

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

WP 3

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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 <u>http://www.iot-catalogue.com</u>). 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 <u>www.iot-catalogue.com</u>. 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 	 Access to the list of components that compose a product
 Understand which IoT functionalities create added-value to the end-users Explore Real-World IoT Solutions 	 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 <u>http://www.iot-catalogue.com</u>). 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.

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

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.

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Explore Real-World IoT Solutions	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 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 IoF2020¹ 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 <u>https://www.iot-catalogue.com/usecases/IoF2020</u>



- 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.

	Dairy	Fruit	Vegetables	Meat	View all
IoF2020 Project Case Stud	lies				4 Case Studies
Farm Machine Interoperabi One of the biggest problems f interoperability of farming e different digital standards.	lity armers face is the quipment due to This lack of	Precision Crop Managem Nitrogen and water availabili limiting factors in wheat pro sensor data embedded in	ent ity are the two main duction. By utilizing a low-power, long-	bya Protein Management ost plant based proteins are o ya bean. Currently, the EU im Ilion tons of soya (mainly as	derived from the ports around 32 processed soya
Within-field Management Z In Europe, arable farming requirements and challenges resource efficiency, environr	faces increasing when it comes to mental protection,				
Statistics					
35 Solutions	12 Validations	12 Places	25 Value Propositions	11 ICT Problems	45 Components
Component by use case					45 Components
365FarmNet Innovative free field mapping sold agricultural helding allowing the r Data Algorithm Platform (C	x3 ution for entire management of koud Data +1	Farm Gateway Place Collects data from sensors and Product Radio Bridge	x2 holder I sends it to Cloud	aspberry Pi 3 Model B	Best price 35.00 €
Sigfox & BLE Wireless This placeholder product aim is to Cloud	s Radio o send data to the	ITPhotonics poliSPEC Using its built-in GPS and Near ITPhotonics poliSPEC NIR Ser	C NIR Sensor InfraRed Sensor, Isor can be utilised	F Instruments CMD-DU F Instruments CMD-DUO Electro onductivity Meter uses an electro	JO magnetic magnetic
Product Sensor Location	+3	Product Sensor Location		Product Radio Sensor Lo	+ 10

Figure 3: IoF2020 Landing page with Arable option selected.

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



V IoF2020 Project Case Studies

19 Case Studies A

Added-Value Weeding Data

When growing organic vegetables, weeding represents one of the most important and frequent activities to control both the quality of

Chain-Integrated Greenhouse Production

IoT is about connecting systems so as to enable an integrated, multidimensional view of farming activities and allowing a deeper understanding of

Farm Machine Interoperability

One of the biggest problems farmers face is the interoperability of farming equipment due to different digital standards. This lack of

Happy Cow

The adoption of technology in the European dairy farming sector lags behind compared to other farming sub-sectors: less than 20% of all dairy

Meat Transparency and Traceability

Today food is all about communication. Consumers want to know what they are eating: is it healthy, safe, fresh, organic and locally

Precision Crop Management

Nitrogen and water availability are the two main limiting factors in wheat production. By utilizing sensor data embedded in a low-power, long-

Within-field Management Zoning

In Europe, arable farming faces increasing requirements and challenges when it comes to resource efficiency, environmental protection,

Automated Olive Chain

The EU is the largest producer (accounting for almost three quarters) and consumer (accounting for almost two thirds) of olive oil in the world. In

City Farming Leafy Vegetables

Consumer tolerance for dirt, insects and other unwanted ingredients is almost zero. This is especially true for leafy vegetables used in

Fresh Table Grapes Chain

Table grapes are economically important products in the Mediterranean basin. The value of table grapes, more than any other crop,

Herdsman+

Precision Livestock Farming (PLF) has the potential to address societal concerns related to animal welfare, lower the environmental burden

Pig Farm Management

The demands for sustainable production in the competitive pig farming industry can only be met when the whole production chain from farm to

Remote Milk Quality

Central milk and dairy testing laboratories use InfraRed (IR) analyses instruments to analyse milk composition and quality. However, it is a

Big Wine Optimisation

The EU is the most important producer of wine in the world in terms of value. The sector consists of more than 2.4 million vine growers, in small

Enhanced Quality Certification System

The EU quality certification system and protected designation of origin (PDO) is a powerful tool to protect the quality of EU products, especially in

Grazing Cow Monitor

The awareness of the potential negative impact of livestock farming on both the environment and animal welfare is rising in Europe. Dairy

Intelligent Fruit Logistics

Returnable Transport Items (RTI) for packaging and transporting fresh produce play a crucial role in getting fruit from the farm to the consumer's

Poultry Chain Management

This use-case intends to improve the performance of poultry production chain processes through IoT driven technologies. The

Soya Protein Management

Most plant based proteins are derived from the soya bean. Currently, the EU imports around 32 million tons of soya (mainly as processed soya

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 studies².

Name	Validations	Places	Value Propositions	ICT Problems	Products
loF2020 Case Studies	53	78	104	73	193

Table 1: IoF2020 Statistics.

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
	1.1-Within-field Management Zoning	2	2	3	3	21	8	11
able	1.2-Precision Crop Management	1	1	1	3	13	13	8
A	1.3-Soya Protein Management	2	4	5	6	10	11	8
	1.4-Farm Machine Interoperability	4	5	7	7	25	19	18
	2.1-Grazing Cow Monitor	1	1	2	2	7	7	5
iry	2.2-Happy Cow	4	1	4	4	4	6	6
Da	2.3-Herdsman+	2	3	3	3	15	3	5
	2.4-Remote Milk Quality	1	1	1	1	3	5	5
	3.1-Fresh Table Grapes Chain	2	5	5	7	18	7	13
uit	3.2-Big Wine Optimisation	1	2	2	5	17	8	11
Ц	3.3-Automated Olive Chain	2	6	2	12	14	7	10
	3.4-Intelligent Fruit Logistics	7	>7000	30	>7000	5	3	11
es	4.1-City Farming Leafy Vegetables	1	1	2	2	12	8	9
getabl	4.2-Chain-Integrated Greenhouse Production	1	6	3	10	22	7	16
<θ	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
	5.1-Pig Farm Management	2	7	6	7	25	12	17
eat	5.2-Poultry Chain Management	1	3	4	5	13	7	16
Σ	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 (<u>Davis Vantage Pro</u>) can be useful for a use case dedicated to <u>arable</u> 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 (<u>ECH2O 5TE Ground Sensor</u>) 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 (<u>FIWARE - BigData Analysis - Cosmos</u>) is used on <u>Chain Integrated Greenhouse production</u> and <u>Precision Crop Management</u>, 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.

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

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

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.



Pendir	ng authorization from source to the use of the full data
	Afimilk Silent Herdsman Each animal is fitted with a smart neck collar, which monitors its heat expression and health round-the-clock transmits the data wirelessly to your PC, laptop, mobile or tablet. Types Sensor Product Domain Farmer Measurements Eating Location Pumination Heal Detection Predict Fertility Health Target Cow Animal
Components	¥.
♡ Used on	^{30:} 1 Case Study ♣ 1 Problem
	Case Studies Problems
Herdsman+ Precision Livestock Farming (PLF) has the potential to address societal concerns related to animal welfare. lower the environmental burden	Measure Animal Behaviour Cow Fertity Health Eating Location Rumination +2

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.

	Hydreon F Manufacturer Types Measurements Support	Rain Gauge (RG-11) Hydreon Corporation Sensor Precipitation store.hydreon.com		
Used on			[:] 0 [:] 1 Case Study	1 Problem
	Case St	tudies Problems		
Precision Crop Management		Measure Weather Conditions		
Nitrogen and water availability are the two mai limiting factors in wheat production. By utilizin sensor data embedded in a low-power, long-ran	n 9	Outdoor Environment Humidity Ter	mperature Precipitation	

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.



HOME > VALUE PROPOSITIONS > IMPROVE GRAPE QUALITY		
👬 Improve Grape Quality		
Characterization		4 Tags 🧥
Value Proposition Category: Quality Improvement Value Proposition Dimension: Economic Domain: Fruit Target: Grape		
ିଦ୍ୟ Used on	^{⊰©∈} 1 Case Study	♣ 1 Problem ∧
Fresh Table Grapes Chain Table grapes are economically important products in the Mediterranean basin. The value of table grapes, more than any other crop, depends on t. IOF2020 Agriculture Fruit		
ICT Problems		8 Problems 🗸

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.



HOME > PLATFORMS > 365FARMNET	
Pendin	g authorization from source to the use of the full data
	365EarmNet
	SODE attritted Innovative free field mapping solution for entire agricultural holding allowing the management of agricultural business from manufacturers to every branch of the industry. Basic functions: general inventory management, operation-specific basic weather, graphic map of your holding, interactive annual calendar, complete documentation function, aerial views of your fields, The application data for farmers can be simply and automatically entered into the software. Information on current seed collections, manures and plant protection products is always up-to-date. Types Platorm Share Cloud Data Tags Data Algorithm
	Target Farmer Community
	Website www.365farmnet.com
🌣 Used on	¹⁰ ⁶ 6 Case Studies ♣ 21 Problems ∧
	Case Studies Problems
Herdsman+ Precision Livestock Farming (PLF) has the potential to address societal concerns related to animal welfare, lower the environmental burden	Cow Fertility Health Eating Location Rumination +2
loF2020 Dairy	Control Feed Management
	Feed Cow Weight
	Control Milk Production
	Cow Milk Milk per Teat Milk per Day Weight Milking Time
	Measure Milk Quality
	Share Acquired Farming Data
	Cloud Data
Farm Machine Interoperability One of the biggest problems farmers face is the	Share Data with Stakeholders
interoperability of farming equipment due to different digital standards. This lack	
loF2020 Arable	Generate Reports and Field Maps
	Reports Informative Charts Field Maps
	Measure Soybean Protein
	Near InfraRed Scybean Protein
	Monitor Viald
	Yield
	Measure Weather Conditions
	Connon-Environment temperature municity Precipitation wind speed 1-3
	Monitor Soil Moisture
	Soil Moisture
	1

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.

DATALOS./E		K Sawe all changes	<	Add Selected Campal
	Name	Name Barometric Pressure		Search 9,
	Actuator	Category	Actuator	
	Adafruit	Measurements	Pumping +	
iponents	Aminita	1 Product	Dehumidification 🗸	Humidification +
	Activity	Arduino MPL3115A2 Pressure Meter	Irrigation +	Cleaning Teats +
	Alkalinity	Basic Weather Station with a LCD	Heating Pump +	
	Ammonia	Cloud-Connected Weather Station with the Arduino	Treat Water +	
	Animal	MKRFOX1200 Weather Monitor	Component Type	
	Arduino Store	With Phonton Weather Station	Platform +	
	Almospheric Pressu	WAZIUP LoRa Weather Station	Motor +	Antenna +
	Audio	Weather Station Wirelessly Connected to Wunder	Board +	Display +
	Barcode	Add products	Interface 🗸	Radio +
	Barometric Pressure	a 1 Problem	RTC +	Sensor
r Name		Measure Water Quality	Solar Papal +	(Kit

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 guality 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.



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).

88	Overview				~
0	IoF2020 Validation 2 UC4.2	IoF2020 Validation 3 UC4.2	IoF2020 Validation 4 UC4.2	IoF2020 Validation 5 UC4.2	⊘ IoF2020 < >
0	Place				4 Places 🗸
0	Team			1 Con	tact 3 Entities 🗸
*	Characterization		6 Value Propositions 8 ICT	Problems 18 Functions 6 Targ	jets 1 Domain 🗸
۲	Solutions				18 Solutions 🗸
6	Photo Gallery				5 Photos 🗸

Figure 17: Case Studies⁴.

- 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:
 - o 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



S. SPALLY	Church Martin Street	+		
Granada Sierra Nevada National Park	LASS NO.		1	6
		÷ I	Number of Countries	Number of Validations
	2 Almer		4	
			Number of Regions	

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.

8 Overview				
Location	Almería Spaln	Almería Spain	Nijar Spain	Santa María del Águila Spain
IoF2020 Validation 1 UC4.2				1
IoF2020 Validation 2 UC4.2	1			
IoF2020 Validation 3 UC4.2		1	3	
IoF2020 Validation 4 UC4.2		2		
IoF2020 Validation 5 UC4.2	(1		
	OVERVIEW	REGIONS	PLACES	

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.



Almería Spain	2		
Almería #1	Tomato	Both	
Spain	Type of Transported Products	Conventional or Organic	
Almería #2	?		Almeria
Spain	Quantity of Transported Products		2
Almería #3			meden

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.







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.

Value Proposition	ICT Problem	Function	Target
Increase Data Availability	Sense Crop Growth	Send	Tomato Growing
Increase Yield	Measure Solar Radiation	Device Data	Outdoor Environ
Reduce Production Costs	Measure Weather Conditions	Measurements	End User
Reduce Water Use	Sense Power Consumption	Temperature	Soil
Reduce Pesticide Use	Measure Air Quality	Humidity	Domain
Reduce Pesticide Active Ingredients Level	Analyse Climate Changes	Water Content	Water
	Measure Crop & Soil Conditions	Electrical Con	
	Share Data with Stakeholders	Photosyntheti	
	Send Data to Cloud	Photosyntheti	

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.

Characterization	6 Value Propositions	9 ICT Problems 24 Functions	7 Targets 1 Domain 🔨
Value Proposition	ICT Problem	Function	Target
Increase Data Availability	Sense Crop Growth	Send	Tomato Growing
Increase Yield	Measure Solar Radiation	Device Data	Outdoor Environ
Reduce Production Costs	Measure Weather Conditions	Measurements	End User
Reduce Water Use	Sense Power Consumption	Temperature	Soil
Reduce Pesticide Use	Measure Air Quality	Humidity	Domain
Reduce Pesticide Active Ingredients Level	Analyse Climate Changes	Water Content	Water
	Measure Crop & Soil Conditions	Electrical Con	
	Share Data with Stakeholders	Photosyntheti	
	Send Data to Cloud	Photosyntheti	

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 Products⁵.

- 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.

	HOME > PRODUCTS > WAZIUP LORA WEATHER STATION	
1	Pending authorization from source to the use of the full data	
	WAZIUP LoRa Weather Station Solution capable of read-time data typical of a weather station, using different sensors, and capable of communicating via LoRa.	
	EC Project WAZUP Types Antenna Board Interface Radio Sensor Solar Panel Battery Connector Product Measurements Temperature Humdity Wind Speed Wind Direction Raining Detector Wind Gust	
	Image: Control of the second secon	
3-	Exert in the set of t	
	🕫 Components 🔶 🕅 🚳 🙋 🛄 奎 💷 💭 🐑 🗖 🥑)
5-	🖗 Used on 🕸 1 Case Study 🔹 1 Problem 🗸	
)
7-	I Generate Sketch	

Figure 30: Product⁶.

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



	ter 214.52 € Best Price				MOUSER 601	n cooking hacks	Aadatruit ^	
2	7 Components 1 Con 79.79 € 8.	mponents 1 Comp 33 € 44.6	Contracting hocks Contracting hocks for the second hocks for t	Realine 1 Components 8.75 €			214.52 € Total Price	H 3
					Best Price	214.52 € Single	Store€	- 4
	SparkFun W Available	Weather Shield	I 1 44.65€ to 49.20€		bet i Fellem	44.65 € Last update: a day ago	View in stor	
5-	Weather M	Meters in 4 stores © Fron	n 73.00€ to 98.40€		cooking hacks	73.00 € Last update: a day ago	View in stor	
	Adafruit F	eather M0 with	RFM95 LoRa Radio	- 900MHz	EXPITECH	36.95 € Last update: a day ago	View in stor	_ •
	AM2315 -	Encased I2C Te	mperature/Humidity	y Sensor	EXPTECH	26.18 € Last update: a day ago	View in stor	•
	36-pin 0.1	" Female heade	r - pack of 5!		EXPTECH	3.20 € Last update: a day ago	View in stor	8

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.

214.52 € Best Price Image: Set Price											
Image: SparkFun Weather Shield Image: SparkFun Weather Motors Image: SparkFun Weather Motors Image: SparkFun Weather Motors Image: SparkFun Weather Shield Image: SparkFun Weather Shield <tr< th=""><th>test Price</th><th></th><th></th><th></th><th>EXP</th><th>тесн</th><th>MOUSER</th><th>bet î</th><th>cooking hacks</th><th>Aadatro</th><th>* ^</th></tr<>	test Price				EXP	тесн	MOUSER	bet î	cooking hacks	Aadatro	* ^
Best Price 214.52 € Single Store SparkFun Weather Shield Available in 3 stores © From 44.65 € to 49.20€ Weather Meters Available in 4 stores © From 73.00€ to 98.40€ Adafruit Feather M0 with RFM95 LoRa Radio - 900MHz Adafruit Feather M0 with RFM95 LoRa Radio - 900MHz AM2315 - Encased I2C Temperature/Humidity Sensor Machar I Female header - pack of 5! Best Price 214.52 € Single Store 214.65 € Last update: a day ago Were in store Control 1 Female header - pack of 5! Best Price 214.52 € Single Store 214.52 € Single Store 44.65 € Last update: a day ago Were in store So store 49.20 € Last update: a day ago Were in store No STORE Last update: € Last update:	TECH 7 Components 79.79 €	Monase 1 Components 8.33 €	1 Components 44.65 €	cooking hacks 1 Components 73.00 €	¥tadefruit 1 Components 8.75 €					2 ⁻	14.52 € Total Price
SparkFun Weather Shield ☆ Available in 3 stores ⓒ From 44.65€ to 49.20€ Weather Meters ☆ Available in 4 stores ⓒ Adafruit Feather M0 with RFM95 LoRa Radio - 900MHz Image: All of the stores Adafruit Feather M0 with RFM95 LoRa Radio - 900MHz Image: All of the stores Adafruit Feather M0 with RFM95 LoRa Radio - 900MHz Image: All of the stores All of the stores Image: All of the stores							Bes	t Price	214.52 € Single S	Store	€
Weather Meters Image: Available in 4 stores Image: From 73.00€ to 98.40€ Image: Last update: a day ago Image: Adafruit Feather M0 with RFM95 LoRa Radio - 900MHz Image: Last update: a day ago Image: Last update: a day ago Image: AM2315 - Encased I2C Temperature/Humidity Sensor Image: Last update: a day ago Image: Last update: a day ago Image: Absolution of the store of the st	Spa 🐺 A	rkFun Weathe vailable in 3 stores	r Shield ⓒ From 44.65€	to 49.20€			bot î Fellom		44.65 € Last update: a day ago	^	View in store
Adafruit Feather M0 with RFM95 LoRa Radio - 900MHz	Wea	ather Meters vailable in 4 stores		to 98.40€			bot î rellom		44.65 € Last update: a day ago		View in store
AM2315 - Encased I2C Temperature/Humidity Sensor MO STORE 49.20 € Last update: a day ago NO STORE€ Last update:€ Last update:€	Ada	fruit Feather M	10 with RFM95	5 LoRa Radio	- 900MHz		EXPTECH	4	44.95 € Last update: a day ago		View in store
NO STORE Last update: € Last update:	AM2	2315 - Encased	d I2C Tempera	ture/Humidity	Sensor	1	PIROBOTICS	3	49.20 € Last update: a day ago		View in store
	36-r	oin 0.1" Femal	e header - pac	k of 5!				4	€ Last update:	~	

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.

	Over Dealers
	Case Studies Problems
Chain-Integrated Greenhouse Pr loT is about connecting systems so as to enable an integrated, multidimensional view of farming activities and allowing a deeper understanding	Measure Weather Conditions Temperature Humidity Wind Speed Wind Direction Wind Guat +3
loF2020 Vegetables	
Automated Olive Chain	Measure Weather Conditions
The EU is the largest producer (accounting for almost three quarters) and consumer (accounting for almost two thirds) of olive oil in the world.	Outdoor Environment Temperature Humidity Wind Speed Wind Direction +
loP2020 Agriculture Fluit	
Farm Machine Interoperability	Measure Weather Conditions
One of the biggest problems farmers face is the interoperability of farming equipment due to different digital standards. This lack	Outdoor Environment Temperature Humidity Precipitation Wind Speed + 3
loF2020 Arable	
Sova Protein Management	Measure Weather Conditions
Most plant based proteins are derived from the soya bean. Currently, the EU imports around 32 million tons of soya (mainly as processed s	Outdoor Environment Temperature Humidity Precipitation Wind Speed + 3

Figure 34: Product Used On.



Documents

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

	@ C	Documents	
1	ĺ₽ ₽	LoRa Weather Station - Technical Guide Agriculture MVP Technical details on material, main architecture and acquired test results for LoRa Weather Station LoRa Weather Station - Assembly Guide Weather Station MVP Steps to a correct assembly and deploy LoRa Weather Station	LoRa Weather Station - Assembly Guide Agriculture MVP Steps to a correct assembly, upload software and to deployment for LoRa Weather Station

Figure 35: Product Documents.

Generate Sketch

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

	Generate Sketch		^
	A file will be generated containing a sketch inten libraries can be added under Sketch->Include Li	ided to be used on Arduino IDE and the required libraries obtained through the repository page, brary->Add .ZIP Library	, the
	Libraries used	Generate s	sketch
	MPL3115A2 Altitude and Pressure Sensor	Code Quality Project	Activity
\mathbf{H}	HTU21D Humidity/Temperature sensor	Project	Activity
	Library for AM2315 sensors		

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

Components⁷ 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



HOME > COMPONENTS > RASPBERRY PI 3 MODEL B					
e.	Raspberry Manufacturer Types Support	y Pi 3 Model B Raspberry Pi Board www.raspberrypi.org			
₩ 35.00 € Best Price			c	ooking hacks	~
🌣 Used on			⁻ [©] 2 Case Studie:	s 🛊 7 Problems	•

Figure 37: Component⁸.

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.

HOME > VALUE PROPOSITIONS	Filter Name 🗸	Show 10 results V
Expand to add filters		~
Reduce Stress	1 Case Studies 1 Solutions 1	Validations 3 Places
Reduce Treatment Frequency (TFI)	1 Case Studies 1 Solutions 2	Validations 5 Places
Reduce Waste and Not Qualified Products	1 Case Studies 28 Solutions 1	Validations 1 Places
Reduce Wasted Crop during transport, storage and packaging (%)	1 Case Studies 2 Solutions 1	Validations 2 Places
Reduce Wasted/Rejected Crop at Harvest (%)	1 Case Studies 15 Solutions 4	Validations 5 Places
Reduce Water Costs	5 Case Studies 17 Solutions 13	Validations 15 Places
Reduce Water Use	9 Case Studies 31 Solutions 25	Validations 38 Places
Reduce Worktime	2 Case Studies 28 Solutions 2	Validations 4 Places
Stop Pesticide Run Off	1 Case Studies 1 Solutions 1	Validations 2 Places
Stop Pesticide Use	1 Case Studies 1 Solutions 1	Validations 2 Places
< 1 4 5 6 7 8	9 10 >	

Figure 38: Values Propositions⁹.

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.

н	DME > VALUE PROPOSITIONS > REDUCE WORKTIME	
	Reduce Worktime	
0	Value Proposition Category: Cost Reduction Ease of Work Value Proposition Dimension: Economic Social Domain: Farmer	
	Used on	[®] ² 2 Case Studies ≯ 1 Problem ∨

Figure 39: Value Proposition¹⁰.

- 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).

Used on	^{30⊱} 2 Case Studies ≯ 1 Proble
Happy Cow The adoption of technology in the European dairy farming sector lags behind compared to other farming	
sub-sectors: less than 20% of all dairy farmers.u	
Grazing Cow Monitor	
The awareness of the potential negative impact of livestock farming on both the environment and animal welfare is rising in Europe. Dairy processors, NG	
loF2020 Dairy	

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



HOME > ICT PROBLEMS		Filter	Name 🗸 Show	w 10 results 🗸
Expand to add filters				~
Control Milk Production		1 Case Studies 3	Solutions 3 Validations	3 Places
Control and Identify Products		1 Case Studies 1	Solutions 1 Validations	a 2 Places
Control and Monitor Agricultural Machinery		1 Case Studies 2	Solutions 2 Validations	a 2 Places
Digitise Paper-based Work		1 Case Studies 1	Solutions 1 Validations	s 1 Places
Distinguish Crops from Weeds		1 Case Studies 1	Solutions 1 Validations	a 1 Places
Drilling		1 Case Studies 1	Solutions 1 Validations	s 1 Places
Early Disease Detection		2 Case Studies 3	Solutions 2 Validations	s 4 Places
Educational Activity		1 Case Studies 1	Solutions 3 Validations	5 Places
Evaluate Food		1 Case Studies 1	Solutions 3 Validations	5 Places
Food Tracking		1 Case Studies 1	Solutions 3 Validations	5 Places
< 1 2 3	3456	7 8 >		

Figure 41: ICT Problems¹¹.

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.

HOME > ICT PROBLEMS > EARLY DISE	EDETECTION
Early Cow Disease Detection	Early Poultry Disease Dete <>
1 IoT Function: Predict Health Measurements Chew Count	Veasurements Eating (Measurements Rumination Measurements Heat Detection Measurements Accelerometer
Used on	1 Case Study ≱ 1 Problem 🗸
3 Products	5 Products 🗸

Figure 42: ICT Problem¹².

- 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.

IOME > PLATFORMS		Filter	Name 🗸	Show 12 results 🗸	
Expand to add filters					~
	2: 4F	F 🛛		and the second second	
365FarmNet	AEF ISOBUS Database	-	ARVALIS App	1111	
Innovative free field mapping solution for entire agricultural holding allowing the management of	With a few mouse clicks users can check wh ISOBUS functionalities a certain product/mad	ich chine			
Data Algorithm Platform Cloud Data +1	Agriculture Platform Interoperability	TION	Platform Nitroge	n and Water Management	• 2
Image: Transmit of the second state of the	Angele Gegraff annua Angele Gegraff annua Angele Gegraff annua		nting 2010 - Mill South	Baga Xeoled per Pold	
Atimitik mySilent Herdsman	Ag Leader Agriniti Being connected makes farming easier and r	nore	Ag Leader SMS Sof	tware beins you to take data	
via the internet, rather than just on the computer in	efficient by allowing for more decision making	g on t	from your field and t	um it into smart managemer	nt
Data Algorithm Platform + 6	Platform Field Maps Reports Locati	on	Platform Reports	s Informative Charts + 4	
Connect Meanada (KA14 1) and 141					
Brave Transmission for LLA surger satisfying series code at State Brave Transmission for the LLA surger satisfying series code at State December 2 State December 2 Decembe			R. 848 & A. A	*****	
AgriSyst PigExpert	Agriculture analysis and contr	ol	Akkerweb		
AgriSyst PigExpert is available as desktop, server or as cloud solution, complete integrated with the	Web portal for viewing/analysing sensor data specifying algorithms and models and autom	atic	Akkerweb compiles central geo-platform	all the farm information in or and this is a unique service	ne
Platform Data Algorithm Notification + 4	Platform Market volume / price		Platform Reports	Field Maps + 5	

Figure 43: Platforms list¹³.

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

			Pending authoriza	tion from source to the	use of the full data	
Marina Marina Marina Marina Marina Marina	Constant Solutions		365Farn Innovative free from manufact specific basic aerial views of Information on	nNet e field mapping solution for turers to every branch of th weather, graphic map of yo y your fields. The application i current seed collections, r	entire agricultural holdi industry. Basic functio ur holding, interactive a i data for farmers can b nanures and plant prote	ng allowing the management of agricultural business ins: general inventory management, operation- innual calendar, complete documentation function, e simply and automatically entered into the software. ction products is always up-to-date.
No. 201 Bandarda	1 Verbulge Buchangen	Alf bernan term Alf bernan	Types	Platform		
1. MJ	8.942 Sc.947	N.82 N.75	Tags	Cloud Data Data Algorithm	-0	
Ð		- 2.7 - 2	Target	Farmer Community		
			Website	www.365farmnet.com		

Figure 44: 365FarmNet Platform¹⁴.

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.

Used on	^{⊲Q:} 6 Case Studies 🏼 🕈 21 Problems 🔨
-	Case Studies Problems
Herdsman+ Precision Livestock Farming (PLF) has the potential to address societal concerns related to animal welfare, lower the environmental burden of.m	Measure Animal Behaviour Cow Fertility Health Eating Location Rumination +2
loF2020 Dairy	Control Feed Management Feed Cow Weight
	Control Milk Production Cow Milk Milk per Teat Milk per Day Weight Milking Time
	Measure Milk Quality Milk Fat Protein Lactose Conductivity Color Temperature
	Share Acquired Farming Data
Farm Machine Interoperability	Share Data with Stakeholders
Interoperability of farming equipment due to different digital standards. This lack	Generate Reports and Field Maps
	Reports Informative Charts Field Maps

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: Learning¹⁵.

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.

HOME > STORES		Show 12 results ¥
AS COMMUNICATIONS	adafruit	ADVANTECH
amazon.com	ambient weather;	ARDUENO
ARROW	AtlasScientific	AVNET
BâH	SANANA ROBOTICS	Banggood Strepping with fan ecom Bert Bang For Your Buck
	c 1 2 3 4 5 6 7 11	>
	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.

HOME > STORES > ADAFRUIT	Adafruit URL Shipping	www.adafruit.com	
9 Products using stores from Adafruit			~-1
23 Components			~-2

Figure 48: Store¹⁷.

Products using Stores

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

ľ	0.		
	Arduino Air Quality Meter	Arduino Anemometer Wind Spee	Arduino Barcode Reader to
	The CCS811 has a 'standard' hot-plate MOX sensor, as well as a small microcontroller that	Measure wind speed with Arduino.	Using this solution in cooperative the management of the inlet/outlet products will be easier and quic
ь	Outdoor Environment +5 Best price 37.37 €	Wind Speed + 5 Best price 59.15 €	Cooperative + 5 Best pr 102.65
н	Arduino DHT Temperature &	Arduino Human & Animal	Arduino Plant Watering Alarm
н	This solution can use DHT11 or DHT 22 , but using DHT22 is a basic, low-cost digital temperature an	This solution allow to detect motion from pets/humanoids from about 6 meters away.	This solution helps extend the life of your plant b reminding you to water it.
н	Temperature Humidity +6 Best price 28.67 €	Motion Truck Animal +3 Best price 28.67 €	Humidity + 5 33.06

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.

Δ ΔΤΔΜΔRS	Davis	Davis
DAVIS INSTRUMENTS		DIGITAL METERS
S DRAGINO	Dynamax	EGM
3 EUROTECH	1 Qexafan	EZTRONICS

Figure 51: Manufacturers¹⁸.

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.

HOME > MANUFACTURERS > EUROTECH	nding authorization from source to the use of the full data	
EUROTECH Imagine. Build. Succeed.	URL www.eurotech.com	
1 Product		~_1
3 Platforms from EUROTECH		~ 2

Figure 52: Manufacturer¹⁹.

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.

	Ev Tryware IoT	
	n	
EUROTECH Everyware Cloud	EUROTECH Everyware IoT	EUROTECH Everyware Software
EUROTECH Everyware Cloud is the IoT Integration Platform that provides all the services required for	EUROTECH Everyware IoT is an integrated platform for the IoT which provides gateways for	The enterprise-ready IoT Edge Framework EUROTECH Everyware Software Framework is a
Platform MQTT Analytics +9	Platform Analytics Notification + 20 EC	Platform Analytics Notification + 12

Figure 53: Manufacturer platforms.

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

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



1	EUROTEC EUROTECH Even management of lo management and	CH Everyware Cloud ware Cloud is the IoT Integration Platform that provides all the services required if gateways and devices in the field, including configuration management, applicat remote access	for the tion life-cycle
	Developer	EUROTECH	
	Communication Protocol	MOTT	
	Support	Device Remote Access Application Life-Cycle Management Device Management	
_	Types	Platorn	
	Report	Analytics	
	Tags	Data Algorithm Data Integration Device Integration	
	Website	www.eurotech.com	

Figure 54: A Platform from a manufacturer²⁰.

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.

	HOME > LIBRARIES		Show 10 results V
1-	Adafruit GFX Library	★★★★☆ Code Quality	Project Activity
	Adafruit GPS		Project Activity
	Adafruit HX8340B		Project Activity
	Adafruit INA219		
	Adafruit LED Backpack Library for our 8x8 matrix and 7-segment LED backpacks		Project Activity
	Adafruit MPL115A2		
	Adafruit Motor Shield v2 Library		
	Adafruit PCD8544 Nokia 5110 LCD	★★★★☆ Code Quality	Project Activity
	Adafruit Python Library for DC + Stepper Motor HAT		
	Adafruit SSD1306		Project Activity
	< 1 2 3 4 5 6 7 8 >		

Figure 55: Libraries²¹.

https://beta.iot-

20

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 (<u>https://beta.iot-catalogue.com/tags</u>).

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 link²² and the component here²³.

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".

23https://www.iot-

²² <u>https://www.iot-catalogue.com/products/59b1797c763cfc066f6d092b</u>

catalogue.com/products/59b1797c763cfc066f6d092b/component/5889db8b1a51d38d0517c1bb

The Manufacturer is available here²⁴

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 here²⁵.

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 here²⁶ and the ICT Problem here²⁷.

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.

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 photold – 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