Model for the creation and Exploitation of a sustainable IoT lab

DTAM

DIGITAL TRANSFORMATION IN ADVANCED MANUFACTURING

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1. Introduction:

DTAM (Digital Transformation in Advanced Manufacturing) is building a transnational network of "learning labs" for students and adult learners. It consists of four demonstration centers (LABs) focused on implementing IOT solutions in advanced manufacturing environments. These LABs provide ecosystems that foster the cooperative implementation of technological solutions based on digital transformation.

The LABs serve as collaborative spaces, bringing together VET schools, universities and businesses for cooperation and creating a bridge between the skill supply and demand for digital transformation services. These centers act as gateways for companies and students interested in exploring new technologies, applications, services, and experiences that can contribute to their evolution and growth in the digital era.

The network's cooperative experience relies on the interoperability of its centers, which are equipped with hardware components and a software platform enabled by the project partner Sarenet. The network operates within a collaborative space that encourages resource sharing and provides digital content, fostering economies of scale and the development of shared knowledge, practices, and cultures.

This document aims to propose a model demonstration center for DTAM network members. It will outline a service scheme that includes various actions, services, and target groups catered to by the LABs. This model is available for the current partners of the DTAM IOT Hub but it aims to encourage other labs to join the network. Therefore, this is not a closed network but the objective is to grow to have more regions involved. The scope is to cover different European regions with the collaboration of labs.

Furthermore, the document will provide a foundational approach to the organization and operational definition of the network. While the document serves as a general proposal, it is intended to be adaptable to the specific needs of each region, while maintaining the necessary commonalities to ensure coordinated actions among the network nodes.

Internet of Things

The Internet of Things (IoT) refers to the interconnection of physical devices through the internet, enabling them to collect and share data wirelessly. These devices, known as "smart objects" or "connected devices," can range from household appliances and sensors to vehicles and industrial equipment.

The key characteristics of IoT are as follows:

- Connectivity: IoT devices connect to the internet using various technologies such as Wi-Fi, Bluetooth, cellular networks (3G, 4G, 5G), Zigbee, or LoRaWAN. This connectivity allows them to send and receive data remotely.
- Data Collection: IoT devices gather a wide range of data through integrated sensors. This data can include environmental information, device status, biometric data, geographical location, among others.
- Communication: IoT devices can communicate with each other over the internet, forming complex networks and systems. This communication can be device-to-device, device-to-server, or even device-to-person.
- Automation and Control: IoT enables process automation and remote device control. The data collected by devices can be used to make decisions and perform actions automatically, without direct human intervention.
- Data Analysis: The large amount of data generated by IoT devices can be analyzed to derive valuable insights and make predictions. Data analysis helps in making informed decisions, optimizing operations, and improving efficiency.

Regarding possible remote connections in IoT, here are some common options:

- Cloud Connectivity: IoT devices can send the collected data to cloud platforms, where it is stored and processed. This enables remote access to the data from anywhere and the possibility to utilize cloud services like advanced analytics or cloud-based applications.
- Mobile Device Connectivity: IoT devices can connect through mobile applications on smartphones or tablets. These applications allow users to remotely control and monitor devices, receive notifications, and access collected data.

- Network Protocol Connections: IoT devices can use different network protocols to connect and communicate with each other or other systems. Some common examples include MQTT (Message Queuing Telemetry Transport), CoAP (Constrained Application Protocol), and HTTP (Hypertext Transfer Protocol).
- Integration with Management Systems: IoT devices can integrate with existing enterprise management systems or industrial control systems. This enables remote monitoring and control of devices from a centralized system, facilitating administration and optimization of operations.

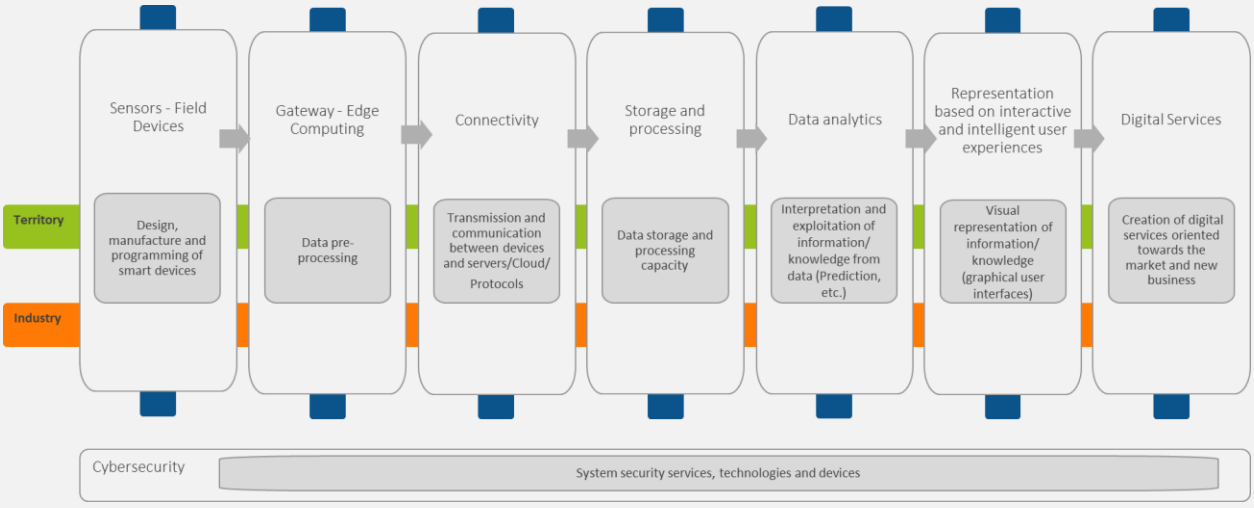


Image: IOT hub by GAIA

What is the DTAM IOT HUB??

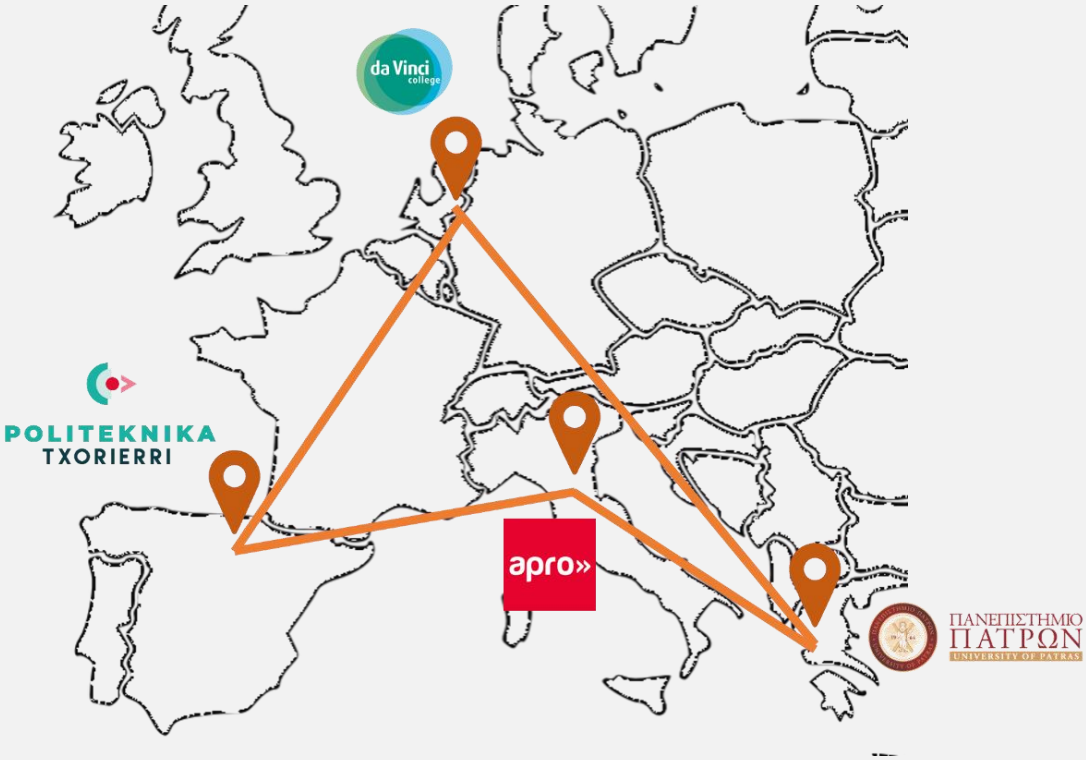
DTAM IOT Hub is a collaborative space where different entities that have a physical IOT lab can work together to benefit from each other. The objective is that thanks to the collaboration between different entities and working in a network, the users of the labs can have a greater reach by being able to use remote facilities to greatly expand the options of interacting with IOT technology.

Although all the labs are focused on IOT technology, the participating entities are of different nature and are immersed in other realities that although they may be similar, they do have some distinctions.

The entities that are immersed in the DTAM IOT Hub will make their equipment available to other labs so that they can interact with each other thanks to the interconnection that exists within the network and that is explained below. Thanks also to a reservation methodology accessible from Moodle, users will be able to make use of remote facilities.

It should be noted that the DTAM IOT Hub is born after the realization within the DTAM project but it is not closed only to the partners participating in the project, but it will be open to other centers that have a lab dedicated to the IOT can join the network by contributing their technology so that it can be available to other users and can benefit from the labs that are already collaborating.

This document will serve as a basis for this collaborative networking and will show the governance methodology.



2. Background of partners hosting LABs

Host entities

Politeknika Txorierri is a Vocational Training School with electronics, ICT and mechanical design and manufacturing courses. They have 120 high school students and around 300 VET students. They participate in educational organizations such as Ikastolen Elkartea and Hetel, and we have many collaborations with other private and public instituions.

Closeness to the companies has always been one of the main goals of Politeknika Txorierri. For this reason, they have important business alliances, modern technical means and innovative projects that facilitate job placement and entrepreneurship through new methodologies that enhance personal and professional development. They are part of the Mondragon Corporation; thus they are a cooperative of institutions, families and workers/teachers.

The people who make up Politeknika Txorierri are professionals committed to the environment, close to students, families and organizations. They have a great ability to adapt to technological, social and environmental changes and they enjoy participating in projects that add value to the center. They encourage the democratic participation of all sectors and transparency in all areas.

Apro Formazione is a Vet center located in Alba, Italy. Apro provides courses for young people, workers and unemployed people since 1958 and works in a lot of fields: industrial, restauration and tourism service, beauty and wellness, healthcare etc. Actually there are 500 young students involved and every year around 4000 people uses Apro training services.

Apro is a private consortium composed by the municipality of Alba, the main local companies as Ferrero, Miroglio, Egea, Banca d'Alba, trade associations and a lot of PMI of the territory.

University of Patras is one of the leading higher education institutions and the third largest in Greece. Its success is built on a strong partnership with its students and academic staff and a clear focus on high performance, enhancing University of Patras's position as a world-class university with a strong academic reputation and a commitment to excellence. It comprises of 7 Schools with 35 Departments and 180 labs in total. It currently employs 693 Faculty members, 232 Scientific staff members, 368 Administrative staff members, and 2,742 Researchers. Moreover, it currently has 30,185 Undergraduate students, 1,704 Postgraduate students, and 2,051 Ph.D. students.

The faculty of the Department of Management Science and Technology that represents University of Patras in the DTAM project has participated in many Erasmus+ and other R&D projects at the area of higher education, adult education and VET. Moreover, it has demonstrated extensive expertise in e-learning technologies, web systems, big data and learning resources development. UPATRAS has been also the coordinator of the SEnDIng Erasmus+ Sector Skills Alliance project (591848-EPP-1-2017-1-EL-EPPKA2-SSA) that has successfully completed on January 2021

DA VINCI

Da Vinci College is a renowned educational institution committed to providing high-quality education and equipping students with the skills necessary to succeed in their chosen fields. With a focus on innovation and a forward-thinking approach, the college prepares students for the demands of the digital era.

The faculty of IT, Software development and Media from Da Vinci College are partner of the project. Through their collaboration, the DTAM project aims to empower teachers by providing comprehensive lessons and exercises on cybersecurity, IoT and sensors, big data, machine learning, and transversal skills. These resources enable educators to effectively teach their students about the latest advancements in digital transformation, ensuring that they are well-prepared for the evolving demands of the manufacturing industry.

Regions involved

This IOT lab network with contain four nodes in four different European areas: Basque Country (Spain), Alba (Italy), Patras (Greece) and Dordrecht (Netherlands). These are some specificities of the labs:

Politeknika Txorierri is located in **Derio**, 10 km from **Bilbao** (the main city in the Basque Country), very close to the Bizkaia Science and Technology Park; and in the Txorierri valley, an industrial area where design and manufacturing is one of the main bases of the companies.

Industry 4.0 is the new paradigm of the modern industry; IOT ,automation and robotics are a needed, also value extracted from gathered data, thus Big Data and Artificial Intelligence are starting to play a role in our industry. There are some "big" companies in the region that have already incorporated these new technologies, but many SMEs need help to start this digitization process, those are the ones the project is aiming to reach.

Exporting products and services is one of the most important economic activities in the region, so to be competitive companies have to incorporate technologies that allow them to improve the efficiency of our processes and reduce our costs. Students are part of the workforce that feeds the industrial and productive companies in our environment, so they need the most advanced knowledge in the technologies that they can find in their workplace.

Alba region is very active in industrial production. Thanks to the supply chain of Ferrero and to the activities related to the wine production, there are more than 300 PMI specialized in the industrial machines/plants building and service.

The territory was recently connected to the national Highways network, thus allowing connections with the rest of the Nation making a further step of the activities grow up.

In this environment the new IoT lab, alongside the other workshops, will allow Apro to give an additional service to the students and the companies, by providing courses and technologies unique to the territory. The lab is also available for other technical schools of the territory and used as focus lab during the school orienteering activities.

The IoT lab of the University of Patras will be accessible by diverse stakeholders both from the education and industry that are located in the region of **Western Greece** and are potentially interested in using the infrastructure e.g. for education and training purposes. Such stakeholders are a) universities, such as the University of the Peloponnese and the Hellenic Open University, b) R&D centers, such as the Computer Technology Institute and Press “Diophantus” and the Institute of Industrial Systems, c) accelerators such as Corallia,

d) enterprises (operating in the IoT industry) such as Meazon and e) VET schools. We do not foresee any special regulatory requirements for the exploitation of the IoT lab by the aforementioned stakeholders. Moreover, no cultural or language differences exist in the region of Western Greece. Considering the remote access to the IoT lab, this will be open to any interested party from education and the industry.

Dordrecht (Netherlands…)

As part of its commitment to providing students and industry professionals with hands-on experiences in emerging technologies, Da Vinci College boasts a state-of-the-art DTAM Internet of Things (IoT) Lab. This dedicated space serves as a hub for exploration and experimentation with IoT devices, including Raspberry Pis, networking devices, and Arduinos. The IoT Lab offers a collaborative environment where both students and companies can engage in cutting-edge projects and harness the potential of IoT technology.

The IoT Lab at Da Vinci College is equipped with the latest tools and resources to facilitate the development of IoT applications. Students have the opportunity to delve into the world of IoT by working with Raspberry Pis, versatile single-board computers that enable them to connect and control various sensors and actuators. By utilizing networking devices, they can establish communication between IoT devices, enabling data exchange and remote control.

In addition to Raspberry Pis, the lab also provides access to Arduino boards, renowned for their versatility and compatibility with a wide range of sensors and actuators. Arduino boards allow students and industry professionals to create interactive projects and prototypes that leverage the power of IoT technology.

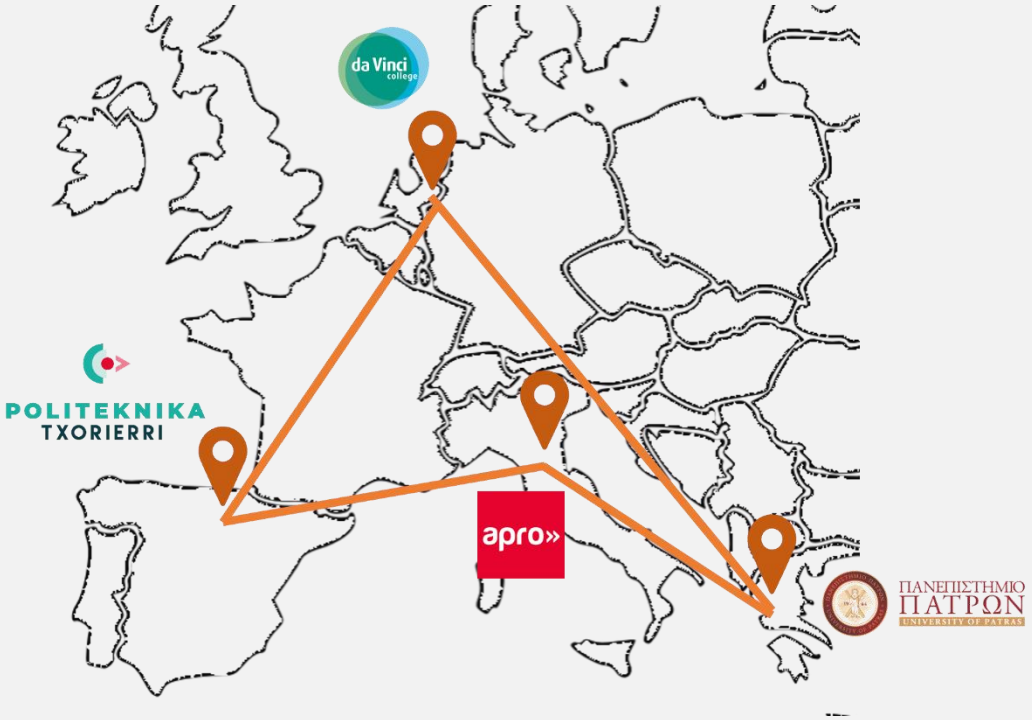
The IoT Lab serves as a collaborative space where students can work together on projects, exchange ideas, and explore the potential of IoT applications in the context of advanced manufacturing. It promotes a multidisciplinary approach, encouraging students from various fields to come together and apply their expertise in a real-world setting.

Beyond the academic setting, Da Vinci College's IoT Lab extends its services to industry partners, allowing companies to leverage the facility and expertise available. This collaborative approach enables businesses to experiment with IoT devices and explore

innovative solutions for their specific needs. By bridging the gap between academia and industry, Da Vinci College fosters a dynamic ecosystem where knowledge and practical insights are shared to drive advancements in the manufacturing sector.

The IoT Lab's emphasis on hands-on learning aligns with Da Vinci College's philosophy of providing students with practical experiences that complement theoretical knowledge. By engaging with IoT devices in a dedicated space, students develop a deeper understanding of the technology and gain valuable skills that are highly sought after in the industry.

3. Labs Description



Focus of the labs

The four labs will be interconnected and will serve as practice point of the different technologies in which DTAM project has been working on, therefore these are the main objectives of the labs:

- Practice with IoT sensor: physical connection, programming and data reading
- Data communication using different protocols (Node-red and MQTT)
- Data collection from commercial and didactic IoT and industrial devices
- Generate local and cloud databases
- Managing databases (in a NAS)
- Data visualization and interpretation (Python, Grafana and Thingsboard)
- Secure connections configuration (Cybersecurity)
- Orienteering activities using the lab as FabLab for primary and secondary school students
- Predictive analytics using machine learning models

These will be the main features that the IOT hub will provide

Facilites description

There are four labs within the IOT lab network:

TXORIERRI (DERIO, BASQUE COUNTRY):
LAB is located in a 70 m2 room, with 8 work places for at least 8 people (it could be escalated working in pairs). There are didactic devices (arduino and raspberry pi) used to collect data from different sensors, and also professional devices (IOT sensors and gateways), and industrial equipment (PLCs) to replicate similar exercises but with the type of equipment students will find in their professional activity.

There is also a NAS (Network Attached storage) where data will be collected from the IOT devices and used to create visualization panels. A further step will be to create a “Big” data set which could be used in Python Machine Learning exercises to extract knowledge and conclusions/predictions.

APRO (Alba, Italy):

The Lab is located in the technical department, and it covers a surface of 70 square meters. It is composed of 18 workplaces for learners and one for the teacher. It has a hexagonal desks solution in order to facilitate the team work.

A lot of commercial and industrial devices are available, in addition. The IoT lab can be easily connected to our Industrial Automation Lab to integrate more technologies in the activities.

A centralized network cabinet provide three different networks to the workplaces: the wired school network, the IoT lab network (connected to the DTAM System) and a Wi-Fi network with free connection for the users

A electronic assembling desk with soldering facilities and some 3d printers and a laser engraver/cutter are available in the IoT lab

UNiVERSITY OF PATRAS (PATRAS, GREECE)

The lab exists in the second floor of the “Karamanli Building” within the University Campus currently occupying a 84 m2 room. The lab will be renovated in 2024. Currently there is an open space structure with an administrative office and four working spaces (co-working “islands”) providing space for 20 people to work at the same place. The lab is open for students allowing for individual or collaborative work. The lab provides Arduino and Raspberry Pi, with a selection of different IoT sensors and gateways. Using these resources students can create several exercises and demos like the following ones.

DA VINCI (DORDRECHT, NETHERLANDS)

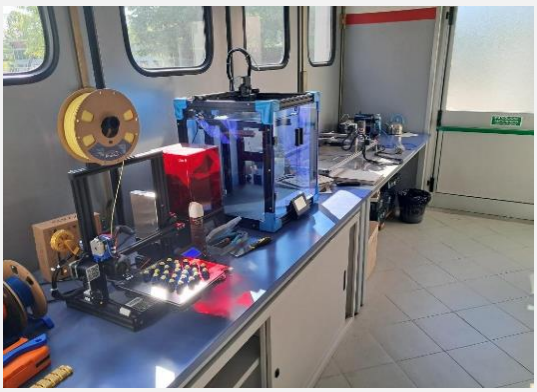
The labs are located in two buildings, one of the in Gorinchem, the other in Dordrecht. Both are educational rooms, used for both DTAM curriculum and IT Networking engineering curricula.

Gorinchem can have 30 students work in the same room,
Dordrecht can have 24 students work in the room.

Pictures of the LABs

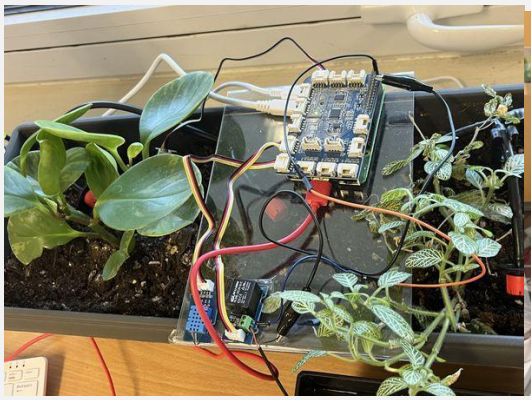
LAB in Txorierri

LAB in APRO



LAB in Da Vinci

LAB in PATRAS



Devices and connections

This is a network of labs, therefore the positive thing is that in case one of the labs has some needs which cannot be fulfilled in their own space, thanks to the interconnection it will be able to use equipment and connections from other places. This interconnection will enable the cooperation of students from different regions included in the DTAM Iot Hub.

These are the features and devices that will be interconnected and accessible from the different labs:

List of features of each lab

Each of the labs has the accessibility thanks to:

- Wired ethernet network connections available for each workplace
- Wired ethernet network connections for permanent or temporary devices
- Wi-Fi network connections available for each workplace

Devices interconnected in the IOT Hub:

	TXORIERRI	APRO	UPATRAS	DA VINCI
Arduino	x	x	x	x
Raspberry	x	x	x	x
PLC and HMI	x	x		
NAS (data storage	x	x		x
Motor drives		x		
Lora sensors and Gateways	x	x		x
Desktop, computers, screens	x	x	x	

- **Types of data to be transmitted?**

TXORIERRI	APRO	UPATRAS	DA VINCI
Data from LORA sensors (temperatura and humidity)	Data from industrial devices generated by sensor connected to PLC and by motor drives	Data from Arduino/Raspberry Pi (e.g. temperature and humidity, distance, vibration, light level, presence…)	Data from many different sensors available
Data from arduino/raspberry (temperature and humidity, distance, vibration, light level, presence…)	Data from arduino/raspberry (temperature and humidity, distance, vibration, light level, presence…)		Data from arduino/raspberry (temperature and humidity, distance, vibration, light level, presence…)
Data from PLCs (using onboard signal generators)			

- **Protocols and communications to be used**

	TXORIERRI	APRO	UPATRAS	DA VINCI
MQTT	X	X	X	X
LORA	X			X
WIFI	X	X	X	X
HTTP/HTTPS	X	X	X	X
TCP/IP	X	X	X	X
MODBUS	X			
INDUSTRIAL ETHERNET	X	X		
CYPHRED TUNNELS (VPN) TLS/SSL	X	X	X	X
INDUSTRIAL PROTOCOLS		X		

Results

The result of the network of labs will be that there will be several exercises and challenges that will be implemented in each of the labs, and thanks to the interconnection of them, it will be available for the network. After the analysis, there are a range of exercises that will be performed in the network and a set of challenges that students and other stakeholders will be able to face.

Exercises:

- Data collection using didactic IOT devices (Arduino, Raspberry with Wifi and Ethernet), commercial IOT devices (LORA sensors and gateways) and industrial devices (PLC) to store data in a NAS or in a cloud
- Data communication and conversion using Node-red and/or MQTT
- Python programming to collect, visualize and manipulate data
- Manipulation of Mysql Databases
- Data visualization exercises, using Node-red and Grafana
- Cybersecurity exercises to analize the system cybersecurity status, create secure communications and monitor the network
- Transfer of data to the Hadoop cluster for analysis and manipulation
- Basic machine learning models for data analysis

Challenges defined:

- Data adquisition, storage and visualization in an industrial company
- Cybersecurity status of an industrial company: improvement of actual status
- Improvement of efficiency using stored data
- Data analysis and visualization using Python

Data analysis at Hadoop cluster

Partnerships

Thanks to the collaboration of different partners of the LABs hosting entities, there are a broad number of stakeholders that may interact with the labs and will be engaged in the activities and services. There are some of them listed below:

- H/VET providers and their staff

  - Basque Country: Tknika, Hetel Schools interested, Public Schools interested
  - Alba: VET providers and technical shools of the region. They could use the Lab and the DTAM courses and/or take inspiration to implement themselves similar Labs
  - Western Greece: University of Peloponnese, Hellenic Open University, Olympic Training and Consulting

- Other training providers

  - Alba: Apro collaborate also with temporary employment agencies, organizing upskilling courses for workers. They coul be interested to the proposed arguments

  - Basque country: UNEMPLOYED AND LANBIDE

- Advanced Manufacturing companies

  - Basque Country: Ormazabal, Matrici, Mufer could be industrial production companies interested in training for their staff in cybersecurity and digital competences related to data acquisition and storage.
  - Alba: at least 50 PMI companies could use the DTAM and Iot Lab services

- Digital/technological providers

  - Basque Country: Nexmachina, GBM, Sarenet, Aindeep, Perseus, Lanmedia would be service providers for SMEs in the Industry 4.0 competences related to data (IOT, data management, cybersecurity). Members of GAIA that can be reached through the cluster

- Policy makers:

- Basque Country: IVAC and specializacion pogramme

- Research Centers: Those partners may be interested to use the lab for running experiments that are relevant to the domains of the DTAM curriculum.

  - Basque Country: KNIKA

- Computer Technology Institute and Press “Diophantus”
- Institute of Industrial Systems

Indicators

These are the technical capacities of the lab and we quantify which is the size of our lab network

	TXORIERRI	**APRO**	**UPATRAS**	**DA VINCI**
Nº of sensors	123	>200	106	>200
Nº of PLC screens	6	40		no PLC
Nº of engineering workstations	12	20		6
Nº of available IoT gateways	4 commercial Lora indoor 6 didactic Lora	10		1 (beta)
Nº. of connections to machines/processes		10		6 *status of many network devices in lab*
No. of open source software and learning options available via the various partner IoT Labs	Node-red, Mysql Database, Chirpstack Lora server, Arduino and Raspberry Pi, Portainer for docker administration, Grafana for visualization, Jupyter for Python compiling	open software, such as Node-red, Mysql Database, Chirpstack Lora server, Arduino and Raspberry Pi, Portainer for docker administration, Grafana for visualization, Python		Node-Red, Grafana, MySQL, PHP Webserver, Python runtime environment, Portainer for Docker containers, Arduino and Raspberry
Nº of partners and associated partners involved	Nexmachina GBM			DZH (duurzaamheids fabriek) Dordrecht
No. of specific characteristics				Lab for advanced manufacturing machines

4. IOT-Labs Network

4.1 Requisites of the labs:

These are the requirements for the IoT-lab

- All assignments from the different training modules of the DTAM curriculum can be performed in the IoT-lab
- The IoT-lab will be designed to accommodate a minimum of 10 students simultaneously, provided they work in teams of 2. This means that a minimum of 5 experimental setups need to be available.
- The IoT-labs will be connected to a central cloud, allowing for the exchange of data.
- Data will also be stored locally in each IoT-lab
- Necessary services will run locally in each IoT-lab to guarantee local availability in case of network or cloud problems.

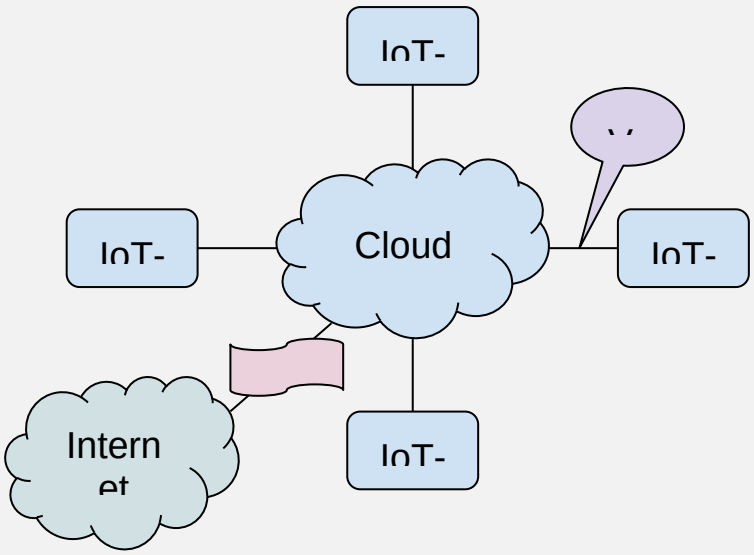
4.2 Interconnection of IoT Labs

The network of LABs must work in an interconnected manner. In order to do so, a software platform must be available that allows the management of cloud content accessed using credentials from the different LABs. This tool must function as a centralized system for managing the contents to be used on the network and must provide the following functionalities for the correct functioning of the different demonstration spaces or LABs:

- Ability to upload and manage heterogeneous content from an administration backend and distribute it to the teams in each LAB.
- The distribution of the contents must be able to be carried out securely and with controlled diffusion according to types and user privileges. Once the content has been downloaded, it must not be possible to extract it for use in another context (encrypted storage).
- The platform must consist of a cloud-backend and a series of players to be installed on each computer hosting the LABs. Each LAB must have as many user accounts as there are teams in the demonstration area in order to manage the content.

- In turn, each account must be characterized in the backend based on its nature, in order to enable the download of only content that can be run on the computer.
- The platform must offer to users multilingual access as it is an international network. Likewise, it is recommended that the players of each LAB be adapted or personalized with their corresponding name and corporate image.

In addition to those mentioned, the specific functionalities of the tool will be defined with the management team of each LAB according to the identified needs.



The basic interconnection of the IoT-labs will be through a central cloud of Sarenet. The connections to the cloud will be done via 2 different ways:

- Directly from they labs
- Through a VPN: securing all exchanged data and virtually joining all labs in one network.

For security purposes, all network traffic will be routed through the VPN connections, even internet traffic. This means that the whole network of IoT-labs is only connected to the internet at one point, making it more secure and only dependent on the configuration of one firewall.

All the existing labs have already the access to the Cloud implement, but for those labs that will join later, they will get all the information for the configuration of the access to the cloud.

4.3 Reservation system

In the DTAM moodle platform, there will be a link to the reservation system where each lab owner will be able to access and reserve different slots from other labs of the network. Each lab owner will be responsible to ensure that access to their facilities suffers no problems and ensures the connection.

5. Services

Joint Services

Thanks to the creation of the lab network, some joint services will be offered by the IOTHub in collaboration. The main service that will be offered by the IOT Lab network will be the organization of events. There are different kind of events that might be organized:

EVENT: we refer to an "event" as a sector-specific and geographically based occurrence held.

- Coordination: led by each LAB's leader.
- Duration: 1 hour.
- Audience: minimum of 8 people.
- Scope: presentation of technological innovations, case studies, etc., specific interest to a collective.
- Location: in-person/digital.

WORKSHOPS: We refer to a "workshop" as a technical event aimed at a broad audience of potential participants.

- Coordination: specialist companies in the field, in collaboration with the LAB coordinating team.
- Duration: 2 hours.
- Audience: minimum of 4 people.
- Scope: in-person training of individuals in the use of tools.
- Location: in-person/digital.

MEETING: We refer to a "meeting" as a strategic gathering related to the development of the LAB, involving participants, organizing actions, and/or designing and developing new cooperative programs.

- Coordination: led by each LAB's leader.
- Duration: 1 hour.
- Audience: minimum of 2 people.
- Scope: cooperation agreements, projects, etc. • Location: in-person/digital.

The services presented and defined below may be **sectoral or geographical in nature**, and **local or international in scope**, depending on the interests and capacities of their organizers, these were be organized depending on the type of service as a kind of event defined in previous section. These are the main services:

Awareness / Demonstration

Sharing the advantages and benefits arise from the practical use of IOT technologies and devices in the advanced manufacturing field. Some different activities with different formats might be organized.

Training

Execution of professional training services as main service for students but also for professionals from companies and partners of LAB owners.

Education

Development of services linked to the training of people with professions that involve risks for others or for themselves during the execution of their functions.

Research / transfer

Study, formulation, testing or experimental application of new products, solutions and/or technologies.

(Intra) Entrepreneurship

Identification of business or service opportunities, definition of projects, metrics and/or resources necessary for the improvement of processes, or the creation of new strategies, structures or technology-based organizations.

Disclosure / Dissemination

Socialization of new technologies, systems, solutions and/or success stories.

Networking

Socialization of the work model for the incorporation of new offer members to the network of collaborators and the demand for solutions.

Marketing

Sample of the possibilities of customizing solutions adapted to the needs of specific clients, closing offers, etc.

Demand generation and demonstrations

Physical place where industry can check the current application of IOT devices in form of best practices in different sectors and the possibility to apply to their own companies.

Management of the services

It is suggested that the LABs 'dynamization and coordination tasks be carried out by two complementary profiles. Their dedication can be partial or total, depending on individual resources and expectations:

Organizer/Facilitator

It is suggested that group organization and relationship building tasks be carried out by a person with leadership skills and in-depth knowledge of the structure of the regions' innovation system. They must be familiar with the main administrative and business

partners to have easy access to the different existing structures generating confidence and having sufficient legitimacy and credibility to act and mediate.

Similarly, it is preferable for this profile to have basic or average technical knowledge regarding immersive products and technologies and how they work. The profile should understand the way the lab works sand know how to mediate in a basic way between business supply and demand.

Technical secretary

It is recommended to have a support person who can facilitate the execution of actions between participating people and organizations. Similarly, the profile person should have basic skills to set up the rooms, devices and systems, in order to be able to adapt them when visits are made.

6. Management of the Lab Network

Roles for the management

The continuation and the exploitation of the DTAM IOT hub and the sustainability model will be possible thanks to a management structure which will enable the coordination of actions within each of the labs but also the whole network. That is why it is important to establish certain roles for the coordination of the IOThub. It is important to say that these are rotatory roles and can be changed/adapted temporarily. These roles will consist on a "Steering Committee" which will serve as a working group for:

- Managing the joint activities
- Sharing best practices
- Updating information about status and events happening in each labs
- Accepting new members and collaborations
- Seeking new projects
- ...

These are the specific roles assigned for the management of the IOT hub:

- **DTAM IOT Hub Coordinator**

The role will be the overall coordination of the activities of the lab network and joint activities. It also implies the coordination of monthly/bi-monthly meetings for the updating of activities and proposals of new actions. This person will also be the contact point to the enquiries coming from outside IOT Hub Network or the interest of new entities to join this hub.

- **Lab responsible**

Each of the labs will assign one person who will be responsible to report and update information about the individual labs. This person will report about stakeholders collaborating, events, funding schemes and all relevant information from each of the labs which can serve to the whole team as applicable or as best practice.

- **Expert guests**

Other kind of stakeholders not directly managing the labs might be invited to participate in the labs to solve any problem or suggest certain activities. These partners will be proposed by any member of the steering committee

- **Treasurer**

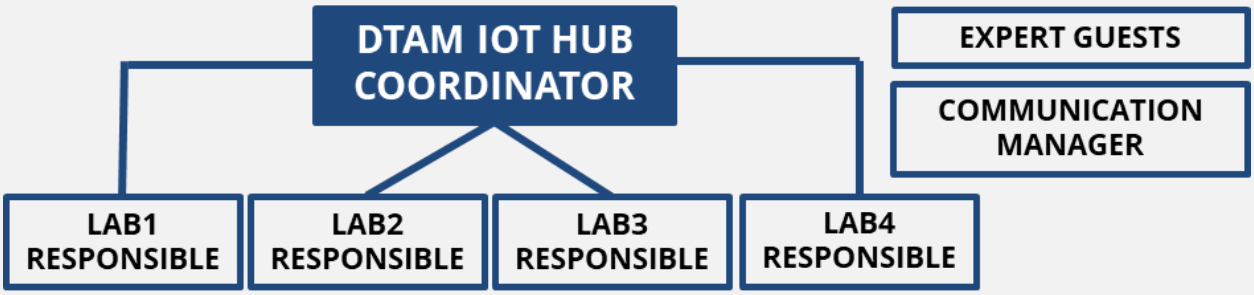
In case, at the end there is a need to create a joint bank account and perform joint activities, a treasurer might be selected to keep the money and perform the transactions. At this stage it is not foreseen the need of this role, but in the future, it might be considered.

- **Communication manager**

There will be one partner responsible to coordinate all the actions related to communication. The task will be to follow-up the communication plan, set-up and maintain social channels, monitoring of communication actions… the tasks are defined in the communication plan developed further.

Meetings:

The DTAM IOThub will have follow-up meetings every two months and the responsibility of hosting them and taking notes will be of the DTAM IOT Hub Coordinator. This person will have to organize the meeting and invite all people involved in the steering committee.



Steering Committee composition

7. Communication Strategy

The DTAM project will establish a DTAM IoT International network with an open call for VET centres with an IoT lab (or a lab projected / under construction) to participate in the DTAM open lab initiative. The following communication strategy aims to create publicity and attract and grow the international network of DTAM labs, making more labs available for learners via the DTAM hub or IoT creation experiences available for VET 4.0 centres.

External communication

The external communication of the DTAM IoT hub is focused on increasing the awareness of the DTAM network and its mission to foster digital transformation in advanced

manufacturing environments. On the other hand, the partnership efforts will focus on - promoting collaboration among the various stakeholders e.g. VET schools, universities, and businesses in implementing IoT solutions, while encouraging other labs to join the DTAM network by highlight the benefits of the network, such as **access to remote facilities and knowledge sharing**.

In particular, the LABs have three direct objectives related to communication aspects:

1. Involving supply companies that can provide educational and practical content.
2. Involving requesting companies, students and other interest groups interested in the use, training and/or exploitation of IOT solutions i.e. exploring new technologies and services.
3. Sharing good practices and publicizing the progress made.

The objectives are complemented by the following indirect objectives:

1. Positioning the network as a reference for laboratories in the participating regions.
2. Creating and strengthening the image of the network and its solutions.
3. Identifying useful talent for the different participating interest groups.

Segmenting the target audience

The network targets its communication action at the following specific interest groups

	TARGET AUDIENCES
Students	VET students, High school students, and university students majoring (interested) in digital transformation and advanced manufacturing.
Educational Institutions	VET schools, universities, training centers and their staff
Adult learners	Professionals seeking to enhance their skills in IoT and digital transformation.
Businesses	AM companies, digital/technological providers , manufacturing companies, SMEs, and industrial organizations.
Other Labs	Existing labs with IoT capabilities that can contribute to and benefit from the network.

Channels

The network will share the following channels to reach its preferred recipients:

	Digital channels	Traditional channels
TXORIERRI APRO UPATRAS DA VINCI	- Network website - Own website - Social media - Mailing - Webinars - Bulletins or Newsletters	- Telephone communication - Individual emails - Newspapers, television and radio: Interviews, press releases, Tribunes etc.

Resources (dissemination materials)

The network has its own corporate identity, as well as a series of useful materials for communicating the activity:

- Presentations
- Website: www.dtam.eu
- Project brochure.
- Roll up
- Testimonial videos
- Social media channels

Detailed materials must be convenient and frequently updated to meet the communication needs of the network. In particular, they must be adapted to the specific circumstances required by each of the actions carried out.

English is the official language for this program. However, each of the members of the network is responsible for the creation of communication content for the actions carried out in their corresponding regions.

Social media

The network will use two social networks for its dissemination operations: Facebook and Twitter. The following will be news publishable by the network:

- Schedule of planned actions
- Results of previous actions
- New Projects.
- Process improvements.
- Case studies.
- Commercial/technical agreements.
- Technology related news

Communication operations agenda

Each of the network's action will be accompanied by a series of digital communication and marketing operations, starting with the completion of the current project. The network schedules is the following:

	Pre-event communications	Post-event communications
Online event	Twitter LinkedIn (via partner's pages) Mailing	Twitter LinkedIn (via partner's pages)
Workshop		
Media publications	Mailing	Twitter Linkedin (via partner's pages)

Pre-event communications will be undertaken one month prior to the action, and will be repeated weekly. During the last week, they will be communicated twice.

The post-event communications will be sent one day after the celebration of the action, and will be repeated one month after being published.

Specific ascites to be implemented:

- Host a dedicated online event;
- Specific new media (infographics and articles)
- F2F reach out to TGs
- Videos to showcase the labs (e.g. explaining the network's mission, lab capabilities, and success stories)
- Project website invitation

Dissemination reach targets:

- At least 1 online event;
- 3 infographics & 3 articles;
- Attract at least 1 other VET from each country;
- Contact national VET public bodies;

Homogeneity of external communication

The network considers necessary to homogenize the messages to be sent. In order to do so, it is required the monitoring of communication actions. The network will exploit the existing Dissemination & Promotion and manager of the DTAM project (RCCI), who will plan and share the planned communication activities for the next period, and to review those carried out during the current period.

Measurements will need to be carried out in order to assess the impact of communication actions on the network's target audience. To do so, the communication manager will monitor the following indicators:

- Number of new followers per social media channel.
- Number of comments on posts.
- Number of interactions on posts.
- Number of shares of posts.
- Total number of followers.

**In general, the defined indicators will be followed by the designated communications team for the development of the project.*

Keywords

IoT, IOTHub, DTAM, Digital labs, Innovation, Digitization, Advanced Manufacturing, IOT, Digital skills

Key Message

Join the "Digital Transformation for the Advanced Manufacturing" IoT Network!

Hashtag

#DTAM

#DTAMIoTHub

#DigitalTransformation

#AdvancedManufacturing

#IoT

#Industry 4.0

#DigitalIndustry

Complementarity of individual channels and resources

Each partner is responsible for building and maintaining communication with their own network of contacts and collaborators. Moreover, in relation to its regular press channels, through periodic information on the activity carried out on the network.

Internal communication

The Communication Team will be continuous and fluid. The following resources will be used:

- **Face-to-face meetings.** The network is committed to seeking resources to carry out missions and visits to the different nodes, in order to strengthen relations and generate transnational teams. The aim is to have at least a physical meeting every year
- **Videoconference.** At least every two months, and whenever necessary.
- **Email.** When required.
- **Phone calls.** When required.

All members of the network are responsible for maintaining communication and contributing to the network relationship. Communication will be bidirectional: from the labs to the network, and from the network to the labs. Each member is responsible for creating their own communication activities. The network is also responsible for generating new communication operations and their publication.

8. Sustainability Model

Funding sources

The project's partner organizations have committed to the absence of current and/or future funding for the promotion and/or maintenance of the lab network and its activity. Each of the partner will be using the labs with their students as daily basis, both in formal education, but also for the unemployed people and for the upskilling of workers.

The funding of the LAB network is built based on the existence of the organizations with legal capacity as lab hosts, which will be responsible for its dynamization and management. The resources and equipment available to the network have therefore been made available by these organizations for its general promotion. Thus, three main sources of financing are considered for the maintenance of the LABs:

1. **Participation in programs:** public subsidies received by the different "sub-networks" of organizations that based in a laboratory or its network, present projects to the administration. Working together with relevant stakeholders will help to create new projects which might be supported by the local, regional or national public bodies. ERASMUS+

2. **Direct contributions by lab participants:** continuity in the provision of resources by the network as a monthly/yearly fee to maintain
3. **Income by activities: COURSES** charging different stakeholders for the use of the different services defined might be interesting in order to find a business model which can be applied to the sustainability of the IOTHub.

Different "sub-networks" constituted may be internal to each node, or superior, transcending the geographical area of the node and including other members of the network.

The partnership will further support the sustainability of the project by:

- Organizing local webinars and workshops to engage with stakeholders, share knowledge, and promote the benefits of joining the DTAM network.

- Collaborating with industry associations, educational institutions, and business networks to host joint events, conferences, or panel discussions on digital transformation and IoT in manufacturing.

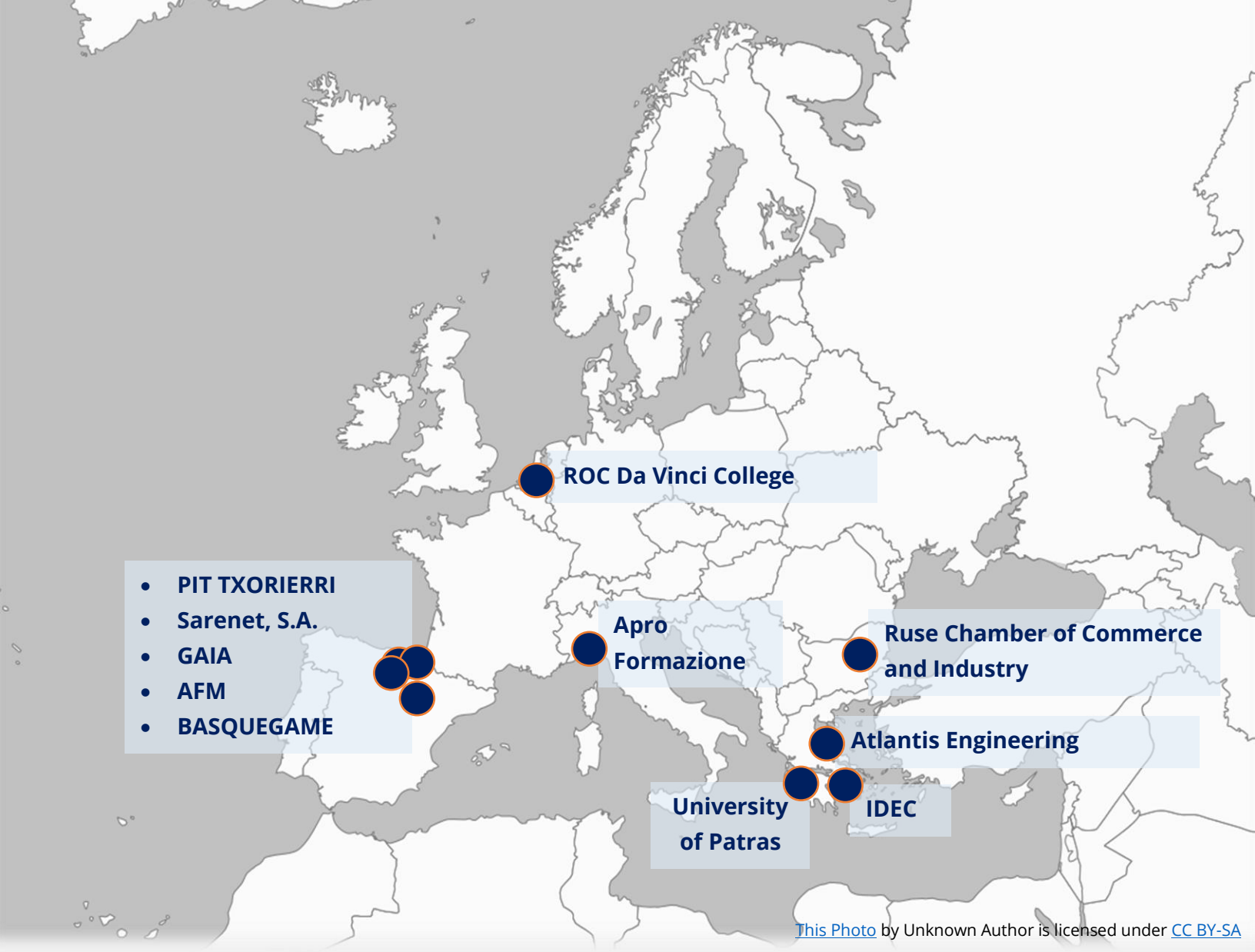
- Attending relevant conferences, trade shows, and exhibitions to showcase the DTAM network, connect with potential partners, and generate leads.

- Establishing strategic partnerships with industry leaders, IoT solution providers, and technology companies to leverage their expertise, gain visibility, and enhance the offerings of the DTAM network.

- Collaborating with educational institutions and training centers to integrate DTAM network services into their curriculum and offer joint programs or certifications.

In addition the partnership will establish a referral program that incentivizes current members of the DTAM network to refer new labs, educational institutions, or businesses to join the network. The incentives will include discounts, exclusive access to resources, priority in booking time or recognition for successful referrals.

The innovative nature of the network makes the ability of its members to identify and attract funding from regional/national funding programs critical to maintain its structure and operations.



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