REPORT AND ACTION PLAN ON THE DIGITALIZATION IN MSTCS OF THE AA

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Title	Report and Action Plan on the Digitalization in MSTCs of the AA
Creator	Fundación Tecnalia Research & Innovation
Description	This report describes the results and the processes to accurately determine the digitalization starting position and needs of the MTSCs in the field of simulation-based training systems.

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1 Executive Summary

The AT-VIRTUAL project aims to accelerate the digitization of Maritime Safety Training Centres (MSTC's) in the Atlantic Area (AA) in order to improve their operability and performance, through the introduction of new emerging Industry 4.0 (I4.0) related technologies (Vision Technologies, Big Data/Analytics, Internet of Things (IoT)) in simulation-based training systems.

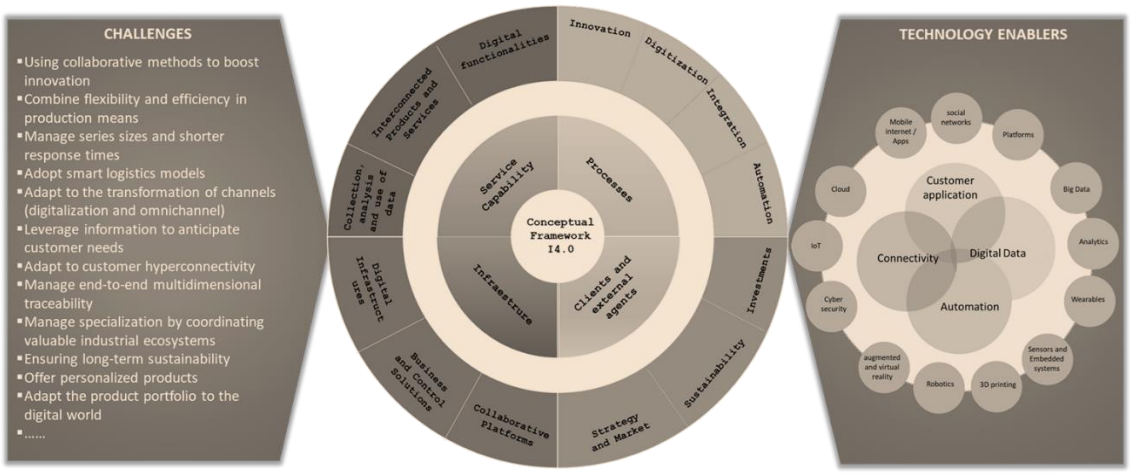


Figure 1: Conceptual Framework I4.0

The MSTCs target is to define needs and their subsequent technological challenges so that start-ups can propose their prototypes. Specifically, the different developments with emerging technology and their implementation are intended to satisfy the needs of the MSTC in the field of training systems for maritime security operations. This will improve AA capacity, preparedness, resilience and incident response to maritime incidents and emergencies in Atlantic waters, while fostering innovation and sustainable growth in businesses.

To achieve this objective, a personalized work of concretion and definition of challenges and applied technology has been carried out through technical and operational cooperation between MSTC and Tecnalia (research organization).

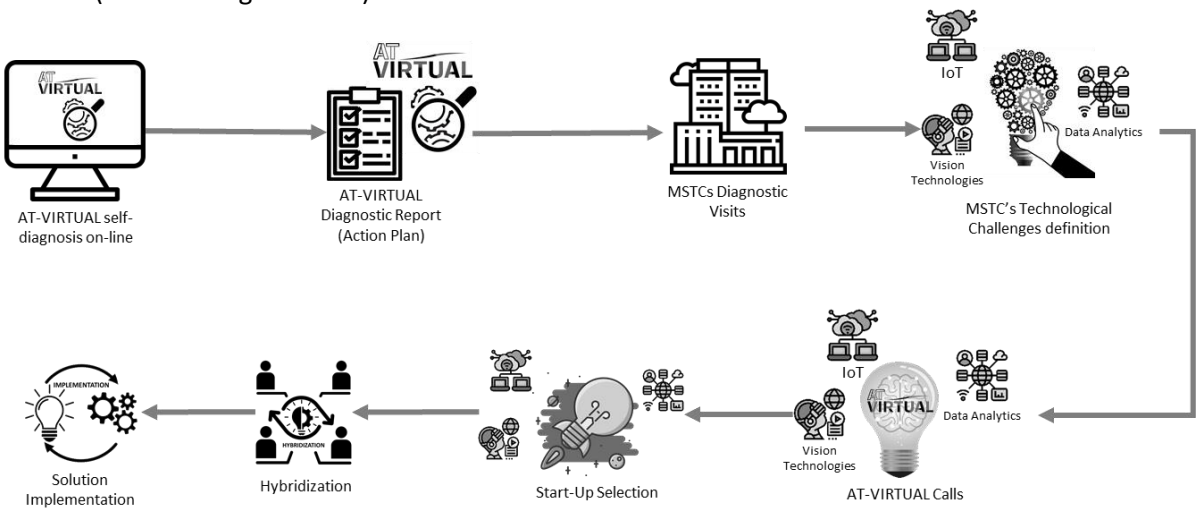


Figure 2: AT-VIRTUAL Action Plan on the Digitalization in MSTCs of the AA

1. **The 1st step** has been to accurately determine the digitization start position and needs of MTSCs in the field of simulation-based training systems. To this end, Tecnalia **developed a digital online self-diagnosis tool** for the different Maritime Safety Training Centers of the project. This tool is accessible from the project platform and is designed to self-assess the level of digital maturity and as a support to determine the needs in the MTSC in the AA.
2. After completing the self-diagnoses tool, **the 2nd step,** to highlight is **the approach and diagnosis visits** that Tecnalia made to the MSTCs. Here the technological reality of the MTSCs, their activity and the scope of the project as a whole and in greater detail were visualized and verbalized.
3. Once the diagnostic visit was completed, the next step, the **3rd step**, was the **definition of the technological challenges of the MSTCs**. To this end, 9 challenges (3 per MSTC) related to IoT, Big Data/Data Analytics and Vision Technologies were identified. For this definition, multiple virtual meetings were held with the centers in order to specify and define the challenges. All the challenges defined have a common framework.
4. Once the challenges have been identified, **4th step**, the **calls were launched** to receive offers with the solutions to the challenges posed by the start-ups.
5. Once the calls have been closed, the next step opens, **5th Step**, which **is the selection of solutions/start-ups to the challenges posed** through an evaluation process considering the requirements of each challenge and the established evaluation criteria.
6. **Hybridization Process**, **6th step**, a hybridization methodology has been developed inside of the project to accelerate the process of design and implementation of the selected solutions, based on agile techniques and rapid prototyping.
7. **Solution Implementation**, **7th Step**, implementation of the solutions developed within the project in the MSTCs

Below we highlight the most relevant conclusions to date related to the status of adoption of digital technologies in the AA MSTCs, the main needs and potentials in relation to I4.0 (Report and action plan on the digitization of MSTCs in the AA) and the way to approach this project. The identified needs have formed the basis for defining the Technological Challenges of the MSTC, for which startups in the AA must propose technological solutions.

The self-diagnosis has been completed by four MSTCs, three of them were originally part of the project (Jovellanos Maritime Safety Center in Spain, the National Maritime College of Ireland and AEMAR in Portugal) and the other MSTC - Escola Superior Nautica Infante D. Henrique (ENIDH) is the new partner of the project instead of the other MSTC Portuguese partner that give up the project. The results are in the annexes section. The visits made correspond to the first two centers, it was impossible to make an appointment with the Portugal center due to problems unrelated to Tecnalia´s agenda.

MAIN CONCLUSIONS

The main conclusions identified during this process (self-diagnosis, field visit report, definition of needs and challenges, hybridization process and solution implementation) are the following:

1. **ABOUT THE SELF DIAGNOSIS TOOL:**
    - **The self-diagnosis tool is an opportunity of evaluating themselves**. It is a still picture of their organisation. It is recommended to answer honestly to the questions so that the improvement path is appropriate to the needs of the organization. Generally, when organizations complete self-diagnoses online about their organizations there is a tendency to value themselves better than they really are, nobody likes to go wrong in the picture.
    - **Self-diagnosis tool describes the Technological Situation of the Training Center**, in all its extension and its most common processes. This tool does not provide guidelines for the centers to make improvements in the management of their business, nor in how they should organize themselves internally to improve their processes, nor what are the necessary training courses to be more competitive, etc.
    - **The results of the survey depend on the role that the MSTC adopts when filling the survey**. After visiting each center, we realized that the results from the survey (sometimes) didn't reflect the actual reality of the center in the training area. It has been found that depending on the person and their role in the center, the answers to the same questions are different, therefore, it is important that the questionnaire be completed by those who have knowledge of the subject area of the questions. in order to avoid distorted pictures that are not a reflection of reality.
    - At some point in the questionnaire there may have been some problem with the interpretation of the information (in the question or in the answer)
2. **ABOUT THE DIAGNOSTIC VISITS:**
    - The MSTCs have enough technological infrastructure and the digital skills to be able to develop the challenges in I4.0
    - During the diagnostic visits, it has been shown that MSTCs collect data automatically, but its exploitation is limited and the integration between systems and the information exchange are limited.
    - In the case of the Cork MSTC, it has been seen that in its environment there is an ecosystem of technological start-ups to provide them with solutions regarding the project technologies
    - The MSTCs are oriented to the customization of their training activities and they are very oriented to innovation.
    - During visits and afterwards we have checked the different speeds with which the MSTCs work. For a better use it is necessary that all the necessary personnel are involved from the beginning. The interlocutors and team changes mean that achieving the intended results is not delayed.
3. **ABOUT THE TECHNOLOGICAL CHALLENGES:**
    - It is necessary to reinforce concepts, objectives of the challenges, interpretation of needs, etc. A self-questionnaire and a visit are not enough. In fact, several virtual meetings, emails and phone calls have been required to achieve an optimal result. Certain deficiencies in technological competences, as well as of the sector, means that a greater effort is needed.

- The big data challenge has been difficult to adjust to the real needs of the MSTCs. In some situations, because not having historical data to analyse or not having different data sources and in others, because they do not see the application of big data analysis in teaching.
- Virtual reality and immersive reality in the education sector is very easy to apply, especially for training related to dangerous environments. However, many of these applications that have a very good visual finish are very expensive.
- Difficult to limit the economic scope of the challenge. The interpretation that has been given in the case of necessary hardware for the challenges, the MSTCs will have an extra budget outside the calls.
- The legal form of the MSTCs must be taken into account for calls. A public center (Jovellanos) does not work the same way as a private one (Ireland) to make a tender.

4. ABOUT THE PROTOTYPING PROCESS:

- The possibility of developing or refining an idea with the direct support of technology experts, adapting the possibilities to the specific need of the user, in this case the MSTC, and even modifying the original idea with input from the start-up.
- By tabling discussion of project management practices and tools as a mandatory preliminary implementation step and providing identifiable topics with clear application of guidelines, collaborative working environments suiting both MSTCs and startups can be agreed upon rapidly.
- At any time during the implementation phase, when relatively short but intense bursts of agile communications become essential (e.g., during design revisions), communications tools and management practices are already in place to smooth transitions
- If the parent idea is not sufficiently clear, the hybridization process can be extended over time and successive inputs and modifications can move the final result away from the original idea.
- The methodology presented (https://www.at-virtual.eu/implementation download) is commendably thorough and deals comprehensively with project management communications theory, but we found the suggested schedule of weekly updates and recommendation for constant communication flow to be too intense, intrusive, and time-consuming for our short-term consultancy projects.

5. IMPLEMENTATION PROCESS:

- The main constriction for the development of the solutions was the limitation in budget imposed by the contractual national laws for the Spanish administration. This kind of rules, complicate the possibilities for open calls or this kind of formulas when there are no commercial products to cover and specific need.
- Call documents and, to a certain extent, startup proposal documents, proved ambiguous and open to interpretation posing a threat to smooth implementation. In our BD/DA project, misconceptions over requirements not picked up during early implementation meetings caused us to encounter unexpected volumes of work later in in the project when it became necessary to re visit domain analysis and requirements refinement

- Although not a barrier in day-to-day dealings with startups, language differences contributed to extended kick off periods for both projects contracted to non-Irish startups due to drawn out rounds of tax and financial arrangement correspondence.
- Technology and hardware issues did not pose barriers to any NMCI/MTU projects, however procurement necessary to undertake testing and verification became mired in bureaucracy that prevented projects from adhering to planned timelines.
- NMCI/MTU faced peculiar barriers to smooth execution of startup projects. Personnel responsible for evolving project calls identifying MSTC needs, authoring call documents and managing implementation do not deliver training and lie at the far end of complex bureaucratic chain. Timely access to instructors, training managers, and staff essential for supporting AT VIRTUAL projects proved unattainable forcing startups to wait for instructions for lengthy periods and prevented original timelines from being adhered to
- All projects:
    - Slow payments (at least two weeks and up to a month between submitting invoices and getting them processed) posed financial barriers to all startups. Payment schedules were interrupted, and delays exacerbated by the Christmas holiday season.
    - Lengthy and complex preparation phases (registering with the Irish tax authority, registering with MTU finance department, and negotiating contract terms with NMCI particularly in relation to IP).
    - Budget limitation, Understanding of the concept and Lack of knowledge of the maritime domain

2 Development of AT-VIRTUAL self-diagnosis tool

The main objective of this action is the elaboration and implementation of a digital self-diagnosis online tool for the evaluation of the maturity level of digitalization of MSTCs.

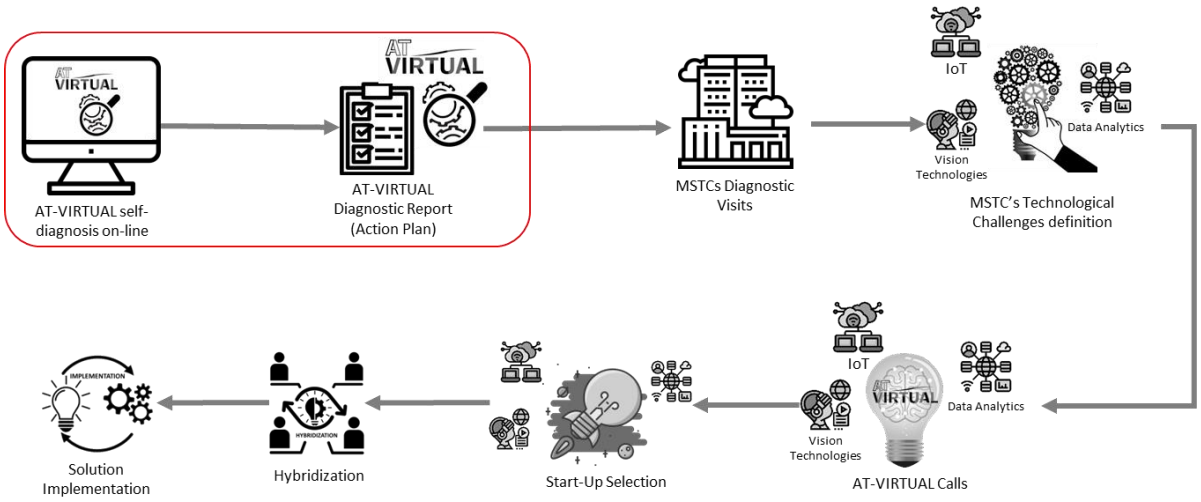


Figure 3: Action Plan 1st and 2nd Steps: Development of AT-VIRTUAL self-diagnosis tool

2.1 Background tools

To develop the AT-VIRTUAL self-diagnosis tool, different tools based on Industry 4.0 have been used, mainly with a tool and the methodology developed by Tecnalia for the diagnosis and impact on Industry 4.0 called [MDI 4.0], with other tools based on the transformation digital in educational systems, as well as with the UNE060 and UNE061 regulations. The sum of this knowledge applied to the project has resulted in the special AT-VIRTUAL self-diagnosis tool for Maritime Safety Training Centers that we will explain later.

2.1.1 Diagnosis and Impact Model in Industry 4.0 [MDI 4.0]

It is a digital maturity model in Industry 4.0 developed by Tecnalia that approaches the company through the analysis of the eight dimensions or spaces that describe how a company is defined as 4.0.

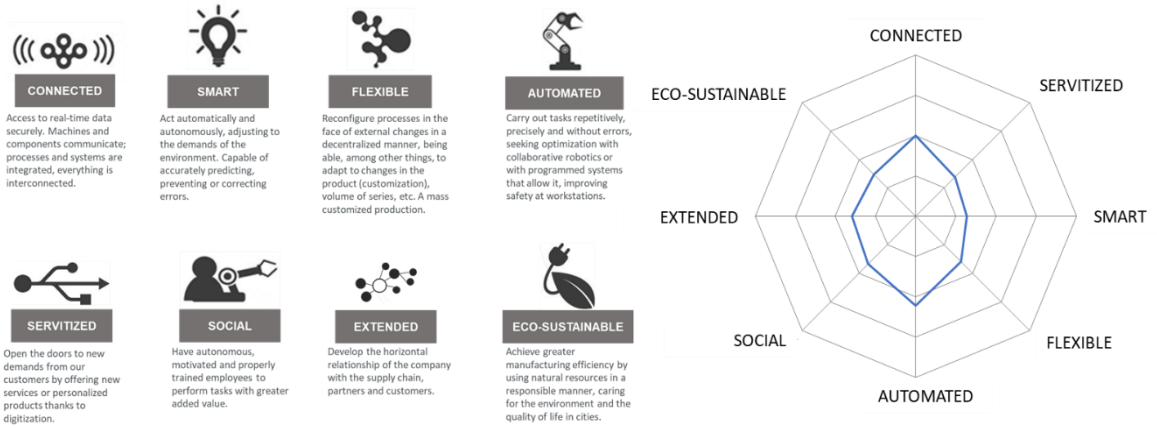


Figure 4: digital maturity model in Industry 4.0 developed by Tecnalia

These eight dimensions are:

1. CONNECTED
2. SERVITIZED
3. SMART
4. FLEXIBLE
5. SOCIAL
6. EXTENDED
7. AUTOMATED
8. ECO-SUSTAINABLE

In this, in this process, the consultor does not analyse the capacity or methods of their activity, but the link they have in each area with technologies.

2.1.2 Diagnosis Model Digital transformation

It is a digital maturity model in Industry 4.0 developed by EOI, and that Tecnalia has used with several manufactured companies. It approaches the company through the analysis of the five key dimensions in the company's strategy and operations:

1. **Strategy and business model:** evaluating the organization's adaptability to the environment and the market.
2. **Processes**: Analyzing the digital capabilities of the operating model.
3. **Organisation and people**: Identifying the organization's capabilities and its relationship model with other agents/stakeholders.
4. **Infraestructures**: Identifying the transformation capacity that its cyber-physical infrastructures allow.
5. **Products and services**: Assessing the level of incorporation of technology into existing products and services, as well as their potential for digitization.

At the same time, for each dimension, those drivers are identified that allow the digital transformation of companies to mature in Industry 4.0. These 16 drivers are the work areas that will be used as a guide to identify the main areas of development of the company to reach to digital maturity.

Strategy and business model:

- Strategy and market
- Investments
- Innovation
- Sustainability.

Processes:

- Digitalisation
- Integration
- Automation.

Organisation and people:

- Organization and collaboration model
- Skills and competences
- Digital competences.

Infrastructures:

- Digital Infraestructures
- Business and control solutions
- Collaborative Platforms.

Products and services:

- Components and digital functionalities
- Interconnected products and services
- Collection, analysis and use of data.

2.1.3 Technological Maturity Model of the Educational Center

Tecnalia developed a maturity model and an associated evaluation method to establish and improve the level of digitization of the Educational Centers in Basque Country. The model is intended as a practical guide to the successful digitization of Educational Centers.

The Technological Maturity Model the Educational Center as reference framework:

- **Comprehensive**: establishes a common and shared objective regarding the pedagogical use of ICT, valid for all types of Centers.
- **Flexible**: adaptable to the different types of centers (stages, sizes, location, specific characteristics ...), so that each center will have its own digital maturity plan adapted to its needs and real commitment.

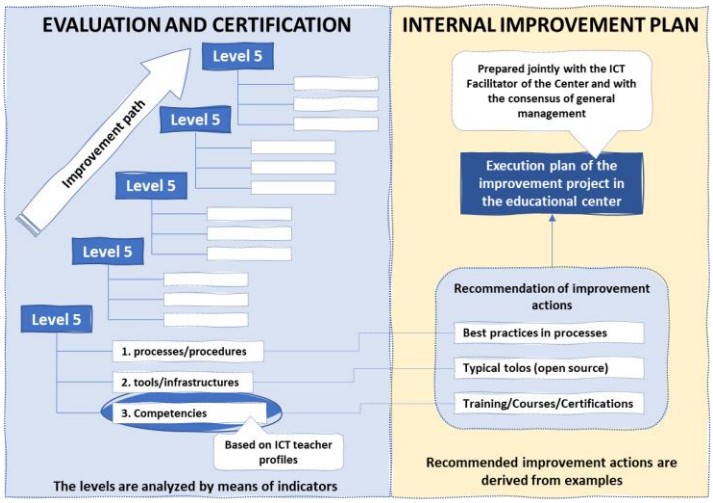


Figure 5: Technological Maturity Model of the Educational Center

- **Measurable**: based on objective criteria that allow establishing a general ranking of centers.
- **Gradual**: based on levels, it will allow evaluating the continuous improvement in the use of ICT by the Centers, as well as serving as a guide for achieving it.
- **Based on process improvement management models**
- **Strong**: supported by the best practices of pedagogical use of ICT at the international level.
- **Public**: the parameters, evaluation criteria and objectives that make up the model are public and known by the educational community in general.

This model allows obtaining in practice:

- an **exact picture** of the **technological situation** of a center,
- the **improvement path to follow** to reach the agreed level.

For the definition of the Model are identified:

- The key areas or areas of interest in which the center must work and improve to achieve the digitization of its processes effectively and efficiently. The areas of interest are groups of processes around a common distinctive feature. The first division of process blocks are: "Training Processes" (inside and outside the classroom) and "Administrative or Management Processes of the Center".
- Maturity levels are well-defined sequential states that describe the characteristics that the center must have to increase its maturity.

2.2 AT-VIRTUAL Diagnosis Tool and maturity level of digitalization of MSTC

This tool will analyse the current and potential degree of digitalization of the set of processes in different areas of MSTCs. It will permit to have a picture of the comparative situation among organizations with different levels of maturity, resources and activities.

The self-diagnosis survey consists of 47 questions and each question has 4 possible answers. Each answer has a score (Answer 1 → 1 point; Answer 2 → 2 points; Answer 3 → 4 points and Answe 4 → 8 points) and analyzes four dimensions in the operation of a MSTC, each containing questions on a different set of issues:

1. **Processes**: to analyze how operations are carried out in the center.
2. **Service Capability**: to know the level of incorporation of technology to existing services.
3. **Infrastructure**: to evaluate the digital capabilities of the center.
4. **Clients and external agents**: identify the adaptation of the organization to the environment and the market.

In the methodology used in the self-diagnosis Tecnalia has identified the **different characteristics** so that an MSTC is an MSTC 4.0. Each of the questions of the self-diagnosis survey has a specific weight (weighting) for each of these characteristics

CONNECTED
A center that can collect, store and access data in real time of all its elements (machines, processes, people, ...) in a safe, traceable and ubiquitous way. Everything is interconnected and integrated, allowing data to be stored automatically. Hyperconnectivity.

SMART
A center capable of working automatically and autonomously, adjusting to the demands of its environment. Able to predict, prevent or correct accurately reducing errors.

FLEXIBLE
A center that reconfigures the processes before changes of the outside in a decentralized way. It can adapt to changes in its service, depending on the needs or demands of clients/customers, etc. thanks to digitalization. Massive personalization.

SOCIAL
A center that has self-employed employees, with the capacity to make decisions, motivated and adequately trained to use new technologies and perform tasks of greater added value.

EXTENDED
A center that develops the relationship with the supply chain, partners and customers, working with them in a collaborative manner to improve products, services and processes.

Enabling technologies: IoT, Cybersecurity, Cloud Computing, Artificial Vision, Big Data, Data analytics, Simulations, digital twin, Virtual Reality, Augmented Reality, Wearables, System integration, collaborative robotics, etc. and Tecnalia has also identified 4 progressive levels for each of the characteristics:

LEVELS	SCORE
BASIC	from ≥ 1 to ≤ 2
AWARE	from >2 to ≤ 3,5
COMPETENT	from >3,5 to ≤ 5,5
ADVANCED	>5,5

that allows a unified diagnosis.

For each of these levels a description is made based on the values obtained during the diagnosis.

In order to evaluate the characteristics defined above, only the responses of the online self-check were considered.

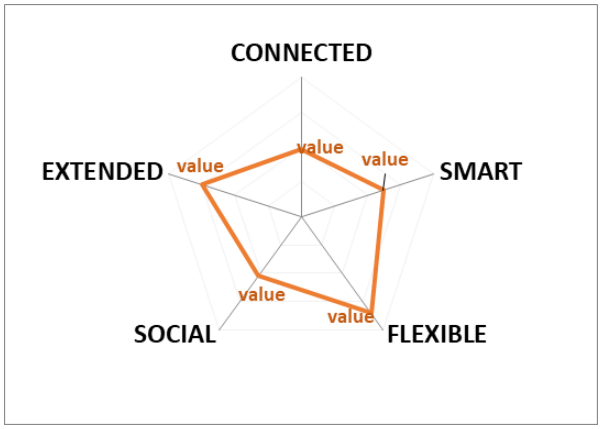
The tool gives the information in the following way:

Digital Characterization of MSTC name					
Attribute	**CONNECTED**	**SMART**	**FLEXIBLE**	**SOCIAL**	**EXTENDED**
Value	**“value”**	**“value”**	**“value”**	**“value”**	**“value”**

Figure 6: Digital Characterization of MSTC name

As the position moves away from the center it is because there is greater use of technologies for that attribute and therefore, higher level of MSTC 4.0. to achieve a better positioning, it is possible to implement impact measures.

Next, according to the values obtained in its diagnosis, the self-diagnosis tool explain the situation of your organization for each of the characteristics of the model according to the score obtained for each characteristic:



CHARACTERISTIC	ACHIEVED LEVEL			
CONNECTED	BASIC LEVEL	AWARE LEVEL	COMPETENT LEVEL	ADVANCED LEVEL
	A center whose processes are manually intensive. It uses simple computer systems and it is beginning with the digitalization of teaching and administrative material. The integration between systems and the information exchange are limited. Its security level for the systems is very low. The center uses few ICTs in the classrooms.	The center has basic telematic tools and infrastructure for optimization of digitalization and its services. There is information exchange within the center. The security policy of its assets and infrastructure is not fully developed and implemented. They use ICTs regularly in the pedagogical process and in the administrative process.	The center's systems are fully integrated with the management systems, collecting information automatically in real time. The center uses sensors with technological functionalities that allow the collection and analysis of data during use. There is cybersecurity solutions. The center works with telematic tools and online accessing information at any time and for any process.	There is an infrastructure that facilitates the exchange of information internally and externally. Cybersecurity solutions and cloud solutions that offer a flexible technological architecture have been applied. There are always permanently accessible educational platforms and from anywhere.
SMART	The data of its administrative processes, planning, organization, control and training are informative, with a low level of exploitation.	The center has implemented tools and software to address processes in an integral way. The center collects data automatically, but its exploitation is limited.	The center uses tools such as Business Intelligence Applications, simulation tools, etc. for the improvement of its services and to help to the decision making. The center is starting to work on the prediction for the maintenance of their infrastructures.	The systems collect large amounts of data that the center uses for continuous improvement. The center uses technologies such as big data to analyze their services and tasks and work with intelligent virtual environments.

CHARACTERISTIC	ACHIEVED LEVEL			
FLEXIBLE	**BASIC LEVEL**	**AWARE LEVEL**	**COMPETENT LEVEL**	**ADVANCED LEVEL**
	Its ability to offer training is limited. The contents and the way of teaching are similar for everyone. The Center uses basic resources, without technological support.	The center adapts the contents and repositories according to the students/clients. The center has incorporated technological and multimedia support and it has developed activities in a web environment for greater accessibility and improved results.	There is a combination of pedagogical tools depending on the needs of each user, in which they have introduced virtual environments and human-machine interaction. The center is beginning to explore autonomous and self-correcting processes.	The center uses virtual, interactive and adaptive environments. It is oriented to the customization of its training actions. The data collected in the different processes (training and administrative) are used for the development of new products and services. Its processes react autonomously.
SOCIAL 	The center lack of digital strategy and transformation based on the use of technologies and innovation. The traditional solutions coexist with telematic tools for internal communication.	The center has a digital transformation strategy and makes investments and advanced technological initiatives. Internal communication is unidirectional, although the Center uses online channels.	All departments promote the introduction of new technological solutions through innovation management. The exchange of information within the center is based on the use of online and bidirectional devices, to have information in real time.	The center has launched a transformation strategy that involves all its processes and periodically monitors its investments. Collaborative innovation management is carried out at the level of all staff and areas.
SOCIAL 	The external communication combines the traditional tools with some related to the website.	Marketing 2.0 actions are carried out and different bidirectional channels are considered to interact with the outside world.	There is information exchange with external agents. The center is beginning to integrate information with suppliers, customers and students. The center develops additional services based on the data collection from the training process.	The center works omnichannel for its relationship with the outside. The center has educational platforms accessible through the Internet, which allows permanent and bidirectional communication with the rest of the agents. The collaborative innovation management is supported by external agents.

Figure 7: AT-VIRTUAL Self-diagnosis tool

2.2.1 AT-VIRTUAL SURVEY

AT VIRTUAL DIAGNOSIS TOOL

This diagnosis on the technology used in your Center, has been made exclusively for informative purposes for its assessment and does not contain recommendations or explicit advice.

Please keep in mind that you can only choose one answer, please choose the answer that is closest to how things are done in your organization

COMPANY DATA

Name of the MSTC

_____

Contact Person

_____

Contact Person email

_____

City

_____

Country

_____

Number of employees

_____

PROCESSES: STRATEGIC

The purpose of this section is analyze how operations are carried out in the Center.

What extent is your organization's strategy aligned to digital transformation?

- ☐ Our Organization doesn't have a definite strategy
- ☐ A digital transformation plan is being developed with the participation of all the staff of the Training Center
- ☐ There is a Strategic Plan together with an ICT Project of the center (infrastructure and equipment, services and resources software, Training, Human Resources, Digital Content, Communication and Management Processes, Teaching Processes, etc.)
- ☐ Annual plan articulated around the center's ICT Project, with defined indicators and annual objectives

What is the level of implementation of the principles of Digital Transformation in your organization?

- ☐ These principles work at the Computer Systems Department level
- ☐ These principles work at the training level of Management and Computer Systems
- ☐ These principles work at the training level of all relevant positions in the organization
- ☐ The entire staff has internalized the principles of Digital Transformation through training actions and projects development

What has been your organization's level of investment in technological solutions over the last few years?

- ☐ At the administrative level (Office tools, Management Applications, Renewals...)
- ☐ Implementation of integral management solutions type CRM, ERP...
- ☐ Investments in Software/hardware of Simulations and Simulators...
- ☐ Development of projects based on IOT, Big Data, Artificial Intelligence, Augmented Reality...

How is the Innovation Management and Knowledge Managament carried out? *

- ☐ Through the Department or area meetings, our organization lacks the digital system set
- ☐ The creation of ideas and suggestions are recorded digitally and there is manual follow-up by the responsible staff.
- ☐ Through a Management System shared with employees, Technological Surveillance Systems...

- ☐ Through sharing Knowledge Management system with workers, customers and suppliers, that's to say Collaborative platforms

What actions do you take aimed at early detection of market trends or new business opportunities? Do you perform market analysis?

- ☐ We do some one-time analysis
- ☐ We carry out continuous and procedural analyses (Technological Surveillance)
- ☐ By means of Business Intelligence Applications, data mining automated and continuous
- ☐ We use Big data analytic technology, predictive analytics, ...

PROCESESS: MANAGEMENT

The purpose of this section is analyze how operations are carried out in the Center.

How is the Management and Economic Planning of the Center carried out?

- ☐ Through a computer application.
- ☐ By means of a software tool specialized in management
- ☐ Via multi-process interconnected systems
- ☐ Through contrasts and analysis of deviations with simulation, planning and indicators in real time

How is the teaching schedule in training managed in your organisation?

- ☐ The Schedule management is planned and checked manually by a manager or person in charge
- ☐ By means of a shared and semi-automatic platform for planning schedules, with a supervisor
- ☐ Through planning and resources parallel systems and non-interconnected
- ☐ Through an intelligent schedule management system that reflects staff's availability and infrastructural needs in real-time

How is the staff/employee's information managed in your organisations?

- ☐ Through separate systems with manual entry of data
- ☐ Payroll send via email, person in charge introduces or validates the information before sending
- ☐ By means of Production System and Human Resources System that they are not connected. Employee portal used to view payroll, make time parts, or record absences.
- ☐ Through Employee portal with self-service and connected with production data. Single or interconnected system.

How is the facility space and resources management carried out?

- ☐ The management of the reservation of physical spaces and resources is done by filling in a template document that is available in digital format
- ☐ The management of the reserve of physical spaces and resources is done through a computer application with manual monitoring
- ☐ The management of the reservation of physical spaces and resources is done through a remote and real-time computer application
- ☐ Through an intelligent schedule management system with people's availability and real-time facilities needs

How is the work control of the maintenance actions carried out and its analysis?

- ☐ There is no record of the operations and tasks performed
- ☐ By means of a manual record of specific variables (non-centralized) in the system (in an excel or similar application) for corrective maintenance checks
- ☐ Through automated registration in a centralized management program for historic data and contributes to predictive maintenance
- ☐ Through automatic registration in the system at the task level (traceability) with intelligent analysis of the operation looking for patterns for predictive analysis. Predictive maintenance in real time. (prognosis)

What use is given to the information of the data collected in the different sensors / devices that people carry in the provision of services?

- ☐ The data collected are used only on an informational level
- ☐ The data collected are used manually to make a choice about the provision of the service

- ☐ The data collected are worked automatically to make a choice about the provision of the service
- ☐ The data collected are worked automatically to make a choice about the provision of the service including Big Data for the improvement of the process

How are Academic Performance Records (Academic Transcript) generated?

- ☐ The Academic Performance Records are not generated
- ☐ There is a computer application or database from which the student's academic records are generated.
- ☐ Teachers carry out the administrative and academic management of the training center (enrolment, student cards and absences, and students reports) through a Web application
- ☐ The training center's administrative and academic management computer application (enrolment, notes and absences, and records) allows students access online to academic data

How is the order application that you use with your providers? How do you manage your supplier information?

- ☐ Through office tools (phone, mail....) from the purchasing department
- ☐ Through an ERP software
- ☐ Through a provider-connected systems (intranet)
- ☐ Through interconnected systems, automatically when detecting a need for raw material or a spare part

How do you manage your customer information and opportunities?

- ☐ Through Office tools: Excel sheets, access...
- ☐ Through an ERP, a CRM
- ☐ Through a system which is integrating customer data with partners
- ☐ Through a constant access to information about your customers on the web and other sources

How are enabling technologies taken into account in the training of trainers? Is there a Training Plan for The Digital Competences of Teachers?

- ☐ The enabling technologies are not taken into account.
- ☐ Through a training plan with refresher courses requested by staff
- ☐ Through a Versatility matrix involving the entire staff in the training process. There is a document establishing the competences of teaching staff, and which provides guidance for the development of the annual training plan.
- ☐ Through the actions raised in the previous answer and also working with the training centers and companies in the design of the curriculum training

What level of integration of the tools and systems of administration and management does your training center have?

- ☐ The different tools and systems used are independent. Scanned documents in folders
- ☐ An ERP system with manual, visual review is available, ...
- ☐ Full integration of ERP and human resources, materials, financial and communication economic management. Local and remote access
- ☐ Total integration in an automated and intelligent way (gives notices, business intelligence....)

Service Capability

The target of this section is to know the level of incorporation of technology to existing services

What type of training does the Center offer?

- ☐ A training Face-to-face /online (same for a group of people performing the same tasks)
- ☐ Theoretical with support of multimedia material (videos, photos), with access to a repository with learning pills, mobile training, Self-service according to level.
- ☐ Theoretical-practical courses in real environments and with the support of visualization systems
- ☐ Theoretical-practical learning supported by total immersion simulators. (Immersive reality), m-learning platform, providing more information and learning about errors or situations of danger. With gamification tools.

Are Virtual Learning Environments (multimedia resources, Web environments ...) used in the training processes?

- ☐ There are no virtual learning environments
- ☐ Some training actions have developed some didactic unit with activities within the virtual learning environment. (Blogs, Wikis, WebQuest. Webinars...)
- ☐ Most training services have developed some didactic units with activities within the virtual learning environment. (Blogs, Wikis, WebQuest. Webinars...)
- ☐ There is a virtual interactive community and co-creation of teaching materials among advocates, students and start-ups

How do the students receive support during their training process to do exercises or assimilate concepts?

- ☐ By means of theoretical training and static documentation only. Task description in navigable digital documents based on a query system
- ☐ Through a task description in dynamic documents with contextual presentation based on student profile/levels
- ☐ By means of contextual data based on connected sensors and student profile
- ☐ Through a presentation of key data of the task graphically in augmented reality

How is the programming of the different courses developed? Which are the tools used?

- ☐ Through analogical documents and traditional classrooms
- ☐ By means of a digital format held in a repository.
- ☐ Through documents accessible from an open and interactive platform, student chats, visual supports...
- ☐ Through the tools raised the above answer plus individual learning simulators....

How are resources /educational material digitized and identified?

- ☐ Through a Folder Infrastructure for digital resources categorized by educational levels for teachers and students
- ☐ Giving access to educational digital resources from all spaces dedicated to teaching
- ☐ By means of a virtual environment of collaborative work of teachers of digital educational content for teachers
- ☐ Through the use of content repository to host educational digital resources for teachers and students. There is a virtual community with digital documentation sharing

Do you have any sensors to know the reactions of students in performing an exercise? Ex: wearables in people, temperature sensors....

- ☐ We do not use sensors
- ☐ We only use environment sensors only with standard reaction alarms
- ☐ We use environment off-line sensors plus wearables in people with custom alarms
- ☐ We carry out analysis with remote and online controlled wearables; biometric sensors with variable settings. Human Factor. Sensors in clothing...

In the case of using sensors, do you collect, store and analyze student data in your practices?

- ☐ It is not managed
- ☐ The student data are collected and saved but not analyzed
- ☐ Biometric monitoring is available and is analyzed manually
- ☐ All the student data are analyzed automatically looking for patterns of behaviour

How does each teacher prepare the Teaching Memory of the course?

- ☐ Less than 50% of teachers prepare the memory of their course and/or area in digital format
- ☐ At least 50% of teachers prepare the memory of their course and/or area in digital format
- ☐ At least 75% of teachers prepare memory in a standardized and accessible format
- ☐ All teachers elaborate the memory in a standardized and accessible and collaborative format for the whole center

How are the reports and report cards of each student produced?

- ☐ Only in digital format and with a manual send from the center (mail or paper)
- ☐ The reports are manually introduced to a platform that the student accesses on time
- ☐ They are manually introduced to a web application accessible to the user from any computer at any time where it finds more information and can interact

- ☐ Different continuous evaluation variables are automatically collected. You can access a web application or app where you can find more information and interact

DIGITAL INFRAESTUCTURE

The purpose of this section is to evaluate the digital capabilities of the Center

Is ICT Infrastructure Inventoried? Ex: Computers, mobile devices, simulators, servers..

- ☐ There is no full digital inventory
- ☐ The center collects in digital format only critical resources (barcode, RFID cards...)
- ☐ The center has digitally identified all resources
- ☐ The center has digitally identified all resources, sensorized and connected to know its location or status

How does your organisation update and maintain ICT systems?

- ☐ Through solving problems face-to-face and in a corrective way
- ☐ By means of a preventive procedure for updating and maintaining the Systems apart from the corrective way
- ☐ Through a maintenance corrective, preventive and data collection to work on a predictive future
- ☐ There is predictive and individualized maintenance of each ICT system (software and hardware) With intelligent BIG DATA-TIME REAL analysis tools, based on external data. Generation of proactive maintenance plans

What type of support do the maintenance operator have in the execution or supervision of her/his task?

- ☐ The support is coming from a task description in navigable static documents based on a consultation system
- ☐ Help is based in a task description in dynamic documents with contextual presentation according to the operator's profile
- ☐ The support is based in the presentation of contextual data based on connected sensors and user profile
- ☐ The technical support is through a graphical presentation of key data in augmented reality, or expert support with on-line teleassistance with traceability.

What type of devices do teachers use in training?

- ☐ Teachers use analogical devices, provided with specific spaces to teaching (computer or mobile device, projector, screen, printer).
- ☐ Each teacher is provided with mobile devices with cloud access to the information
- ☐ Training center is provided with ICT classroom, VR simulators, friendly and multimodal interfaces (Glasses, voice, haptics, touchscreens, gestures, RA...)
- ☐ The center counts with personalized sensor technology, custom human factor aspects

How do the internal communication systems for the employees of the center work?

- ☐ By means of office tools (phone, mail…)
- ☐ Through a one-way communication system: newsletters, Web...
- ☐ By means of a two-way communication systems: Platform, user communities, social networks ..., but is manually done.
- ☐ Through a collaborative platform across the entire workforce including knowledge management system

Does the training center have tools to facilitate remote work? Is cloud software used?

- ☐ This choice it is not feasible in the training center
- ☐ Only in administrative positions are provided with cloud email
- ☐ In the administrative and management departments they have ERP or CRM in the cloud or through VPN
- ☐ In all the administrative processes and for the teaching staff are used the cloud systems

Do you collect data from the systems used by the students on the devices in real time? How does your organisation manage computer information? Is it stored in any system?

- ☐ Those data are not collected and not managed
- ☐ The data collection is done manually via tags, QR codes
- ☐ Machines (computers, devices...) are connected but not all data collected are saved
- ☐ There are connected machines and their data are stored in real time

INFRAESTRUCTURE: SECURITY

Is your organisation labelled with or does it meet any safety standard? Ex: ISO 27001, ISO 27032, IEC 62443, ISO 22301

- ☐ Center does not have any certification
- ☐ There is no certification but assets, risks, security plan are documented through a person/company responsible for tracking systems.
- ☐ There is a certification and the center adheres to the recommendations.
- ☐ There is a certification and the Center is on alert and increasing with new cybersecurity measures

What type of Internet access is offered in the center? Is it possible to get access from any computer in the office?

- ☐ Unrestricted free access but is not possible to get access from any computer in the office just to avoid trouble
- ☐ Limited internet access to internal staff
- ☐ Controlled internet access to internal staff and students
- ☐ Internet access regulated, documented, and verified both internally and externally

Does your organization have separate networks for office, educational spaces and visitors? Do you have WIFI?

- ☐ Shared network in offices and classrooms and/or unique WIFI for all is provided
- ☐ Separate network and/or WIFI for internal use of the center (office), classrooms and visits. are provided
- ☐ Networks segmented by functions in office, in classrooms, for visits, are provided
- ☐ Networks separated with DMZ between them. Presence of firewalls, proxies and encryption of communication between segments are provided

What is the level of protection of your organisation's systems and jobs?

- ☐ Protection by role-playing access to systems and folders. Antivirus on computers. Open USB ports
- ☐ Individual accesses, folders and documents with passwords. Secure password policy. Secured CPD.
- ☐ Encrypted systems for key documentation for both save and send. USB ports locked or controlled
- ☐ Access through biometric systems. Registration of access to systems, directories and documents locally and by network.

What is the level of surveillance, monitoring, control of your organisation's information systems?

- ☐ Antivirus warnings
- ☐ Network traffic log. Manual software update to security patches.
- ☐ In real time monitored network. Automatic software update to security patches. Security audits
- ☐ Monitored network in pursuit of excessive and unusual traffic, control of repeated connection attempts. Ethical hacking.

What is the backup system like?

- ☐ There's none. Local Manual copies
- ☐ Automatic networked system copies.
- ☐ Only distributed copies. Redundant and automatic systems.
- ☐ Copies in the cloud. Regular verification of recovery procedures

What is the level of Physical Security implemented in the center for ICT Resources?

- ☐ Against power outages, there are uninterruptible power supply systems (UPS).
- ☐ We define our own safety requirements using external frameworks for guidance.
- ☐ Our safety requirements are bound by regulations.
- ☐ A Disaster ICT Resource Recovery Plan has been defined and documented, and the ICT resource plan has been updated on an annual basis.

How does your organisation control internal or outsourced staff's access on-site? Access control in warehouse, office

- ☐ By means of Identification cards
- ☐ Through identification cards with access permission chip, passwords on the computers...
- ☐ By means of physical recognition system (iris, fingerprint...)

- ☐ Through wearable devices (mobile, chip card, bracelet...)

CUSTOMERS AND EXTERNAL AGENTS

The objective is to identify the adaptation of the organization to the environment and the market.

How does the Training Center communicate with their clients and with the students before, during and after the training? What tools does the training center in its interaction/communication?

- ☐ Through standardized document models. By means of office tools (phone, mail, sms....), one-way web page
- ☐ By means of office tools plus web applications (whatsapp) and social networks. Two-way communication system.
- ☐ Through two-way communication system (the above answer) adding a customer portal or custom extranet of restricted access where the client has shared information (e.g. forums, chats, historic data...)
- ☐ By means of documents or reports customised to the customer's needs. Through interconnected systems (OMNICANAL) the customer automatically accesses or receives the info

What tools does your organisation use in its business relationship?

- ☐ We do not do marketing campaigns, only through our website.
- ☐ At the informational level: web page, mass mailing campaigns (one-way street), events.
- ☐ Campaigns targeted in user communities, social networks (Facebook, LinkedIn....) two-way street manually.
- ☐ Big data, artificial intelligence, with personalized communication (marketing campaigns, other needs...), chatboot

How are the actions of Marketing 2.0 carried out within your organization?

- ☐ At least one social network is actively used to promote the company and its image.
- ☐ Through Web positioning actions have been carried out in search engines (SEO) and/or Internet advertising campaigns (SEM). Continuous manual monitoring of the impact of the Website and the visits it receives (Google Analytics, Visitor Log, etc.).
- ☐ By means of social networks plan. The company's presence on the web and social networks has been planned and a plan has been defined with concrete actions to increase the company's impact on these channels.
- ☐ Through a Community Manager service or by means of using comprehensive Social Media management applications (Hootsuite, etc.)

How are new training activities designed in your organisation according to possible customer needs?

- ☐ It is very difficult to design new training actions because the training activities depends on certifications and approvals.
- ☐ Through a request from a customer and adjusted to the assets available at the center
- ☐ Through an open platform, custom projects (customization)
- ☐ By means of a platform, with recommendations based on variables (oriented customization), market studies and applying technology.

How do you associate to your partners, for example: commercial actions, purchase actions, process improvement actions?

- ☐ We do not proper actions with partners, sometimes We exchange information through office tools or face-to-face tools
- ☐ Sharing information through social networks, websites or workgroups
- ☐ Collaborating through the interconnection of systems
- ☐ By means of collaborative actions via orchestrating cloud services

How is collaboration established for innovation with external actors or stakeholders?

- ☐ There are no collaboration actions with external actors or stakeholders
- ☐ Through participation in projects under requirements or specific circumstances
- ☐ By means of participation with other organizations (other Training Centers, institutions or companies) in methodological innovation or innovation projects in teaching management.
- ☐ Through a collaborative platform intercenter, companies, Europe with artificial intelligence, big data to which we belong

How do you manage your competitors' information?

- ☐ It is done manually through Excel Sheets or Office tools
- ☐ By means of a specific software and technology surveillance
- ☐ It is done manually through Partners and Competitors Data Integration
- ☐ Through Big Data actions that suppose a constant access to information from different sources

3 MSTC's Technological Challenges

To identify the technological challenges of each MSTC, the following work procedure was established as follows:

1. Each MSTC complete the questionnaire in the AT-Virtual platform and get its "Diagnostic Report of Digital Maturity 4.0"
2. TECNALIA visit each MSTC to clarify your answers and to identify the challenges
3. TECNALIA identifies and proposes challenges based on technologies
4. TECNALIA and MSTC by means of virtual meetings and email refine the Technological Challenges to the final version

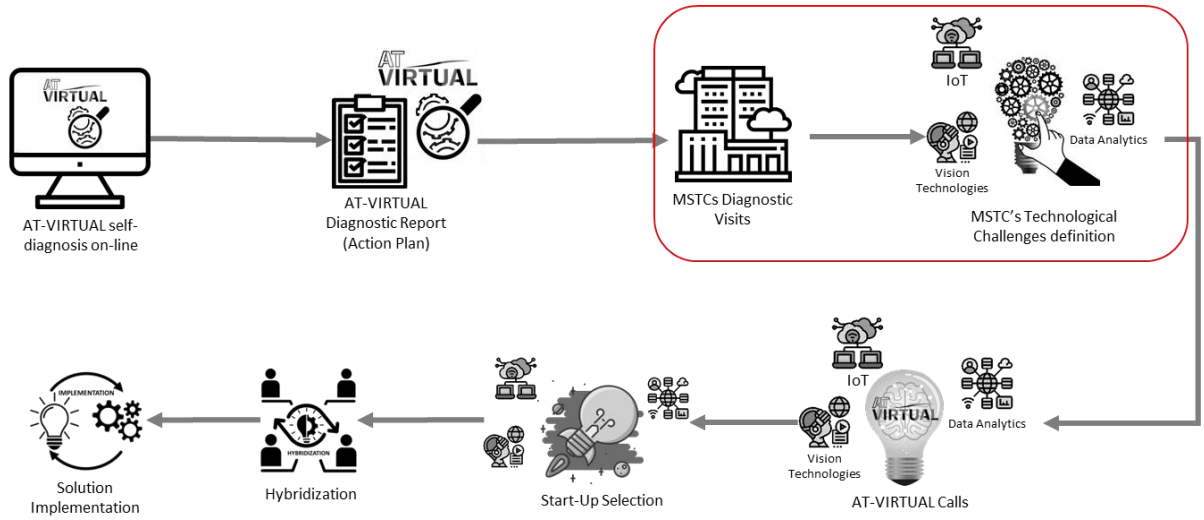


Figure 8: Action Plan 4th Step: MSTCs Technological Challenges Definition

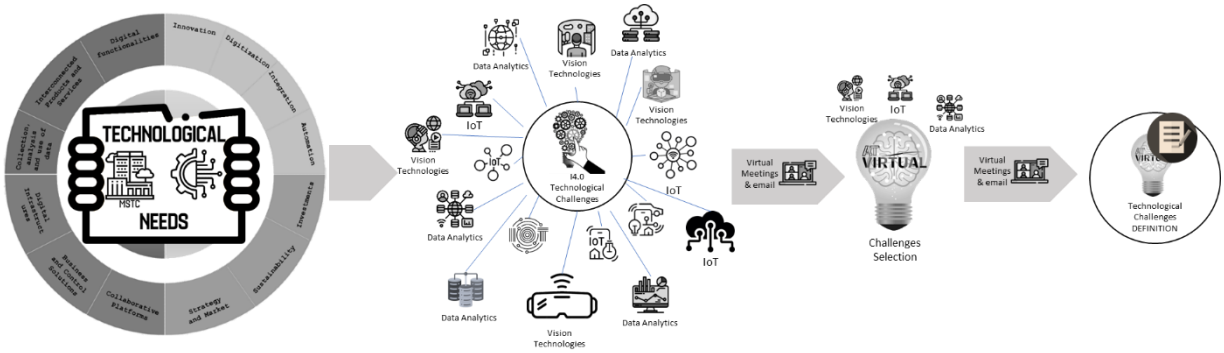


Figure 9: Process of identification and definition of the challenges

After this process were identified three technological challenges for each MSTC:

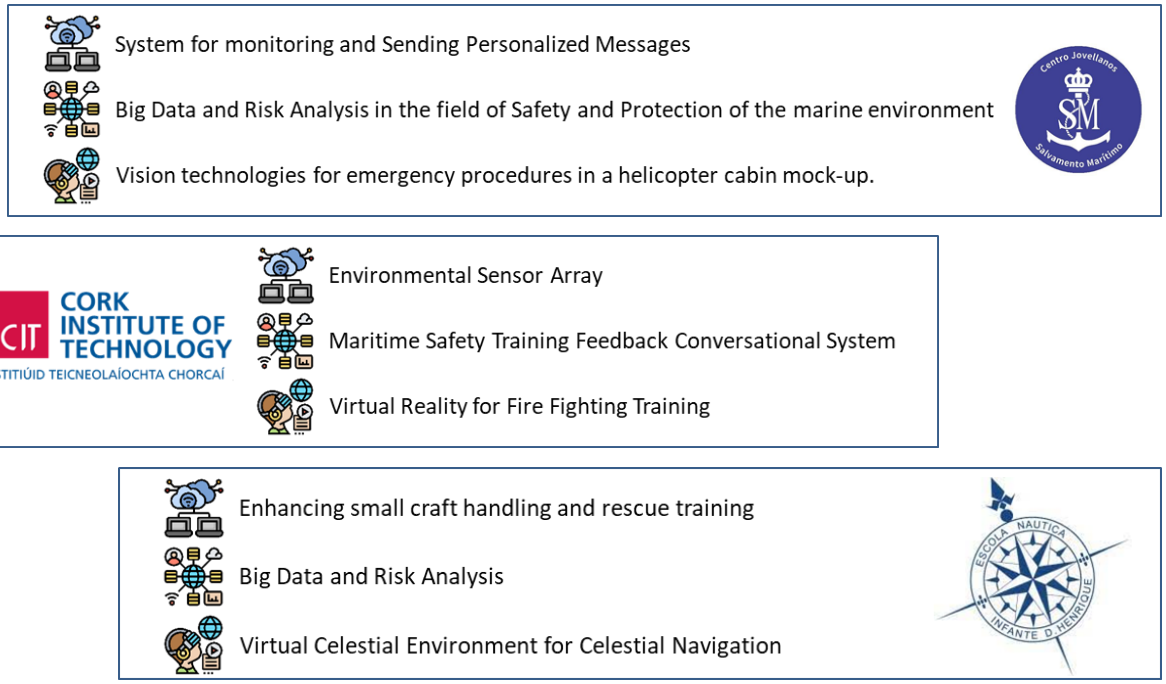


Figure 10: MSTCs Technological Challenges identified

Each Technological challenge follows the same structure in its description:

1. Context, definition of the problem
2. Challenge definition. Description of need
3. Requirements
4. Expected Outcomes
5. Budget

3.1 Centro Jovellanos Challenges

3.1.1 First Call Internet of Things (IoT) "*System for monitoring and Sending Personalized Messages*"

1. Context, definition of the problem

The mission of Centro Jovellanos is to implement, develop and design comprehensive rescue and maritime safety training systems that are high quality, highly specialised, certified, innovative, and sustainable to ensure the most remarkable levels of professional training.

During training sessions, communications among instructors and participants are essential to coordinate and give guidelines to ensure the proper development and safety of each training.

Training sessions at Centro Jovellanos have a wide range of profiles, conditions, and locations where participants are in the same session.

Nowadays communications during training sessions are solved through different procedures and protocols, most of them face to face. Depending on the type of practice, instructors should move from one location to another or try to catch the attention of participants in environments with difficulties

for the visibility and hearing or interrupt, in a certain way, the grade of immersion of the participant in the environment of the training session giving a message.

2. Challenge definition. Description of need

The objective of this challenge is focused on designing and implementing a system for monitoring and sending alarms and / or messages of support to mobile devices (smartphone and / or wearables) that students carry during their training practices.

These personalized messages / signals / instructions will be received on the device carried by the student depending on the locations of the devices, assigned roles or specific situations, specifically:

- When the teacher (administrator) considers appropriate to launch them manually during the training session. These messages may be in video, text, photo and or vibration format.
- When the identified device enters a specific area of the campus.
- When defining other types of triggers are defined.

The devices will be assigned to each student based on their role for the practice. The situations where the devices must be serviced will be indoors (training room), inside a swimming pool, where the messages should be, especially, easily interpretable and in outdoor practice areas.

The instructor in addition to sending messages as deemed appropriate, may follow the reception of messages to know the status of the training at any time.

3. Requirements

- Multi-device: The system for monitoring and sending instructions must be multi-device with controlled access permissions. The essential system will be for Android system, valuing other platforms.
- User Friendly system: The allocation and identification devices to a student and to a role, as well as the type of message or instructions sending to them, must be dynamic and friendly.
- The messages/signals/instructions must be easily interpretable by the student in any situation.
- The final purpose is that every participant has his/her devices depending on the practice. So, the developed solution must admit several devices with which to interact in the future. The pilot project must work with 50 users at the same time.
- Open: the application must be an open platform to allow it to be expanded with new functionalities in the future.
- Functionality: the final solution will establish a communication protocol where to integrate those devices and/or wearables chosen by the startup according to their functionality or operational capacity.
- The proponent may use any technology or communication protocol he deems appropriate. However, the proponent must consider that the zones may vary, change classrooms, change outdoor zones, so the solution must be movable (not fixed infrastructure).
- Screening: the system will display all the devices and their status.
- Durability: the proposed devices must have sufficient autonomy for a training day

4. Expected Outcomes

The proponent will develop a comprehensive system that allows personalized information to be sent to different devices carried by the student depending on the practice or the moment. Also, the implementation of the prototype will be launched.

5. Budget

The solution will have a 15,000€ budget for the development of the system.

Jovellanos Centre will make available the hardware for the implementation of the prototype with their own resources or assuming the purchase of new assets up to 3000 euros. The proponent will provide full details (brand, model, supplier and cost) of hardware that should be procured for the development of the prototype for the project.

3.1.2 Second Call Big Data/Data Analytics "*Big Data and Risk Analysis in the field of Safety and Protection of the marine environment*"

1. Context, definition of the problem

One of the objectives of the Spanish Maritime Search and Rescue Agency (hereinafter, SASEMAR) is to monitor and support the maritime traffic. For that purpose, there are twenty operational centres that record the transit of ships along the waters in which Spain has sovereignty, sovereign rights or jurisdiction.

The main sources of these records come from the information provided by the radar tracking systems whose antennas are strategically located on earth, and from the ship's transponders (AIS, Automatic Identification System) whose signals are captured by VHF antennas different from the previous ones. These data are stored on the SASEMAR servers, with access under permission.

Centro Jovellanos during the training of Vessel Traffic Services Operators has identified that in certain areas with high maritime traffic density, the large amount of data using traditional methods could be hiding potential risks to consider and be trained.

2. Challenge definition. Description of need

The challenge is to find a Big Data driven solution aiming at allowing users to acquire a real vision of the latent risks in a specific maritime area monitoring all the available data in the same map.

This solution must show all variables of the maritime traffic, AIS data stored in SASEMAR servers, together with available spatial marine data which traffic is affected directly or indirectly.

The solution must be deployed on a web map server open source and generate traffic lines and densities identified with different colours according to intensity.

The solution will allow users to:

- Filter which type of information to visualize, such as: type of vessel, ranges of courses, intervals of date-time and speeds, draft, etc.
- Deploy collision probability maps and the quantification of risk.

- Deploy stranding probability maps and the quantification of risk.
- Draw over the webmap and export the results as a vector georeferenced layer (geojson, kml, etc)
- Export the graphical results as a jpg image and also georeferenced (.tiff) image.

In order to achieve this goal, a specific time period and/or area should be possible to be selected and data sets of information must be analysed to be part of the result.
The solution developed will focus on a specific area of the Spanish Territorial Waters, but the idea is to apply it in other areas of their territorial waters.

SASEMAR, through its training centre (Centro Jovellanos), will provide the developers with the necessary data and technical criteria within the field of maritime traffic, which allow the development of the expected results to achieve the objectives of the challenge[1].

3. Requirements

The solution must fulfil the following technical requirements:

- Consider available spatial marine data which affected directly or indirectly traffic data. In this way, data significant values should be crossed with maritime traffic data to propose the solution.
- Consider available spatial marine data which affected directly or indirectly traffic data. In this way, data significant values should be crossed with maritime traffic data to propose the solution.
- Provide collision and the stranding probability maps, and the representation of maritime traffic density, georeferenced and in a specific time period and area.
- Provide stranding maps according to bathymetry.
- Allow the exportation of results to different georeferenced formats.
- Be capable of importing layers of vector information and also '.csv' tables or similar.
- Include time bar displayed and the possibility of saving the different obtained results.
- Use a base map based on nautical cartography
- Be accessible for future improvements[2].

The database will be registered on a server of the Centro Jovellanos.

4. Expected Outcomes

The proponent will develop a minimum viable product implemented or the proof of concept specifying the elements including all the required elements and functionalities.

5. Budget

The solution will have a 15,000€ budget for the development of the system.

[1] SASEMAR has a geographic viewer for training that, if it is necessary, will make it available to the developers for the implementation of the Big Data solution.

[2] This is the link http://ideihm.covam.es/servicios.html of valid free web services for this challenge.

Jovellanos Centre will make available the hardware for the implementation of the prototype with their own resources or assuming the purchase of new assets up to 2.500 euros. The proponent will provide full details (brand, model, supplier and cost) of hardware that should be procured for the development of the prototype for the project.

3.1.3 Third Call Vision Technologies "*Vision technologies for emergency procedures in a helicopter cabin mock-up*"

1. Context, definition of the problem

Earlier on, in the framework of a project to improve their training programs, and focused on search and rescue helicopter's crews, Centro Jovellanos developed together with an Asturian start-up their first prototype based on vision technology.

The objective of the prototype was to validate a hybrid solution, physical and virtual environment, as a training tool. A non-complex emergency situation was selected to be tested, in this case, a single emergency exit manoeuvre.

Virtual reality and the hybrid prototype proved to be valuable tools to train with.

To achieve a comprehensive training of a helicopter crew, there are key elements missing in this first approach:

- The prototype was developed for a single player and does not enable a joint and coordinated training of the emergency procedures for the whole crew. The crew of the Spanish Maritime Safety Agency SAR helicopter is usually consisting of 4 or 5 members.
- The prototype does not offer trainees the possibility to see their bodies, preventing trainees from an immersive experience as well as making it almost impossible to interact with other participants and with the elements of the cabin during their practice (e.g., during the evacuation manoeuvre when using an emergency exit window, having a precise view of the body is necessary to complete the procedure correctly and safely).

Centro Jovellanos considers virtual reality as a valuable tool to be used in our training programmes but, for this specific type of training, a hybrid solution seems to be the ideal tool to reach our goals. Merging a modular realistic helicopter cabin mock-up together with a multiplayer augmented reality/mixed reality system.

2. Challenge definition. Description of need

The development of an augmented reality/mixed reality system that will be overlaid on top of a realistic scale model cabin of an AW139 helicopter. The objective of the system will be to offer the possibility to train the whole crew of a SAR Helicopter (4 – 5 members) on emergency and working procedures.

Jovellanos Centre will place at the start-up's disposal, this realistic scale model of the helicopter's cabin.

3. Requirements

The solution must fulfil the following technical requirements:

- Create a hybrid reality: Combining and integrating:
    - The **physical reality** of the user's physical surroundings, such as the cabin of the helicopter - without decorative features or textures-emergency exits, extinguisher as well as other common equipment of the cabin,
    - with a **virtual environment** that will overlay a realistic environment, will put decorative features or textures to the scale model cabin as well as include other visual and sound elements, such as alarms and smoke,

  allowing the user to interact with and among real-world and virtual objects.

- The final solution will develop a virtual environment of the internal and external elements of the model AgustaWestland AW139 used by the Spanish Maritime Safety and Rescue Agency.
- The solution will be developed to be used by 4-5 trainees at the same. Each trainee will be distributed in different locations of the helicopter.
- The model will let each trainee interacts with the other crew members.
- The model will let each trainee interacts with physical elements of the scale model as operative emergency exits and extinguishers.
- The prototype may include an intercom and external communications system. It could be integrated or not.
- The final solution will develop an emergency landing/ ditching scenario.
- The proponent may use any technology he deems appropriate to find the solution. The use of Unity or a licensed flight simulation software will be deemed as positive.
- The solution will be based on wireless technologies.
- The solution be accessible for future improvements.

Centro Jovellanos will make available the physical elements to the developer and will be in charge of any modification needed to connect the physical elements to the virtual ones.

4. Expected outcomes

The proponent will design the technological solution including software, specifying all the required elements and functionalities.

5. Budget

The solution will have a 15,000€ budget for the development of the system.

Jovellanos Centre will make available the hardware for the implementation of the prototype with their own resources or assuming the purchase of new assets up to 5.000 euros. The proponent will provide full details (brand, model, supplier and cost) of hardware that should be procured for the development of the prototype for the project.

3.2 NATIONAL MARITIME COLLEGE OF IRELAND

3.2.1 First Call Internet of Things (IoT) "*IoT Environmental Sensor Array*"

1. Context, definition of the problem

Part of the NMCI's key infrastructure is a jetty and lifeboat deployment structure located on the northern side of the campus from which davit launched, open launched and free-fall lifeboats are deployed along with other types of small boat (e.g. fast rescue craft). NMCI vessels participating in survival craft/small boat training range into Cork harbour as far as 3.2km from the jetty.

NMCI small boat/survival craft exercise programs are constrained by environmental limitations (wind speed, wave height, swell, visibility, tidal flow and tide height) set low enough to avoid personnel or equipment being damaged or negative learning outcomes.

Safe conditions in which to conduct exercises exist when wave amplitude, wind speed, swell and tidal stream combine to produce surface conditions less than Beaufort Sea State 2. When surface conditions are at or above Beaufort Sea State 3, training does not take place. When harbour conditions are between (or forecast to be between) Sea State 2 and 3, instructors employ various mitigation strategies and take extra safety precautions to prevent risks escalating according to the nature of the training exercise, the lesson, and candidates' experience level.

In the absence of real-time environmental data, NMCI instructors (highly trained mariners with significant sea-going and small boat training experience) are forced to rely on local knowledge, tide tables and meteorology apps when they dynamically assess risks posed by hazards such as bridge arches or reaches of shallow water that amplify tidal flow, or rocky outcrops that exposed by the fast-falling tide when water volumes in the harbour are low.

2. Challenge definition

The challenge consists in design and develop a jetty/inshore scalable IOT data network. In detail develop and deploy an experimental wireless-enabled shallow-water sea-state measurement buoy.

The proponent shall give the comprehensive solution. The development of the Web open platform with the suitable sensors for measuring wind speed, wind direction, wave characteristics (amplitude and period), water speed and water depth.

3. Requirements

The solution must satisfy the following criteria:

- Data should be reported via an appropriate network messaging protocol that is easily parsed with standard software library functions.
- The solution must give information updated every 5-10 seconds and the frequency to send data by each sensor should be every 5-10 seconds.
- The buoy, or at least the section below the water line, should be stabilised to facilitate water depth measurement.

- A flag, pendant or windsock should be incorporated so that wind direction can be estimated visually from any location in the training area.
- A multi-axis MEMS IMU device should sense wind direction so that wave action can be simultaneously reported with minimum hardware cost overhead.
- The buoy should incorporate a remotely controlled ultra-bright white LED, to serve as a warning beacon. The buoy should be self-sufficient for power therefore the design should make provision for fitment of a solar power array and possibly a water turbine.
- Above-water elements of the buoy (wind speed, wind direction measurement, visible wind indicator, warning light, power and wireless connectivity) should be re-deployable as a stand-alone wind-reporting node for placement on the jetty.
- Develop mobile device and desktop PC dashboard solutions for interaction with harbour data. The solution must offer realistic end-user experiences.

3.2.2 Second Call Big Data/Data Analytics "*Maritime Safety Training Learning Evaluation (feedback and resource platform)*"

1. Context, definition of the problem

The NMCI offers training within the above-mentioned maritime and offshore safety realms. In considering current evaluation practices within the NMCI, at present this is fulfilled through use of a post-course feedback mechanism.

At present, this mechanism consists of a post-course feedback form (hand written and anonymous; short closed question sections and open 'comments' field). In considering the above internal and external considerations, evaluation is therefore an essential component to NMCI and indeed all Maritime Training Centres for the following reasons:

- To ensure that learning outcomes are fulfilled.
- To ensure candidates are satisfied with training.
- To facilitate internal quality control.
- To provide the necessary oversight from global certification bodies

Furthermore, as a result of the robust nature of the training activities completed within the NMCI, and the extensive global regulatory oversight, data driven approaches to learning evaluation have the potential to increase performance and maintain business continuity by facilitating more effective decision-making strategies.

2. Challenge Definition

To produce a scalable maritime safety training web resource. **The website should implement a recommender system or similar data analytic engine to suggest pages of interest during browsing sessions, to enhance candidate user experience**

This website will be used by prospective, newly qualified and experienced holders of maritime safety training competency qualifications to:

- Interact anonymously with instructors who have delivered their training, in order to provide feedback in a way that instructors can respond do, if necessary (student identity withheld to instructor).
- Interact with learning tools provided by the MSTC or third parties they can use to enhance knowledge, e.g. quizzes, written and video tutorials
- Access FAQ's relating to their training and qualification regulations

3. Requirements

The solution must fulfil the following requirements:

- The website will be used by MTSCs to strengthen delivery of courses that candidates indicate weaknesses in understanding or skill level from questions asked and browsing history.
- Evaluation outputs derived from the website should also address internal NMCI and external accreditation body quality control considerations
- Architecture chosen for the platform should support scalability to cater for user-base not restricted to NMCI candidates
- The site could serve all maritime training candidates, or specifically target OPITO or SOLAS STWC candidates.

Only data generated through use of the site will be used for data analytics. No personal details about candidates should be stored on the site and any other GDPR must be complied with

3.2.3 Third Call Vision Technologies "*Virtual Reality for Fire Fighting Training*"

1. Context, definition of the problem

Firefighting training, a core subject in NMCI's maritime safety training syllabus, is included in the Munster Technological University nautical studies curriculum and offered to commercial customers taking offshore industry (IMO and OPITO) accredited courses. Trainees learn theory and technique in a classroom setting and then apply knowledge during robust action-based practical exercises that take place in the Fire-Training Unit (FTU), a compartmentalised space that mimics areas aboard ships or offshore installations where fires most commonly start. Trainees, safely exposed to flames, smoke and heat in a controlled manner, practice firefighting and learn how to negotiate typical access constraints (stairwells, ladders, lockable hatches) under emergency response conditions.

Fear of the dark claustrophobic conditions in the FTU, and possibly a degree of pyrophobia, impacts negatively on some first-time trainees' abilities to plan courses of action and recall procedures. Cognitive impairment, in addition to physical discomfort and difficulty maneuvering while wearing heavy breathing apparatus and restrictive protective clothing, can delay the onset of positive learning outcomes desired by instructors. Candidates must achieve proficiency in firefighting in order to acquire or maintain professional qualifications upon which their livelihoods depend; therefore, instructors mentor individuals until they demonstrate competency. Time and resources might be saved if candidates suffering cognitive overload could be screened during induction and equipment

familiarization phases of training and given time to acclimatize to training scenarios before being introduced to live-flame conditions in the FTU.

2. Challenge definition. Description of need

NMCI wishes to employ immersive VR as means to ease cognitive transition from classroom environments to live-fire conditions in the FTU.

However, strict maritime safety legislation prescribes not only learning outcomes and demonstrable standards of competency, but also mandates types of training system employed so VR cannot be introduced as a front-line teaching aid in existing NMCI curricula. Nevertheless, NMCI considers it desirable for reasons of cost saving, environmental damage reduction, and training efficacy to embrace immersive technology, but first evidence of VR benefits in firefighting training must be provided in order to initiate regulatory evolution.

Proposed solutions must meet two needs:

1) Benefit the current generation of trainees without infringing on course content and delivery methods agreed by training accreditation agencies. NMCI envisages offering the system to candidates as an optional extracurricular activity during on-site training and as a revision resource. Retraining intervals for offshore training may be as long as five years, so provision for interim re-training would be a unique selling point and valuable marketing tool for NMCI courses.
2) Serve as a technology demonstrator, when enhanced by outputs of future NMCI research, for convincing offshore industry regulators that VR has a role to play reducing reliance on live-fire training during mainstream maritime safety training.

3. Requirements

The proponent will develop a cross-platform, first-person, immersive reality serious game in which players:

- Familiarize themselves with layout of the NMCI FTU in varying degrees of simulated visibility.
- Reinforce knowledge of correct actions after discovering a fire, including choice, preparation and pre-operational checks of fire-fighting equipment.
- Reinforce knowledge of smoke-filled area search and evacuation techniques.

General

1. Unity 3-D development platform will be used for software development.
2. The game will be published to PC, Occulus and WebGL platforms.
3. The solution must be robust and not need continuous adjustment.
4. Interaction will be by keyboard and mouse, standard VR controller and Occulus hand tracking gestures.
5. Software should be structured to facilitate future incorporation of multiple players with body and object tracking, customized VR controllers to mimic firefighting tools.

Gameplay

Gameplay in each theme (familiarization, equipment preparation and evacuation drills) will comprise three levels:

1. Guided walk-through session giving player hints and information.
2. Practice sessions in which players' actions are accompanied by optional hints and feedback.
3. Evaluation level in which players carry out exercises with no feedback other than responses of the game itself. Players performance will scored anonymously (player accounts are not envisaged).

Players will negotiate steps and ladders, operate catches and locking mechanisms on doors and hatches during gameplay, and interact with the following key props as indicated:

- Fire hoses (unreel hoses, attach nozzles, and operate flow control valves).
- Portable fire extinguishers (check pressure, remove guard pin, and operate trigger).
- Breathing apparatus (check air pressure, operate cylinder valve, listen to end-of-service-time whistle, couple face mask to supply hose, and operate face mask valves).
- Smoke hood (don and neck break seal to admit air).
- Personal safety equipment (check contents and don) survival suit, grab bag, torch, smoke hood.

Gameplay for theme three should include a casualty search exercise focusing on correct teamwork techniques (maintaining a chain, checking floor soundness, maintaining wall contact). A game-controlled avatar (acting as optional lead member in the chain) will be included.

Gamespace

Internal dimensions of the FTU and locations of entrance/exit hatches/doors, steps, and ladders should be accurately modelled. Surfaces in the FTU are featureless and textureless, therefore to enhance learning in VR space, gamespace surfaces should be decorated with appropriate textures and populated with essential props (see section 3.1). Generic maritime-themed internal structure textures can be used for spaces other than the accommodation cabin, galley and machinery space, which should be represented in detail sufficient to meet requirements stated in section 3.4.

Smoke, flame and illumination levels should vary according to game logic, however the game will not teach fire extinguishing techniques so combustion physics modelling (beyond the Unity game engine's out-of-the-box smoke and flame simulation capabilities) is not anticipated. However, consequences of incorrect player actions (for example, choice of inappropriate extinguisher media, incorrect media dispersal pattern, or opening door/hatch concealing fire) should be indicated by with stylized sudden escalation of flame/smoke.

Fidelity and real-world relevance

Render quality should be sufficiently high fidelity that safety training accreditation authority observers judging the usefulness of VR will not be detracted by cosmetic limitations. Similarly, gameplay should

be implemented in a manner that makes it clear to observers how skill and knowledge acquired in-game is relevant to real life.

4. Expected Outcomes

The proponent will deliver immersive VR content viewable on PC systems, Occulus HMDs and WebGL-enabled browsers.

The user experience will reinforce players' knowledge of firefighting drills and exercises. After completing gameplay and interacting with modal props, players will be familiar with the NMCI FTU layout in good and bad visibility whilst wearing simulated breathing apparatus, and will be confident in their ability to prepare for service and operate firefighting equipment simulated by the game. Players who have completed the game will not be held back by negative emotions when exposed to live-flame conditions in the FTU and will therefore experience better learning outcomes than trainees whose progress is held back by sensory overload.

5. Budget

A budget of 15,000€ is available to cover manpower costs. A separate capital outlay budget of 3.000€ is available for purchase or hire of computers and VR accessories, and for procurement of 3D assets.

3.3 Escola Superior Nautica Infante D. Henrique (ENIDH)

3.3.1 First Call Internet of Things (IoT) "*Enhancing small craft handling and rescue training*"

1. Context, definition of the problem

ENIDH is a higher education institution mainly focused on educating and training merchant marine officers. All aspects of maritime safety, such as survival at sea, search and rescue operations, firefighting, occupational safety, among others, are covered in the curricula of study programs. Part of the maritime safety training is carried out on a lifeboat and on a rescue boat, used to develop small craft handling skills and to allow students to experience the difficulties of rescuing people from the water and manoeuvring these vessels while affected by currents, wind and waves. Students' performances are assessed during the exercises and corrections are suggested to improve the outcomes. However, currently there is no way to obtain an external perspective on the movement of the vessels and the dummy used for rescue training, which would be valuable to increase the students' understanding of the effects of wind and current, as well as to aid the trainers in providing feedback and suggesting corrections to the students.

2. Challenge definition. Description of need

We propose the development of a solution to improve the real-time monitoring and the debriefing stage of the maritime safety training conducted in the training vessels, by being able to record and replay movements of both training vessels (the lifeboat and the rescue boat) and of the rescue dummy. The solution shall also be able to record and replay the measurements of an existing weather station. The objective is to have a graphical display of the movements of the vessels and the dummy, and a dashboard with numerical information of: the vessels' speed, course, heading, roll angle, pitch angle

and distance to dummy; the dummy's course and speed (which can be used to estimate current); the wind direction and speed obtained from the weather station. By sharing and analysing this information with the students, both in real-time and during debriefings, trainers will be able to explain the causal relationships between environmental factors, the vessels' paths and attitude, and the outcomes of the exercises, hopefully resulting in improved learning outcomes.

3. Requirements

The solution is required to collect data at least from the following IoT sensors:

- 3 GPS sensors, 1 in each vessel and 1 in the rescue dummy.
- 2 inertial movement sensors (or equivalent, to be defined), incorporating accelerometers and gyroscopes (and possibly magnetometer).
- 1 existing weather station

The solution is required to graphically display the positions of the vessels and of the dummy in a dedicated "chart like" environment and on google earth, additionally providing a dashboard with numerical information collected and sent by the sensors. The dashboard should be configurable by the user (regarding the placement and amount of information shown) and should allow the display of information of additional IoT sensors that are added to the system in the future. The graphical display solution should also be open to the incorporation of additional sensors in the future, through a configuration menu. A menu to start and stop data recording, as well as to start and stop replaying is required.

The following information shall be available to be incorporated in the dashboard:

- From the vessels:
  - Speed
  - Course
  - Heading
  - Pitch angle
  - Roll angle
  - Rate of turn
  - Distance to dummy
  - Distance to other vessels
- From the rescue dummy:
  - Course
  - Speed
- From the weather station:
  - Wind speed
  - Wind direction

The solution is also required to enable the configuration of an UDP port to receive live AIS data in standard format. AIS data, if available, shall be recorded and the position of AIS equipped ships shall be shown in the graphical display when replaying the exercises.

A copy of all received data in its raw format shall be saved, to be used in research projects.

The graphical interface shall be available both on PCs and on mobile phones, for the debriefings and for real-time monitoring.

4. Expected Outcomes

The expected outcome is a user friendly, highly flexible and configurable solution to enhance the learning of small craft handling and search and rescue techniques, and to record data that may be used in future research projects. The use of IoT technology in the described maritime safety training activities is expected to have a positive impact on the proficiency level of students, once the training is completed, due to the possibility of performing more accurate analysis and corrections of their performance, both in real-time while in the vessels and in a classroom environment. IoT technology implemented in this solution will also provide tools for trainers to improve the way they transmit knowledge, and potentially increase the students' interest in maritime safety related subjects.

5. Budget

The solution will have a 15,000€ budget to cover the proponent's costs. The project will have a 3,000€ budget for hardware procurement, but this cost will be met by the tenderer independently of HR funding. The proponent will provide full details (brand, model, supplier and cost) of hardware procured for the project.

3.3.2 Second Call Big Data/Data Analytics "*Big Data and Risk Analysis*"

1. Context, definition of the problem

The STCW (Standards of Training, Certification and Watchkeeping) Convention requires that training and assessment of seafarers are administered, supervised and monitored in accordance with the provisions of the STCW Code.

Institutions and courses must be approved by the national maritime administrations of parties to the STCW Convention. Escola Superior Nautica Infante D. Henrique (ENIDH) is the only institution in Portugal approved by the national maritime administration (Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos - DGRM) to train and assess officers. ENIDH offers higher education courses which are audited by the national higher education accreditation agency (A3ES), by the DGRM and by the European Maritime Safety Agency (EMSA), as well as short STCW courses which are also audited by DGRM and EMSA.

The education programmes for officers also comply with the requirements of the STCW-F (Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel) and with national requirements for pleasure craft operators.

The constant evolution of the maritime industry results in regular updates to the training requirements. The International Maritime Organization (IMO) regularly updates and publishes new model courses, designed to help training institutions to maintain the desired standards. On the other hand, regular audits put pressure on education and training institutions to ensure their programmes are always up to date.

One of the problems identified in the course approval processes is the fulfilment of all requirements defined in the applicable legal documents.

In this sense, the solution to be developed will allow the verification, that the courses contain all applicable legal requirements. In case of differences, the solution will identify those differences.

This solution will allow a better verification of compliance with legal requirements, comparing all course units with the contents of applicable legal documents and identify the missing contents or contents that are different of legal legislation applicable.

2. Challenge definition. Description of need

We propose the development of an intelligent solution to verify the compliance of the maritime course programmes with the various different requirements.

The main objective of the solution is to compare whether all the contents defined in the legal documents are introduced or not in the curricular units of the Bachelor and Master degree course in Bridge and Deck Operation.

If some of the legal requirements are not introduced in the curricular units, the missing content should be identified.

If the curricular units have content that is not part of the legal requirements, those contents must also be identified.

This solution shall be able to import the course programmes from the training institution database or from text files, import the files containing international Codes, applicable legislation, and other training requirements, and output which mandatory subjects are included in the course programmes and where, as well as compare the number of hours of training with the ones suggested by model courses, if applicable.

The solution shall suggest a human review of content matching when an obvious correspondence cannot be found.

3. Requirements

The solution must fulfil the following technical requirements, with the main propose to compare the curricular units contents and the applicable legislation to maritime training.

- *Data inputs*: The solution must create a collection of data (data set), of at least the following documentation:
  - Create a data set of the curricular units of the Bachelor and Master degrees in Bridge and Deck Operation.
  - Create a data set of the legal requirements applicable to maritime training, such as:
    - International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).
    - International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (STCW F).

- IMO Model Course 7.06 - Officers in charge of Navigation Watch on a Fishing Vessel.
- IMO Model Course 1.33 - Safety of Fishing Operation.
- IMO Model Course 7.03 - Officer in Charge of a Navigational Watch.
- IMO Model Course 7.01 – Master and Chief Mate.
- IMO model course 1.34 - Automatic Identification Systems (AIS).
- IMO model course 1.07 - Radar Navigation at Operational Level.
- IMO model course 1.27 - ECDIS Model Course.
- IMO model course 3.17 - Maritime English.
- IMO model course 2.03 - Advanced Training in Fire Fighting.
- IMO model course 1.23 - Proficiency in Survival Craft and Rescue Boats Other Than Fast Rescue Boats
- IMO model course 1.14 - Medical First Aid.
- IMO model course 1.39 - Leadership & Teamwork.
- IMO model courses 1.19 - Proficiency in Personal Survival Techniques.
- IMO model courses 1.20 - Fire Prevention and Basic Fire Fighting.
- IMO model courses 1.21 - Personal Safety and Social Responsibilities.
- IMO model course 1.08 - Radar Navigation at Management Level (Radar, ARPA, Bridge Teamwork and Search and Rescue).
- IMO model courses 1.22 - Ship Simulator and Bridge Teamwork.
- Other IMO Model courses and other legal documents.

All legal documents will be provided by ENIDH.

Reading Formats: The solution must be able to extract information from at least the following file formats:

- *Reading* of documents in PDF, Image, Word, e-book formats.

Updates to data set: The solution must allow at least the follow updates:

- Enable the introduction of new contents or new legal documents.
- Enable the introduction of new contents or new curricular units.

User Interaction: The solution must be able to allow the user to define filters to generate the information in the reports. The solution must be user friendly.

4. Expected Outcomes

The expected outputs of the solution to be developed are the following:

- **Reports**: Creation of reports that allow identifying the contents inserted or missing in the curricular units or courses comparing in the legal requirements select for maritime training. The solution must allow the selection of the information to generate the report. At least the following reports must be available:
  - Identify the contents of the selected legal requirements in the selected curricular units or course.

- Identify the contents of the selected legal requirements not available in the selected curricular units, or course.
- Compare the number of training hours defined in legal requirements with the training hours defined for the curricular units and courses, whenever this information is available.
- Identify the contents of the curricular units or course that are not part of the content of the legal requirements.
- Identify the contents of the legal requirements that are not part of the curricular units or course.
- Historic reports of updates to legal requirements and curricular units.

- **Updates**: The program must generate a historical record of all changes made to legal documents, curricular units or courses with at least the following information:
  - Record all updates made to legal documents, curricular units and courses.
  - Identify last update made to the legal documents, curricular units and courses.
- **Automatic learning**: The program shall be able to query the user when a possible, but not clear match between the contents of the legal requirements and the contents of curricular units and courses is found. The program shall learn from these interactions with the user, for future content comparison.

5. Budget

The solution will have a 15,000€ budget to cover the proponent's costs. The project will have a 3,000€ budget for hardware procurement, but this cost will be met by the tenderer independently of HR funding. The proponent will provide full details (brand, model, supplier and cost) of hardware procured for the project.

3.3.3 Third Call Vision Technologies *"Virtual Celestial Environment for Celestial Navigation"*

1. Context, definition of the problem

The STCW (Standards of Training, Certification and Watchkeeping) Convention requires that training and assessment of seafarers are administered, supervised and monitored in accordance with the provisions of the STCW Code. Knowledge of Celestial Navigation is part of STCW Code including the "Ability to use celestial bodies to determine the ship´s position".

Astronavigation is the only alternative method to electronic means to determine the ship's position in ocean navigation. It is used as a secondary method for confirming the position obtained by electronic navigation equipment and, in lack of these, it will be the primary and the only method to get the ship's position. In this sense, it becomes essential to familiarize the students and simplify the teaching and learning processes of this method.

The training in astronavigation can be summarized in the following items:

- Correctly adjust sextant for adjustable errors.
- Determine corrected reading of the sextant altitude of celestial bodies.

- Accurate sight reduction computation, using a preferred method.
- Calculate the time of meridian altitude of the sun.
- Calculate latitude by Polaris or by meridian altitude of the sun.
- Accurate plotting of position line(s) and position fixing.
- Determine time of visible rising/setting sun by a preferred method
- Identify and select the most suitable celestial bodies in the twilight period
- Determine compass error by azimuth or by amplitude, using a preferred method
- Training in celestial navigation may include the use of electronic nautical almanac and celestial navigation calculation software.

In the training process, students have difficulty in visualizing the celestial sphere, identifying the Sun, Stars, Planets and Moon, used in Astronavigation, and their localization using the Horizontal and Equatorial coordinate systems, the position triangle and apparent movement over the horizon.

The proposed solution will make possible to develop, with greater ease understanding, the acquisition of knowledge for the use of the Astronavigation by the students and by ship's deck officers at sea.

2. Challenge definition. Description of need

We propose the development of a solution of vision technologies (immersive 3D environment) that can show the celestial bodies above the horizon with the essential detailed information to train the celestial navigation. This solution will allow to observe the 57 stars and their constellations, the 4 planets, the Sun, the Moon and to show Aries, on the celestial sphere, with the observer located on the deck of a ship.

Other objective of the solution is allow the user to identify and to understand the apparent movement of celestial bodies.

The main objective of the solution is to support students and deck officers to identify and view the main topic of Astronavigation. Depending on the geographic coordinates and time, it will be possible to identify the visible horizon and all the stars that are above the horizon. When selecting the star, the observer should graphically visualize the Horizontal and Equatorial coordinates.

The celestial sphere is an imaginary sphere of infinite radius with the Earth at its centre (Figure above). The north and south celestial poles of this sphere, PN and PS respectively, are located by extension of the Earth's mean pole of rotation. The celestial equator is the projection of the plane of the Earth's equator to the celestial sphere. A celestial meridian is a great circle passing through the celestial poles and the zenith of any location on the Earth.

The point on the celestial sphere vertically overhead of an observer is the zenith, and the point on the opposite side of the sphere vertically below him or her is the nadir.

The Navigational Triangle is a triangle formed by arcs of great circles of a sphere is called a spherical triangle. A spherical triangle on the celestial sphere is called a celestial triangle.

The spherical triangle of particular significance to navigators is called the navigational triangle, formed by arcs of a celestial meridian, an hour circle, and a vertical circle. Its vertices are the elevated pole, the zenith, and a point on the celestial sphere

The observer should also be able to visualize the position triangle and the values of all coordinates.

Will be desirable, to see the apparent movement in real time or fast motion mode, to identify Sunrise, Sunset and meridian passage.

The solution will be very useful in training, but also in use on ships.

3. Requirements

The type of solution to be proposed must be within the scope of vision technology and must fulfil the following technical requirements, with the main build a virtual sky to Celestial Navigation:

- Possibility of introducing the geographic coordinates of any location for the visualization and time required.
- Automatic update of the coordinates of the Nautical Almanac for each year;
- Possibility to select each type of celestial coordinates, in order to view only partial information, as described on the expected outcomes.

4. Expected Outcomes

The expected outputs of the solution proposed to be developed are the following:

- Attractive and interactive application with different colours displayed to better show the info
- Identify all coordinates systems
- Show the Astronavigation triangle.
- Show the prime meridian (Greenwich meridian) in celestial sphere
- Apparent motion of the sun, moon and stars in real time speed or faster mode, for see the apparent motion of 24 hours in 1 minute.
- The ecliptic with the position of the 4 reference points
- Show the Zodiac
- Solar and Lunar Eclipse in the position they happen.

5. Budget

The solution will have a 15,000€ budget to cover the proponent's costs. The project will have a 3,000€ budget for hardware procurement, but this cost will be met by the tenderer independently of HR funding. The proponent will choose the most suitable software and hardware for the success of the challenge. The proponent will provide full details (brand, model, supplier, and cost) of hardware procured for the project.

4 Start-ups Solutions Evaluation process

Once the challenges have been identified, it is necessary to receive solutions to the challenges posed by the MSTCs in order to be able to select the best solution. In order to choose the best option within the AT-VIRTUAL project, an evaluation procedure has been developed for the solutions presented by the Start-ups.

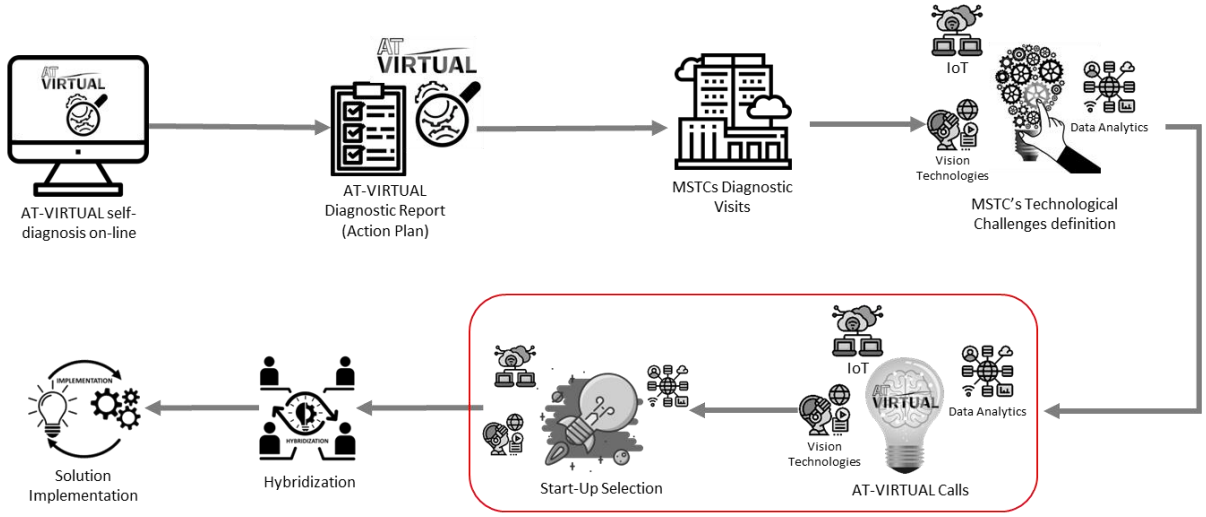


Figure 11: Action Plan 5th and 6th Step: MSTCs Evaluation and Selection process

As previously presented, in order for Start-ups to present their solutions to the challenges posed, it is necessary that these are well defined and structured, for this reason, from the AT-VIRTUAL project we propose the following index:

1. Context, definition of the problem
2. Challenge definition. Description of need
3. Requirements
4. Expected Outcomes
5. Budget.

The first point to assess for each of the solutions/proposals presented is **the degree of compliance with the requirements set out in the proposals** and for this the following evaluation template is suggested where the following aspects are assessed:

1. **Coherency** of the proposal for the implementation of the project.
2. **Experience / background** of the company related to the challenge / topic addressed
3. **Evaluation of the technology and innovation** of the proposed solution according to the state of art.
4. **Risk evaluation** that could be introduced in the project.
5. **Availability and assessment of company resources** in relation to the plan proposed
6. **Feasibility of the budget** for the implementation of the solution and timeframe for the implementation of the solution.

7. **Other added value** to be assessed

Total Score	60	Requirements of the Challenge IoT Assesment of Applications

Company	XXXXXX	Date	11/12/2020

Nº	Description	Score	Thredshold	Score	Clasification	Aproved	Justification
A	**Coherency** 1-10	Poor: 1-3 Good:4-6 Excelent: 7-10	5	6	Good	✓	
B	**Experience** 1-20	Poor: 1-6 Good:7-13 Excelent: 14-20	10	15	Excelent	✓	
C	**Innovation** 1-20	Poor: 1-6 Good:7-13 Excelent: 14-20	10	15	Excelent	✓	
D	**Risk Evaluation** 1-20	Poor: 1-3 Good:4-6 Excelent: 7-10	5	1	Poor	✗	
E	**Resources** 1-20	Poor: 1-6 Good:7-13 Excelent: 14-20	10	13	Good	✓	
F	**Budget** 1-10	Poor: 1-3 Good:4-6 Excelent: 7-10	5	3	Poor	✗	
G	**Added Value** 1-10	Poor: 1-3 Good:4-6 Excelent: 7-10	-	7	Excelent		

Total 60

Poor	The criterion is **inadequately addressed**, or there are serious **inherent weaknesses**.	**Good**	The proposal addresses the criterion well, but a **number of shortcomings** are present	**Excelent**	The proposal **successfully addresses** all the relevant aspects of the criterion. Any shortcomings are minor.	**Leyend**

Figure 12: AT-VIRTUAL evaluation form

5 Hybridization

The process of digitization will be carried out through a collaborative hybridization process, facilitating the cooperation between 3 MSTCs and start-ups who will act as digital enablers, supported by a research organization and I4.0 experts. The development of a digitalization procedure through collaborative hybridization processes and agile methodologies, putting together MSTCs, researchers, I4.0 experts, business incubators and start-ups.

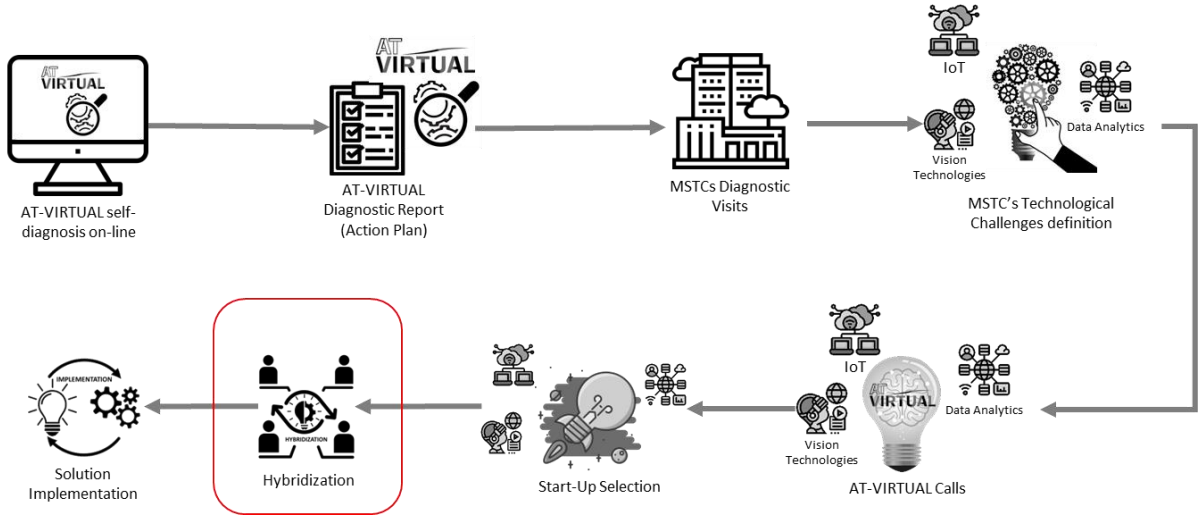


Figure 13: Action Plan 7th Step: MSTCs Hybridization process

To this end, a hybridization methodology has been developed inside of the project to accelerate the process of design and implementation of the selected solutions, based on agile techniques and rapid prototyping.

Self-management does not mean a lack of organization, but rather that the work is not organized from the top down. Unlike in hierarchically organized companies, people in self-managed environments have to communicate how they are going to do things. They must have a mutual understanding of the processes and division of the workload. Although there may be roles, people tend to be on the same level hierarchically speaking. They have an agile mindset, which includes things like working iteratively, reflecting on results and processes, as well as teamwork, and continuous improvement. It seems logical that they not only work in an agile way but also communicate in an agile way.

In direct contact we get immediate feedback on whether someone understands what we are saying and roughly agree with us through facial expression and preverbal cues such as modulation. When misunderstandings happen, it is easier to ask more questions. That is why, when we implement digital communication, it is important to take care of the channels and dynamics.

Despite digitization, people who work in agile contexts often use highly analog media. They often use group dynamics on whiteboards, where they write, draw, and use sticky notes to collect ideas. They understand the power of face-to-face communication and direct interaction. It is not that they do not

take it seriously when drawing or even going out to have a group discussion, they use new ways to be more efficient and effective in their communicative interactions.

There are many “old communication tools” that can be used for agile communication. Many of the “old dynamics and tools” can be transferred to the virtual world, an example can be whiteboards with sticky notes.

We don't have to reinvent communication for the agile era. We just have to remember some of the existing techniques and methods and be aware of the values they bring to become agile. As easy as that, we can bring agility to communication and collaboration. It is not about reinvention, but about selection and prioritization, adapting “old tools” to a new world of a different complexity and rhythm.

The different actions to be carried out in a one-month work plan are detailed below. The following figure shows an example; however, this work plan can be adapted to the needs of each project. For this reason, AT-VIRTUAL propose the following Hybridization process (Work Schedule):

Figure 14: AT-VIRTUAL Hybridization process

The following table shows when each action should be performed, and is organized chronologically:

	Monday	Tuesday	Wednesday	Thursday	Friday
WEEK 1	▪ Start-up meeting ▪ Update weekly objectives ▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document ▪ Progress review
WEEK 2	▪ Update weekly objectives ▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document ▪ Progress review

WEEK 3	▪ Follow-up meeting ▪ Update weekly objectives ▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document ▪ Progress review
WEEK 4	▪ Update weekly objectives ▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document ▪ Progress review
WEEK 5	▪ Follow-up meeting ▪ Update weekly objectives ▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Collaborative document	▪ Active communication ▪ Closing meeting ▪ File documents

6 Solution Implementation

After the activity carried out in the previous steps-process where the MSTC and the start-up have agreed on the final solution to be developed, the agreed solution is developed. For this phase, a minimum duration of 6 months has been established, but depending on the challenge, more time may be established.

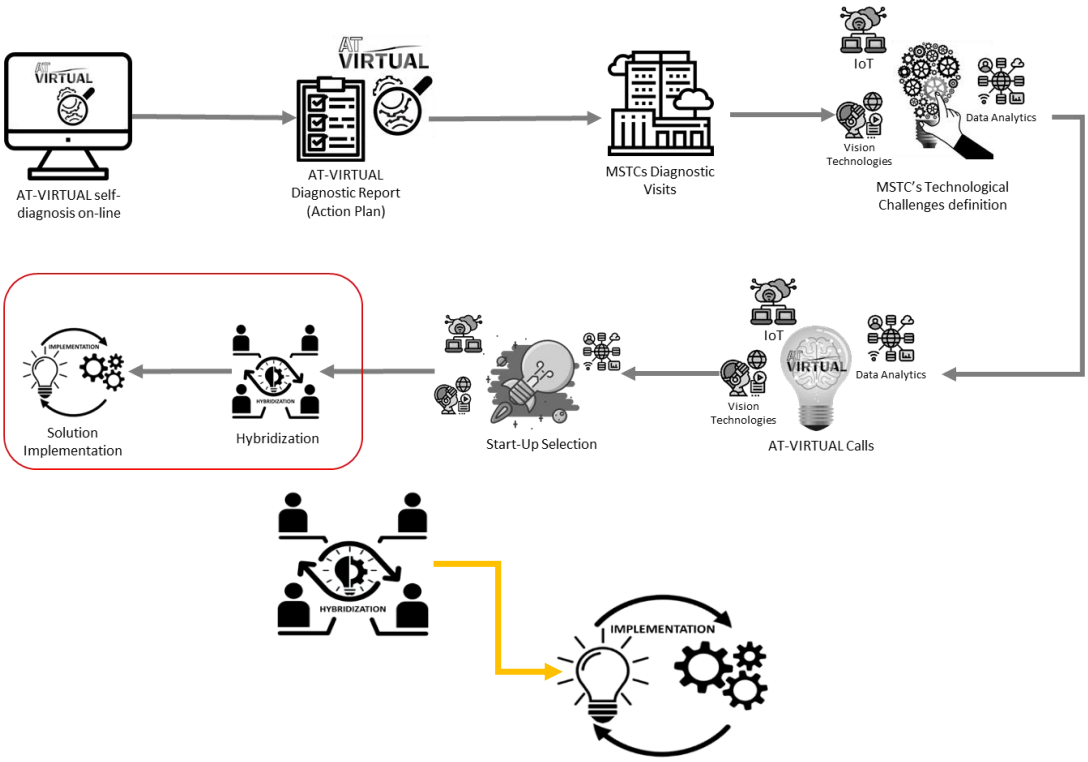


Figure 15: AT-VIRTUAL Solution development and implementation

There are several key factors to consider when implementing a technological solution, including:

- Keep in mind who will be impacted by the technological solution. It helps in understanding that the solution is meeting their needs.
- Follow the detailed plan developed in the Hybridization process to follow the scope, timeline, and resources required for the implementation.
- Communication and collaboration: Effective communication and collaboration between all stakeholders involved in the implementation process is crucial to ensure a successful outcome.
- Testing and quality assurance: Testing and quality assurance should be conducted at various stages of the implementation process to ensure that the solution meets the requirements and functions as intended.
- Training and support: Providing training and support to users of the technological solution is important to ensure that they can effectively use the solution and address any issues that may arise.