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

D1.1
Requirements and Collaboration Design for Manufacturing and Logistics in Four European Use Cases

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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 36 months.

Executive Summary

This deliverable D1.1 focuses on functional and non-functional requirements of the four use cases that will be carried out on the NIMBLE platform.

The first chapter gives an overview of the document's objectives and presents our general approach with the methodology and tools for handling requirements. The elicited information by each use case are processed and consolidated in SysML models.

The elicited requirements are transformed and expressed into a formal representation. Each use case with its specific domain has a dedicated section in the second chapter. A group of scenarios is subordinated to each use case. The final section of the requirements chapter presents general requirements of four use cases, e.g. login functionality, search and filtering, product representation, data upload, protection of the protect corporate value (know-how).

The third chapter concludes the deliverable.

1 Introduction

1.1 Objectives

WP1 will establish an initial set of requirements covering each of the four use cases. The use cases will develop their requirements in parallel, each accompanied by research and technology partners (D1.1). An important aspect of WP1 will be identification and subsequent design of business models and collaboration patterns between companies in order to cover the activities of searching, finding, negotiating and execution of desired business collaboration in supply chains (D1.2). This will be achieved through the requirements consolidation, driving WP1 from requirements gathering to the creation of superior collaboration patterns and accelerators of the NIMBLE platform. This work will establish the baseline requirements to be fulfilled in WP2 and WP3. The second wave of requirements gathering will be an outcome of WP4 that constitutes the first-round validation of the NIMBLE platform. Requirements from WP4 will then influence value added business services in WP5.

1.2 Methodology and tools

General

A prepared template (see Appendix) is used to gather information from each use case owner accompanied by a dedicated academic / technological partner from the consortium. The template guides the addressee with categories and matching descriptions / examples along a structured form. Firstly, the business perspective addresses the overall use case. Secondly, the context of the use case is clarified by its environment, legacy systems, perceived problems and limitations. Furthermore the form then leaves space to insert information regarding general system requirements and is questioning risks and challenges.

Nevertheless, gathered information via the described template is fundamental input to define the use cases; additionally researchers and developers in charge of D1.1 and D1.2 visited each use case (company) to clarify all open questions collected from the templates and to get a more detailed overview of the use case environment, e.g. manufacturing processes.

Furthermore, the use cases are described using the formal notation of SysML.

SysML

Once requirements have been captured, the usage of Systems Modelling Language (SysML) requirements diagrams is intended, to model and document them in a formal manner. SysML provides powerful modelling constructs within a formal graphical notation to represent text-based requirements and relate them to other modelling elements. SysML is a general-purpose modelling language for systems engineering applications. It supports the specification, analysis, design, verification and validation of a broad range of systems and systems-of-systems. SysML was originally developed by an open source specification project, and includes an open source license for distribution and use.

Using SysML requirements diagrams to visualise the requirements captured in NIMBLE has a number of advantages compared to other approaches. The graphical notation (summarized in the following Table 1 and Table 2) allows for a structured, clear and logical representation of requirements, which can easily be grasped. In SysML, a requirement is defined as a stereotype of UML Class subject to a set of constraints. A standard requirement includes properties to specify its unique identifier and text requirement. Additional properties such as verification status can be specified by the user. Several requirements relationships are specified

that enable the modeller to relate requirements to other requirements as well as to other model elements. These include relationships for defining a requirements hierarchy, deriving requirements, satisfying requirements, verifying requirements, and refining requirements.

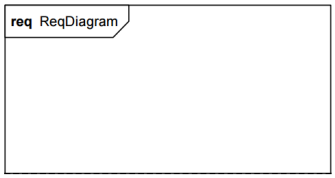
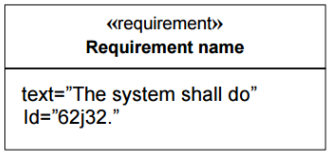
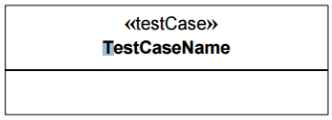
A major strength of SysML requirements diagrams lies in its potential for requirements reuse. There is a real need for requirement reuse across product families and projects. Typical scenarios are applicable across products and/or projects and requirements that are reused across product families (versions/variants). We also expect to capture those requirements, which are repetitive through all use cases in NIMBLE, e.g. login, search and filtering. These requirements will be modelled once and will be reused across the scenarios. In these cases, one would like to be able to reference a requirement, or requirement set in multiple contexts with updates to the original requirements propagated to the reused requirement(s).

Lists of requirements can quickly be generated from the graphical representation by simple transformations. This means that lists of functional specifications, as required e.g. for contact specifications, can be quickly and reliably generated.

SysML is defined as an extension of a subset of the Unified Modelling Language (UML) using UML's profile mechanism. Consequently, SysML requirement diagrams are fully compatible with the UML diagrams NIMBLE might later use to specify software.

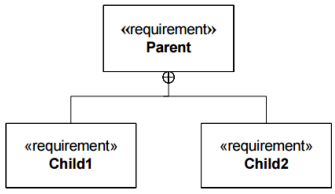
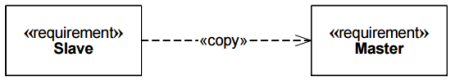
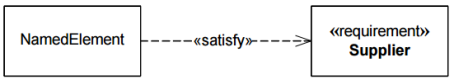
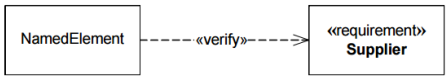
On top of the above characteristics, SysML defines a “verify” relationship for how a test case or other model element verifies a requirement. A test case or other named element can be used as a general mechanism to represent any of the standard verification methods for inspection, analysis, demonstration, or test. This way, the test and verification of requirements can be defined already within the requirements analysis process. This can significantly improve the quality of test design.

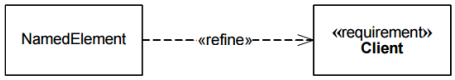
Table 1: Syntax and Description of Requirements Model Elements

Name	Syntax	Description
Requirement Diagram		Specifies the capabilities of the system, or the conditions that it should satisfy.
Requirement («requirement»)		Specifies the capabilities of the system, or the conditions that it should satisfy. For better readability in models, the syntax can be reduced to the upper part (only requirement type and name).
TestCase		A test case is a method for verifying a requirement is satisfied.
«extendedRequirement»		Base Class is a «requirement». A mix-in stereotype that contains generally useful attributes for requirements
«functionalRequirement»		Requirement that specifies an operation or behaviour that a system, or part of a system, must perform.
«interfaceRequirement»		Requirement that specifies the ports for connecting systems and system parts

		and the optionally may include the item flows across the connector and/or Interface constraints.
«performanceRequirement»		Requirement that quantitatively measures the extent to which a system, or a system part, satisfies a required capability or condition.
«physicalRequirement»		Requirement that specifies physical characteristics and/or physical constraints of the system, or a system part.
«designConstraint»		Requirement that specifies a constraint on the implementation of the system or system part, such as the system must use a commercial off the shelf component.

Table 2: Syntax and Description of Requirements Model Relationship Types

Path Type	Syntax	Description
Requirement containment relationship		A containment relationship defines a hierarchical structure of requirements. Graphically displays ownership of one element within a parent element.
Copy Dependency		A Copy relationship is a dependency between a supplier requirement and a client requirement that specifies that the text of the client requirement is a read-only copy of the text of the supplier requirement.
Derive Dependency		A DeriveReqt relationship is a dependency between two requirements in which a client requirement can be derived from the supplier requirement. For example, a system requirement may be derived from a business need, or lower-level requirements may be derived from a system requirement. As with other dependencies, the arrow direction points from the derived (client) requirement to the (supplier) requirement from which it is derived.
Satisfy Dependency		A Satisfy relationship is a dependency between a requirement and a model element that fulfills the requirement. As with other dependencies, the arrow direction points from the satisfying (client) model element to the (supplier) requirement that is satisfied.
Verify Dependency		A Verify relationship is a dependency between a requirement and a test case or other model element that can determine whether a system fulfils the requirement. As with other dependencies, the arrow direction

		points from the (client) element to the (supplier) requirement.
Refine Dependency		The refine requirement relationship can be used to describe how a model element or set of elements can be used to further refine a requirement.

Each of the four use case model is structured using the same System Engineering model pattern (see package left of Figure 1). At present, the Systems Engineering Model contains only a requirements model, and can be extended through the further development. The requirements model itself is subdivided into the three packages functional requirements (structured by scenarios), non-functional requirements (generally interconnected to functional requirements) and use cases diagram that as well describe behaviour and specifically involved actors for each scenario on a basic level. Figure below shows the general structure of the SysML model of each use case, exemplarily on Whirlpool model

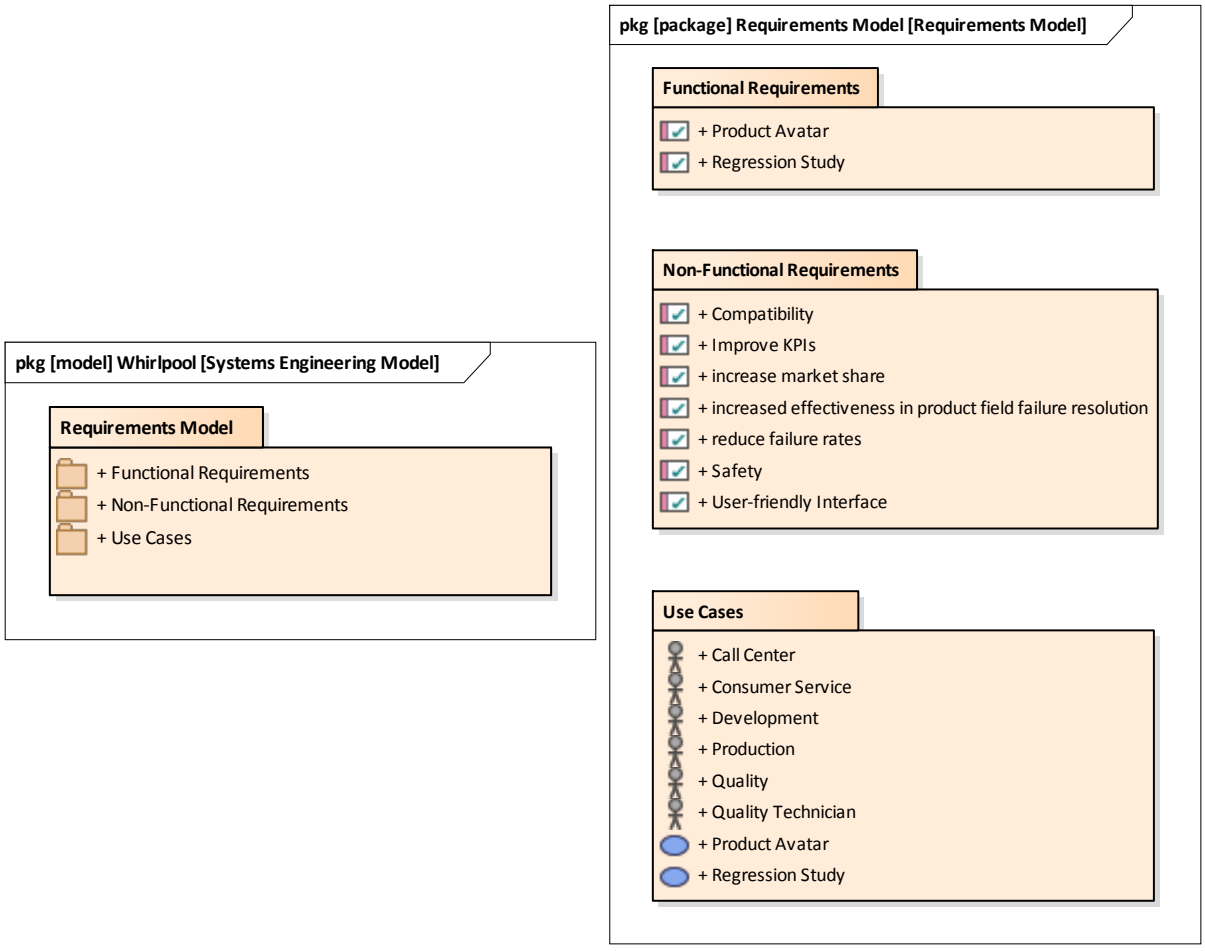


Figure 1: Structure of SysML model; exemplary on Whirlpool Use Case

2 Use Case Requirements

In the following subsections, the four industrial use cases are described. Each use case comes with an initial description in a general way, accompanied by the broad SysML requirements model containing Functional and non-functional requirement of the entire use case. Furthermore, each use case is structured in several scenarios that give a more detailed insight.

2.1 Childcare Furniture Use Case - Micuna

Use Case Description

The Child Care Furniture Use Case is focused on the definition and configuration of an optimal value chain from a rich and reliable business ecosystem. This value chain covers both production needs and logistics. The ecosystem includes information about certifications of their members, as well as the option to access the normative and regulation awareness system provided by AIDIMME.

Dependencies

Despite the four use cases covering different industrial clusters, many aspects about logistics and product representation in the platform will be common for all parties.

No direct dependencies with other use cases have been found.

Use Case Vision

Main business objectives from MICUNA:

- Breaking barriers to new markets particularly outside the EU through information sharing.
- Collaborative supplying partnership.
- Increase innovation capabilities.
- Adaptation of product specifications and manufacturing processes according to regulations and normative of each market.
- Cost reduction in the supply chain.
- Cost reduction in manufacturing / prototyping.

Key System Capabilities *(Functional requirements)*

- Browsing of product catalogues by typology.
- Filtering / Comparing mechanisms in ecosystem.
- Communication exchange mechanisms in supply chain.
- Company reputation in NIMBLE ecosystem.
- Agile catalogue data submission.
- Awareness of normative and legislation for entering a new market.
- Contact with NGO and charitable organisations for donation of used products.
- Product replacement, receiving the used product and offering a new one at a discount.

Key System Characteristics *(Non-functional requirements)*

- Data protection in information publishing.
- Secure communication channels for members.
- Reliability of published information.
- Company reputation in NIMBLE ecosystem.

- Agile catalogue data submission.
- User-friendly and accessible interface.
- Members may have access to the AIDIMME regulation awareness system from NIMBLE.
- Quality of published information.

Environment

Supply chain procurement for the manufacturing of a cradle.

Legacy systems

The AIDIMME "Technology Surveillance and Knowledge Management System" may be accessible from NIMBLE to consult normative and legislation related to products. It provides updated information to potential stakeholders and national companies about normative and legislative aspects. It means an added value to the subscribers of this AIDIMME service.

Description of perceived problems or limitations

The level of adoption of NIMBLE is of great importance in order to provide a rich and appealing ecosystem for companies in the furniture sector. The number of manufacturing and supplier companies should be balanced to foster business opportunities while the adoption and use of NIMBLE at contact level seems to be smoothly realizable, the completion of transactional business processes, such as order formalization and payments can be difficult to achieve in the current furniture industry businesses.

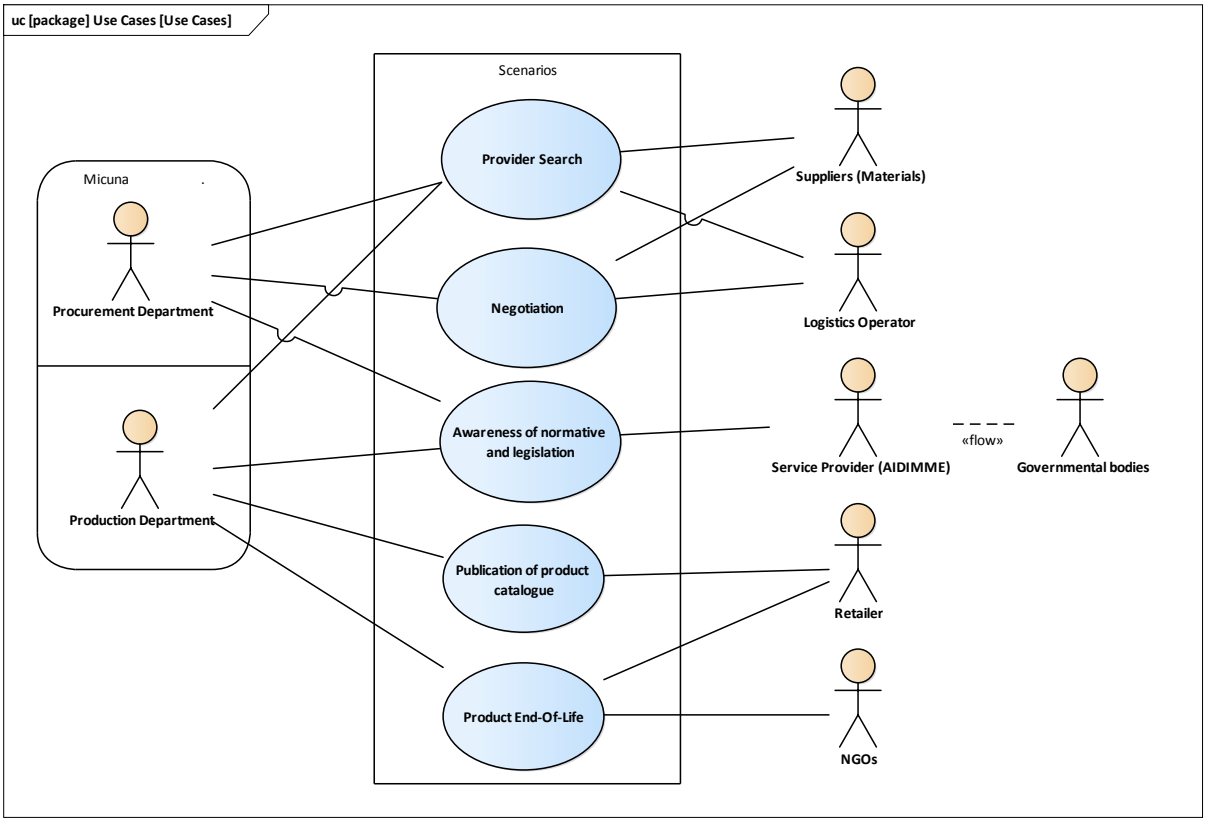


Figure 2: Use Case Diagram Micuna

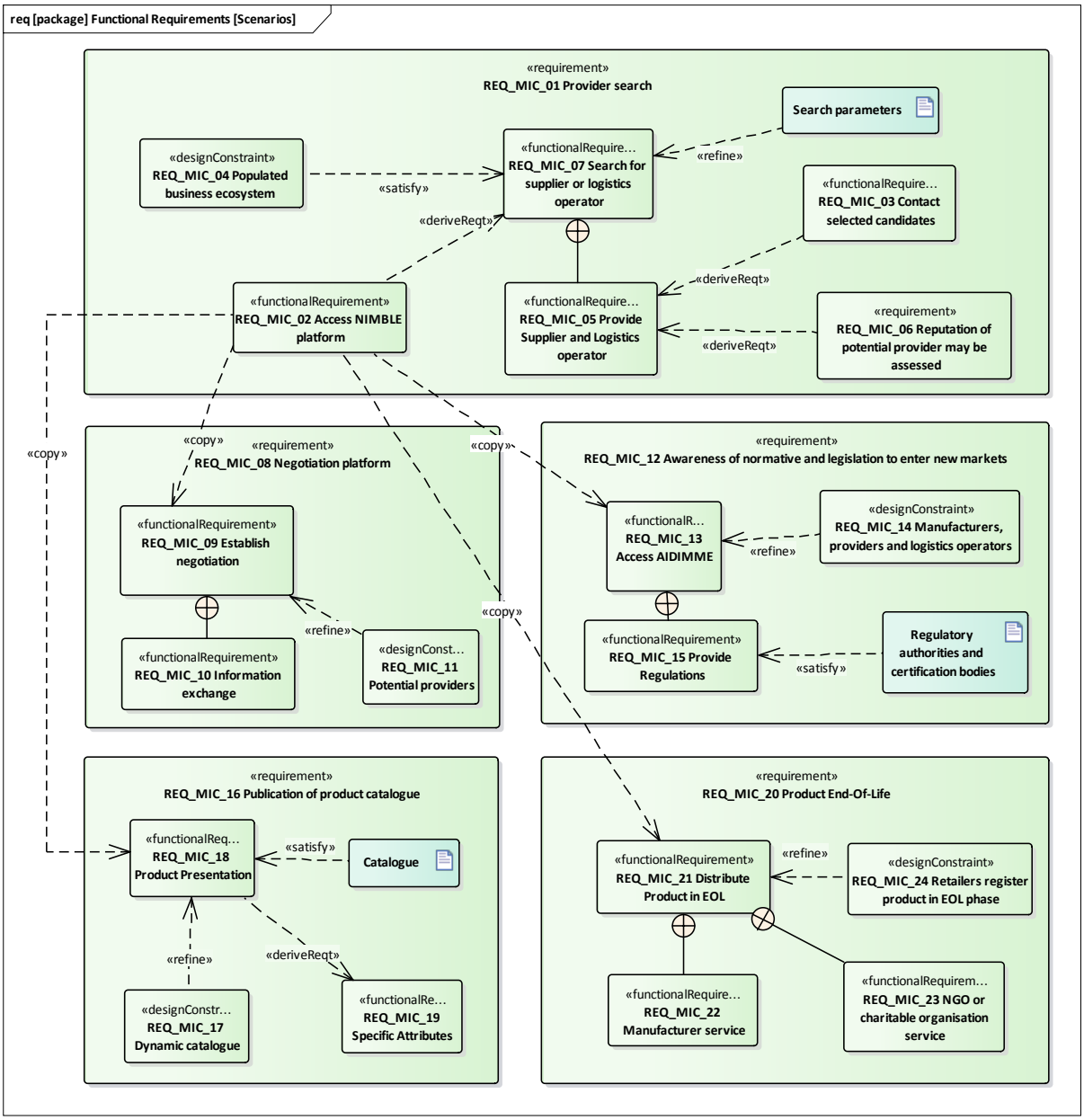


Figure 3: Model Functional Requirements Micuna

Table 3: Functional Requirements Micuna

ELEMENTS OWNED BY REQ_MIC_01 Provider search The manufacturer aims at finding providers of required materials and operations which cannot cover by its own resources or aims at improving at different levels (i.e.: operational costs, ultimate quality).
REQ_MIC_02 Access NIMBLE platform : FunctionalRequirement «functionalRequirement» Establish a connection between Micuna user and NIMBLE platform for interaction and / or data exchange.
REQ_MIC_07 Search for supplier or logistics operator : FunctionalRequirement «functionalRequirement» The company (Micuna) enters NIMBLE and searches the ecosystem introducing keywords related to seek resource

ELEMENTS OWNED BY REQ_MIC_01 Provider search
The manufacturer aims at finding providers of required materials and operations which cannot cover by its own resources or aims at improving at different levels (i.e.: operational costs, ultimate quality).

REQ_MIC_03 Contact selected candidates : FunctionalRequirement «functionalRequirement»
- To find adequate supplying partners to their stores for customers.
- To find adequate supplying partners to reach production objectives or improve the current supply chain, considering fine granularity specifications of products and services and negotiation capabilities. Also higher visibility to retailers is considered.

REQ_MIC_04 Populated business ecosystem : DesignConstraint «designConstraint»
covering main supplies typology

REQ_MIC_05 Provide Supplier and Logistics operator : FunctionalRequirement «functionalRequirement»
NIMBLE user retrieves a list of companies that matches the introduced parameters. Then, the company is able to filter the results and compare different providers.

REQ_MIC_06 Reputation of potential provider may be assessed : Requirement «requirement»
The assessment of the potential partner is made internally. Optional, this might be published via NIMBLE.

ELEMENTS OWNED BY REQ_MIC_08 Negotiation platform
Manufacturer and supplier negotiate all the aspects of business conditions. Firstly, financial and delivery terms are agreed. Then, technical aspects are reviewed to ensure the needs are properly fulfilled. The manufacturer includes the provider in the ERP System if missing.

REQ_MIC_09 Establish negotiation : FunctionalRequirement «functionalRequirement»
Manufacturer (Micuna) and selected provider negotiate the order conditions through the platform.

REQ_MIC_10 Information exchange : FunctionalRequirement «functionalRequirement»
Members of the platform should be able to exchange any kind of information needed to perform the negotiation. This allows the exchanging of needed documentation via file sharing and providing a messaging system or platform inbox to discuss further details.

REQ_MIC_11 Potential providers : DesignConstraint «designConstraint»
manufacturers, suppliers, retailers and logistics operators:
To have mechanisms available to negotiate with known and new production partners in the platform achieving collaboration agreements.

ELEMENTS OWNED BY REQ_MIC_12 Awareness of normative and legislation to enter new markets
A company is interested in entering a new market to export products. To that end, it needs to know all the regulations needed in the destination country regarding the goods the company wants to to export. The compliance with normatives in the destination market may lead to significant changes in product design, selection of materials or manufacturing processes.

REQ_MIC_15 Provide Regulations : FunctionalRequirement «functionalRequirement»
Consult about normative and legislation related to specific products Micuna want to produce or request. This system maintains a structured repository of information related to normative and legislation in the furniture industry.

REQ_MIC_13 Access AIDIMME : FunctionalRequirement «functionalRequirement»
Provision of access to the “Technology Surveillance and Knowledge Management System“ through NIMBLE.

REQ_MIC_14 Manufacturers, providers and logistics operators : DesignConstraint «designConstraint»
Agile mechanisms to be aware of normative related to specific products and destination countries through the AIDIMME service in NIMBLE.

ELEMENTS OWNED BY REQ_MIC_16 Publication of product catalogue

A company publishes part of their product catalogue on the platform, in order to be visible to other supplier and manufacturing companies for doing business together or establish collaboration relationships.

Information introduced in the platform may have a public and a private side, sharing the information of the private side only with selected potential collaborators.

REQ_MIC_18 Product Presentation : FunctionalRequirement «functionalRequirement»
The products of Micuna will be published on NIMBLE by following an user-friendly template.

REQ_MIC_19 Specific Attributes : FunctionalRequirement «functionalRequirement»
More detailed product information is also available to introduce depending on the nature of the product, so this can be better identified and categorized in the platform. After checking the introduced data, products are finally published.

REQ_MIC_17 Dynamic catalogue : DesignConstraint «designConstraint»
To have available agile and friendly mechanisms to publish products from the company catalogue in the platform, with mechanisms available to keep the product information updated.

ELEMENTS OWNED BY REQ_MIC_20 Product End-Of-Life

The company is interested in managing the product EOL in two approaches. On one hand, the manufacturer aims at offering a renovation of the used product (i.e.: replace the cot by a child's bed), at a discount in the new product and support in the furnishing of the room. On the other hand, some products can be donated to NGOs and charitable organisations to give them a second life.

REQ_MIC_21 Distribute Product in EOL : FunctionalRequirement «functionalRequirement»
Capabilities to manage the EOL of their products, saving time in contacting parties to take charge of these products and often saving also effort in finding the adequate "evolved" product they need.

REQ_MIC_22 Manufacturer service : FunctionalRequirement «functionalRequirement»
The retailer informs the manufacturer about the product EOL, so this evaluates the option of offering a renovation to the user, receiving the used product and offering a new one at a discount, arranging this contact through NIMBLE. The manufacturer may also re-use some components of the product returned.

REQ_MIC_23 NGO or charitable organisation service : FunctionalRequirement «functionalRequirement»
The retailer or manufacturer may donate the used furniture to some NGO or charitable organization through NIMBLE, giving a second life to the product. These parties will be contacted to manage the distribution of donated products. More visibility to perform the appropriate donation of used products.

REQ_MIC_24 Retailers register product in EOL phase : DesignConstraint «designConstraint»
Added service to customers meaning the entry point of the EOL management. Retailers are informed about available products in their EOL phase by customer.
They will contact the retailer for both, getting rid of the product no longer used, aiming at giving it a second life, or negotiate a product renovation with the manufacturer.

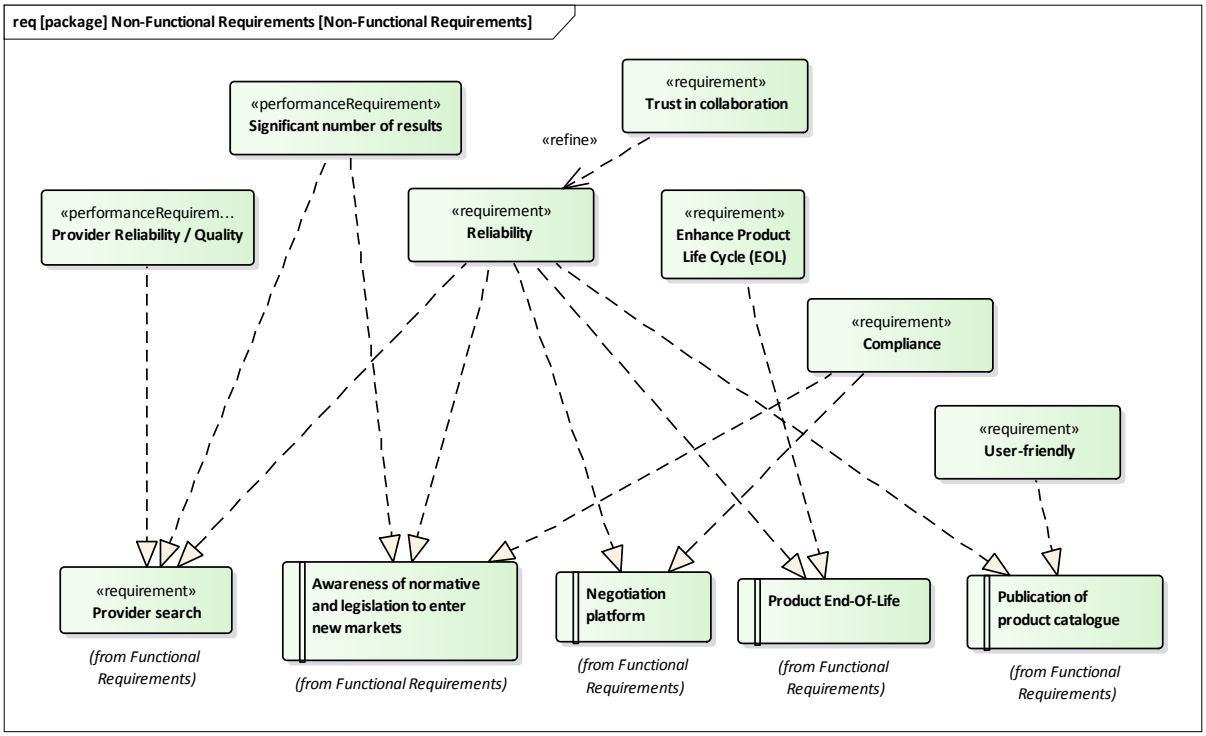


Figure 4: Model Non-Functional Requirements Micuna

Table 4: Non-functional requirements Micuna

Non-Functional Requirements
REQ_MIC_25 Compliance Compliant to normative and legislation related to specific products
REQ_MIC_26 Enhance Product Life Cycle (EOL) Give the product an added value and longer life-cycle.
REQ_MIC_27 Provider Reliability / Quality Information exhibited by potential providers should be reliable.
REQ_MIC_28 Reliability If the platform collapses due to any cause, such as unexpected concurrent access, error connecting to databases, or temporal server downfall, the system should notify users about this situation to avoid bad user experiences. Server clustering or other techniques could be adopted to recover from these faults.
REQ_MIC_29 Significant number of results It is desired to have a high number of results (e.g. providers of parts) for comparison and avoiding single point of failures or monopole.
REQ_MIC_30 Trust in collaboration Focus on the definition and configuration of an optimal value chain from a rich and reliable business ecosystem.
REQ_MIC_31 User-friendly Easy to follow processes and guidance on NIMBLE platform, e.g. by templates helping inserting appropriate data.

2.1.1 Scenario 1 – Provider search

Scenario Description:

The manufacturer aims at finding providers of required materials and operations, which it cannot cover by its own resources or which it aims at improving along different dimensions (i.e., operational costs, ultimate quality).

Actors involved:

- Potential providers (manufacturers, suppliers, retailers and logistics operators)
- From the point of view of a given manufacturer we can distinguish among:
  - Production Dep. MICUNA
  - Purchase Dep. MICUNA
  - Designer

Stakeholders and Interests:

- Provider Manufacturer:
- To find adequate suppliers to reach production objectives or improve the current supply chain.
- Provider Supplier and Logistics operator:
- Higher visibility to potential manufacturers.
- Provider Retailer:
- To find adequate supplying partners.

Pre-Conditions:

- Information exhibited by potential providers should be reliable
- Reputation of potential provider may be assessed
- Populated business ecosystem (covering main supplies typology)

Workflow (AS-IS):

The manufacturer searches the Internet to search companies that produce the required materials or perform the needed operations.

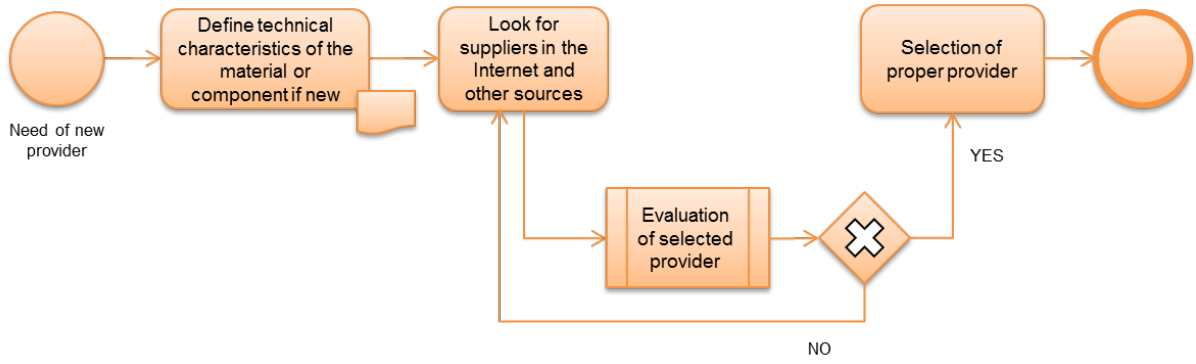


Figure 5: Micuna Scenario 1 As-Is Workflow

Workflow (TO-BE):

Once technical characteristics of required materials or components are defined, the company enters NIMBLE and searches the ecosystem. The search process is performed either by browsing the different categories presented in the platform or by introducing a free text with words related to the items to search for.

NIMBLE retrieves a list of companies that match the introduced parameters. Results can be retrieved in a thumbnails mosaic or a simple list and they should be printed or exported to some spreadsheet format. Then, the company is able to filter the results and compare differ-

ent providers. The company should be able to select the fields to be used in the comparison, considering all of them selected by default if no selection of fields is performed. The company does an internal evaluation of the provider before making a final selection for the specific supply.

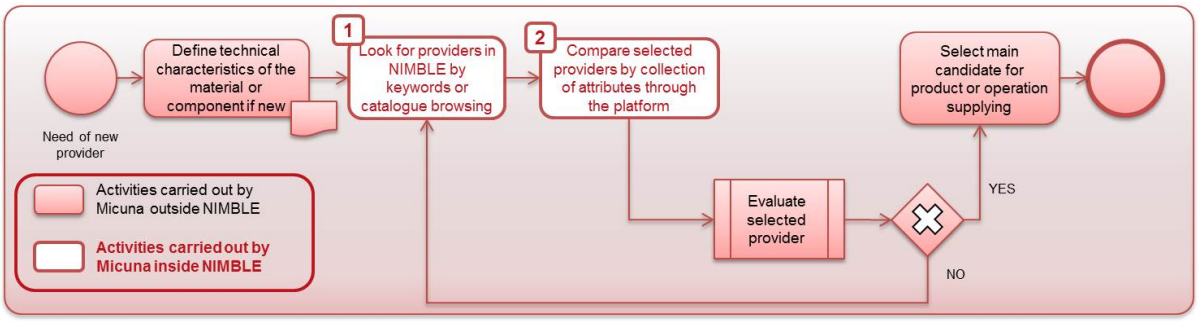


Figure 6: Micuna Scenario 1 To-Be Workflow

Post-Conditions:

- KPI: Number of NIMBLE adopters
- KPI: Number of significant results returned by the platform. (QUAN)
- KPI: Level of reliability/quality of the company/product data returned by the platform (QUAL)

Expected outputs:

Provider Manufacturer

- To find adequate supply partners to reach production objectives or improve the current supply chain, considering fine granularity specifications of products and services and negotiation capabilities. Also higher visibility to retailers is considered.
- Provider Supplier and Logistics operator:
- Higher visibility to potential manufacturers with improved negotiation capabilities.

Provider Retailer

- To find adequate supplying partners to their stores for customers.

2.1.2 Scenario 2 – Negotiation

Scenario Description:

Manufacturer and supplier negotiate all aspects of business conditions. Firstly, financial and delivery terms are agreed. Then, technical aspects are reviewed to ensure the needs are properly fulfilled. The manufacturer includes the provider in the ERP system if missing.

Actors involved:

- Potential providers (manufacturers, suppliers, retailers and logistics operators)
- From the point of view of a given manufacturer we can distinguish among:
    - Production Dep. MICUNA
    - Purchase Dep. MICUNA

Stakeholders and Interests:

Potential providers (manufacturers, suppliers, retailers and logistics operators), to have improved negotiation mechanisms available.

Pre-Conditions:

Information published in the platform by members should be reliable. Members of the platform should be able to exchange any kind of information needed to perform the negotiation, such as messaging system and file sharing

Workflow (AS-IS):

Financial and delivery terms are negotiated and agreed. If this is a new supplier, this is inserted in the ERP system. Technical aspects are also discussed to meet the manufacturing requirements. If the company wants to maintain a list of suppliers for this single operation, then it looks for alternative suppliers as described in scenario #1.

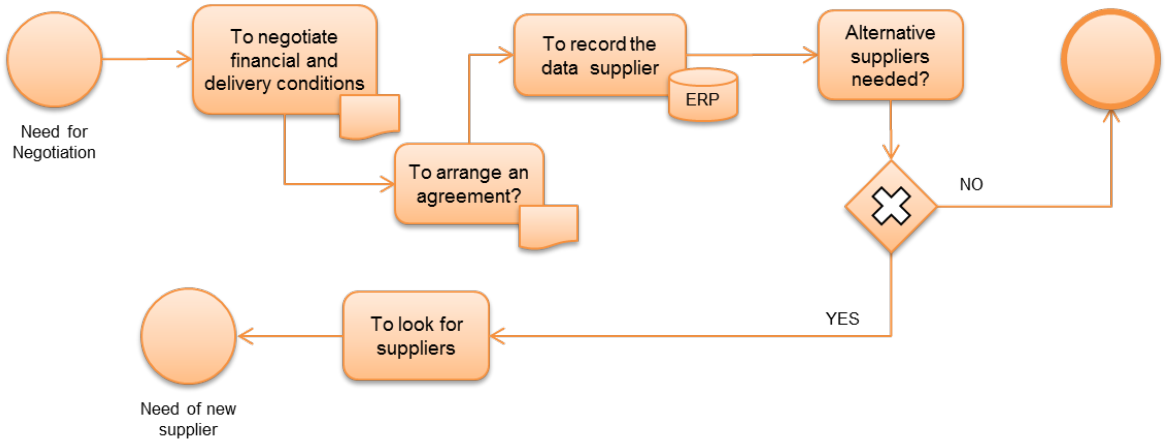


Figure 7: Micuna Scenario 2 As-Is Workflow

Workflow (TO-BE):

To have a first contact with selected candidates, a remote session with voice, video, chat and sharing documents capabilities is arranged through NIMBLE. A negotiation request is sent by the company to the potential providers and this is managed through NIMBLE. Manufacturer and supplier negotiate the order conditions through the platform. This allows the exchange of needed documentation via file sharing and providing a messaging system or platform inbox to discuss further details. A kind of "negotiation template" should be sent to the selected provider indicating the fields for which the company wants to retrieve more detailed information, as well as specific questions to the provider. Messages exchanged between companies should be performed through secure channels and they should be temporarily stored in the system to keep a conversation history for traceability. In this regard, some evaluation mechanisms are required so that companies could rate each other giving rise to a valuable reputation system.

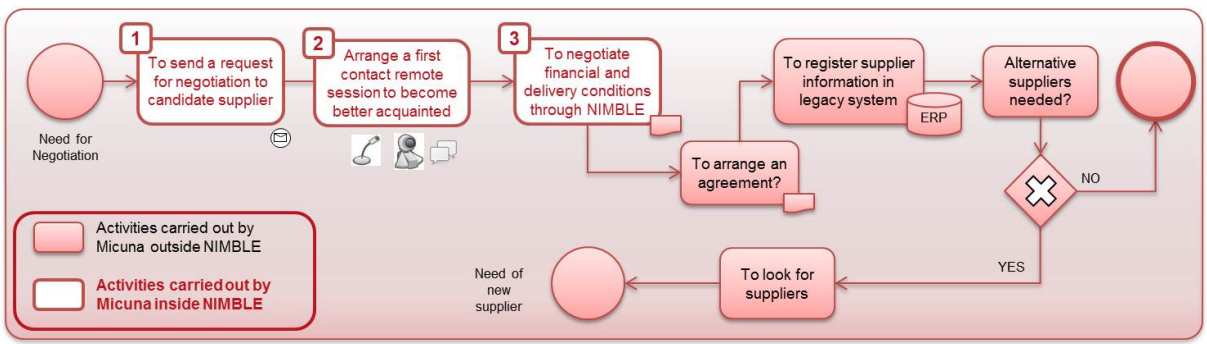


Figure 8: Micuna Scenario 2 To-Be Workflow

Post-Conditions:

- KPI: Number of company relationships (contacts) arranged through the platform

- KPI: Number of negotiations made via the platform which had resulted in business collaboration (successful / less successful)

Expected outputs:

- Potential providers (manufacturers, suppliers, retailers and logistics operators):
- To have mechanisms available to negotiate with known and new production partners in the platform achieving collaboration agreements.

2.1.3 Scenario 3 – Awareness of normative and legislation to enter new markets

Scenario Description:

A company is interested in entering a new market to export products. To that end, it needs to know all the regulations needed in the destination country regarding the goods the company wants to export. The compliance of destination normative may lead to significant changes in product design, selection of materials or manufacturing processes.

Actors involved:

- Manufacturers
- Providers
- Logistics operators
- AIDIMME

Stakeholders and Interests:

Regulatory authorities and certification bodies: These parties are the source of information about normative and legislation used in the system. Specification bodies in particular will be required by manufacturers, providers and logistics operators to obtain required certifications.

Pre-Conditions: N/A

Workflow (AS-IS):

The company usually makes lots of searches in the Internet to find information about current regulations in the destination country. This is usually a long and tedious process so there are many different sources of information with different structures. Most cases, the company relies to AIDIMME, which supports in providing all necessary information about regulation and required certification depending on the country and product to export. This is a semi-automatic process carried out by analysing the relevant pre-identified sources. The company may acquire the needed norms from the corresponding certification association (i.e.: AENOR in Spain). If some certification is required in the target country, the company should turn to some laboratories to make the proper testing in order to get the corresponding certification.

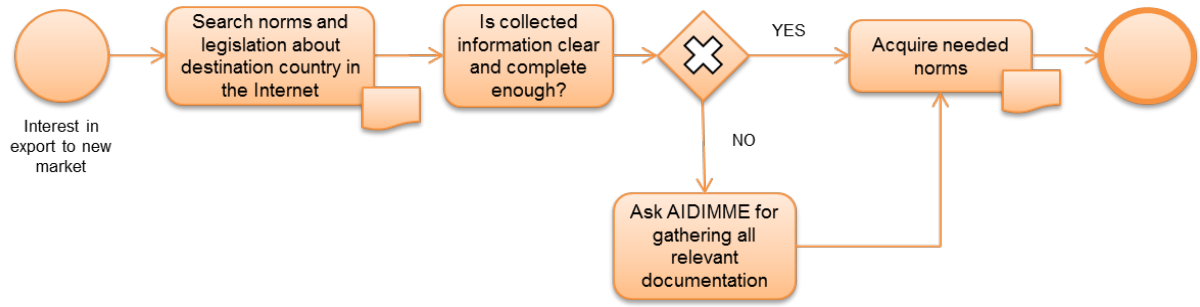


Figure 9: Micuna Scenario 3 As-Is Workflow

Workflow (TO-BE):

The company can access the AIDIMME "Technology Surveillance and Knowledge Management System" through NIMBLE to consult about normative and legislation related to specific products they want to produce or request. This system maintains a structured repository of information related to normative and legislation in the furniture industry. This way, the search becomes more agile and focused.

This system mainly covers the Spanish market, providing updated information to potential stakeholders and national companies. If the company interested in looking for specific market requirements does not find the needed information or it has any doubt related to the relevant information that it should be aware of, the company can directly contact the person in charge of the AIDIMME system through the NIMBLE platform.

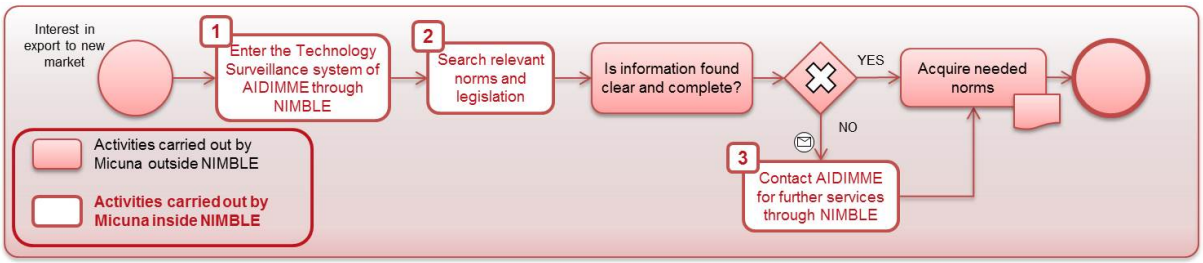


Figure 10: Micuna Scenario 3 To-Be Workflow

Post-Conditions:

- KPI: Number of required certifications detected for product exportation via the AIDIMME service through NIMBLE which have been finally acquired and fulfilled

Expected outputs

Manufacturers, providers and logistics operators:

- Agile mechanisms to be aware of normative related to specific products and destination countries through the AIDIMME service in NIMBLE.

AIDIMME:

- Provision of access to the "Technology Surveillance and Knowledge Management System" through NIMBLE.
- Regulatory authorities and certification bodies will gain visibility and specification bodies in particular will be required by manufacturers, providers and logistics operators to obtain required certifications.

2.1.4 Scenario 4 – Publication of product catalogue

Scenario Description:

A company publishes part of their product catalogue in the platform, in order to be visible to other supplier and manufacturing companies for doing business together or to establish collaboration relationships.

Information introduced in the platform may have a public and a private side, sharing the information of the private side only with selected potential collaborators.

Actors involved:

- Manufacturers
- Suppliers

Stakeholders and Interests:

Retailers have available a portfolio of products from different manufacturers for their stores.

Pre-Conditions:

The company has the product catalogue introduced in the internal system (ERP / PLM) or another internal legacy system. The catalogue can be also available in a design format to deliver printer versions for commercial use.

Workflow (AS-IS):

MICUNA actually introduces product of the catalogue in the company website. Data introduced is validated just before make them public on the website. Some products are also published in some online stores, which are mainly targeted to customers.

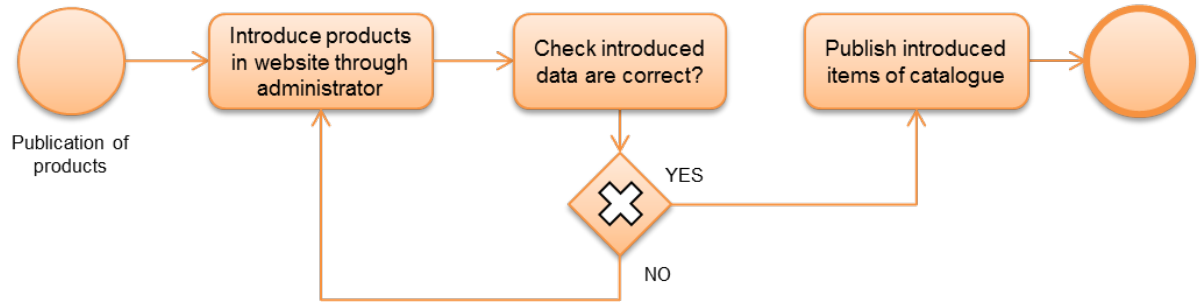


Figure 11: Micuna Scenario 4 As-Is Workflow

Workflow (TO-BE):

MICUNA introduces their products in NIMBLE following a user-friendly template. More detailed product information is also available to introduce depending on the nature of the product, so this can be better identified and categorized in the platform. After checking the introduced data, products are finally published.

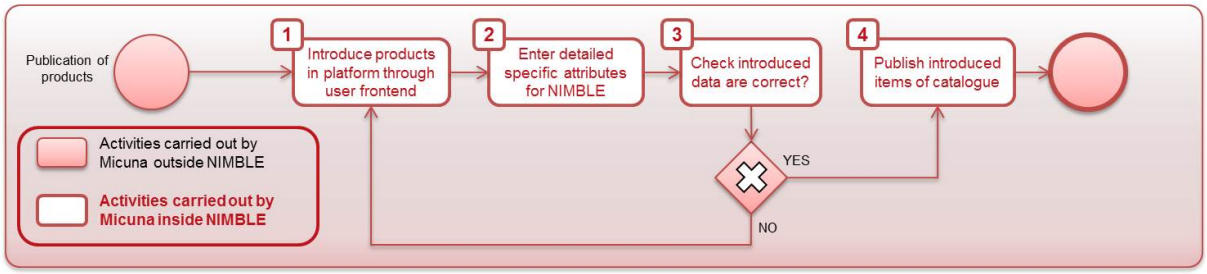


Figure 12: Micuna Scenario 4 To-Be Workflow

Post-Conditions:

- KPI: Number of products of the company published in the platform
- KPI: Number of products of the company with some rating or opinion in the platform
- KPI: Average rating of products of the company
- KPI: Average rating of the company in the platform
- KPI: Most visited products of the company
- KPI: Most sold products of the company, involved finally in some business with other company
- KPI: Average order value for the company

Expected outputs:

- Manufacturers and suppliers; to have available agile and friendly mechanisms to publish products from the company catalogue in the platform, with mechanisms available to keep the product information updated.
- Retailers; a showcase of manufacturers and products to fill their stores for customers.

2.1.5 Scenario 5 – Product End-Of-Life

Scenario Description:

The company is interested in managing the product End-Of-Life (EOL) in two approaches. On the one hand, the manufacturer aims at offering a renovation of the used product (e.g. replace the cot by a child's bed), at a discount in the new product and support in the furnishing of the room. On the other hand, some products can be donated to NGOs and charitable organisations to give them a second life.

Actors involved:

- Manufacturers
- Retailers
- NGO and charitable organisations: These parties will be contacted to manage the distribution of donated products.

Stakeholders and Interests:

- Customers: They will contact the retailer for both, disposing of the product that is no longer used, aiming at giving it a second life, or negotiate a product renovation with the manufacturer.

Pre-Conditions: N/A

Workflow (AS-IS):

When the customer no longer uses the product, it is in most cases thrown away as garbage, with the hope of being properly recycled. In other cases, the customer publishes the used product in some second-hand platform to sell it for money. The last alternative (less usual) is that the end user brings the product to a local NGO to donate the furniture. Furthermore, to replace the furniture by a new one, adapted to the new requirements of the children´s age (i.e.: the cradle by a small bed) the family starts again their search in the market (including MICUNA's competitors). Sometimes furniture elements that can be still used are discarded because the design is very different, generating higher cost to the user and more waste.

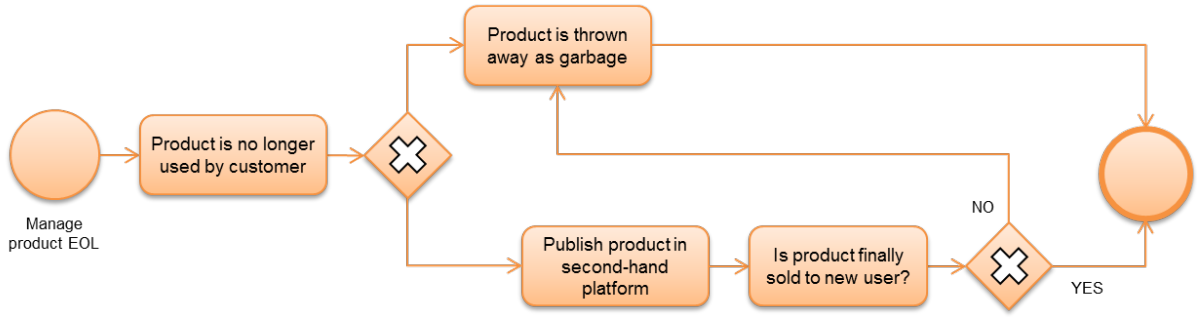


Figure 13: Micuna Scenario 5 As-Is Workflow

Workflow (TO-BE):

When the customer no longer uses the product, they contact the retailer to get information about the available options regarding the End-Of-Life of the used product. At this point, the customer provides information to the retailer about the use experience and the product condition (damaged or eroded painting or missing component). The retailer informs the manufacturer about the product EOL through NIMBLE and the manufacturer evaluates the option of offering a renovation to the user, receiving the used product and offering a new one at a discount, arranging this contact through NIMBLE. The manufacturer may also consider the reuse of some components of the product returned. As an alternative, the retailer or manufac-

turer may donate the used furniture to some NGO or charitable organization giving a second life to the product.

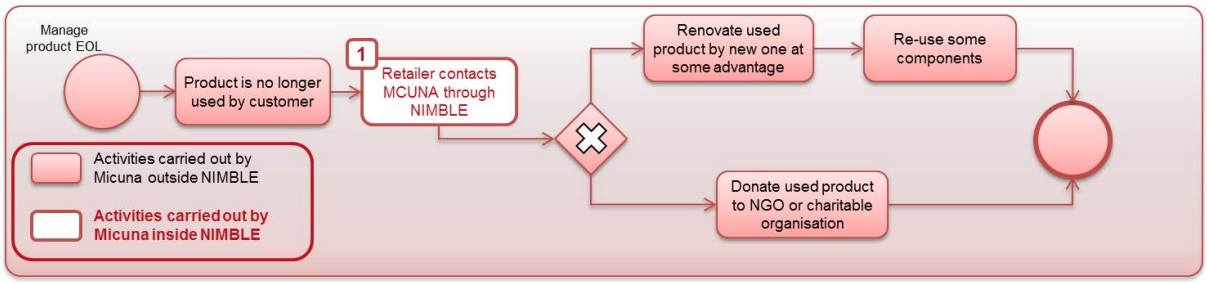


Figure 14: Micuna Scenario 5 To-Be Workflow

Post-Conditions:

- KPI: Number of product renovations arranged with customers
- KPI: Number of products donated to NGO's and charitable organisations

Expected outputs:

- Manufacturers: to receive the product used by customer, enabling the option of re-using some product components. Furthermore, to improve the customer loyalty by offering a new product renovation to the customer also offering advice for the while room furnishing according customer needs.
- Retailers: Added service to customers as entry point of the EOL management.
- NGO and charitable organizations: More visibility for donation of used products.
- Customers: Capabilities to manage the EOL of their products, saving time in contacting parties to take charge of these products and often saving also effort in finding the adequate "evolved" product they need.

2.2 Textile Manufacturing Use Case - Piacenza

The company *Fratelli Piacenza S.P.A.* (following Piacenza) provides the business case pilot for demonstrating the NIMBLE platform in the textile sector. The use case is focussed on SMEs like Piacenza, which make up 90% of the total textile and clothing companies. We aim to achieve the following objectives scenarios:

1. Collaborative design and production;
2. Dynamic, real-time access to supplier virtual catalogues and inventories for fast design development;
3. Full manufacturing, product traceability and real time vision of production to provide customers with information about their orders and deliveries.
4. Automatic preferential origin certificate declaration, including ethical and environmental fulfilment evidences.

Possible commonalities:

- Dynamic, real-time access to supplier virtual catalogues, inventories and production for fast design development;
- Live production data at machine level;
- Full manufacturing and product traceability (and application of plug & work sensors);

Use Case Vision

In the vision of the Textile use case, NIMBLE should be a platform for a fast and reliable data exchange service, based on IoT, M2M and B2B data transfer. The platform itself should act as a virtual working place where textile industries can monitor/exchange/provide data to fulfil the purposes of the selected 4 main scenarios. The main value of the platform would be standardization of company interaction with new customers/suppliers (mainly B2B), without having to set up a new channel (and format) of communication and using their legacy systems. They can find all the data needed through the platform. This is particularly important for SMEs because they can dedicate only very limited resources to interface their legacy systems with the external business environment. The objectives of the system should be:

- to create an easier communication channel (thanks to standardization, that allows the fast integration of new actors in the market, using the format adopted by the platform),
- to be able to trace all the production actions of the value chain and to provide, easily and quickly, those data to the customers, with a real time granular monitoring of production flow; to provide real time, accurate forecasts of machinery and product availability,
- to monitor the workflow with “plug and play” sensors,
- to produce the preferential origin certificate declaration automatically.

Key System Capabilities / Characteristics

The necessary minimum characteristics of the platform are: speed, reliability, security and user friendliness, plug & play adoption. The system must be based on a reliable architecture, which supports a trustworthy data exchange system. Security/Privacy aspects must be properly addressed as well, protecting each involved actor data and providing accurate access credential definition. It is also required to track the data itself, track the data exchange, and to store the data in reliable and protected environment. The system should have a friendly user interface, reacting in real time. It should be user friendly and properly supported

by instructions and tutorials to guide users. The use case must be ready to interact with heterogeneous subsystems, depending on the architecture of the system (NIMBLE) itself.

In general, considering for example the origin certificate declaration, some data may be disclosed to different users (customers, competitors, etc.), but preserving the privacy of others. A typical example is the situation in which user A is supplier of user B who in turn, is supplier of user C. User C may need to have information on the production of user A in terms of origin of the goods but other data have to remain confidential. Humans are an important factor in the setup of the platform, to fully exploit the potential data exchange benefits, to evaluate all the possible variants of data exchange and to record all the instructions on how to use the platform. Once the system is running, the new users should be guided to the use of the platform by clear tutorials in order to minimize the time spent from the registration to the first activity in the platform. A proper user acceptance qualitative assessment will be conducted during the pilot implementation.

Legacy systems

NIMBLE will use, when possible, some sector standards already set up for the textile sector, e.g. eBIZ and MODA-ML. This approach will ease the adoption of the system by textile SME industries: the ones already using the e-Biz and MODA-ML standards, should be able to use NIMBLE with no legacy problems. The ones working with their own data format and legacy systems, will be required to adapt some of their software towards standards but the related efforts will be minimized to an affordable level for SMEs, considering the very small (approx.. 10 employees) average size of EU textile actors.

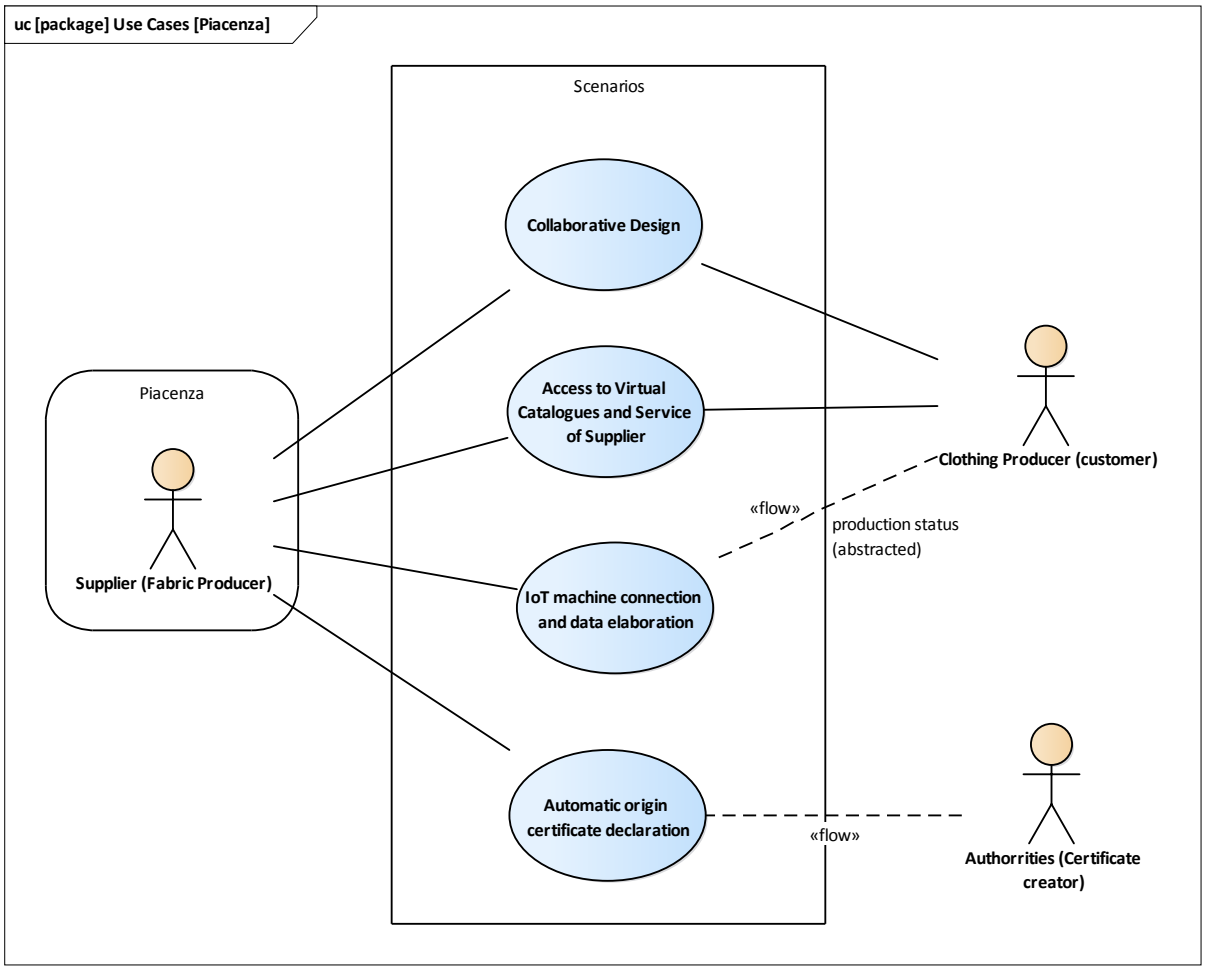


Figure 15: Use Case Diagram Piacenza

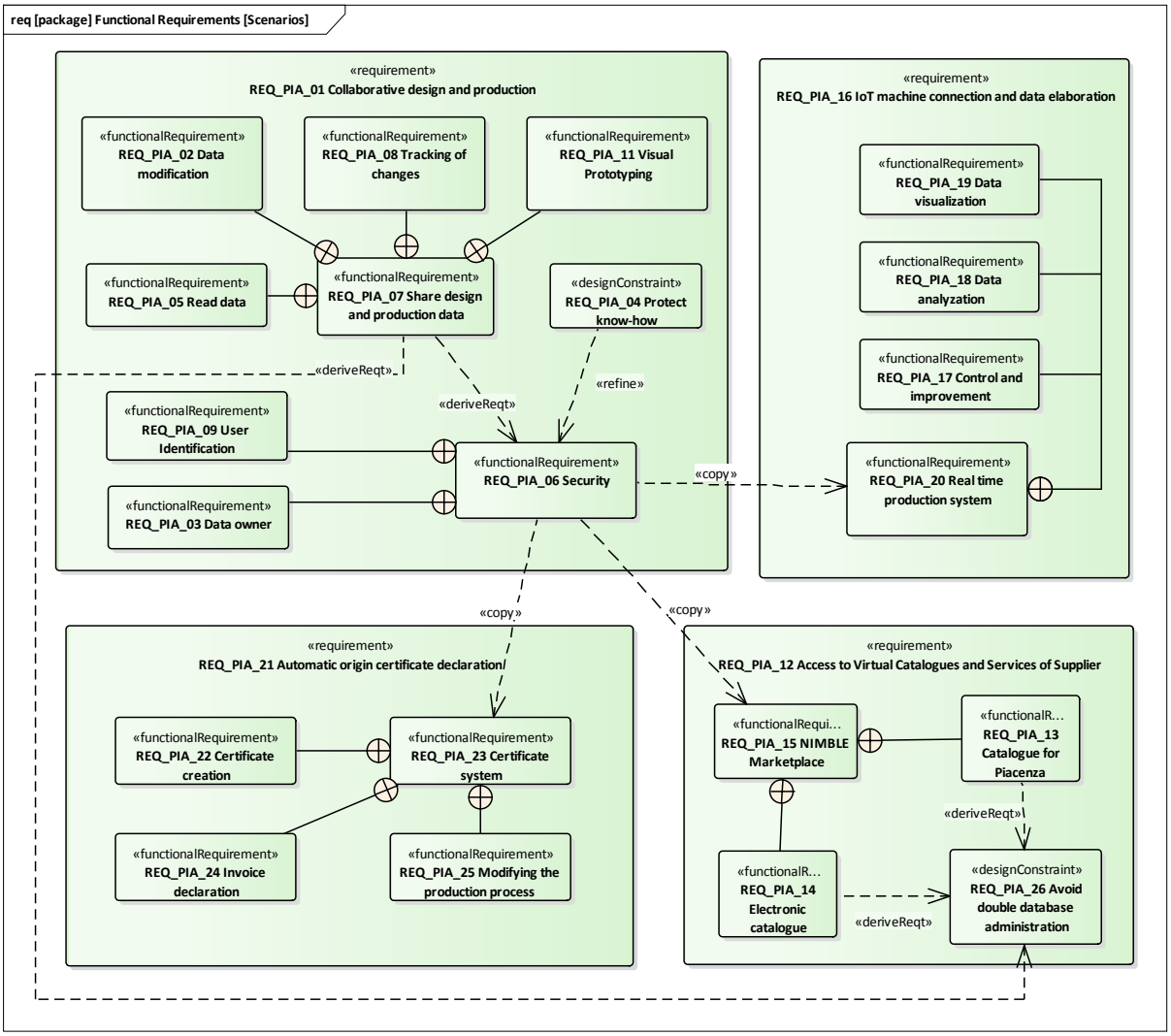


Figure 16: Model Functional Requirements Piacenza

Table 5: Functional Requirements Piacenza

ELEMENTS OWNED BY REQ_PIA_01 Collaborative design and production Company A (e.g. fabric supplier) can share design or production data with company B (e.g. its customer, a clothing producer). The latter can modify them and exchange again the data. Data changes must be tracked and available for all users.
REQ_PIA_02 Data modification : FunctionalRequirement «functionalRequirement» The latter can modify them and exchange again the data.
REQ_PIA_03 Data owner : FunctionalRequirement «functionalRequirement» The data owner must be able to manage the rights of access to data at different levels (read only, read and share, modify, etc.)
REQ_PIA_04 Protect know-how : DesignConstraint «designConstraint» See "Protect intellectual property". Neither process know-how nor product designs shall be released to the publicity without any explicit action of the data owner. (e.g. creating an individual catalogue for a dedicated customer, expected delivery date without showing processes and hiding it behind an anonymous visualization, e.g. a process bar)
REQ_PIA_05 Read data : FunctionalRequirement «functionalRequirement» Retrieve design and production data that is released for declared (by data owner) audience / users.

ELEMENTS OWNED BY REQ_PIA_01 Collaborative design and production
Company A (e.g. fabric supplier) can share design or production data with company B (e.g. its customer, a clothing producer). The latter can modify them and exchange again the data. Data changes must be tracked and available for all users.

REQ_PIA_06 Security : FunctionalRequirement «functionalRequirement»
Security: an accurate management of the rights of access to data is compulsory. Data need to be read/modified/shared only by users with the proper rights of access and credentials, identifying clearly who is the owner of the data.

REQ_PIA_07 Share design and production data : FunctionalRequirement «functionalRequirement»
Company A (e.g. fabric supplier) can share design or production data with company B (e.g. its customer, a clothing producer).

REQ_PIA_08 Tracking of changes : FunctionalRequirement «functionalRequirement»
Data changes must be tracked and available for all users with appropriate credentials.

REQ_PIA_09 User Identification : FunctionalRequirement «functionalRequirement»
Users have to have the proper rights of access and credentials.

REQ_PIA_10 User friendliness : FunctionalRequirement «functionalRequirement»
The platform must be user friendly and properly supported by instructions and tutorials, in main user languages.

REQ_PIA_11 Visual Prototyping : FunctionalRequirement «functionalRequirement»
Hereby virtual prototyping (TO-BE) the supplier packs the article in a XML description and sends this virtual customized design to the customer for the evaluation, before manufacturing. On the other side the customer is not a passive evaluator, but is allowed to modify it within constraints predefined by the supplier (on the basis of available materials, colors and machineries).

ELEMENTS OWNED BY REQ_PIA_12 Access to Virtual Catalogues and Services of Supplier
Dynamic, real-time access to supplier virtual catalogues and services for fast design development.

REQ_PIA_26 Avoid double database administration : DesignConstraint «designConstraint»
The data catalogue of products and processes from Piacenza will stay on-site and not moved / duplicated to the platform. One reason for this is the protection of company's assets and values, on the other hand double data administration needs double administration which is not economical

REQ_PIA_13 Catalogue for Piacenza : FunctionalRequirement «functionalRequirement»
From the technical point of view (and requirements for the NIMBLE core system) we need to underline that the catalogue for Piacenza includes not only the products for the customer, but also the services for the collaboration platform with the supplier already shown in the previous scenario, the order traceability and the origin certificate emission described in the next scenarios.

REQ_PIA_14 Electronic catalogue : FunctionalRequirement «functionalRequirement»
In the TO-BE scenario physical samples are not required anymore, except for a few units of the approved new design, leading to a reduction of the number of physical catalogues released to customers in order to receive their feedbacks.

REQ_PIA_15 NIMBLE Marketplace : FunctionalRequirement «functionalRequirement»
The main change lies in the NIMBLE marketplace, where the supplier will be enabled to present its catalogue and could receive suggestions by its customers.

ELEMENTS OWNED BY REQ_PIA_16 IoT machine connection and data elaboration
The user shall be able to get access to real time data at machine and product level, exploiting IoT and M2M scenarios. The data are expected to come from plug and work sensors integrated into the machineries and processed at factory level to produce information about, for example, the order status and forecast a shipment date.

REQ_PIA_17 Control and improvement : FunctionalRequirement «functionalRequirement»
This map is useful for the next two processes: the raw control and the darning.
In particular the second one is often delegated to external suppliers, for whom this information (update after the raw control data) is very important because allow them to quickly identify the position of the defects to be repaired.

ELEMENTS OWNED BY REQ_PIA_16 IoT machine connection and data elaboration The user shall be able to get access to real time data at machine and product level, exploiting IoT and M2M scenarios. The data are expected to come from plug and work sensors integrated into the machineries and processed at factory level to produce information about, for example, the order status and forecast a shipment date.
REQ_PIA_18 Data analysis : FunctionalRequirement «functionalRequirement»
REQ_PIA_19 Data visualization : FunctionalRequirement «functionalRequirement»
REQ_PIA_20 Real time production system : FunctionalRequirement «functionalRequirement» All data are sent to a service on the company systems that link different data aggregations to the specific production order and publish to interested parties (e.g. customers or services providers)

ELEMENTS OWNED BY REQ_PIA_21 Automatic origin certificate declaration Automatic origin certificate declaration (simple and preferential), including ethical and environmental fulfilments
REQ_PIA_22 Certificate creation : FunctionalRequirement «functionalRequirement» Automatic production of a document that is required by law in some Countries. This document gives proof of the ethical behavior of the company, that is important on the market. In the future, all the documents could be only in electronic versions (also those that, at the moment, are provided in paper by the Chamber of Commerce): the NIMBLE shall allow the sharing also of those documents for the interested sectors (textile, shoes, furniture).
REQ_PIA_23 Certificate system : FunctionalRequirement «functionalRequirement» see contained requirements
REQ_PIA_24 Invoice declaration : FunctionalRequirement «functionalRequirement» Including the declaration of origin into the invoices reducing the time for handling the research of invoices by administrative people.
REQ_PIA_25 Modifying the production process : FunctionalRequirement «functionalRequirement» Modifying the production process to use these goods and have a final product eligible for such a declaration

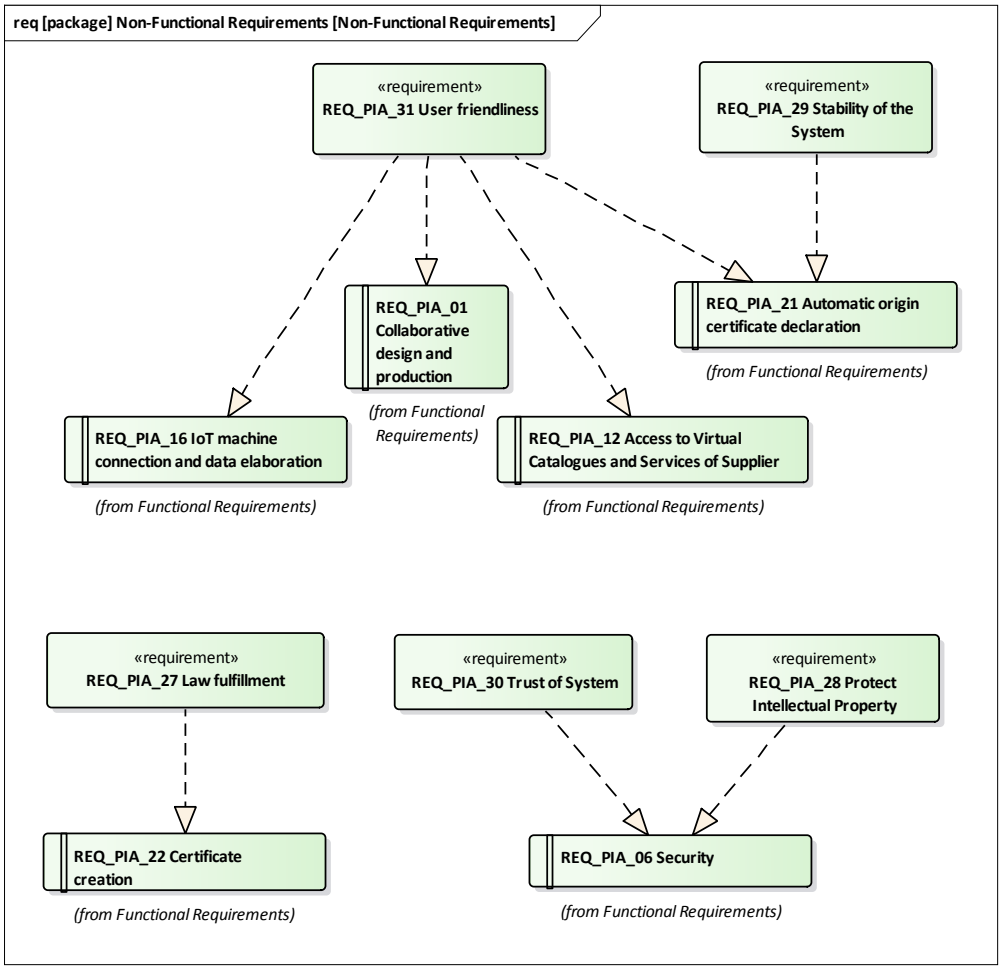


Figure 17: Model Non-Functional Requirements Piacenza

Table 6: Non-functional Requirements Piacenza

Non-Functional Requirements
REQ_PIA_27 Law fulfillment The documents produced by NIMBLE, such as the origin certification, are required by law in some States and may determine specific rates for duties and taxes. Therefore it is important that these documents fulfill completely the law requirements of each country specified by end users.
REQ_PIA_28 Protect Intellectual Property Product (new collections) and process know-how are essential business values that need to be protected.
REQ_PIA_29 Stability of the System Users must be sure that the platform is always running with no technical problems.
REQ_PIA_30 Trust of System Users must be sure that the platform is intrinsically stable and secure. Bugs and service interrupts must be limited already from design phase by a proper strategy to minimize customer service in commercialization phase considering also the high number of expected users in different languages.
REQ_PIA_31 User friendliness The platform must be user friendly and properly supported by instructions and tutorials, in main user languages.

2.2.1 Scenario 1 – Collaborative design and production

Scenario Description**:**

Company A (e.g. a fabric supplier) can share design or production data with company B (e.g. its customer, a clothing producer). The latter can modify them and exchange again the data. Data changes must be tracked and available for all eligible users.

Actors involved:

Software developers, with a specific knowledge of the textile data and standards available/adoptable. Data modellers. Developers with specific know-how in the languages and tools used by NIMBLE.

Stakeholders and Interests:

- Textile and clothing manufacturers, for the practical test and use of the platform;
- Corporate / bodies / communities for the adoption of standards for data exchanges, to expand the use of standards;
- open source communities, for the use of the platform itself;
- platform data manager, who provides the maintenance and the customer service of the platform and the animation of NIMBLE community
- IT providers commercialising the service provided by the platform

Pre-Conditions:

- Security: an accurate management of the rights of access to data is compulsory. Data need to be read/modified/shared only by users with the proper rights of access and credentials, identifying clearly who is the owner of the data. The data owner must be able to manage the rights of access to data at different levels (read only, read and share, modify, etc.);
- Trust of the system: users must be sure that the platform is intrinsically stable and secure. Bugs and service interrupts must be limited already from design phase by a proper strategy to minimise customer service in commercialization phase considering also the high number of expected users in different languages.
- User friendliness: the platform must be user friendly and properly supported by instructions and tutorials, in main user languages.

Work-flow AS-IS:

The definition of a customized product in the fashion sector has about 6 to 8 weeks of latency from the initial request of the customer, that asks for improvement/customization in a product to the final order to the supplier. This is mainly due to the *physical sample production* that the supplier has to carry out in order to show the effective aspect result of a new article. This approach is also very expensive for the supplier, who is asked very often to manufacture more than one variant of the fabric.

The workflow of a customized fabric definition and production can be summarised as follows:

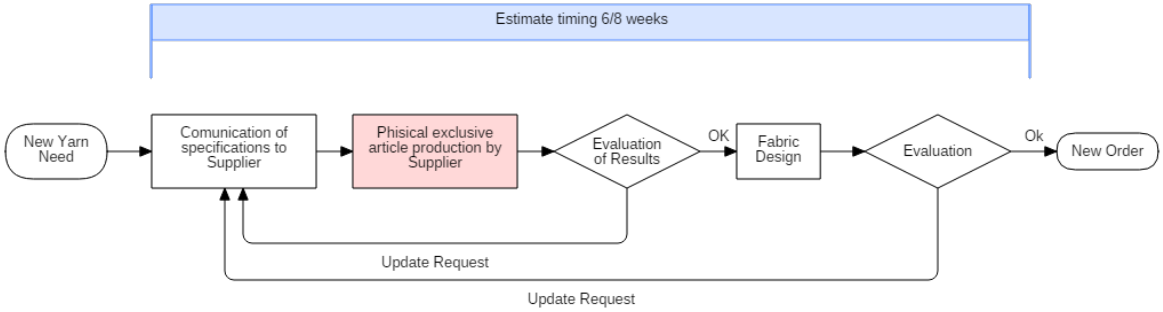


Figure 18: Piacenza Scenario 1 As-Is Workflow

- The customer wants to change a yarn in the fabric (for example to change colour) and sends the request to the fabric producer, providing details by phone, e-mail or personal meeting.
- The supplier designs the new fabric and produces a physical sample of it, which is sent to the customer.
- An evaluation of the sample could generate some new requests, sometimes requiring new physical samples.
- After the final approval, the customer sends the order of the new customized fabric.

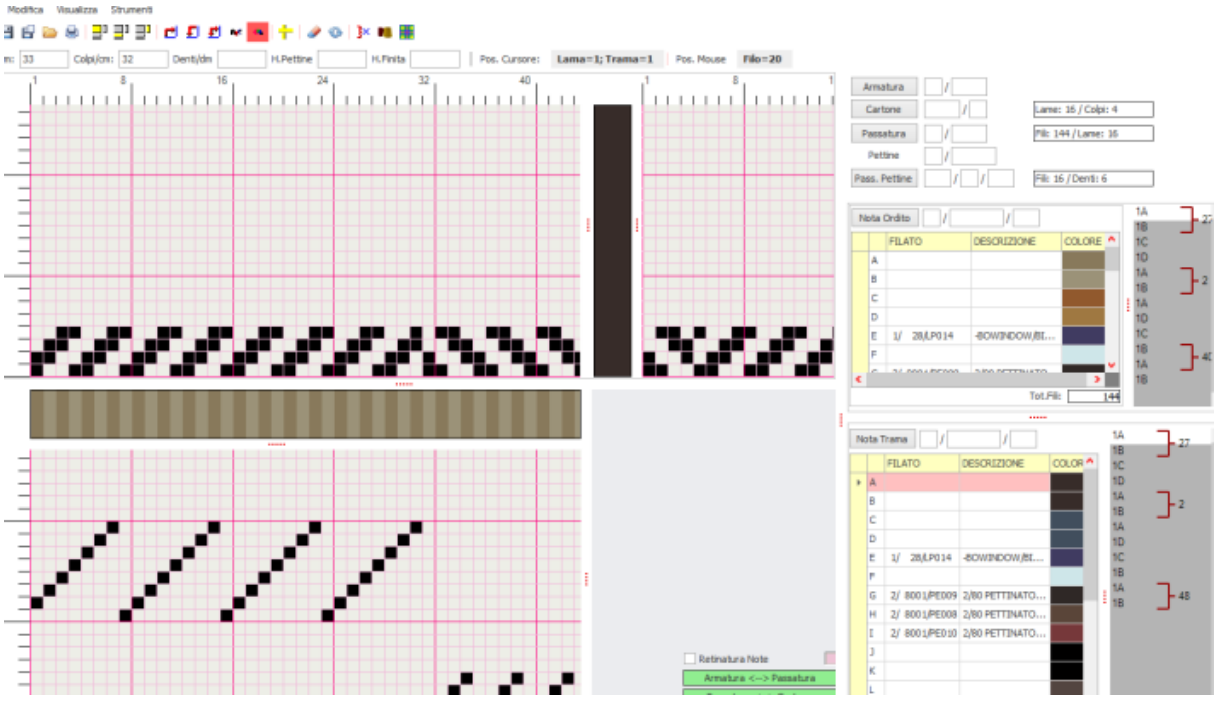


Figure 19: Piacenza Scenario 1 As-Is CAD System 1/2

In this scenario the software infrastructure is limited to the design phase, in particular the supplier use a CAD system to create a simulation of the product and produces a sample that is sent to the customer.

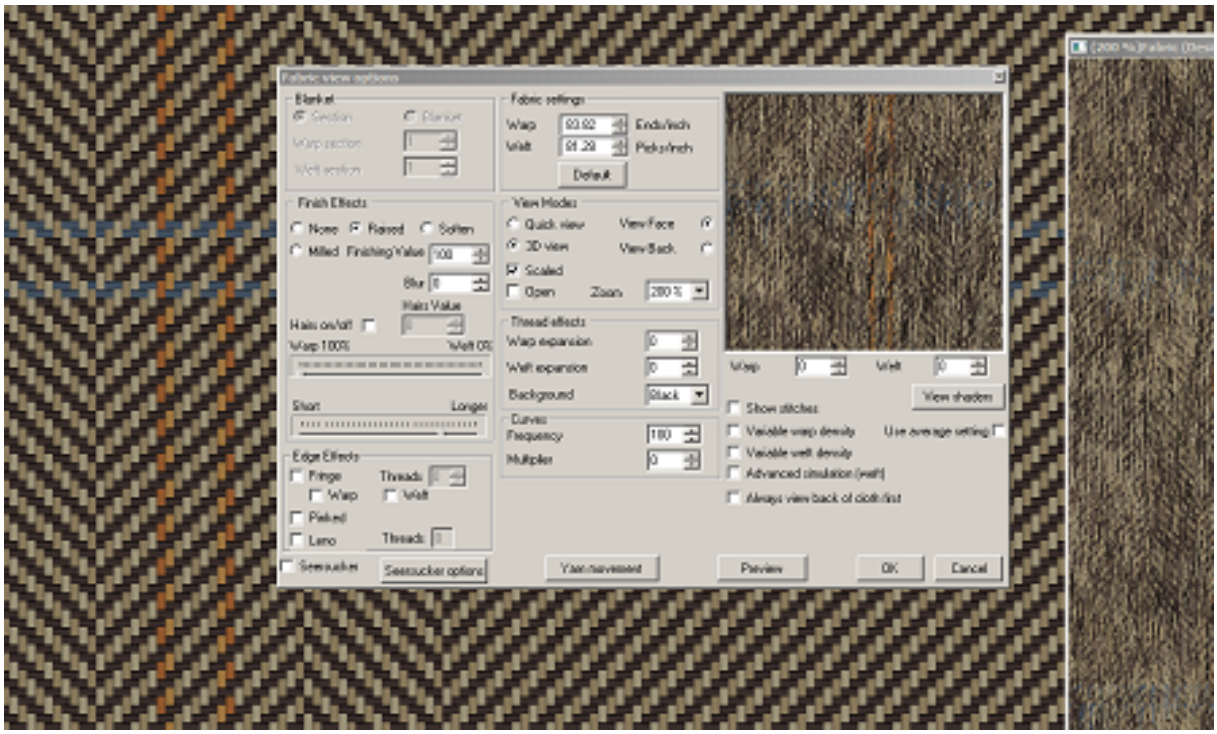


Figure 20: Piacenza Scenario 1 As-Is CAD System 2/2

Different CAD tools used by textile companies use different data formats or are unable to manage a complete set of data, thus the only way to share digital information is by e-mail (text and image rendering of the article if possible). Due this technical limitation, the fastest collaboration is performed by e-mail and phone call. The data involved in this scenario are the technical information of the textile product. eBIZ/MODA-ML standard has been already applied in the modelling of technical data, most of them related to the exchange of information about order, delivery and quality.

Work-flow TO-BE:

Virtual design offers an alternative solution: fabric and clothing producers can exchange not a simple image or free text, but the precise structure of the article in order to render it on the CAD or Viewer of the customer. By this way, the virtual design can also exploit the collaborative design in real time among the different actors. In this scenario the customer could start the collaboration from a new virtual fabric proposal, from which the customisation process starts. The request is translated into an XML model, public and well documented: the resulting file is sent to the supplier. The supplier could upload the model into its CAD software, visualize and elaborate it to satisfy customer requirements.

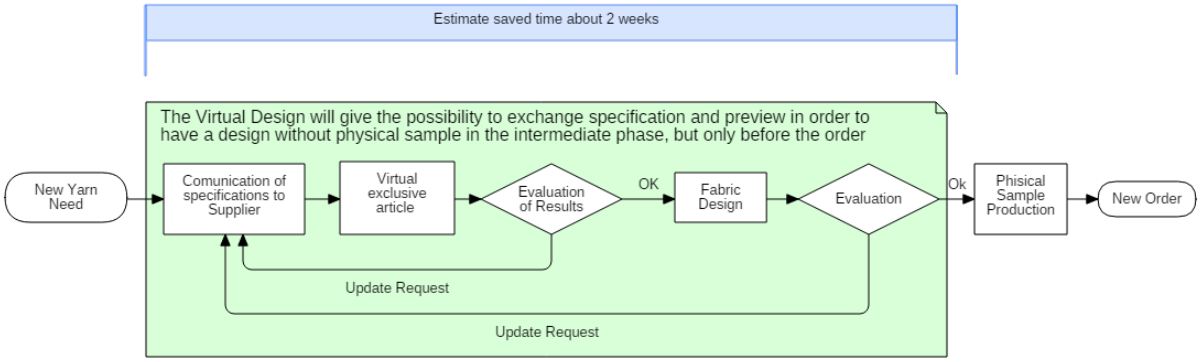


Figure 21: Piacenza Scenario 1 To-Be Workflow

At this point, in the AS-IS workflow, sample production is carried out. Hereby virtual prototyping (TO-BE) the supplier packs the article in a XML description and sends this virtual customised design to the customer for the evaluation, before manufacturing. On the other side the customer is not a passive evaluator, but is allowed to modify it within constraints predefined by the supplier (on the basis of available materials, colours and machineries). The goal of this activity is to suggest to the supplier what is effectively required. The set of parameters that the customer could change is very limited, but the possibility to change the colour of yarns is a good step towards collaborative design of fabrics. After the final approval of the customer the supplier produces at least one sample in order to show the final result to the customer. However, the production of other samples and designs could be reduced, thus saving time due to the interactive cooperation with the customer. One of the enabling technologies to fully exploit virtual prototyping potential and to implement the above mentioned TO-BE scenario is represented by the extension of the actual standard eBIZ/MODA-ML, in order to integrate the virtual design file of fabrics (that will be a complement of the technical parameter already in place) into the standard. NIMBLE architecture should be able to search, discover and put in communication the services that support the transfer of these data from supplier (fabric producer) to customer (clothing producer), and vice versa. To achieve this result we propose to integrate sector-specific communication standards such as eBIZ/MODA-ML, already in use in textile sector, into NIMBLE platform.

The simple implementation of this use case into the NIMBLE platform requires the availability of web services allowing the data exchange among the partners. A very simplified UML Sequence Schema of this collaboration is represented in the following Figure 22.

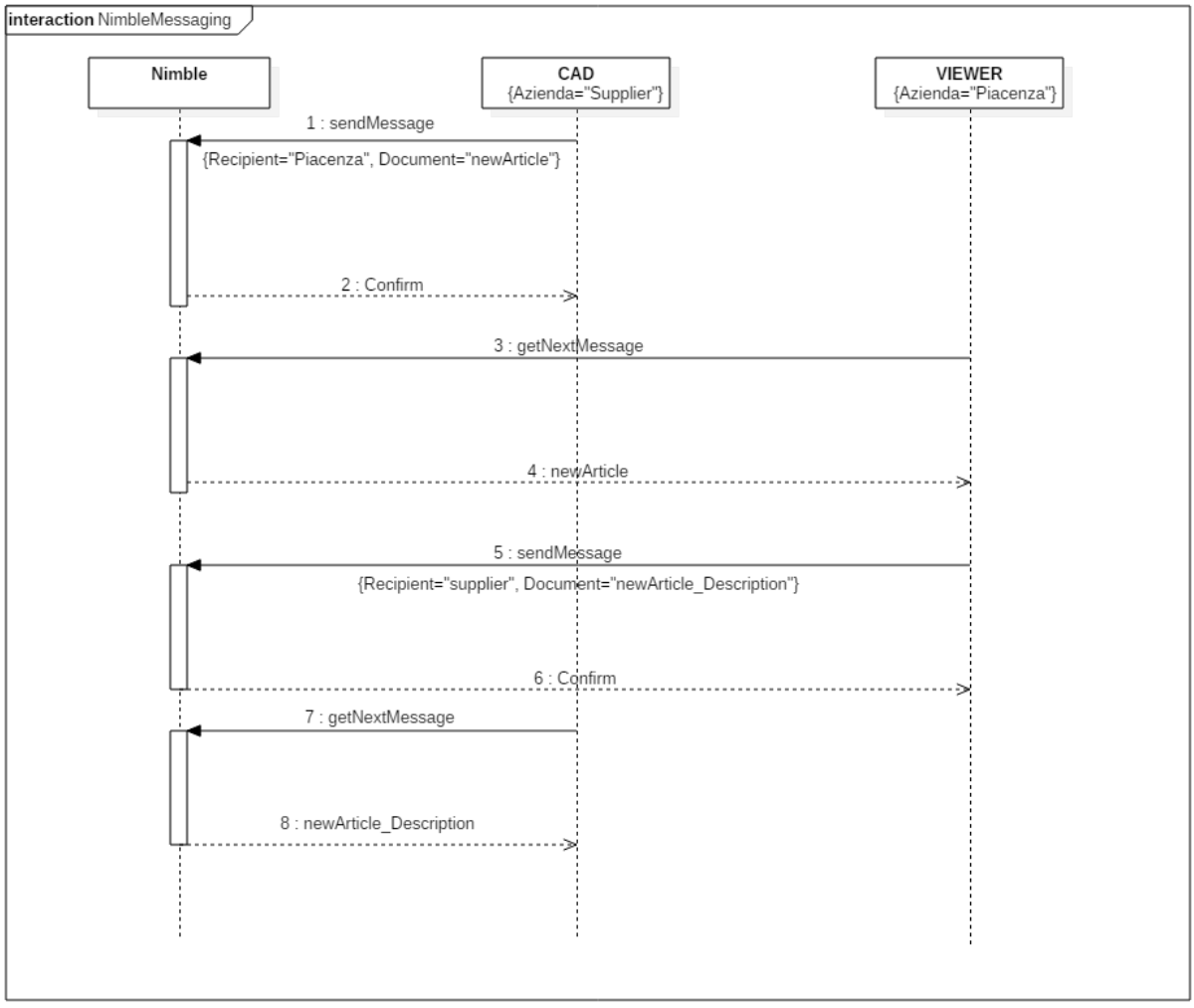


Figure 22: Piacenza Scenario 1 To-Be Sequence Diagram

The WSDL representation of this web service may be:

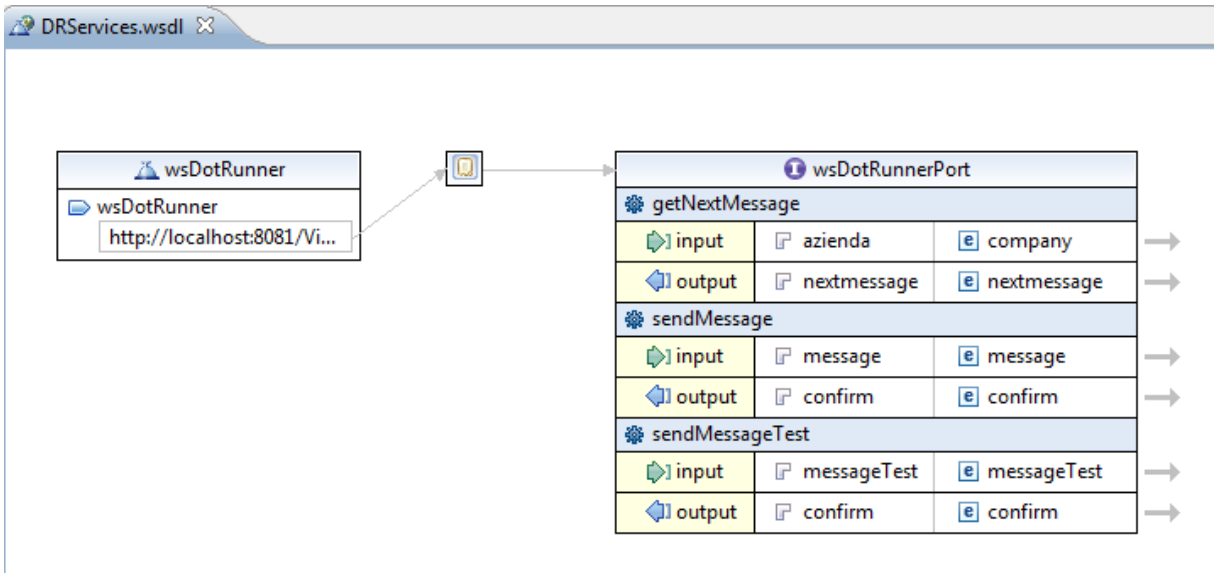


Figure 23: Piacenza Scenario 1 To-Be WSDL representation

- *sendMessage*: this method checks if the XML message is valid. The same process is applied when writing in the output format, following the schema rules.
  In this last case the service could forward it to an another node that respects the same interface, or could park the message until a *getNextMessage* of the recipient will be called.
- *getNextMessage*: ask for stored messages and retrieve them, one each per call.
- *sendMessageTest* : is similar to “sendMessage”, but it does not forward the message. It checks only if the message is valid, against the expected format and the schema rules. (Useful to test new messages, rules or validation).

The interface has strict control over the permission on the *sendMessage* service. The rules are owned by the recipient and he is the only one to be allowed to open or map the other ones. Collaboration among the different actors has to take into account non-optimal situations, as, for example, the case the Internet connection is not always available for both the partners. For this reason, both the actors can have an asynchronous access to the services.

Post-Conditions (expected benefits):

- time saving
- trust in the data exchange (what you get is what the other company sent to you, with no distortion)
- track data exchange
- easy exchange of data with new suppliers/customers in the platform (therefore widening the horizons of the partnerships).

Expected outputs:

- Corporate/bodies/communities for the adoption of standards for data exchanges, to get a populated and active platform;
- Open source community, spread the use of the open source wider;
- Platform data manager, build a very populated community, long lasting platform, easy to maintain and to improve.

- NIMBLE is required to support SoA Technologies in order to publish the web service interface used in this scenario and should be able to unpack the XML sent to the service and forward it with the rules stored by the document schema name and recipient .
- In particular the rules should explain the permission, the validation and the channel method of delivery (by saving the message and wait the call of *getNextMessage* or directly to another *sendMessage*).

2.2.2 Scenario 2 – Virtual catalogues and services

Scenario Description:

A dynamic, real-time access to supplier virtual catalogues and services is intended for fast design development. The company shares its catalogue online with potential customers. On the other side, the company logs into the portal and gets access to the supplier virtual catalogue just with a few clicks. It has to manage the publication of catalogues very carefully, because usually the fabric catalogues are not available to anyone, for copyright reasons.

NIMBLE has to be able to manage several types of catalogue:

- a public one, open to everybody;
- a restricted one: a catalogue that may be uploaded once by the company and that is going to be shared only with certain customers (via temporary tickets, or setting a list of permission before);
- a private one, that is shared only with one customer.

For all those catalogue types, Piacenza would like to have some statistical data: it would be an added value to have periodical reports on the access of the customers (frequency and duration of the visit), on which items they spend more time (frequency and duration of the view per item). It would be helpful to get those statistics for each user, but also a generic statistic would be good enough. Those statistics may have to deal with some privacy issues: surely the ones made on each user, but for the aggregated statistics there should be no privacy problems.

Actors involved:

- Software developers with a special knowledge of the textile data and standards available/adoptable
- Software developers with generic knowledge

Stakeholders and Interests:

- Textile and clothing companies, for the practical use of the platform; corporate/bodies/communities for the adoption of standards for data exchanges, to expand the use of standards;
- open source community, for the use of the platform itself;
- platform data manager;
- IT providers commercialising the service provided by the platform.

Pre-Conditions:

- Security: good management of the rights and credentials to access to data is absolutely needed. Data need to be read/modified/shared by users with the rights of doing so, identifying clearly who is the owner of the data. Data owner must be able to manage the access easily , at different levels (read only, read and share, modify, etc.);
- User friendliness: the platform must be really simple and friendly to use

Workflow (AS-IS):

This is the most traditional process in a textile company and it is performed at least two times per year, one for each season (F/W and S/S). The new collection of products starts with a fashion trends analysis, followed by a phase of product design and physical samples manufacturing. Once the catalogue is ready, it is presented at fairs or personally to the customer. The catalogue contains many different samples of fabric that the customer can appreciate evaluating different elements (touch and feel, colours, design etc.).

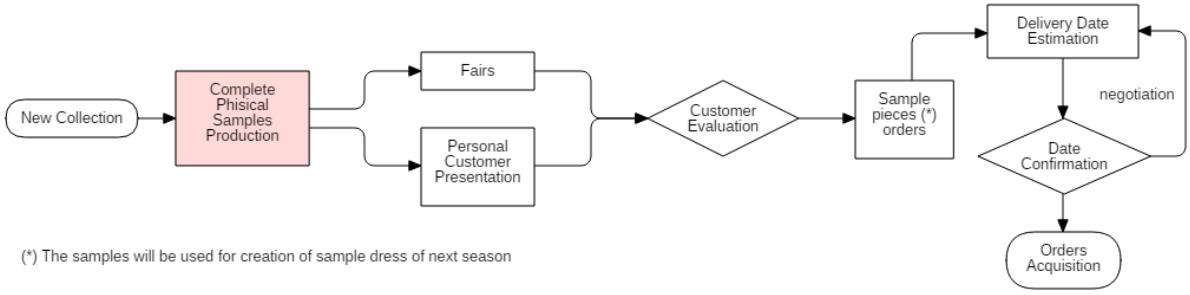


Figure 24: Piacenza Scenario 2 As-Is Workflow

After the customer's evaluation of the offered goods, the manufacturer acquires new orders and starts the production of the orders on the catalogue.

Currently the internal legacy system supports the company in the design phase with the CAD system, the sample production with the PLM and the order acquisition with the CRM.

Workflow (TO-BE):

With NIMBLE a new opportunity can significantly improve this process by the implementation of new channels of communication. New collection design and sample production remain unchanged, though the physical production of samples will be limited to few units through the adoption of the digital representation of the product. Currently the sample production is needed because customers want to evaluate the touch feeling of the fabric (hand) in order to understand the physical characteristics and its surface finishing effect.

The main change comes with the NIMBLE marketplace, where the supplier will be enabled to present its catalogue and could receive suggestions by its customers.

In the TO-BE scenario, physical samples are not required anymore, except for a few units of the approved new design, leading to a reduction of the number of physical catalogues released to customers in order to receive their feedbacks. This type of operation requires strict and customizable permissions on the electronic catalogue stored in the NIMBLE platform, in order to avoid unfair practices from competitors.

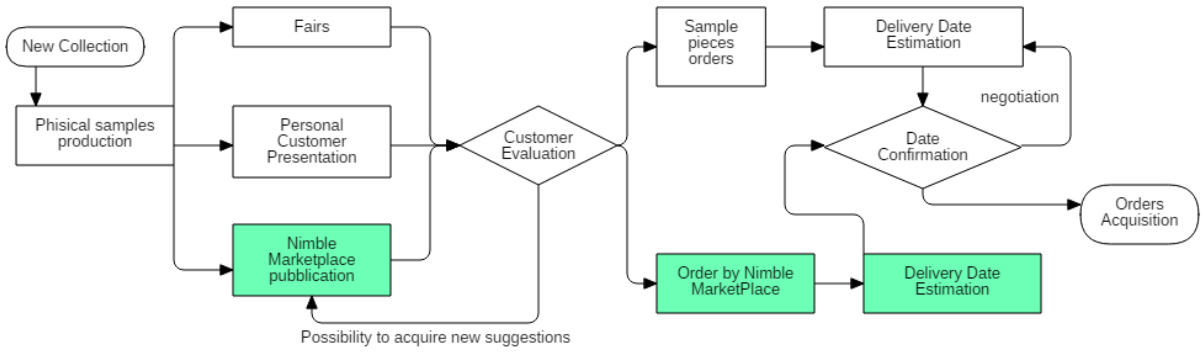


Figure 25: Piacenza Scenario 2 To-Be Workflow

Another important aspect of the marketplace is the possibility to send an order to the company directly from the marketplace and to follow the status of the order itself through the tools

provided by NIMBLE. In the textile/clothing sector the eBIZ/MODA-ML standard provides the necessary documents exchanged during business collaboration and the possible workflows that companies can follow in data exchange. NIMBLE should support both the documents and the workflow to quickly integrate companies already using this standard and to reduce the adaptation/configuration phases for the other that want to enter into the platform to provide goods and services for the textile/clothing sector.

From a technical point of view (and requirements for the NIMBLE core system) we need to underline that the catalogue for Piacenza includes not only the products for the customer, but also the services for the collaboration platform with the supplier already shown in the previous scenario, the order traceability and the origin certificate emission described in the next scenarios.

Therefore, on the one hand a search engine is expected in the marketplace to discover not only the products but also the services that a company is able to provide, and, on the other hand, the possibility to configure the access rules for a specific content (product/service) by the identification of a specific user. (Something like “OK we could do this job but we need a subscription to this, so a list of requisites/actions that you need to have/ to do”).

Having a federated system, we expect to have the possibility to publish different catalogues (or different catalogues) to NIMBLE, based on currency, country, language , etc.

Also, the registered company shall insert data and files accessing to only one implementation of the NIMBLE platform and decide upon the propagation of this information to other implementations. For example, accessing the Italian platform, data have to be shared with the other platforms using criteria decided by the partner itself.

Post-Conditions (expected benefits):

- Support of a real time remote virtual co-design process
- Shared tracing of all changes/suggestions/feedback
- Reduction of physical sampling
- Reduction of order input errors
- Time saving in sharing the catalogue with potential customers
- Statistics on the visualization of the catalogue.

Expected outputs:

- Textile and clothing companies: a platform user friendly, reliable, fast to navigate;
- Corporate/bodies/communities: adoption of standards for data exchanges, to get a populated and active platform;
- Open source community: spread the use of the open source wider;
- Platform data manager, build a very populated community, long lasting platform, easy to maintain and to improve.

In general NIMBLE is expected to provide a scalable solution in order to cover a massive request of its services, a different catalogues publication, centralized management of access permission for all nodes of NIMBLE.

2.2.3 Scenario 3 – IoT machine connection and data elaboration

Scenario Description:

The user shall be able to get access to real time data at machine and product level, exploiting IoT and M2M scenarios. The data are expected to come from plug and work sensors integrated into the machineries and processed at factory level to produce information about, for example, the order status and forecast a shipment date.

Actors involved:

- Software developers with a special knowledge of the textile data
- Software developers able to install and manage plug and play sensors
- Software developers with generic knowledge (if needed, a support)
- End user to collect the data.

Stakeholders and Interests:

- Textile and clothing companies, for the practical use of the platform;
- Plug and play sensors producers, in order to manage the collection of the correct data;
- open source community, for the use of the platform itself;
- platform data manager,
- IT providers commercialising the service of the platform

Pre-Conditions:

- Security and privacy: a good management of the rights and credentials to access to data is absolutely needed. Data need to be read/modified/shared by users with the rights of doing so, identifying clearly who is the owner of the data. Data owner must be able to manage easily the access to them, at different levels (read only, read and share, modify, etc.).
- Trust of the system: users must be sure that the platform is always running with no technical problems.
- User friendliness: the platform must be really simple and friendly to use

Workflow (AS-IS):

In Piacenza, actually the machineries of a specific department (looms of weaving) have been connected with the internal legacy system in order to optimise the production time of machinery. Starting from this result NIMBLE will explore the possibility to use the same data to enhance the collaboration with the costumers and provide detailed information about the production status, forecasting a more precise date of shipment and provide more data on a specific piece.

The fabric production in Piacenza (and in textile, in general) starts with four processes:

Figure 26: Piacenza Scenario 3 As-Is Workflow

The sequence of these processes is fixed: in the first two a new piece of fabric is produced, in the other two quality checks and the correction of defects are performed. Fabric defects are generated in the first two processes, in particular in the second one, where looms wave the fabric. Looms are monitored and connected by a Generic Enabler, IoT Data Edge Consolidation GE; in particular they use the module Esper4FastData. From this monitoring process it is possible to collect data about the machinery state (load, empty, running, stop), the machine ID and the production order. Time frame is actually one minute and can be modified depending on the required granularity.

Exemplary data sets

```
39,6,56687,"2014-04-23 15:52:51",6
40,7,56741,"2014-04-23 15:52:51",6
41,8,56412,"2014-04-23 15:52:51",99
42,9,56387,"2014-04-23 15:52:51",26
```

Workflow (TO-BE):

Starting from this information we want to create an aggregation per production order, in order to map the stops of the machine per each order.

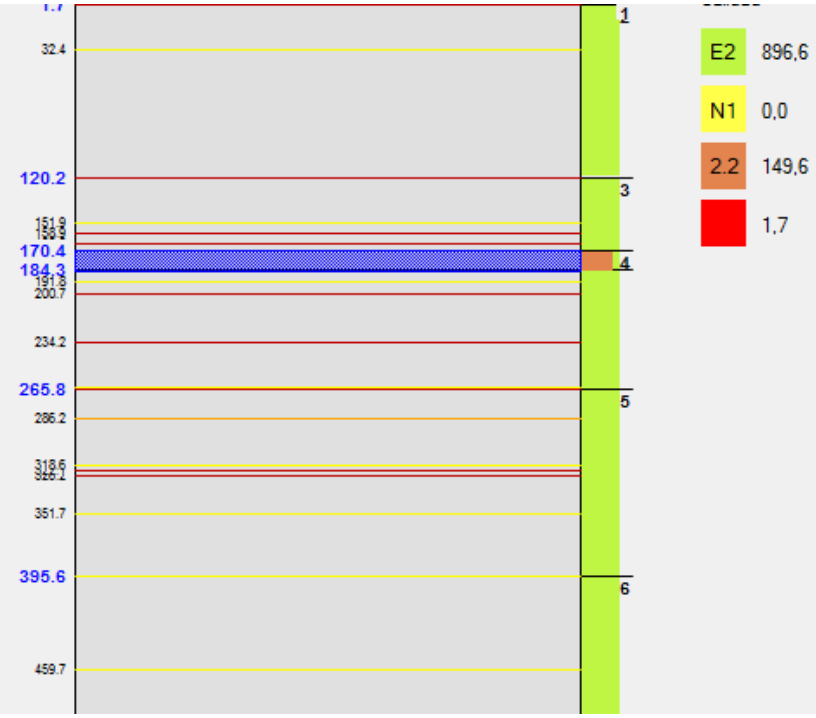


Figure 27: Piacenza Scenario 3 To-Be Registration of Machine Stops per order

This map is useful for the next two processes: the raw control and the darning. In particular the second one is often delegated to external suppliers, for whom this information (update after the raw control data) is very important because it allows them to quickly identify the position of the defects to be repaired. One of the end user pre-requisites is the easy adoption of the NIMBLE platform for the supplier in order to promote the advantages of this new approach instead of the traditional one.

From the technical point of view, the workflow can be described as follows:

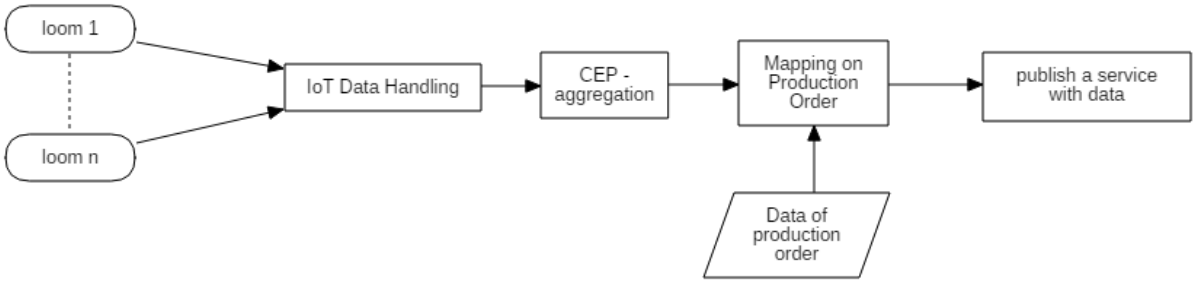


Figure 28: Piacenza Scenario 3 To-Be Workflow

All data are sent to a service on the company systems that link different data aggregations to the specific production order and publish to interested parties (e.g. customers or services providers). It is expected that the data exchange is following the eBIZ/MODA-ML standard already implemented at Piacenza to share information about the order status and defect positions in the fabric piece.

Post-Conditions (expected benefits):

- Direct access to real time production for control and planning purposes (time savings in planning the production, and forecasting the delivery)
- Real time monitoring of production
- inner control of the material and fabric workflows
- better service and update of expected deliveries and communication to customers (when possible)
- Full production traceability

Expected outputs:

- Textile and clothing companies: a platform easy to use, reliable, fast to navigate;
- Corporate/bodies/communities for the adoption of standards for data exchanges, to get a populated and active platform;
- Open source community, spread the use of the open source wider;
- Platform data manager, build a very populated community, long lasting platform, easy to maintain and to improve.
- IT provider, who will introduce, install an commercialise the service
- Integration with IoT Data Edge Consolidation GE of Orange that is the contains the last version of Esper4FastData[1].

2.2.4 Scenario 4 – Automatic origin certificate declaration

Scenario Description:

Using NIMBLE platform, a company can re-collect real time machine data at the end of the production run and produce automatically the preferential[2] origin certificate declaration. To the latter, the platform will be able also to add information about the ethical and environmental fulfilments of the company.

Actors involved:

- Software developers with a special knowledge of textile data, of ethical and environmental data/legislation
- Software developers with generic knowledge (if needed, a support)
- A specialist in ethical and environmental data management, able to deal with all the problems concerned)
- Manufacturing end user

Stakeholders and Interests:

- Textile and clothing companies, for the practical use of the platform (especially considering that the info that are going to be generated automatically are required by law);
- open source community, for the use of the platform itself;
- platform data manager, it provides the service of the platform and may be interested in building and keeping alive the community
- IT provider, which will commercialise the service
- Customs and public bodies interested in product origin and traceability

Pre-Conditions:

[1] https://catalogue.fiware.org/enablers/iot-data-edge-consolidation-ge-cepheus. The GE contains also the CEP for the message aggregation

[2] https://en.wikipedia.org/wiki/Certificate_of_origin#Non-preferential_and_preferential

- Security: a good management of the rights of access to data is absolutely needed. Data need to be read/modified/shared by users with the rights of doing so, identifying clearly who is the owner of the data. The data owner must be able to manage easily the access to them, at different levels (read only, read and share, modify, etc.);
- Stability of the system: users must be sure that the platform is always running with no technical problems.
- User friendliness: the platform must be really simple and friendly to use
- Law fulfilment: the documents produced by NIMBLE, such as the origin certification, are required by law in some States and condition the applications of duties and taxes. Therefore, it is important that these documents fulfill completely the law requirements of each country specified by end users.

Workflow (AS-IS):

At the moment two different actions can be taken by the Company:

- ask for a Certificate of Origin from the local Chamber of commerce that, basing upon the data included in the request, emits the certificate. This certificate states that a product is made in a specific country and do not allow the company to access specific opportunities; This certificate is provided on paper printed and signed.
- declares, for specific products, the Origin. This declaration can be made, in the case of textiles, only if two major production steps are made in Italy. For this reason, the textile producer (as Piacenza) has to know which materials (e.g. yarns) are made in Italy: only these yarns, plus the textiles production, can grant the company in making a reliable origin declaration.

Actually the information regarding the material and the process of those fabrics for which the certification of origin is required are collected manually from available databases (raw materials purchases, production performed steps) and from paper documents and supplier declarations. These pieces of information are not integrated, require manual activity and a dedicated physical archive, which must be ready for administrative and fiscal inspections. Moreover the certificates of origin are physically sent to clothing industries which require them.

NIMBLE is expected to provide the instrument to collect full tracking of used raw materials (and their origin) and of fabric production, including the identification of used machineries (from the previous use case) or external suppliers. It is expected to create an integrated database of all pieces of information require to support the certification of origin and to electronically transfer it to customers by eBIZ/MODA-ML standard tools.

Workflow (TO-BE):

In the NIMBLE platform the producers can identify which sellers can provide high quality goods together with origin certificates for those goods. Data about the certificate are linked to the invoices and imported automatically into ERP or other administrative tool together with the other commercial data.

Having the information on which goods in the warehouse can be used to produce goods which origin can be declared allows the producer in:

- modifying the production process to use these goods and have a final product eligible for such a declaration;
- including the declaration of origin into the invoices reducing the time for handling the research of invoices by administrative people.

In the future, all the documents could be only in electronic versions (also those that are currently provided in paper by the Chamber of Commerce): the NIMBLE shall allow the sharing also of those documents for the interested sectors (textile, shoes, furniture).

Post-Conditions:

The main expected benefit is the automatic production of a document that is required by law in some Countries. This document gives also a proof of the ethical behaviour of the company that is important for the market.

Expected outputs:

- Textile and clothing companies: an easy way to produce a document required by law;
- open source community, spread the use of the open source wider;
- platform data manager, build a very populated community, long lasting platform, easy to maintain and to improve
- IT provide, commercialising the service

2.3 Eco Houses Use Case - Lindbäcks

Use Case Vision

The supply chain of Lindbäcks will be improved to seamless connect stakeholders and exchange data for manufacturing building and as well concerning closed-loop PLM approaches.

Key System Capabilities

Build modularized buildings rapidly on a construction site, while assuring a quality-builded apartment buildings (buildings that should last for 100 years).

Key System Characteristics

- Design/development level
- Workshop level (line production)
- Construction sites (delivery of modules)
- Usage of buildings

Environment

Production, construction sites and ambient living inside of the end product (apartment)

Legacy systems

LPS – Lindbäcks production system.

Blatraden platform (not interconnected yet)

Description of perceived problems or limitations

Each building by Lindbäcks is designed from scratch with the support of Lindbäcks experience to build in a modularized approach. Every individual detail, e.g. dimensions, positioning, properties, wall colours, equipment, sanitation, etc., are collected in one document called “Rumsa”. This document is basis for each following planning step. Regarding information are distributed to the associated stakeholder, e.g. first tier supplier like Blatraden receive information about bathroom module.

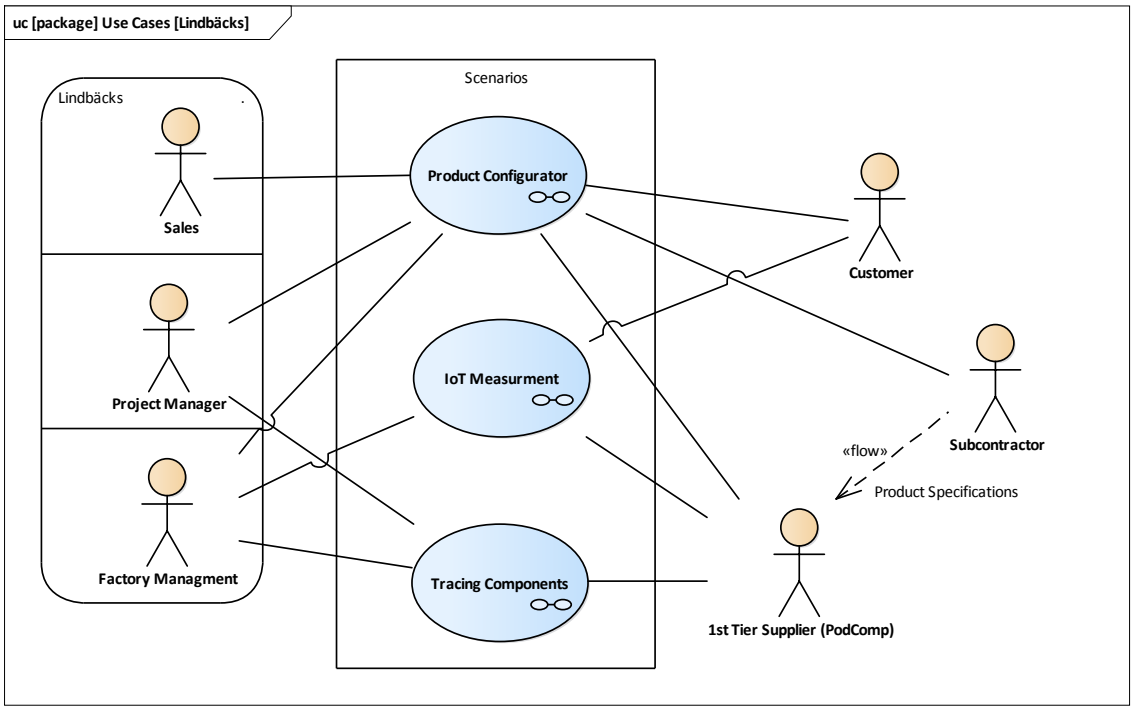


Figure 29: Use Case Diagram Lindbäcks

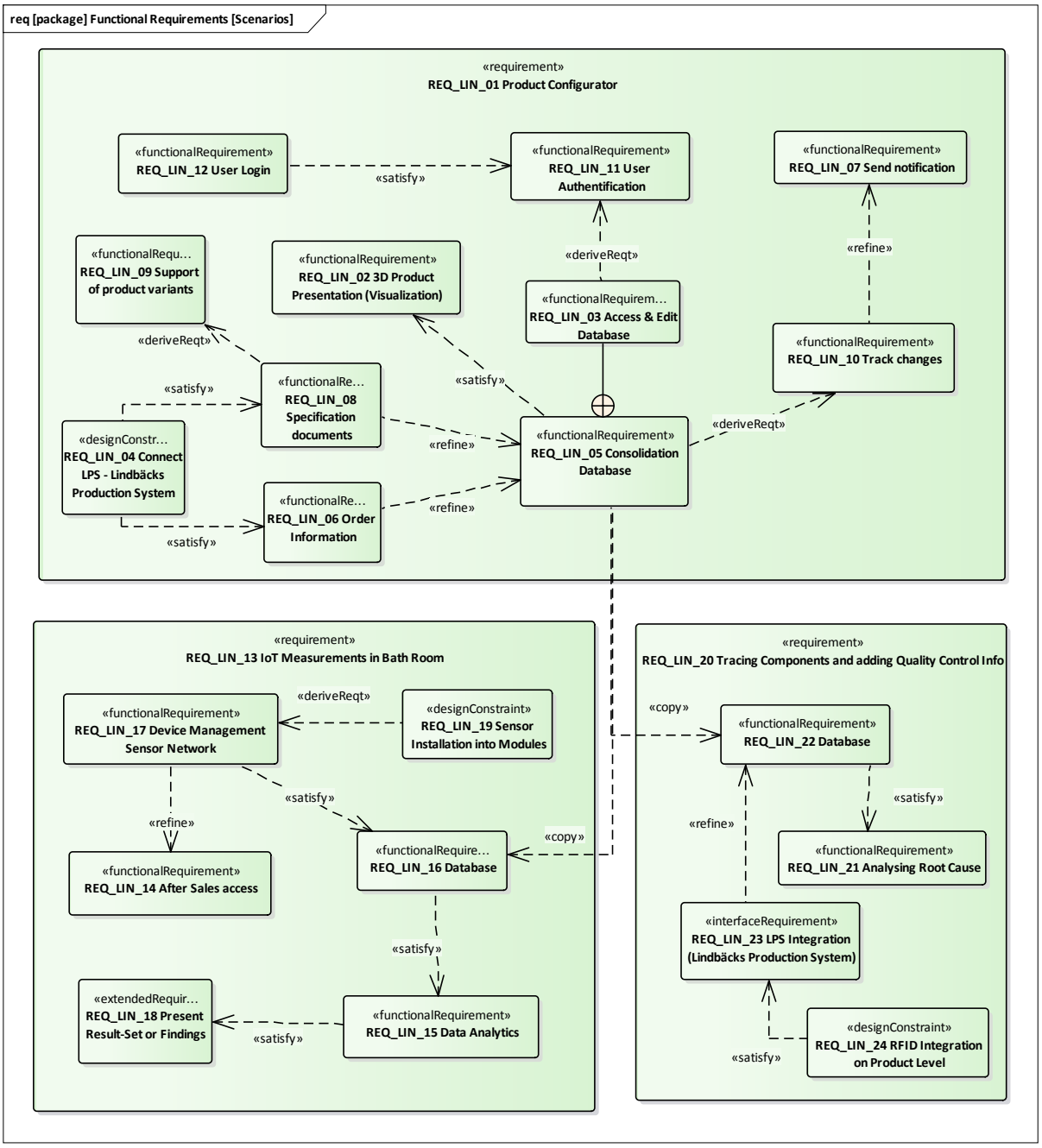


Figure 30: Model Functional Requirements Lindbäcks

Table 7: Functional Requirements Lindbäcks

ELEMENTS OWNED BY REQ_LIN_01 Product Configurator The customer is able to make changes on the features and properties of a bath room that will be part of the flat in a future eco house. This will be realized by a bath room product configurator.
REQ_LIN_02 3D Product Presentation (Visualization) : FunctionalRequirement «functionalRequirement» Standard formats for 3D model of products or modules (e.g. bath room), which are in the database shall be made representative via a 3D Viewer on NIMBLE platform. This should enable the user of the platform to get a realistic view and impression of a product that is in the database.

ELEMENTS OWNED BY REQ_LIN_01 Product Configurator
The customer is able to make changes on the features and properties of a bath room that will be part of the flat in a future eco house. This will be realized by a bath room product configurator.

REQ_LIN_03 Access & Edit Database : FunctionalRequirement «functionalRequirement»
A user is able to add, update and remove database entries. The data itself is protected and owned bay the user who pushes data into the database. The data can be shared, when the data owner gives access rights (read-only, accessible, read-write). An optional approach could be the usage of roles a data owner can give to others.

REQ_LIN_04 Connect LPS - Lindbäcks Production System : DesignConstraint «designConstraint»
Data from the LPS should be transferable to the NIMBLE database.

REQ_LIN_05 Consolidation Database : FunctionalRequirement «functionalRequirement»
Database with all information connected to a product in the whole life time.

REQ_LIN_06 Order Information : FunctionalRequirement «functionalRequirement»
The database should handle

- Subject of Contract
- Partners
- Subcontractors
- description / details
- invoices and standard business contraction

connected to

- List of specification documents

REQ_LIN_07 Send notification : FunctionalRequirement «functionalRequirement»
Send a notification about changes to affected stakeholder (contract partner)

REQ_LIN_08 Specification documents : FunctionalRequirement «functionalRequirement»
Databases should be able to store a List of specification documents

- RUMSA (PDF files)
- DVG Files
- Word documents
- Spreadsheets
- products (interior)

connected to

- Subject of Contract

REQ_LIN_09 Support of product variants : FunctionalRequirement «functionalRequirement»
Showing products in a 3D visualization needs the consideration of variants. Therefore products are presented e.g. in several different colors, without loading a complete new model.

REQ_LIN_10 Track changes : FunctionalRequirement «functionalRequirement»
Changes in the data base should be tracked. When and who edited or updated database entries (e.g. documents).

REQ_LIN_11 User Authentification : FunctionalRequirement «functionalRequirement»
A user, who accesses the database must be verified to do so.

REQ_LIN_12 User Login : FunctionalRequirement «functionalRequirement»

ELEMENTS OWNED BY REQ_LIN_13 IoT Measurements in Bath Room
Measurements of temperature, RH, Leakage and energy consumption. With measurement of the conditions of the modules the quality in the end-product (finalized building). As well closed-loop product lifecycle management shall be realized via information about the modules.

REQ_LIN_14 After Sales access : FunctionalRequirement «functionalRequirement»
After finishing a building the future owner or operator shall be able to access the installed sensor network for observing a buildings status.

ELEMENTS OWNED BY REQ_LIN_13 IoT Measurements in Bath Room
Measurements of temperature, RH, Leakage and energy consumption. With measurement of the conditions of the modules the quality in the end-product (finalized building). As well closed-loop product lifecycle management shall be realized via information about the modules.

REQ_LIN_15 Data Analytics : FunctionalRequirement «functionalRequirement»
Stakeholders with interest in this data need to be verified to get access. The data shall be enriched by a “Analysis Supplier” with regarding expertise in ecohouses to transform plain data into knowledge (e.g. usage conditions based on RH and temp, or leakage to a distinct alarm in a specific area).

REQ_LIN_16 IoT data to Database : FunctionalRequirement «functionalRequirement»
see REQ_LIND_05
A user authentication and data set manipulation are part of this as its copy.

REQ_LIN_17 Device Management Sensor Network : FunctionalRequirement «functionalRequirement»
This software component handles all devices that are available on production and construction level. It aggregates data and is the entry point to the database on the NIMBLE platform. Data access configuration is set here by authorized personal from Lindbäck/Blatraden.

REQ_LIN_18 Present Result-Set or Findings : ExtendedRequirement «extendedRequirement»
The outcome of an analysis will be carried out as a valuable information.
As output, a report could be expected.

REQ_LIN_19 Sensor Integration into Modules : FunctionalRequirement «functionalRequirement»
Based on a sensor network inside of the modules, conditions like temperature, RH, leakage (contact sensor) and energy consumption are observed.

ELEMENTS OWNED BY REQ_LIN_20 Tracing Components and adding Quality Control Info
With the traceability of single parts up to modules the supply chain should gain substantial increase of quality in the end-product (finalized building). As well closed-loop product lifecycle management shall be realized via information about production processes inside of the product (e.g. NFC/RFID chips as a carrier of data).

REQ_LIN_21 Analysing Root Cause : FunctionalRequirement «functionalRequirement»
The consolidated data on the NIMBLE platform is used. Deviations that occur, are registered and connect to specific used parts to make analysis and find a root cause of perceived problems (parts and processes).

REQ_LIN_22 Integrate quality data into Database : FunctionalRequirement «functionalRequirement»
Based on available information (see scenario 1A) of Rumsa specification document, data already available from production (LPS) and a complementary RFID solution to identify parts (up to modules) a tracing shall be realized on production and construction level.

REQ_LIN_23 LPS Integration (Lindbäcks Production System) : InterfaceRequirement «interfaceRequirement»
Push available production data for tracing parts into database.

REQ_LIN_24 RFID Integration on Product Level : FunctionalRequirement «functionalRequirement»
Based on available information (see scenario 1A) of Rumsa specification document, data already available from production (LPS - Lindbäcks Production System) and a complementary RFID solution (alternatively NFC, or something else) to identify parts - up to modules - a tracing shall be realized on production and construction level.

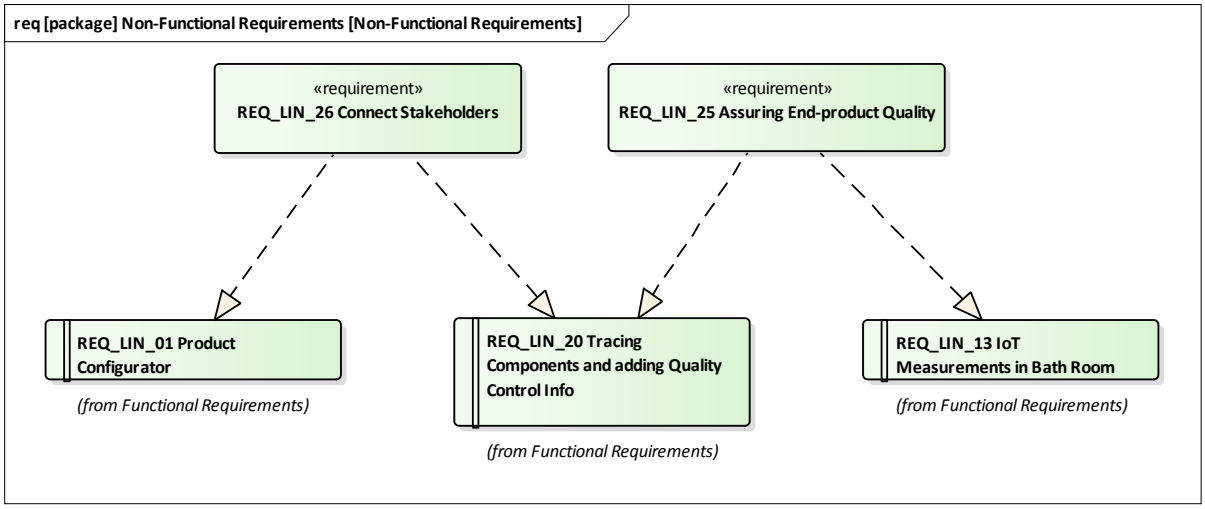


Figure 31: Model Non-Functional Requirements Lindbäcks

Table 8: Non-functional Requirements Lindbäcks

Non-Functional Requirements
REQ_LIN_25 Assuring End-product Quality Build modularized buildings rapidly on a construction site, while assuring a quality-builded apartment buildings (buildings that should last for 100 years).
REQ_LIN_26 Connect Stakeholders The supply chain of Lindbäcks will be improved to seamless connect stakeholders and exchange data for manufacturing building and as well concerning closed-loop PLM approaches.

2.3.1 Scenario 1 – Product configurator

Scenario Description:

The customer of bathrooms is able to make changes on the features and properties of a bathroom that will be part of the flat in a future eco house. This will be realized by a bathroom product configurator.

Actors involved:

- Customer of bathroom
- Sales
- Project managers (responsible for building project)
- Factory management

Stakeholders and Interests:

- Customer of houses (not tenants)
- Lindbäcks
- Blatraden
- Suppliers
- Subcontractors
- Consultants

Pre-Conditions:

A lot of data is manually transferred between word and excel documents

Workflow (AS-IS):

General document “Rumsa” (specification document) is available in Excel and drawings in DVG and pdf for distribution/sharing.

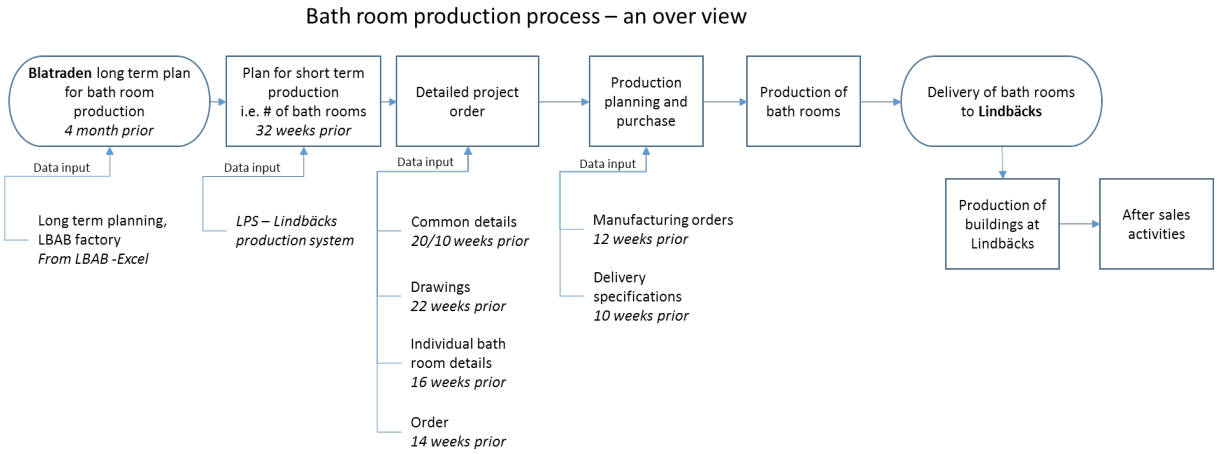


Figure 32: Lindbäcks Scenario 1, 2 and 3 As-Is Workflow (Lindbäcks – Blatraden Collaboration)

Workflow (TO-BE):

All stakeholders and possible business partner shall be able to publish ordering information (e.g. invoices) and specification documents for direct B2B exchange. Those documents which are in different formats (e.g. tables and documents like Rumsa). The information of essential documents /specifications need to be saved in a database. Access to this data base have only authorized B2B partner. Both are able to make changes, while other are notified by changes. A database with all information connected to a product in the whole life time.

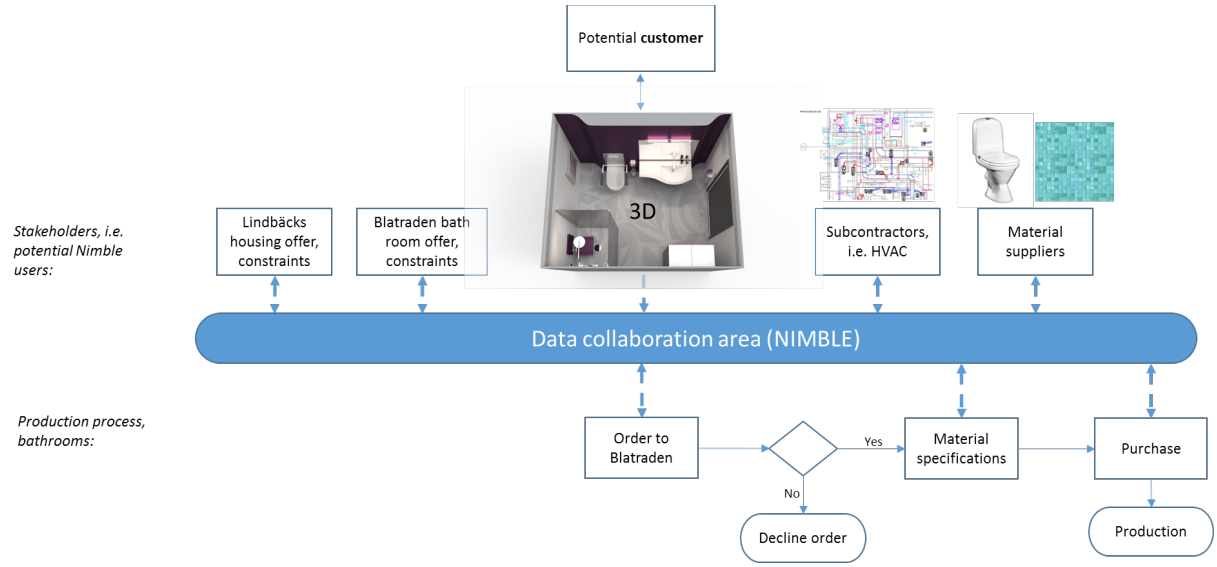


Figure 33: Lindbäcks Scenario 1 To-Be Workflow

The customer of bathrooms (e.g. Lindbäcks) receives a 3D representation of the bathroom. This 3D viewer is part of an application that is available on NIMBLE (e.g. an open source viewer module, as a provided service on NIMBLE). Based on this, properties of the bathroom are changeable (e.g. colour, tiles, equipment, etc.). Those change requests are stored in the database (see scenario 1A). Those change requests are forwarded to Blatraden and verified. Affected subcontractors by changes are informed as well.

Post-Conditions:

Product configuration and triggered collaboration along the value chain, based on a custom 3D picture for customer of bathrooms; Data is only logged onetime by the different stakeholders.

Expected outputs:

More satisfied customer of bathroom and consequently the customer of the house by dynamic handling of change requests that leads to individual solutions. Each stakeholder can retrieve the right info every time.

2.3.2 Scenario 2 – IoT Measurements in bathrooms

Scenario Description:

Measurements of temperature, relative humidity (RH), leakage and energy consumption. Measurement of the conditions of the modules in the end-product (finalized building) and product lifecycle management.

Actors involved:

- Designer
- factory worker
- supplier

Stakeholders and Interests:

- Lindbäcks
- Blatraden
- Insurance companies

Pre-Conditions:

Connection of pipes and consequent water damage is a general issue. If the problem is connected to process-caused reasons (adjustment of manufacturing processes) or end customer usage is not clear (re-design of piping system necessary).

Workflow (AS-IS):

Make-by-order -> one-directional information flow from Rumsa-document to supplier. No connection of parts to orders between delivery of modules between Blatraden and Lindbäcks (see Figure 32).

Workflow (TO-BE):

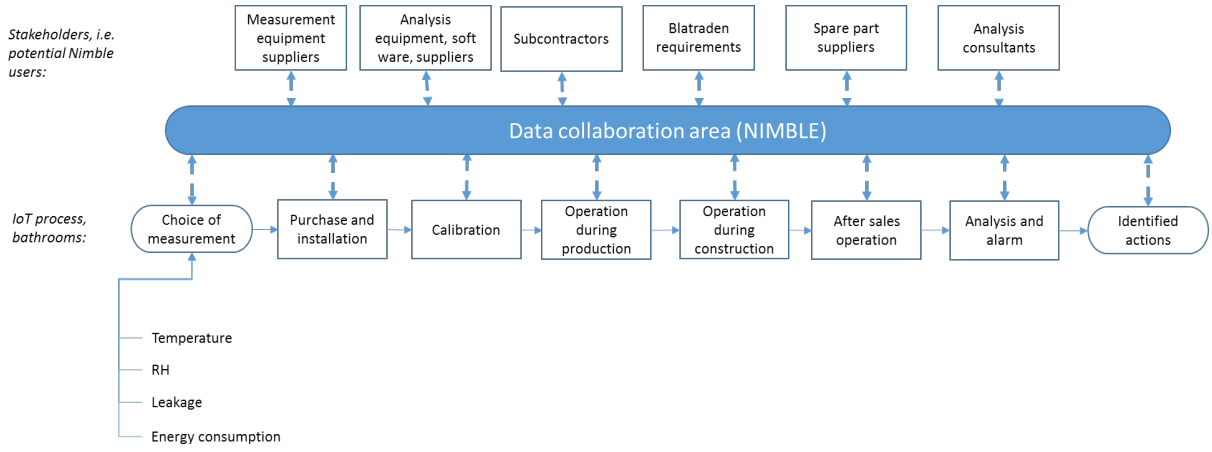


Figure 34: Lindbäcks Scenario 2 To-Be Workflow

Based on a sensor network inside of the modules, conditions like temperature, RH, leakage (contact sensor) and energy consumption are observed. The occurring data stream is forwarded to another system and will be stored in a database. Using the expertise alongside the

value chain, the data can be analysed and further detailed insights could be realised. The sensor data will cover the processes / stages of production, construction and after sales. Stakeholders with interest in this data need to be verified to get access. The data shall be enriched by an “Analysis Supplier” with regarding expertise in ecohouses to transform plain data into knowledge (e.g. usage conditions based on RH and temperature, or leakage to a distinct alarm in a specific area). This shall encourage a closed-loop PLM among all stakeholders (B2B; Lindbäcks, Blatraden and other potential suppliers and may be even customers of Lindbäcks / House owners; not necessarily tenants).

Post-Conditions:

Monitoring quality of the modules while production and after sales.

Expected outputs:

Lower insurance fee for customer of houses.

2.3.3 Scenario 3 – Tracing components and adding QC (Quality Control)

Scenario Description:

With the traceability of single parts up to modules the supply chain should gain substantial increase of quality in the end-product (finalized building). As well closed-loop product lifecycle management shall be realized via information about production processes inside of the product (e.g. NFC/RFID chips as a carrier of data).

Actors involved:

- Designer
- factory worker
- supplier

Stakeholders and Interests:

- Lindbäcks
- Blatraden
- 1st Tier supplier
- Insurance companies

Pre-Conditions:

The transparency of single parts up to modules in the material flow on supply chain level is not holistically captured and communicated amongst the associated stakeholders.

E.g. materials that are used are not sustainable / best-suitable for the building in the long-term. Product improvement is the challenge.

- Painting inside of bathrooms gets loose which causes a lot of rework.
- Mechanical or chemical stress can influence tiles.
- Connection of pipes. Water damage is a general issue.

Is the problem related to the process-caused reasons (handling the materials wrong) or the choice of components (unconsidered interdependencies of materials in combination with other materials)?

Workflow (AS-IS):

Make-by-order -> one-directional information flow from Rumsa-document to supplier. No connection of parts to orders between delivery of modules between Blatraden and Lindbäcks (see Figure 32).

Workflow (TO-BE):

Right assembly of parts on workshop level. (Pipe connections)

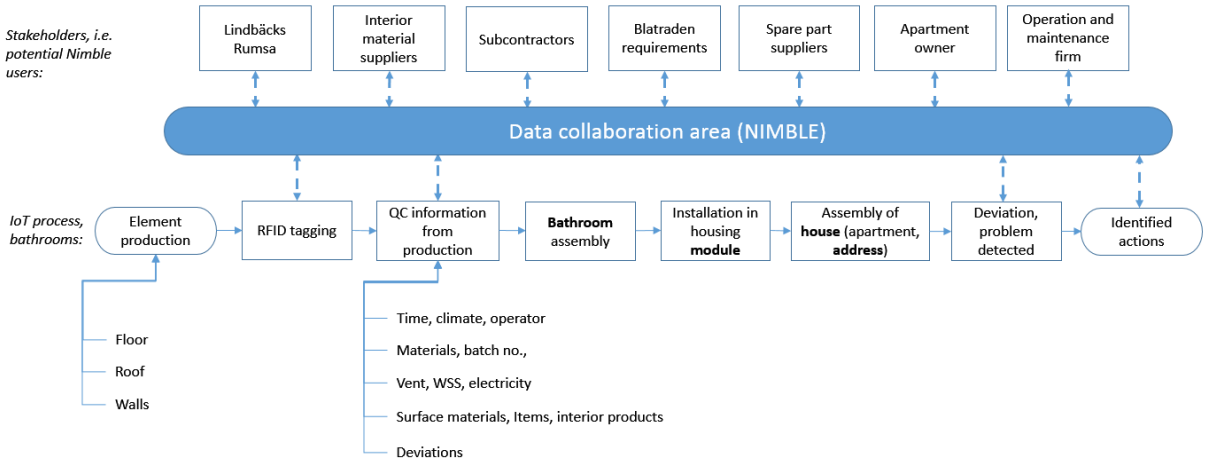


Figure 35: Lindbäcks Scenario 3 To-Be Workflow

Based on available information (see scenario 1) of Rumsa specification document, data already available from production (LPS) and a complementary RFID solution to identify parts (up to modules) a tracing shall be realized on production and construction level. The data is consolidated on the NIMBLE platform. Deviations that occur are registered and connected to specific used components for the analysis and finding the reasons of the problems (components and processes).

Post-Conditions:

Monitoring quality of a working / operated building. Insurances are going to be included into the information flow.

Expected outputs:

Generated documentation about production processes to assure process quality and traceability

2.4 White Goods Use Case - Whirlpool

Use Case Vision

Is to firstly achieve a collaborative environment to share in a correlated way product quality data coming from different sources (considering and consolidate complementary data sources). This relates to scenario 1: Regression Study. Secondly, it allows actors in the product lifecycle to improve their capability to take product related development decisions (scenario 2: Product Avatar). This will have an impact on product quality and reflecting in a reduced failure rates in the marketplace, increased effectiveness in product field-failure resolution and, in long term, an improved overall quality perception from the market with a consequent increase of the market share (non-functional requirements).

Key System Capabilities

The system must provide services to recover information about a specified product combining data coming from different and separated datasets (see data sources on Figure 40). Those services should include a product search engine and a data analytics engine.

Key System Characteristics

The system has to provide a user-friendly interface, able to be deployed on different terminals (PC, Tablet, and Smartphones). Real time capabilities are not required. It has to interact with many different legacy system and database in a unidirectional way

Environment

Industrial and Field Service environment.

Legacy systems

The system has to interface with existing systems, databases and Whirlpool internal policy on admissible device, OS, protocols.

Description of perceived problems or limitations

Overall complexity due to many different data sources is a limiting factor.

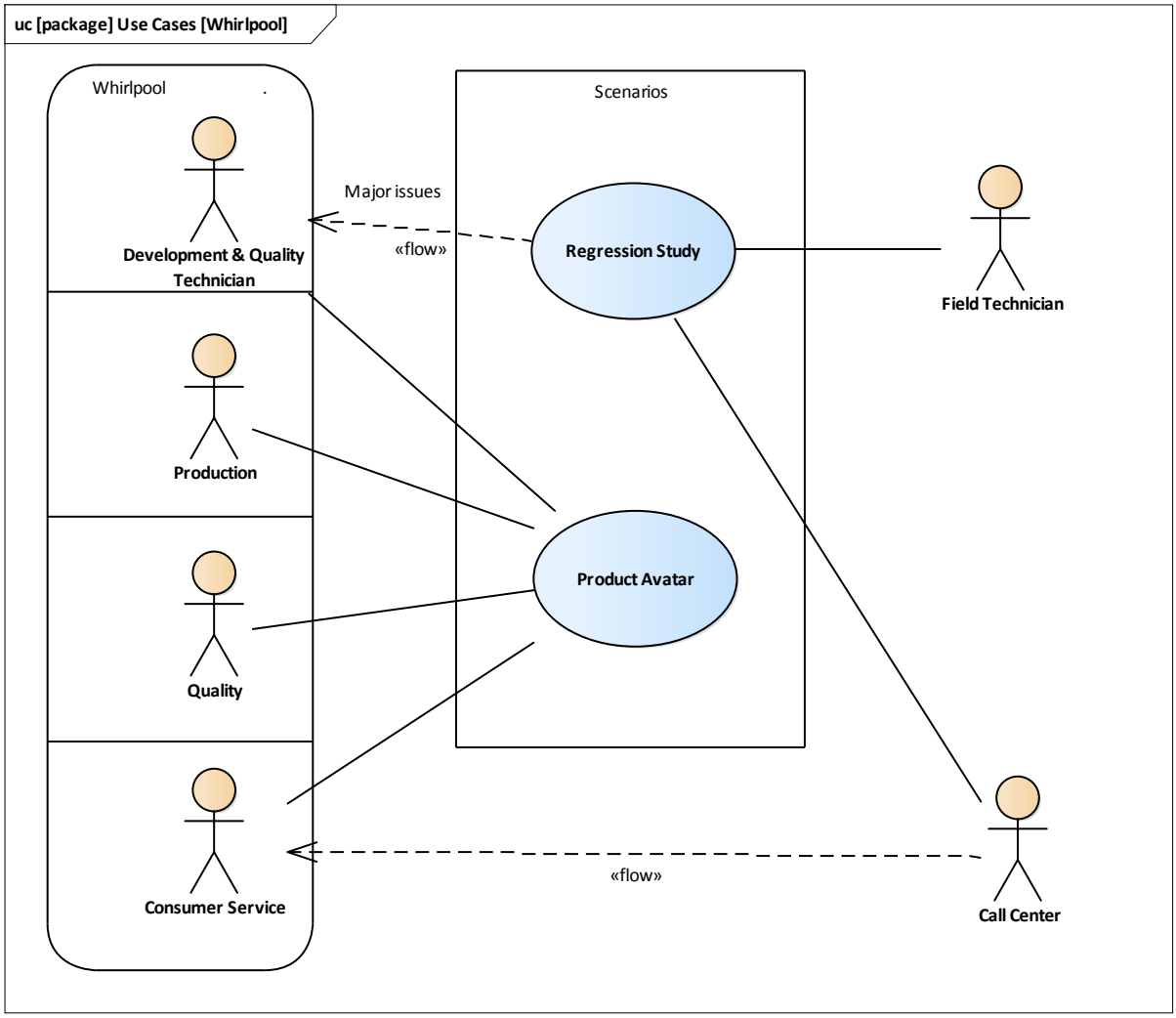


Figure 36: Use Case Diagram Whirlpool

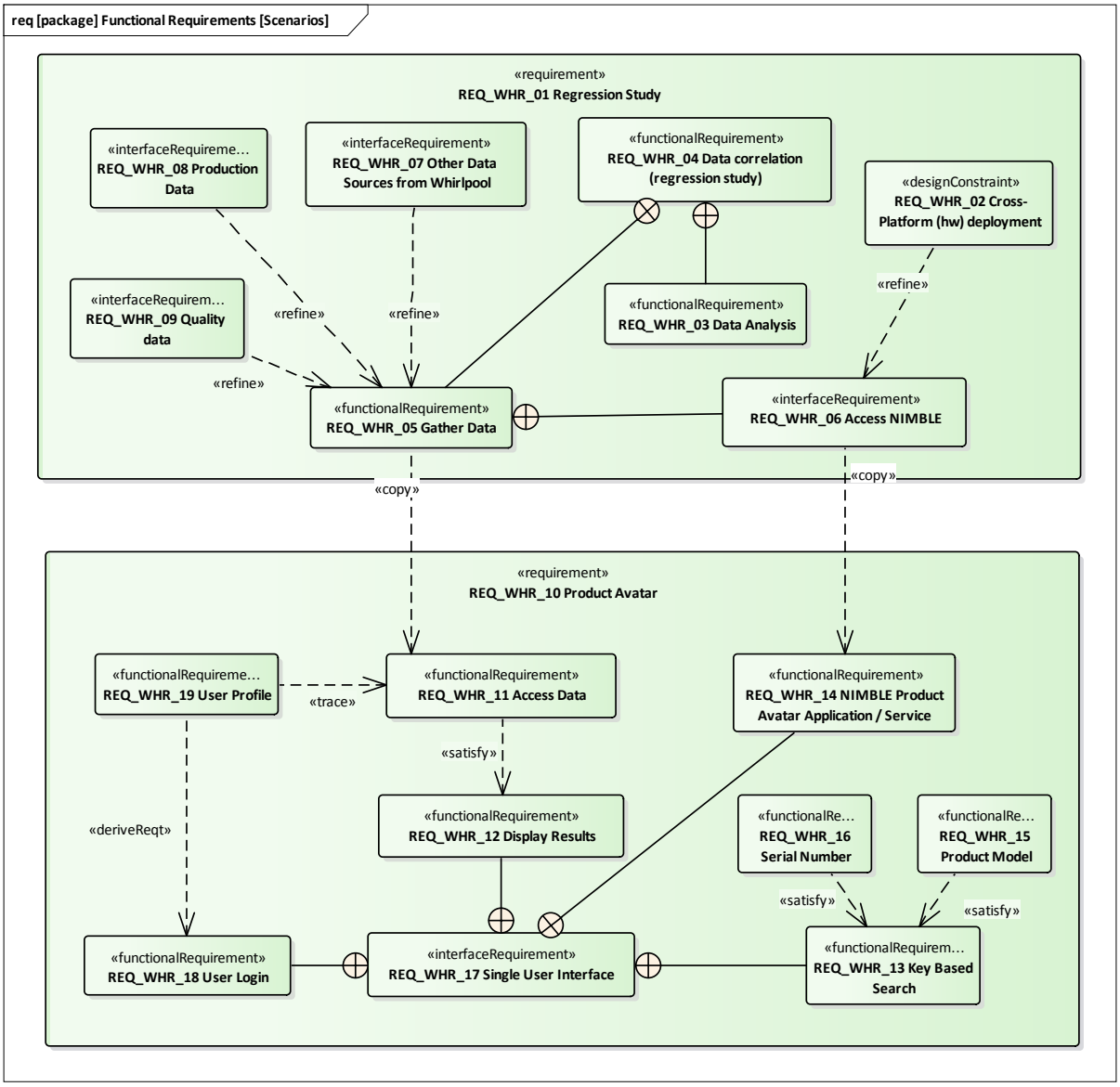


Figure 37: Model Functional Requirements Whirlpool

Table 9: Functional Requirements Whirlpool

ELEMENTS OWNED BY REQ_WHR_01 Regression Study Correlation of issue from field to Manufacturing process
REQ_WHR_02 Cross-Platform (hw) deployment : DesignConstraint «designConstraint» Must be able to be deployed on different terminals (PC, Tablet, Smartphone)
REQ_WHR_03 Data Analysis : FunctionalRequirement «functionalRequirement» Analytics (expertise from Whirlpool) are applied to identify or even solve problems extracted from gathered data sources.
REQ_WHR_04 Data correlation (regression study) : FunctionalRequirement «functionalRequirement» Issues from field should be correlated with production recorded data.
REQ_WHR_05 Gather Data : FunctionalRequirement «functionalRequirement» Get data from several sources and different interfaces related to an identified major issue from the field.
REQ_WHR_06 Access NIMBLE : InterfaceRequirement «interfaceRequirement» User (service technician in the field) can access and transmit data via a mobile entry point (as granted user) to NIMBLE directed to Whirlpool.

ELEMENTS OWNED BY REQ_WHR_01 Regression Study Correlation of issue from field to Manufacturing process
REQ_WHR_07 Other Data Sources from Whirlpool : InterfaceRequirement «interfaceRequirement» This might be volatile occurring data source connections.
REQ_WHR_08 Production Data : InterfaceRequirement «interfaceRequirement» Get data from production, e.g. company assets from MES (Manufacturing Execution System). Explicit data sources TBD.
REQ_WHR_09 Quality data : InterfaceRequirement «interfaceRequirement» Data from field is aggregated at the quality department. ON-TRAC (On-line Tracking of Rates and Claims), GSIR (Global Service Incidence Rate) or SAP HANA.

ELEMENTS OWNED BY REQ_WHR_10 Product Avatar Recover of all product quality related information from a single point
REQ_WHR_11 Access Data : FunctionalRequirement «functionalRequirement» Data integration methods should be applied to access different data sources and consolidate them for the specific information request on a product.
REQ_WHR_12 Display Results : FunctionalRequirement «functionalRequirement» Based on the profile the user is now served with pre-filtered / dedicated information, that is based on their profile.
REQ_WHR_13 Key Based Search : FunctionalRequirement «functionalRequirement» The user will be able to enter two keys – product model and serial number. Based on the profile the user is now served with pre-filtered / dedicated information, that is based on their profile.
REQ_WHR_14 NIMBLE Product Avatar Application / Service: FunctionalRequirement «functionalRequirement» Provide an (mobile) Application or Widget to handle Product Avatars
REQ_WHR_15 Product Model : FunctionalRequirement «functionalRequirement» Enter Product Model. Several models can have the same data (e.g. joint manuals for variants).
REQ_WHR_16 Serial Number : FunctionalRequirement «functionalRequirement» Enter Serial Number. A specific serial number refers only to one single object and can lead to factory quality test before delivery.
REQ_WHR_17 Single User Interface : InterfaceRequirement «interfaceRequirement» All the information will be accessible from one single user interface.
REQ_WHR_18 User Login : FunctionalRequirement «functionalRequirement» Identify user, user group assignment and user rights.
REQ_WHR_19 User Profile : FunctionalRequirement «functionalRequirement» A user must have a user profile, e.g. part of a distinct user-group (designer, quality engineer, etc.) to apply user-based queries.

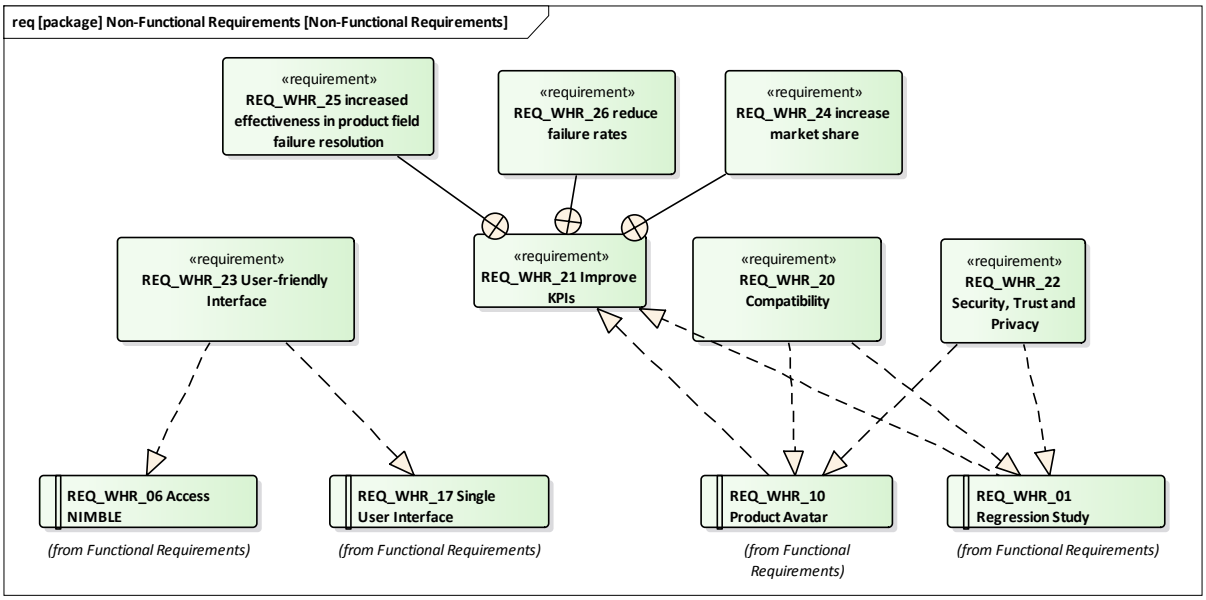


Figure 38: Model Non-Functional Requirements Whirlpool

Table 10: Non-functional requirements Whirlpool

Non-Functional Requirements
REQ_WHR_20 Compatibility The system need to be able to interact with different legacy systems in a unidirectional way.
REQ_WHR_21 Improve KPIs see REQ_WHR_24 - 26
REQ_WHR_22 Security, Trust and Privacy Quality data are sensitive. Access to the system has to be grant using Whirlpool internal policy (LDAP).
REQ_WHR_23 User-friendly Interface Provide a user-friendly interface.
REQ_WHR_24 increase market share See REQ_WHE_21
REQ_WHR_25 increased effectiveness in product field failure resolution See REQ_WHE_21
REQ_WHR_26 reduce failure rates See REQ_WHE_21

2.4.1 Scenario 1 – Regression Study

Scenario Description:

Issues from field are currently not correlated with production-recorded data (e.g. on-line test, functional tests, Statistical Quality check etc.). Correlation of issue(s) from field to manufacturing process shall be realized using customer-driven input and quality data inside the processes.

Actors involved:

- Call Centre
- Quality Technicians

Stakeholders and Interests:

- Quality
- Production
- Product
- Development

Pre-Conditions: N/A

Workflow (AS-IS):

In particular, data and knowledge sharing from customer and “field service” are not fully integrated yet. In many countries a third party carries out the “field service”.

Workflow (TO-BE):

Access to set of correlated data referring to specific product family and containing information about product data, production process history and results, collection of feedback coming from previous field service activity and collection of consumer claims or feedback.

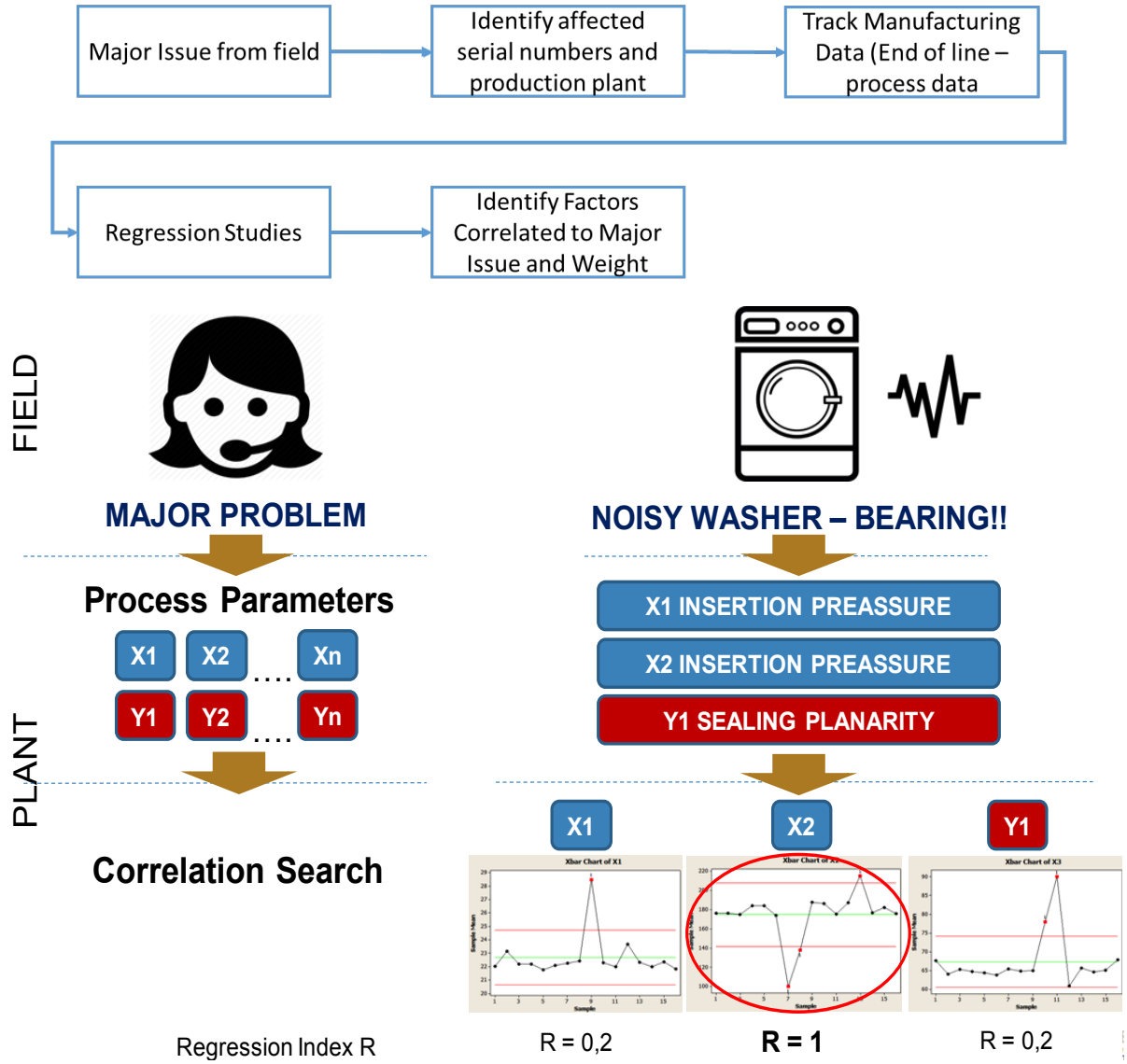


Figure 39: Whirlpool Scenario 1 To-Be Workflow with customer and production view

2.4.2 Scenario 2 – Product Avatar

Scenario Description:

Recover of all product quality related information from a single point

Actors involved:

- Quality
- Production
- Development
- Consumer Service

Stakeholders and Interests: N/A

Pre-Conditions: N/A

Workflow (AS-IS):

Whoever wants to reconstruct the history of a specific product has to access different system in the company. Currently nobody has integral access to all the systems and has all the meta-information to retrieve data from the system. The reason for this is a historically grown company structure (merged companies), different subsystems (data sources) and access rights (various user groups). As a result, to reconstruct the story of a product (i.e. product family related data, production data, logistic and consumer) it will take days.

Workflow (TO-BE):

All the information, indicated on the bottom of Figure 40, will be accessible from one single user interface: the user will access the system inserting the serial number of the product and will retrieve all desired information associated to it.

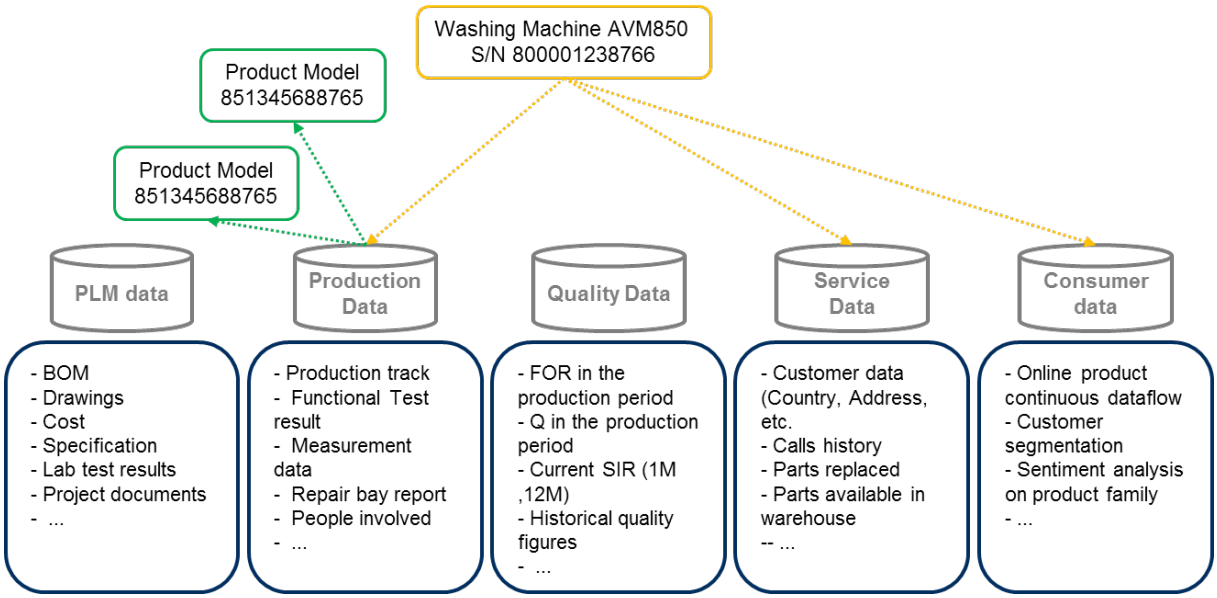


Figure 40: Whirlpool Scenario 2 To-Be - Data Source Description

Post-Conditions: N/A

Expected outputs: Software as a Service

2.5 Cross Domain Viewpoint

2.5.1 General System Requirements

Due to the fact that the use cases are nested in different domains, but nevertheless will be present on the same platform, joint or similar functionalities from the platform are expected. The following requirements are derived from the use cases to address these functionalities.

Basic features for all use cases to approach or access the NIMBLE platform are:

1) Provide Login
    a. User management (e.g. to define company internal authority)
    b. internal and external representation of company data and process
    c. access rights for different users (how much details are released to public or specific partner for collaboration)
2) Data upload / integration
    a. provide proper and reliable information about company on NIMBLE platform
    b. company information can be product / service catalogues
    c. upload of data or reference to resource
3) Product representation
    a. publish company-relevant data (products and services in a self-defined degree of detail) to public or intended target group in a desired format
4) Search functionality
    a. for users (companies that can be customers and / or suppliers), services and products
    b. filtering for detailed and accelerated search
5) Protect corporate value (know-how)
    a. of process know-how
    b. of product know-how

Table 11: Requirements reference

Basic Feature (see list above)	Referenced requirements (derived from)
1)	REQ_MIC_01, _08, _12, _16, _20, REQ_PIA_01, _12, REQ_LIN_01, _13, _20, REQ_WHR_01, _10
2)	REQ_MIC_01, _12, _16, REQ_PIA_01, _16, _21, _12, REQ_LIN_01, _13, _20, REQ_WHR_01, 10
3)	REQ_MIC_01, _16, REQ_PIA_01, _12, REQ_LIN_01, REQ_WHR_10
4)	REQ_MIC_01, _16, _20, REQ_PIA_21, _12, REQ_LIN_01, _13, REQ_WHR_10
5)	REQ_MIC_01, _08, _16, _20, REQ_PIA_01, _12, _16, _21, REQ_LIN_01, _13, _20, REQ_WHR_01, _10

Consideration on system behaviour for different industry sectors:

- **Furniture Use Case Perspective**
    - *Data*
      This information depends on the entities and their attributes managed in the furniture

industrial cluster use case. The definition of all these entity structures is currently in progress. If data is not available in a given moment, the system should warn users about this situation to avoid bad user experiences.

- *Reliability*
  If the platform collapses due to any cause, such as unexpected concurrent access, error connecting to databases, or temporal server downfall, the system should notify users about this situation to avoid bad user experiences (server clustering or other techniques could be adopted to recover from these faults).
- *Security, Trust and Privacy*
  The platform should present terms of conditions so users may accept them when they join NIMBLE. These conditions should include legal aspects related to the leak of private information. If some critical privacy violation occurs, companies will be interested in contacting some NIMBLE responsible and they could take legal actions. If system administrator is aware of possible or effective information leaks, affected companies should be advised of this situation. Unless there is some bug in the data submission system, adopters are responsible of the correctness of their submitted information. If some party considers that the information exhibited by other member may be wrong, it should have mechanisms to notify the company about this issue through the platform.
- *Interoperability*
  AIDIMME manages the ISO 10303-236 funStep standard to catalogue representation, as well as the furniture ontology and a furniture industrial processes taxonomy. Piacenza relies to eBiz and MODA-ML that are branch specific The interoperation of these elements with the rest of system will depend on the level of adoption of these resources in NIMBLE. Furthermore, the Technology Surveillance system of AIDIMME that manages normative and legislation in the furniture sector aims at being accessible from NIMBLE.

- **Textile Use Case Perspective**
  - *Interoperability*
    From the technical point of view, only a simple interface is required, based in the previous WSDL and figures, allowing the end user to send a message (sendMessage) containing a document and to collect incoming messages (getNextMessage). The content of the documents included into the messages is consumed by the NIMBLE platform that act as a message gateway for all the users involved in the collaboration. Several protocols may be used to implement such an interfaces, mainly WS*, granting in any case an high level of security on data channels. eBIZ/MODA-ML standard already contains the large part of the necessary templates for data exchange, but necessary improvements are necessary to fully support the use case. In any case, the necessary standard are quite available.
- **White Goods Use Case Perspective**
  - *Data*
    The overall data structure and distribution is very complex and heterogeneous that is shown by following overview:
    PLM data - product information stored in Windchill (drawings, Instruction for Use, Specifications)
    Production data - Defect Collection system, Production Tracking, Functional and Safety Test, Zero Hour Quality.
    Quality data - OnTrac SAS, SAP BW
  - *Communications*
    The information flow inside of the use case are widely spread in different areas of the

company, even by external sub-contractors and field services. UI must be available on mobile device.

- *Security, Trust and Privacy*
  Quality data are sensitive. Access to the NIMBLE system has to be granted using Whirlpool internal policy (LDAP).

- **Eco-House Use Case Perspective**
  - *TBD*

2.5.2 Challenges and Risks

Additionally each use case indicated desired system requirements and anticipated challenges / risk that could occur, when applicable for their specific use case. Furthermore, recommendations have been formulated as well.

(1) MICUNA

Business Challenges

Main aspects which affect current business models covered by the furniture use case are the optimization of value chain configuration

- cost reduction
- quality improvement
- increase of a collaborative supplying partnership
- faster adaptation of processes through an agile and effective awareness about normative and legal issues in new markets.
- Improvement in product launch (regarding both cost and time consumption)
- Less prototyping iterations
- More market visibility, especially for potential providers

Technical Challenges

Given the strong performance offered by main B2B platforms now in operation, performance is a key issue for the NIMBLE platform. This aspect, together with the data security, may dramatically determine the level of adoption.

Implementation Challenges

Migration of data coming directly from the ERP is not completely dismissed. However it is not being considered by the moment given the initial requirements.

Even considering the presence of an effective purchasing system thorugh NIMBLE, the integration of ERP data in the platform may lead to duplications and additional work in maintenance.

Regulatory Challenges

Privacy of information of company adopters is a key issue. The furniture use case proposes the splitting of the company profile in a private and public side, enabling adopters to share the private information of their profiles only with selected members of the platform, especially when negotiation is being conducted.

Deployment Challenges

In the furniture use case, the integration of the AIDIMME Technology Surveillance system in NIMBLE in order to be accessible from the platform means a specific implementation.

AIDIMME aims at providing access to companies subscribed to this service through NIMBLE.

Suggestions and recommendations to NIMBLE

NIMBLE should be a “viral” platform, with an increasing number of adopters, transactions and visibility. More international members (from inside and outside Europe) will be needed. This should be a convenient, agile, visual and well-maintained platform. Interface texts, such as menus, should be at least in both English and the language of the user, especially considering Spanish, Italian, German and French. Information about products, such as product names, should be at least in both English and the Federation language (i.e.: Spanish). The availability of product information only in English may lead to blocking situations to face the adoption of NIMBLE.

(2) PIACENZA

Business Challenges

Scenario 1: On the business side, the implementation of this scenario is conditioned by two key factors:

- cost and timing for new tool adoption (critical for SMEs)
- the critical mass of adopting subjects.

Both these challenges can be properly managed on the basis of partner past experiences, especially the Moda ML one.

Scenario 2: The benefits from the adoption of virtual tools by NIMBLE can be fully exploited if all the phases of the value chain (i.e. yarn production, fabric production and clothing manufacturing) are covered. Since it is the larger subject, which can effectively suggest the adoption of the instruments to its suppliers, Piacenza and Domina will provide their effort to introduce NIMBLE adoption to its network of yarn producer. They will also promote the adoption of the system by clothing industries, starting from the ones who have already adopted eBIZ/Moda-ML based instrument.

Scenario 3: Production delays and accuracy of several steps are key elements to improve and to maintain the competitiveness of the company. Allowing the services providers to perform their tasks better and faster, together with the provision of a precise date for shipment can be a booster for companies involved in NIMBLE, which can improve not only the quality of the products but also provide high quality data to their customers.

Scenario 4: Given the interest of clothing industries to this tool, the major challenge will be to be able to collect and integrate all the pieces of information necessary to implement the scenario (sometimes still on paper) into a single database, which will fulfil the requirements of custom and fiscal administrations (especially in case of preferential certificate of origin, for duty calculation reasons)

Regulatory Challenges

Several elements are mandatory for the pilot:

- security of data (industrial spying and counterfeiting are the two main challenges to be faced);
- trusting of the other companies in NIMBLE is also a relevant elements, in particular for production planning.

No regulatory challenges on data and commercial documents are required for the pilot.

Description of perceived problems or limitations

The adoption of the platform may be limited by unsolved security/privacy issues. The system must be ready to face this problem.

An additional issue is the language. In the textile industries, operators know very well the specific dictionary of the sector in their own language but English. NIMBLE platform is expected to manage the use various languages to address the requirements of local communi-

ties according to the spoken language of the companies/operators. A proper translation dictionary should be available to support international interactions.

Suggestions and recommendations to NIMBLE

Currently, Piacenza is using eBIZ/MODA-ML standard to support several industrial collaborations with both its providers and customers. NIMBLE is expected to exploit this as much as possible in order to allow Piacenza's network (both of suppliers and customers) to enter quickly and easily into the number of NIMBLE users (if the platform will be attractive enough for them). Eventually some other standards (as UBL) may be integrated to cover other aspects not already covered by eBIZ/MODA-ML.

Integrating the test bed into the NIMBLE platform may allow the end user to quickly connect with the platform and to start its exploitation. The implementation of the Test Bed system shall allow the user to select a Business cases (generic) as, for example, acquisition of goods from a provider. The identification of the user by its industrial sector shall enrich the generic business case with further information, allowing the user in choosing which goods he/she wants to buy. At this point, simple configuration elements or a web interface should enable users (more precisely the technician) to start the tests of all the necessary aspects of the collaboration, for first standard conformance (list of necessary standards comes from the knowledge inside NIMBLE to interoperability with the test bed platform).

The general architecture is expected to consist in some necessary elements:

- the identification of which NIMBLE instances are relevant for the user (for example the German Instance and not the Chinese one). This selection enables the user to select the market to approach;
- data protection and different permission on documents loaded into the platform (as catalogues) can help the user to manage relevant business collaboration (preferred and relevant customer, affordable and reliable providers etc.), allowing them to re-building the network of relationships they have in NIMBLE;
- trust, reputation and respect of deadlines and quality are critical aspects in textile sector because of the vary complex and fragmented value chain, where an un-expected event might affect several subjects.

On the business side, it is strongly suggested to consider cost and timing of NIMBLE adoption by SMEs to create the necessary critical mass for a successful commercial exploitation, taking into consideration that more than 90% of textile companies are SMEs. Affordability and easy adoption are compulsory and must be taken under control, also respecting the need of IT provider for a successful exploitation.

(3) WHIRLPOOL

Implementation Challenges

Many different data sources to be interfaced result in a high complexity.

Deployment Challenges

Internal security and accessibility policies

(4) LINDBÄCKS

Implementation Challenges

Integration effort to Lindbäcks Production System to NIMBLE is uncertain. Furthermore is the decomposing and distribution of currently used specification documents challenging. Suppliers beside Blatraden might use volatile or no IT system support for their production process, which might be difficult for a holistic integration on real value chains.

Technical Challenges

Physical integration of sensors is still an ongoing process that will be carried out in parallel to process development and integration on NIMBLE. Effort on the integration might rise.

3 Conclusion

The elicited requirements were analysed and brought into a formal notation using SysML. The requirements of each use case were separated into several scenarios. All actors who are connected to the scenarios are modelled in extensible use case diagrams. Since SysML is compliant to UML, it is possible to exchange the created models between different partners and extend them using different tools.. The models can be further applied in the development phase.

This document serves as a repository for the requirements as seen by the use case partners. In D1.2 we will add to this, the perspective of potential NIMBLE platform providers who require KPIs and metrics that are pertinent to managing an on-line, multi-sided market place.

Prior to implementation, we will go through a requirements prioritisation exercise in which we decide which of the requested functionalities will be implemented and in what order. This will determine the actual services that will be available for use by the participants in the NIMBLE supported marketplace.

4 Appendix

4.1 Use Case Outline Template

The following template was used to elicit requirements from each use case owner. This template is designed and structured to gather information with a holistic view on complex system or even system of systems.

A. APPLICATION (*required*)	
1. GENERAL	
NIMBLE Use Case ID:	
Author and Company:	
Use Case Description:	
Application Domain:	
Dependencies: *(Possible commonalities with or reliance on other use cases and/or application domains/areas)*	
2. BUSINESS PERSPECTIVE	
Use Case Vision: *(Include business value and system objectives)*	
Key System Capabilities: *(Functional requirements: What the system does to achieve system objectives?)*	
Key System Characteristics: *(Non-functional requirements:* *How the system should behave?* *Does the use case require the interaction of heterogeneous subsystems?* *Are humans an important part of the system?)*	
3. CONTEXT:	
Environment: (*This is the environment that the use case is targeted for, e.g. public building, charging station, etc.*)	
Legacy systems*:* *(Context also creates some constraints such as existing **legacy systems**, existing technologies or specific requirements to use some technologies, regulatory constraints, etc. What kind of systems are currently used and for what (specify only systems related to NIMBLE)? Are there technical constrains / Boundaries. Are there specific requirements caused by the use case interacting with legacy systems?)*	
Description of perceived problems or limitations *(Main issues; Technology, Processes, information / Knowledge limitations)*	
4. USAGE AND OPERATIONAL SCENARIOS *(Copy paste rows below if more than two scenarios. Use a non-table format right under Table 1 if more space is required for this section)*	
Scenario Name 1:	
Scenario Description:	
Actors involved: (*Position/role of actors both in your company and in other parties that*	

you are collaborating with)	
Stakeholders and Interests:	
Pre-Conditions: (*e.g. security/privacy/trust/reputation concerns for realization of this scenario)*	
Workflow **(AS-IS)**: *(Text, e.g. story / process description and/or diagrams, e.g. flow chart)* *(Please elaborate the way legacy systems are used at relevant steps/parts of the flow/scenario)* *(Please specify the information exchanges during the flow/scenario)*	
Workflow **(TO-BE)**: *(Description of the task sequence as it should be with NIMBLE; Text and/or diagrams, e.g. flow chart)*	
Post-Conditions: *(Expectations: provide some KPI; try to quantify the main expected benefits; describe some mean of verification)*	
Expected outputs: *Describe what do you expect from NIMBLE (Software, methodology, etc…)* *(Please categorize the outputs and expected capabilities for each stakeholder)*	
Scenario Name 2:	
Scenario Description:	
Actors involved:	
Stakeholders and Interests:	
Pre-Conditions:	
Workflow **(AS-IS)**: *(Text, e.g. story / process description and/or diagrams, e.g. flow chart)*	
Workflow **(TO-BE)**: *(Description of the task sequence as it should be with NIMBLE; Text and/or diagrams, e.g. flow chart)*	
Post-Conditions:	

Table 1: Application

B. SYSTEM REQUIREMENTS (*if applicable and known, try to answer questions that are listed on the left column*)	
Data: *(Physical Properties: What physical properties are being monitored? What physical properties are being acted upon?* *Volume and Velocity: Describe the size of the datasets being processed and the speed at which it comes into/out of the system.* *Aggregation: Describe the requirements to aggregate different data types* *Variability: Is the size of data being generated/used consistent or is there a growth/shrinkage trend?)*	
Compute: *(Describe the computation effort and processing required to achieve the use case goals)*	
Communications: *(Network QoS (latency, throughput, reliability), scale, connectivity, local vs. wide area, wireless vs wired, bridge requirements)*	
Reliability: *(What are the robustness requirements? (preventing a fault)* *What are the resiliency requirements? (recovering from a fault or sub-fault))*	
Performance: *(Performance specifications in the domain of the use case. [e.g. patients processed/second])*	
Security, Trust and Privacy: *(Confidentiality: What happens if information within the system leaks (or is pulled) out?* *Integrity: What happens if the system acts on incorrect data (including software)?* *Availability: What happens if the system or data it generates is not accessible and prepared to function properly when and where needed?)*	
Interoperability: *(Required interfaces between different entities and actors)* *(Messages, protocols, standards used in intra- or inter-company communications.)*	
Accuracy: *(Error Sensitivity: Describe the sensitivity of the system to errors in the data.* *Certainty: What is the level of uncertainty in the data being generated/processed and the assurance of the resulting actions taken by the system?)*	

Table 2: System Requirements

C. CHALLENGES AND RISKS(*if applicable and known*)	
Business Challenges: *(e.g. business model, competition & incumbents, decision process, regulatory environment)*	
Technical Challenges: *(e.g. unknown techniques, scaling, performance, security, immaturity)*	
Implementation Challenges: *(e.g. legacy migration, testing requirements, interoperability)*	
Regulatory Challenges: *(e.g. privacy of users, security, choice, control, transparency, permission from government agencies)*	
Deployment Challenges: *Challenges (e.g. legacy integration, politics, privacy)*	
Suggestions and recommendations to NIMBLE: *[This section is designed for the use case owners to provide additional information that may be useful to NIMBLE reviewers (academic partners / University of Bremen). Suggested approaches (e.g. standards) that may address the problem; Test bed requirements and challenges; Reference architecture requirements and challenges; Public recommendations; Feedback to use case; Comments that we are looking for]*	

Table 3: Challenges and Risks