



## 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

#### REPORT FOR THE AGRICULTURE WORKSHOP

**9 January 2019**

#### 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**.

#### 2. **EXECUTIVE SUMMARY**

The European Commission invited experts and representatives from Member States to provide input on the upcoming TEFs for the agricultural sector under the Digital Europe programme. 15 Member States were represented, particularly by officials from the Permanent Representations, and 41 experts from RTOs, universities, industry and associated countries' governments (CHE) participated in the workshop.

In the workshop, the Commission presented its thinking and ambition for the future TEFs and asked for input from the experts and national delegations on different aspects of the future TEFs, including the needs and structure of the future TEFs and budget and timing considerations.

There were a few clear take-aways from the workshop on TEFs for agriculture in Digital Europe Programme with the experts and representatives from Member States. First, the sector is ready to absorb funding for future TEFs since a clear majority of participants prefers the call for TEFs for the agricultural sector to start in 2021. Second, experts also stressed the need for the TEFs to cover the diversity of the sector in terms of biogeographic and climatic conditions across the EU and/or cropping cycles, as it regards e.g. the number and distribution of testing sites. Third, collaboration was seen as key by experts and can be done via many different mechanisms such as DIHs, open standards, open

data, data exchanges, contractual agreements and ensuring regular dialogue between stakeholders in one forum. Fourth, TEFs should also be complementary and linked up to other relevant EU initiatives, such as the data spaces. Fifth, 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 discussed the existing landscape of testing sites, presenting relevant projects, and possible recommendations for future TEFs for the agricultural sector. Some key common themes emerged from the **expert discussions** on recommendations for AI TEFs in the agricultural sector, including the need to make TEFs easy to use from the perspectives of cost, skill level, geo-graphical distance and support offered. Conditions at TEFs should also be as close to real as possible. TEFs could play a role in providing certification/validation, thereby improving trust among farmers, consumers and intermediaries along the value chain in new technologies. TEFs would also more generally create a level playing field between the different players, big and small, as well as strengthen Europe's global leadership in the sector.

### 3. EXISTING LANDSCAPE:

In the workshop, the European Commission asked experts and Member States' representatives to provide examples of existing testing sites in the agricultural 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 projects of existing testing sites where emerging technologies, including algorithmic-based solutions, are tested and piloted through an IT infrastructure in the agricultural sector. Relevant projects for future TEFs for AI-solutions included:

- **The Netherlands Plant Eco-phenotyping Centre (NPEC):** NPEC is an integrated, national research facility housed by Wageningen University & Research and Utrecht University and has been co-funded by The Netherlands Organisation for Scientific Research (NWO) for 10 years.
- **Agroscope:** Agroscope is a Swiss federal centre of excellence for research and development in the field of agriculture, food and environment. Regarding research and development tasks, it conducts research for stakeholders in the agriculture and food sector, e.g. plant breeding and seed testing, research for developing sectoral policies for Swiss agencies and fundamental research, e.g. knowledge on the prevention of antibiotic resistance. It also performs legal tasks: official controls, e.g. feed inspection, and control assistance for policy implementation, e.g. PPP testing.

### 4. NEEDS AND IMPACT

**Experts** discussed the needs and impact of new reference TEFs.

**Discussing the needs of the agricultural sector**, points of agreement between the experts emerged on several points<sup>1</sup>, including:

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<sup>1</sup> The below list contains a list of points which were made by several experts. If a related point is made by one expert, it is referenced explicitly by mentioning that one expert made the point. This approach was taken for all of the remaining document.

- **Easy to use and open access:** Using the TEFs should be straightforward for its users. This has implications for the geographical distance, the level of skills needed and the administrative burdens involved. The easier to use, the more likely SMEs can benefit from TEFs as a resource to develop new technological solutions. One expert even suggested to provide incentives for farmers to engage with the TEFs. Some experts proposed a pan-European registry of available test facilities and associated information models as a concrete solution.
- **Low costs:** Using TEF's would have to be economically feasible and have a clear price-schema. Ideally, access to regulatory sandboxes, AI and computing resources should be free or close to free. This is important for SMEs, R&D institutes and small/medium producers.
- **Collaboration:** Getting the different players involved (academia from different disciplines, farmers, producers, technology providers, end-users) was seen as important by several participants. There's a lack of understanding about agriculture in tech and of tech in the agriculture community. One expert suggested a registry of user groups/stakeholders to gather domain insight and feedback on developed/planned tech as a solution. This would mean that TEF users could get access to relevant stakeholders to test their solutions. A benefit of this approach would be that TEFs could allow quick adaptations of new technologies with fast return on investments.
- **Regulatory sandboxes:** Regulatory rules should be adapted in TEFs to test new AI-powered solutions.
- **Awareness raising:** Some experts lamented the limited knowledge of existing or potential technological solutions in the agricultural sector. This is especially true across different sub-sectors. A single access point (website) where stakeholders can access/view demonstrations across multiple sectors could among others address this problem according to one expert.
- **Certification/Validation & Trust:** Some experts mentioned that farmers had in the past negative experiences with acquiring new (but not yet ready) technological solutions. This led farmers to lose trust towards new farming methods. TEFs could play a role in providing validation and certification of new solutions, therefore addressing the trust issue in the sector and for the consumer.
- **Practical & real:** TEFs should be used for technologies close to practical implementation and have to be done under real farm/production settings. A marketplace where existing and even undeveloped integrations could be listed was given as concrete way to make this possible.
- **Standards & Interoperability:** Recommendations from experts ranged from mandating interoperability to one single standard in Europe. In addition to facilitating cross-border coordination, replicating of experiments would be easier thanks to common standards. A common/standard descriptor for experiments including verified deployment models could be useful in that regard.
- **Resources** such as high-performance computational infrastructure, high speed internet access, satellite navigation positioning network, data storage solutions and low cost fast support were seen as important resources for TEFs to have.
- **Networks:** TEFs should be connected to existing European networks.
- **Alignment:** EU funded TEFs should be aligned with regional and national initiatives, especially for smart specialisation and digitisation of the industry. TEFs should also be aligned with Digital Innovation Hubs (DIHs). This could be done by including TEFs in the service offerings of DIHs.

- **Data Access and data-sharing:** Getting access to different public (and private) data sets (satellite data, labelled datasets, background knowledge (from different plants, soil, etc.)) was deemed important to be able to test new AI applications. While access to public data was seen as more straightforward, access to private data access can be more complicated. Clear rules of data ownerships should be ensured, especially to reassure farmers, as well as offering attractive incentives for data owners to make their datasets available. The importance of data-labelling was highlighted by several experts. Many also agreed that every application model would have to be re-trained to fit the specific local conditions. One expert also flagged the importance of ensuring and facilitating data protection and privacy. Another wanted the TEF to contribute to data spaces and data marketplaces.
- **Virtual TEFs:** Many experts called for virtual Agri-TEFs in addition to physical facilities where stakeholders could test their AI and Big Data applications. One expert proposed to set up an open source database similar to the existing ImageNet for AI (proposed name “AgNet”) and make it more suitable for agriculture by for instance making the images more visual (adding multi-spectral components and signals from other sensors) and more 3-dimensional.
- **Portability/reusability:** To avoid duplication, reusability and portability of components (existing facilities, data-sets and algorithms) tested in TEFs should be supported.
- **Expert support:** TEFs should provide access to a multidisciplinary team of experts, especially as it is difficult for agriculture to attract IT experts. These teams would include:
  - Domain experts such as farmers, but also end-users / end-beneficiaries,
  - Technology stakeholders with proven background in big data management and applied ML R&D in Agri-food complementary disciplines,
  - Technology stakeholders with experience in geospatial data, sensors/streams management and analysis, machine vision etc.,
  - Infrastructure and hardware providers.

One expert argued that solutions to be tested at TEFs should be restricted to those to be implemented in short and mid-term, allowing a (quick) return on investment.

With a view on better uptake by industry and farmers, one expert also recommended among others that TEFs should offer end-user training/education, validation processes, demonstration sites and stakeholder management as well as integrate the already existing infrastructure that works.

**On impact for the agricultural sector,** many experts agreed on the following points:

- **Quality & lower costs:** AI-powered services and products have the potential to be more robust and machine operations would be of higher quality and of lower costs and environmentally friendly. Testing and development is needed to realise this potential.
- **Level-playing field:** TEFs would allow smaller players, especially SMEs, to compete with bigger, global players in testing and rolling out new technologies. Some believed that this would lead to a diversification of the sector.
- **Autonomy:** TEFs could play a role in speeding up how quickly new AI-based technologies could reach levels of autonomy.
- **Global leader/competitiveness:** TEFs should aim to make European players more competitive and strengthen their role as a global leader in supplying (digital) farming technology.

- **Sustainability:** AI-powered solutions could help Europe move towards greater sustainability.

Some experts feared that EU-financed technology know-how would be transferred to third countries and called for measures to prevent this technology transfer from happening.

Experts mentioned several different **use cases**, including:

- IoT components and devices, digital farming platforms, autonomous agriculture robots, agri-food data spaces, connectivity technologies, food traceability solutions.
- Smart implements (sensing and actuation), weather station, decision-making, drone with payload, earth observation satellite, sensorised silos, sensorised animals, soil/crop sensor, autonomous harvester/tractor.

## 5. STRUCTURE OF THE “FACILITY”

For context, one expert emphasised that agriculture is different from other sectors because action only happens once (harvesting vs production of cars) and that the time window is limited (sometimes you can just harvest once a year), making new TEFs more expensive than elsewhere.

On the **structure of the facility**, many experts agreed on the following recommendations:

- **Practical & real:** TEFs should be used for technologies close to practical implementation and that need to be done under real farm settings. A marketplace where existing and even undeveloped integrations could be listed was given as concrete way to make this possible. One expert also stressed particularly the importance of end-user involvement.
- **Diversity:** TEFs should reflect the diversity of the agricultural sector (Different crops, soils, climates, farm structures).
- **DIHs:** (Physical) links with DIHs were encouraged to make use of DIHs’ one stop shop function.
- **Regulatory sandboxes/reforms:** Many agreed on the need of regulatory sandboxes for AI-powered solutions, including for liability and insurance, safety, data ownership and IP attribution issues. Another suggested to allow automatic takeoff and landing for drones and autonomous driving in all circumstances for robots.
- **Virtual:** Many experts argued for a virtual TEF where users could test their AI and Big Data solutions, which would be in addition to the physical TEFs. One expert said two different kinds of virtual facilities would be needed: data integration and another on analytics.
- **Access to data:** TEF users should have access to relevant data (satellite, LiDAR, land use, protected sites, etc.). One expert believed data captured on reference farms should be open to external parties. Another argued for a EU Code of Conduct on agricultural data sharing to ensure data ownership.

One expert emphasised that TEFs should develop a business model that is sustainable in the long term. This could be done via public-private partnerships and alignment of EU funding. However, if TEFs were to rely on structural funds this would mean excluding certain actors. The expert also argued that TEFs should be structured bottom-up from agriculture and that the expert advice for technologies should be at the service of the agricultural players. Another thought the TEF should be structured similarly to DIHs with a core facility and competence centres. Ideally the TEF would combine testing with incubation and acceleration.

One expert listed the needed infrastructure for a TEF, including access to the internet, e.g. 5G; access to clouds (or other disk space); computing power; data generating instruments: sensors, drones, cameras, GPS, satellites; robots; fields, crops and animals; expertise: farmers, technological experts (robot building, AI, cloud/edge computing specialists etc.), researchers.

In the expert discussion, many stressed the importance of collaboration in general, and a few collaboration between different sites. One expert suggested as a collaboration mechanism a registry of user groups/stakeholders to gather domain insight and feedback on developed/planned tech as a solution, another thought using VPN and container technology would be useful. **Experts and national delegations** recommended, in a **live poll** conducted at the workshop, many collaboration mechanisms between projects, including:

- DIHs,
- Regular dialogue between stakeholders in one forum,
- Coordination and support actions,
- Contractual agreements, e.g. MoU,
- Models and data standards, and
- Open standards, open data, software platforms.

One expert recommended to establish 30 autonomous reference farms (open source) and 300 testing locations in collaboration with farmers (selectively open). Another suggested to follow a rule of thumb of two physical facilities not being no further than ‘1 day away’ from each other.

How to attribute the IP created at TEFs will be a difficult issue for the **practical implementation** of the TEFs.

## 6. TIMING

On timing, experts differentiated between TEF for algorithm development (urgent) and TEF for autonomous farms (less urgent). Speaking mainly about digital technology, another also argued that the technology is mature (TRLs 4-8) and that many players can absorb funding rapidly, recommending to prioritise better access to data, new data services, data ecosystem. Training models for AI, new technologies like edge AI and setting up the pipeline with the different building blocks should also be considered priorities according to a different expert.

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, 45% believed the call should be made in 2021, while 39% it should be in 2022 and 16% in 2023-24.

## 7. FUNDING:

**On funding**, some experts believed that charging external parties for labelled datasets to train algorithms could act as a leveraging effect. In addition, when determining funding rates, one should ensure that the right incentives are in place for the right value chain players, as those who have the data are different players than those who benefit and/or make AI technologies.

One expert gave the following guidance for TEFs for the agricultural sector:

- 10 to 20 million EUR per reference autonomous farm

- Upscale existing farms to test locations and collaboration areas: 1-2 million EUR

Another expert argued for a minimum funding rate: To avoid inequalities between different Member States, a minimum level of funding for new TEFs should be ensured.

Using high enough reimbursement rates would motivate a lot of companies to participate according to one expert. For example a rate of 70% for an innovative research project (starting) is interesting for companies. For projects that are closer to market allowing companies to gain revenue quicker, a rate of 35%-40% could be used.

**Experts and national delegations** were asked in a **live poll** conducted at the workshop to answer several questions related to funding:

- The biggest group of participants said they would invest 50-75% of the grant in personnel costs, including subcontracting.
- Most said they would invest 25-50% of the grant in equipment and facilities.
- A majority of participants said they would invest 5-10% of the travel costs, while 25% said they would use up to 5% of the grant and another 23% would use 10-20%. Only 2% would use more than 20% for travel costs.
- The majority of participants was split between whether costs other than travel costs should be reimbursed by the grant at 25% or no reimbursement should be made.
- A clear majority in the workshop believed that the minimum funding needed to make an impact in the sector is at €50 million.
- Most believed that the remaining 50% of the Member State funding for the facility should be covered in kind.
- A strong majority said that national funding, e.g. from national strategies, should be the source of Member State co-funding for the facility and travelling.

## 8. **EU ADDED VALUE:**

The biggest cross-border issue discussed by **many experts** was the importance of speaking a common language in the different TEFs. Recommendations ranged from mandating interoperability to one single standard in Europe. In addition to facilitating cross-border coordination, replication of experiments would be easier, duplication avoided and costs/administrative burdens kept low. A common/standard descriptor for experiments including verified deployment models could be useful in that regard, according to one expert.

Speaking of the needs and impact of TEFs in the European dimension, one expert highlighted that for algorithms the priority was for data input to train and validate algorithms whereas for physical autonomous farms there was a need for testing, certification and homologation centres.

The challenge of climate change was seen as a key challenge that needs to be tackled at EU level and TEFs could be part of this effort.

The **live poll** conducted at the workshop also covered a related EU added value aspect as a clear majority of experts and national delegations believed that it should be a consortium that would own the TEF.<sup>2</sup> A consortium is more likely to involve cross-border collaboration.

## 9. ECOSYSTEMS – ACCESS TO VALUE-CHAINS:

Many experts emphasised the need for collaboration. This means getting the different players involved: academia from different disciplines; users/ farmers to identify problems, testing solutions, expert knowledge, etc.; Integrators like contractors and machine builders; technology providers business coaching, e.g. Data Innovation Hubs and lawyers (liability and insurance issues).

One expert suggested a registry of user groups/stakeholders to gather domain insight and feedback on developed/planned tech as a solution. This would mean that TEF users could get access to relevant stakeholders to test their solutions.

Many experts believed the sector and its supply chains to be ready and available. Some even said funding was urgent (see above in timing section).

Answering to a live poll at the workshop, 72% of the experts and national delegation representatives believed the grant should be handled by a consortium, while 28% thought this should be individual partners.

## 10. CONCLUSIONS:

There were a few clear take-aways from the workshop on TEFs for agriculture in Digital Europe Programme with experts and representatives from Member States. First, the sector is ready to absorb funding for future TEFs. A clear majority of participants prefers the call for TEFs for the agricultural sector to start in 2021. Second, experts also stressed the need for the TEFs to cover the diversity of the sector in terms of biogeographic and climatic conditions across the EU and/or cropping cycles, as regards e.g. the number and distribution of testing sites. Third, collaboration was seen as key by experts and can be done via many different mechanisms such as DIHs, open standards, open data, data exchanges, contractual agreements and ensuring regular dialogue between stakeholders in one forum. Fourth, TEFs should also be complementary and linked up to other relevant EU initiatives as the data spaces. Fifth, 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. Finally, the TEFs should ideally be done by a European consortium.

Some key common themes emerged from the **expert discussions** on recommendations for AI TEFs in the agricultural sector:

- **Easy to use:** Using the TEFs should be straightforward for their users. This has implications for the geo-graphical distance, costs, the level of skills and technical support needed as well as the administrative burdens involved. The easier to use, the more likely SMEs can benefit from TEFs as a resource to develop new technological solutions, and the more they will attract multipliers and serve the need of capacity building.
- **Practical & real:** TEFs should be used for technologies close to practical implementation and that have be done under real farm/ production settings.

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<sup>2</sup> 72% believed the grant should be handled by a consortium, while 28% thought this should be individual partners.



- **Certification/Validation & Trust:** TEFs have the potential to improve (low) trust among farmers in new farming methods by providing validation and certification of new solutions, including the independent assessment of the increase in resource efficiency and sustainability performance of the application of certain digital and data technologies.
- **Level-playing field:** If TEFs were made easy to use, the European Commission could empower smaller players, especially SMEs, to compete with bigger, global players in testing and rolling out new technologies.
- **Global leader:** TEFs should aim to make European players more competitive and strengthen its role as a global leader in supplying (digital) farming technology.

The Commission plans the following next steps:

- Clarification of the TEF as regards their form and structure, timing of their set-up and process lifecycle, mode of operation, including interaction with any size company e.g. large, SMEs, Start-ups, Academia, etc.
- Description of funding mechanisms.

## 11. ANNEX:

In a live poll of the experts and Member States' representatives gave some indications on funding and 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, 45% believed the call should be made in 2021, while 39% it should be in 2022 and 16% in 2023-24.
- Responses from **experts and national delegations** to a **live poll** conducted at the workshop indicated that the majority wanted TEFs to be spread geographically, while they disagreed whether there should be many or few TEFs.
- 60% believed that the minimum funding needed to make an impact in the sector is at 50 mio EUR. Others believed this threshold to be at 35 mio EUR (30%) or at 20 mio EUR (10%).
- 63% said that national funding, e.g. from national strategies, should be the source of Member State co-funding for facility and travelling. 24% believed it should be other sources and 12% said it should be regional funding.
- 64% believed that the remaining 50% of the Member State funding for the facility should be covered in kind, while 36% said it should be in cash.
- 32% said that costs other than travel costs should be reimbursed by the grant at 25%, while 30% said no reimbursement should be made. Others believed that reimbursement by the grant should be at 50% (16% of the respondents), 75% (12% of the respondents) or 100% (10% of the respondents).
- 50% said they would invest 5-10% in the travel costs, while 25% said they would use up to 5% of grant and another 23% would use 10-20%. Only 2% would use more than 20% for travel costs.
- 48% said they would invest 25-50% of the grant in equipment and facilities, while 29% would invest 50-75%. 21% would invest up to 25% of the grant in equipment and facilities while only 2% said they would invest 75-100% of the grant.

- 43% said they would invest 50-75% of the grant in personnel costs, including subcontracting and 30% said it would be 25-50%. A minority would invest either 75-100% (13% of the respondents) or up to 25% (15% of the respondents).