



# Twin4Resilience

## Four Frameworks for Local Digital Twins

### *Summary*

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Twin4Resilience



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Four Frameworks - on **Ethics, Inclusion & Democratisation, Governance, Education & Training** and **Technical Design** – were developed in the first phase of the Twin4Resilience project. These Frameworks are supporting the development of 8 Pilot Action Plans, the implementation of 8 pilots, the development of Training Modules and overall joint learning. The Frameworks are not supposed to be prescriptive, but rather informative, supportive and inspiring.

To ensure that the T4R project partners can quickly find the information they need, the Framework's findings are presented in **four Digital Twin (DT) 'Situations' (Lab, Studio, Arena, or Agora)** in a maximum of **10 critical questions per situation**.

A **'Situation'** is defined as **a set of circumstances in which one finds oneself with the DT initiative, the state- of- affairs, the location, and the surroundings of that place [1]**. In each situation, the most critical questions are listed.

Partners K8 and HKU defined the Digital Twin Situations as a base for the training modules to be developed. They are described in detail the T4R Joint Train-the-trainers Framework. On the next page, they are described in very short form to better understand the presentation of the Frameworks' findings.

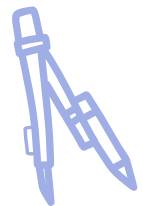
**[1]** Partners have also referred to situations as 'spaces', and as 'innovation ecosystems' (defined by Moore in 1993 as 'Loosely interconnected organizations that co-evolve capabilities around a shared set of technologies, knowledge and/or skills developing new products and services together').

We avoid referring to 'levels of DT maturity' here, as better understanding of 'maturity' is an important part of the outcome of T4R, hence not suitable as a structuring concept for our findings yet.

# About Situations



**DT Lab** is the situation of DT **experimentation and exploration** (not only by tech people but also - if not especially - in terms of governance, ethics, inclusion, democratization, and education and training). It's the place where the vision of the Local Digital Twin (LDT) is discussed and becomes alive, first within a small internal group.



**DT Studio** is the situation where experimenters and explorers work with other experimenters and explorers of other Labs, accumulating **lessons learned**, **discussing standards** and **adopting best practices** from other DT Labs. It is the **project management phase**. The initiators of the LDT gather all feedback they can get from other cities, suppliers and other relevant parties. With this information and vision for their LDT, the initiators try to onboard as many relevant departments as possible in the LDT project and discuss together how they see the whole LDT.

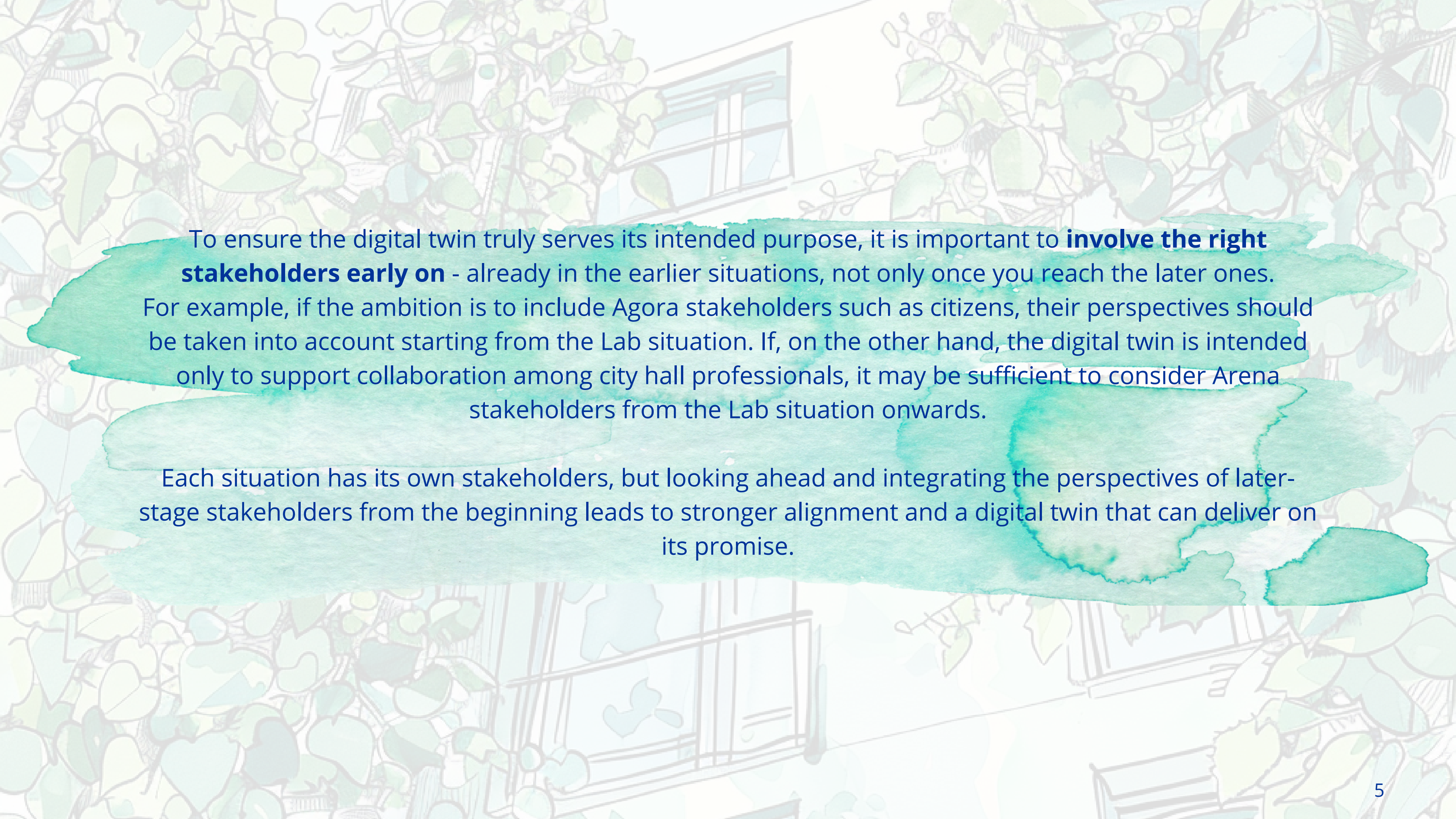


**DT Arena** is the situation of **implementation and field testing by professionals within the organisation** hosting the digital twin (policymakers, urban planners, legal experts, ethics experts) to solve real-world challenges through decision-making in territorial planning. It is the piloting phase where you start gathering feedback from stakeholders (citizens, external experts, etc.) on prototypes or Minimum Viable Products, before launching the intended version of your LDT.



**DT Agora** is the situation of **implementation and upscaling with stakeholders from outside the organisation** hosting the digital twin. Whereas the Arena is the situation where a digital twin is used for internal purposes (in support of territorial planning decision making among professionals), the Agora is the situation where public institutions, NGOs, companies, and individuals (citizens) are getting involved in the decision-making.



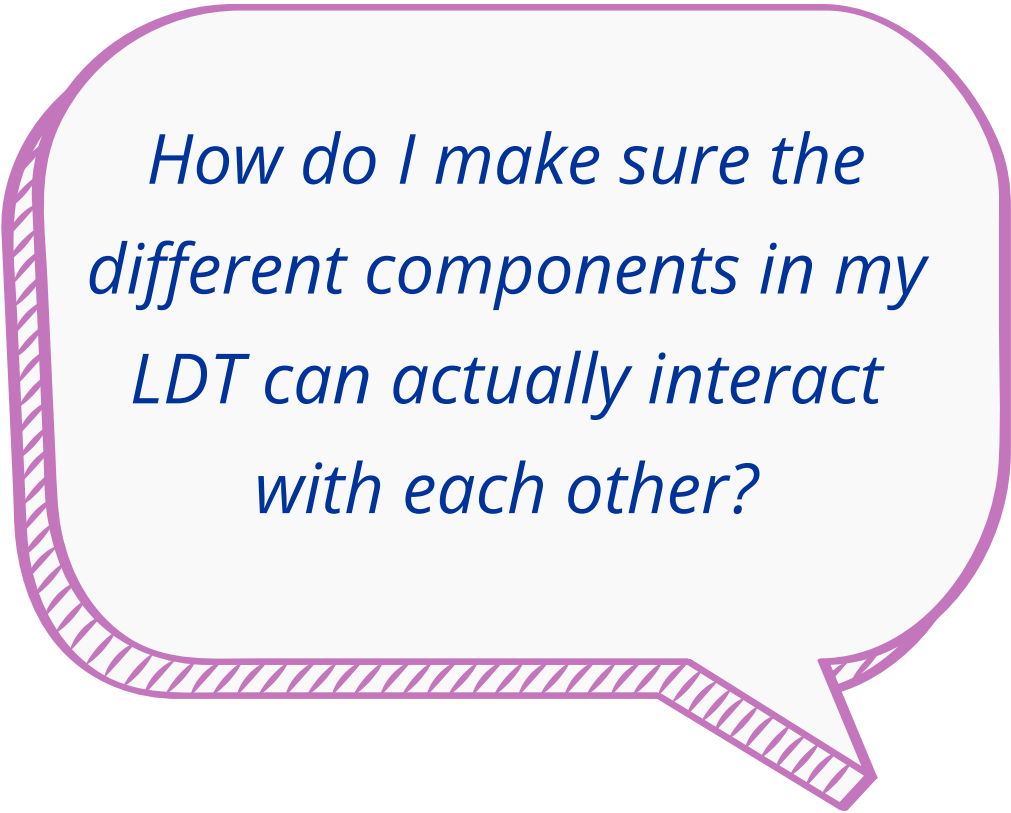


To ensure the digital twin truly serves its intended purpose, it is important to **involve the right stakeholders early on** - already in the earlier situations, not only once you reach the later ones. For example, if the ambition is to include Agora stakeholders such as citizens, their perspectives should be taken into account starting from the Lab situation. If, on the other hand, the digital twin is intended only to support collaboration among city hall professionals, it may be sufficient to consider Arena stakeholders from the Lab situation onwards.

Each situation has its own stakeholders, but looking ahead and integrating the perspectives of later-stage stakeholders from the beginning leads to stronger alignment and a digital twin that can deliver on its promise.



# About Critical Questions



*How do I make sure the different components in my LDT can actually interact with each other?*

*Example from Framework Technical Design, Arena Situation. theme*

Anyone embarking on an innovative mission, such as a digital twin initiative for decision support in territorial planning, will be faced with a multitude of questions. Those who have explored further ahead already have discovered which of those questions proved to be essential and which questions proved to be trivial. We exploit this power of hindsight in each framework. The objective of this exercise in this project is not to be 'complete' or 'comprehensive'. Instead, we focus on **'critical questions' per Framework per Digital Twin situation**. In doing so, we aim to support all cities in avoiding the most important pitfalls and build on the most important lessons learned. In each DT situation, there are critical questions in all Framework domains. However, some Frameworks may have a concentration of questions in one DT situation. For example, ethical questions may be critical mostly in Lab and/or Studio, while training questions may be critical mostly in other situations.

In the frameworks, each critical question is answered to help those making decisions on DT development. Answers may contain best practices and lessons learnt by project partners and/or organisations outside the T4R consortium, suggestions, resources, links, and some context. Even when questions are not directly relevant to an organisation hosting a DT, they can still be valuable as they help to understand possible DT situations. To navigate the critical questions more easily, partner DKSR has labeled all questions with Framework-specific themes that you will find on the next page.

*In the Annex, you will find all Critical Questions, organised by Framework, Digital Twin Situation and Theme.*



# Themes per Framework

## Governance

- Challenges & Vision
- Tools
- Involvement & Responsibilities
- Data Management Strategy
- LDT Implementation Goals & Policy-domain Overarching Use-cases
- Data-driven Policy Making
- Financing & Procurement Mechanisms

## Technical design

- Usability
- Service & Support
- Security & Data Protection
- Interoperability & Reusability
- IT-Infrastructure
- Data flow, Standards & Interfaces

## Ethics, Inclusion & Democratisation

- Purpose & Value Alignment
- Participation & Fairness
- Trust & Transparency
- Data Ethics
- Inclusivity

## Education & Training

- Organisational Readiness & Internal Capacity Building
- Learning Infrastructure & Strategy
- Citizen Engagement / Citizen Co-creation & External Communication



# Next Steps



## 8 Pilot Actions

Between July and December 2025, the Pilot Partners will each draft a Pilot Action Plan for their local use case, using the four Frameworks as a foundation. The critical questions serve as guidance in this process. The experiences gained during the development of the Pilot Action Plans will provide valuable feedback on the Frameworks. Implementation of the Pilot Actions is planned for 2026.



## T4R Starter Kit

In 2026, we will continue developing the Frameworks. Building on feedback from the Pilot Action Managers, these will be consolidated into a Joint Starter Kit for Local and Regional Authorities.



## T4R Joint Handbook

Mid-2027, the T4R Consortium will deliver the T4R Final Joint Strategy: the **Implementation Handbook**, which is based on the Four Frameworks, the experiences from the Pilot Actions and the completed Training Scheme.








# *Annex:*


# **Critical Questions**





	Theme	Questions
<div>Lab Situation</div> <div>  </div>	Challenges & Vision	What specific challenges do you want to tackle within your team and how do you decide on the prioritisation?
	Tools	What specific tools can support your LDT lab experiment?
	Data management strategy	How is data managed in a lab situation? Are there any specific management procedures applied?
	Involvement & responsibilities	Who is typically responsible, accountable, consulted and informed during a lab situation?
<div>Studio Situation</div> <div>  </div>	Challenges & Vision	What specific challenges do you face when cooperating with colleagues?
	Tools	What common tools and goals may support integration and joint development?
	Data management strategy	How is data managed in a studio situation? Are there any specific management procedures applied?
	Involvement & responsibilities	Who is typically responsible, accountable, consulted and informed during a studio situation?
	LDT implementation goals & policy-domain overarching use cases	How to setup Digital Twin initiatives (joint use cases)?





		Theme	Questions
 Arena Situation		LDT implementation goals & policy-domain overarching use-cases	What LDT goals do you want to achieve as an internal organisation?
		Challenges & Vision	What specific organisational challenges will you have to face?
		Tools	(How) will the LDT-related tools fit into the overall information and digital transformation strategy?
		Data-driven policy making	is there an established culture of data-driven decision-making in your organisation?
		Data-driven policy making	Do you have formally documented procedures for data-driven decision-making in your organisation installed?
		Data-driven policy making	Are there rules to follow regarding data-driven decision-making in your organisation?
		Data management strategy	How is data managed in an organisation-wide arena situation? Are there any specific management procedures applied?
		Financing and procurement mechanisms	What financing mechanisms are available, already used and needed to support LDT development and long-term support?
		Financing and procurement mechanisms	What (innovative) procurement mechanisms are most suitable for LDT design, development and sustainable long-term LDT support?
		Involvement & responsibilities	Who is typically Responsible, Accountable, Consulted and Informed during an Arena situation?
		LDT implementation goals & policy-domain overarching use-cases	How to organise a sustainable domain-overarching Digital Twin initiative?


	Theme	Questions
<div> <div>Agora Situation</div> <div>  </div> </div>	LDT implementation goals & policy-domain overarching use-cases	What LDT goals do you want to achieve for external stakeholders?
	Challenges & Vision	What stakeholder-related societal challenges do you have to tackle?
	Data-driven policy making	Is there a recognised culture of data-driven decision-making in the LDT ecosystem?
	Data-driven policy making	Are there established procedures for data-driven decision-making that have been agreed upon by all stakeholders in the agora?
	Data management strategy	How is data managed in an organisation-overarching agora situation? Are there any specific management procedures applied that take external users into account?
	Involvement & responsibilities	Who is typically Responsible, Accountable, Consulted and Informed during a Agora situation?



	Theme	Questions
 Lab Situation	Interoperability & Reusability	How do we make sure that the LDT system we envision is a fit for the organisation?
	Usability	How do we create insights that are interpretable and well-balanced?
	Interoperability & Reusability	How can we create results in the short term, while staying relevant towards the future?
	Security & data protection	How do we avoid lock-ins?
	Interoperability & Reusability	How do we make sure our solution is re-usable?
	Interoperability & Reusability	How do we make sure our solution is interoperable with other organizations?
 Studio Situation	Data flow, standards & interfaces	Which capabilities do we need to find, operate and interrogate our data sources?
	Data flow, standards & interfaces	Which capabilities do we need to combine, validate and verify our data sources?
	Data flow, standards & interfaces	Which capabilities do we need to gain insights from our data sources?
	Data flow, standards & interfaces	Which capabilities do we need to make sure we can trust the insights we get from our data sources?
	Usability	How do we communicate our insights to our stakeholders?
	Usability	How do we manage the complexity of a solution and make sure we can 'mix and match' different building blocks?




	Theme	Questions
 Arena Situation	Usability	How do we make our solution user friendly?
	Interoperability & Reusability	How do we combine different components that are part of/or contribute to our solution?
	Usability	What kind of visualization interface do I need to communicate my insights to the users?
	IT-Infrastructure	What does my data storage landscape look like?
	Data flow, standards & interfaces	How do I make sure my users can actually find the right data sources, models, dashboards?
	IT-Infrastructure	How do I make sure the different components in my LDT can actually interact with each other?
	Interoperability & Reusability	Which systems do I need to have in place to support my data governance processes?
 Agora Situation	Usability	How appropriate are the systems we deploy to the size and goals of our organisation?
	Service & Support	How do I want my deployments to be rolled out to users?
	Interoperability & Reusability	What types of technical frameworks do I need to address the training and education requirements?
	Service & Support	What type of Service Level Agreements (SLA's) do I have to internally and externally?
	Security & data protection	Do I have the right security frameworks in place?
	Service & Support	Do I have observability in place to monitor my systems in terms of cost, incidents, performance etc.?
	Usability	How do I make sure the type of my LDT is aligned with the goals of my organization?

		Theme	Questions
 <div>Lab Situation</div>		Purpose & Value Alignment	What is the objective (aim) of your LDT? Which question(s) should be answered by LDT? What will it be used for?
		Participation & Fairness	Who is your target audience? Who'll benefit from it?
		Trust & Transparency	How can you analyse the positive and negative implications of your LDT in terms of ethics, inclusion, and democratisation?
		Purpose & Value Alignment	What are the core values, principles and mission of your organization? Does your LDT adhere to these values?
		Purpose & Value Alignment	How can you make your LDT more sustainable?
		Data Ethics	What data governance best practices, contractual safeguards and regulations need to be complied by for LDT design and deployment to ensure administrations and citizens protection in a human-centric purpose?
		Inclusivity	Have you taken into account the principle of non-discrimination of data (gender and social equity, minorities, etc.) ?
		Inclusivity	How can your LDT be designed to be culturally sensitive and relevant?
		Inclusivity	How can you take social values, human behaviours and soft data such as feelings, opinions and emotions into account in your LDT project and its data?



	Theme	Questions
Arena	Trust & Transparency	How to improve trust in LDT?
	Participation & Fairness	How to ensure fair and unbiased decision-making is achieved through implementation of LDTs for planning use cases?
Studio	Participation & Fairness	How to ensure that as many citizens as possible can consult and/or use an LDT?
	Participation & Fairness	How democratic is the use of AI for your LDT?
	Data Ethics	How reliable and trustworthy is the use of AI in your LDT project?

		Theme	Questions
<div>Agora Situation</div> 		Trust & Transparency	How to foster transparency through your LDT?
		Participation & Fairness	Who is your target audience for communicating about your LDT project and use case?
		Participation & Fairness	How will you communicate with your target audience?
		Participation & Fairness	What kind of communication media should you use to communicate about your LDT?
		Participation & Fairness	How to communicate the results and outputs from the LDT model?
		Participation & Fairness	Can people who are/may get affected by your LDT appeal, give feedback or request changes to anyone in your organisation? If yes, to what extent?
		Participation & Fairness	When to involve citizens in the process of setting up a LDT to make sure all necessary end user functionalities are taken into account?
		Participation & Fairness	How could you reach out to the citizens for your LDT project with minimal resource investment?
		Participation & Fairness	If a city wants to conduct citizen participation in its LDT project, which profiles should be involved to ensure the LDT is inclusive and representative of the city's population?
		Participation & Fairness	How to engage and make citizens participate to the LDT process/project? How can an LDT be used for citizen participation? Is it a proper tool for this goal, or are there better alternatives?



	Theme	Questions
Lab Situation	Organisational Readiness & Internal Capacity Building	Did the project team critically review the use case for the LDT and the expectations towards the LDT with all stakeholders at least twice (necessity, expected impact, availability of required data, amount of resources needed for implementation, dependency on vendors vs. “build something yourself”...)?
	Organisational Readiness & Internal Capacity Building	What are the skills needed to expand the lab team and reach out across the organisation? How can the project team inspire and motivate them?
	Organisational Readiness & Internal Capacity Building	Subquestion: a) Who (else) is already working on/with LDTs outside the project team and needs to be brought in?
	Organisational Readiness & Internal Capacity Building	Subquestion: b) What (additional) technical and non-technical skills do they need to become part of the process?
	Organisational Readiness & Internal Capacity Building	Subquestion: c) Which of the organization's existing content/work processes/tools can be integrated?
Studio Situation	Organisational Readiness & Internal Capacity Building	Is the project team aware of any perceived barriers that employees in the organization have towards new technologies (hardware / software)? If so, how can the project team address these through mediation, workshops, etc.?
	Organisational Readiness & Internal Capacity Building	How can the organization ensure that the skills acquired, and the knowledge gained (e.g. interaction and collaboration with the LDT) remain in the team, even if individual team members leave the team? How can the organisation facilitate knowledge transfer from one team member to another?

	Theme	Questions
Arena Situation	Learning Infrastructure & Strategy	What resources are available within the entire organization for integrating a wider group of future users into the LDT process?
	Learning Infrastructure & Strategy	Who is part of the community of learners? Who will be working with the LDT and requires appropriate training? Is there already a group or are these individuals who still need to be organized into a group/team?
	Learning Infrastructure & Strategy	How can these people be reached for training?
	Learning Infrastructure & Strategy	Is there an existing training program that can be augmented with LDT-specific content?
	Learning Infrastructure & Strategy	How does the organization deal with change - is training part of any overarching strategy or change management approach?
Agora Situation	Citizen engagement / citizen co-creation & External Communication	Is societal impact already part of how your organisation defines the LDT's added value?
	Citizen engagement / citizen co-creation & External Communication	Do training units exist that help communicate the benefits of LDT for society, or do citizen engagement formats exist that can be adapted to engage citizens in discussions related to the LDT?
	Citizen engagement / citizen co-creation & External Communication	Does the organisation have general guidelines on low-threshold / inclusive communication, or staff skilled in this area, that could offer useful resources in such training for citizen engagement?





#### **Framework Governance**

Veerle Beyart & Lieven Raes  
[veerle.beyaert@vlaanderen.be](mailto:veerle.beyaert@vlaanderen.be)  
[lieven.raes@vlaanderen.be](mailto:lieven.raes@vlaanderen.be)

#### **Framework Technical Design**

Marcel van Lieshout & Wietse Balster  
[m.lieshout@amsterdam.nl](mailto:m.lieshout@amsterdam.nl)  
[w.balster@amsterdam.nl](mailto:w.balster@amsterdam.nl)

#### **Framework Ethics, Inclusion & Democratisation**

Mani Dhingra & Manon Reniers  
[mani@smartd8.ie](mailto:mani@smartd8.ie)  
[manon.reniers@brucity.be](mailto:manon.reniers@brucity.be)

#### **Framework Education & Training**

Sónia Alves  
[sa@k8.design](mailto:sa@k8.design)

#### **Frameworks Summary**

Hester Wolrich, CITYUTR-LP  
Communication manager T4R

#### **T4R Project Coordinator**

Muriël Pels  
[m.pels@utrecht.nl](mailto:m.pels@utrecht.nl)

[t4r.nweurope.eu](http://t4r.nweurope.eu)

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