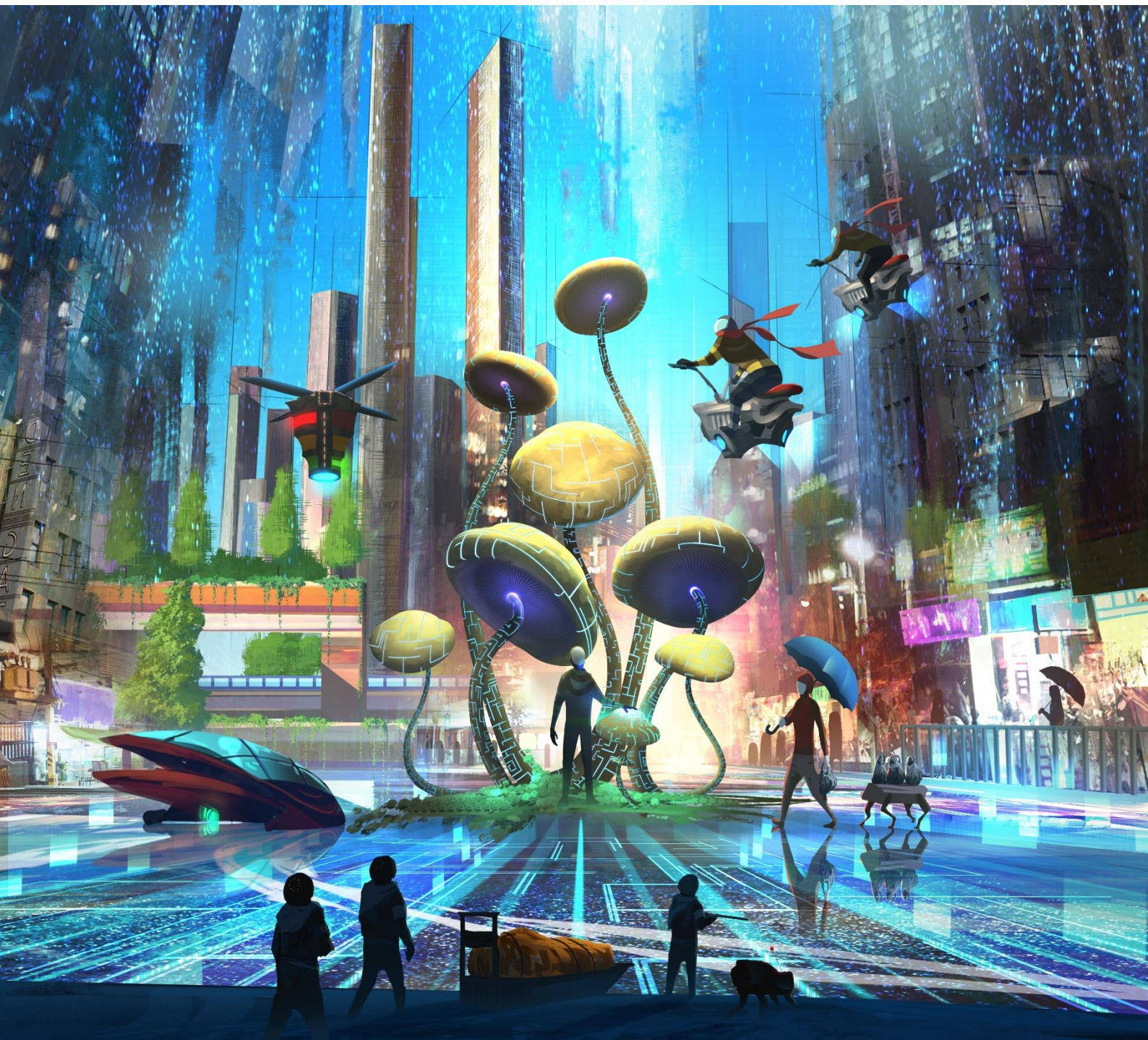


EDA Technology Foresight Exercise 2021

Final Results – Publishable Executive Summary





Final Results

Publishable Executive Summary
EDA Technology Foresight Exercise'21

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About The Exercise

The EDA Technology Foresight Exercise Technology aims at informing future defence policies and programmes of the European Union and its Member States. The Foresight Exercise looks up to 20 years into the future, to provide this strategic vision of the possible impact of technologies in defence in 2040+.

To facilitate outside-the-box thinking, different activities took place within the exercise, and it was open to high-level experts from different technological and non-technological domains, as well as from non-governmental bodies, academia, industry, and civil society.

Overall process and methodology followed

The exercise started with a back-casting activity, looking into the past to be able to better foresee the future. The back-casting was performed by experts, who assessed the relevance of past technologies and predictions relevant for defence identified in the last decades that is then complemented by the other EDA Technology Watch and Foresight activities. In addition, the “future tellers”, which were a core team of multidisciplinary experts participating in the exercise, imagined a set of possible futures, providing the framework for the foresight activity.

As part of the back-casting activity, looking into the past, two surveys (one themed on the 2007’s R&T technologies and one on Sci-Fi movies) were launched:

- The Sci-Fi survey aimed at identifying thinking patterns, when foreseeing the future and technologies’ impact, turning points, drivers, and showstoppers in the technology development process. To illustrate these ideas Sci-Fi movies from the 70’s, 80’s and 90’s was assessed on what they predicted the 2020s may look like.
- The R&T technologies survey assessed 22 EDA R&T priorities from 15 years ago to gain a better understanding of their evolution and to derive lessons to be applied in the exercise for foreseeing future evolutions.

In addition, the “future tellers” helped to facilitate the outside-the-box thinking this exercise needs to be successful. They are experts from a diverse set of technological and non-technological domains, with civil and military background and have collaboratively drafted 4 future narratives meant to inspire all the exercise’s participants. During the exercise’s events the “future tellers” had differing roles, as either members of the “red team” to challenge and thereby enhance proposed ideas, as “future shapers” to encourage participation and conform (some) ideas, or simply as subject matter experts (SMEs) with the addition of contribution to the final reporting and selection of ideas for further analysis.

With this food-for-thought information, a set of three events were organized allowing divergent and convergent thinking, to explore and define future technologies of interest for EU defence.



The first of the events was devoted to divergent thinking, to gather the widest range of ideas, whereas the second and third events were focused on convergent thinking, towards the identification of the weak signals, technology trends and potential disruptive technologies.

On the Divergent Thinking Event

The goal of this event was to ideate functional views of alternative futures and possibilities with direct or indirect relevance for Europe and Defence in 2040+. This was performed by a divergent thinking approach to the future visions with a combination of what is known, what is unknown, and what is imagined or envisioned. The most promising of these alternative futures views served as the basis for the discussions of the posterior events of the Foresight initiative.

The event was organized around the concept of a virtual world-café, fostering discussions around different topics, starting with the proposed four futures¹ arranged around the following dimensions:

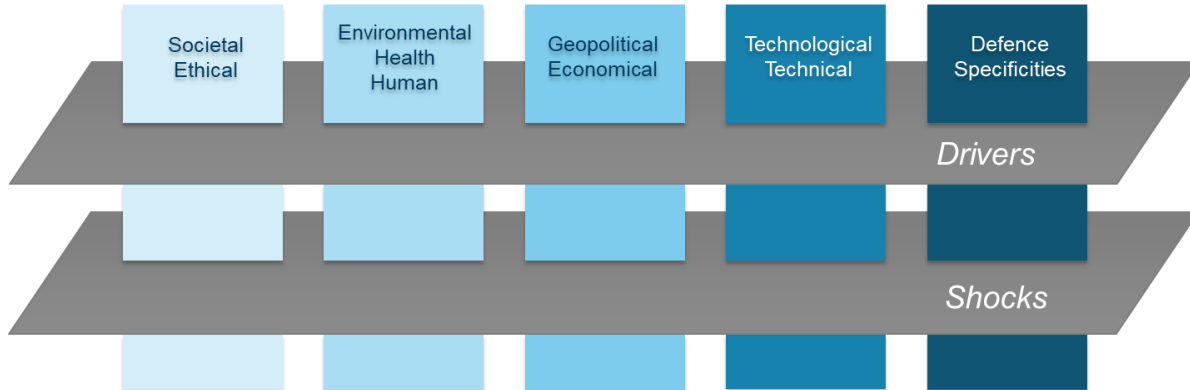
- Societal and Ethical. Potential impact on society or address specific social and ethical needs.
- Environmental, Health and Human. Potential impact related to environmental, health and human aspects.
- Geopolitical and Economical. Potential impact to affect future dependencies in critical value chains, to affect peace and stability, and to leverage financial resources in support of geopolitical and economical objectives.
- Technology and Technical. Potential impact on future critical technologies or technological needs.
- Defence specificities. Potential impact on future defence needs and capabilities.

Also, the possible drivers, shocks and other aspects were looked upon, considering the interwoven impacts of the different dimensions. The drivers aggregated those factors that may inflict significant changes in any of the dimensions. They are mostly trends of different nature. The shocks, instead, aggregated those unexpected events and changes, focusing specifically on those which might have a strategic nature. Examples of such shocks are disrupting technical breakthroughs, or natural/man-made catastrophes.

¹ The four futures proposed were: TechUtopia, Business as usual, Darwinian Games and Humanity versus the Hungry Beast.



The following figure depicts the conceptual structure of the dimensions.



Conceptual structure of the dimensions

These dimensions represent thinking axes which aggregate relevant ideas about the future and are not mutually exclusive. Therefore, around a similar topic there could be several ideas-aspects distributed around different dimensions.

Due to the pandemic related restrictions, the event was held fully on-line in July 2021. Therefore, to allow the world-café type of exchange, a virtual whiteboard, using the commercial IT tool called VIIMA, was provided to the participants for their discussions. This tool was embedded in the Exercise website, accessible to the registered. The website of the Exercise was also used as a central hub where to find all the relevant information (read-ahead materials, the presentations made during the meetings, agendas, links to the meetings, the inspirational talks, etc.).

The experts were requested to have an active participation, providing constructive ideas and comments, even if challenging and/or provocative. They were requested to think about the regular What?, Why?, When?, Where?, and How?, and also beyond trying to reply to Why not?, What If?, or What Else?

The ideas and opinions were mainly the contributions from experts participating in the event and from the Future Tellers. The ideas were characterized during the event along these different aspects, thanks to the comments of other experts. The ideas included a title, a short description, and then room for additional details as links to documents, relations with other ideas, discussion board, etc. The full list of ideas discussed can be found at annex I.

During the event, these ideas were assessed by the participants, regarding the:

- Relevance of the idea for Europe. Addressing how much an idea is expected to impact Europe in 2040+.
- Relevance of the idea for defence matters. Addressing how much an idea is expected to impact defence matters in 2040+



- Idea plausibility in the future. Addressing how likely is an idea to happen in the future (2040+).
- Singularity of the idea or how uncommon the idea is. Addressing how singular or unique is an idea in relation to other ideas about the future (mainly in the context of the exercise).

In total, 97 ideas were identified across the 8 days of asynchronous participation of more than 160 experts representing various organisations and nationalities from 20 EDA participant Member States (pMS) and associated countries (CH & NO), as well international organizations (EEAS, EC-JRC, NATO-STO), industry, SMEs, academia, and research centres.

The set of ideas and discussions represent a wide range of perspectives. The resulting 92 ideas are distributed across the 7 perspectives providing an interesting coverage of possible futures, and a successful indicator of the divergent character of the event.

Despite the divergent character of the results, the ideas, and discussions, present many inter-relations, ensuring that expected key aspects are addressed from different points of view.

A good and varied set of divergent ideas on the future stands a good foundation for performing posterior foresight analysis, even if this only performed on a small subset of those ideas, as it helps to understand side and contextual issues of the selected ideas for posterior analysis.

This analysis was performed in the next phases of the exercise, in a convergent thinking approach, starting from a general depiction of the future, in which both technologies and defence capabilities, and systems are the aspects of interest. To do so the approach adopted is to focus the thinking process on the futures selected, out of the key aspects presented below from the first event. Then, iteratively converging from those futures towards the present, by identifying which changes would have need to happen to those futures take place. This process, known as future backwards, is the methodological backbone of the second event.

Results of the Divergent Thinking

Summary of the key aspects

On a general and high-level view, the shared ideas provide a vision of the future in 2040 with the following key aspects:

Key Aspects
Biotechnology as a threat and challenge
Information and misinformation as pivotal
The emergence of an extended reality
Demography and an aging society conform a new playground



Key Aspects
Shifting values and beliefs
The new frontier of human enhancement
Environment as a driver
New contexts require new regulatory and ethical frameworks
The pervasiveness of cyber and AI
The evolution of the battlefield
The many challenges of autonomy
New space. The space domain is redefined as an operational domain
New warfare aspects in conflicts
A new order beyond the conventional geo-strategies

Details on the key aspects

The details of around these key aspects are expanded in the following table:

Key Aspect	Description
Biotechnology as a threat and challenge	<p>Advances in biotechnology (gene edition, synthetic biology...) will originate new biohazards that may be used as bioweapons. At the same time, these technologies will allow a rapid and reliable identification of those new biological threats, and to be prepared for them through appropriate medical care, containment, and control.</p> <p>Climate change is becoming a threat multiplier of disease transmission by progressively weakening ecosystem resilience, reducing biodiversity, and removing natural buffers between disease hosts and humans.</p>
Information and misinformation as pivotal	<p>By 2040, the new information age will be based on new dimensions of information (breakthroughs in information technologies, quantum computing and brain-machine interfaces) which will open new capabilities never thought before.</p> <p>At the same time, the power of misinformation has become a weapon of choice. The misuse of information becomes a weapon targeting other information systems and enabling influence operations on a scale that challenges the capability of nation-states to counter or control.</p>



Key Aspect	Description
The emergence of an extended reality	<p>In 2040 the evolution of information technologies, integrated with new concepts of communication and making use of new advances in fusing Brain-Computer Interfaces (BCI) with Augmented / Virtual Reality (AR/VR) have led to the creation of an extended reality where many aspects of our existence (learning, relation, properties...) are deployed exclusively or in combination with the actual reality.</p>
Demography and an aging society conform a new playground	<p>The impact of aging western societies and an accelerated demographic decline greatly affect Europe in 2040 both from the military and general society point of view. This will impact society across many aspects. This exercise identified of particular interest:</p> <ul style="list-style-type: none"> • The importance of robotization and its extension to military. • Declining manpower for traditionally military matters. • Growing support for human-life enhancements, specifically with those dealing with life-extension.
Shifting values and beliefs	<p>By 2040, the perception of the world and society will have changed, among the most significant characteristics that will have shaped the perception and understanding of the world and society are:</p> <ul style="list-style-type: none"> • Climate change, population growth, and depletion of some key resources (raw materials, especially unique ones), or the increase of polluting resources can destabilize financial transactions on major exchanges and bourses. • The development of technologies as biomanufacturing, robotics, and mixed-material additive manufacturing push the development of new food and food industry habits and lead to a local market. • The scramble to defend informational sovereignty in an era of intrusive internet surveillance, and the rapidly emerging power of data leads to a digital world controlled by a handful of corporations.
The new frontier of human enhancement	<p>Advances in biotechnology (synthetic biology and gene editing technologies) and brain-machine interfaces (advancement of intracortical brain-computer interfaces, etc.) combined with advances in information technologies (AI, information transmission technologies, etc.) and robotics, provide a potential enhancement (intelligence, cognitive and physical) of the soldier.</p>



Key Aspect	Description
	<p>This potential will pose a great challenge on defining and enforcing the regulatory and ethical framework for the new possibilities, both at European and global scale.</p>
<p>Environment as a driver</p>	<p>By 2040, environmental changes have ignited new threats (global climate disasters, greenhouse effects, food, and water shortage) where the military will have to play additional roles (emergency and disaster management, increased protection against non-controllable movement of the population).</p> <p>Additionally, defence organizations will have to adapt to this driver as well, from the point of view adapted infrastructures, energy sources, and compliance with validation and verification and certification specifications of constrained environments (such as the military one).</p>
<p>New contexts require new regulatory and ethical frameworks</p>	<p>In 2040, advances in technologies and the evolution of stakeholders' power and role will require sound and practical ethical and regulatory frameworks. Key contexts requiring these new frameworks are:</p> <ul style="list-style-type: none"> • Hybrid conflicts and the understanding of tactical, ethical, and practical consequences of hybrid warfare. • Biological weapons and new genetic engineering techniques. • The use in 2040 of technology for soldier enhancement (intelligence, performance, cognitive, physical). • The weaponization of cyberspace and misinformation. • LAWS (Lethal Autonomous Weapon System) • By 2040, Space has been transformed into a contested domain.
<p>The pervasiveness of cyber and AI</p>	<p>By 2040, an accessible and contested cyberspace domain exacerbates hybrid conflicts and consolidates cyberspace, with Electronic Warfare (EW), and the control of electromagnetic spectrum, as a powerful operational environment.</p>
<p>The evolution of the battlefield</p>	<p>The battlefield in 2040 will be a software-based battlefield. The development of technologies related to artificial intelligence, machine learning, 5G/XG communication networks, will make the conflicts to be conducted in a faster way. Increased development of system-systems based defence solutions on the above-mentioned technologies will require appropriate software and algorithms to ensure systems stable operation on the different platforms and processing and storing data</p>



Key Aspect	Description
	<p>necessary to perform the mission. Well-functioning software will be mission critical.</p> <p>Linked to the software-based battlefield vision, the system of systems as an offensive capability is present in 2040 as a real threat to many platforms and systems. The most common approach to this system of systems advantage is the swarming of numerous autonomous or automatic systems. Furthermore, the risk of cascade failures makes the system of systems advantage a very effective capability, in some cases, even from the cost-effective point of view.</p> <p>In parallel, the application of new science and technological dimensions will introduce new/enhance capabilities. In this sense, quantum technologies will be source of technical breakthroughs which may revolutionize battlefield aspects as real-time mapping of dynamic environments based on advance sensing and navigation capabilities.</p>
<p>The many challenges of autonomy</p>	<p>2040 security and defence operations require extraordinary capabilities to operate in contested operating environments and to master the command-and-control challenges of complex systems and interdependencies. Mission success is strongly linked to effective interaction and collaboration with non-human autonomous and intelligent systems.</p> <p>However, by 2040 the adoption of autonomy will be still challenging the defence organizations from many different perspectives:</p> <ul style="list-style-type: none"> • Decision loop and ethical implications. Weapon systems are becoming increasingly autonomous and intelligent, operational complexity is increasing dramatically, making soldiers more and more dependent on solutions proposed by AI systems, and their decisions are not based on human moral judgment, losing their ability to think critically. • International Humanitarian Law compliant /robust / certified LAWS. • Technical and technology developments <ul style="list-style-type: none"> ○ The software developer role. Designing ethically sensitive machine learning systems. ○ Reaching developments in the field of modelling human thinking and behaviour.



Key Aspect	Description
	<ul style="list-style-type: none"> ○ Number, characteristics, and diversity of the entities required to interact and collaborate in Joint Systems Operations. ○ Operational sub-domains in which these entities operate. Interdependencies among operations in these domains and the effects they create. ● Organizational challenges. The availability and proliferation of unmanned platforms in the battlefield induce major changes to the defence MODs as organizations. In special from the point of view of military operational doctrine, materiel and acquisition policy and logistics implications.
<p>New space. The space domain is redefined as an operational domain</p>	<p>In 2040 Space has been transformed into a fully operational domain. New threats to commercial and military uses of space have emerged. In addition to increasing digital connectivity of all aspects of life, business, government, and military it has also facilitated significant vulnerabilities and threats</p>
<p>New warfare aspects in conflicts</p>	<p>The growing role and involvement of private military and security companies, ghost conflicts, and particular interests of international corporations or institutions will drive and shape some of future conflicts up to 2040.</p> <p>The increasing hybridization of conflicts (misinformation as a weapon of choice, the military use of the passive or active role of citizens as intelligence providers, grey zones of humanitarian and conflict laws, etc.) set the focus on the society as a new operational domain.</p> <p>In this new domain, traditional states, and multilateral organizations (NATO, UN, etc.) face new challenges as they clash with emerging aspects of conflicts and new stakeholders (empowered individuals, misinformation creators, etc.).</p>
<p>A new order beyond the conventional geo-strategies</p>	<p>In addition to the current drivers for geostrategic order, there are new drivers shaping the world order, such as:</p> <ul style="list-style-type: none"> ● New domains of potential confrontation and types of conflict (Arctic, overseas, ghost conflicts, Africa, the commercialization of conflicts, or targeting the society as new operational domains...). ● New actors and perception of order across the world.



Key Aspect	Description
	<ul style="list-style-type: none"> • New energy sources, resources and, economic drivers (water scarcity, potential economic boosts of new geographical areas such as Africa...).

On the convergent thinking events

The objectives of these events were to build upon the previous results, starting from the future snapshots/scenarios, to identify the most relevant technologies, trends and weak signals and their associated impact. In this way, at the end of the process, it was expected to identify technology areas, factors, trends, and weak signals that could be relevant towards 2040 by the ideation of functional views of alternative futures with direct or indirect relevance for Europe and defence. The most promising of these alternative futures views, coming out of the first event, served as the basis for the discussions of these events. They took as starting point and foundation the results gathered in the first event (divergent thinking). These events changed the thinking process approach (from divergent thinking to convergent thinking, from looking forward to retracing those steps backwards).

This convergent thinking is essentially about problem solving, considering that for this specific activity there was no correct answer. Therefore, within the frame of this exercise, the convergence was designed towards the identification of key technology aspects (e.g., areas, factors, trends, and weak signals) and their impact from different point of views (e.g., EDA's KSA, CDP, and OSRA).

The methodology applied was futures-backwards, starting from a possible given future, traveling back to the present. With this trip through the cone of future plausibility, from the set of selected 2040 scenarios to the present, it was expected to identify an evolutionary path towards a possible future in 2040, with known and expected technologies and capabilities evolution, but also new and revolutionary ones, with unaware or unidentified technologies and weak signals.

To guide the thinking process, several turning points were established, in 2025, 2035, in addition to the "now", 2021, and the time horizon in 2040. These turning points were used to map the effect-results of a given scenario, and the causes and changes at each turning point.

For each turning point, the impact of technology on future capabilities and systems functionalities, how it impacts or tackles the capability challenges at the turning point, how the technological challenges / obstacles at the turning point were overcome or developments, milestones, breakthroughs at the turning point and contributing factors (e.g., enablers, means) was looked upon. The structure of the different areas was the regular one: capabilities,



systems/functionalities, technology, and then enabling technologies, knowledge, skills, and EU means.

The idea behind the different scales set for the turning points was to have shorter time-leaps at the extremes, to make the thinking process easier from the exercise references (2040 and present, 2021). However, it was highlighted that these time-points were to be taken as approximations to better come with ideas about the evolution of the aspects under discussion. In this way, in some areas there could be need for only one turning point, for example in 2030. It was also highlighted the “clash” of timelines with long term planning of key platforms. At the same time, these already “fixed” aspects and systems provide a contrast to the estimates and the guessing on technologies and impacts on the scenarios under analysis.

The experts had similar roles as in the first event:

- Participants. As the general role for all the experts contributing to the events.
- Future shapers. Conforming (some) ideas, providing a future framing (e.g., perspective, wording/terms, projection into the future) to those ideas lacking that, contributing to the weak signals and trends identification, and establishing links between ideas within a given scenario or in other scenarios.
- Red team to enhance and complement the understanding and insight of ideas, challenging to cooperatively find out / think of new perspectives of those ideas, questioning facts and introducing/looking for uncertainties, proposing changes / perspectives in the used hypothesis (e.g., approaches, paradigms). In a similar way to their role in the first event, the red team was not so much the traditional enemy/adversarial point of view but applying the red perspective to widen the defence and sovereignty perspective, helping to identify vulnerabilities and EU dependencies, as geostrategic shifts, and the adversary perspective in new defence domains. Also, to identify indirect impacts and unexpected shocks.
- Moderators. Responsible to fine-tune the wording, adding links and tags to the ideas and comments.

The information gathered in these events, plus the results from the survey, was analysed to identify the most promising and potentially disruptive technologies for the future.

Results of the Convergent Thinking

Summary of the scenarios

The list of scenarios that were used for the analysis are the following:

Scenarios
SC01. Software based battlefield.
SC02. Space as an operational domain.



Scenarios
SC03. An extended and augmented reality.
SC04. Impact on defence organization of the dominance of unmanned and autonomous platforms on the battlefield.
SC05 Hybrid human-machine teaming.
SC06. Protection against new bioweapons.
SC07. Cognitive enhanced soldier.
SC08. Real time mapping of dynamic environments.
SC09. Chicken and egg race of misinformation and related polarization.
SC10. The conforming power of environmental aspects and its implications on energy.

Each of these scenarios focused the discussions within the defined timeframe of 2025-2040, starting with the defined vision in 2040 (derived from the descriptions in event 1) and moving on retrospectively towards the present time, through an intermediate analysis in 2035 and another one in 2025.

Details on the scenarios

Scenario	Description
Software based battlefield	<p>This scenario focuses on the evolution of defence solutions which will require appropriate software (SW) and algorithms to ensure the stable operation of the systems on the different platforms, as well as the processing and storage of the data needed to perform the mission.</p> <p>Central to this 2040 scenario is how well-functioning SW is critical to ensure that missions are conducted in an effective and efficient way. In this respect, it is considered that the platform will be less important than the SW itself.</p>
Space as an operational domain	<p>This scenario addresses a 2040 future vision, in which space has been transformed into a fully operational domain. New threats to commercial and military uses of space have emerged. In addition to increasing digital connectivity of all aspects of life, business, government, and military it has also facilitated significant vulnerabilities. Many countries will be a global space power in 2040. They will have to deal with security threats and challenges in that domain and secure its space assets to serve its national interests. This new operational domain will need to deal with vulnerabilities (both of natural and human origin). A combination of developments in space technologies and in defence technologies used in the other</p>



Scenario	Description
	<p>domains (e.g., hypersonic/hypervelocity missiles) will increase the need to provide security and defence from space and consequently also the need to counter all the expanded capabilities. This redefinition of the space as an operational domain, will also motivate/request a redefinition of the regulatory framework for space.</p>
<p>An extended and augmented reality</p>	<p>This scenario addresses a 2040 vision, in which the evolution of information technologies, integrated with new concepts of communication and making use of new advances in fusing brain-computer interfaces (BCI) with augmented and virtual reality (AR/VR) has led to the creation of an extended reality where many aspects of our existence (e.g., learning, relation) are deployed exclusively or in combination with the actual reality. The main aspects of this future vision are:</p> <ul style="list-style-type: none"> • Pervasiveness of these capabilities to almost all aspects of life. • The convergence with other digital aspects (e.g., artificial intelligence, misinformation). • The synergy with the robotization and evolution of society (e.g., aging, shift in world understanding) and with the role of autonomous platforms in defence and new capabilities in the battlefield.
<p>Impact on defence organization of the dominance of unmanned and autonomous platforms on the battlefield</p>	<p>In the long-term (2040) the increasing pervasiveness of unmanned platforms will induce major changes to the defence MoDs as organizations. Specifically, from the point of view of military operational doctrine, materiel and acquisition policy and logistics implications.</p> <p>The main aspects of this future vision are:</p> <ul style="list-style-type: none"> ▪ Changes of materiel and acquisition policy and logistics needs. ▪ Redesign of platforms, not needing to host "humans". ▪ Redirection of investments previously allocated to life-support subsystems.
<p>Hybrid human-machine teaming</p>	<p>This scenario addresses a 2040 future vision, in which the pervasiveness and availability of unmanned platforms has induced major changes from the point of view of military operational doctrine. The main aspects of this future vision include the increase of cyber/IT protection, training, change of tactics, doctrine, etc. Taking the above as a starting point, and within this scenario, four key trends were identified:</p> <ul style="list-style-type: none"> • Hybrid decision-making. • AI support. • Human-machine interfaces (HMI). • Advanced combat suit.



Scenario	Description
Protection against new bioweapons	<p>This scenario focuses on how potential new and evolving diseases from the natural environment (by changes in climate, the movement of people into cities, and global trade and travel), new resistant microbes originated from misuse of antibiotics and other drugs, or new biohazard originated from the use of synthetic biology and gene edition technologies may be used as biohazard/bioweapon/biothreat.</p> <p>The main aspects of this future vision are:</p> <ul style="list-style-type: none"> • Safety and security issues derived from the human gene modification as a new capability/weapon and bioethical and legal considerations. • Technological advances in biotechnology, enabling easier access and handling of biotechnologies, and faster, cheaper, more accurate technologies to edit genes. • Capability to identify new biological weapons, and to be prepared for them. • Rapid and reliable identification for appropriate medical care, containment, and control.
Cognitive enhanced soldier	<p>Advances in biotechnology (synthetic biology and gene edition technologies) and brain-machine interfaces linked to advances in information technologies are used to enhance (e.g., intelligence, cognitive, and physical) the soldier.</p> <p>The main aspects of this future vision are:</p> <ul style="list-style-type: none"> • Technological advances on biotechnology, brain-to-brain transmission of information robotic, artificial intelligence, quantum technologies, autonomy, etc. • Social acceptance and ethical issues arising from the use of technologies to enhance human (physical and cognitive) performance. • Governmental settings of standards.
Real time mapping of dynamic environments	<p>Quantum technologies will be source of technical breakthroughs which may revolutionize battlefield aspects, among others, this scenario focused on the potential future possibility of real-time mapping of dynamic environments based on advance sensing and navigation capabilities.</p> <p>Some main aspects of this future vision are:</p> <ul style="list-style-type: none"> ▪ Quantum technologies will continue creating a new paradigm in the field of communications, computing, sensing, and navigation. ▪ New quantum-based sensing and navigation capabilities are expected to be mature (and to be fielded) by 2040.



Scenario	Description
	<ul style="list-style-type: none"> ▪ Some of these capabilities may lead to very disruptive applications, such as, real-time mapping of dynamic environments, transparent-oceans, or some level of cloaking.
<p>Chicken and egg race of misinformation and related polarization</p>	<p>The misuse of information is becoming a key weapon, this scenario addresses how in 2040 it will become a weapon of choice to targeting other information systems and enabling influence operations on a scale that challenges the capability of nation-states to counter or control.</p> <p>The main aspects of this future vision are:</p> <ul style="list-style-type: none"> • Commercialization and hybridization of conflicts. • Control and mitigation of misinformation weapons. • Regulation issues.
<p>The conforming power of environmental aspects and its implications on energy</p>	<p>In 2040 climate aspects and biodiversity will become strategic drivers for stakes and world order. They will be both considered at world scale and at national sovereignty perspective leading to become a driver for conflicts and confrontations.</p> <p>This will be strongly related with diverse attempts to control weather. Moreover, some geo-engineering initiatives are being developed and in-place, raising concerns on the unexpected consequences at local and global scale (including the use as a weapon).</p> <p>In this 2040 context, energy remains a major driver for strategic dominance. From the point of view of defence, and despite the many different and intensive investments in energy generation and storage, the energy density, efficiency of the systems and cost effectiveness of many power systems is not enough to discard energy as a challenge for most of the defence systems and operations.</p> <p>The main aspects of this future vision are the following:</p> <ul style="list-style-type: none"> • New ways of conflict. • Economic factors changing how society is perceived and lived. • Environment shocks will conform society and its order. • Beliefs and understanding of human being. • Greater interconnectivity may lead to greater polarization in values. • Emerging actors (in society and in conflicts). • New resources needed to develop new technologies. • Energy density, the efficiency of the systems and cost-effectiveness. • Environmental concerns and restrictions under EU laws. • Research and development on new geoengineering technologies.



Scenario	Description
	<ul style="list-style-type: none"> • Need to an international legal framework to control the impact on climate and resources at planetary power.

During the exercise, the key trends identified in the scenario were connected to key ideas organized in the following categories relevant to the specific scenario:

- Technology
- Impact on Defence
- Context
- Threats and challenges

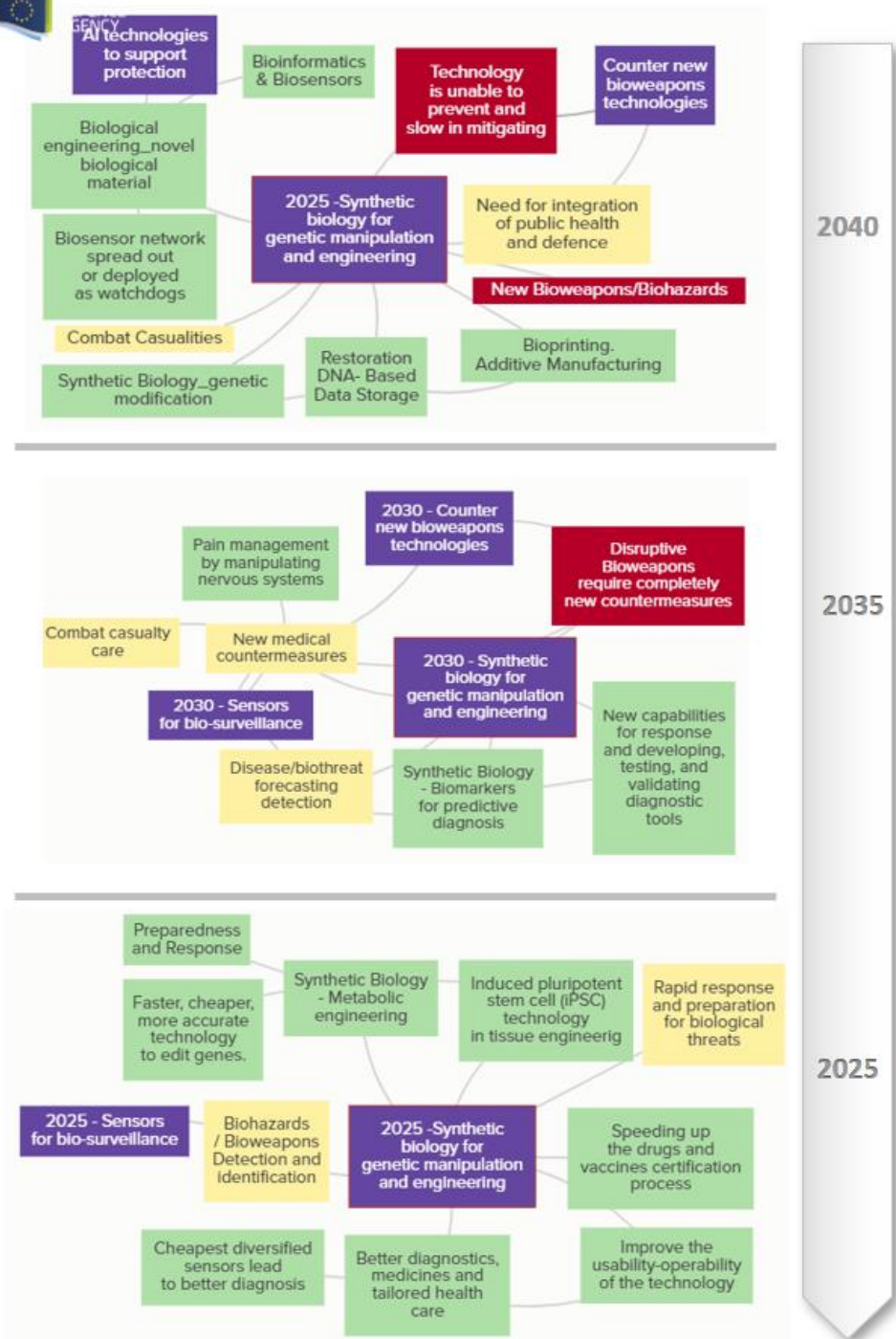
The collection of ideas and their relations were also organized in a visual manner along the time axis. The following figure is an example of the visual representation of the ideas and their relations to other ideas and trends within the scenario. This visual representation provides an overview of the activities that make up the trend and how they are integrated with each other.



2040 scenario: **PROTECTION AGAINST NEW BIOWEAPONS**

- Technology
- Impact on Defence
- Context
- Threats and challenges

AGENCY SYNTHETIC BIOLOGY FOR GENETIC MANIPULATION AND ENGINEERING





Conclusions and way ahead

The exercise attracted more than 200 participants from various governmental and non-governmental organizations and saw the active contribution of experts from a broad range of expertise (e.g., sociology, ethics, economy, medicine, history, international relations, defence capabilities and operational needs, philosophy, biosciences).

The innovative nature of the exercise was also demonstrated in the combination of different methodologies and processes applied, along with best practices and lessons learned from the wider EDA community of foresight practitioners.

The outcomes from the exercise will contribute to:

- provide a high-level, long-term vision on multiple possible futures with defence relevance, with a special focus of the impact of emerging and emerged disruptive technologies.
- take advantage of the synergies between technology foresight and the Capability Development Plan (CDP) Strand B, to produce an input for any future updates of the EDA Prioritization tools such as the Overarching Strategic Research Agenda (OSRA), CDP or Key Strategic Activities (KSAs).
- contribute broadly to the European Union's resilience building and strategic autonomy efforts, while also informing future technology foresight workshops, the OSRA process and, in general, all the R&T activities within EDA.



Final Results

Publishable Executive Summary
EDA Technology Foresight Exercise'21

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