EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR COMMUNICATIONS NETWORKS, CONTENT AND TECHNOLOGY

Artificial Intelligence and Digital Industry
Robotics and Artificial Intelligence

Reference Testing and Experimentation facilities in Digital Europe Programme

WORKSHOP REPORT ON REFERENCE TESTING AND EXPERIMENTATION FACILITIES FOR SMART CITIES, MOBILITY, ENVIRONMENT AND ENERGY

24 January 2020

1.1. BACKGROUND: THE DRAFT ORIENTATIONS FOR THE PREPARATION OF THE WORK PROGRAMME(S) 2021-2022 OF THE DIGITAL EUROPE PROGRAMME:

[…] The first two years of the programme will focus on developing an infrastructure which offers businesses and the public sector access to AI tools and components and data resources, as well as reference testing and experimentation facilities in some prioritised application sectors.
Actions will focus on […]:

- **developing world-class large-scale reference Testing and Experimentation Facilities (TEF) for AI hardware, software, components, systems and solutions, and underlying resources (data, computing, cloud) in a number of sectors;[…]**

Developing Large Testing and Experimentation Facilities to provide a common, highly specialised resource to be shared at European level and foster the deployment of trustworthy AI in the following areas:

1) a common European platform to design and manufacture edge intelligence components and systems based on neuromorphic and quantum technologies;
2) reference sites for applications in essential sectors such as health, agri-food, manufacturing, smart cities and smart mobility (including environment and climate perspective).

This orientations document also stressed the strong links that will be established with the initiative to **establish EU-wide common data spaces**.

1.2. EXECUTIVE SUMMARY

Key lessons learned

- €50 million as the minimum funding level to have an impact in the sector, which covers AI for smart cities, smart mobility, energy and environment.
- Experts believe that the maturity of the smart cities sector makes it possible to launch a first call as early as 2021.
- Investment needs to cover both data-driven and physical systems, as both may be ground-breaking and innovative. Physical systems may significantly increase societal acceptance of AI.
- There was a fair amount of focus on data and data-related aspects. However, for balance, and in the light of the role it can have in the sector, hardware (e.g. robots) and the necessity to test it before deployment needs a stronger emphasis in line with the needs of the sector and the added value that TEFs can bring.

Summary of the Discussion

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Erasmus University Rotterdam, Forum Virium Helsinki, Open and Agile Smart Cities, Alliance for Internet of Things Innovation, Big Data Value Association, European Distribution Systems Operators, AUTOPILOT Project, ZalaZONE Proving Ground Project, EnergyLab Nordhavn, AI4EU Project, Tata Consultancy Services, Wiener Stadtwerke, TM Forum, other industry and academia players

Existing Landscape

- Networks of smart cities and testing AI (such as AI4Cities), as well as smart mobility testing facilities (such as the ZalaZONE in Hungary), are already in existence.
- **AI4Cities project:** Its main goal is to support cities' transition to carbon neutrality. The existing testing sites are focussed on the domains of smart living and mobility and they use open, real-time data in order to achieve interoperability between different components.
- **BDVA - CLASS project**. Creation of a common knowledge base between cars and the city for intelligent traffic management, simulation of air pollution in real-time and advanced driving assistance systems. The reference to the development of European data i-spaces (built on existing infrastructure with the aim of federating TEFs) stands out – these are cross-sectoral environments where BDV technologies and applications are quickly tested, piloted and exploited.

Needs in the sector for TEFs

- **Common standards** for testing and deployment.
- The broader topic of smart cities should not be regarded as a one-dimensional application domain. This is due to the inherent complexity confronting smart cities.
- **Data quality and availability**, as well as the reduction of environmental impact are key requirements.
- Need for connection to **HPC resources** (EuroHPC)
- **Key challenges**: Population growth, environmental challenges, increased demands from engaged citizens.
- **Key aims**: The improvement of sustainability (economic, social, environmental), resilience and orchestration of big data analytics and AI for the processing of geographically distributed data sources.
- Focus on cities as well as on the needs of communities – importance of networks.
- **Policy challenges**: It is necessary to see smart cities as part of a broader ecosystem linking cities of various sizes, smart mobility, energy and environment. Furthermore, it is important to prioritize a mix of data-driven and physical systems, not to focus solely on data. Societal acceptance plays a significant role in the development of AI in this area. However, proposed budgets are not sufficient to allow for sufficiently full coverage. Therefore, links with other testing facilities must be close. Other sources of funding, such as private funding, need to be considered with care, as they may lower societal acceptance.
- It was proposed that the testing and experimentation facilities should be run by a consortium rather than a single entity, with a small number of facilities (up to 10) distributed, based on geographical location and socio-economical characteristics. It was suggested that the funding should be at least €50 million for the smart cities sector. The largest part of the funding should go into personnel costs, and there should be significant coverage of infrastructure costs. Travel costs should represent only a small part of the funding. The EU should fund about 10 million per facility to ensure that more facilities receive meaningful funding. Experts believe that the maturity of the smart cities sector makes it possible to launch a first call as early as 2021.

1.2.1. Existing Landscape:

In the workshop, the European Commission asked experts and Member States' representatives to provide examples of existing testing sites in the smart cities, mobility, environment and energy sector. The examples provided and listed below do not influence the outcome of future calls, they just serve to illustrate the types of facilities, their setup, function, etc. Any Member State willing to provide to the European Commission additional examples of testing sites is welcome to do so.

Experts presented networks of smart cities and testing AI (such as AI4Cities), as well as smart mobility testing facilities (such as the ZalaZONE in Hungary), which are already in existence, in more detail:

- **AI4Cities project:** Its main goal is to support Helsinki's transition to achieve carbon neutrality. The existing testing sites are focussed on the domains of smart living and mobility and they use open, real-time data in order to achieve interoperability between different components.
- **BDVA - CLASS project:** Creation of a common knowledge base between cars and the city for intelligent traffic management, simulation of air pollution in real-time and advanced driving assistance systems. The reference to the development of European data i-spaces (built on existing infrastructure with the aim of federating TEFs) stands out – these are cross-sectoral environments where BDV technologies and applications are quickly tested, piloted and exploited.
- **Vienna**: Asparn Smart City Research (ASCR) is a joint venture between a network operator, an international technology company, an energy generation and supply company, and the City of Vienna. It also works together with universities such as Vienna Technical University, University of Vienna, Institute for Science & Technology and non-university research with Austrian Institute of Technology and Austrian Research Society for AI (OFAI).
- **Torino City Lab (TCL)**: TCL is an "open laboratory" designed in the city of Torino, Italy. It aims to create simplified conditions for companies interested in testing in real conditions frontier technologies and solutions for urban living. The City of Torino offers its assets (physical and technological infrastructures, know-how and relations) to test and then scale up breakthrough solutions in any domain of public interest. TCL gives access to the city infrastructures, services and data, scientific support, access to mentorship and investors, business development support and access to international networks. TCL has projects in the areas of autonomous mobility (public transport and cars), drones, IoT and 5G, entertainment solutions and CleanTech such as clean technologies, renewable energy and circular economy.
- **European Innovation Partnership on Smart Cities and Communities (EIP-SCC)**: In the first Lighthouse Project, the programme seeks to tackle different urban challenges, including sustainability (renewable energy, reduced greenhouse emissions and energy consumption), improving mobility, housing and quality of urban infrastructure, digitisation (intelligent energy management technologies and the deployment of an adaptive and dynamic ICT data hub), e-government services, across different European cities.
- **Rotterdam**: Rotterdam is developing an Open Urban Data Platform (OUDP) fed by public, open and external data sources. The OUDP contains a 3D visualization component and an upcoming possibility to simulate ongoing scenarios of plausible and probable motion of 'objects' in the city of Rotterdam. On top of the OUDP, private and public stakeholders of the city are enabled via a standardized information and communications layer to build their own applications.
- **Shipping testing**: A limited number of sea testing and experimentation facilities have already been built, including 3 test sites in Norway (Trondheimsfjorden test area, Horten, Storfjorden), Plymouth, UK, Jaakonmeri and Turku Test Area, Finland, and the autonomous ship test area in Belgium/Flanders.

1.2.2. Needs and Impact

Several experts believed the sector's needs for a TEF to be:

- **Networks**: TEFs should be set up as a network. One expert suggested that there should be one TEF acting as a central hub, but this could be on a rotating basis. Similarly, an expert argued that TEFs should be operated in a "reference" city to make transfers between these reference cities easier. To do so, cities should be categorized on relevant factors such as size and one city of each category should have a testing facility. Some experts put forward the idea of a two-tier approach with large TEFs for the initial testing and a second network of smaller TEFs to test for scaling-up, e.g. follower cities.

- **Need of common standards** for testing and deployment, some argued for open data standards. One expert said that the knowledge generated should be open to at least the administration, whether at municipal, national or European level.

- **Data quality and availability** is key to train AI. Data security, the possibility of integrating open data with privately collected data and digitized data collection of infrastructure (public transport, energy, traffic lights, etc.) were seen as important.

- **Infrastructure**: need for HPC resources (EuroHPC), public transport & energy network, connectivity etc. for use cases and test-areas with willing citizens (>500 participants).

- **Easy use**: TEFs should be easy to use, e.g. API management or portals to integrate solutions, especially for SMEs.

- **Realistic conditions**: Whether in smart cities use cases or transport/logistics, realistic conditions are important, also for data.

- Importance of **public safety and personal security**.

- **Physical and digital**: Both digital and physical were needed, but some TEFs could be either according to some experts. Robotics are key for smart cities, especially for health and care angle.

- **Trust**: Trust was seen as essential and the triple helix structure as a good way to achieve it, according to some experts. One expert mentioned the Google project in Toronto which was ultimately rejected by the citizens as they felt their data was exploited without getting a fair return. They didn't trust Google to have their best interest at heart.

- **Sandboxes**: As currently it is cumbersome to set up regulatory sandboxes, one expert suggested to create a stable sandbox for TEFs and to provide specific funding for sandboxes.

Other points raised by individual experts on the needs of the smart cities and mobility sectors for a TEF included:

- Clear **IP model** to incentivise private sector,

- Need **minimal interoperability mechanisms** (MIMs), which reduce risks of investment, which in turn increase investment.

Experts raised the following **possible impacts and benefits** of TEFs for the smart cities and mobility sectors:

- Brings data sets together

- Supports hands-on learning by doing and iterative approach

- Facilitates open innovation (use of open standards, link R&D, student involvement)
- Neutral, risk free environment for testing, tool validation and use case development
- Develops a shared perspective on data/AI ethics
- Improves digital literacy of users
- Supports the testing of solutions to reduce risk of failure, adapt if needed and having a clear product that can be easily bankable.
- Creation of high-skilled jobs
- Sustainability (reduced traffic congestion, energy consumption, higher energy efficiency etc.).

Grand challenges the TEFs could solve included tackling sustainable development goals, accessibility of AI, population growth, health, and well-being, environmental challenges (energy efficiency, waste management), increased demands from engaged citizens, (road) safety, secure, robust and ethical AI.

Major **use cases/promising areas** include personalised health, crime detection based on image analysis, autonomous driving/shipping, drones, 5G, IoT, road conditions anomaly and proactive maintenance, sensoring and measuring/learning human patterns to optimize resources (energy consumption, water consumption, mobility), urban planning, design, modelling, visualization of urban development, digital twins and algorithms for urban planning.

One expert structured potential use cases into short-term and long-term impact:

- "short"-term impact:
  - AI in Maintenance: Building inspections, energy network, power plants, etc.
  - AI in customer interaction: natural language processing for process efficiency (towards utilities or administration)
  - Mobility Management to optimise mobility services city-wide
- "long"-term impact
  - Optimization of infrastructure planning
  - Predictive Maintenance: prediction of faults in infrastructure (trains, tracks, power plants, etc.)
  - Individualization of customer experience: individual routing in case of a fault in public transport or energy supply
  - Increasing sustainability through optimization of "operating mode" (how a power plant is operated, speed/ location of public transport routes, etc.)

One expert recommended creating a separate TEF for logistics as it is an intrinsic sector with many AI use cases and an important role in making Europe more sustainable. Another enquired whether an off-shore facility for robotics was planned, arguing that the sea was an important sector for Europe's agri-food sector.

1.2.3. Structure of the "facility"

Responses from experts and national delegations to a live poll conducted at the workshop indicated that the majority (54%) wanted to have few (no more than 10) TEFs to be spread geographically. 34% believed there should be many TEFs (more than 10) spread geographically. A clear minority wanted the TEFs to be geographically concentrated (2% wanted few TEF to be geographically concentrated and 10% wanted many TEFs to be geographically concentrated).

One expert argued for more than 10 TEFs organized vertically and getting cities on board and developing this as a business through a public-private partnership. TEFs should also be a structure, not a project. While geography may not be as important as originally thought, e.g. flooding happens in most cities, the size of the cities matters as there are different combinations of challenges and resources in particular sized cities.

In the same poll, 50% thought that the minimum funding per facility should be at €10 million. 26% want it at more than €40 million, 14% at €20 million and 10% at €30 million.

When asked on collaboration, experts and national delegations preferred to put systematic mechanisms between the TEFs and other relevant projects like DIHs, data spaces and the AI-on-demand-platform in place (60%). Funding a coordination and support action was the second most preferred option to ensure good collaboration with other relevant projects (23%). Other, less popular options included open standards, open data and software platforms (13%) and data exchanges (5%). Interestingly, no one included contractual agreements such as MoUs which had been chosen by several participants in other workshops in the live polls.

Experts discussed the structure of the facility and made following points:

- **Physical and digital**: Both digital and physical were needed, but some TEFs could be either according to some experts.
- Access to **resources** like tools, storage, processing through European central open source cloud environment. One expert cautioned that TEFs need a mechanism to prevent companies insisting on what solutions to use, e.g. buying only their proprietary equipment.
- **Collaboration**: meeting with experts to discuss the technologies was seen as crucial to get the necessary insights and analysis. This could be built on an organisational model that includes collaboration framework and principles, data governance protocols, metadata repository, agile teams. One expert pressed for a quadruple helix collaboration (business, research, municipalities and citizens) structure.
- **End-user involvement:** There should be strong involvement of the local community to foster co-creational processes and citizen engagement.
- **Learning and capacity building** using repositories, open source, teaching use cases, education programmes.
- **Links with city administration:** The facility must institutionalise links with the city administration and the infrastructure operator as this will make it easier to implement use cases. Another expert argued that there should be a clear commitment from cities working with the TEFs to provide datasets, challenges and evaluation methodology to select or validate solutions.
- **Funding**: TEFs should be able to provide funding to start-ups and SMEs, but also larger enterprises, according to one expert.
- **Dissemination**: Active communication of every project should be a fundamental necessity for every funding.
- **Complementarity**: From the technological focus viewpoint, complementarity between different sites could help concentrate critical mass of resources; however, certain technologies are intrinsically interdependent by nature, e.g. 5G for AV, and therefore these technologies should be tested together in the same TEF.
- **Sandboxes**: Sandboxes should cover regulations on the use and ownership of data as well as IPR. Industry shouldn't be the only one that gets access to the data according to one expert. Another flagged that the current lack of rules is preventing initiatives for autonomous shipping.

In terms of practical issues with implementation, one expert believed that the first step to set a vision and specific goals within the city is crucial so that all the resources and efforts from the community are pointing to the same direction.

For the shipping industry, one expert argued that TEFs would need to be tailored to specific use cases/boats.

1.2.4. Timing

The majority of **experts and national delegations** at the workshop believed that the sector is ready to absorb funding for TEFs. In a **live poll** conducted at the workshop, 92% believed the call should be made in 2021, while 5% it should be in 2022 and 3% in 2023-24.

Regarding the priorities over the years of the TEF call, one expert suggested for the shipping industry that simulators and testing sites need to be set up as well as infrastructure investments, relevant technologies like AI for navigation, data platforms, training of staff and updating current rules.

1.2.5. Funding:

One expert argued that the TEFs should each be funded with at least €30 million per year. A typical project size varies from €100,000 to 2-3 million depending on the infrastructure investment needed.

An expert for the shipping industry gave the following estimates: A single off the shelf testing platform capable of limited sea going missions can cost from €15,000 to 600,000 depending on the sensor set-up and capabilities. A certified real life simulator and control centre can cost between € 50,000 and 200,000.

In a live poll, experts and national delegations gave the following feedback on funding:

- 83% believed that the minimum funding needed to make an impact in the sector is at €50 million. Others believe this threshold to be at €35 million (13%) or at €20 million (5%).
- 50% thought that the minimum funding per facility should be at €10 million. 26% want it at more than €40 million, 14% at €20 million and 10% at €30 million.
- 50% said that national funding, e.g. from national strategies, should be the source of Member State co-funding for the facility and travelling. 29% believed it should be regional funding and 21% said it should be other sources.
- A clear majority (82%) believed that the remaining 50% of the Member State funding for the facility should be covered in kind and in cash, while 10% said it should be in cash and 8% in kind.
- 39% said that no reimbursement of costs other than travel should be made, while 46% believed that non-travel costs should be reimbursed by the grant at 50%, 10% that it should be at 100% and 5% that it should be at 25%.
- 44% said they would invest 5-10% of the grant in travel costs, while 27% said they would use up to 5% and 27% would use 10-20%. Only 7% would use more than 20% for travel costs.
- 48% said they would invest 25-50% of the grant in equipment and facilities, while 35% would invest 50-75%. 13% would invest 75-100% of the grant in equipment and facilities and 5% would invest up to 25% of the grant.
- 51% said they would invest 50-75% of the grant in personnel costs, including subcontracting. A minority would invest either 25-50% (27% of the respondents), 75-100% (17% of the respondents) or up to 25% (5% of the respondents).

According to one expert, other sources of funding, such as private funding, need to be considered with care, as they may lower societal acceptance.

1.2.6. EU Added value:

The European added value of the future TEFs were seen to lie in having a network among different testing sites across which resources and experiences could be shared and bottom-up approach better

coordinated. Hope was also expressed that TEFs would give rise to EU-wide standards, giving SMEs and Europe a competitive advantage. Similarly, TEFs could help in developing benchmarks for AI applications: fields of application, ethical guidelines, GDPR-conformity solutions, exclusion of unwanted applications ("red-lines" for AI applications, e.g. prohibition or moratorium).

For more detail, see the needs and impact covered in the above section.

1.2.7. Ecosystems – access to value-chains:

The majority of experts and national delegations at the workshop when asked in a live poll believed that the sector is ready to absorb funding for TEFs.

One expert argued that TEFs should have a cross-sector approach for AI to work in real life and at scale.

Several argued it was important to have user-involvement, ideally in a behavioural economics approach as this is where the market is moving towards.

To do testing at scale, bigger players need to be involved according to one expert, including cities which can pool and package their demand, tech players that can be interested in the development of a new European Palantir for instance and venture capitalists. The AI4EU On-Demand platform was deemed essential.

1.3. CONCLUSIONS:

There was a fair amount of focus on data and data-related aspects. However, for balance, and in the light of the role it can have in the sector, hardware (e.g. robots) and the necessity to test it before deployment needs a stronger emphasis in line with the needs of the sector and the added value that TEFs can bring.

The experts and national delegations were asked to participate in a live poll at the workshop and gave the following indications on **funding, timing, collaboration mechanisms and project structure**:

- The majority of **experts and national delegations** at the workshop believed that the sector is ready to absorb funding for TEFs. 92% believed the call should be made in 2021, while 5% it should be in 2022 and 3% in 2023-24.
- The majority (54%) wanted to have few (no more than 10) TEFs to be spread geographically. 34% believed there should be many TEFs (more than 10) spread geographically. A clear minority wanted the TEFs to be geographically concentrated (2% wanted few TEFs to be geographically concentrated and 10% wanted many TEFs to be geographically concentrated).
- 83% believed that the minimum funding needed to make an impact in the sector is at €50 million. Others believe this threshold to be at €35 million (13%) or at €20 million (5%).
- 50% thought that the minimum funding per facility should be at €10 million. 26% want it at more than €40 million, 14% at €20 million and 10% at €30 million.
- 50% said that national funding, e.g. from national strategies, should be the source of Member State co-funding for the facility and travelling. 29% believed it should be regional funding and 21% said it should be other sources.
- A clear majority (82%) believed that the remaining 50% of Member State funding for the facility should be covered in kind and in cash, while 10% said it should be in cash and 8% in kind.

- 39% said that no reimbursement of costs other than travel should be made, while 46% believed that non-travel costs should be reimbursed by the grant at 50%, 10% that it should be 100% and 5% that it should be at 25%.
- 44% said they would invest 5-10% of the grant in travel costs, while 27% said they would use up to 5% of the grant and 22% would use 10-20%. Only 7% would use more than 20% for travel costs.
- 48% said they would invest 25-50% of the grant in equipment and facilities, while 35% would invest 50-75%. 13% would invest 75-100% of the grant in equipment and facilities and 5% would invest up to 25% .
- 51% said they would invest 50-75% of the grant in personnel costs, including subcontracting. A minority would invest either 25-50% (27% of the respondents), 75-100% (17% of the respondents) or up to 25% (5% of the respondents).
- A clear majority (79%) preferred a consortium to handle the grant for several facilities rather than an individual partner (21%).
- When asked on collaboration, experts and national delegations preferred to put systematic mechanisms between the TEFs and other relevant projects like DIHs, data spaces and the AI-on-demand-platform in place (60%). Funding a coordination and support action was the second most preferred option to ensure good collaboration with other relevant projects (23%). Other, less popular options included open standards, open data and software platform (13%) and data exchanges (5%). Interestingly, none of the participants included contractual agreements like MoUs, which has been mentioned in other workshops in the live polls.