Collaborative Network for Industry, Manufacturing, Business and Logistics in Europe

D7.1
Value Proposition of NIMBLE for the White Goods Service Supply Chain

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NIMBLE in a Nutshell

NIMBLE is the collaboration Network for Industry, Manufacturing, Business and Logistics in Europe. It will develop the infrastructure for a cloud-based, Industry 4.0, Internet-of-Things-enabled B2B platform on which European manufacturing firms can register, publish machine-readable catalogues for products and services, search for suitable supply chain partners, negotiate contracts and supply logistics. Participating companies can establish private and secure B2B and M2M information exchange channels to optimise business work flows. The infrastructure will be developed as open source software under an Apache-type, permissive license. The governance model is a federation of platforms for multi-sided trade, with mandatory interoperation functions and optional added-value business functions that can be provided by third parties. This will foster the growth of a net-centric business ecosystem for sustainable innovation and fair competition as envisaged by the Digital Agenda 2020. Prospective NIMBLE providers can take the open source infrastructure and bundle it with sectorial, regional or functional added value services and launch a new platform in the federation. The project started in October 2016 and will last for 42 months.

1 Introduction

1.1 Objectives

This document describes how the value proposition for the White Goods use case has developed within the NIMBLE project. With Whirlpool being the only large enterprise present in the group of use case partners, a specific aspect of this deliverable has been to describe how a multinational company could benefit from NIMBLE concepts as originally identified and described in the Description of Action (DoA) and further analysed in D1.1. It is also objective of this deliverable to describe how the platform functionalities have been implemented and how stakeholders evaluated them from a technical and business perspective.

1.2 Methodology and tools

The Value Proposition was analysed using Platform Design Toolkit described in D8.12 *Project Business Plan*. The technical evaluation was performed through several remote testing sessions. The business evaluation was performed through interviews with stakeholders.

1.3 Connection with Other Deliverables

D7.1 is the evolution of what was described in D1.1 *Requirements and Collaboration Design for Manufacturing and Logistics in Four European Use Cases* and D1.2 *Requirements for Business Models and Collaboration Patterns in Supply Chains*, and provides a more focused description of the Business Case in terms of connection and integration with NIMBLE concept.

D8.12 *Project Business Plan* provides the detailed description of the Platform Design toolkit and methodology that was used in section 2 of this document.

The outcome of D4.2 *Platform User Experience* has been considered for the technical and business evaluation.

D5.3 *Cost and Ecological Footprint Estimation for Product Life Cycles* describes the scenario involving the Life-Cycle Performance Analysis (LCPA) validation in detail.

2 Value Proposition

The foremost value proposition for Internet Platforms in general is that through digitalisation and fast information interchange, friction is reduced across a business network, resulting in lower transaction cost. Ideally, the benefits of this reduction are then shared between the stakeholders, i.e. the participants and the owner/provider of the platform. The main purpose of the NIMBLE platform is to reduce friction in business for SMEs, and in particular, for manufacturing SMEs acting as suppliers to other companies, big or small". Evidently, the business frictions for an SME cannot be the same as they are for a large multinational company such as Whirlpool EMEA.

As a matter of fact the main functionalities that the platform provides to enhance collaboration between enterprises are essentially addressing the mainstream business process, i.e. buying and selling of goods, a process that in Whirlpool has these characteristics:

1) Toward Suppliers: the process to acquire goods from supplier is managed by Procurement and a tool to connect suppliers to Whirlpool is already in place, based on SAP and fully integrated with the other functions (Administration, Finance, Supply Chain). The Supplier Base of Whirlpool is huge and the process to let new supplier enter into the network takes many steps of interactions between the company and the supplier. The company has not the need to find new suppliers since they are usually proposing themselves through many channels.
2) Toward Customers: the process is managed by Sales Department and a set of tools are in place based on SAP and fully integrated with other functions (Administration, Marketing, Finance and Supply Chain). The Customer network is broadly divided into three groups: Trade Partners, Kitchen Builder and Web. Also in this cases the company is not in the need of finding new partners and the channel of direct web commerce is built fully integrated with others Information Systems (ERP, CRM, etc.)

Hence, NIMBLE's core functionalities have already been tackled within Whirlpool Business and the tools used currently in the company are the result of years of work, millions of euro of investments and reflect the urgent company need for having fully integrated business processes. This kind of investment has been carried out by Whirlpool, thanks to its economic capabilities, but is out of reach for most of the SMEs and midcaps, demonstrating the business need and usefulness of the core business functionalities of Nimble.

The NIMBLE Platform includes also innovative business functionalities such as the possibility to trade data and information through the data-channels. This has been from the very beginning to the project considered by Whirlpool a great opportunity to address a hidden need that will be more and more important in the near future.

As the economy is based more and more on data, from acquisition to management and trade, the WHR (Whirlpool) business case has explored how the NIMBLE Platform could be used to enable a fast, easily enabled, contract-related, polymorphic, trustworthy and standard data trade process within its network of partners in the value chain. These partners around the world are almost all SMEs that will need a tool able to create data-channels toward their IT systems in a smooth, simple way with as little programming effort and cost as possible.

That was the initial Value Proposition expressed in the description of use case requirements under the scenario #2 Product Avatar, which, is a first demonstrator of the possibilities of an open Data Trade.

Trading Data has several commonalities with physical products trading, and therefore the core business functions of Nimble. In fact, for an open data market there is the need for a catalogue to enable data-buyers to autonomously find the data interesting to them, a contract negotiation, to enable flexibility but within clearly defined boundaries, and a "logistic" which in the case of data is represented by the data-channel as the medium to "transport" the data from the IT system of the seller to the one of the buyer in a simple and smooth way, automatically generated once the contract is signed.
In the last years, many players emerged with the core business of trading data: Apple I-Tunes, Netflix, Amazon are already selling data to end consumers in the form of music files, video streams, e-books etc.
The European commission, with the call DT-NMBP-40-2020, Creating an open market place for industrial data (https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/dt-nmbp-40-2020) acknowledges the importance of open data market places, as well as, since it's a Research and Innovation Action, the fact it's a topic which will reach the market in 4-6 years.
Nimble is therefore one of the first players in the market able to act as an open marketplace for data, and has to be considered therefore as a frontrunner of this concept, being thought 3 years before the idea arrived in the EC call and having now a working demonstrator of the overall solution.

The value proposition of a platform for a company producing physical goods, for trading data has to be analysed broadly and that's why in a second phase of the project we had the opportunity to be helped by a workshop organized by NIMBLE partner INNOVA.

The Value Proposition for White Goods, derived from the initial use case description, has been deeply analysed using the Ecosystem Canvas Platform Design Toolkit introduced by [https://platformdesigntoolkit.com/] and described in detail in D8.12 (Project Business Plan – Year 2).

2.1 Analysis Using Ecosystem Canvas Platform Description Toolkit

The adoption of the toolkit brought us to a more concrete and complete vision of the potential of utilization of a platform to trade data thanks to a step by step guided process:

1) Stakeholder Analysis
2) Entities Portrait
3) Platform Experience Canvas
4) Motivation Matrix
5) Transaction Board

As will become clear at the end of this chapter, this approach let us identify a new stakeholder that was not considered at the use case definition stage and that can enlarge the spectrum of potential benefit in NIMBLE platform adoption.

2.1.1 Stakeholder Analysis

In the Stakeholder Analysis the platform canvas is used to map the potential actors of the platform to four different categories: Producers, Consumers, Partners and Platform Owner.

The Platform Owner should be, according to Whirlpool strategy, a third party: WHR currently doesn't have any interest in running a platform open to other competitors or other industries and doesn't have internal competencies or organizational structure to manage it.

The platform run by a third party could provide in fact, desirable features such as independence and impartiality being not interested in the nature and content of data traded but only in the number of transactions and traffic. But more importantly, a third party will be more interested in growing the number of users without concerns about (product) competitors and thus enlarging the base of potential users.

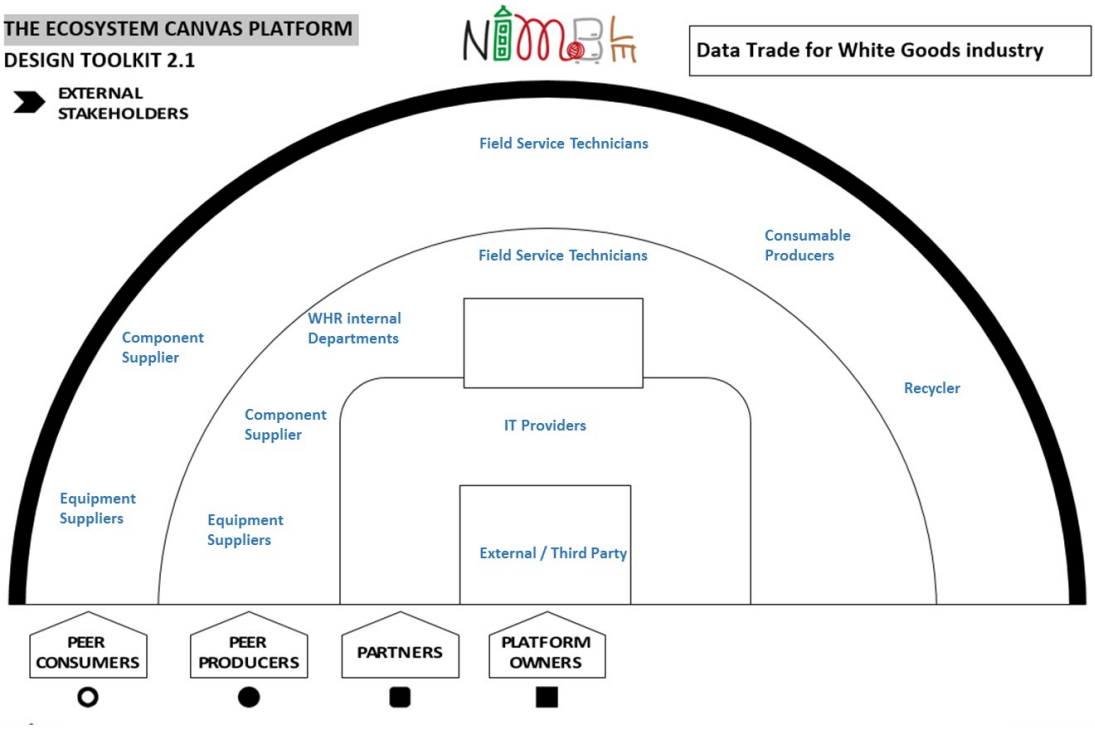

Figure 1: Stakeholder identification

Potential partners are IT companies that could provide Platform enrichment and personalization according to the federated concept of NIMBLE.

Peer Suppliers and Producers are represented by the set of WHR business partners potentially interested in accessing "data in motion" of other partners. Of course Field Service Technicians are, as declared in the DoA, the main and most important target of Data Sharing through Product Avatar functions, but also Equipment and Component suppliers, could benefit from exchanging data with WHR and with each other: as an example we can think of an equipment supplier who wants to access data of machines sold and now operating in Whirlpool plants to gather data from them in order to improve design or to implement some predictive maintenance procedures; or a Component supplier that accesses Functional Test data in order to verify statistical performance of one component (e.g. a compressor in a refrigerator).

A further two potential partners that are not currently part of WHR chain have also been identified: Consumable Producers and Recyclers. The first group are e.g. producers of detergents, the latter is represented by companies who deal with end-of-life of appliances and who can use data owned by WHR to improve the recycling process.

For the further analysis, only the interactions between WHR and Field Service Partners has been taken into consideration.

2.1.2 Ecosystem Entity-Role Portrait

The second step of Platform Design toolkit requires a deep analysis of the entities involved in the platform ecosystem: Whirlpool as a *Peer Producer* and Field Service as a *Peer Consumer*

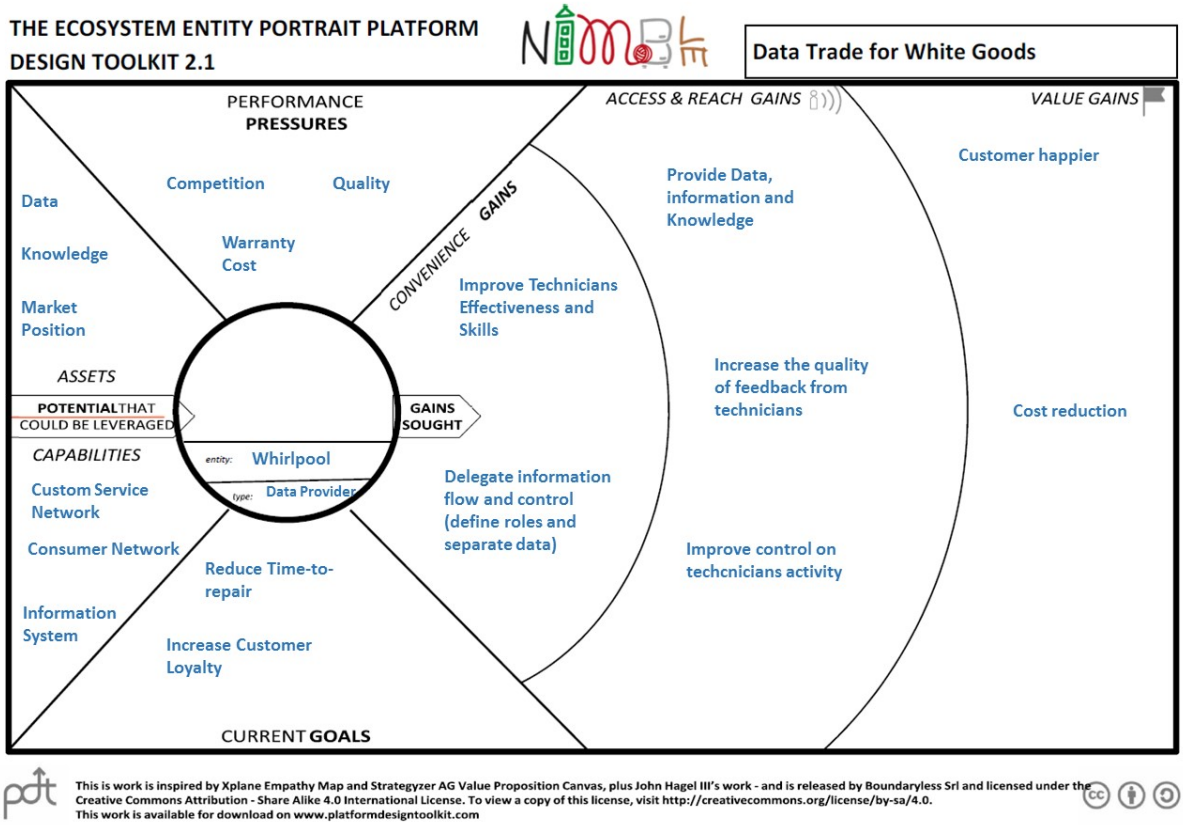

Figure 2: Entity Portrait for Whirlpool

The result of the analysis shows that WHR has some specific goals in the field of Servicing: reducing the Time-To-Repair and more broadly, increase Customer Loyalty. These two goals are based on the assumption that, once a problem or a failure occurs on an appliance, the consumer wants to have it solved in the shortest time and with a positive experience (i.e. the Consumer needs to feel the intervention process very professional, performed by knowledge-able people). These two conditions increase the trust of the consumer in the brand and improve his/her loyalty: a good service level will act as a motivator in case of buying a new appliance.

Since Field Service Partners are *third parties* that have a non-exclusive contract with Whirlpool (meaning that most of them are performing repair services also for competitors of Whirlpool) there are not so many direct ways for Whirlpool to improve their performance other than a statistical evaluation ex-post on the work done and a reflection on the partnership contract. On the other hand, there are some *assets* and *capabilities* that could be leveraged to improve the process: providing access to Whirlpool's own data and knowledge so as to increase field tech-nicians' skills and effectiveness.

The fact of having a multifaceted composition of Field Service Partners provides also a further challenge: the information provided from Whirlpool should be made available with a strict ac-cess control to avoid spreading sensitive data to all: the possibility to delegate to an external platform, run by a third party, all the aspects of data separation and flow control will provide further short term advantages to WHR.

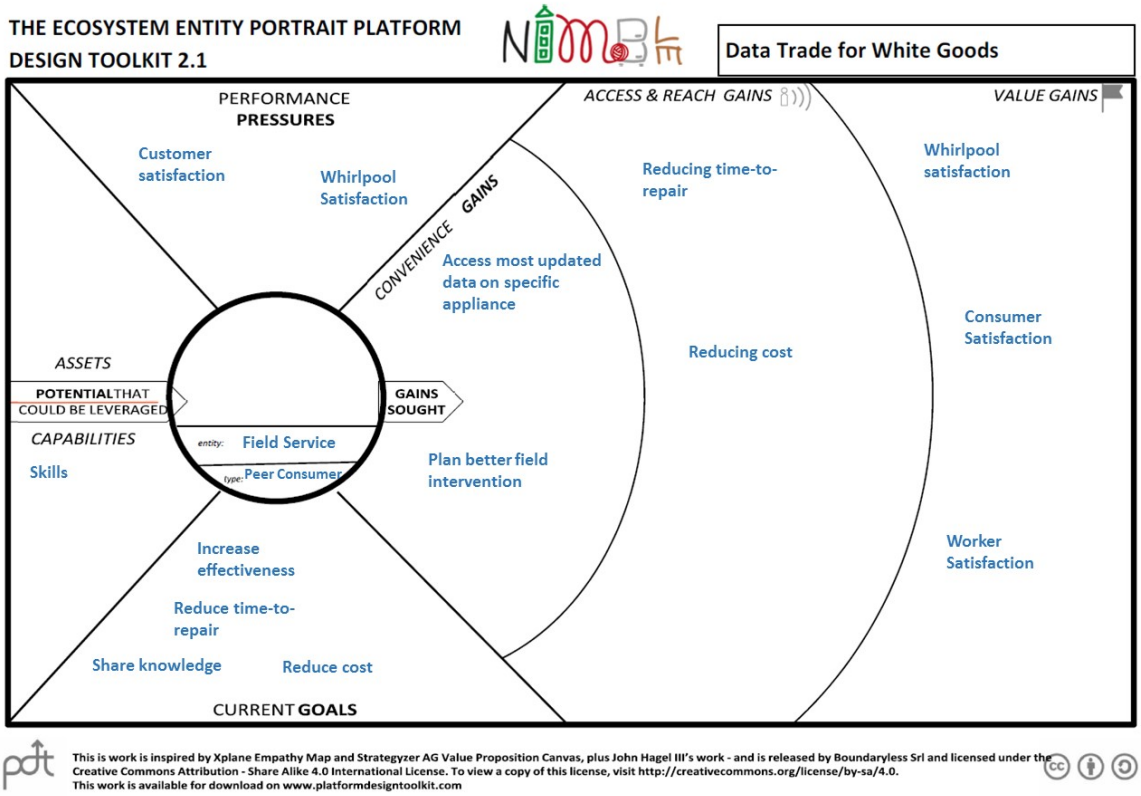

Figure 3: Entity portrait for Field Service Partners

The same picture can be seen from the perspective of Field Service Partners.

FSTs' major capability is represented by their skills that allow for a quick and positive resolution of consumer appliance problems. An FST needs to satisfy at the same time, the consumer who is asking for a service to be performed and Whirlpool as licenser (and thus providing the marketplace).

The key goals of the FST are therefore to increase speed and effectiveness of repairing intervention, reduce internal cost and to share knowledge. The platform can be used to let FST workers have access to relevant information about the product to be assisted and thus influence positively the intervention in terms of planning and service preparation. A tailored set of data, accessible through a specific query mediated by platform services will enable FST workers to learn about historical data of the product, recorded in different phases (Design, Production, Test, Shipping) and currently owned by other companies (i.e. Whirlpool)

By accessing WHR data, Field Service can expect an improvement in the service offered which translates into reducing cost and a reduced Time to Repair which is leading to more satisfaction with all the actors involved (WHR, Service Partner Companies and Consumer).

2.1.3 Platform Experience Canvas

The next phase of the platform business canvas is dedicated to the Platform Experience. Four main perspectives were identified: two of them are closely related to user experience; the other two are acting in the background.

The two operating modes that users have at their disposal to interact with the platform are, a *web interface* (i.e. the one available in NIMBLE Platform release) and an *app* running on mobile devices that will embed the Product Avatar functionalities.

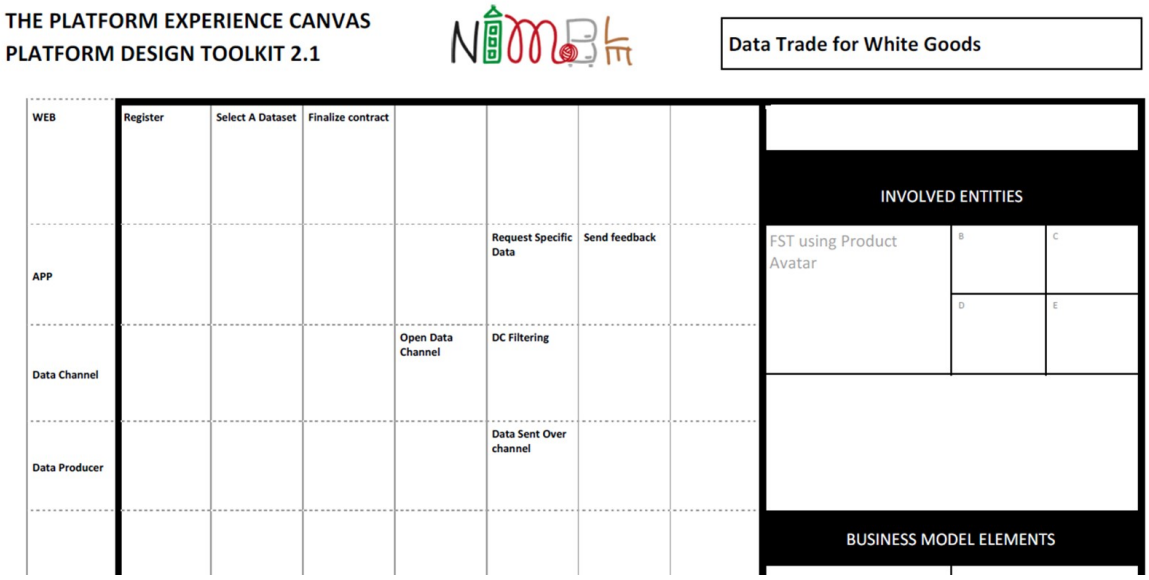

Figure 4: Platform Experience Canvas for WG Data Trade

The users will access the platform through its standard web interface to perform basic functionality such as Registration, Catalogue Editing, Selection and Contract Definition.

In this context we are intending to use Platform Functionalities that were initially designed to deal with physical products, to be referring to intangible goods such as Datasets. The Data Producer will prepare a catalogue of datasets that will represent different offerings in terms of Product Family, Countries etc. The Data Consumer will select the dataset of interest and “buy” it: the term “buy” has to be explained: since datasets are not physical products that can be shipped (important to notice that datasets are not containing data at rest, i.e. product static information, but data in motion, i.e. constantly updated by the data producer) the Platform itself will act as the transporter through the functionality of Data Channels. The user will also experience indirectly two characteristics that allow the data presented to be directly sent and dynamically filtered by the platform.

2.1.4 Motivation Matrix

A further step in Platform Design is represented by the Motivation Matrix, in which the roles of Consumer and Producers are analysed in terms of how they can benefit from the transactions happening through the platform: in this specific step the analysis has been extended to all the stakeholders identified in the Stakeholder Analysis to capture the potential market for a data trade.

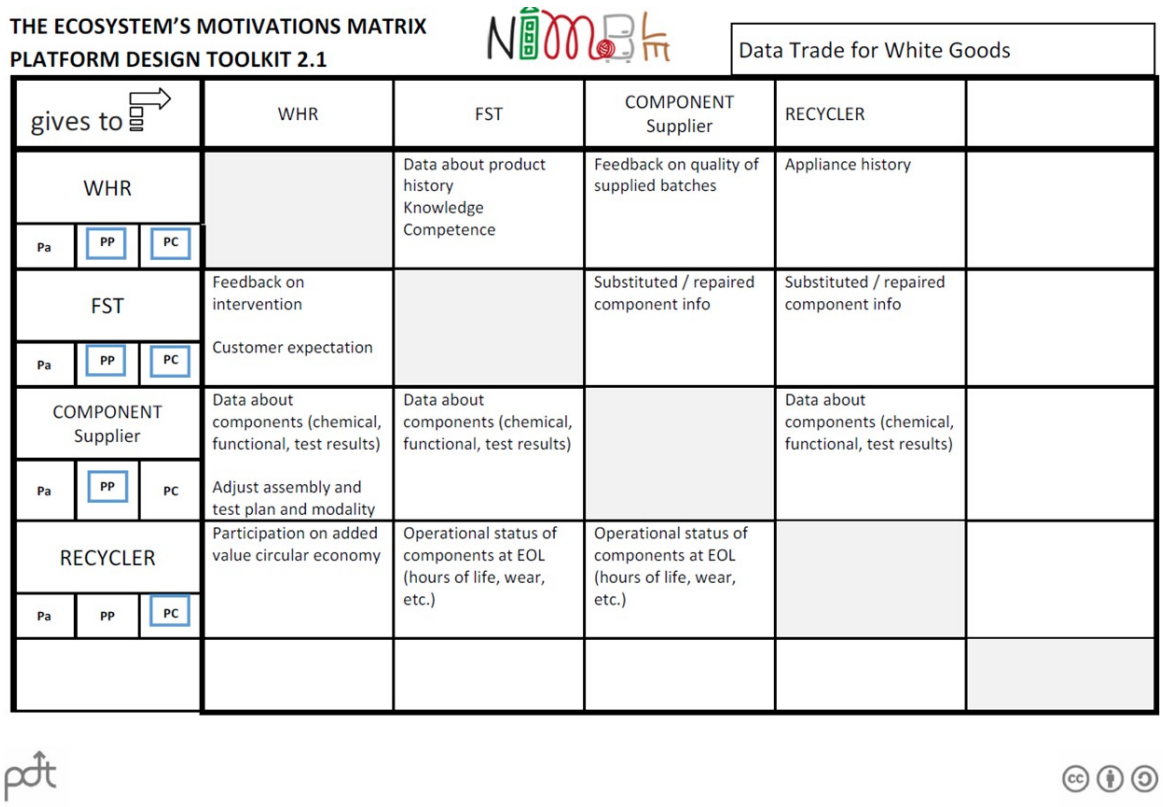

Figure 5: Motivation Matrix

In this analysis each stakeholder has been considered in both role of Data Producer (PP) or Data Consumer (PC) trying to depict which data could be traded and which use of them could provide advantages.

Beside the pairing WHR – FST that has been thoroughly analysed in the previous steps of the Platform Design toolkit, the interactions between other stakeholders are worth to be taken into consideration: in particular, a potentially high degree of motivation could be found in the family of Component Suppliers who could share data about their parts supplied to WHR (chemical composition, functional measurement and test results) so that this data could be used to tailor appliance setup or functional tests.

Another interesting motivation could be seen in how Recyclers of Appliances at end-of-life could leverage the data representing the product they are about to recycle: a complete set of information related to the whole life of the appliance (comprising Design, Production and Operating stages) are one way to improve the degree of re-use and refurbish versus recycling or landfill.

2.1.5 Transaction Board

The last stage of the Platform Design toolkit was performed to identify the transactions between users in a Data Trade Platform for White Goods between WHR and FST.

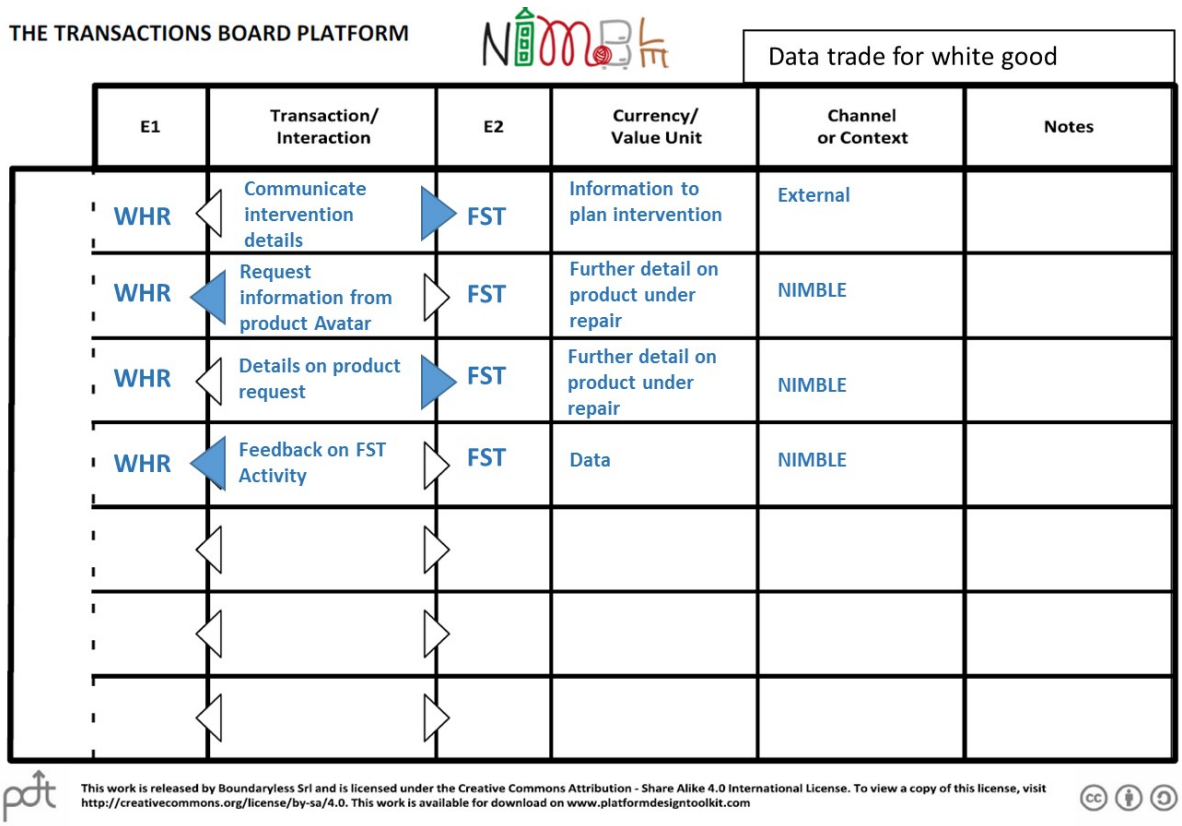

Figure 6: Transaction Board

The outcome is a perfect representation of a two-way collaboration between producer and consumer interacting through the NIMBLE platform to share information and data: this interaction sequence is actually the basis for the White goods demonstrator.

2.2 Final Scenario for White Goods

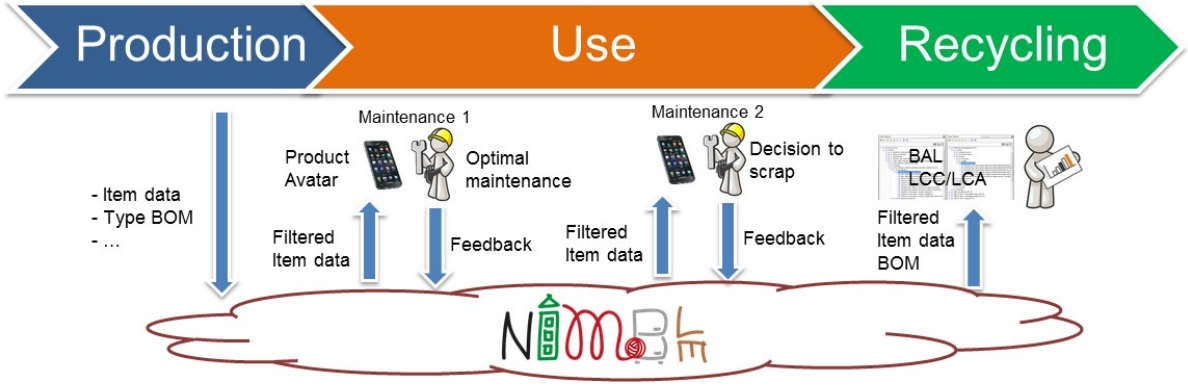

Figure 7: Overall Scenario schema

The previous picture shows the overall white good scenario; in the proposal it was thought to demonstrate the open data-trading scenario through the Field Service Scenario; during the project it has been decided to add also another scenario, focusing on the recycling, so that the overall lifecycle of the physical good is taken into consideration, different actors are involved, demonstrating more business implications of the data marketplace and demonstrating more of the technical possibilities of NIMBLE. In the following the two scenarios will be described.

In fact, with these two scenarios it's possible to demonstrate the polymorphism of the data-channel as it can be used in three different ways, which can be easily configured and activated through contracts:

- **Seller to Buyer**: In this scenario the data producer is the seller, who will not receive any feedback from the buyer on the activities carried out using the data. This is used by the recycling scenario, where recyclers acquire a single item Bill of Materials (BOM) to optimize the recycling process and logistics, but are not equipped to provide any feedback. Other possible scenarios have been evaluated but are not implemented in NIMBLE.
- **Buyer to Seller**: This scenario is technically equivalent to the previous, as both are one-way data exchanges. An example for the possibilities from this scenario is that the buyer of an appliance will provide his/her usage data in exchange for a discount of the appliance itself.
- **Two way data channel**: in this case the contracts will set the data channel to enable the information exchange both from the seller to the buyer and from the buyer to the seller. In this way feedback from the data usage can be provided to the buyer, creating a positive loop of enrichment of the information. This scenario is used by the FST, where the real time IoT data are provided by the seller (WHR) to its 7000 repair centres network, while they'll provide feedback on the executed actions and activities to enrich the database and enable further optimized maintenance or recycle.

The key innovative element of NIMBLE as data trading platform is that these channels are dynamically created and capable of data polymorphism, thus enabling an open marketplace for industrial data, which is a leap ahead of current dataflows among companies which are rigid and need ad hoc programming work to be setup from both ends of the data chain.

2.2.1 Field Service Scenario

Field Service in WHR is organized in a mixed way: in some countries the technicians are Whirlpool employees while in other countries, they are independent third parties which underwrite a partnership agreement contract with Whirlpool.

Figure 8: Field Service figures at a glance

The numbers involved in Customer Service are quite impressive: more than 33000 calls from consumer are managed every day in Europe by our call centre and dispatched to a network of more than 7000 technicians in all of Europe, and solutions are found in less than 48h with a 78% rate of First Time Resolution. Despite these positive figures Whirlpool aims at improving the Customer Loyalty and reduce cost of maintenance during the warranty period. The Value Proposition presented in section 2.1 has thus to be demonstrated both from a technical and a business point of view.

The business validation has started in Whirlpool through the Customer Service Department who is the internal organization in charge of defining, managing and measuring all the relations with the final consumer and that organizes and coordinates the Field Service Partner network.

The first step to verify the assumed business value proposition, has been the selection of the right combination of reference market and product group:

1. Reference Market: The need is to find a selection of advanced Service Partner with a strong and fruitful cooperation during the years who is in strict contact with Customer Service. These requirements led us to choose the Italian market and to limit the selection of potential Platform users to those who are in close proximity to our headquarters in Fabriano.

2. Reference Product Group: Since the value proposition (i.e. Trading Data) has to rely on data availability and richness, and not all the factories and product group are currently providing the same amount of information, we selected the Washing Machine as the reference product group for the experimentation which has two factories, Naples

and Poprad with advanced information systems providing structured and reliable datasets.

Dataset

The preparation of the dataset to be processed by the Platform Product Avatar required a predigestion of Whirlpool data which are currently spread over 5 different internal systems.

Data	Grouping - KEY	Meaning	Source	Data type	Dynamicity	Service Technician	CS	Product Owner	Mobile / PC	Life Cycle
Production date	SN	Date when the product has been produced	DB Production	Datetime	NO	Read	Read	Read	Mobile	BOL
Factory Reparation Detail	SN	Type of repairing done (if any)	DB Production (DCS)	text	NO	read	read	NO	Mobile	BOL
SIR 12M	12NC	12 Months SIR	ON-TRAC	Integer	Low	NO	Read	NO	Mobile	MOL
SIR 1M	12NC	1 Month SIR	ON-TRAC	Integer	Low	NO	Read	NO	Mobile	MOL
Product Call History	SN	List of calls recorded for SN	Extraction from CSBI	Ordered list of datetime	Medium	Read	Read	Read	Mobile	MOL
Product Call History	SN	List of calls recorded for SN	Extraction from CSBI	text	Medium	Read	Read	Read	Mobile	MOL
Product Intervention avoidance	SN	List of call resolved from Call center	CRM	text	High	Read	Read	Read	Mobile	MOL
Five star index	Family product (MIDI-Phoenix)	Review dei consumatori	CLARABRIDGE	integer (1-5)	Low	Read	Read	NO	Mobile	MOL
Campaign	SN	description of repairing / workaround in case the product is interested by a repair campaign	manual (to be brought to system)	text	High	Read	Read	NO	mobile	MOL
Registration	SN	Recording SN to call	Barcode	text	NO			WRITE	Mobile	MOL

Table 1: Dataset for FST scenario

Typical Activity Diagram

In the next section we describe a typical interaction between Producer (WHR) and Consumer (FST) considering a realistic case starting with a person owning a Whirlpool appliance call assistance to have its product repaired.

	Description	Technical Implementation	Comments
1	Product Owner (i.e the customer) contacts the Call Center of the Customer Service about an issue. Field Technician (FST) has to intervene on an appliance, after request of the customer to the Call Center.		
2.1	The Customer Service (CS) successful logs into the NIMBLE platform through the Product Avatar app	Single Sign On and authentication of the user	Each user has a specific role that grant him access to some data.
2.2	CS accesses data of a specific product item to know how a product (family) is behaving and optimise communication with FST	APP sends the code to NIMBLE platform and opens the requested data channel, selects the data to be shown, format them and send trough a secure channel. It has to be verified that filters provided by Data Channel are sufficient: possible extension / improvement of filtering mechanism.	
2.3	The APP shows the data according to the characterization of the user.		
2.4	CS closes the APP		
3.1	The Field Technician successfully logs into NIMBLE platform through the Product Avatar app	Single Sign On and authentication of the user.	Each user has a specific role that grant him access to some data.
3.2	FST scans the Barcode representing the serial number on the product or puts it manually as communicated by CS	APP send the code to NIMBLE platform and open the requested data channel.	

3.3	FST navigates the APP to select the desired information	APP sends the selection to NIMBLE platform and selects the data to be shown, format them and send through a secure channel.	
3.4	The APP shows the data according to the characterization of the user.		
3.5	FST closes the APP		
4.1	The Quality Service (QS) successfully logs into the Product Avatar app.	Single Sign On and authentication of the user. Nimble identity service / aspects of security?	Each user has a specific role that grant him access to some data.
4.2	QS accesses data about interventions performed on the product and results		
4.3	The APP shows the data according to the characterization of the user.	APP sends the code to NIMBLE platform and opens the requested data channel, selects the data to be shown, format them and sends through a secure channel.	
4.4	QS closes the APP		

2.2.2 Recycling Scenario

The recycling scenario has been introduced as it is a very promising and interesting scenario, both for project marketing (EC) and commercial reasons; in fact, according to the Italian roadmap on Recycling, we can assert that

- The Italian separate collection and recycling system coped with the crisis better than others.
- Excellent results for all the recycling pipelines.
- With 33 million tons of recovered materials, Italy is a leader in the EU, only second to Germany.
- Recycling allows to save 53 million tons of CO2, i.e. 10% of Italy's emissions.
- 200 million tons of materials, worth US$90 billion, are handled on the global market.

- The recycling industry is a key component of the European green economy with over 500.000 employees.

This will enhance the business motivation of the scenario; together with the previously defined and enlarged FST scenario, it will enable us to demonstrate more of the possibilities of the NIMBLE data trading platform.

DataSet

The data traded in this scenario are very different from the previous; in fact here a dynamic BOM (Bill of Materials) is needed, taking into account the BOM as the product was produced as well as the changes due to maintenance and revisions. The BOM has to be then exploded and re-composed, creating a dataset like the following:

Label	Unit of measure	Value	Value	Value	Value	Value	Value	Value	Value	Value
Group	-	DishWasher	DishWasher	DishWasher	Refrigerator	Refrigerator	Refrigerator	Air conditioner	Air conditioner	Air conditioner
Product TYPE	-	Whirlpool WFO 3T123 PF	Whirlpool WFO 3P23 PL X	Whirlpool WFO 3O32 P X	WTH5244NFX	WTNF82OMXH.1	TTNF8212OX	COPR3S-SAI18K39DC2	COPR3S-SAI18K39DC1	COPR3S-SAI22B39MC0
Product Item (serial)	-	SN154789631456 7	SN WHI007644	SN859991020920	SNp-648534	SN	SNp-722590	SNSAI18K39DC2	SN SAI18K39DC1	SNSAI22B39MC0
Description	-	lavastoviglie Whirlpool: color inox. Classe energetica A++, per consumi ridotti di energia elettrica. Un utile timer digitale che segnala la fine del ciclo di lavaggio. Tecnologia innovativa che garantisce un funzionamento super silezioso, per un elettrodomestico senza rumori. Eccellente capacità di pulizia per risultati di lavaggio ideali.	Lavastoviglie a libera installazione. Classe di efficienza energetica A++. Tecnologia 6° SENSO Power Clean Pro. 10 programmi. Capacità 15 coperti. Consumo d'acqua 11 l Tecnologia 6° SENSO Power Clean Pro. 10 programmi. Partenza ritardata. Emissione acustica 43 dB. Colore Acciaio Inox	Lavastoviglie a libera installazione. Classe di efficienza energetica A+++. Capacità 14 coperti. Consumo d'acqua 9 l. Tecnologia 6° SENSO Power Clean Pro. 10 programmi 3 temperature. Partenza ritardata. Emissione acustica 42 dB. Colore Acciaio Inox.	Frigorifero Doppia Porta WTH5244NFX No Frost Classe A+ Capacità Lorda / Netta 532 / 515 Litri Colore Inox	Frigorifero: Combinato Classe di efficienza energetica: A ++ Capacità netta frigo: 234 l Capacità netta congelatore: 104 l Consumo energia annuo: 271 kWh/anno Sistema di raffreddamento frigo: No Frost Colore: Inox Mirror	Frigorifero: Doppia porta. Classe di efficienza energetica: A ++. Capacità netta frigo: 322 l. Capacità netta congelatore: 101 l. Consumo energia annuo: 296 kWh/anno. Sistema di raffreddamento frigo: No Frost. Colore: Inox.	3D Cool Wifi Pro 1.5 Ton, 3 Star Inverter Air Conditioner (Copper)	3D Cool Purafresh Pro 1.5 Ton, 3 Star Inverter Air Conditioner (Copper)	Magicool Pro 2 Ton, 3 Star Inverter Air Conditioner (Copper)
Quantity of Iron	Kg	21,9910	21,9910	21,9910	27,1200	27,1200	27,1200	17,8930	17,8930	17,8930
Quantity of Plastic	Kg	14,1860	14,1860	14,1860	5,8000	5,8000	5,8000	9,9991	9,9991	9,9991
Quantity of Copper	Kg	1,0980	1,0980	1,0980	1,7800	1,7800	1,7800	5,0457	5,0457	5,0457
Quantity of Silver	Kg	0,0350	0,0350	0,0350	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Quantity of Gold	Kg	0,0001	0,0001	0,0001	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Quantity of Palladium	Kg	0,0099	0,0099	0,0099	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Quantity of Inox	Kg	2,8750	2,8750	2,8750	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Quantity of Aluminium	Kg	1,0530	1,0530	1,0530	1,0000	1,0000	1,0000	2,5811	2,5811	2,5811
Quantity of Glass	Kg	0,0000	0,0000	0,0000	0,2000	0,2000	0,2000	0,0000	0,0000	0,0000
Quantity of Gas	Kg	0,0000	0,0000	0,0000	0,3000	0,3000	0,3000	0,0000	0,0000	0,0000
Quantity of Oil	Kg	0,0000	0,0000	0,0000	0,2500	0,2500	0,2500	0,4522	0,4522	0,4522
Quantity of Concrete to be disposed	Kg	6,9350	6,9350	6,9350	7,6000	7,6000	7,6000	0,1306	0,1306	0,1306
Quantity of Waste to be disposed	Kg	2,3550	2,3550	2,3550	0,9500	0,9500	0,9500	0,8944	0,8944	0,8944

Table 2: Dataset for Recycler scenario

In fact, to evaluate the best recycling process, it's key for the recyclers to know the different amounts of materials of which the white good is made of. In the previous example, 9 different items have been considered, with the list of key materials present in each of them.

2.3 Adoption Activity

The two different communities (FST, Recycler) will be approached separately and using two channels.

1) **FST - Field Service Technicians**. FST partner network is coordinated through Consumer Service department, a unit of Whirlpool EMEA based in Fabriano Headquarters. FST are usually SME that operate in the country, very often with non-exclusive contracts. The FST that will be contacted to ask for the participation in NIMBLE needs to have some special

characteristic: medium sized; strong partnership record; openness to collaborate. Consumer Service department will thus select an initial list of FST that will be asked to register in the platform and that will be exposed to the demo.

2) **Recycler**. Recycling is a very fragmented world in the field of WG (White Goods) and there is no formal contact between Whirlpool and recyclers. So, we have contacted ECODOM which is a consortium of more than 100 SMEs operating in the sector and acting as a formal validator. ECODOM has already participated in research projects with Whirlpool and can provide a solid contribution. We will also contact Consorzio Remedia, the second largest recycling consortium in Italy. If we manage to get interest from both consortia, we would reach almost 80% of the recycled white goods appliances in Italy.

3 Technical Validation

3.1 Platform Validation

3.1.1 Platform Architecture

The White Goods application scenario exploits and leverages the NIMBLE MVP Platform, output of WP3 activities and deployed on IBM servers. This NIMBLE Instance - part of the federation and used in sharing with the Textile use case and the related technical partners - is enriched by the integration of some of the Advanced Intelligent Services (AIS) services developed in WP5 and which provide added-value to the user. This choice is motivated by the fact that White Good and Textile sectors do not have sectorial characteristics and market dynamics so significant for requiring heavy personalization of the platform. Obviously, the concept of federation in NIMBLE enables the use of sectorial platforms, but it is always useful to consider the right trade-off between all the aspects affecting platform adoption, i.e. the user needs, field requirements and required technical effort / skills.

According to the choices made and exposed before, the architecture of the platform consists of the same infrastructure at the base of NIMBLE MVP, which represents a B2B and supply chain-oriented customization of an openly available PaaS infrastructure (Cloud Foundry). The following picture presents an overall view of the NIMBLE integrated cloud platform, addressing the main requirements of security, scalability, extension and federation. The figure shows the Core Components, which are a part of the platform and the main interactions between the various components.

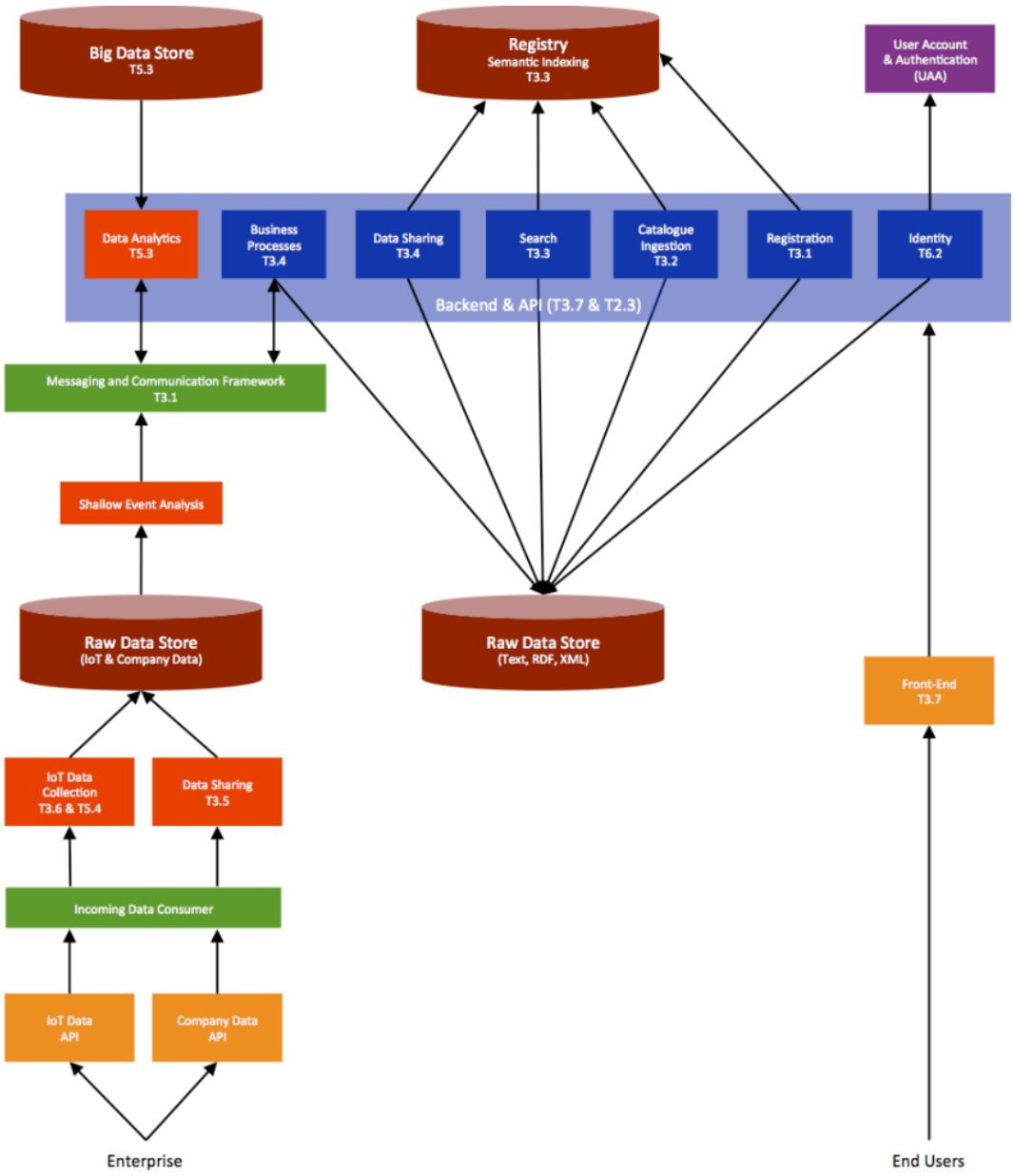

Figure 9: NIMBLE MVP infrastructure.

3.1.2 Component Description

The table below lists the Core Components of Nimble MVP, giving for each component a brief description, indications about how it is used in the WG scenario and the expected benefit provided in the WG scenario.

Table 3: NIMBLE MVP in WG scenario

IT Component	Description	How it is used in WG	Added-value provided by the Component in WG
Front-end	Main access point into the NIMBLE platform for end-users, integrates various components for interacting with platform applications and back-end	No modifications, same usage as in MVP	Allows end-users the use of the components, including the ones exploited in WG
Identity	"Security" component managing user authentication, authorization, access control issues	Identity Management used also by AIS, which point to the specific NIMBLE Instance supporting WG	
Registration	Provides features for user and company registration	No modifications, same usage as in MVP	Allows registration of the adopters
Search	Provides search functionalities and communicates with the Catalogue to get information about products	No modifications, same usage as in MVP	Searches for product in catalogue
Publish	Provides administration of products and categories used for their semantic annotation, interacts with the data stores to get details about categories maintained as taxonomies	No modifications, same usage as in MVP	Publishes products which can be object of order and negotiation in WG scenario
Catalogue	Stores products and services persistently	No modifications, same usage as in MVP	Presents WG products for order
Negotiation	Provides functionalities supporting and augmenting negotiation between companies	No modifications, same usage as in MVP	Enables the negotiation in the use of the data monitoring option, at the base of the concept of data-trade
Matchmaking	Provides functionalities for matching companies, which are likely to fulfil each other requirements	No modifications, same usage as in MVP	No added-value for WG scenario except for default use

Business Process	Provides the definition of communication workflows among multiple supply chain partners and the execution of the designed process through the Camunda BMP	No modifications, same usage as in MVP	No added-value for WG scenario except for default use
Data-channel	Provides functionalities for transferring, making available and filtering data	Exposes features and access points allowing integration and use of AIS	Enables the use of the AISs Advanced Product Avatar and BAL.LCPA Tool
Analytics	Performs analytics on collected data	No modifications, same usage as in MVP	Not used for supporting the WG scenario
Product Avatar (basic version)	Provides a mobile frond-end for IoT and PLM data retrieval and visualization	Integrates extensions concerning the use of AIS features	Enables advanced optional functionalities supporting WG
Logistics		No modifications, same usage as in MVP	Not used for supporting the WG scenario

3.2 Integrated Product Avatar Validation

3.2.1 Description

The product avatar is an app demonstrating the potential of IoT data exchange over the NIMBLE platform. It has been defined as generic as possible to be a reference and a first version for further implementation activities, where the functionalities could be more tailored to the target scenario. The product avatar enables authentication within the NIMBLE platform (Figure 10). A role with specific permissions and authorizations to access services and information is assigned to each user. After the login phase, the home form (Figure 11) provides the access to the app tools and settings options (Figure 12)

It enables then to search for active contracts and to select the data source. This part is useful if a user has several potential data providers of different datatypes (Figure 13)..

The access to the data of a product is performed starting from its identifier, e.g. the part number, which can be obtained by scanning the bar code / QR code or by editing it in the specific textbox (Figure 14Figure 15). If information related to a product is present in the data channel (because of the presence of possible current issues or procedures about the product to be managed), it is provided to the user: only the pertinent set of data is made available, as a set of filters considering item identifier, user localization and role is applied by the web services of the system.

The retrieved data related to a product and its lifecycle can be visualized by selecting the pertinent area of interest, e.g. interventions, issues, sales, test, etc. related to the Whirlpool scenario addressed in NIMBLE (Figure 15 and Figure 16).

The user of the app is then able to send back some comments and information, which will be posted on the data-channel and then provided to the data producer as feedback (Figure 17).

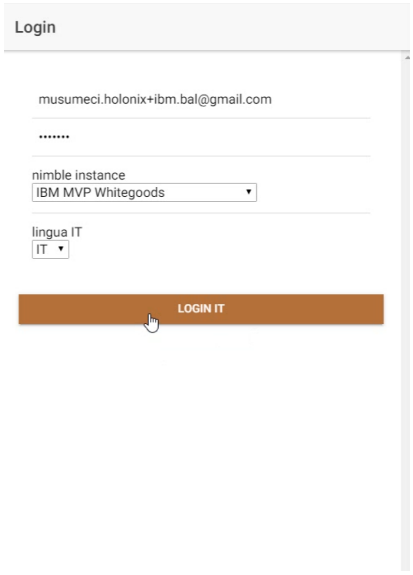

Figure 10: Selection of NIMBLE Instance and Login

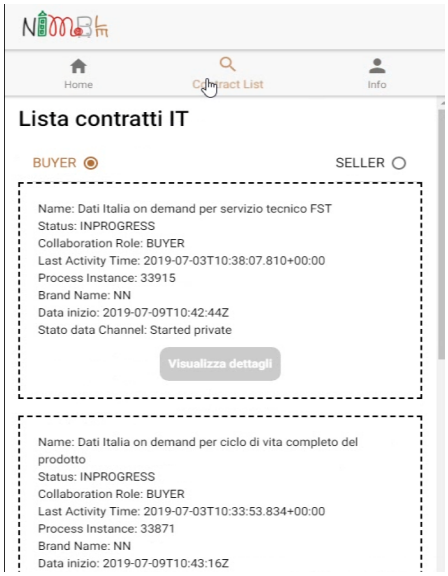

Figure 11: Contract list associated to the company

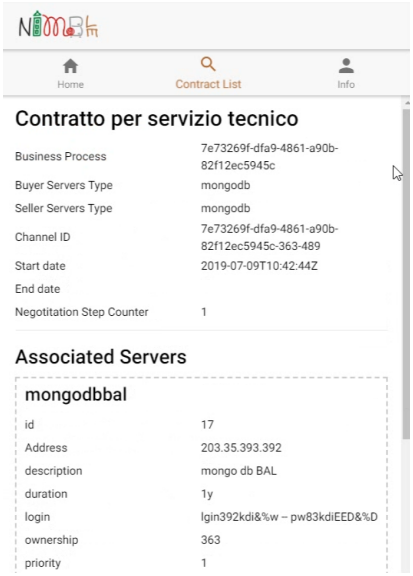

Figure 12: FST contract details

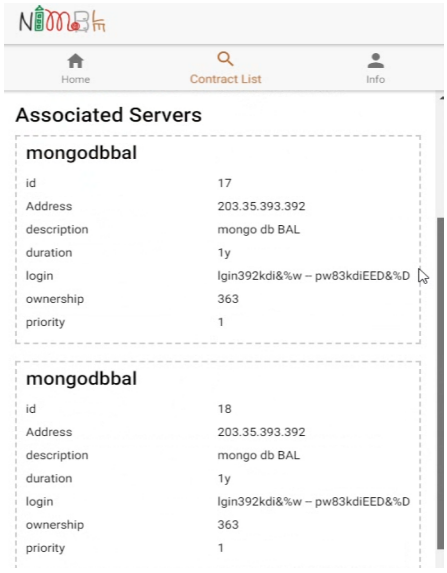

Figure 13: list of servers for providing data

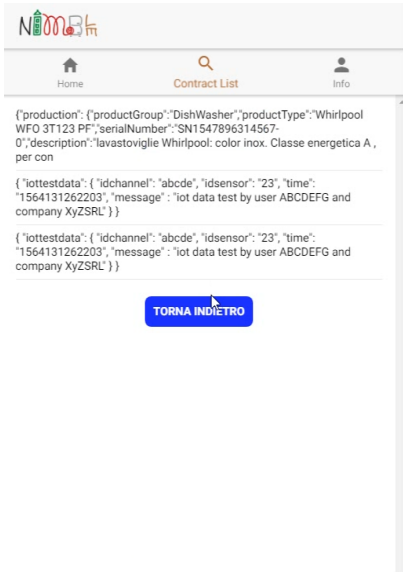

Figure 14: Available data

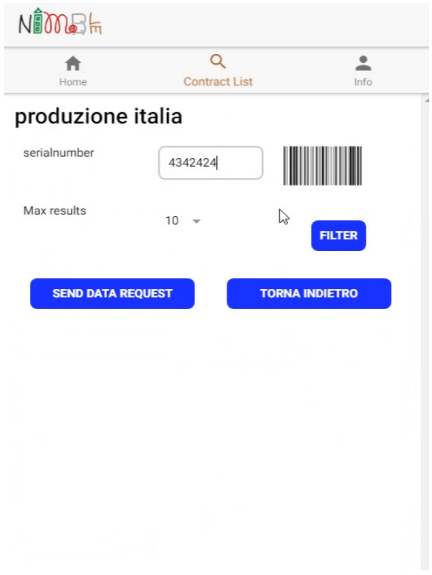

Figure 15: Search and filtering by serial number

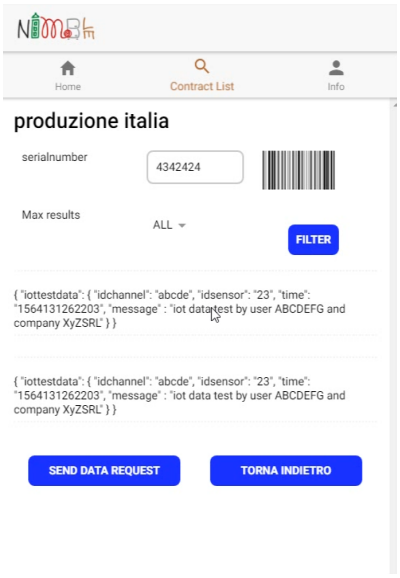

Figure 16: Data retrieval and visualization

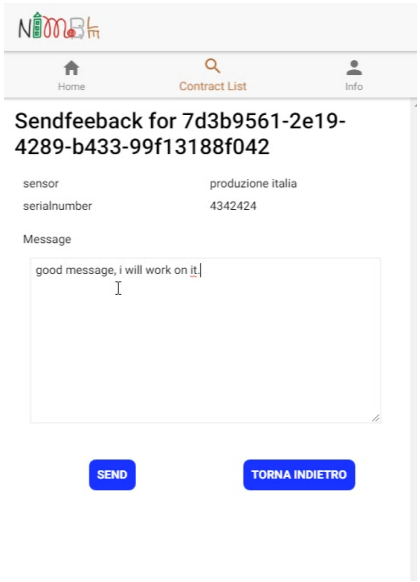

Figure 17: call-back functionality

3.3 LCPA Validation

The Life Cycle Performance Analysis (LCPA) is one of the additional services available on NIMBLE. The BAL.LCPA (BALance Life Cycle Performance Analysis) tool is a commercial tool which offers evaluation services on request for NIMBLE products. The tool facilitates the LCA (Life Cycle Assessment) and the LCC (Life Cycle Costing) in parallel by taking product data from the platform via an API, performing the calculations and returning the results to the platform using the same API. A detailed description can be found in D5.3 Cost and Ecological Footprint Estimation for Product Life Cycles.

The LCA is a consolidated process that evaluates the environmental burdens of a product, a process, or a service, quantifying the resources used and the emissions released along the whole lifecycle. Within the WHR scenario described in this document the LCA plays a minor role.

Life Cycle Costing (LCC) is an accounting method, which considers every cost flow throughout the lifecycle of a product The LCC is usually divided into three categories covering development costs, utility/service costs and recycling/reprocessing costs. For the WHR scenario the recycling costs are in the focus of the evaluation.

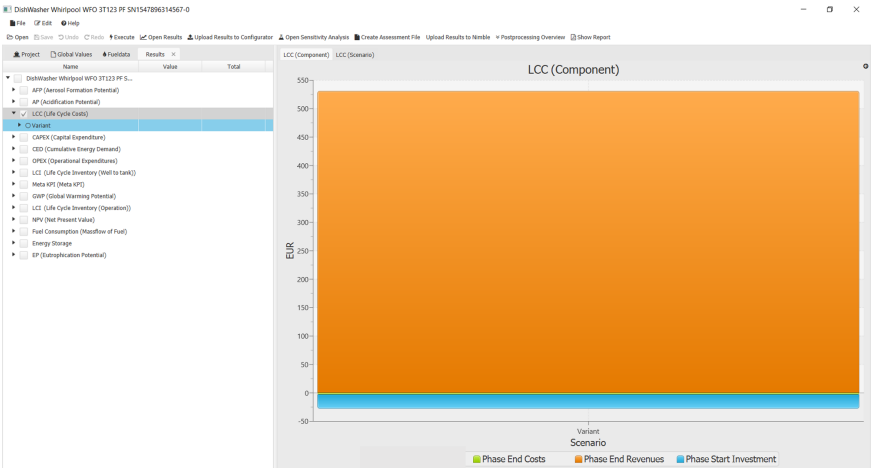

Figure 18: Exemplary result presentation in the BAL.LCPA tool

The data set for the Recycler Scenario (Table 2) is the basis for recycling process validation. Based on the amount of valuable materials within the white good (a specific dish washer) a recycler can calculate the possible benefit. The actual market prices of the valuable materials (gold, copper, iron, etc.) are stored in the tool and are updated on a daily basis. By using the purchased WHR data the recycler can decide whether he/she takes the scrap or not and how they will process it. The recycling process costs can be stored in the tool to calculate the revenues for the specific recycling process in connection with the specific product.

4 Business Validation

There are two different business levels that have to be validated in the White Goods use case: the first is related to the overall business value of Trading Data as an additional service; the second is related to the effective usage of this data by the Partner. Each of these layers has to be evaluated by the two perspectives of seller and buyer

Let's start by setting the initial condition: neither Whirlpool nor their partner has previous experience in Data Trading as a business stream. In the past, whenever Whirlpool had the need of sharing some data in motion with their partners, they either provide access to its system to the external user by creating an account in their own LDAP system, or build an ad-hoc application. The two solutions are today no more acceptable if the need is only a Data Sharing, the first not being safe enough and the second being too rigid and expensive.

Thus, the overall business opportunities to have a NIMBLE Platform which provides all the functionalities to enable Data Trading provide a value per se.

The first level of validation is related to how the NIMBLE Platform is able to let the Data Trading business start, develop and consolidate: in this aspect the evaluation will focus on how much the experimentation has impacted the willingness and availability of the parties involved.

4.1 WHR Perspective

WHR point of view is made mainly on the Producer side since the transaction of making data available to third parties is considered more important, for the time being, than other exchanges.

4.1.1 WHR evaluation of NIMBLE as Platform for open trading of data

The potential offered by the NIMBLE Platform is very promising as it is enabling business processes not easily feasible before. It's absolutely not possible today to quantify data trading in absolute monetary value since a direct market for these products is not yet established, however, as explained in the Value Proposition description, there are many reasons to believe that a benefit from the company can be estimated.

Of course, in the business evaluation the cost of the Platform management has to be taken into account. Whirlpool cannot be interested in running the platform as part of its business, so a convenient partner has to be identified for exploitation of results. The business model for the partner running the platform should be clearly identified according to the needs of WHR that can be summarized as:

1) **Stability**: the platform functionalities and performances should be guaranteed for a medium to long term (minimum 5 years) in order to build relationships and explore potential new trading opportunities
2) **Flexibility**: the platform should be able to be interfaced with legacy systems or new applications in an easy and fast way.
3) **Open to future evolution**: as soon as a standardize way to govern data sharing will be present (e.g. Industrial Data Space Association, https://www.internationaldataspaces.org/) the platform should be adhere to standard.

4) **Open to innovative revenue model**: platform owner should be able to find alternative way to ensure income other than fees from users.

4.1.2 Impact of data traded in WHR Business

The impact on WHR business derived from trading data with FSP will be actualized after some months after its full introduction. The consequential mechanism behind is based on the assumption that partners will be improving their effectiveness in delivering a service for Whirlpool which has a direct impact on cost for appliances under the warranty period and an indirect impact on customer loyalty on all the appliances.

Of course we are expecting that the platform will also enable a positive continuous feedback from the FST on the nature and the quality of the data supplied: as soon as new data will be generated thanks to an improved digitalization of WHR business processes, these could made be available in existing streams or as new streams.

4.2 Field Service Partner Perspective

4.2.1 FSP evaluation of NIMBLE as Platform for trading data

Field Service Partners perceive a slightly different business value on the Platform to trade data streams: the main advantage is that they could have a single point of contact to several appliance maker (let's reinforce the fact that FSP are frequently acting in a non-exclusive contract, i.e. the provide service to many maker at the same time) leaving to the platform owner the duty of attracting appliances producers to make use of the service offered. From FST point of view the platform owner should offer:

1) **Standard Interface (Product Avatar)**: the interaction with product avatar and the way data is presented should be maintained in time and independent from the data producer.
2) **Semantic Consciousness**: meaning that data interpretation should be more and more embedded as a service provided by platform, reducing the need for alignment meetings and training with data producer

In both cases the Business requirements coming from FSP are quite difficult to be accepted by a platform owner: in the first case its fulfilment put at risk potential different request coming from Producers; in the second case the platform should lose a status of agnosticism on the contents it's helping trade and acquire a connotation much closers to an added value service.

4.2.2 Impact of data traded in FSP Business

It's quite natural to state that some activity could be improved by accessing relevant data and information. For FST the possibility to know details about the appliance that is requiring an intervention could have positive influence and be measured quite easily: its efficiency in planning and preparing the intervention could be drastically improved thanks to it. However, it is fundamental that the information provided is relevant, reliable and updated.

Of course the real impact will be realized when the final user, i.e. technicians, will use the Product Avatar interface to access the service offered through the platform: keep the technical performances of robustness, availability and response time are basic condition that if not respected will cause the user to loose trust on it.

4.3 Platform Owner Perspective

As stated in the introduction, Whirlpool shows that the core business functionalities of NIMBLE are a must for companies nowadays; a large multinational as WHR has had the economic capabilities to integrate most of them within their internal systems and make them coherent with their ERP (SAP). This kind of investment isn't possible for SMEs, who however are pushed by the competition of non-EU companies and therefore will need to raise the efficiency of their supply and value chains, and hence, will follow the same integration path. One of the outcomes of the analysis of the Whirlpool use case therefore is to demonstrate the high potential of the core business services, which are considered as very important value-added services to be sold for a platform owner.

NIMBLE is however not limited to the core business services, but has the innovative capability to be also a data trading platform, whose functionalities and capabilities aren't available even in large and structured companies like Whirlpool.

Usually companies IT systems have grown in a inhomogeneous way, and are therefore composed of several data-lakes. Currently several efforts are ongoing in the companies to merge and manage these coherently, the possibility to share and sell data within these data lakes will emerge as soon as this process will be ended, or it will be limited to sections of the data available whose exchange with partners will be hard-wired and rigid.

The exchange and sale of these data has to be seen as one of the future trends of industry, and therefore the NIMBLE platform can be considered as a frontrunner of this revolution, as it is well ahead even of the ideas introduced in the European commission calls as project aiming at "Creating an open market place for industrial data" (DT-NMBP-40-2020) which still have to be funded.

Being the frontrunner is a huge advantage, but also a risk; in fact, if the market isn't ready, the idea will be spoiled, presented to possible competitors but will not get enough market volume and sales to be sustainable. From a first evaluation, we consider that the market for a data trading platform will be ready in 3-5 years.

The NIMBLE platform owner can therefore first focus on the core business services, which are currently adopted, easy to understand and use for SMEs, while continuing to develop the data-trading possibilities to be launched on the market in a few years.

5 Conclusion

The aim of this deliverable is to describe the White Goods use case; during the analysis important concepts have emerged; first of all the usefulness of the main business functionalities of the NIMBLE platform; these functions are already implemented in Whirlpool at the cost of investments of millions of euro and wouldn't be accessible for SMEs without a shared investment which the NIMBLE platform already presents to them. NIMBLE includes also an extremely innovative concept of trading data within a marketplace, where these are accessible from a catalogue and can flow from a company to another using a self-configured data channel able to manage polymorphic data. This is a quantum leap compared with the current expensive closure, rare disclosures and hardwired connections among different company IoT systems.

The approach needed for the platform has been then analysed with the platform business canvas.

Its implementation and demonstration has been described and detailed, showing also the tools that interact within the use case.

The functionalities have therefore been described and it has been presented how stakeholders evaluated them from the technical and business perspective.