstaan in ronde 1.1 (+ je kunt jezelf vinden in de eis, - je kunt jezelf niet vinden in de eis)
- Per ontwerpeis deelnemer kort laten toelichten

Ronde 2.2 (10 minuten)

- Deelnemers +/- achter bestaande ontwerpeisen laten schrijven (+ je kunt jezelf vinden in de eis, - je kunt jezelf niet vinden in de eis)
- Per eis paar mensen aan het woord laten om mening te achterhalen.



9 Annex 4: Overzicht aanvullende instrumenten

Verwijzen naar excel sheet



10 Annex 5: Overview requirements

Verwijzen naar excel sheet