Interreg Europe

Co-funded by the European Union

MAE

Mapping the local Aerospace Ecosystem

Guidelines

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Forewords

The Aerospace Ecosystem

By "aerospace ecosystem" we mean the interconnected network of industries, organizations, technologies, regulations, and individuals involved in the development, production, operation, and support of aerospace-related activities. From the early stages of research and to the final markets, the aerospace ecosystem encompasses a wide range of activities and services related to both aeronautics (aviation) and astronautics (space exploration). From education to finance, from startups to large enterprises, from institutions to local and global community, the aerospace ecosystems impacts on many stakeholders and has the potential to shape the future of regional territories.

In the MAE project, we exchange knowledge on how to make sure local aerospace ecosystems are (re)designed to meet the challenges of a sustainable (green and socially accountable) development, through open governance of innovation.

Warning: the MAE project focuses on upstream aerospace and so does the mapping exercise. However downstream aerospace is going to play an increasing role not just in the global and local economies, but in pursuing other development priorities, as in the case of fighting climate change: preventing risks, managing environmental catastrophes, as well as implementing precision agriculture (just to mention a few applications domains). While not focusing on downstream aerospace, MAE will keep an attentive eye on it and feed related information into our mapping exercise.

The “Model” Aerospace Ecosystem

The mapping of local ecosystems is based on the description of the Delft aerospace ecosystem, both in terms of what is already and successfully in place and what the local stakeholders feel needs to be improved or built.
In line with the spirit of Interreg Europe project, common working methodologies are created through interregional exchange, rather than “in vitro”.

The Mapping

The local mapping process consists in pooling the current understanding of the MAE partners of their local aerospace ecosystems with insight from a variety of stakeholders. Such inside is collected through informal interactions with the members of the Local Stakeholder Groups.
The outcomes of the local mapping processes are shared and compared both as a basis of exchange for improvement of the policy instruments (the final objective of Interreg Europe projects) and to improve the design of the model ecosystem, so it become fully reusable by parties outside MAE.

The Specialisations

Within the realm of possible specialisations, each ecosystem focuses on priorities for its own competitive developments.

Aviation and/or space and upstream and/or downstream aerospace: where does the ecosystem lean towards at present?

Manufacturing, services, infrastructures: what is the backbone of the ecosystem made?

What are the major trends is the ecosystem embracing?

The Stakeholders

There are several main organisms (the order is random):

- **Aircraft, Spacecraft, Drones Manufacturers**
- **Component and Systems Suppliers** (from diverse industries)
- **Support and Service Providers** (from diverse industries)
- **Research and Development Organizations**
- **Universities and Academic Institutions**
- **Space Launch Providers**
- **Airlines and Operators**
- **Regulatory Bodies**
- **Investors and Venture Capitalists**
- **Policy and Government Agencies**

More on the Stakeholders

- **Aircraft, Spacecraft and Drones Manufacturers**

Identifying their cohort through NACE codes (or similar-scope national coding system) might be tricky and lead to underestimating the actual dimension of the ecosystem, as sometimes aerospace is only part of their business and not the main one.
Official statistics should be combined with other forms on assessment (ideally website scraping, realistically interviews with business associations, organisations managing infrastructures, service providers, knowledge providers, etc.)

- **Component and Systems Suppliers (from diverse industries)**

A value-chain perspective is key to identify current (and potential: the very goal of MAE!) component and system suppliers. While mapping production of parts can be like mapping manufactures of the final products, mapping avionics suppliers is a challenge within the challenge: engaging with knowledgeable stakeholders is key.

- **Support and Service Providers (from diverse industries)**

From logistics to downstream aerospace, the list of stakeholders falling under this heading is long. Again, to realistically identify local players, engaging with knowledgeable stakeholders is key.

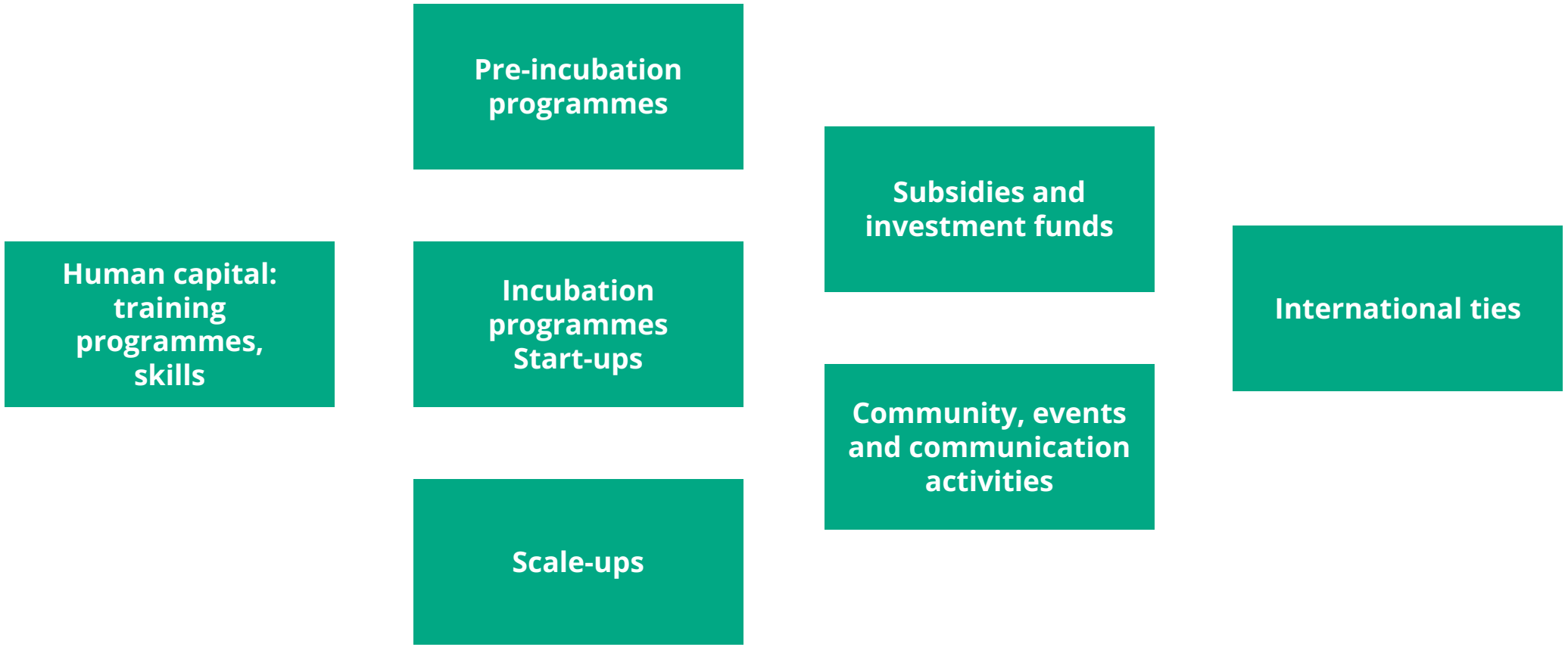
The Environment Factors

The interactions among the organisms happen within a dynamic environment, which the organisms contribute to shape dynamically. The environment encompasses tangible and intangible elements (the order is random):

- **Rules and Regulations**
- **Regional Development Priorities and Policies** (starting with S3s)
- **Enabling & Emerging Technologies**
- **Sustainability Goals**
- **Airports and Spaceports**
- **Communication and Ground Infrastructure**
- **Innovations Hubs/Hotspots** (facilities and communities)

The Boosters

Some features/forms/elements of the organisms of the ecosystem have a boosting power on the ecosystem's development and growth:



The Catalyser

In MAE, we believe the development and growth of local aerospace ecosystems can benefit from:

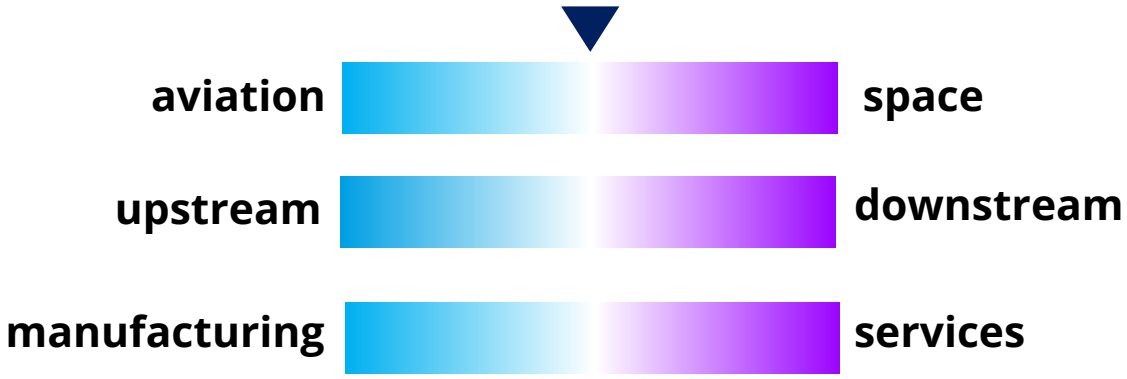
- **A Responsible Research & Innovation Approach**

The MAE project does not focus on structurally embedding Responsible Research and Innovation in the running of the local ecosystem: it would be beyond our scope and forces. However, we believe that innovation should always contribute to a just transition towards a more sustainable future and that this can only be achieved through shared innovation governance (open and transparent engagement of quadruple-helix players, through truly participative processes).

From an operational point of view, this means mainstreaming sustainability and stakeholder engagement in all decision processes around the design and development of the local aerospace ecosystem, evaluating which impacts are desirable and which are viable, although challenging.

Mapping Specialisations made easy

Which is the focus of the ecosystem?



Which infrastructures are available/planned?

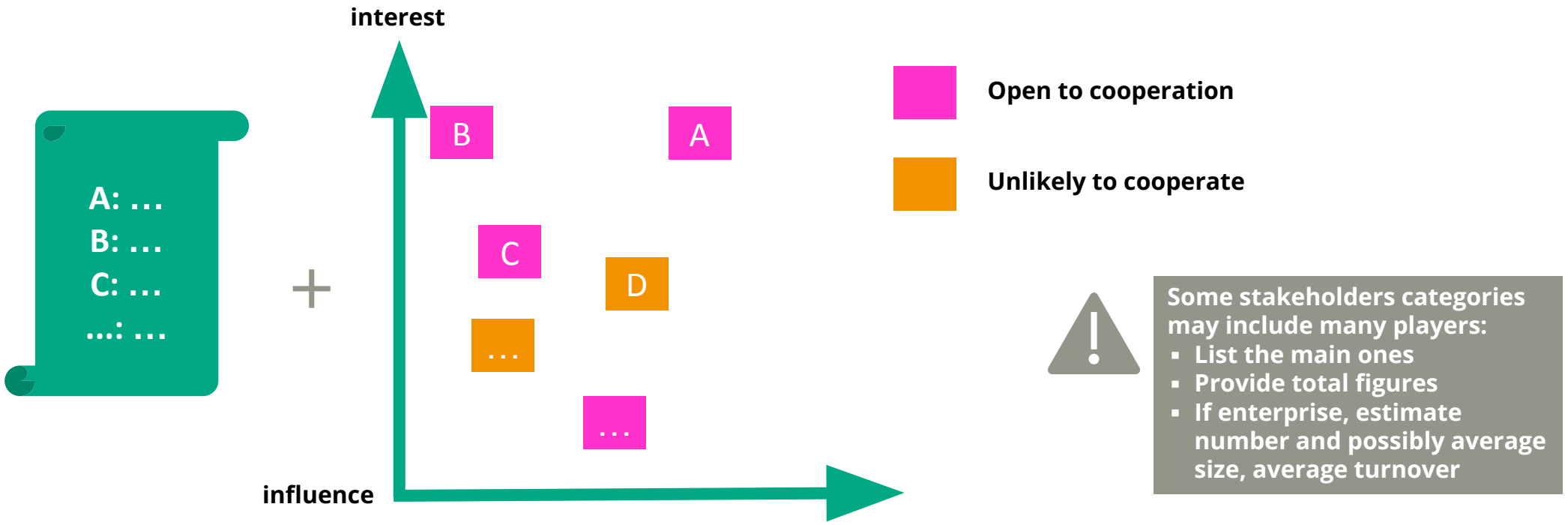
- Airport(s)?
- Spaceport (s)?
- Vertiport (s)?
- Large research infrastructures?
- ...?

Which main trends is the ecosystem embracing?

- Climate resilience and neutrality?
- Advances air mobility?
- Maintenance?
- Satellite miniaturisation?
- Space access?
- In-orbit servicing?
- ...?

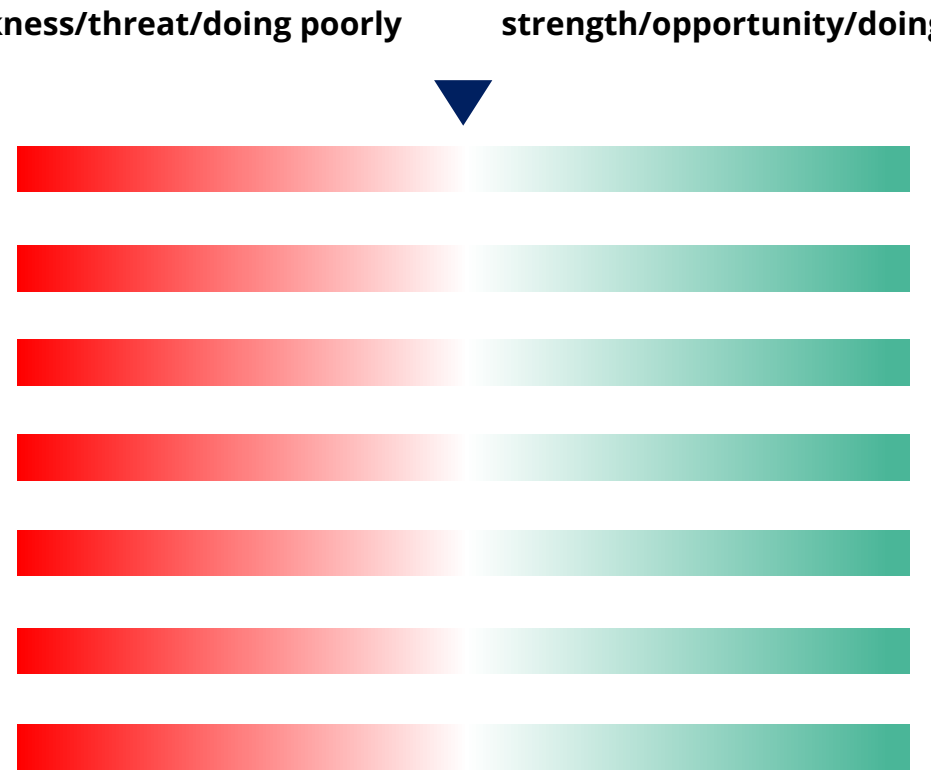
Guidelines for Mapping the Stakeholders

List and describe them. What is their level of interest in building/developing the local aerospace ecosystem? What level of influence can they exercise? Are they inclined to engage in shared governance and open innovation?



Guidelines for Assessing the Environmental Factors

How does your ecosystem fare?



Rules and Regulations

Part of Regional Development Priorities

Enabling/Emerging Technologies* (IPR/access)

Awareness of Sustainability Goals

Airports and Spaceports**

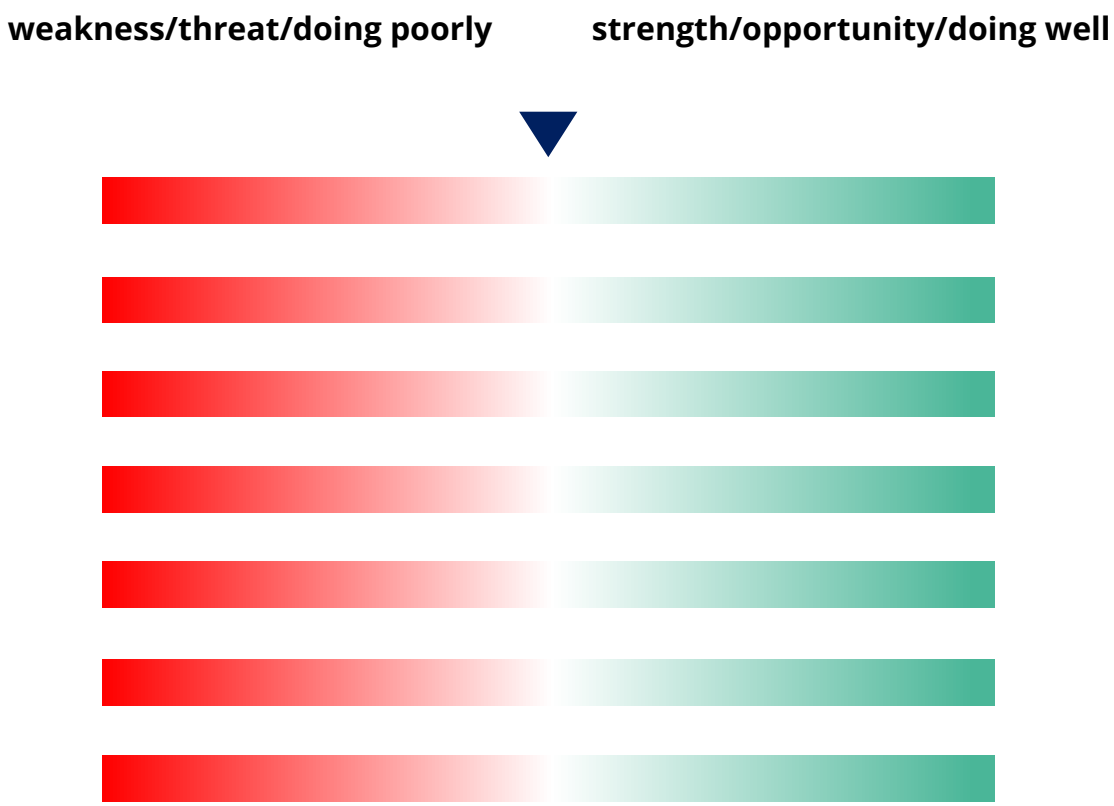
Communication and Ground Infrastructure*

Innovations Hubs/Hotspots*

* e.g.: advanced materials, robotics, orbital debris technologies, edge computing, drones, rocket technologies, AI & Big data, Propulsion, 3D Printing, EEE sensors and components, etc.
** Also, list their managing organization as stakeholders

Guidelines for Assessing the Boosters

How does your ecosystem fare?



Human capital

Pre-incubation programmes

Incubation programmes / Start-ups*

Scale-ups*

Subsidies and investment funds*

Communities*, events and communication

International ties**

* Also, list their managing organisation as stakeholders

** Describe briefly

Guidelines for Assessing the Catalyser

To the extent of the mapping exercise, we do not apply complex and formal RRI assessment methodologies from technical literature, but we adapt the suggestions of **OECD's Transforming S3 to S4+ through RRI Towards a Framework and Methodology for Measurement**, co-developed with the Interreg Europe204-2021 MARIE project.

(https://www.oecd.org/regional/multi-level-governance/MARIE_Transforming%20S3%20to%20S4%20through%20RRI_FINAL_13102022.pdf)

Also, see the *Annex – RRI*.

Guidelines for Assessing the Catalyser

Which sustainability challenges have been identified as relevant?

GLOBAL CHANGES

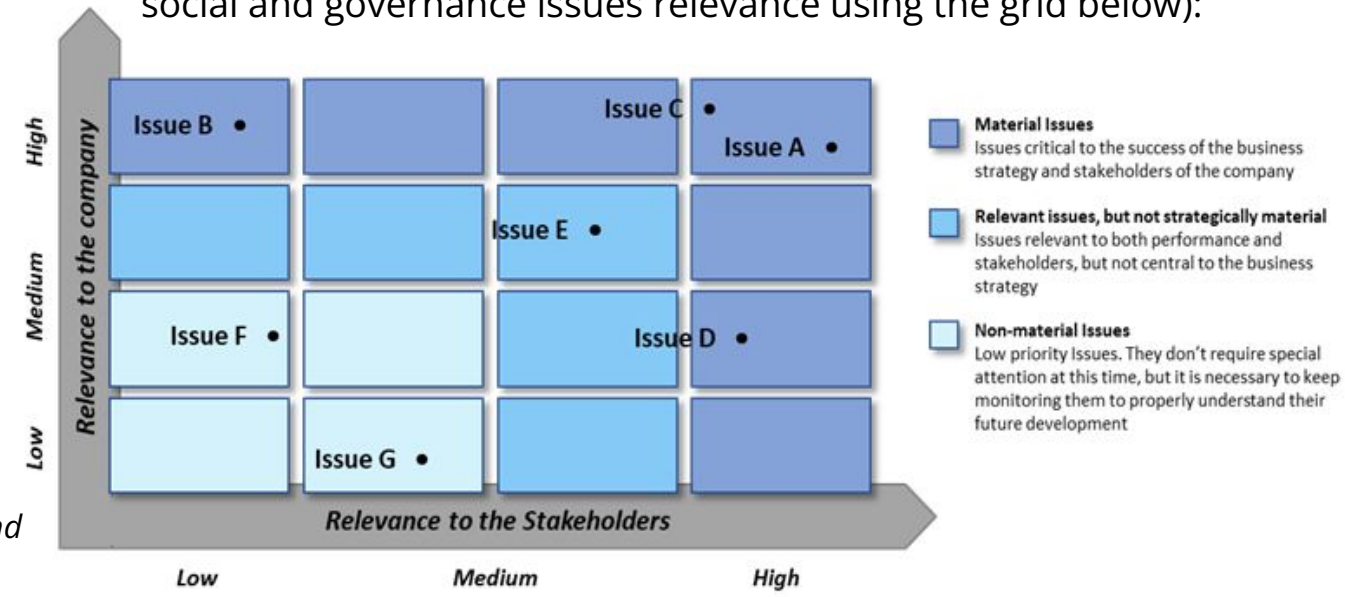
- ❑ Climate change
- ❑ World population growth of the Asia Pacific region and shifting economic (super)powers
- ❑ As a result of above: shift towards sustainability and reduction of waste geopolitical tensions,
- ❑ Tightening Labour Market
- ❑ Inflation rates reaching record numbers
- ❑ Brexit
- ❑ Need for Cyber Resilience
- ❑ …

AEROSPACE CHANGES

- ❑ Building a Sustainable Future for Aviation
- ❑ Green & Autonomous
- ❑ Airports Shrinking Space,
- ❑ New Space Economy & Downstream Services
- ❑ The Potential of Unmanned Aerial Vehicles (UAV's)
- ❑ New materials
- ❑ Automation and AI in manufacturing
- ❑ …

More insight: *Interreg Europe MAE Masterclass on Responsible design of sustainable aviation - ethical considerations, roadmaps and standards* by Emad Yaghamei, TU Delft.

Starting from he issues identified by actors of the Delft aerospace ecosystem add your own and assess materiality (i.e., understand the relative importance of specific economic, environmental social and governance issues relevance using the grid below):



Diversity & Inclusion:

- Does the S3 stakeholder engagement process ensure broad, inclusive and continuous participation of stakeholders relevant to the integration of RRI into the smart specialisation strategy?
- Are there any regional indicators on diversity (e.g. on gender) in research and innovation projects available? If yes, can those be used to measure diversity in projects funded through S3?
- Are there any tensions in the type of innovation supported through smart specialisation in your region and the RRI principles (e.g. privacy vs security concerns in patient surveillance innovation)?
- What are the incentives, drivers and barriers to including RRI-related objectives in the S3 priorities?

Openness & Transparency:

- Did you have a discussion within your S3 design and implementation process on potentially harmful impacts of your research and innovation projects on the public or the environment?
- Are there any criteria to assess RRI-related benefits and risks in your smart specialisation projects? If not, would you be able to come up with such criteria in your region?
- Are tasks and responsibilities to assess the impacts of S3-related innovation on society and/or the environment clearly allocated among relevant actors in your region (e.g. policy makers, or researchers in charge of innovation projects)?
- Does your S3 incorporate any regional ethical code of conduct?

Responsiveness & Adaptive Change:

- How are the views of CSOs and/or citizens included in evaluating RRI within S3?
- Is there any exchange with peers, researchers, and innovators from different disciplines in RRI projects that are supported through S3?
- How do you ensure that research and innovation projects funded under S3 can adapt to unforeseen events or societal changes (e.g. making changes in research plans possible)?
- Can you dedicate resources to support RRI projects within your S3 or add an RRI dimension to already existing projects (e.g. can you hire an RRI staff expert)?

Guidelines for Assessing the Catalyser

Self-assessment questions to reflect on the RRI value dimensions

Read “aerospace ecosystem” where the framework mentions “region” and whenever it states “S3” focus its overarching policies and its subsets policy instruments and governance tools that apply to/matter for the aerospace ecosystem.

Answers should be concise.

Source: **OECD’s Transforming S3 to S4+ through RRI Towards a Framework and Methodology for Measurement**

Self-assessment questions to reflect on RRI

Diversity & Inclusion:

- Does the stakeholder engagement process ensure broad, inclusive and continuous participation of stakeholders in the innovation processes within the ecosystem?
- Are there any regional indicators on diversity (e.g., on gender) in research and innovation projects available?
- Are there any tensions in the type of innovation supported by the ecosystem players and RRI principles?
- What are the incentives, drivers and barriers to including RRI-related objectives in innovation processes within the ecosystem?

Openness & Transparency:

- Do ecosystem players have a discussions on potentially harmful impacts of your research and innovation projects on the public or the environment?
- Are there any criteria to assess RRI-related benefits and risks that the ecosystem players share?
- Are tasks and responsibilities to assess the impacts innovation on society and/or the environment clearly allocated among relevant ecosystem actors?
- Do (some of) the ecosystem players share ethical codes of conduct?

Responsiveness & Adaptive Change:

- How are the views citizens included in evaluating the impact of innovation?
- Is there any exchange with peers, researchers, and innovators from different disciplines, including human sciences?
- How do you ensure that innovation projects within the ecosystem can adapt to unforeseen events or societal changes?
- Can you dedicate resources to add an RRI dimension to already existing projects?

Annex / RRI - The Prodromes

The Precautionary Principle is enshrined in Article 191(2) of the Treaty on the Functioning of the European Union.

It guides decision-making in situations where scientific evidence is uncertain, but potential risks to human health, safety, or the environment exist. It allows for preventive action to be taken even in the absence of full scientific certainty.

The Precautionary Principle states "*Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.*"

The precautionary principle was included in the Treaty on the Functioning of the European Union (TFEU) with the entry into force of the Treaty of Amsterdam on May 1, 1999.

The Precautionary Principle has been further elaborated in other EU legal instruments, regulations, and directives, as well as in the case law of the Court of Justice of the European Union (CJEU).

Annex / RRI - the Concept

Responsible Research and Innovation is a framework (principles, methodologies, tools) for **innovation management and governance.**

It aimes at steering innovation towards **market acceptance** and **neutral-to-positive impact** on the environment and the society.

On the innovation front, RRI intersects **eco**-innovation, **social** innovation, **gendered*** innovation, **frugal** innovation and **corporate social responsibility**.

On the science front, RRI intersects **post-normative science****.

RRI can operate **mission-oriented** innovation, **transformative** innovation and the vision of «not leaving anyone behind» along the green and digital transition.

* gendered innovation integrates gender analysis into research and innovation processes to enhance the quality and impact of scientific knowledge, technology, and design

** post-normative science challenges the notion of value-neutral or objective scientific inquiry, acknowledges that is influenced by subjective judgments, social constructions, interests, and recognizes the role of norms, values, and power dynamics in shaping scientific knowledge and its applications.

Annex / RRI – the Definition

Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).

(Von Schomberg, 2011)

The above is the most widely referred-to definition within the ample debate in Europe over the last decade. However, there are other, wider definitions, as:

- *Responsible innovation means taking care of the future through collective stewardship of science and innovation in the present* (Stilgoe et al., 2013);
- *RRI is a higher-level responsibility or meta-responsibility that aims to shape, maintain, develop, coordinate and align existing and novel research and innovation-related processes, actors and responsibilities with a view to ensuring desirable and acceptable research outcomes* (Stahl, 2013).

Annex / RRI – the Why (an example)

Best Case Scenario of Unmanned Air Mobility:

1. Efficient Transportation: faster and more efficient modes of travel. UAVs reduce commute times and help alleviate traffic congestion in urban areas.

2. Emergency Response: enhanced emergency response by quick and direct access to remote or disaster-stricken areas. UAVs deliver medical supplies, conduct search and rescue operations, assist in disaster management.

3. Environmental Benefits: more environmentally friendly compared to traditional modes of transportation. Electric-powered UAVs reduce carbon emissions and contribute to sustainable transportation solutions.

4. Improved Connectivity: connectivity in remote or underserved areas, enabling access to healthcare, education, and other essential services that were previously challenging to reach.

Worst Case Scenario of Unmanned Air Mobility:

1. Safety Concerns: If not implemented and regulated properly, malfunctions, technical failures, or cyberattacks could lead to accidents, collisions, injuries.

2. Privacy and Security Issues: UAVs with cameras and sensors may be used for unauthorized surveillance or misuse of collected data could compromise individuals' privacy rights.

3. Noise Pollution: UAVs could contribute to noise pollution in urban areas if not properly regulated, thus disturbing communities and affect the quality of life.

4. Unequal Access & Social Implications: UAM could exacerbate existing inequalities if access to this mode of transportation is limited to certain groups or areas.

Annex / RRI – the Why

Risk assessment is a powerful tool in managing the innovation process.

*However, in case of new research or new tech that have the potential to be disruptive and radically change the state of the art, **the risk assessment process may lack data** to build reliable scenarios.*

*RRI is about innovators and stakeholders engaging in **building mutual understanding and shared knowledge on wanted and unwanted scenarios** so that the innovations that are delivered are responsible by design, thus acceptable or even desirable.*

RRI is a particularly powerful framework for innovation public policies: innovations that create economic growth and contribute to mitigating or solving environmental and social challenges cover a wider range of public goals and multiply the impact of funds earmarked for innovation.

Annex / RRI – the Operational Dimensions

The operational dimensions* translate the RRI framework into an actionable process:

1. **Anticipation** emphasizes the need to identify and assess potential ethical, social, economic, and environmental impacts of research and innovation in advance, before they are fully developed or implemented.
2. **Reflexivity** refers to the continuous reflection on the values, motivations, and potential biases of researchers and innovators throughout the research and innovation process. It encourages self-awareness and critical evaluation of the societal and ethical implications of their work.
3. **Inclusion** calls for the active involvement of diverse stakeholders (citizens, civil society organizations, industry representatives, policymakers) in the research and innovation process, to ensure different perspectives, values, and needs are considered and the decision-making is transparent and participatory.
4. **Responsiveness** involves adapting the research and innovation process based on the inputs and feedback from stakeholders. It is about aligning the research and innovation activities with the broader goals of sustainable development and societal well-being at the design phase and in the longer term.

* Owen et al. (2012) and Stilgoe et al. (2013)

Annex / RRI – the EU RRI Keys (or Pillars)

While the EU-wide and global debate on RRI thrived, RRI was strongly emphasized in Horizon 2020 as a crosscutting theme. Within the Science with and for Society Workprogramme, funding was provided for research in the domain of RRI and its embedding in industrial practices and public policies (with a focus on regional innovation policies).

The EU Commission translated RRI into the following main themes:

1. **Public Engagement**: involving citizens, stakeholders, and communities in the research and innovation process; creating opportunities for dialogue, participation, and co-creation; ensuring that diverse perspectives and values are taken into account;
2. **Open Access**: providing free and unrestricted access to research results, data, and publications; promoting transparency, knowledge sharing, and collaboration; allowing wider participation and utilization of research outcomes;
3. **Gender Equality**: addressing gender imbalances and biases in research and innovation; ensuring equal opportunities, representation, and participation of women and men in all aspects of research and innovation activities;
4. **Science Education**: promoting science literacy, education, and outreach; enhancing public understanding of science, foster critical thinking; encouraging active engagement with scientific issues and debates;
5. **Ethics**: adhering to ethical principles, guidelines, and norms; ensuring the responsible and accountable use of research outcomes; addressing the potential risks and societal implications of new technologies;
6. **Governance**: ensuring mechanism for quadruple-helix setting innovation agendas and designing policy making, as well and monitoring and reviewing them

In Horizon Europe RRI still is a crosscutting theme, but the approach has been partially reviewed and can be summarized by the following:

Anticipation & Reflexivity - Inclusion & Public Engagement - Open Access & Open Science - Ethical Considerations - Gender Equality

Annex / RRI - the Reference Values

WARNING: the following reasoning is from an EU perspective. At global level, specific cultural, political, institutional and behavioral dimensions may influence how pillars are understood.

A strong and global reference in terms of ethical values and goals is the UN Agenda 2030 and its SDGs.

Such reference is consistent with the EU RRI keys/pillars, which are a cross-over of operational dimensions and reference values and have a closer EU and research focus.

The EU has adopted and embedded in Horizon 2020 a mission-oriented innovation approach.

It involves setting ambitious goals addressing complex problems and achieving specific outcomes within a defined timeframe. It focuses on **mobilizing resources, knowledge, and expertise across various sectors and disciplines to solve societal challenges** and deliver **measurable impact**. It demands **stakeholder engagement, flexibility and adaptability**.

Prioritised innovation missions align with the SDGs:

- Fighting Cancer;
- Climate-Neutral and Smart Cities;
- Healthy Oceans, Seas, Coastal, and Inland Waters;
- Soil Health and Food;
- Climate Resilience.

Interreg Europe

Co-funded by the European Union

MAE

The project MAE is implemented in the framework of the Interreg Europe programme and co-financed by the European Union.

www.interregeurope.eu/mae