D3.12 - IOF2020 REFERENCE CATALOGUE FOR THE REUSE OF OPEN PLATFORMS

WP 3

May 16th, 2019

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PROJECT SUMMARY

The internet of things (IoT) has a revolutionary potential. A smart web of sensors, actuators, cameras, robots, drones and other connected devices allows for an unprecedented level of control and automated decision-making. The project Internet of Food & Farm 2020 (IoF2020) explores the potential of IoT-technologies for the European food and farming industry.

The goal is ambitious: to make precision farming a reality and to take a vital step towards a more sustainable food value chain. With the help of IoT technologies higher yields and better-quality produce are within reach. Pesticide and fertilizer use will drop and overall efficiency is optimized. IoT technologies also enable better traceability of food, leading to increased food safety.

Nineteen use-cases organised around five trials (arable, dairy, fruits, meat and vegetables) develop, test and demonstrate IoT technologies in an operational farm environment all over Europe, with the first results expected in the first quarter of 2018.

IoF2020 uses a lean multi-actor approach focusing on user acceptability, stakeholder engagement and the development of sustainable business models. IoF2020 aims to increase the economic viability and market share of developed technologies, while bringing end-users' and farmers' adoption of these technological solutions to the next stage. The aim of IoF2020 is to build a lasting innovation ecosystem that fosters the uptake of IoT technologies. Therefore, key stakeholders along the food value chain are involved in IoF2020, together with technology service providers, software companies and academic research institutions.

Led by the Wageningen University and Research (WUR), the 70+ members consortium includes partners from agriculture and ICT sectors, and uses open source technology provided by other initiatives (e.g. FIWARE). IoF2020 is part of Horizon2020 Industrial Leadership and is supported by the European Commission with a budget of €30 million.

EXECUTIVE SUMMARY

Deliverable D3.12 represents a catalogue of IoT components, with the objective of supporting initially the IoF2020 use cases, and later a wide audience of IoT users and providers, in identifying and re-using components that were successfully developed, integrated, deployed and validated. The Deliverable 3.12 comes from the effort of developing a platform to show the use cases in a structured and interactive way, and to present the reusable components across them. Reusable components occur in the form of IoT products, platforms and software that are being used to solve problems in different use cases.

The 'catalogue of IoT (reusable) components' is aimed especially at IoT users (particularly at advisors working close to the farmers) and technology providers/integrators of IoT solutions. The catalogue is intended to include all the features as to allow users to access the information in order to identify and choose (reusable) components for their applications/projects.

The 'catalogue of IoT (reusable) components' enables to showcase the results of two WP3 objectives:

- Identify common platform APIs and generate common information models, context adaptors and components, which can be integrated into different IoF2020 use cases;
- Facilitate identification, coordination and realisation of synergies in use cases. Identify and/or develop platform and IoT device related common components relevant for several use cases in WP2.

Instead of developing a platform from scratch, it was chosen to use and improve the already existing IoT-Catalogue (available at http://www.iot-catalogue.com). The IoT-Catalogue is a result of the H2020 research project WAZIUP, where it was used to present its use cases. The IoT-Catalogue is a web-based catalogue for Internet-of-Things (IoT) solutions. It brings IoT users and technology providers together, from the domain needs to IoT products (and back) via validated solutions with components, assembly guides, and more.

In IoF2020, the IoT Catalogue is being exploited to be a public website that showcases the technology dimension of the Use Cases. For this, it has a dynamic interface that shows what composes a use case and how they are linked together, by showing its Domain, Value propositions, ICT Problems, functions, target, and used solutions.

IoF2020 had more demanding needs in terms of the use case information than what was present in the already existing version of IoT-Catalogue. Therefore, the IoT-Catalogue was improved in IoF2020 to provide new capabilities that meet the new requirements. The Use Case interface follows a new modelling approach to accurately represent this new Use Cases information, supporting this new dynamic interface.

At the date of release of this document, 15 out of the initial 19 use cases are publicly available in the IoT-Catalogue of reusable components. For a use case to be public, it goes through a well-defined process of feedback and approval which ensures that the available information is updated, depicts the current status of the use case, and that no confidential information is made public. This feedback process is supported by a private version of the IoT-Catalogue, which is protected with password, only accessible within the consortium, to support the interactions of the use case partners and the IoT-Catalogue team. Due to the complexity of the information within the use cases, it was expected that the use cases were made publicly available at different times. This is an ongoing process, of collecting, approving and publicising information for the project's use cases.

TERMINOLOGY

The IoT-Catalogue is based on some concepts that define how information is presented to the users. And they are the following:

Case Studies	Show a real utilization of a technology to solve a real problem.
Value Propositions	Domain specific added value represented by the IoT solution.
ICT Problems	This is an Information and Communication Technologies problems, so it depicts anything solved by a technological solution.
Validations	Describes if the solution works in real world, i.e. the solution was tested by real people.
Components	Components have intrinsic characteristics and are used to characterise the device. This can be a software module, an electronic component, etc. Devices help to reach the desired solution/function.
Products	A Product can be a product by itself or composed by components. Product help to reach the desired solution/function.
Platforms	This is how the digital data can be showed and allows to access information from anywhere.
Libraries	Libraries are a collection of code that makes it easy for users to interface any type of device. Libraries facilitate how users interact with hardware and manipulating data.
Learning	It is set up as a series of steps that progress through levels of difficulty and understanding.
Region	Represents the geographical area where a use case applies.
Place	It is the location where a use case is being deployed, depicting is individual characteristics.

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1. INTRODUCTION

1.1. WHAT IS THE IOT-CATALOGUE?

The IoT-Catalogue is a web-based catalogue for Internet-of-Things (IoT) solutions, available at www.iot-catalogue.com. The IoT-Catalogue brings IoT users and technology providers together, from the domain needs to IoT products (and back) via validated solutions with components, assembly guides, and more.

The IoT Catalogue offers specifically the following features to two target groups:

IoT Users:	**Technology Providers:**
• Information about domain specific problems that benefit from IoT Technologies • Understand which IoT functionalities create added-value to the end-users • Explore Real-World IoT Solutions	• Access to the list of components that compose a product • Get guidance on how to assemble a product • Compare prices between stores • Match products with IoT functionalities

Each use case is characterised in terms of value propositions, ICT problems, functions, targets and domains. This characterisation is part of the validation, which includes information about places where that occurs, who was the responsible and the team, photos (it can be showing the assembly process and so on) and the products were used to address the problem.

The IoT-Catalogue shows value propositions, in an effort to bring together the needs from the IoT and the application domains, highlighting the added value to the company/user. In addition, it shows ICT problems in easy to understand terms, describing issues needing a technological solution, i.e. different kind of functions needed to get the problems solved, where they will be applied and domain depicting its area of interest.

Validation is a key aspect of the work and showcases that the presented solution works in the real world. This mean the solutions were tested by actual stakeholders.

1.2. WORK CONTEXT

IoT-Catalogue Use Case functionality is one of the improvements done in the context of Task 3.3: Smart Agri-food Open Platforms. This task will specify and develop common smart agri-food Open Platform components that could potentially be applied and integrated as part of Open Platforms utilized in the implementation of the different use cases.

IoT-Catalogue address the objective created on the Description of Action: *"IoF2020 will provide a catalogue of reusable system components, which can be integrated in the IoT systems of multiple use cases of the project, and beyond to support large-scale take-up. It is a concrete repository that goes much beyond a checklist and includes practical guidelines and implementation tools. The catalogue is structured based on the IoF2020 Reference Architecture in order to support systematic reuse. It will include as much as possible existing components from previous and running projects and (open source) initiatives, including FIWARE, FIspace, CRYSTAL, SOFIA, EPCIS, and also commercial systems like 365FarmNet, SigFox, among others. If needed, the components will be adapted to the specific requirements of the involved end-users to bring them to new levels of interoperability and fitness for use." as a web-based tool, that provides a information about the reusable components, by showing on which use cases they are being used, what they provide, and how and for what they are being reusable.*

1.3. IOF2020 INFORMATION @ IOT-CATALOGUE

At the date of release of this document, 15 out of the initial 19 use cases are publicly available in the IoT-Catalogue. For a use case to be public, it goes through a well-defined process of feedback and approval, which ensures that the available information is updated, depicts the current status of the use cases, and that no confidential information was made public.

The IoT-Catalogue is a tool, that makes available to the outside world, a set of work done across several activities in the project, and makes them together in a way to proper describe in an interactive way what is a use case, and the components being reused across them.

In the following two sub-chapters, the source of information used as baseline to IoT-Catalogue is identified, and the process of feedback and approval is described.

Data Sources

The IoT-Catalogue presents a set of information that is the aggregation of the complementary work packages of IoF2020. In the following bullets, there is detail per work package about the most relevant outcomes, in terms of deliverables that were used for inserting the information in the IoT-Catalogue, and the detail of where that information relates to the IoT-Catalogue.

- WP2: *D2.2 Trial Implementation Plan*: this deliverable includes a detailed plan for implementation of each trial and individual use-cases outlining "Who does what, when and how?" to the tiniest detail. The plan was developed on Trial and Use-Case level and includes: definition of the exact areas/facilities of deployment, technical requirements (number of devices, data storage space, etc.). *D2.3 Installation, Customization and Integration report*: According to pre-defined templates, this ICI Report was delivered by all use cases, compiled and publish as a joint ICI report. It describes the installation process customization and integration steps taken, and arisen issues and the way they were solved.
    - Taking in account the D2.2 and D2.3 have the detailed information about the deployment site, the installation process at a Trial and Use Case level, it allowed to get information to be used in the IoT Catalogue like components used in each use case, Value propositions, ICT Problems, Entities involved in the process, deployment sites and photos.
- WP3: *D3.9 Progress Report on Synergy Analysis, Decisions and Coordination of Work* (Excel result of the analysis): All use cases are analysed for synergetic developments and decisions by the PIB. Related synergies and decisions were documented and communicated in the scope of this deliverable.
    - The synergy analysis provides information about each use case taking into account categorization and IoT Function, allowing the IoT Catalogue to be fed in terms of IoT Function, target and domains.
- WP4: *D4.1 KPI Catalogue for Each Use Case*: This deliverable lists all KPIs and variables measured regarding its business impact and shows the value network characteristics of each use case. This might be a valuable source for other companies in these fields to assess their performance and enhance the understanding of market potentials.
    - The Business impact is a valuable information to be used in the IoT Catalogue as a Value Proposition.

Additionally, the IoT-Catalogue includes relations between Value Proposition and ICT, taking into account all the deliverables analysed, identifies which products (aggregate products if needed) address certain ICT Product, extrapolates some Value Propositions/ICT Problems and identifies different validations taking in account if there are different sensors in each deployment site. All this information is being represented as described in ANNEX 2 and this structure was made take in account the IoT Catalogue characteristic and the needs to show use cases.

Use Case Information Dataflow

IoT-Catalogue has a very strict approval process for having use cases' information public. This is to ensure quality of information, because the use case partners responsible for the deployments do the final check on the information, and to protect them from confidential information to be made public. The main objective of this process is to guarantee the catalogue always contains updated information for each use case.

To tackle this, it was created a private and internal version of the IoT-Catalogue for members of the consortium only, which allows interaction between the use case responsible and the information on the IoT-Catalogue, allowing a feedback process to be made, which ended on an explicit authorization on the information made publicly available. This flow can be seen in the next diagram:

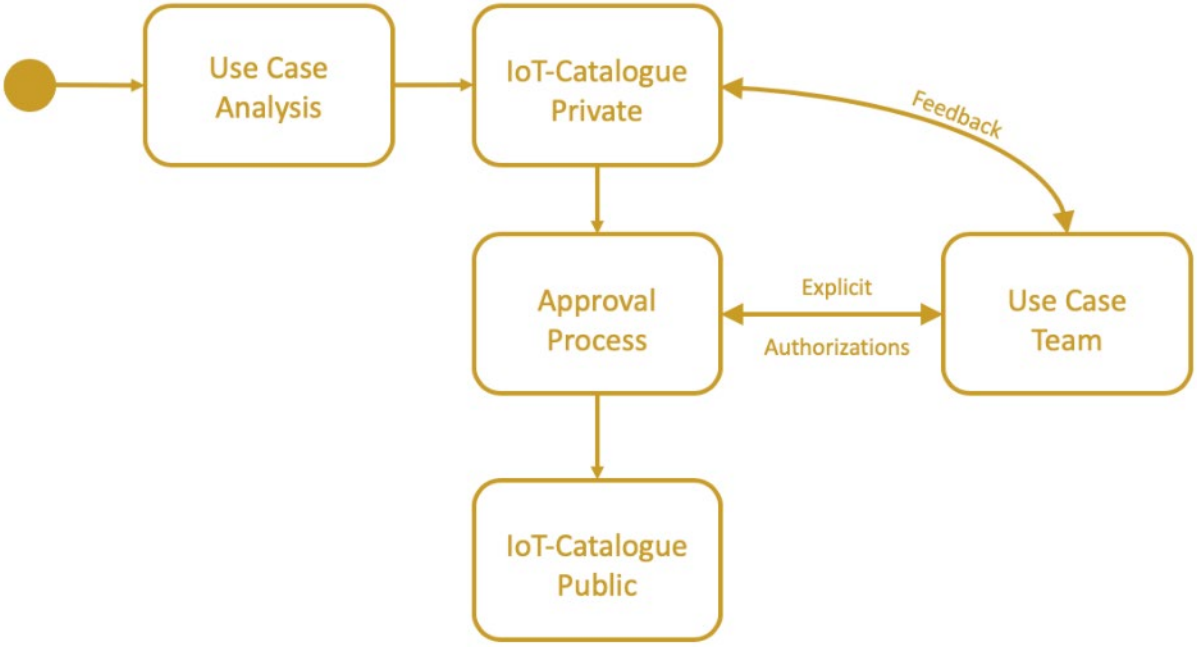

Figure 1: Data Workflow

2. IOF2020 @ IOT-CATALOGUE

Instead of developing a platform from scratch, it was chosen to use and improve the already existing IoT-Catalogue (available at http://www.iot-catalogue.com). The IoT-Catalogue was started and is a result of the H2020 research project WAZIUP, which was already used to present the use cases from the project.

In IoF2020, the IoT Catalogue is being exploited to be a public website to showcase the technology dimension of the Use Cases. For this, it has a dynamic interface that shows what composes a use case and how they are linked together, by showing its Domain, Value propositions, ICT Problems, functions, target, and used solutions.

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Each use case is characterised in terms of value propositions, ICT problems, functions, targets and domains. This characterisation is part of the validation, which includes information about places where that occurs, who was the responsible and the team, photos (it can be showing the assembly process and so on) and the products which solve the real problem.

The IoT catalogue shows value propositions, in an effort to bring together the needs from the IoT and the application domains, it highlights the added value to the company/user. In addition, it shows ICT problems in easy to understand terms, describing issues needing a technological solution, i.e. different kind of functions needed to get the problems solved, where they will be applied and domain depicting its area of interest.

Validation is a key aspect of the work and showcases the presented solution works in the real world. This mean the solutions were tested by actual stakeholders.

The current chapter is divided in three sections:

- IoF2020 Landing page: It is the entry point for the IoF2020 Use Cases, showing an overview with some statistics about all use cases and reusable components;
- Case Studies Statistics: It shows the detailed statistics about the information available in the IoT-Catalogue;
- Reusable components: It demonstrates where and how the IoT Catalogue shows the reusable components.

2.1. IOF2020 LANDING PAGE

This landing Page about IoF2020[1] has a short summary about the IoF2020 project in the bottom, the available trials (1), the use cases with brief introduction of each one (2), statistics (3) and a list with the most reused components (4), as shown in the next picture.

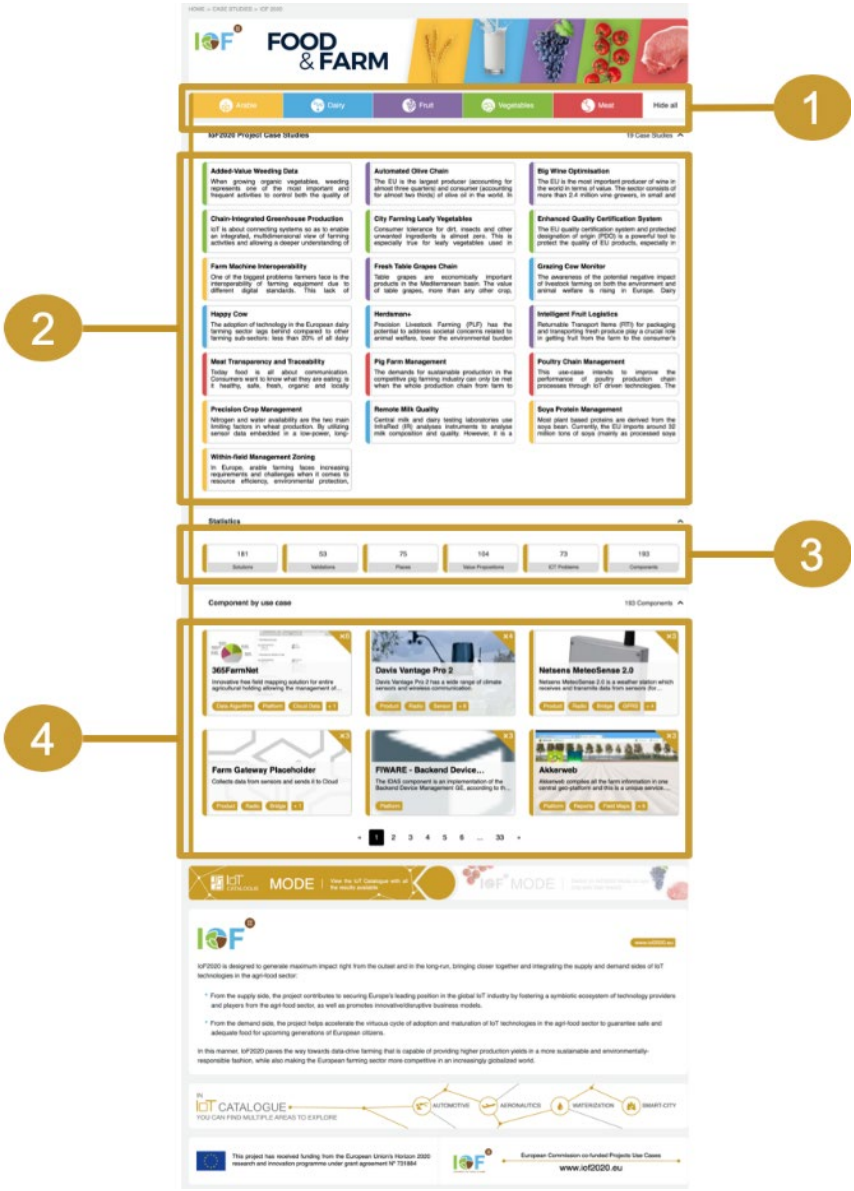

Figure 2: IoF2020 Landing Page.

Each section on the page shows the following:

1. IoF2020 trial selector. It has five options: Arable, Dairy, Fruit, Vegetables and Meat. It also has a shortcut to view or hide all. Depending on the selection, the following options change to reflect the current selection;

[1] https://www.iot-catalogue.com/usecases/IoF2020

2. All the use cases according to the trials selected. It is possible to go directly to the use case clicking in the card;
3. Statistics about solutions, validations, places, value propositions, ICT problems and products according to the chosen trials;
4. A list with how many times the component was reused.

Selecting only one option (trial), the information will be changed accordingly as we can see in the figure below. This shows how dynamic the landing page is.

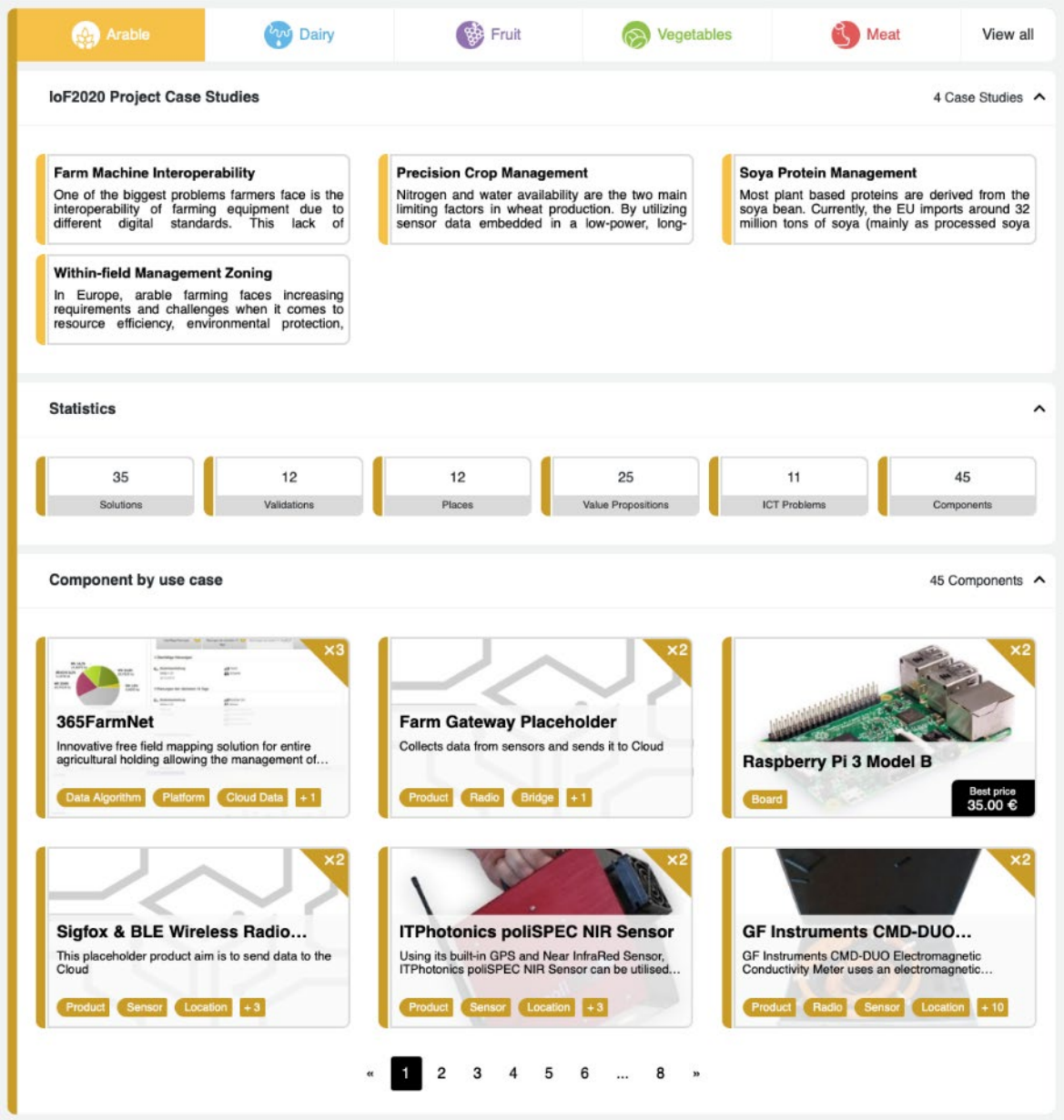

Figure 3: IoF2020 Landing page with Arable option selected.

If all options are selected, all case studies will appear in the IoF2020 landing page.

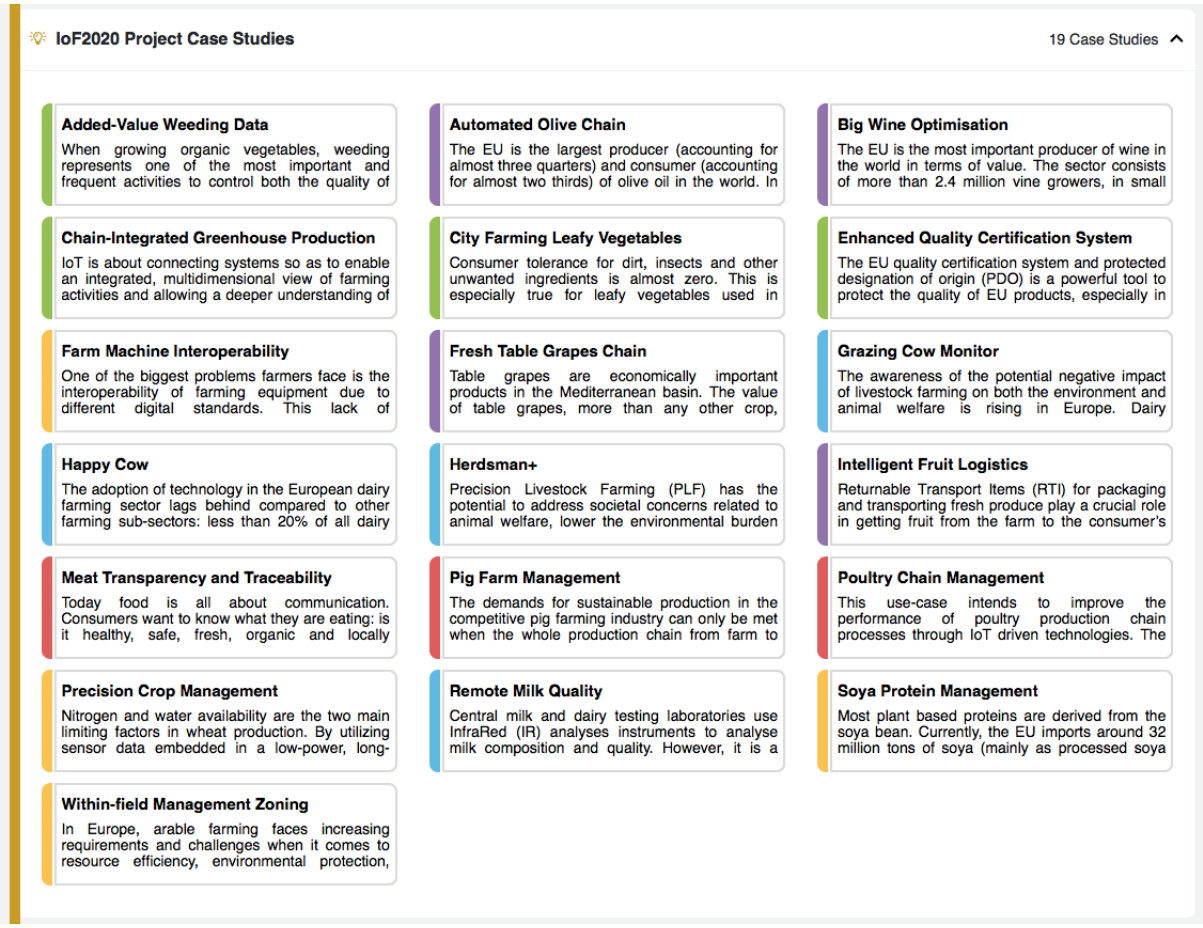

Figure 4: IoF2020 case studies.

The following statistics are available (the figure shows statistic for all trials):

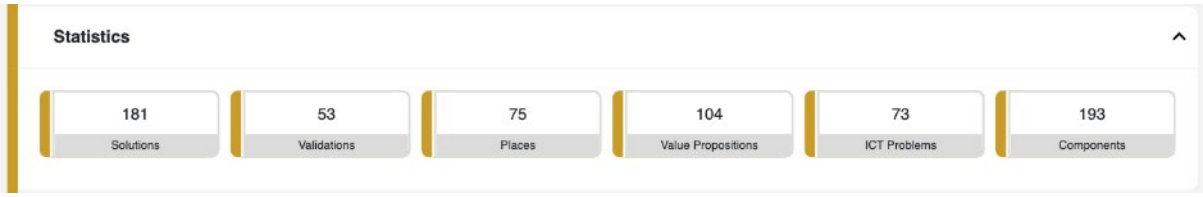

Figure 5: IoF2020 statistics.

We also have a list with the most reused products in IoF2020 use cases at the bottom of the page.

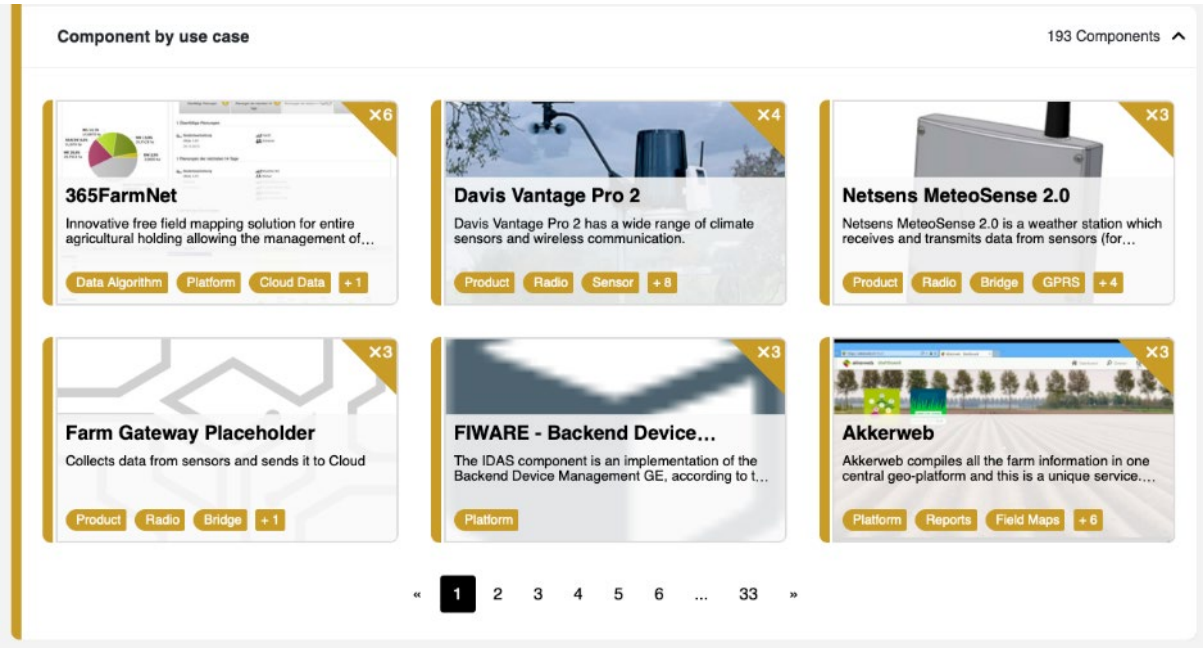

Figure 6: IoF2020 Component by use case sorted by "most reused component".

2.2. USE CASE STATISTICS

Statistics are the easiest way to show the type and number of information available in the IoT-Catalogue. Statistics allow users to get a quick overview about what is being studied in all the IoF2020 Use Cases available.

Table 1 shows how many validations, places, value proposition, ICT problem and products exist in all IoF2020 case studies[2].

Table 1: IoF2020 Statistics.

Name	Validations	Places	Value Propositions	ICT Problems	Products
IoF2020 Case Studies	53	78	104	73	193

In Table 2, the case studies are divided in the different trials, to get a different view.

[2] Since the IoT-Catalogue is a web-based tool in constant evolution, the live numbers can be different.

Table 2: Statistics about each trial.

Trials	Solutions	Validations	Places	Value Propositions	ICT Problems	Products
Arable	35	12	13	25	11	45
Dairy	23	6	10	14	7	26
Fruit	47	14	25	18	20	48
Vegetables	41	10	15	23	16	51
Meat	35	11	15	33	29	39

In Table 3, trials were divided in case studies individually and now we have statistics about each one.

Table 3: List of the actual use cases available in IoT Catalogue.

Trial	Name	Countries	Validations	Regions	Places	Products	Value Propositions	ICT Problems
Arable	1.1-Within-field Management Zoning	2	2	3	3	21	8	11
	1.2-Precision Crop Management	1	1	1	3	13	13	8
	1.3-Soya Protein Management	2	4	5	6	10	11	8
	1.4-Farm Machine Interoperability	4	5	7	7	25	19	18
Dairy	2.1-Grazing Cow Monitor	1	1	2	2	7	7	5
	2.2-Happy Cow	4	1	4	4	4	6	6
	2.3-Herdsman+	2	3	3	3	15	3	5
	2.4-Remote Milk Quality	1	1	1	1	3	5	5
Fruit	3.1-Fresh Table Grapes Chain	2	5	5	7	18	7	13
	3.2-Big Wine Optimisation	1	2	2	5	17	8	11
	3.3-Automated Olive Chain	2	6	2	12	14	7	10
	3.4-Intelligent Fruit Logistics	7	>7000	30	>7000	5	3	11
Vegetables	4.1-City Farming Leafy Vegetables	1	1	2	2	12	8	9
	4.2-Chain-Integrated Greenhouse Production	1	6	3	10	22	7	16
	4.3-Added-Value Weeding Data	2	2	2	2	8	5	7

Trial	Name	Countries	Validations	Regions	Places	Products	Value Propositions	ICT Problems
	4.4-Enhanced Quality Certification System	1	1	1	1	9	7	8
Meat	5.1-Pig Farm Management	2	7	6	7	25	12	17
	5.2-Poultry Chain Management	1	3	4	5	13	7	16
	5.3-Meat Transparency and Traceability	1	1	3	3	1	17	8

2.3. REUSABILITY

A single component can be used to solve problems among several use cases. For example, the weather data obtained from a meteorological station (Davis Vantage Pro) can be useful for a use case dedicated to arable and a use case dedicated to fruit. Knowing that a component is being reused is useful to find other entities working or developing projects with needs similar to yours, allowing the cooperation between several entities with similar interests. This information, which is often hard to obtain, is modelled and provided by the IoT Catalogue.

IoF2020 Reusable Components

In IoF2020, there are 19 use cases characterized by five different trials; each use case contains several components to solve the problem proposed, and in some cases a component is used among different use cases and trials of IoF2020. Figure 7 shows the number of reusable components according to the number of use cases.

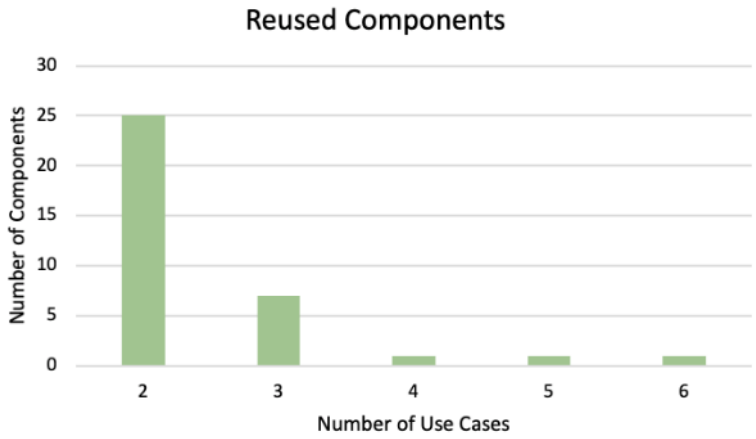

Figure 7: Number of Components reused on use cases.

A component can be reused among different use cases from the same trial or from different trials. For example, a ground sensor (ECH2O 5TE Ground Sensor) is used on Automated Olive Chain and on Fresh Table Grapes Chain, which are two use cases from the same trial (Fruit). This indicates that this component has a specific purpose. However, a platform used for big data analysis (FIWARE - BigData Analysis - Cosmos) is used on Chain Integrated Greenhouse production and Precision Crop Management, two use cases from different trials (Vegetables and Arable). In this case, this component

has a more generic purpose. The following Table 4 gives information about which components belong to different use cases from the same and different trials.

Table 4: Reused components in the same and in different trials.

Number of Use Cases	Same Trial	Different Trials
2	20	5
3	0	7
4	0	1
5	0	1
6	0	1

Reused Components on IoT Catalogue

In this section, it will be showed how the reusable components are presented in the IoT Catalogue. To make this happen, it was necessary to model all information based on the identified data sources presented at the introduction, which results in the data model in the ANNEX 2.

The IoT Catalogue shows where the reusable components are used on:

- Products
- Components
- Value Propositions
- ICT Problems
- Platforms
- IoF2020 Landing Page

Products

Products page has a bar called “Used on” which demonstrates in which use cases the product is being used.

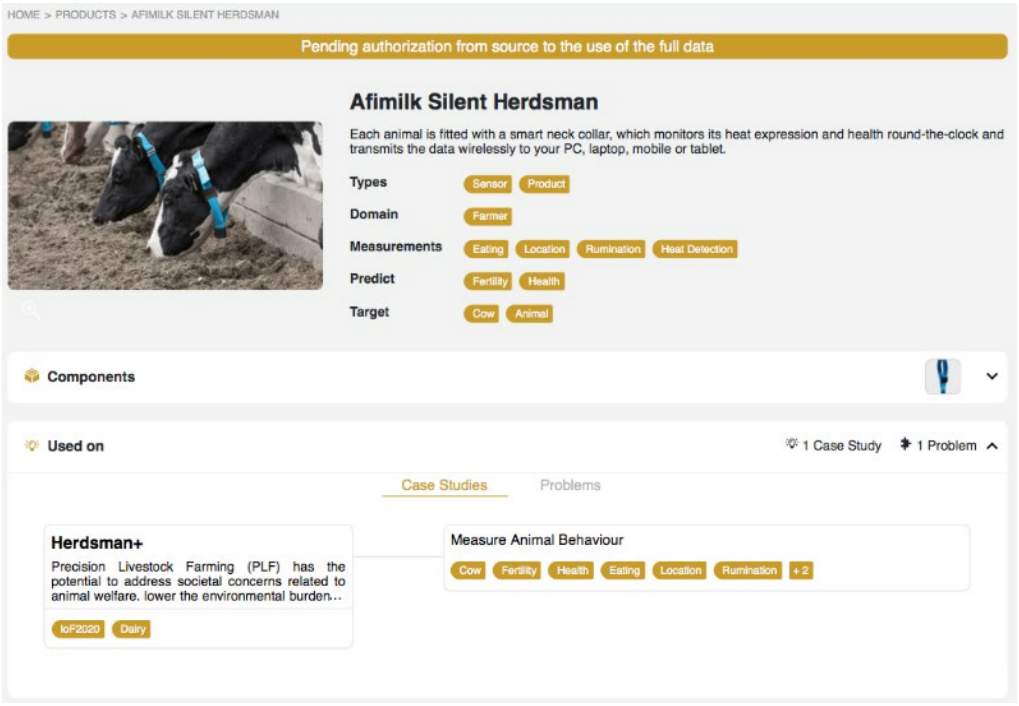

Figure 8: Products "Used On" bar, showing where it's being used.

Components

The Components page is very similar to the previous page showed and it has a bar called "Used on", which demonstrates in which use cases the component is being used.

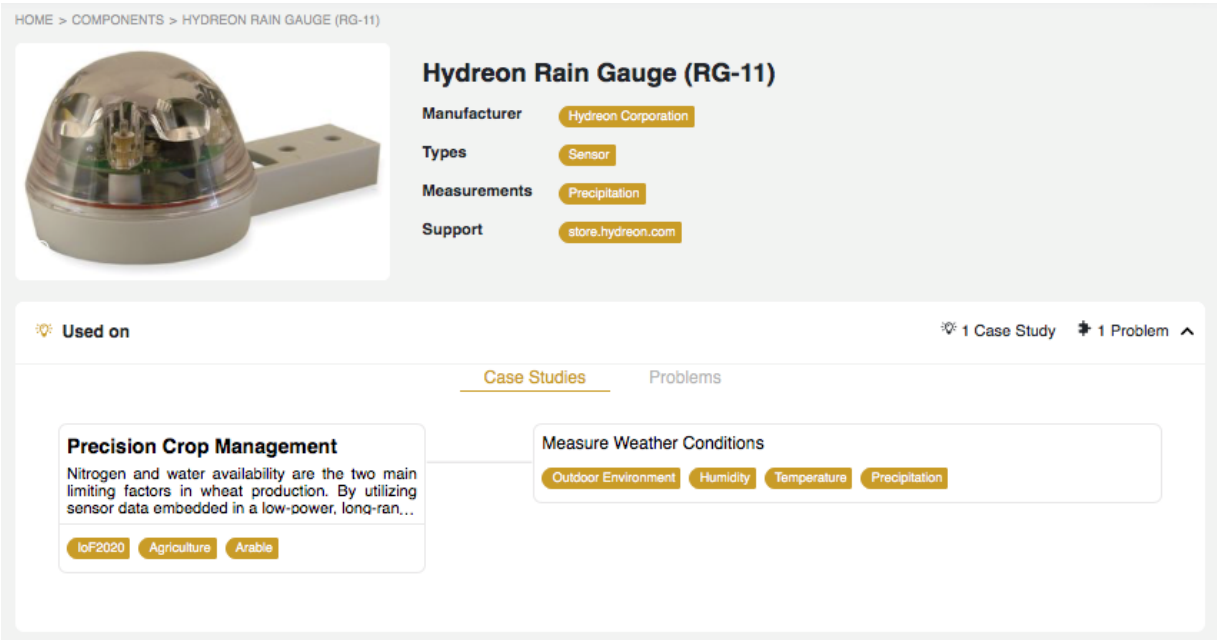

Figure 9: Components "Used On" bar, showing where it's being used.

Value Proposition

Value Proposition page also has a bar called "Used on" which demonstrates in which use cases the Value Proposition is being applied.

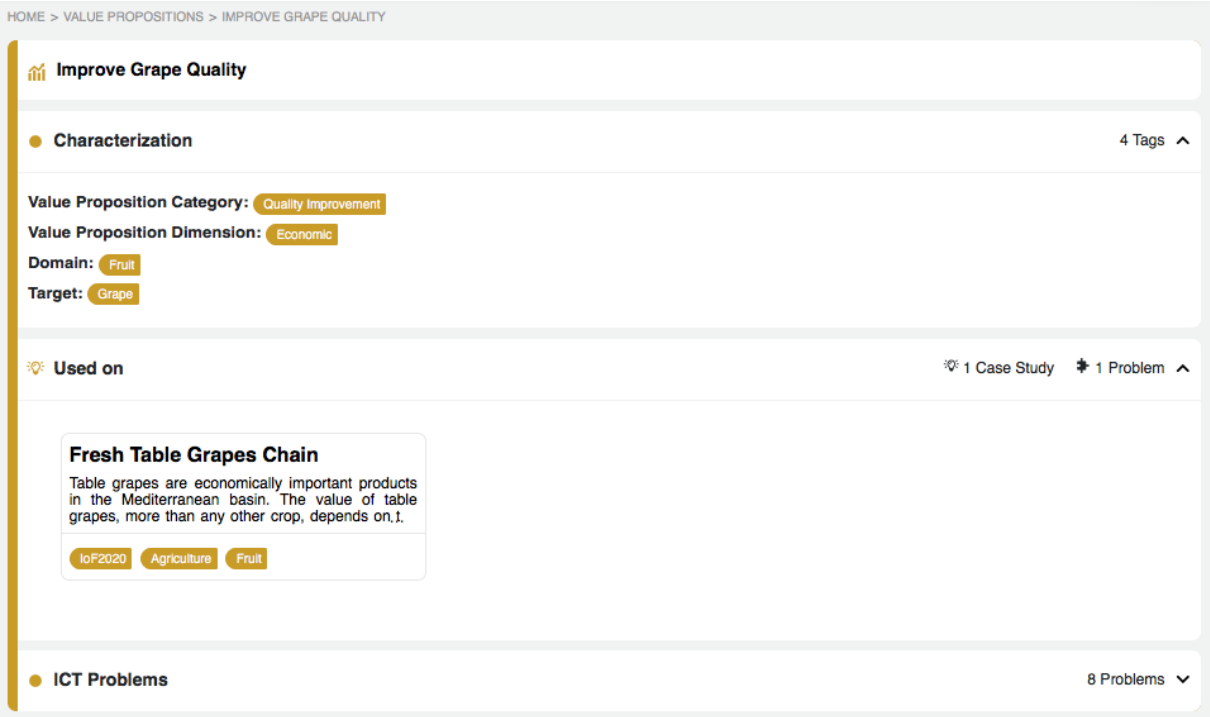

Figure 10: Value Proposition "Used On" bar, showing where it's being used.

ICT Problem

ICT Problem page also has a bar called "Used On" that shows where the ICT Problem is being used.

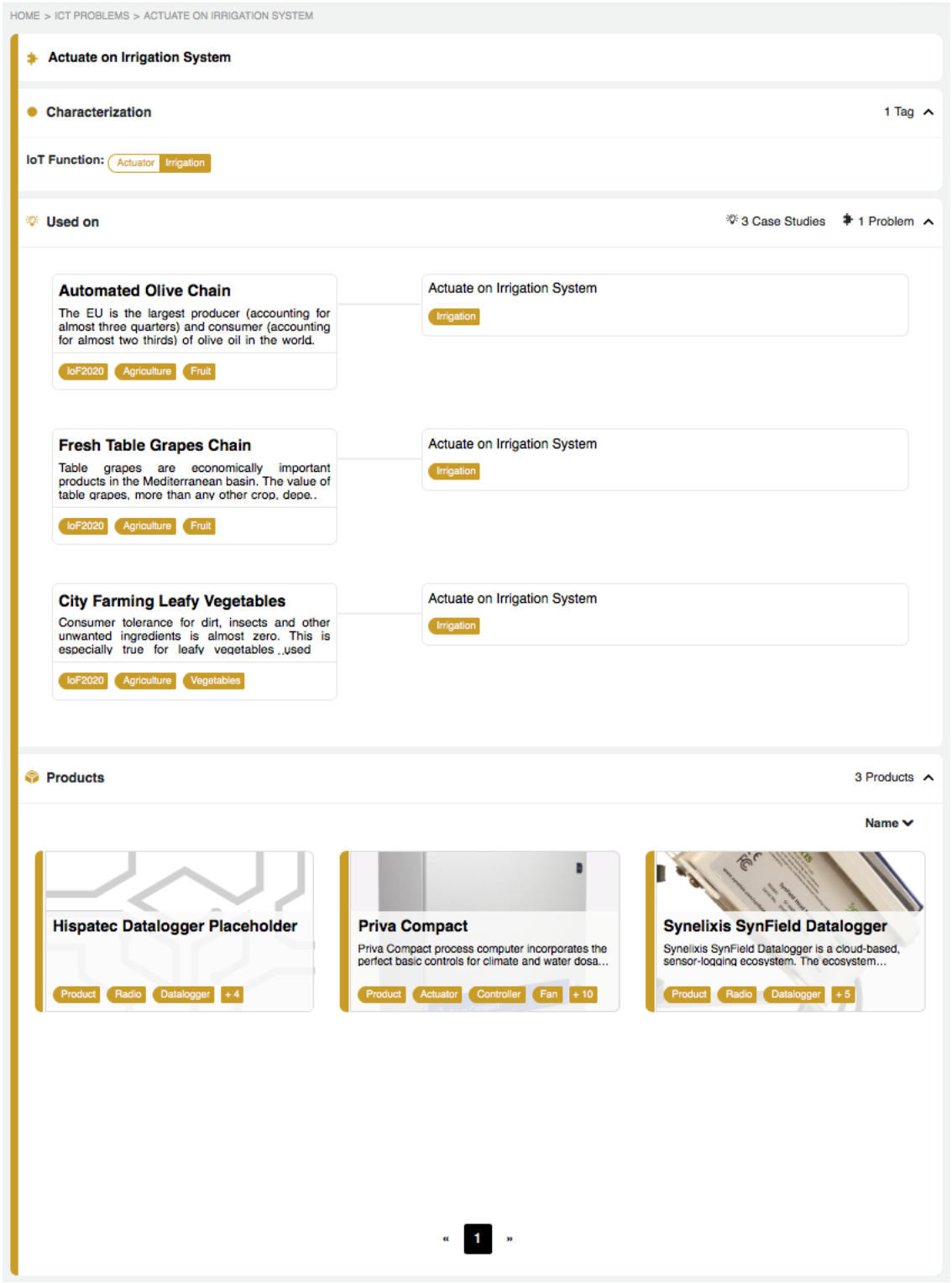

Figure 11: ICT Problem "Used On" bar, showing where it's being used.

Platforms

Platform page has a bar called "Used on" which contains the use cases where it is being used.

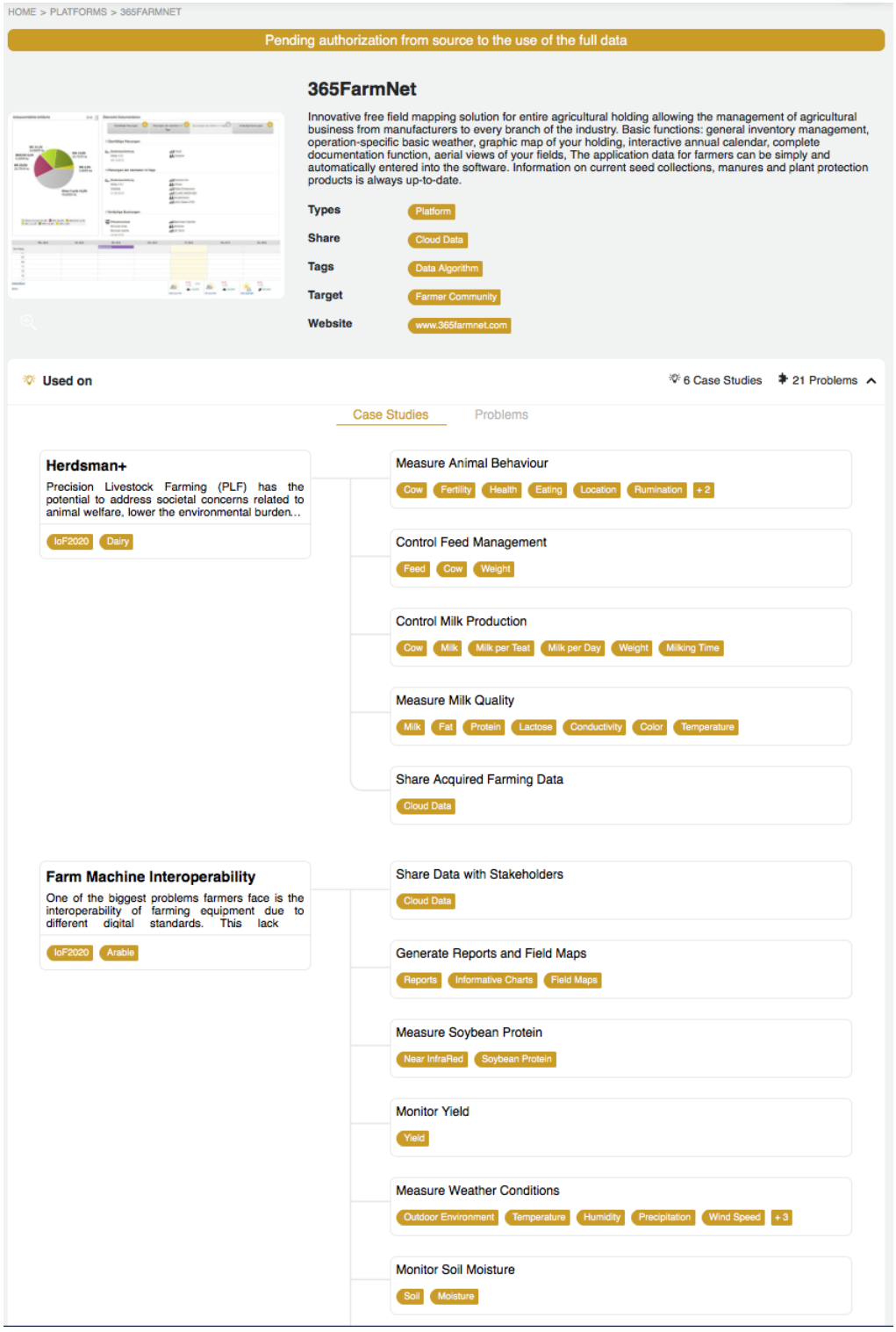

Figure 12: Platform "Used On" bar, showing where it's being used.

IoF2020 Landing Page

IoF2020 Landing page, apart from having all information about the use cases, has a bar called "Component by use case" which sorts the reusable component in a descend form.

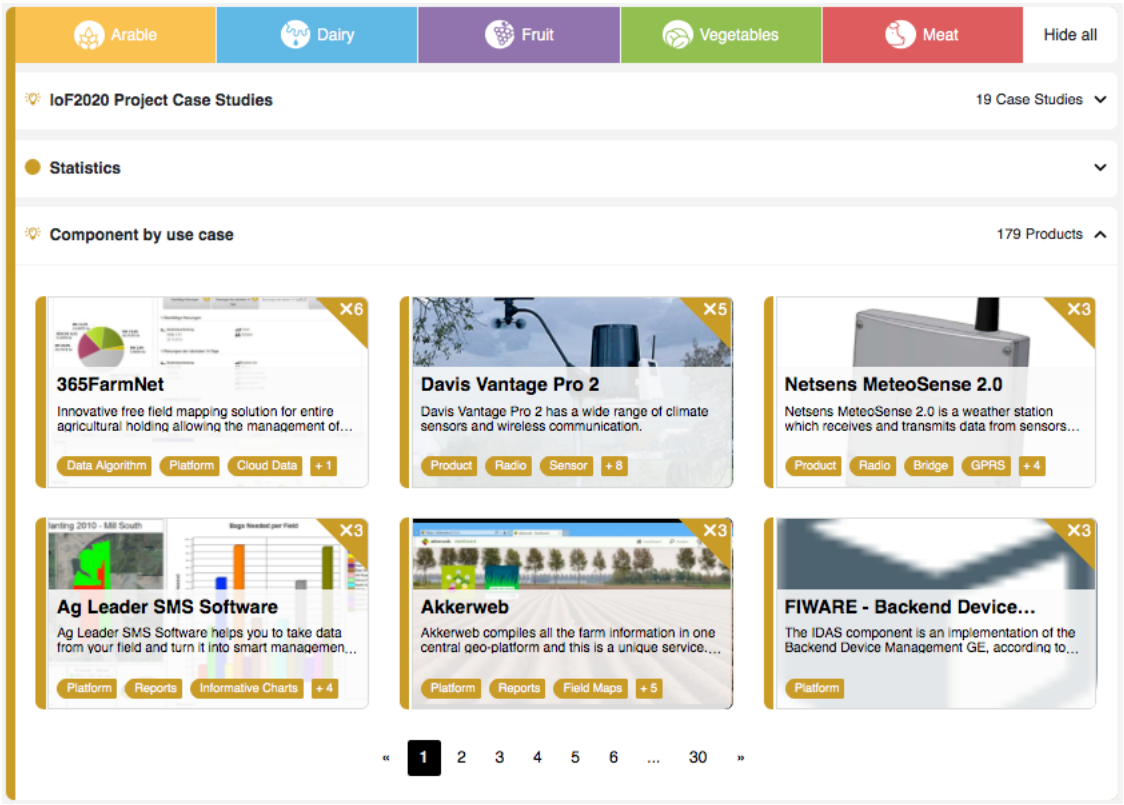

Figure 13: Bar showing the most reused products.

3. CONCLUSION

This deliverable has demonstrated a platform capable to produce and share information about synergies analysis supported by IoF2020 Use Cases and reusable components. Since developing a platform from scratch would require unreasonable effort, it was chosen to use and improve the already existing IoT-Catalogue, which was started as a result of the H2020 research project WAZIUP.

The IoT-Catalogue is being exploited to be a public website to showcase the technology dimension of the Use Cases. Therefore, it was demonstrated in this document which pages are available in the IoT-Catalogue and which information is showed and combined from different sources in order to produce useful information.

It was demonstrated that the IoT-Catalogue is an interactive tool with dynamic pages allowing the interaction with the user. For example, it is possible to see a list with the most reused components for the use cases related with a specific trial.

Information from WP2, WP3 and WP4 was the foundation of the input presented in the IoT-Catalogue, mainly from D2.2 Trial implementation plan, D2.3 Installation, Customization and integration reports, from D3.9 Synergy Analysis and from D4.1 KPI Catalogue. Based on the characterization of the use case and its validation, one can understand how each component can relate to each other and even how this relation can be improved in order to process information in a more efficient way and also to produce a better output to the people consulting it.

This document showed how the reusable components are presented in IoT Catalogue, where it is necessary to model all information related to the use case in a strategic way, and to make it easier to identify how many and where the components were used.

The IoT Catalogue shows where the reusable components are used on:

- Products
- Components
- Value Propositions
- ICT Problems
- Platforms
- IoF2020 Landing Page

The IoT Catalogue, supported by the information provided by IoF2020, provides an interactive interface which allows a person with no technical background to find a solution for his needs. For example, an olive oil producer can use the IoT Catalogue to find suitable products to reduce CO2 emissions related with his activity.

Annex 1 provides a user manual to the IoT Catalogue, with more details about which pages are available and the type of data associated with each one, and also instructions to the user to use the IoT Catalogue.

3.1. FUTURE WORK

The IoT Catalogue was improved in IoF2020 to get new functionalities. This is an ongoing process, with new requirements emerging and the addition of new use cases to the project. Due to these upcoming requirements of the project, a plan was made with the intention to extend the IoT Catalogue with the purpose to meet the new needs. Therefore, there is future work in the context of IoF2020 to be done on IoT Catalogue:

- **KPI:** IoT Catalogue will also be extended to support KPI information coming from WP4, the following mock-up shows the design of this new feature.

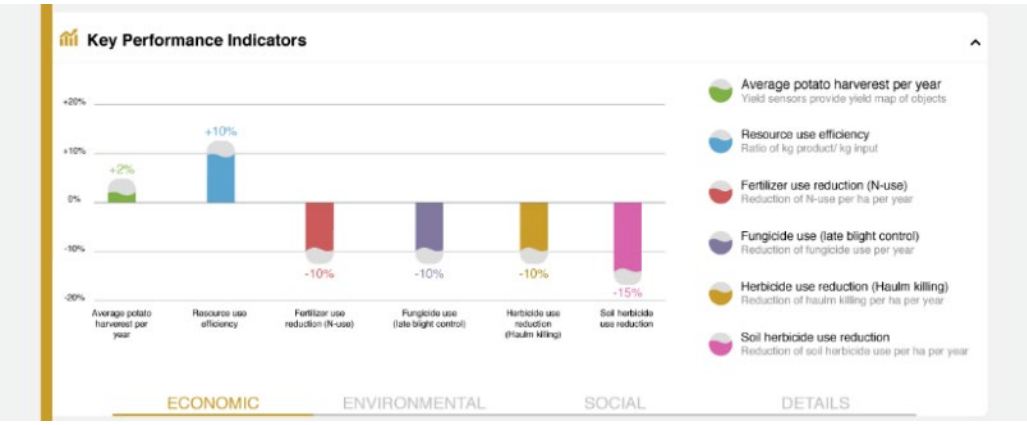

Figure 14: KPI Mock-up.

- **Open Call Use Cases:** The project's new use cases, coming from the Open Call, will go through the same process as the initial ones, and will also be present in the IoT Catalogue.
- **Best Practice:** Synergy analysis task will create a set of best practices for the technology used by the use cases; the IoT Catalogue will provide attractive and interactive guidelines to the end users.
- **Region Explorer:** One of the key aspects in the agri-food domain is the solutions being tailored for specific regions, because the conditions change. It is planned to have an explorer of the regions for the users to be able to find the correct use cases, for conditions that match their needs.
- **Standards:** Agri-food world has its foundations on the usage of Standards. It is planned to add the information about standards usage to the use cases, and a proper way to showcase them to the audience.
- **Security:** Will include Security methodologies to support users in implementing more secure solutions, detailing steps needed to identify any potential failure.
- **Admin:** Admin will allow external users to insert, update and delete information that could be related to a use case or not. That also includes creating a use case from scratch with all the dependencies that it needs.

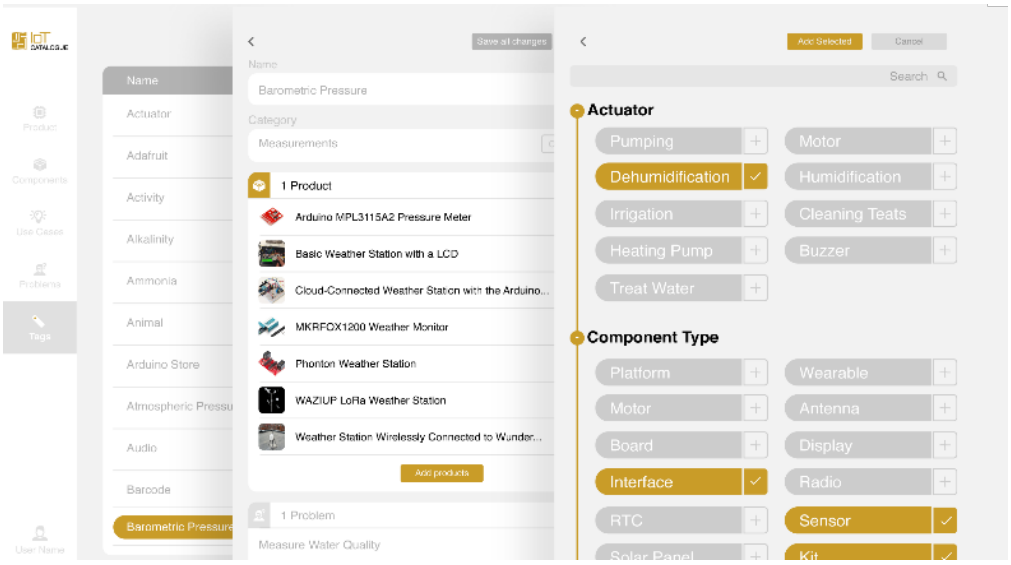

Figure 15: Admin Interface.

Additionally, outside of the IoF2020 World, the IoT-Catalogue is being explored as a tool to showcase the use cases of The IoT European Large-Scale Pilots Programme, that includes the innovation consortia that are collaborating to foster the deployment of Internet of Things (IoT) solutions in Europe through integration of advanced IoT technologies across the value chain, demonstration of multiple IoT applications at scale and in a usage context, and as close as possible to operational conditions.

Work is already in place with the following projects:

- **ACTIVAGE** (ACTivating InnoVative IoT smart living environments for AGEing well) brings together 48 partners from 9 European countries with the objectives to build the first European IoT ecosystem across 9 Deployment Sites (DS) in seven European countries, reusing and scaling up underlying open and proprietary IoT platforms, technologies and standards, and integrating new interfaces needed to provide interoperability across these heterogeneous platforms, that will enable the deployment and operation at large scale of Active & Healthy Ageing IoT based solutions and services, supporting and extending the independent living of older adults in their living environments, and responding to real needs of caregivers, service providers and public authorities. The project delivers the ACTIVAGE IoT Ecosystem Suite (AIOTES), a set of Techniques, Tools and Methodologies for interoperability at different layers between heterogeneous IoT Platforms and an Open Framework for providing Semantic Interoperability of IoT Platforms for AHA, addressing trustworthiness, privacy, data protection and security. User-demand driven interoperable IoT-enabled Active & Healthy Ageing solutions are deployed on top of the AIOTES in every DS, enhancing and scaling up existing services, for the promotion of independent living, the mitigation of frailty, and preservation of quality of life and autonomy.

- **AUTOPILOT** (AUTOmated driving Progressed by Internet Of Things) brings together 43 partners from 14 European countries and 1 from South Korea with the objectives to increase safety, provide more comfort and create many new business opportunities for mobility services. The market size is expected to grow gradually reaching 50% of the market in 2035. AUTOPILOT develops new services on top of IoT to involve autonomous driving vehicles, like autonomous car sharing, automated parking, or enhanced digital dynamic maps to allow fully autonomous driving. AUTOPILOT IoT enabled autonomous driving cars are tested, in real conditions, at four permanent large-scale pilot sites in Finland, France, Netherlands and Italy, whose test results will allow multi-criteria evaluations (Technical, user, business, legal) of the IoT impact on pushing the level of autonomous driving.

- **MONICA** (Management Of Networked IoT Wearables – Very Large Scale Demonstration of Cultural Societal) brings together 28 partners from 9 European countries with the objectives to provide a very large-scale demonstration of multiple existing and new Internet of Things technologies for Smarter Living. The solution will be deployed in six major cities in Europe. MONICA demonstrates a large-scale IoT ecosystem that uses innovative wearable and portable IoT sensors and actuators with closed-loop back-end services integrated into an interoperable, cloud-based platform capable of offering a multitude of simultaneous, targeted applications. All ecosystems are demonstrated in the scope of large-scale city events, but have general applicability for dynamically deploying Smart City applications in many fixed locations such as airports, main traffic arterials, and construction sites. Moreover, it is inherent in the MONICA approach to identify the official standardisation potential areas in all stages of the project.

- **SynchroniCity** (SynchroniCity: Delivering an IoT enabled Digital Single Market for Europe and Beyond) brings together 33 partners from 9 European countries and 1 from South Korea with the objectives to deliver a Single Digital City Market for Europe by piloting its foundations at scale in 11 reference zones – 8 European cities and 3 more worldwide cities. SynchroniCity is working to establish a reference architecture for the envisioned IoT-enabled city market place with identified interoperability points and interfaces and data models for different verticals. This includes tools for co-creation & integration of legacy platforms & IoT devices for urban services and enablers for data discovery, access and licensing lowering the barriers for participation on the market. SynchroniCity pilots these foundations in the reference zones together with a set of

citizen-centred services in three high-impact areas, showing the value to cities, businesses and citizens involved, linked directly to the global market.

Although the IoT-Catalogue is being developed in the scope of IoF2020, it is planned to outlive the project and be a sustainable result. The sustainability of the IoT-Catalogue is planned to be guaranteed mainly by the technology providers. The first step is to establish a community, built on top trusted entities, and involve actors interested in being aware of the current offers in the IoT Domain. Thus, the business model follows:

- IoT Stores to list their prices in the IoT-Catalogue, working on the “price comparer” principle, which they pay by the referrals.
- Solutions providers paying a fee to be discovered in the IoT-Catalogue.
- Since the use case information has the reference information across Europe about the state of the art of the current deployment state of IoT-Technologies, services will be offered, such as market studies.

4. ANNEX I: IOT-CATALOGUE USER MANUAL

This chapter describes all the information about how the catalogue works and what kind of information is available.

The user manual section contains explanation about main features in the following areas:

IoT Catalogue Overview

Case Studies

Products

Components

Value Propositions

ICT Problems

Platforms

Learning

Stores

Manufacturers

4.1. IOT CATALOGUE OVERVIEW

This Menu allows the user to get a shortcut to any available page.

Figure 16: Overview Menu[3].

[3] https://beta.iot-catalogue.com

4.2. CASE STUDIES

The use case has title, description, link, validations, places, team, characterisation, solutions and photo gallery. This has a dynamic component which helps end-users to understand how the value proposition, ICT problem, domains, functions and targets are interconnected. At the bottom of the page, there is an overview with a map with the validation places and statistics about countries, validations, regions, places, products, value proposition and ICT problem. The second bar shows the different validations related to the use case. Different validations can have different information. The overview bar (1) contemplates all validations, and the remaining bars only belong to a specific validation taking into account the selected option in selector bar (2).

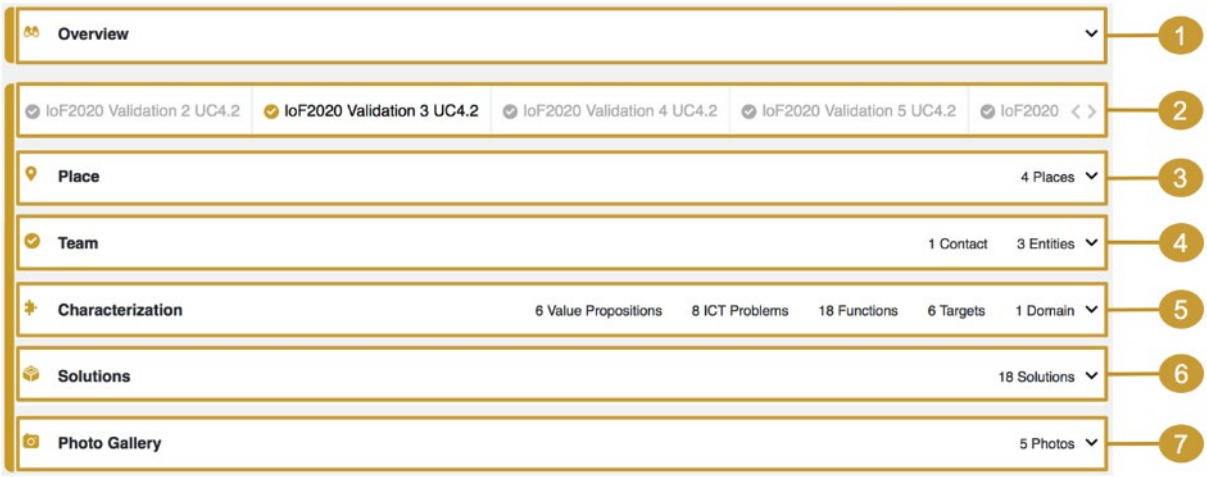

Figure 17: Case Studies[4].

1 – Statistics about Regions and Validations.

2 – Each validation has different regions, validator, characterization, solutions and photos.

3 – Regions where the case study applies.

4 – All the entities/users related with the validation.

5 – Define it in terms of problems, functions, domains and targets.

6 – All the products used to compose the solutions.

7 – All photos showing different stages: assembly, production and so on.

Overview

- Overview is divided in overview, regions and places. The overview contemplates all validations:
    - Overview is divided into maps and statistics about specific use case.
    - Regions is a table with relations between validations and locations.
    - Places has information and a map with the region corresponding to each place.

Overview

The overview includes a map and statistic about specific use case.

[4] https://beta.iot-catalogue.com/usecases

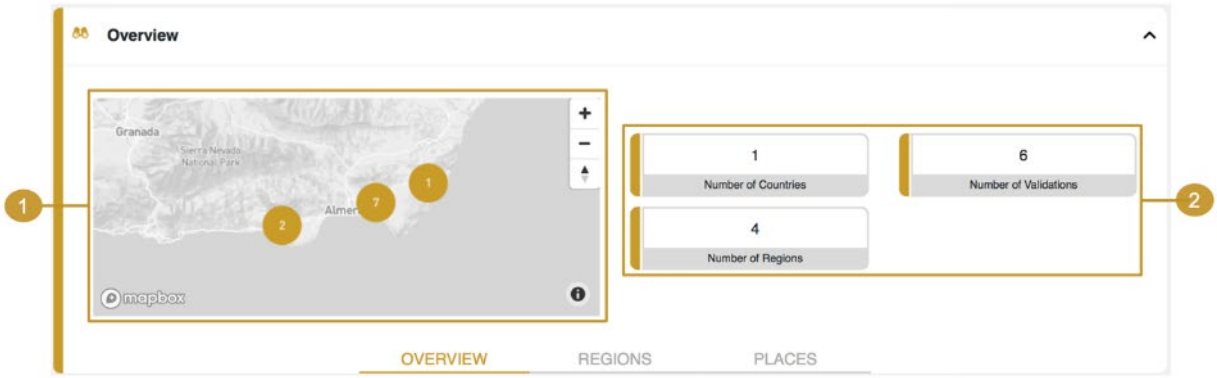

Figure 18: Case study Overview.

1 – Map with the places. With normal zoom, it creates clusters and it is possible to see the aggregation by zones. If we zoom in, the pointers turn into regions. That's why the sum of places on map are greater than the number of regions.

2 – Statistics about the places: number of countries, validations and regions

Regions

This shows a table with relations between validations and regions. With this view, we know, for example, there are three places in Nijar, Spain doing the IoF2020 Validation 3 UC4.2.

Figure 19: Case study overview regions.

Places

Places has information and a map with the region corresponding to each place. This has information about places from the different validations.

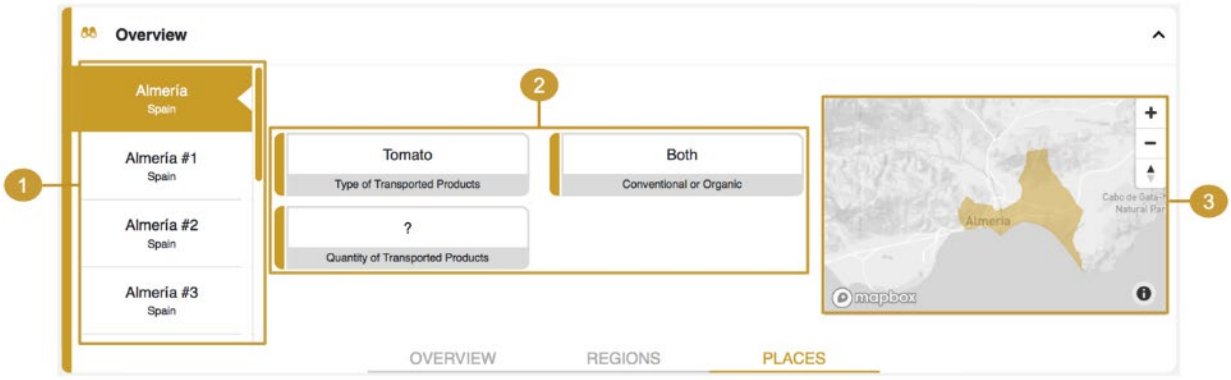

Figure 20: Case Study Overview Places.

1 – All places from the use case (all validations). If the place is in the same region, it becomes numerated. It can be selected and information in boxes 2 and 3 will change accordingly.

2 – Characterisation of the place, like type of production, i.e. conventional or organic, and size of production. This fits in a farm, but it could have different fields.

3 – The region from the chosen place.

Validations

Validations are needed to know if the presented solution works in the real world. This mean the solution was tested by real people or it was given by some expert. This will help the users who want to have some solution to their problem knowing that was previously validated.

This selector allows users to check all information from different validations. Changing this will change all information from the bars below.

Figure 21: Case Study Validations.

Places

Information about the place with a map with the corresponding region.

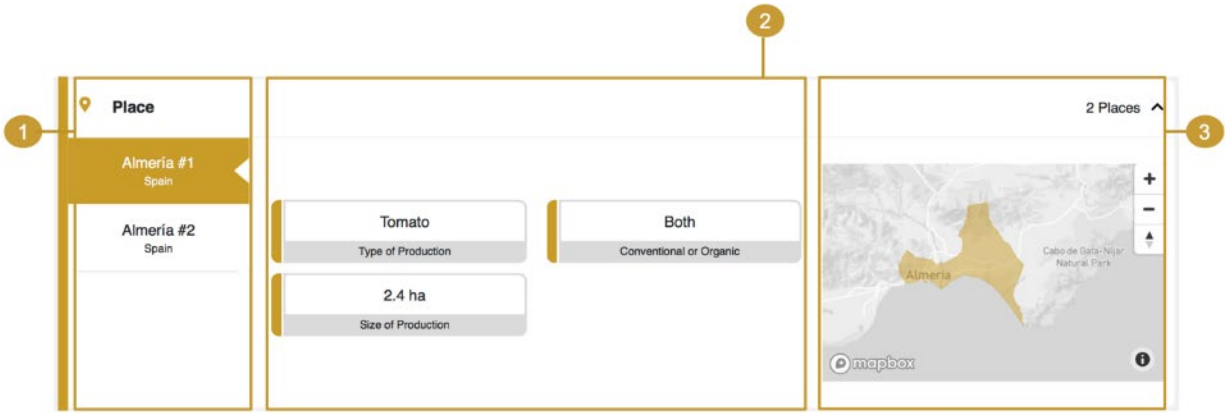

Figure 22: Use case Places.

1 – All places from a specific validation deployed within the country. It only mentions the region. If it is the same region, it becomes enumerated

2 – Characterising the place in terms of size, type etc.

3 – A map showing where the place is located.

Validator

This has information about contact and entities, including name, emails, logos and countries.

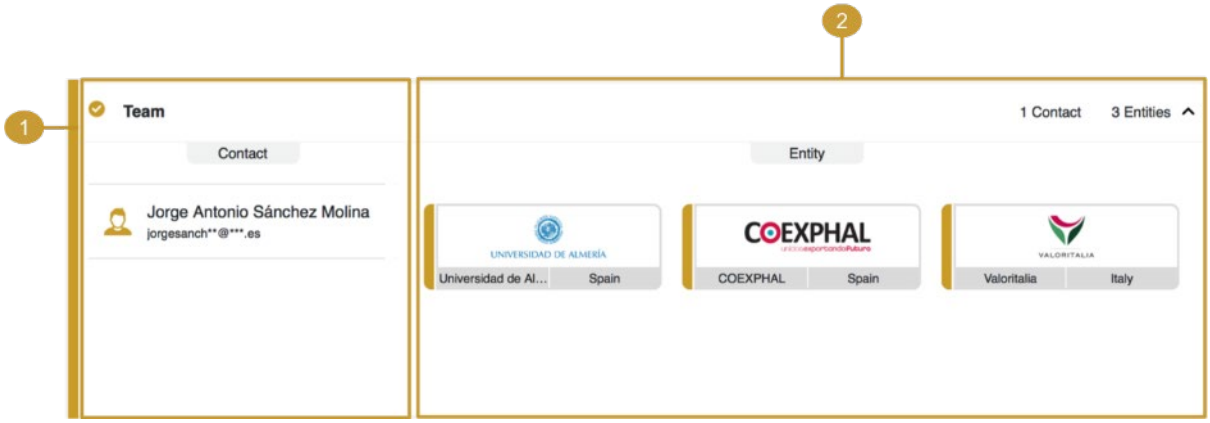

Figure 23: Case Study Validator.

1 – Person or persons responsible by the validation previously chosen.

2 – All the entities that interact with the validation.

Characterisation

The characterisation bar is used to present all information used to characterise the use case. This include value proposition, ICT problem, function, target and domain. This bar has a dynamic component which allows the user to understand better the relations between each characterisation.

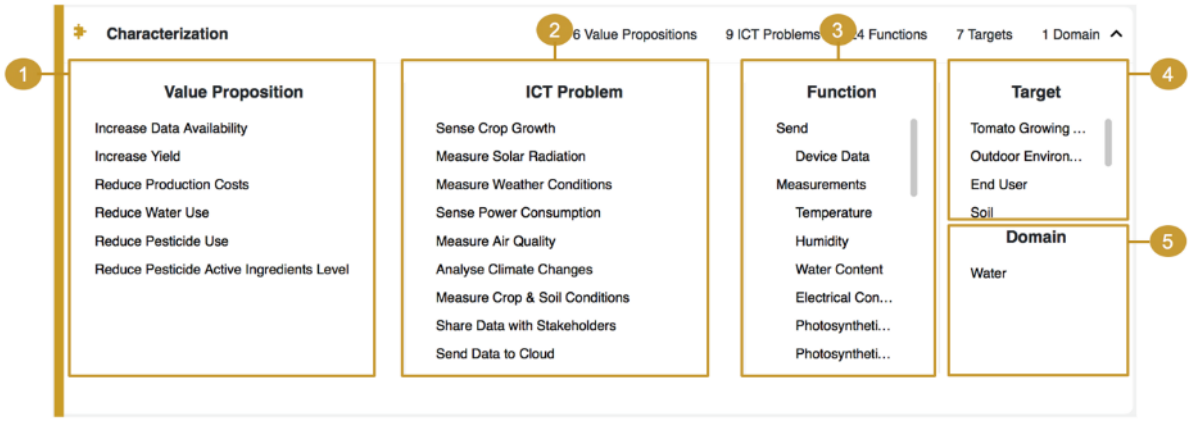

Figure 24: Case Study Characterisation.

1 – This is the added value to the user.

2 – This is the real problem which the user needs to solve.

3 – Kind of functions which need to be done to solve the problems.

4 – Where it is applied.

5 – Case Study domain.

The following figure shows how the dynamism of the user interface affects what is being displayed, and what kind of information it gives the user.

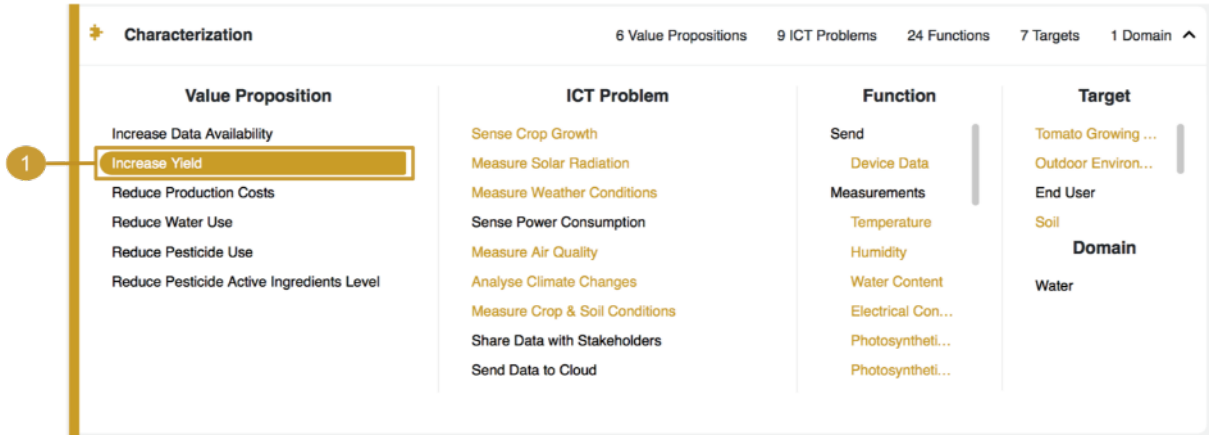

Figure 25: Case Study Characterization Interaction.

1 – Clicking in "Increase Yield" in Value Proposition, it will highlight several ICT problems. That means to resolve the selected Value Proposition, you need to get solutions to the array of ICT problems highlighted. Therefore, each ICT Problem brings the functions which needs to be filled (it also becomes highlighted) and also highlighted domains and targets.

Other types of dynamism are available as we can see in the following figure.

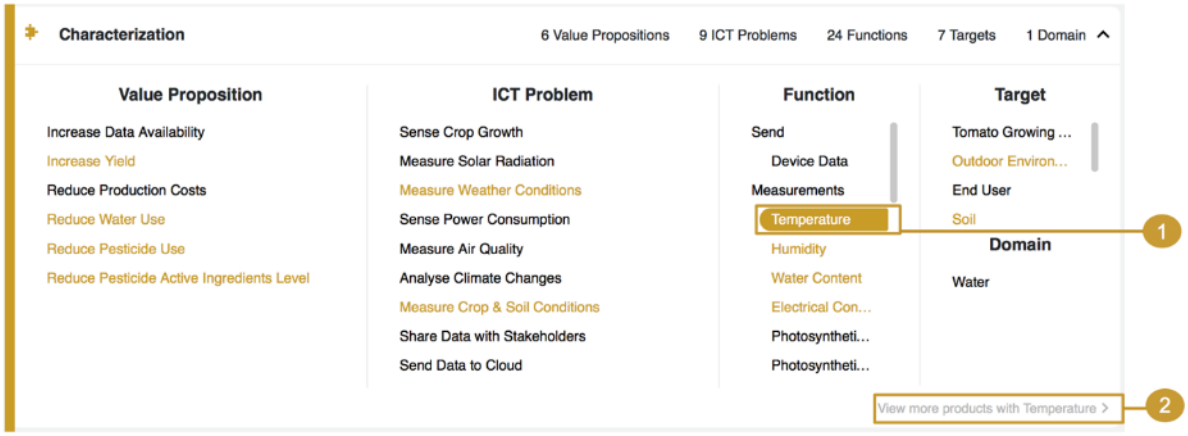

Figure 26: Case Study Characterisation interaction 2.

1 –The interaction works forward and backward. If you click in "Temperature", which belongs to Measurements in Function, it will show how it relates with the rest of the case study.

2 – This option only appears when something from Function is selected. Clicking on this, the user sees a page with components or products which have the function (Measurement: Temperature). Clicking in more than one option will show results which meet all options.

Solutions

Solutions is the group of products which solve the item selected. It could be from Value Proposition, ICT Problem, function, target and domain.

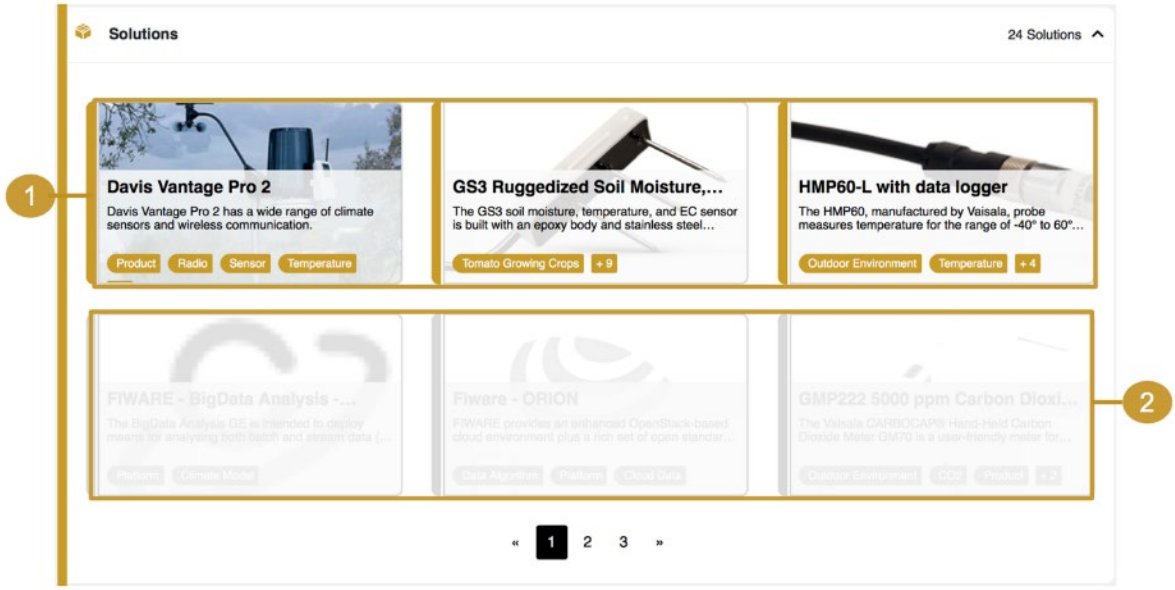

Figure 27: Case Study Solutions.

1 – A number of selected products are called a solution. As it is possible to see, it becomes highlighted when it is selected from the characterisation bar.

2 – The rest of the products become grey.

Photo Gallery

It shows all photos (1) related to the selected validation. This can include photos with all construction steps, assembly and so on. The photos could become bigger if the user clicks on the photo.

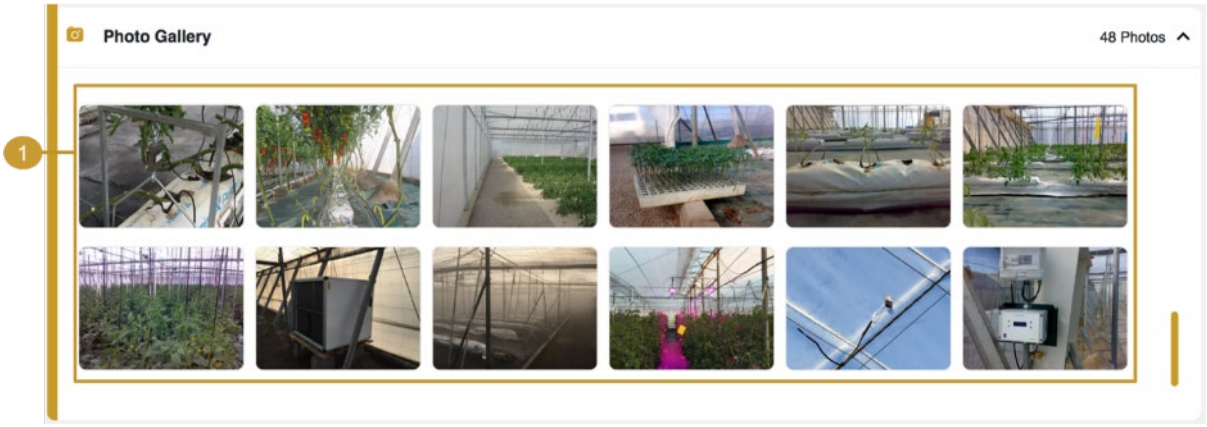

Figure 28: Case Study Photo Gallery.

4.3. PRODUCTS

A product is a device with intrinsic characteristics, represented by tags. For example, it can measure temperature, control an actuator, send data and so on. We also identify what kind of device it is; if it is a sensor, a board, a radio, etc.

We are able to filter using the characteristics already inserted and associated to the products, as it is showed in the figure below.

Filter Products

This feature allows the user to get easily the desired product taking in account their characteristics.

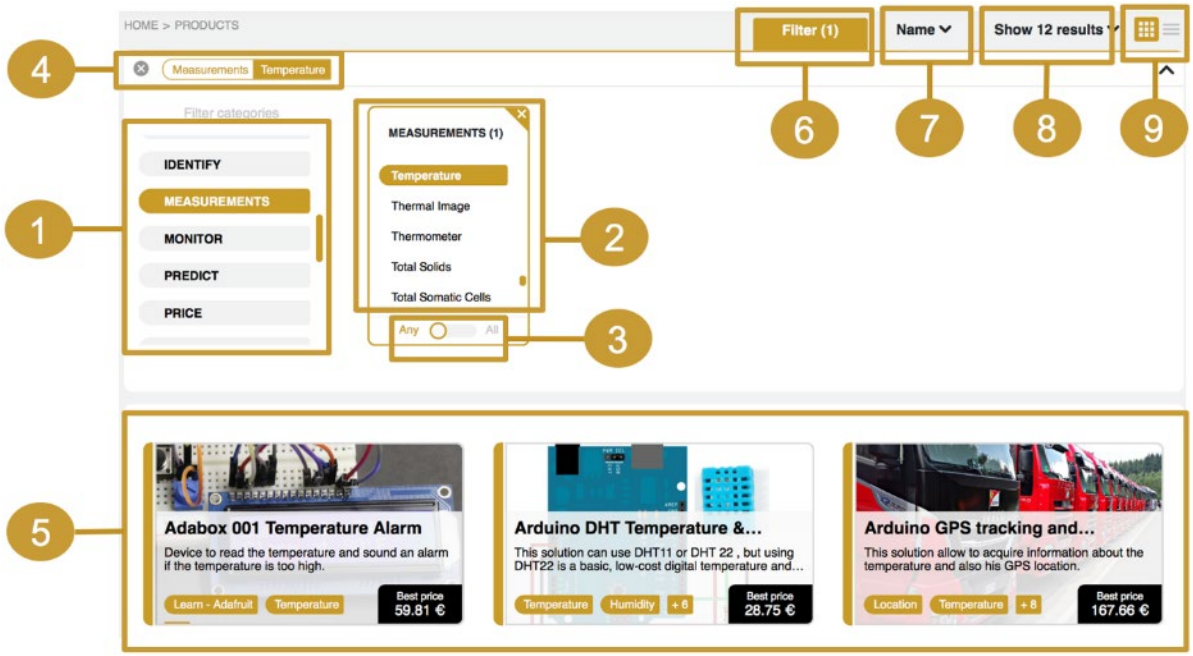

Figure 29: Filter Products[5].

1 – All tags categories used in products.

2 – The tags available from the selected category.

3 – Results containing any of the tags.

4 – A list with the filters selected (category and tag name).

5 – The products resulting from the filters applied.

6 – Filter tab. Clicking on this hides the filter.

7 – Sort tab. It can be sorted by name, description and price (ascending or descending).

8 – The number of results per page.

9 - Changes the way how results are showed: list or grid view.

Product Overview

The products page has the appearance showed in the following figure. This page has all the intrinsic characteristics which define the product. It has information about:

- Where it can be bought and best prices;
- Components which compose the product;
- Where it is used in the panorama of IoF2020;

[5] https://beta.iot-catalogue.com/products

- Document which support this product;
- Generate Sketch will create a zip with all the libraries needed to work with the product.

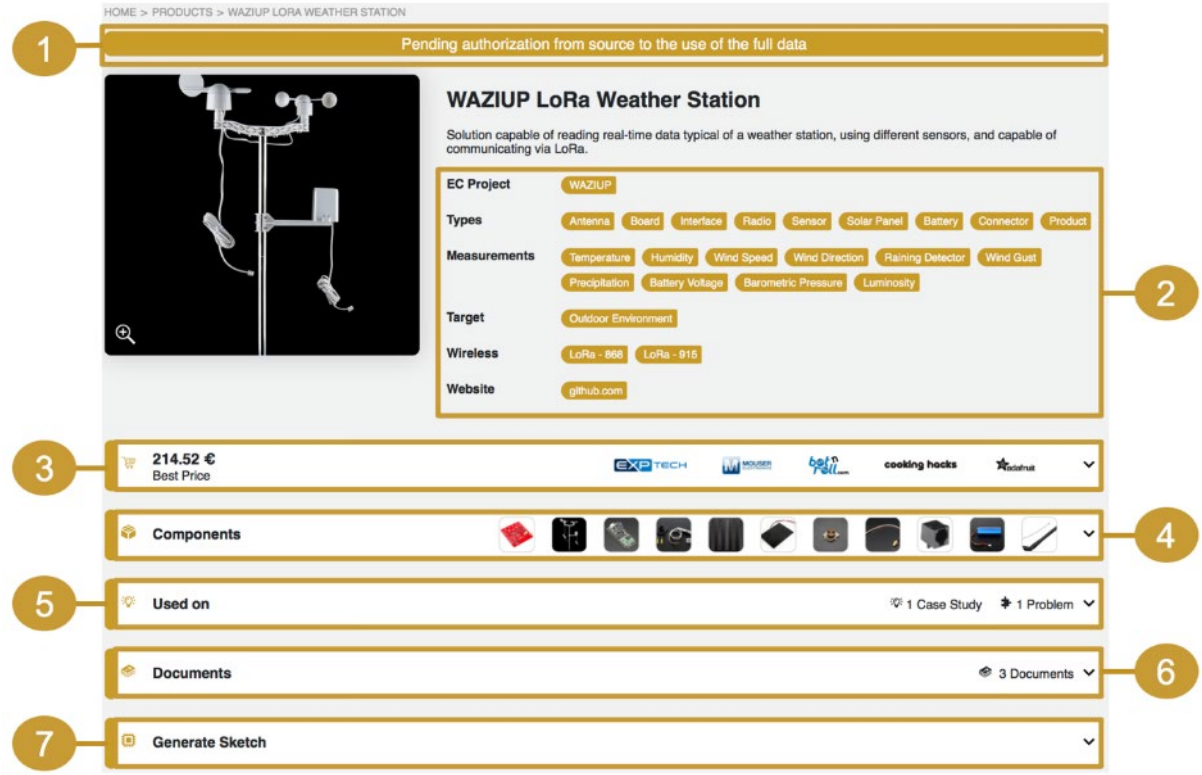

Figure 30: Product[6].

1 – An ad saying the information is pending authorization from the manufacturer/store, if it is still undergoing a review process.

2 – All tags which characterize the product.

3 –The price of all components in different stores (if available) and where to get the best price considering if the components are bought all in the same store or different ones.

4 – The list with all components needed to assembly the product.

5 – The use case and problems where the product is used.

6 – Documents with information on how to assembly or configure, datasheets and so on.

7 – All libraries (for example to Arduino) and the possibility to create a zip file with all libraries ready to use it and test it.

Price

The price bar gives the opportunity to the user to find the best deal. The prices are regularly updated, which helps user to track the prices. Then users can know the price buying all the products from one store or the best price independent where it comes from.

[6] https://beta.iot-catalogue.com/products/59b1797c763cfc066f6d092b

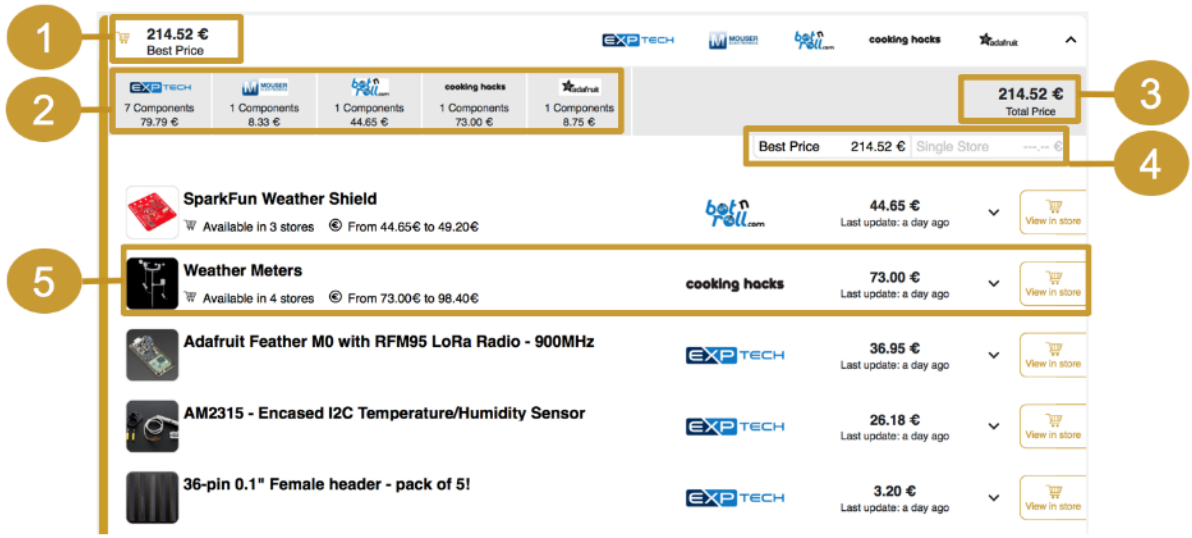

Figure 31: Product Price.

1 – The best price possible for this product (counting with all components needed).

2 – Statistics about the stores which sell the product and how many components are sold in there.

3 – The actual price considering your choices. You can choose to buy the components in certain stores.

4 – This show the best price possible and the price if you buy everything in one store. In this example appears “--.--” in Single Store, because all components are not sold in the same store.

5 – Statistics about the stores (how many stores sell this item and the price range). If only one store sells it, it does not appear. It also has the information when was the last time the price got updated.

User is able to change the store where the price is coming from.

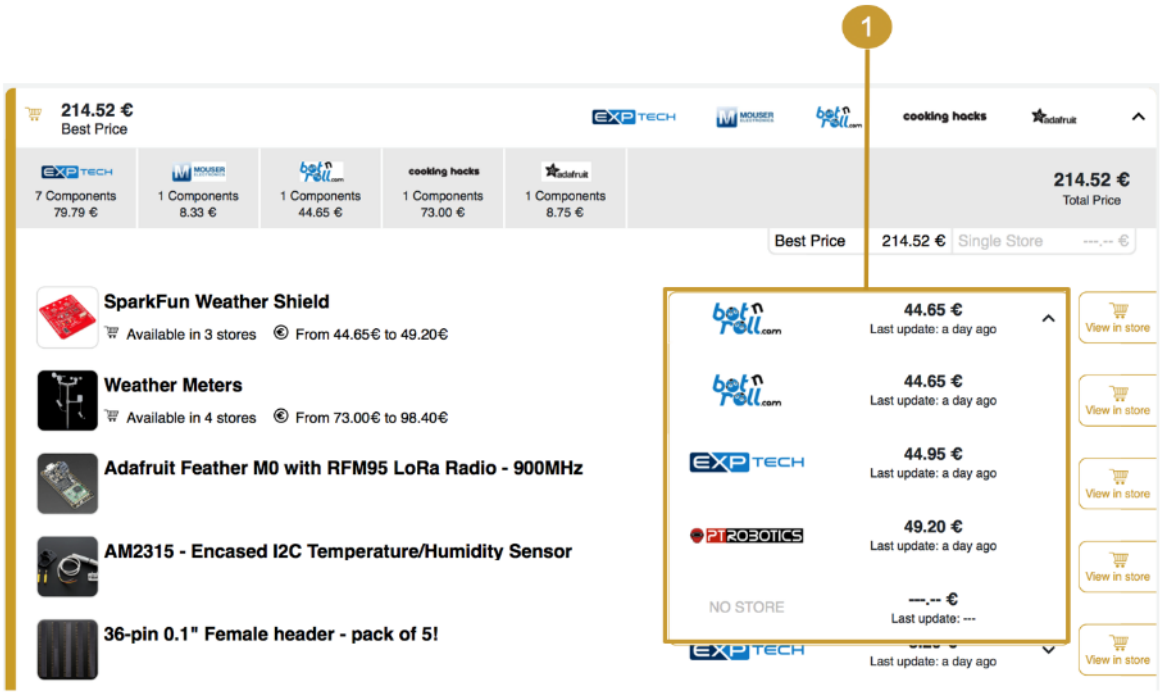

Figure 32: Product Price Stores.

1 – This bar expands after clicking and reveals all stores which sell the product. The first option is the one actually selected and the last one is how we can know the price without this component (selecting the last one).

Components

This is the list where we can see what composes the product.

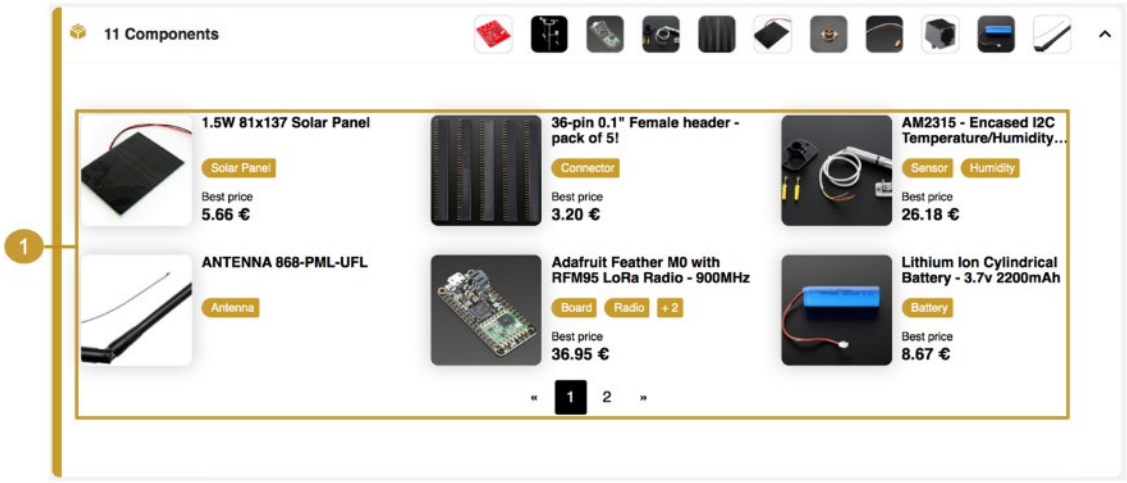

Figure 33: Product Components.

1 – All the components with best price (if stores are available) with the tags (solar panel, connector, sensor, board and so on).

Used On

This (1) will show where the product is being used on, in terms of case studies and problems.

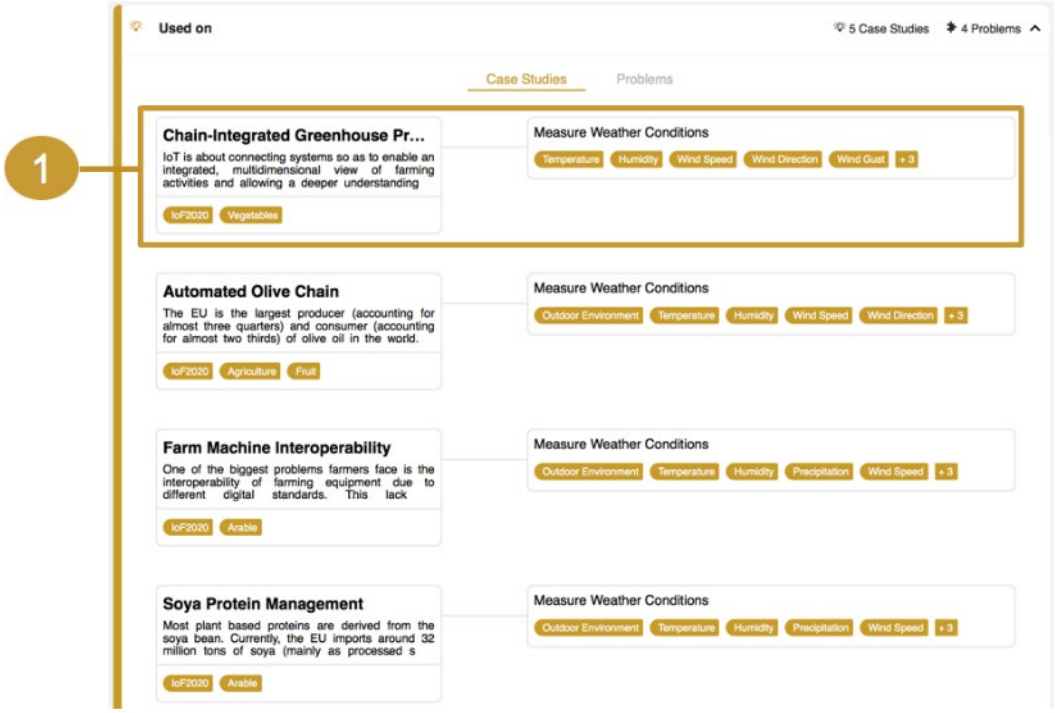

Figure 34: Product Used On.

Documents

Documents bar can have documents (1), for example, pdf or links to other webpages.

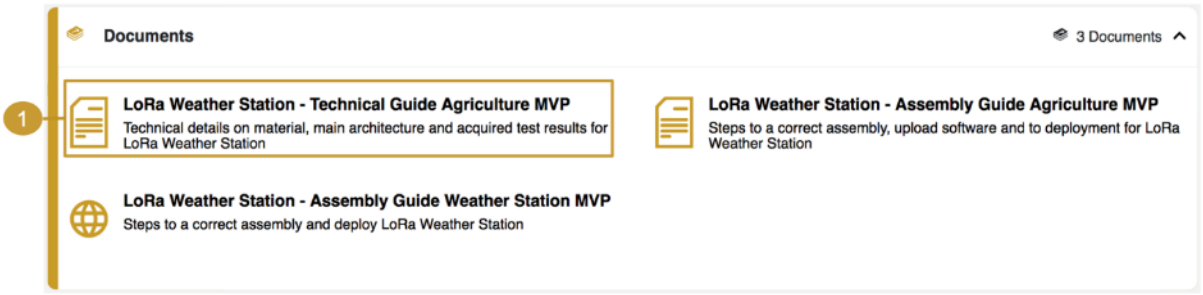

Figure 35: Product Documents.

Generate Sketch

This will create a zip file with the all libraries necessary to get the product working correctly.

Figure 36: Product Generate Sketch.

1 – All library this product needs to work.

2 – It analyses (externally) the code quality taking into account defined metrics. It also checks project activity in GitHub (it is compatible with more repositories) in terms of commit, posts, issues and so on.

3 – It generates a zip with the libraries and the example with the libraries imported.

4.4. COMPONENTS

Components[7] and Products are similar. As we can see in the products chapter, it also has Best Price and Used On. In this example, there aren't libraries, but if it had, it would also appear the bar libraries and generate sketch. The main difference is products may be composed by components. We can see that also in the products chapter checking the existence of a bar called components.

[7] https://beta.iot-catalogue.com/components

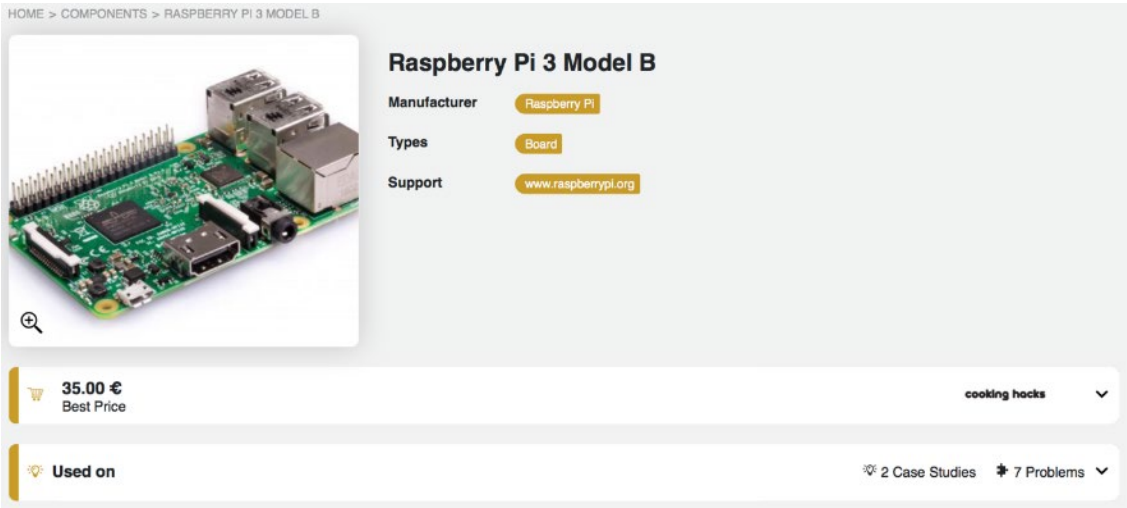

Figure 37: Component[8].

4.5. VALUE PROPOSITIONS

Value Propositions are directly related with ICT Problems. Value proposition is a way to explain how it added value can be provided to the user or entity. To obtain the value, it is necessary to solve one or more ICT Problems.

The different Value Propositions start to be listed as we can see in the figure below, having at the right statistics about them.

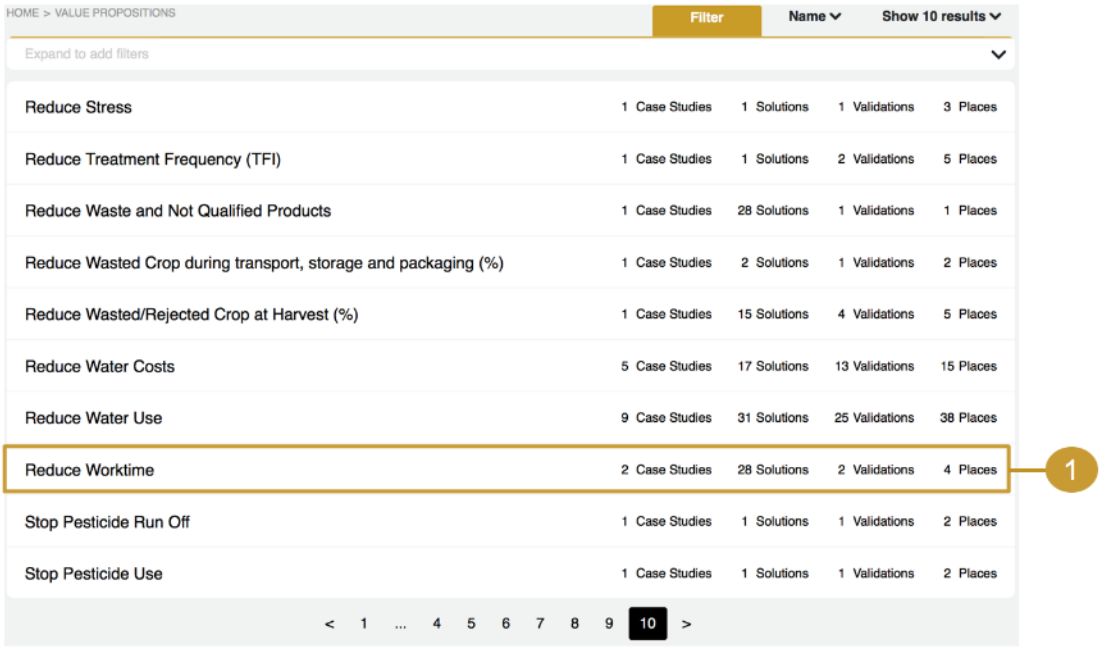

Figure 38: Values Propositions[9].

[8] https://beta.iot-catalogue.com/components/5889c7b1c702dcd70540099b
[9] https://beta.iot-catalogue.com/valuePropositions

1 – Statistics about value propositions in terms of case studies, solutions, validations and places.

Specific Value Proposition page having characterisation and used on bar.

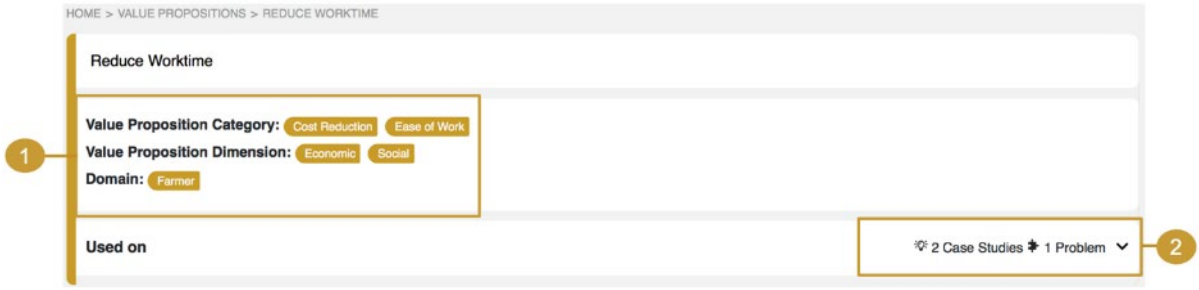

Figure 39: Value Proposition[10].

1 – Characterizing the value proposition.

2 – In how many use case and problem value proposition is used.

Used On

This bar shows the selected Value Proposition is used in 2 use cases (1).

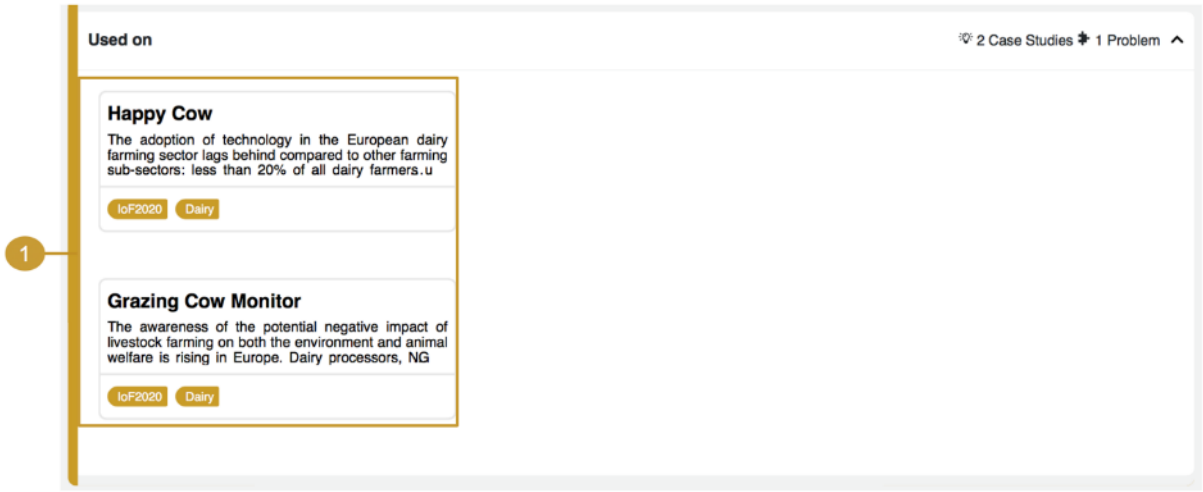

Figure 40: Value Proposition Used On.

4.6. ICT PROBLEMS

ICT Problem can be used alone, for example, if the user just wants to know how to “Actuate on Irrigation System”. This is an Information and Communication Technologies problems, so it can be anything which needs a technological solution.

The different ICT Problems start to be listed as we can see in the figure below, having at the right statistics about them.

[10] https://beta.iot-catalogue.com/valuePropositions/5b4cbe74b8f13022bb5e6d3b

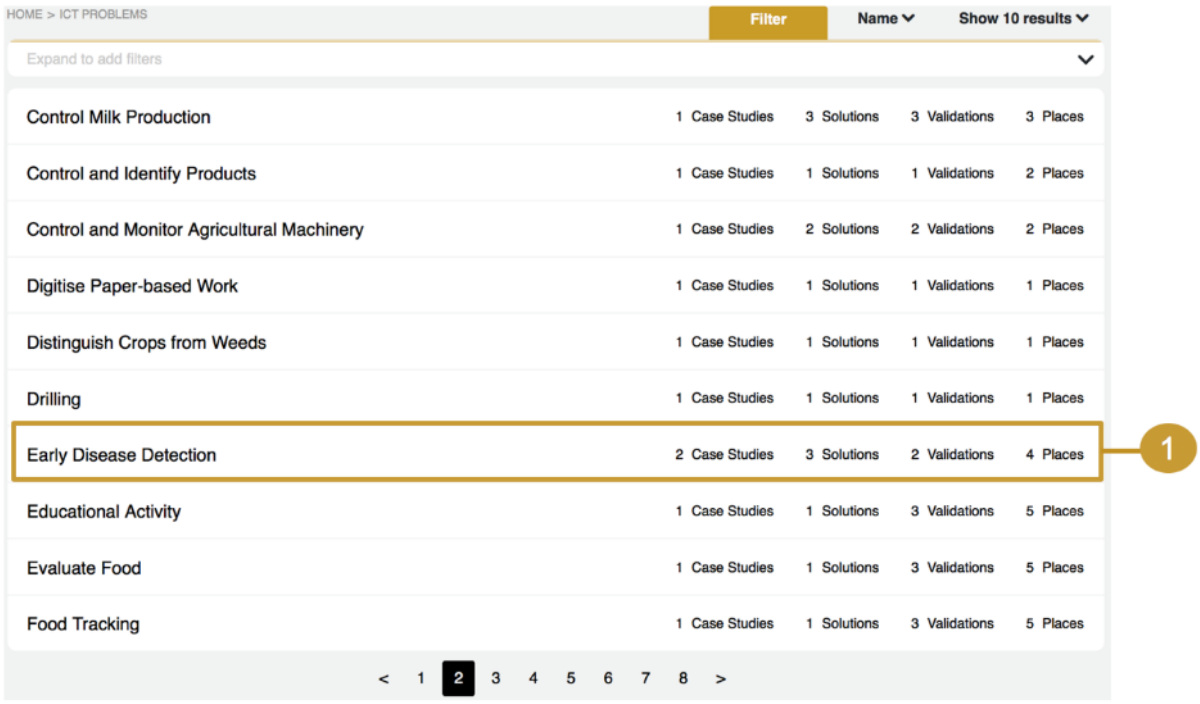

Figure 41: ICT Problems[11].

1 – Statistics about ICT problems in terms of case studies, solutions, validations and places.

The problem can be divided in different ones, if they are related (Early Disease Detection into: Early Cow Disease Detection and Early Poultry Disease Detection). Otherwise it will be unique.

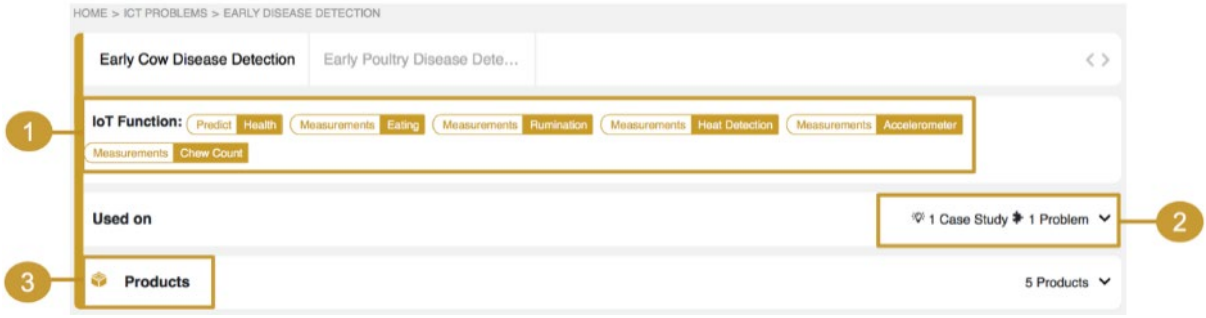

Figure 42: ICT Problem[12].

1 – Characterizing the ICT Problem.

2 – In how many case studies and problem value proposition is used (equal to values proposition).

3 – The products which solves the problem.

[11] https://beta.iot-catalogue.com/ictProblems
[12] https://beta.iot-catalogue.com/ictProblems/5b45f17f7e5cd662c57acc7c

4.7. PLATFORMS

Here will appear all platforms available in the IoT Catalogue. A platform is the easiest way to show the final results, for example gathered from sensors.

Listing all platforms has the following layout.

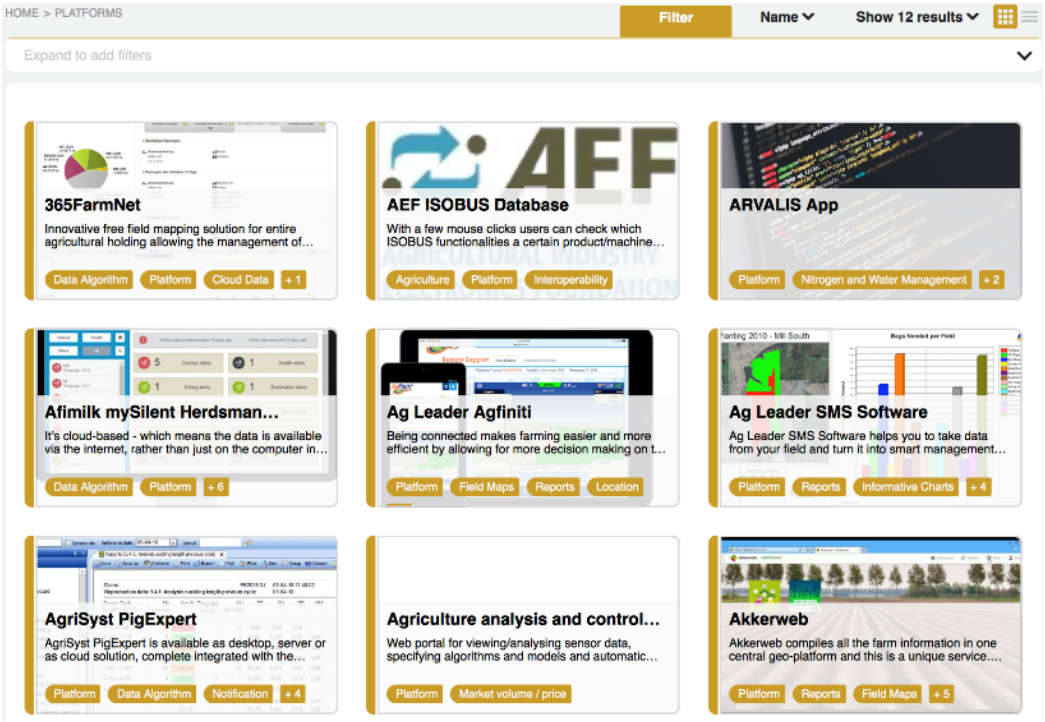

Figure 43: Platforms list[13].

Then each platform page will have this appearance. It could have Used On and Documentation bar.

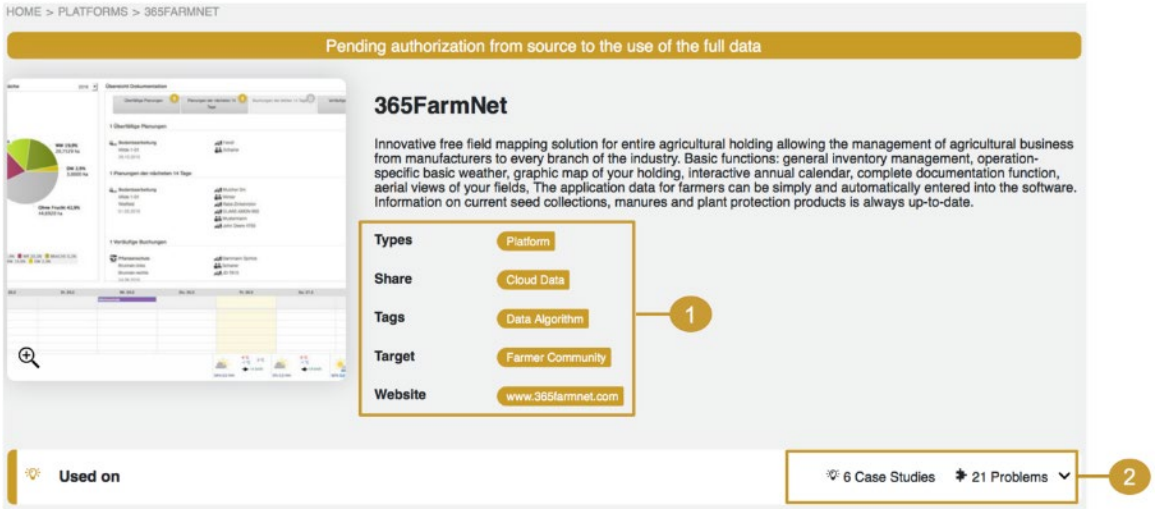

Figure 44: 365FarmNet Platform[14].

[13] https://beta.iot-catalogue.com/platforms
[14] https://beta.iot-catalogue.com/platforms/5a5c98cf82688901abd3d4c2

1 - Platform characterization.

2 - The case studies and problems where the product is used.

Used On

The Used On bar will show you where the platform is used.

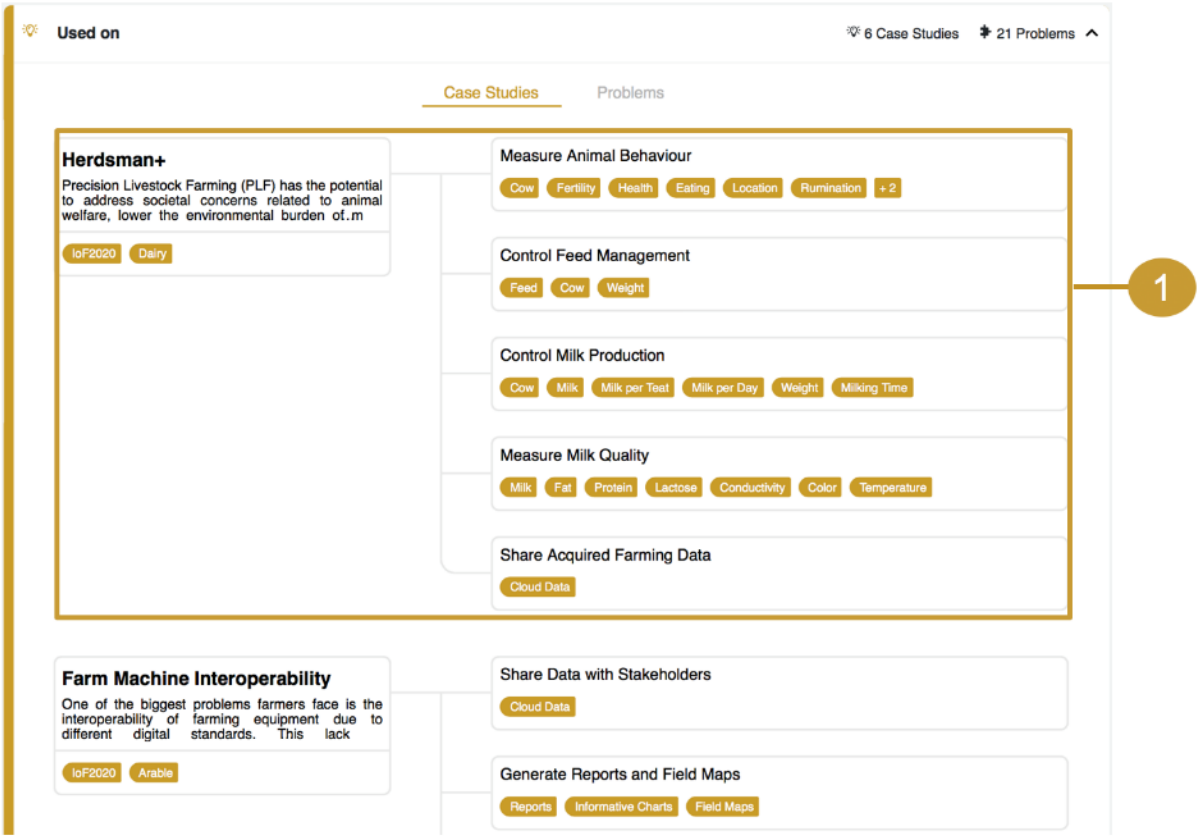

Figure 45: Platform Used On.

1 – This shows where the platform is being used, in terms of case studies (left) and problems (right).

4.8. LEARNING

Learning page has guides, manuals or websites with information which will help you to reach or understand the proposed objective.

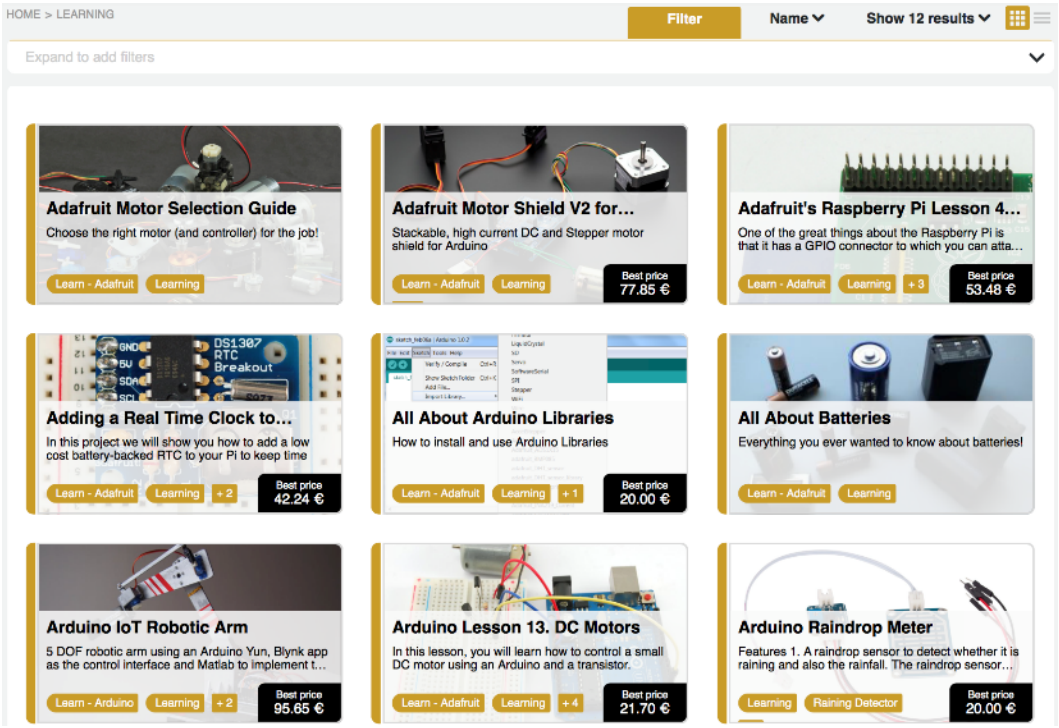

Figure 46: Learning[15].

When we enter in a specific learning, we get a similar page like the products.

4.9. STORES

Stores is the place where we can find the best way to buy our desired product. Store can have different types of bar:

- Products which have components from the selected store.
- Products from the selected store.
- Components from the selected store.

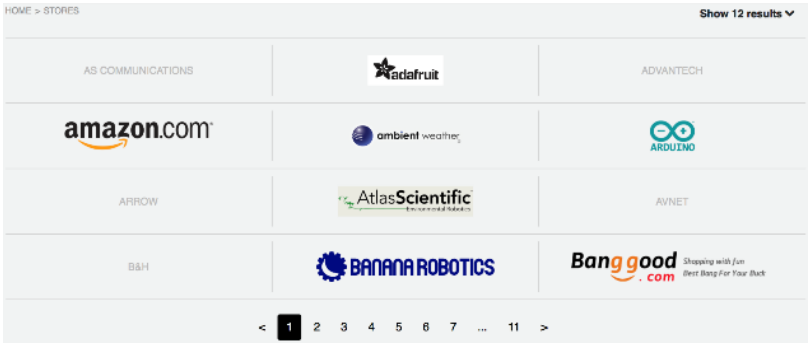

Figure 47: Stores[16].

[15] https://beta.iot-catalogue.com/learning
[16] https://beta.iot-catalogue.com/stores

1 – Each one symbolizes one store. It appears the name when we don't have permission to use images from them.

A specific store can have different bars with information. It can have products which have components sold by the store in context, products or components sold by the store.

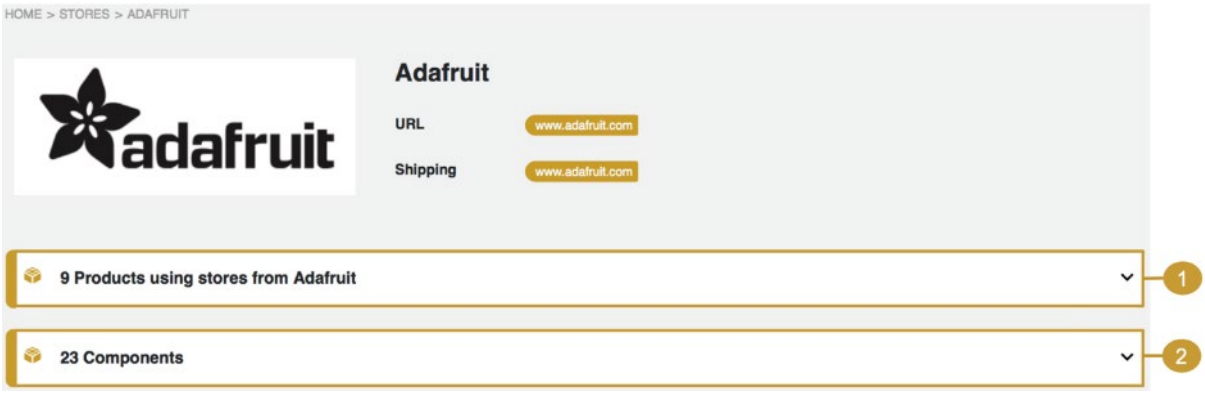

Figure 48: Store[17].

Products using Stores

Products using Stores means a certain product has a component which is actually sold by the selected store.

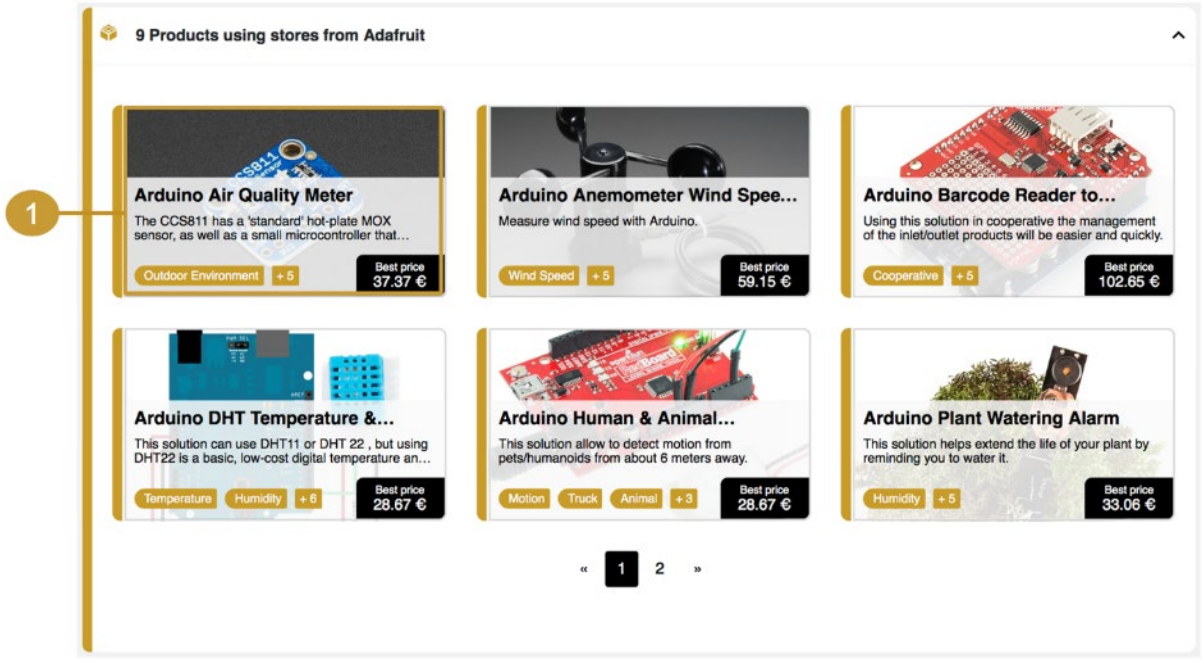

Figure 49: Stores Products Using From.

1 - Choosing one card will open a product page like it is showed in the products chapter.

[17] https://beta.iot-catalogue.com/stores/58f5db94e03b8617070f32f4

Components

These are the components sold by the store. Clicking one card will open a component page like it is showed in the component chapter.

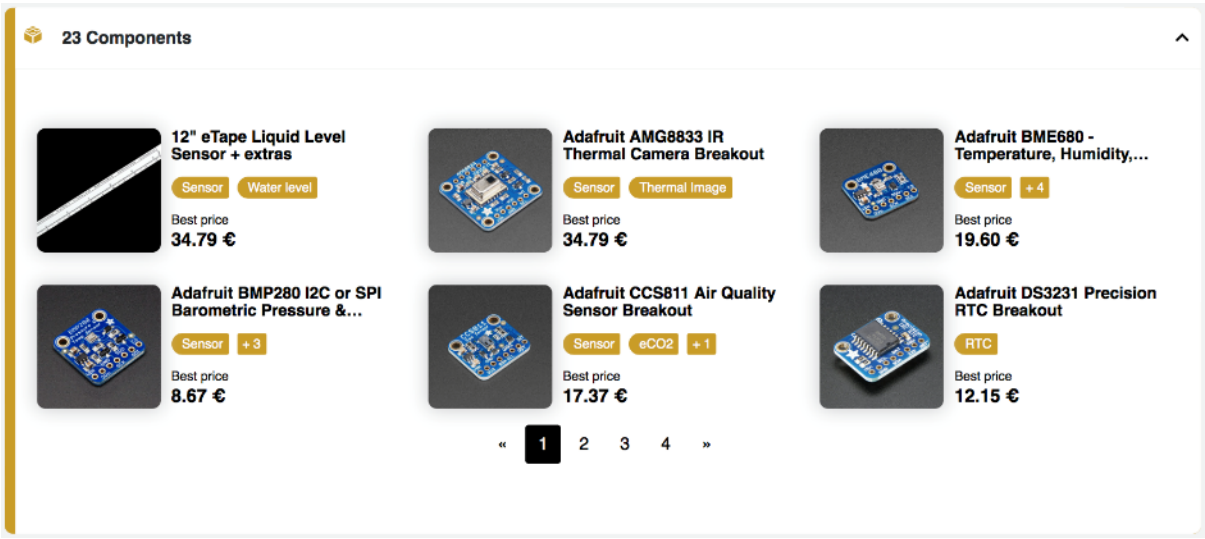

Figure 50: Stores Components.

4.10. MANUFACTURERS

Manufacturer can be Software Developer or a manufacturer from a product/component. Manufacturer can have different types of bar:

- Products which have components from the selected Manufacturer.
- Products from the selected Manufacturer.
- Components from the selected Manufacturer.

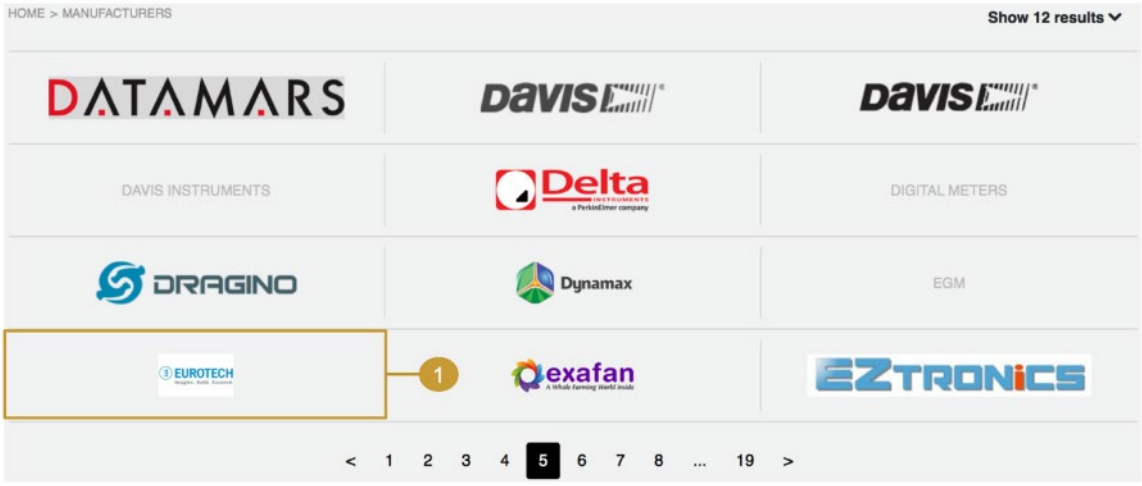

Figure 51: Manufacturers[18].

[18] https://beta.iot-catalogue.com/manufacturers

1 – Each one symbolizes one manufacturer.

This is the appearance of the manufacturers page. It could have three different types of bars: products, components and products which contain components manufactured by the manufacturer. It depends on what each manufacturer has.

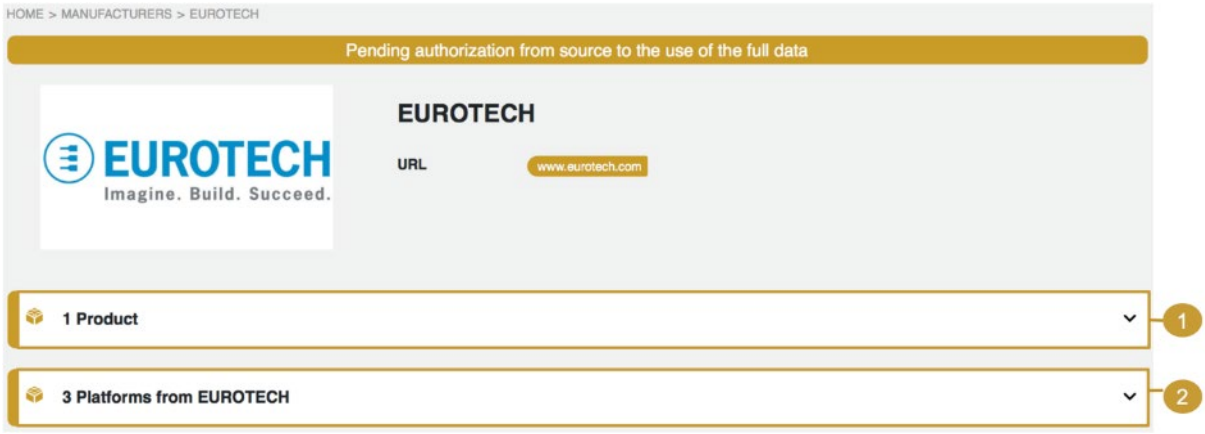

Figure 52: Manufacturer[19].

1 – Products with some components which have been manufactured by Eurotech in this specific case

2 – Platforms which were developed by Eurotech

Clicking in product bar it will have the same structure which is possible to see in stores chapters. In the Platform bar will appear cards showing some information about the platform which belongs to this manufacturer.

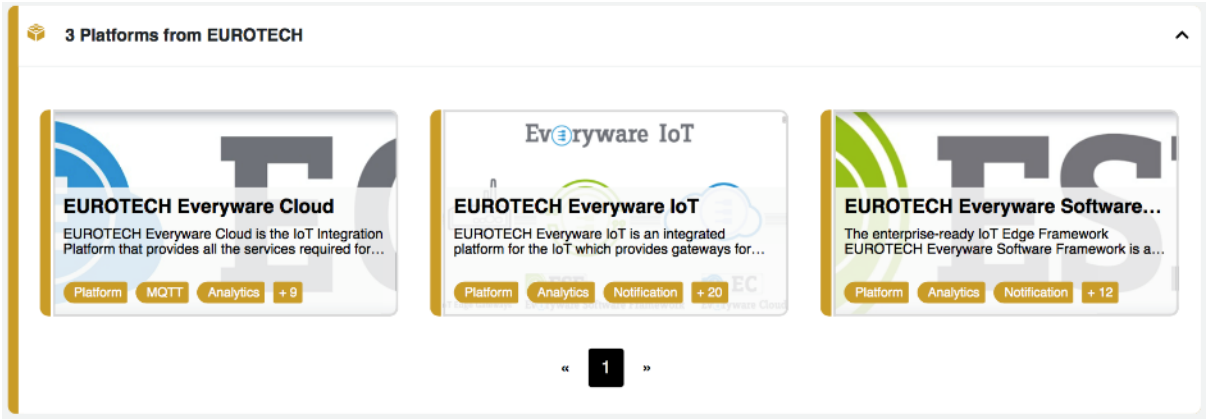

Figure 53: Manufacturer platforms.

Choosing one platform will appear a page similar to this one.

[19] https://beta.iot-catalogue.com/manufacturers/5b4cbe74b8f13022bb5e6f3f

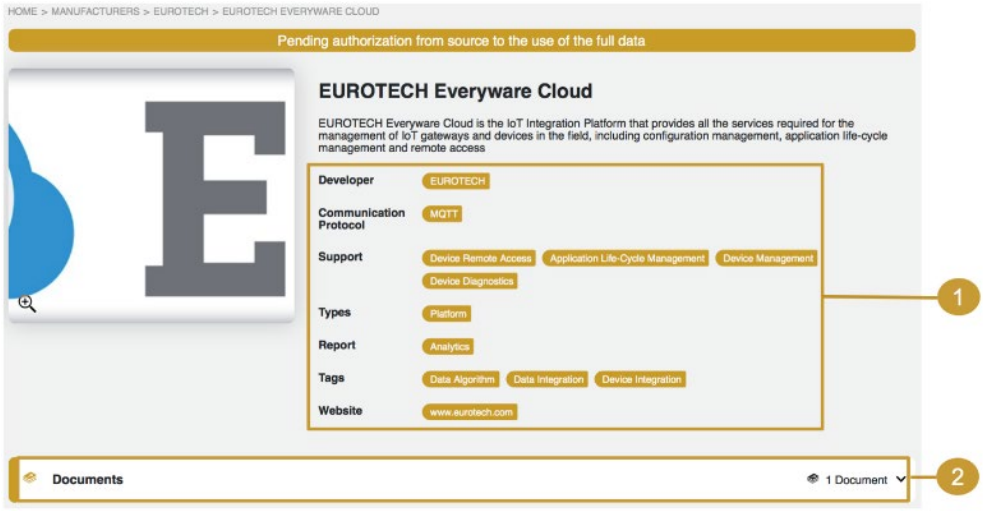

Figure 54: A Platform from a manufacturer[20].

1 – Platform characterization.

2 – Documents which will help to understand/configurate/deploy the platform.

4.11. LIBRARIES

Libraries are a collection of code that makes it easy for users to interface to any type of device. Libraries facilitate how users interact with hardware and manipulating data.

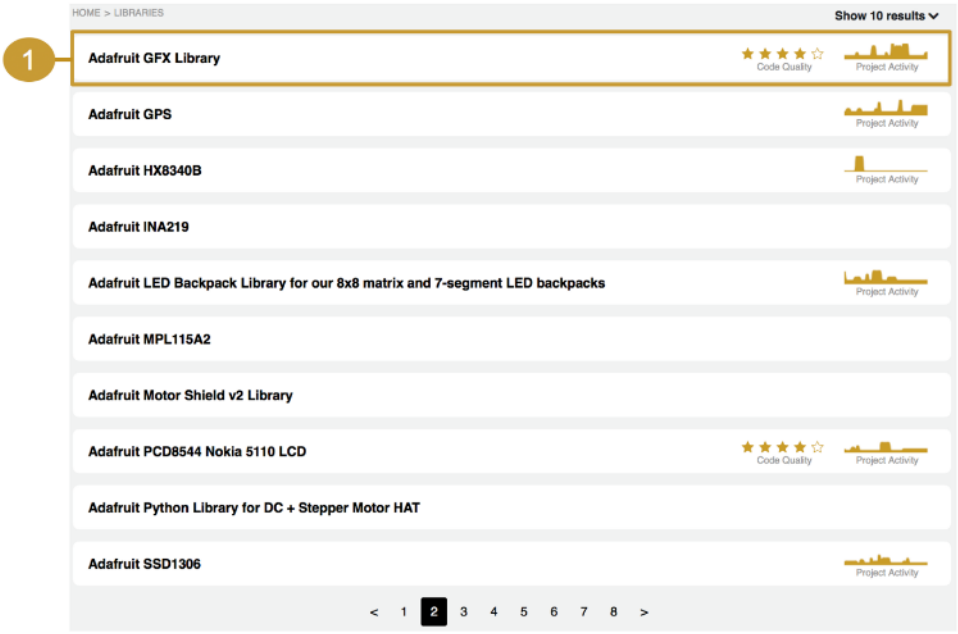

Figure 55: Libraries[21].

20 https://beta.iot-catalogue.com/manufacturers/5b4cbe74b8f13022bb5e6f3f/component/5b4cbe74b8f13022bb5e6f45

21 https://beta.iot-catalogue.com/libraries

1 - It analyses (externally) the code quality taking into account defined metrics. It also checks project activity in GitHub (it is compatible with more) in terms of commit, posts, issues and so on.

This is the library page when it has a link to GitHub or similar. If does not exist, it will only have the product and component bar.

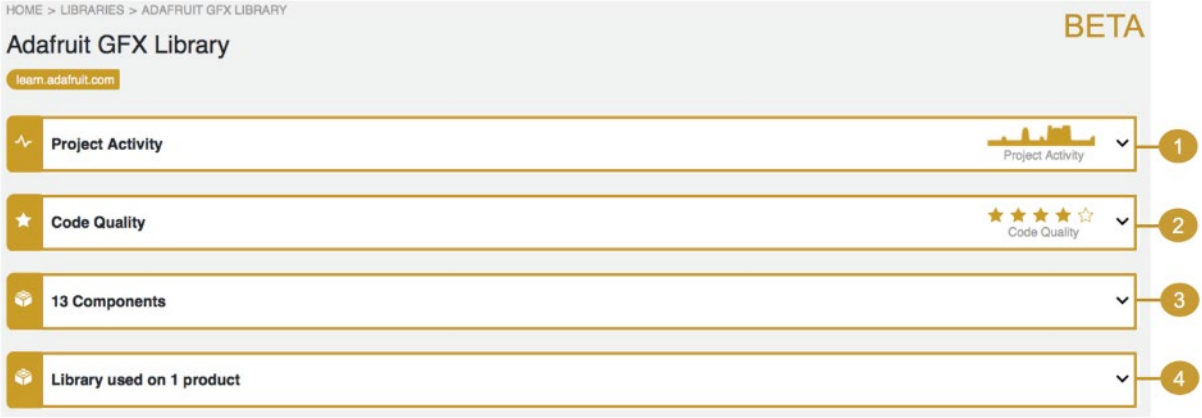

Figure 56: Library.

1 – It analyses the commits per day, bug open time and bugs.

2 – It analyses the code trough COCOMO model and gives a rank.

3 – The components which this library needs to work.

4 – The products which this library needs to work.

5. ANNEX II: DATA MODEL

The Data Model Chapter is proposed to demonstrate what was explained previously in the user guide. For this was created some Json files examples, to show what kind of information is needed.

This chapter explains the structure of the data used to describe a case study and their elements. This will clarify all the fields presented in each element. Each element has mandatory fields (marked with an asterisk "*") as well as optional fields. Note: we encourage to try to fill all information (mandatory and optional) for the case study to become richer.

It is worth noting that the data model has dependencies among each element, and such, there is an order of insertion that needs to be followed.

All the dependencies must be filled which will be explained below. It is mandatory to create all information previously if it is needed in later steps.

The recommended dataflow to insert in IoT Catalogue must be based on these following steps:

1. Insert in advance all necessary tags (as tags can be used in problems and products/components).
2. Insert all components and products needed with the stores and manufacturers.
3. Create Case Study with the link to the project, description and the logo.
4. Create all Value Propositions, ICT Problems and make the cascade relations between them.
5. Create all the user entities needed, such as entities, users, places, etc.
6. Create all the solutions (set of products), which will be used in validation.
7. And finally, validations. This consist in: refer the places validation and who was the team/user responsible for that deploy; enumerate all the relations and all the value proposition and ICT problems; the relation between solutions, problems (ICT Problem) and where it was deployed; the photos related to solution and deploy.

Doing all these steps will result in a Json file which, by combining them, will result in a Case Study with Value Propositions, ICT problems, solutions and photos in IoT Catalogue.

5.1. TAGS

Tags are used to represent properties of products/components, Value propositions and ICT problems. For example, "Measurement: Barometric Pressure" means it has a tag type "Measurement" with a tag name "Barometric Pressure".

There is a link in the IoT Catalogue where all Tags can be found (https://beta.iot-catalogue.com/tags).

Name*	Name of the tags
Type*	The id from the tagTypes which will symbolise the category type.

Please check the example file named "Tags.json". The tag "Barometric Pressure" with the type "5a96e6e4be971823dcd4f36c" (can be verified in "TagTypes.json" that it belongs to a tagtype with name "measurement"), is available in the tags array of the WAZIUP LoRa Weather Station product.

TagTypes

This is used inside of Tags.json (field type) to symbolise the category tag.

Name*	Name of the tag type, this field in used internally by the algorithm.
Text*	Text used to show graphically the name.
Icon	Icon pre-defined. Must of the time this could not be used.
Parent	This is used to associate the tagtype to something else. For example, if we choose parent equal to IoT Function, this means the tag can be showed in case study function characterisation. To see where this is used please check the case study chapter in user guide.

Please check the example file named “TagTypes.json”.

5.2. PRODUCTS/COMPONENTS

Components has features which needs to be addressed. Addressing components characteristics is a very useful task as it helps to distinguish between each other, providing a better and clear view to the case study or to the user needs.

The following items share the same structure: Components, products, learning and platforms. But they are distinguish using tags.

- Component: e.g. temperature sensor
- Product: When it is needed to suit more feature to a sensor it can be conjugated to something else (e.g.: Arduino) and the capacity of the sensor is increased because now it is connected to a microprocessor and is able to treat some data, at this point is considered a product, because the components array has two components and has a functionality.
- Learning: e.g. series of steps of how to assembly a hardware
- Platforms: e.g. 365FarmNet

Name*	Name
Manufacturer*	The manufacturer field is composed by an id and a tag field. The id describes the manufacturer and the tag will let you know if it relates to a software developer or a hardware manufacturer. Check the structure in Manufacturer chapter.
Description	Relevant description
Guides	Pdf files or a url, aiming at helping how to handle the item in any process
Documentation*	It can be a website with information. The type is chosen by the user.
Stores	This field has information about the id of the store, price, url and the last time the price was updated (lastUpdate). Check the structure in store chapter.

Libraries	Libraries used in the product, for example a library for an Arduino
Image*	Representative image
Components	This can have an array of components if this is a product. Will be empty if it is a component. Even being a product, this can be empty in the case the product itself is enough to make the function.
Tags*	Characterise the product using tags. This is also used to know if it is a component (don't have any tag with TagTypes Types), a product (Types:Product), Learning (Types:Learning) and Platform (Types:Platform).

Please check the example files named "SparkFun Weather Shield.json"(component) and "WAZIUP LoRa Weather Station.json"(product). It is possible to verify the SparkFun Weather Shield id presented in the components array from WAZIUP LoRa Weather Station.

The product is available to check in this link[22] and the component here[23].

Stores

Stores provides a description of the physical or online space where the users can buy the products / components.

Name*	The name of the store
Url*	The link of the store
Shipping	Website with information about the shipping
Image*	Representative image of the store

Please check the example file named "Stores.json".

Manufacturer

The manufacturer is the entity who is the software developer or hardware developer.

Name*	The name of the manufacturer
Url*	The link of the manufacturer
Image*	Representative image of the manufacturer

Please check the example file named "Manufacturers.json".

[22] https://www.iot-catalogue.com/products/59b1797c763cfc066f6d092b

[23] https://www.iot-catalogue.com/products/59b1797c763cfc066f6d092b/component/5889db8b1a51d38d0517c1bb

The Manufacturer is available here[24]

Library

Libraries are a collection of code aiming at simplifying interface to users accessing from any type of device. Libraries enable the way how users interact with hardware and manipulate data.

Name*	The name of the library
Repository*	The url from the repository where we can find the code
Download*	Url used in Generate Sketch. This url will download all the repository
IncludeFiles*	The .f files needed to be included in Generate Sketch.
Path*	The path needed to go through to be the files from the library needed. The repository can have more thinks then the library, so it is necessary to specify.

Please check the example file named “libraries.json”.

5.3. CASE STUDY

The Case Study represents a real-world scenario. This will have all problems which needs to be solved and the products which provides their solution.

Name*	Name of the Case Study
Description*	Description of the Case Study
ShortDescription	This is a short version of the previous description, which is used whenever the space is limited.
Tags*	Already explained in previous sections
Link*	Website with information about the case study
Design	This contain the image from the case study, the hyperlink related to the logo and a banner if applicable.

Please check the example file named “caseStudy.json”.

The case study is available here[25].

5.4. VALUE PROPOSITION/ICT PROBLEM

The problems are divided in two types: Value Proposition and ICT Problem. Value Proposition are most of the times the ones in the top, typically economic problems or the added value to the user/company.

[24] https://www.iot-catalogue.com/manufacturers/5908aa93023a54c78115b9aa
[25] https://www.iot-catalogue.com/usecases/5a6b4fc5659fef0f31ceadda

ICT are the technological problems which compose Value propositions. It is the set of technological problems (ICT) that need to be solved to resolve the Value proposition.

Name*	Name of the Value Proposition
Description	Description of Value Proposition
Problem type*	It can be an ICT Problem or a Value Proposition (The tag used to represent value proposition is called “business”, because was the name previously used)
Tags*	Already explained in previous section
RelatedTo	It is possible to relate problems to a main problem. Can be seen in the zip file that exists a problem called "Measure Air Quality". Such problem has a field related to a main one, "Measure Air Conditions".
Parent	It will have the id of the “parent”. That means this problem will inherit all properties from the problem with the id mentioned. It will overwrite the inherited properties if the problem has some fields to replace.

Please check the example file named “problems.json”.

The Value proposition is available here[26] and the ICT Problem here[27].

Relations Problem

This will help to map the relations between Value Proposition and ICT problems.

Root*	Array of Value proposition
Problems*	Array of Value proposition or array of ICT problems
Nodes	This field allow to create value propositions or ICT problems in cascade.

Please check the example file named “RelationsProblems.json”.

5.5. USER ENTITY

User entity can define any kind of entity, i.e, a user, a place, an entity or anything that is necessary to create. With such diversity, each one can have different requirements in terms of definitions. In other words, each entity can be created with different fields. For instance, in an entity representing a company. the team field makes more sense, because such an entity has employers. Describing employers and building the team is an easy way to show how the company is made up.

Name*	It can be the name from place, user, entity or anything which is created.

[26] https://www.iot-catalogue.com/valuePropositions/5a82d2c836acc6d2aa8c5080
[27] https://www.iot-catalogue.com/ictProblems/5a6efe43951d340775eae7a0

ShortName	This is a reduced version, which can be used in some designs where the space limited.
EntityType*	This is used to identify what kind of entity it is (e.g. a place, user, entity, etc).
Country*	This will contain the country id.
GpsCoordinates	This include two fields: latitude and longitude.
Address	This include two fields: region and road.
Permission	This field indicate how deep we can show information. For example, “ALL” means all information can be showed and “REGIONS” means only regions can be showed.
AreasSpecialization	This field contains an array of tags (it should respect the same structure). Usually the tags have the tag category “Specialisation”, although it can have anything the user wants.
Metadata	This is used to create additional data. Such data will also characterise the user entity in parallel with area “Specialisation”.
Contacts	This will contain an array with mobile phone numbers.
Email	This will contain an array with emails.
Website*	A website representing the user entity. This makes more sense to an entity or a place.
Team*	This is divided in two fields: userId and userRole • userId – this field can be also a user entity with the entityType user. • userRole – this will symbolise the role in the company This is applied essentially to entities with employers.

Please refer to the example file named “UserEntity.json”. There is also an example from “AreasSpecialization.json”.

Country

In this structure will have all countries used in IoT Catalogue.

Name*	Country name

Please check the example file named “CountryList.json”.

5.6. SOLUTIONS

Solutions are used to identify more easily where the set of components are being used.

Tags*	The tags field is used to state this is a solution document file.
Components*	An array of components/products which composes a solution.

_validations*	Validations ids where the set of components are used.

Please check the example file named “solutions.json”.

5.7. VALIDATIONS

The validation will address the solution (composed by multiple products/components), which was already tested by other users, experts or entities, related to the case study.

Case Study*	The id of the case study
Name*	Validation name
Description	Validation description
PlaceDeployInfo*	This field contains an array with information about where it was deployed, and the users/entities involved. • DeployId – id from the place where it was deployed • Users – information about the users and entities involved in validation ○ userId – id from the user/entities ○ validationRoleId – role from the userId, which could be admin (used for users), validators (used for entities), etc. The userId with admin roles will appear in the left and the one with validator will appear in the right.
Problems*	Includes an array with all Value Propositions and ICT problem
Nodes*	This field includes a list of ids. Such ids represent the relations between two Value Propositions, two ICT Problems, or between a Value Proposition and an ICT Problem. Some relations can be described in a hierarchically view.
Solutions*	This structure helps to relate the ICT problem id to the specific solution (i.e. set of products) that resolves that problem. • solutionId – this id is the same comes from in the solutions.json file and is used to identify which set of products/components (i.e. solution) will resolve the ICT Problem • problemId – ICT problem id • deployId – this id represents the place, and is also used to identify in which place this solution makes sense.
Photos	These are the photos related to the selected validation that will appear in the photo gallery section • photoId – id identifying the photo. • solutionId – this id is the same in the solutions.json file and is used to identify in which solutions the photos will appear. • deployId – this id represents the place and is used to identify where the photos will appear.

Please check the example file named “validations.json”.a