NARRATE

Regenerative Resilient Smart Manufacturing Networks

D1.1 PROJECT REQUIREMENTS

2024/05/30

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Abstract	This deliverable describes the process of user story and requirements elicitation for NARRATE. It guides through basics, decision processes, the elicitation, refinement and generalisation of requirements.
Keywords	Supply Chain; Resilience; Requirements; Manufacturing as a Service; Supply Chain disruptions

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STATEMENT ON MAINSTREAMING GENDER

The NARRATE consortium is committed to including gender and intersectionality as a transversal aspect in the project's activities. In line with EU guidelines and objectives, all partners – including the authors of this deliverable – recognise the importance of advancing gender analysis and sex-disaggregated data collection in the development of scientific research. Therefore, we commit to paying particular attention to including, monitoring, and periodically evaluating the participation of different genders in all activities developed within the project, including workshops, webinars and events but also surveys, interviews and research, in general. While applying a non-binary approach to data collection and promoting the participation of all genders in the activities, the partners will periodically reflect and inform about the limitations of their approach. Through an iterative learning process, they commit to plan and implement strategies that maximise the inclusion of more intersectional perspectives in their activities.

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ABBREVIATIONS

WP	Work Package
MSx	Milestone x
Mx	Month x
Tx.x	Task x.x
EC	European Commission
KPI	Key Performance indicator
SC	Supply Chain
MO²GO	Method for object-oriented business process optimization
IEM	Integrated Enterprise Modelling
IREB	International Requirements Engineering Board
IMC	Intelligent manufacturing custodian
SME	Smart and Medium sized enterprise
NLP	Natural language processing
OEE	Overall equipment effectiveness
ERP	Enterprise Resource Planning

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EXECUTIVE SUMMARY

The NARRATE project aims to develop an Intelligent Manufacturing Custodian (IMC) integrating AI, Digital Twin, and IoT technologies to enhance manufacturing agility and supply chain resilience. The purpose of this document is to define the detailed requirements for the NARRATE IMC, ensuring it meets the needs of its users and stakeholders. This document is motivated by the need to create a comprehensive and structured approach to gathering and refining the requirements for the IMC's functionality. By clearly defining these requirements, the project aims to ensure that the final product will be effective and efficient in real-world applications. As connection to the reality, three pilots from the furniture production, multi-sector 3D printing, and semiconductor manufacturing were integrated as partners for the requirements elaboration.

The methodology used for this process is inspired by the International Requirements Engineering Board (IREB) standard, which involves stakeholder identification, requirements elicitation, and iterative validation and refinement. Requirements are extracted and formalized from user stories, ensuring they are categorized appropriately. This process involves using tools such as Conceptboard for virtual collaboration and MO²GO for object-oriented business process modelling.

The results of the requirements elicitation show, that unique structures, processes, and IT systems and the manufacturing as a service approach of the enterprises involved in the three pilots lead to specific requirements. The categorization and refinement of the requirements took place in form of functional, Identification, operational and performance requirements.
However, a set of generic functional requirements valid for at least two of the pilots were also elaborated from the specific requirements set. With those, generic information about simulation capabilities, warning and notification system, logistics management, disruption monitoring system, manufacturing management and analytical capabilities as well as production management, environmental management, sales and service tracking and project management were analysed.

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1. INTRODUCTION

As foundation of a complex software architecture, the process of eliciting, analyzing, document and managing of requirements are necessary, which is presented in the following document. This introduction chapter gives an overview of the project which the requirements are necessary for as well as an overview over the document itself.

Disclaimer: during the process of the requirements engineering process, the pilot partner #1 Medwood (MED) was still called Micuna (MIC) which is present in all the documentation. To prevent confusion between the documentation of the requirements and this document, the document is constantly using Micuna as their name.

1.1. PURPOSE OF THE DOCUMENT

This specification describes the various uses and applications of support tool for implementing and holding a resilient supply chain and the requirements for such a system. This document guides through the process of requirements elicitation in a project with three pilot partners out of three different industry domains. It also highlights the most desirable features and preferences for the comprehensive solution developed in the project. The exhaustive wish list compiled from pilot participants, which highlights their desirable features and preferences for the comprehensive solution developed in the project and reveals the significant gaps and magnitude of the problems they are currently facing. This list will be carefully pruned down and prioritized to focus on the most critical needs.

1.2. DOCUMENT STRUCTURE

This document starts with some general explanations, which are needed to understand the nature of the project, its structure and development. Afterwards, the specific challenges regarding the project requirements will be stated as well as an overview of possible methodology usage. Lastly in that chapter, the applied methodology will be stated and explained. For that purpose, a quick deep dive into the used technologies is necessary.

Chapter 3 contains the results of the applied methodology. To get an adequate view to the requirements, the considered pilots with their specific use cases are described. This includes the use case in furniture industry with the partner Micuna (MIC), the partner with a 3D-smart manufacturing network AIDIMME (AID) as well as the SME (small and medium enterprise) Budatec (BUD) in semi-conductor sector. The presentation of the results will be performed with generic requirements for all pilots and specific requirements for each pilot.

The document ends with a conclusion and outlook on the past and future actions and an appendix with complementary information.

1.3. TASKS, DELIVERABLES AND MILESTONES

As part of the European strategy for innovation amidst unforeseen disruptions, the NARRATE project develops a platform, so called intelligent Manufacturing Custodian (IMC), which is a pioneering solution. By seamlessly integrating AI, Digital Twin, and IoT, the IMC not only advances manufacturing agility but also mirrors the EU's call for cutting-edge technologies in resilient manufacturing. The IMC will leverage data from various production sources providing end-to-end visibility and control over supply chain operations, facilitating proactive decision-making, real-time monitoring, and coordination to foster Smart

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Manufacturing Networks. The goal is to predict potential disruptions or react when a disruption occurs, thereby enhancing supply chain resilience. It will demonstrate its capacity through three pilots in substantive real-world conditions in diverse sectors: furniture production, multi-sector 3D Printing as-a-service, and semiconductors. To create such complex software architecture, the first step in the project is to perform requirements engineering.

The deliverable of pilot requirements (D1.1), which is also core of the milestone M1, is the first part of a set of requirements, followed by pilot analysis, energy efficiency and circularity as well as architectural requirements in workpackage 1. For the pilot requirements in this task T1.1, there will mainly be four different requirements elicitated, performance, functional, operational and identification. Functional requirements for declaration of how the project solution should work from the end user perspective. Identification requirements to identify the users of the platform for the developers perspective. Operational requirements to get the extent of necessary actions to provide the functionalities for the functional requirements. And lastly, performance requirements to describe the goal that needs to be fulfilled by the project actions.

1.4. OBJECTIVES

The analysis of requirements defines the needs and expectations of the users in the supply chain. Some of them must be met by the platform. In this vein, the pilot definition enables a high level of definition of the proposed solution by collecting the feedback from the pilots' users and external. The gathering of requirements is initially performed via data collection and analysis and interviews. The pilot requirements include the needs and expectations from the pilot representatives also establishing priorities and the exact environment for each pilot. Specifically, the needs of the industrial partners regarding their issues to establish a regenerative resilient smart manufacturing network have to be assessed and understood. This addresses objectives O1.1 and O1.2 from the project.

2. METHODOLOGY FOR REQUIREMENTS ENGINEERING

This chapter is defining the basic knowledge for understanding the afterwards following content of requirements elicitation in this project as well as describing the applied method. For that purpose, there will first be an overview of some different methodologies and aspects that need to be reviewed. Then, the used technologies of the intention are displayed. Filled with that knowledge, the applied method is described at last.

2.1. METHODOLOGY OVERVIEW

Consolidating requirements from three different enterprise pilots into a one system architecture is a challenge due to their differences in structures, processes, and IT systems. The task demands a balance between specificity and generality to ensure relevance across all pilot settings. Drawing from [1], a methodological approach is proposed, involving the identification of stakeholders, activities, and existing/planned systems within each pilot. Similarities are then sought across the models, facilitating a single consistent requirements model.

Traditional requirements acquisition relies on natural language representation, operating as the primary base of communication between stakeholders and developers [2]. While natural language facilitates expression, it often introduces uncertainty and subjectivity [3]. Supporting natural language processing (NLP) can enhance the effectiveness of requirements elicitation by extracting valuable resources such as use cases and scenarios. However, formal approaches, such as temporal logic, offer the possibility of

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overcoming the limitations of natural language by enabling a precise specification of system behaviour [4].

Formalizing requirements into languages like Vienna Development Method Specification Language (VDM-SL) allows for mathematical analysis of computational systems [5]. The selection of formal frameworks, like pseudo-requirement graphs, should be driven by the required expressiveness of the modelling concepts and analyzability [6]. Additionally, semi-formal modelling techniques facilitate the transition from informal client-side requirements to formal developer-side specifications [7].

Stakeholder selection is crucial for the success of the requirements engineering process [8]. However, methodologies and techniques must be adaptable to diverse system contexts, providing both guidance and flexibility. While precise, technical notations are valuable, informal notations remain essential for capturing the expressive demands of users [9].

The ongoing digitalization trend necessitates a data-driven approach to requirements engineering, leveraging heterogeneous data sources [10]. Preliminary activities involve transforming informal requirements into a conceptual model through natural language analysis [11]. Tools like those proposed by [12] aid in the conversion of natural language and graphical representations into formal models, while others, like [13], enrich UML (unified modelling language) notation with additional constraints for improved precision.

In the context of diverse enterprise pilots, tailored requirements methods are essential, especially in research projects with limited time and resources. Criteria for a robust requirements system include clarity, correctness, consistency, testability, traceability, and completeness [14]. The integration of MO²GO software and Integrated Enterprise Management (IEM) methodology introduces additional criteria such as prioritization, clarity, and correctness [15, 16]. This methodology is compatible with the IREB (International Requirements Engineering Board) standard for requirements engineering [17].

In conclusion, consolidating requirements across diverse enterprise pilots demands a nuanced approach that balances formalization with expressiveness, adapts methodologies to varying contexts, and prioritizes stakeholder involvement and system quality. Through careful selection of formal frameworks, leveraging of data-driven approaches, and consideration of both formal and informal notations, the challenges of requirements consolidation can be effectively addressed.

2.2. USED TECHNOLOGIES

To support the distance situation in the project as well as handling the different balancing challenges in requirements engineering, different tools are used in the applied method. For a better understanding, those tools will be explained in the following section.

2.2.1. Conceptboard

Conceptboard is an online collaboration platform that specialises in virtual whiteboards. Users can share ideas, collaborate and work together on projects using digital whiteboards with access via a variety of devices, including desktop computers, laptops, tablets and smartphones. It offers features such as adding notes, comments, files and images as well as real-time collaboration. This helps to facilitate discussion and feedback. Conceptboard is well suited for teams working in different locations or doing remote work. In this context, the setup of a concept board helped with dealing with the distance between the project partners as well as providing unlimited space for assessing requirements through natural language.

2.2.2. MO²GO

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The software MO²GO, which stands for Method for Object-Oriented Business Process Optimization, is a holistic methodical basis for modelling relevant business aspects of an enterprise, such as requirements, why it is used as the central component of digital requirements engineering. This is based on IEM, so-called integrated enterprise modeling. All the company's data is stored in the core model of an IEM model in two main views, which are the information model and the business process model. In the information model are all the important company objects stored, their characteristics, and how they relate to each other. Meanwhile, the business process model shows how company processes connect and interact with each other. MO²GO combines the information model from the IEM with a dynamic process representation. The IEM is based on three object states, which are supporting resources, shown in green, controlling orders in purple and product states in red. These objects are arranged in the information model in an object-oriented manner with a "is a"- relationship and can inherit their properties in the form of attributes. The three states and the inheritance logic are shown in Figure 1. An example of the logic behind the class structure can be explained with an example from the Order class tree: A setup order is a production order which is an internal order [15].

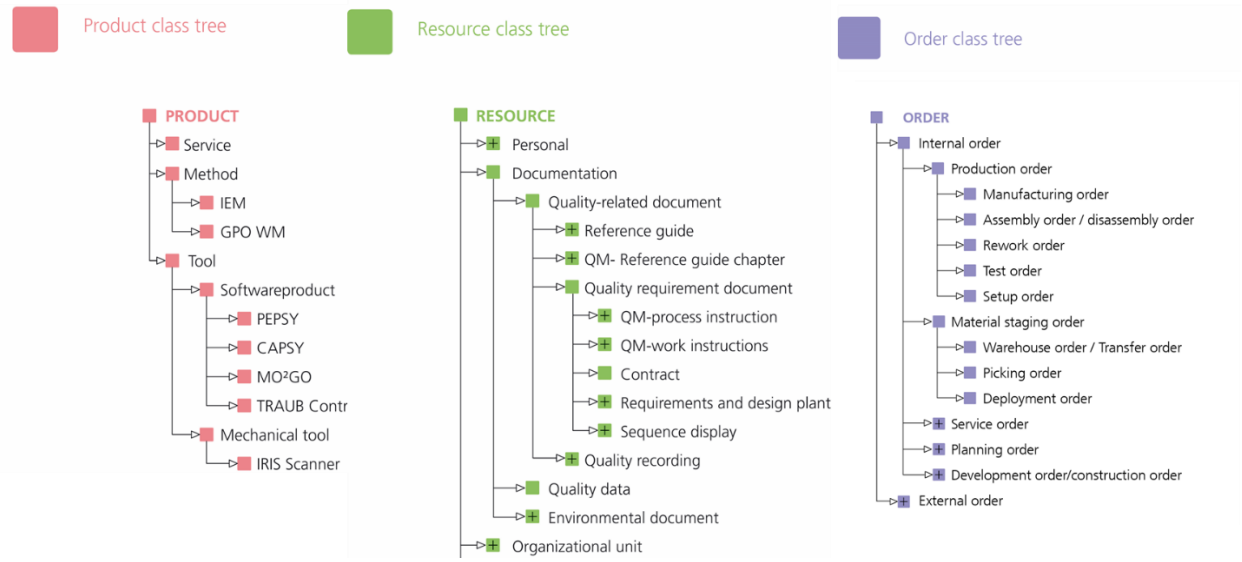

FIGURE 1 OBJECTS OF THE IEM INFORMATION MODEL AND THE INHERITANCE

The second important concept of the IEM is the part structure. The description of the relationship is a "consists of"-relationship. An example of that structure is displayed in Figure 2. For a better understanding of the difference between the relationships, the "is a"- relationship of the following product parts could be e.g. solid for sugar and cake, liquid for egg and icing and semisolid for base.

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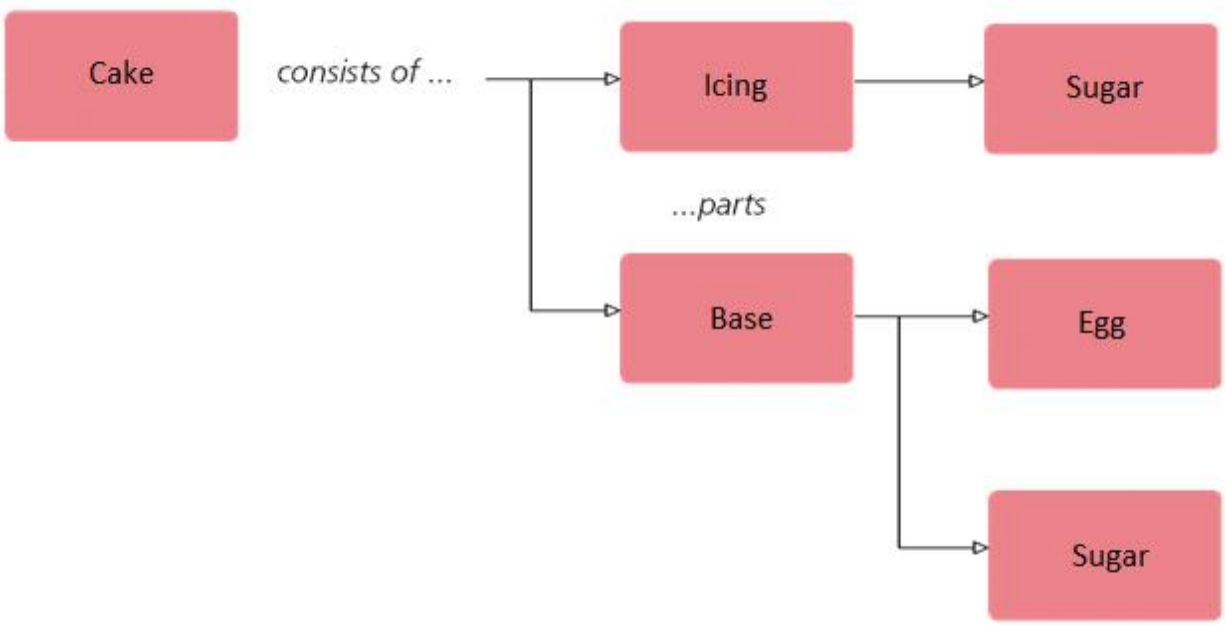

FIGURE 2 EXAMPLE OF THE PART STRUCTURE IN THE IEM

2.3. APPLIED METHOD

The basis of the applied method in this project is inspired by the IREB standard as well as different previous experiences in projects, such as FLEXINET [18], FITMAN [19] and JUMP 4.0 [20]. A validation of the main method was performed in the project IsyProM [21]. This methodology is divided into different steps, starting with stakeholder identification and user story generation. Afterwards, the requirements are extracted from the user stories, are getting formalized and categorized. The next steps are the detailing, refining and correcting of the user stories as well as finding out common, generic requirements and integration into MO²GO. The steps will be detailed in the following sections and also displayed with the partner responsibility in Figure 3.

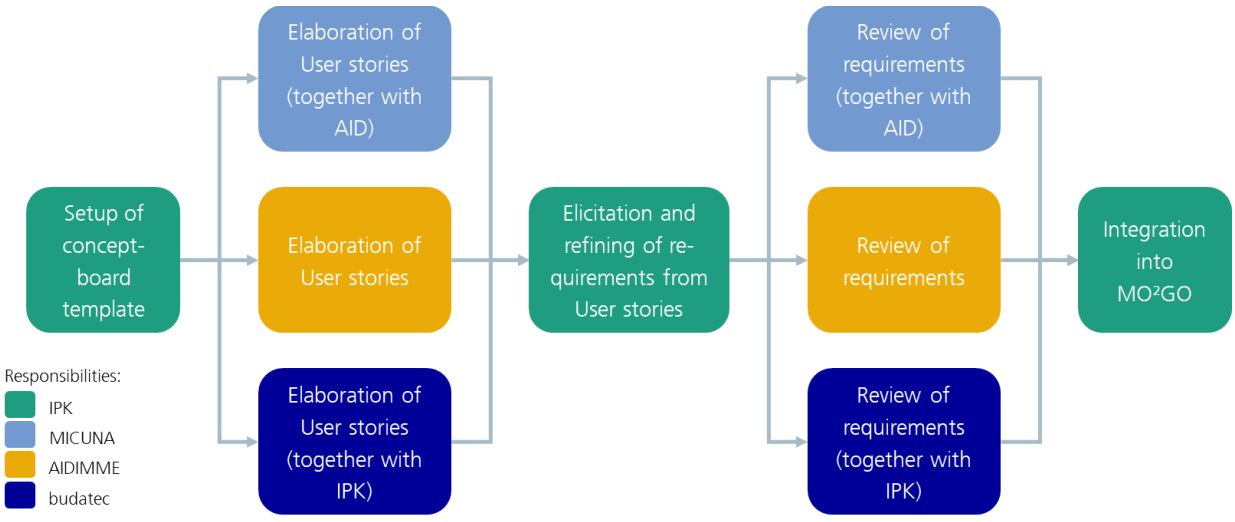

FIGURE 3 SUMMARY OF THE APPLIED METHOD

2.3.1. Requirements elicitation

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The first step is to identify the relevant stakeholders for each pilot partner who will work with the developed system during and after the project. They are asked about the expectations, needs, goals and interests of the resulting system. User stories in natural language were used to generate a comparable and structured framework, but at the same time to pick up the stakeholders and integrate them into the development process [4]. The user stories are a short, simple description of a feature told from the perspective of the person who desires the new capability, usually a user or customer of the system. User stories typically follow a simple template which lead to a formalized structure. It is displayed in Figure 4.

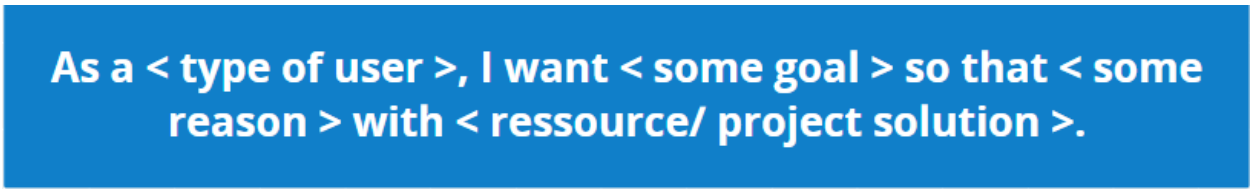

FIGURE 4 TEMPLATE FOR USER STORIES

As the project and its solution is focused on resilience in supply chains, a connection to the SCOR (Supply Chain Operations Reference Model) was implemented [22]. A template was created to classify the user stories both horizontal and vertical. The template is horizontally parted from supplier, your organization up to customer. The user stories should be allocated depending on the impact zone in which the content is relevant. The vertical categorization is mainly separated into physical, planning and management. More clarity will be generated with further subcategories which are equivalent to the business processes. For planning, these processes are plan, schedule, control and sustainability. Cost, capacity management, improvements, performance and again sustainability are the processes for management. To give a better insight, a compressed version of the template is displayed in Figure 5. The following short description of the categories and subcategories shall help with understanding the template:

- Physical: Describes the frame of physical aspects along the supply chain and the organisations, such as Make, Source and Deliver.
- Planning: Activities in a planning area that are directly related to the physical activities and whose actions begin to take effect in a short time horizon.
- Management: Actions in which the impact begins to take effect after a longer time horizon and follow strategic objectives.
- Plan: Strategy outlining actions with direct impact on the supply chain.
- Schedule: Activities regarding planning of resources and timelines.
- Control: Monitoring and regulating actions with ensured relation to planned objectives.
- Cost: Managing and optimizing activities to enhance profitability.
- Capacity Management: Actions to optimize future resource planning with indicators such as forecasting.
- Improvements: Tasks and activities that are related to improvement actions in the enterprise and supply chain.
- Performance: Actions regarding the measurement and evaluation of KPIs, effectiveness and efficiency.
- Sustainability: in context of management, long term impact on integrating environmental, social and economic considerations of actions. For planning, direct impact of actions to environmental, social and economic aspects.

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The user stories will be integrated with interviews with relevant roles in the company. Each role gets a different color to bring transparency into the template. Cards with the role-related color will be filled with the User story and placed at the fitting position in the template. The full conceptboard for each pilot is pictured in the annex. Even if the project provides a specific scope, the elicitation of the user stories wasn't restricted. It is important, not to limit the discussion with the pilot partners because external limitations could lead to wrong limitations the users make themselves. Those could hide necessary information and demands. For that reason, the user stories and also requirements partly leave the projects scope.

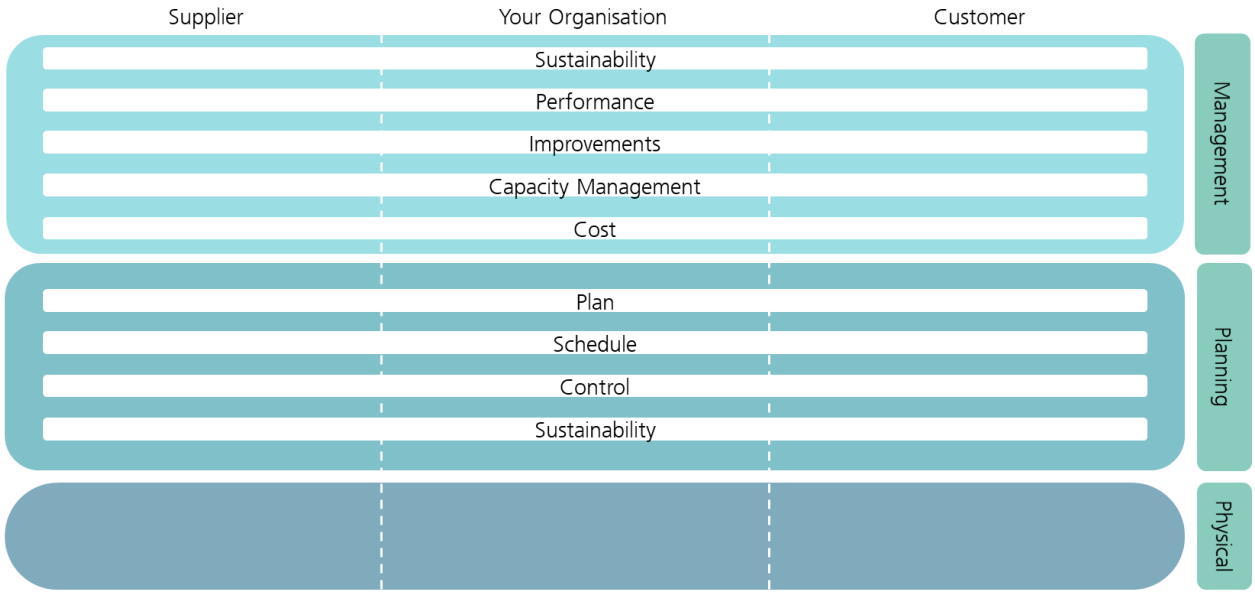

FIGURE 5 TEMPLATE FOR CATEGORIZATION OF USER STORIES

2.3.2. Requirements formalization

Even if the User stories follow the same structure, it is still not enough for a formalized requirements engineering, especially when it comes to overlapping and validation. Therefore, the requirements need to be extracted from the user stories as well as other important information from it. The IREB standard provides different opportunities regarding refinement of requirements.

Firstly, each user story in combination with the SCOR template will be dismantled in up to three functional requirements that are able to fulfil the user story. The <type of user> is the identification of the requirements. With a mapping of the requirements to the pilots, projects and SCOR KPIs, a performance connection is implemented, which will be deepened in D1.2.

Within maximal four steps a requirement is completely formulated. All categories of information are shown in Figure 6. The following refining options are displayed:

- Focus of the requirement: differentiation for this scope will be split between supply chain and supply chain management. The first one describes that the implementation of the requirement improves processes directly in the supply chain. The focus of supply chain management has impact on processes indirect to the supply chain, but to the management of it.
- Operational requirements: a stack of criteria that are necessary to make the requirement work.
- Relevance: the reason that was stated in the user story for the necessity of the requirement
- Limitations: possible drawbacks regarding the implementation of the functional requirements.

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Due to the position in the template for categorization (Figure 5) a first indicator of the necessary source of data in the supply chain is already provided. The other criteria give more information to interpret a relevance and content of data provided by the supplier, the own organisation and the customer of the pilot partner.

If there were any additional information or some special conditions for fulfilling the requirement these are stated as well.

ID	Functional	Operational	Relevance	Limitations	Focus	Identification	Related User Stories	Performance

Requires information from Supplier	Information (supplier)	Requires information from customer	Information (customer)	Requires information from own organisation	Information (own organisation)

FIGURE 6 DETAILED REQUIREMENTS SPECIFICATIONS

2.3.3. Generic requirements

To generate a set of common, generic requirements, overlapping content between the pilots need to be found. The first step to that is to find categories to map the specific requirements. To the categories, the requirements from all pilots are mapped. With that overview it is possible to find overlapping inside of the categories which leads to generic requirements.

In conclusion this means, there is a set of generic common requirements that are suitable to more than one pilot. But there are still specific requirements that are necessary for the content which is attributed to the different branches the pilot partners act in.

2.3.4. Requirements integration into MO²GO

For the purpose of requirements management, the software got a web-based application for assisting with all the different connections between the requirements, the users and the user stories. By uploading a simple excel file, the data is integrated into the software. The in chapter 2.3.2 declared refinements of the requirements will be partly stored in attributes. Through the information model of the IEM, the connections will be handled. The user stories, user and the functional requirements will be integrated in the model as resource objects in classes of the same name. Via the parting structure they are assigned to each other. This gives the possibility of a more structured and varying view as well as a connection to processes later in time. The MO²GO integration is performed in a way, that is displayed in Figure 7. Referring to the section 2.2.2, each user story consists of a stakeholder and requirements which is illustrated on the left side of the figure. But as both, the stakeholders as well as the requirements, can be connected to more than one user story, the part structure is perfect to assign them to another to show their relationship.

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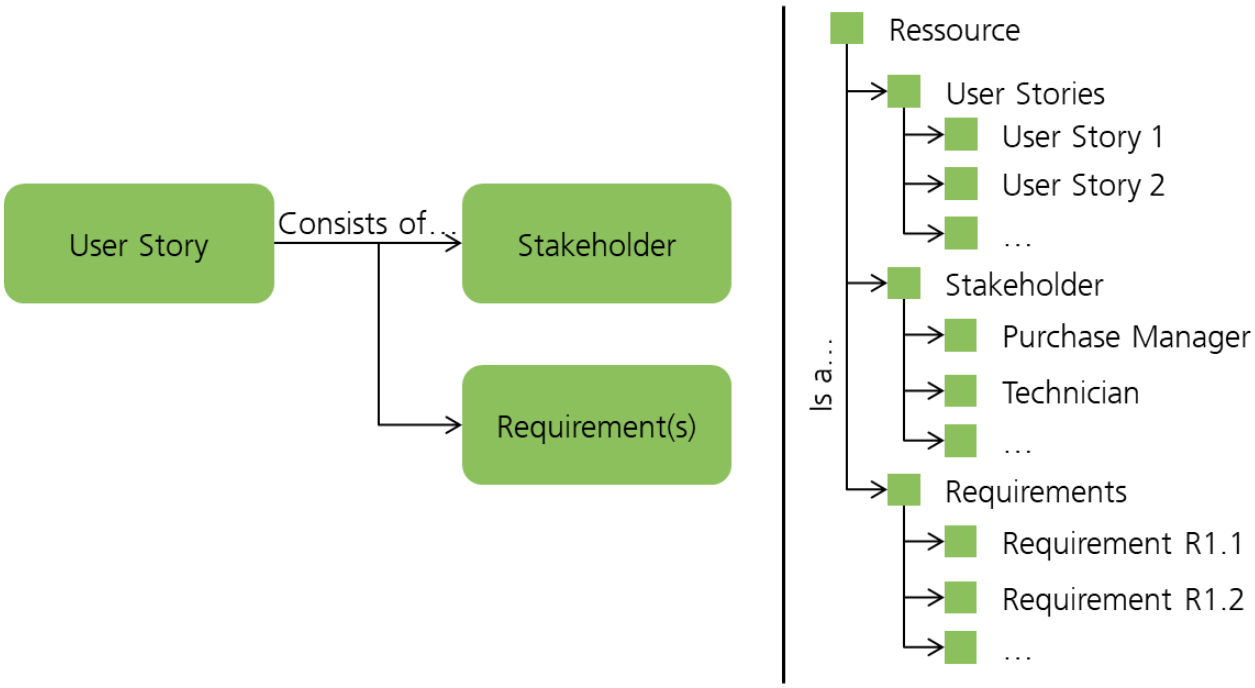

FIGURE 7 REQUIREMENTS INTEGRATION IN MO²GO - CONSISTS OF RELATIONSHIP (LEFT) AND IS A RELATIONSHIP (RIGHT)

3. RESULTS OF THE REQUIREMENTS ENGINEERING

The following chapter is filled with the results of the described methods and procedures to endure a full set of requirements for the planned software development. For that purpose, first the pilot partners are presented. After that, the specific requirements of each partner will be shown as well as afterwards the generic requirements and integration into MO²GO.

3.1. SUMMARY OF THE USE CASES

The description of the three pilot partners, their use cases and expectations should provide a holistic view to the generated requirements content. The description starts with the MICUNA case, which is centred in the furniture industry. The second one opens the field for 3D-printing manufacturing as a service, while the last one provides a SME in the semiconductor industry.

3.1.1. Pilot #1 - Improving Automation & Supply-Chain Resilience in the Furniture industry by MICUNA

Micuna is a manufacturer of children and child support furniture which is leading the national spanish market and fourth biggest in the european market. Previously, an expansion of the company to logistics, polishing and melanin fabrication activities has been taken. Because of the focus of the pilot, DHL will also take part in it. As an SME with limited digital technology support over the supply chain, inefficiency, delays, lack of visibility and transparency are everyday life at MICUNA regarding their own and outsourced activities. This leads to challenges regarding delivery dates, resilience, reactions to disruptions and overall competition on the market. The company is customer driven and is managing various suppliers and customers, both direct customers and sub-contractors. Adaptions to the supply chain after delays at the supplier side or changes in the demand on the customer side take too long. This is also evident from the low level of communication over the whole supply chain. Their workflow is pictured in Figure 8.

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FIGURE 8 WORKFLOW OF THE FURNITURE PILOT

The solution of the NARRATE project should work on two levels. First, monitoring of the suppliers to be aware of anomalies and be able to react. Second, the possibility to find a substitute for materials if they can't be delivered on time. With the support of historical DHL data, the whole process will get an efficiency increase.

3.1.2. Pilot #2 - Printing Network as-a-service to Improve Resilience & Mitigate Unexpected Disruptions by AIDIMME

AIDIMME is a private non-profit organisation and research institute for metal, wood, furniture, packaging, and construction technology including additive manufacturing technologies. The department of 3D-printing is facing challenges regarding the controlling of their orders because it's handled in simple programmes like Microsoft Excel. Disruptions, like machine failures, part deformations and distortions, are common in such a complex manufacturing technology due to many parameters and thermal processes. This combination leads to inefficient management and is not able to adapt to changes. Additive manufacturing as contract manufacturer means building products in small batch sizes with the same ore different geometries in one product step. The new business model of the additive manufacturing department plans on decentralizing their production with so called hubs of a 3D-printing network for customers to outsource the printing. The business models are shown in Figure 9.

FIGURE 9 3D-PRINTING BUSINESS MODELS INCLUDING PRINTING NET IN EUROPE

The ideal solution would have the possibility to manage and control not only the own but also the contracted machines over the additive manufacturing network to have a better chance to react to disruptions. It also should redirect production according to multiple criteria like geographical location, available materials, etc.

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3.1.3. Pilot #3 - Establishing a new resilient supply chain for BUDATEC

Budatec GmbH is an SME in the hardware implementation of automation systems. Up to now, budatec has particularly considered topics regarding energy and resource efficiency, modules in the environment of industry 4.0, an energy management demonstrator including a monitoring component for dynamic process management system and concept for flexible soldering production lines in operational practice in research projects. The company has to decide on major strategic orders within a short period of time, which has a long-term impact on the company. Particularly for large orders, standardised processes (e.g. for approvals) must be followed on the one hand, while at the same time reacting quickly to unforeseen events. Non-substitutable parts have a delivery period of up to one year. The design of production as island production in combination with the general shortage of supplier parts means that the production area is insufficient. Furthermore, the production will be expanded to a second location, which an ideal solution would be a system that, especially for the critical parts, i.e. non-substitutable parts with a long delivery time, can anticipate unforeseen events at the suppliers and suggest solutions for potential delivery failures/delays. These solutions, which is shown in Figure 10, include, for example, new suppliers.

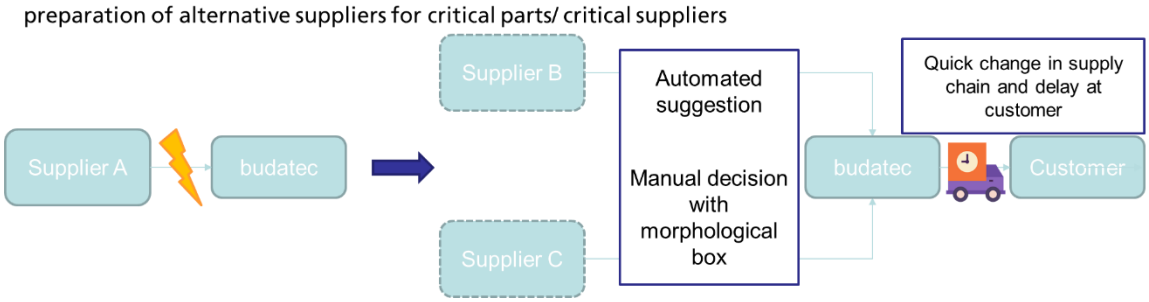

FIGURE 10 BUDATECS EXPECTED PROJECT BENEFIT

3.2. SPECIFIC REQUIREMENTS FOR EACH USE CASE

In this section, the elicitated requirements with their belonging user story as well as all the refinement information are presented for the three pilots. Some of the information are part of D1.2, which will be published on the same date as D1.1. The clarification of those information can be checked in that document. Also, there are some IDs of User stories missing. During the refinement process, those user stories appeared to not be relevant anymore due to changes in the enterprises. The graphic on the bottom of each user story template shows an initial potential information flow over the supply chain and the potential necessary data from supplier, customer and own organisation (pilot organisation).

3.2.1. Specific requirements for Pilot #1

The user stories are presented as one figure for each user story together with the elicited requirements as well as the surrounding information. On the top of each figure is the pilot number and partner, as well as the specific ID to the user story. Below, the identification is stated, also known as the stakeholder of the user story. The surrounding information are project and pilot related KPIs that can be improved by implementing the requirements. The functional requirements are complemented with a unique ID based on the user story ID and a prioritization of each requirement from D1.2. At the bottom of the graphic, operational requirement and limitations are included. For each user story, an initial graphic with a potential information flow along the supply chain is also presented.

User story with ID 1 is pictured in Figure 11 and describes the wish to integrate simulation capabilities into the IMC. The production manager wishes to have the assistance for task sequencing through simulation and assisted scenario analysis regarding several KPIs with already existing manufacturing plans. It outlines

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the performance (KPI) metrics for manufacturing simulations, including improvements in risk identification, on-time delivery, and stock reduction.

ID	1	Pilot #1 MIC			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R1.1	manufacturing simulation incl. Manufacturing plans (e.g. adapter to plant simulation,vistableetc.)	M
improvement in identification of potential risks & disruptions:		60% - 70%	R1.2	scenario analysis regarding different KPIs	M
improvement of on -time delivery		10%- 15%	R1.3	loading and editing of manufacturing plans (manually or automatically)	M
improvement in stock reduction, improved partner relationships (capabilities awareness, quality preservation/just-in-time delivery, increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5-10%			
User story:	As a Production Manager, I want to perform production simulations, so that I can check different options of execution plans a nd task sequencing, with the Digital Twin -related technologies of the IMC.				
Operational:		Limitations:			
provide user -friendly simulation interfaces, offer robust modeling and simulation capabilities, ensure accuracy and reliability of simulation results, and enable seamless integration with existing IMC functionalities and data sources		the complexity of modeling real -world production processes accurately, potential discrepancies between simulation and actual production outcomes, resource constraints for implementing and maintaining Digital Twin technology			

FIGURE 11 MIC USER STORY #1

The second user story in Figure 12 displays requirements regarding analysis of transportation partner information, with KPIs focusing on on-time delivery and customer satisfaction improvements. It includes the user story for the Logistics Manager and operational requirements for managing these partnerships effectively.

ID	2	Pilot #1 MIC			
Identification (role):		Logistics Manager	Functional Requirements:		Priority:
Performance (KPI):			R2.1	analysis of contracted transportation partners information (routes per kg, package or pallet, pickup and delivery frequencies, as well possible restrictions)	M
improvement of on -time delivery:		10% - 15%	R2.2	analysis of alternative transportation partners information (routes, rates per kg, package or pallet, pickup and delivery frequencies, as well as other possible restrictions)	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance		5%- 10%	R2.3	Analytical suggestions for new transportation partners (best option regarding different points)	M
improved partner relationships (capabilities awareness, quality preservation/just-in-time delivery and to implement at least 10-15% of environ. aspects considered as criteria in supplier assessment and selection		5-10%			
User story:	As a Logistics Manager, I want to evaluate different transportation options and providers, so that I can select the best logi stics options, with the Digital Twin -related technologies of the IMC.				
Operational:		Limitations:			
The implementation must support the creation and management of Digital Twins for transportation networks and providers, offer user-friendly simulation interfaces, ensure accuracy and reliability of simulation results, provide access to real-time transportation data, and integrate seamlessly with existing IMC functionalities and data sources.		the complexity of modeling real -world transportation networks accurately, potential discrepancies between simulation and actual transportation outcomes, data availability constraints, and the need for ongoing maintenance and validation of simulation models			

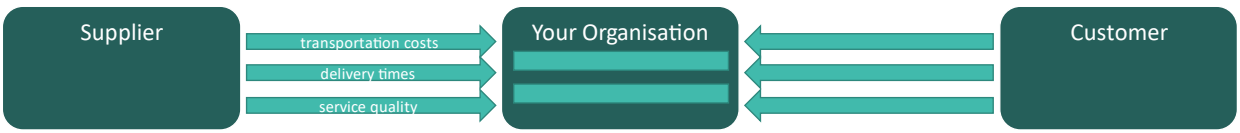

FIGURE 12 MIC USER STORY #2

The next user story from the Purchase Manager on Figure 13 provides the wish for an analysis of supplier information, highlighting customer satisfaction and supplier assessment criteria. Basing on already contracted suppliers, alternative suppliers from the portfolio and new suppliers shall be suggested.

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ID	3	Pilot #1 MIC			
Identification (role):		Purchase Manager	Functional Requirements:		Priority:
Performance (KPI):			R3.1	analysis of contracted supplier information (costs, quality, delivery time, as well as other possible restrictions)	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5% - 10%	R3.2	analysis of alternative supplier information (costs, quality, delivery time, as well as other possible restrictions)	M
to implement at least 10 -15% of environ. aspects considered as criteria in supplier assessment and selection:		5%- 10%	R3.3	Analytical suggestions for new suppliers (best option regarding different points)	M
improved partner relationships (capabilities awareness, quality preservation/justin-time delivery:		5-10%			
User story:	As a Purchase Manager, I want to evaluate different options for the supply of materials and services, so that I can select th e most suitable suppliers, with the Digital Twin - related technologies of the IMC.				
Operational:		Limitations:			
support the creation and management of virtual supplier models, provide intuitive interfaces for simulation and analysis, ensure accuracy of simulation results, enable integration with external supplier data sources, and facilitate decision-making for the Purchase Manager.		the complexity of modeling real -world supplier networks accurately, potential discrepancies between simulation and actual supplier outcomes, data availability constraints, and the need for ongoing maintenance and validation of simulation models.			

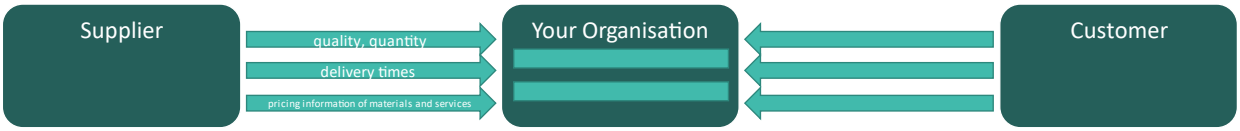

FIGURE 13 MIC USER STORY #3

The next user story on Figure 14 desires a feature that evaluates different manufacturing routes for the Product Developers, with KPIs related to on-time delivery and stock reduction. Requirements for these functionalities are a connected manufacturing simulation as well as scenario analysis.

ID	4	Pilot #1 MIC			
Identification (role):		Production Developer	Functional Requirements:		Priority:
Performance (KPI):			R4.1	manufacturing simulation incl. Manufacturing plans (e.g. adapter to plant simulation,vistable etc.)	M
improvement of on -time delivery:		10% - 15%	R4.2	scenario analysis regarding different KPIs	M
improvement in stock reduction:		5%- 10%			
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5-10%			
User story:	As a Product Developer, I want to evaluate different manufacturing routes, so that I can select the most appropriate one to d evelop new products, with the proposal simulations supported by the IMC.				
Operational:		Limitations:			
provide user -friendly interfaces for simulation and analysis, ensure accuracy of simulation results, integrate with existing product development workflows		the complexity of modeling real -world manufacturing processes accurately, potential discrepancies between simulation and actual production outcomes, data availability constraints			

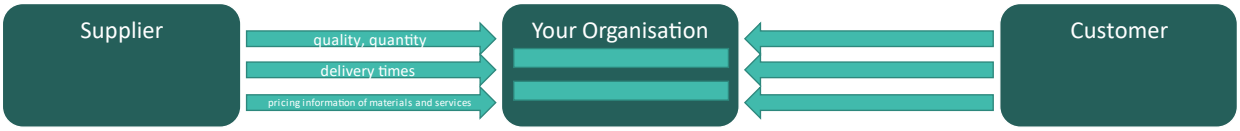

FIGURE 14 MIC USER STORY #4

The Product Developer requires an evaluation support for different suppliers. This can be provided by analytical functionalities that compare already contracted supplier with alternative suppliers. This could among other things help with reducing stock, which is illustrated in Figure 15.

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ID	5	Pilot #1 MIC			
Identification (role):		Production Developer	Functional Requirements:		Priority:
Performance (KPI):			R5.1	analysis of contracted supplier information (costs, quality, delivery time, as well as other possible restrictions)	M
to implement at least 10 -15% of environ. aspects considered as criteria in supplier assessment and selection		5% - 10%	R5.2	analysis of alternative supplier information (costs, quality, delivery time, as well as other possible restrictions)	M
improvement in stock reduction:		5%- 10%	R5.3	Analytical suggestions for new suppliers (best option regarding different points)	M
improved partner relationships (capabilities awareness, quality preservation/justin-time delivery: 5 - 10% improvement in identification of potential risks & disruptions:		60-70%			
User story:	As a Product Developer, I want to evaluate different suppliers from a predefined collection of companies, so that I can bette r address the development of new products, with the proposal simulations supported by the IMC.				
Operational:		Limitations:			
should support the creation and management of virtual supplier models, provide intuitive interfaces for simulation and analysis, ensure accuracy of simulation results, integrate with existing product development workflows, and facilitate decision-making for Product Developers		the complexity of modeling real -world supplier networks accurately, potential discrepancies between simulation and actual supplier outcomes, data availability constraints			

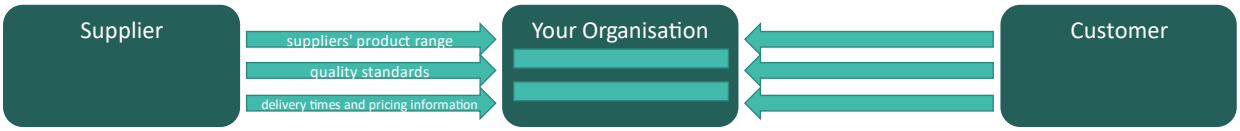

FIGURE 15 MIC USER STORY #5

The Demands Planner wishes to have assistance with capacity and resource planning with prediction tools. This should be based on the management of historical data, analysis of current project data as well as prediction support for the workloads of each workplace, displayed in Figure 16. The reduction of quality incidents and improvement of risk detection is the goal of the tool.

ID	6	Pilot #1 MIC			
Identification (role):		Demands Planner	Functional Requirements:		Priority:
Performance (KPI):			R6.1	management of historical data regarding workloads per workplace, operator or machine	M
improvement in identification of potential risks & disruptions:		60% - 70%	R6.2	analysis of current project data and forecast of resource usage including factors like seasonal fluctuations regarding workloads per workplace, operator or machine	M
reduction of quality incidents, including order errors:		20%- 25%	R6.3	capacity prediction workloads per workplace, operator or machine and alert system	M
improvement of on-time delivery:		10%-15%			
User story:	As a Demands Planner, I want to predit the needs related to the capacity increase of machinery and workers, so that I can adjust the resources based on the future d emand, with the Predictive tools of the IMC.				
Operational:		Limitations:			
support the analysis of historical data, provide accurate forecasting algorithms, offer user-friendly interfaces for demand planning, ensure scalability to handle large datasets, and integrate with existing supply chain management systems		the complexity of modeling real -world demand patterns accurately, potential discrepancies between forecasts and actual demand outcomes, data availability constraints			

FIGURE 16 MIC USER STORY #6

For the possibility to accurately update production plans, the Purchase Manager wishes notification functions for missing materials from supplier. That requires a connection to the delivery system of the supplier, alert systems related to predefined thresholds, shown in Figure 17.

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ID	7	Pilot #1 MIC			
Identification (role):		Purchase Manager	Functional Requirements:		Priority:
Performance (KPI):			R7.1	connection to supplier delivery dates and real time status of deliveries	M
improvement of on-time delivery:		10% - 15%	R7.2	alert system related to predefined thresholds	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5%- 10%	R7.3	comparison of scheduled and real delivery status	M
improved partner relationships (capabilities awareness, quality preservation/just in-time delivery:		5%-10%			
User story:	As a Purchase Manager, I want to receive warnings when some material has not arrived to the premises, so that I can update the plan accordingly, with the management and notification functionalities of the IMC.				
Operational:		Limitations:			
real-time tracking of material shipments, provide accurate delivery status updates, offer configurable notification settings, ensure compatibility with diverse supply chain workflows, and integrate seamlessly with existing procurement systems		data accuracy issues in shipment tracking systems, potential delays in notification delivery, reliance on external logistics partners for shipment information			

FIGURE 17 MIC USER STORY #7

The focus of the user story in Figure 18 is the production manager and the desirable to get notifications for products with quality issues. It presents the requirements focusing on quality management and highlights the need for a quality management interface with a quality alert system, real-time status control of production, and notification of deviations.

ID	8	Pilot #1 MIC			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R8.1	quality management interface incl. quality alert system	M
improvement in identification of potential risks & disruptions:		60% - 70%	R8.2	real-time status and control of production	M
reduction of quality incidents, including order errors:		20%- 25%	R8.3	deviation notification	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. Performance improved partner relationships (capabilities awareness, quality preservation/just in-time delivery		5%-10%			
User story:	As a Production Manager, I want to receive warnings when some product is not correct, so that I can adjust the production act ivities, with the management and notification functionalities of the IMC.				
Operational:		Limitations:			
real-time product monitoring, accurate anomaly detection algorithms, configurable notification settings, compatibility with diverse production workflows and seamlessly with quality assurance systems		the complexity of detecting all potential product defects, false positives in anomaly detection algorithms, reliance on manual inspection for certain quality checks			

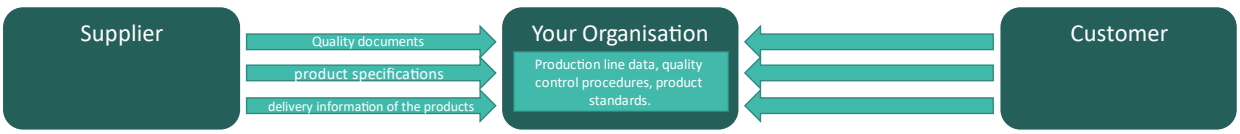

FIGURE 18 MIC USER STORY #8

For the case that a production order hasn't been launched, the Demands Planner wants to get a notification. This needs a monitoring of production orders including the launch data, that is explained in Figure 19.

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ID	9	Pilot #1 MIC			
Identification (role):		Demands Planner	Functional Requirements:		Priority:
Performance (KPI):			R9.1	order management functionalities	M
improvement in identification of potential risks & disruptions:		60% - 70%	R9.2	deviation notification	M
reduction of quality incidents, including order errors		20%- 25%			
improvement of on -time delivery:		10%-15%			
User story:	As a Demands Planner, I want to get a notification when some production order has not been launched, with the management and notification system of the IMC.				
Operational:		Limitations:			
monitoring of production orders, accurate detection of launch delays, configurable notification settings, compatibility with diverse production workflows		the complexity of detecting all potential production order delays, false positives in notification triggers			

FIGURE 19 MIC USER STORY #9

The next user story from the Demands Planner, that is focused in Figure 20, should provide a warning function if historical data doesn't match current order data to be able to update demands among other things. The result could be improvements in risk detection, reduction of quality incidents and improvements in stock reductions.

ID	10	Pilot #1 MIC			
Identification (role):		Demands Planner	Functional Requirements:		Priority:
Performance (KPI):			R10.1	management of historical data	S
improvement in identification of potential risks & disruptions:		60% - 70%	R10.2	analysis of current project data and forecast of material usage including factors like seasonal fluctuations	S
reduction of quality incidents, including order errors		20%- 25%	R10.3	alert for discrepancies between historical data and current demand	S
improvement in stock reduction:		5%-10%			
User story:	As a Demands Planner, I want to receive a warning when the demand does not correspond to the historical data, so that I can u pdate the order points, the security stock, and related data, with management and notification system of the IMC.				
Operational:		Limitations:			
supporting real -time monitoring of demand data, provide accurate analysis of historical trends, offer configurable notification settings, ensure compatibility with diverse demand forecasting models, and integrate seamlessly with existing ERP systems		the complexity of analyzing demand patterns accurately			

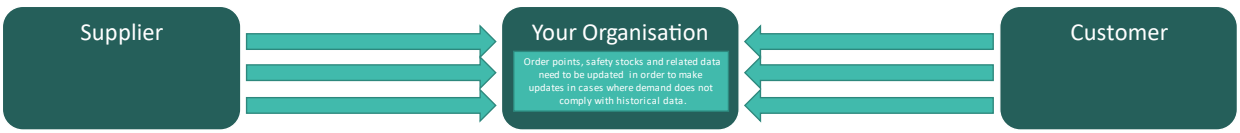

FIGURE 20 MIC USER STORY #10

Figure 21 outlines the functional requirements for a Production Manager to optimize production sequencing and task management. It includes real-time analysis, error identification, and integration with existing systems to improve on-time delivery and risk management.

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ID	12	Pilot #1 MIC			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R12.1	real-time monitoring of production machines	M
improvement in identification of potential risks & disruptions:		60% - 70%	R12.2	implementation of alert system for unexpected downtimes or issues	M
improvement of on -time delivery:		5 - 10%	R12.3	support system for optimal workflow for production planning, especially in disruptive situations (establishment of different rules)	M
improvement in stock reduction		5%-10%			
User story:	As a Production Manager, I want to obtain the optimal sequencing of manufacturing orders based on different rules, so that I can select the most suitable ones, with the simulation functionalities of the IMC.				
Operational:		Limitations:			
support real -time adjustment of order sequencing in response to disruptions, provide accurate simulation and prediction capabilities		complexity of analyzing and adjusting sequencing options in real -time, potential conflicts between different production rules and constraints			

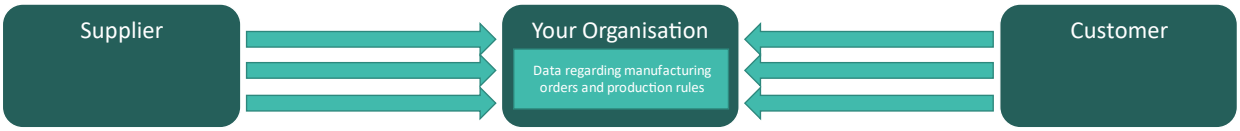

FIGURE 21 MIC USER STORY #12

Figure 22 focuses on the logistics manager's need for real-time updates on the status of deliveries and warnings for potential disruptions. KPIs target improvements in delivery reliability and customer satisfaction, emphasizing the need for real-time tracking and communication systems.

ID	13	Pilot #1 MIC			
Identification (role):		Logistics Manager	Functional Requirements:		Priority:
Performance (KPI):			R13.1	Get and process environmental disruptions and from customer/ supplier,e.g. relevant trade barriers	M
improvement in identification of potential risks & disruptions:		60% - 70%	R13.2	comparison of delivery planning with execution	M
improvement of on -time delivery:		10%- 15%	R13.3	real-time monitoring and alert system	M
increase in customer satisfaction (quality preservation/JIT delivery and informatio on environ. performance:		5%-10%			
User story:	As a Logistics Manager, I want to monitor the status of the deliveries and get disruption warnings, so that I can take correc tive actions, with the simulation funtcionalities and notification system of the IMC.				
Operational:		Limitations:			
real-time tracking accuracy, reliable disruption prediction algorithms, seamless integration with existing logistics systems, customizable notification preferences, user -friendly dashboards for corrective actions		potential inaccuracies in disruption predictions, dependency on reliable real -time data, continuous refinement of prediction algorithms			

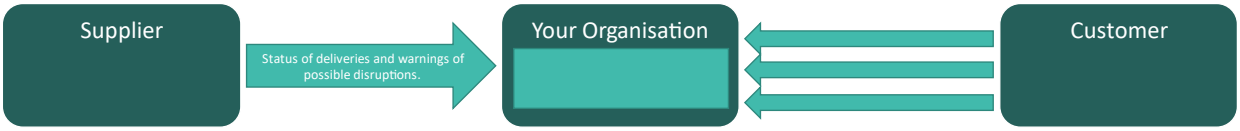

FIGURE 22 MIC USER STORY #13

Figure 23 focuses on the Production Manager's need to verify the sequencing of manufacturing orders. It includes requirements for order task overview and sequencing simulation. The KPIs aim to improve risk identification and on-time delivery, ensuring correct order sequencing.

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ID	14	Pilot #1 MIC			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R14.1	functionality to verify the sequencing of manufacturing orders against predefined criteria	M
improvement in identification of potential risks & disruptions:		60% - 70%	R14.2	order and task overview	M
improvement of on -time delivery:		10%- 15%	R14.3	connected sequencing simulation tool	M
increase in customer satisfaction (quality preservation/JIT delivery and informatio		5%-10%			
on environ. performance					
User story:	As a Production Manager, I want to check the correct sequencing of manufacturing orders, so that I can take corrective action s, with the check simulation functionalities of the IMC.				
Operational:		Limitations:			
real-time sequencing analysis of manufacturing orders, accurate identification of sequencing errors or discrepancies		potential challenges in integrating with existing production systems, the requirement for continuous refinement of sequencing analysis algorithms			

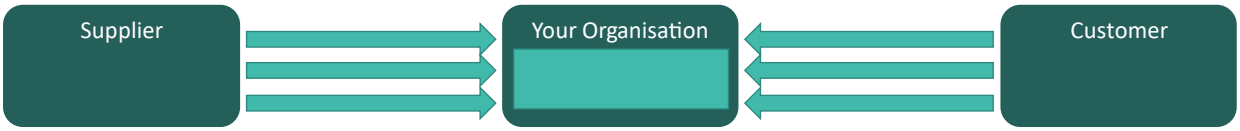

FIGURE 23 MIC USER STORY #14

The logistics manager's needs for monitoring delivery status and receiving disruption warnings are detailed Figure 24. KPIs emphasize improvements in risk identification and on-time delivery, with operational requirements focusing on real-time tracking, disruption prediction, and seamless integration with existing systems.

ID	15	Pilot #1 MIC			
Identification (role):		Logistics Manager	Functional Requirements:		Priority:
Performance (KPI):			R15.1	connection to transportation partners	M
improvement in identification of potential risks & disruptions:		60% - 70%	R15.2	alert system related to issues and disruption during transportation process	M
improvement of on -time delivery:		10%- 15%	R15.3	management of historical data	M
increase in customer satisfaction (quality preservation/JIT delivery and informatio		5%-10%			
on environ. performance:					
User story:	As a Logistics Manager, I want to monitor the status of the deliveries to customers and get warnings about past disruptions, so that I can take corrective actions, with the simulation functionalities and notification system of the IMC.				
Operational:		Limitations:			
real-time monitoring of delivery statuses, accurate identification and notification of past disruptions		potential challenges in integrating with existing logistics systems, the requirement for continuous refinement of alerting algorithms, data availability constraints			

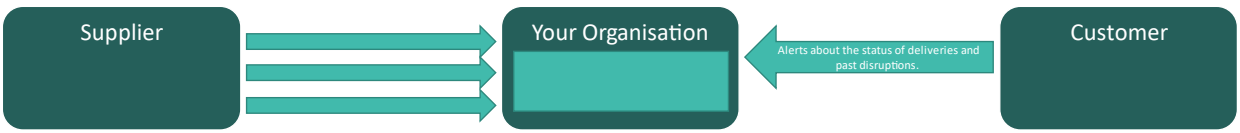

FIGURE 24 MIC USER STORY #15

In the next user story, the Production Manager wishes for functions to get recommendations for production machinery based on different KPIs, mainly related to the difference between energy consumption and auto-consumption rate. This requires a possibility to compare project data and forecast with energy consumption and energy forecast. It is detailed shown in Figure 25.

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ID	16	Pilot #1 MIC			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R16.1	analysis of current project data and forecast of resource usage, including factors like seasonal fluctuations	M
improvement in identification of potential risks & disruptions:		60% - 70%	R16.2	optimization proposals regarding different KPIs	M
improvement of on -time delivery:		10%- 15%	R16.3	integration of energy consumption, self consumption, weather forecasts	M
improvement in stock reduction, increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance		5%-10%			
User story:	As a Production Manager, I want to get recommendations about the use of production machinery based on timeframes, self -consumption and contracted power, optionally based on weather forecast, so that I can check whenever the energy consumtion exceeds the auto-consumption range, determine which machinery to use, and update the information accordingly, with the simulation functionalities of the IMC.				
Operational:		Limitations:			
algorithms to analyze timeframes, selfconsumption, contracted power, and weather forecast data, generate accurate recommendations based on energy consumption patterns, provide realtime monitoring of energy usage, offer customizable alert settings for abnormal energy consumption		the need for accurate data on timeframes, self -consumption, contracted power, and weather forecast, potential challenges in integrating with weather forecast services, the requirement for continuous refinement of recommendation algorithms			

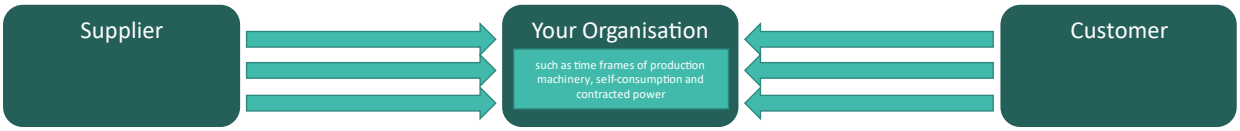

FIGURE 25 MIC USER STORY #16

The user story in Figure 19 highlights functional requirements and key performance indicators (KPIs) such as the reduction of quality incidents and improvement in the identification of potential risks and disruptions. The table also describes operational requirements and limitations in integrating supplier information and selecting optimal suppliers during material disruptions.

ID	17	Pilot #1 MIC			
Identification (role):		Purchase Manager	Functional Requirements:		Priority:
Performance (KPI):			R17.1	Get and process environmental disruptionse.g. relevant trade barriers	M
improvement in identification of potential risks & disruptions:		60% - 70%	R17.2	Get and process disruption information from supplier/ customer	M
reduction of quality incidents, including order errors:		20%- 25%	R17.3	real-time monitoring and alert system	M
to implement at least 1015% of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%			
User story:	As a Purchase Manager, I want to find optimal suppliers when some disruption related to the materials supply occurs, based on decision parameters, so that I can select the most appropriate option, with the supply chain management system of the IMC.				
Operational:		Limitations:			
identifying disruptions in materials supply, evaluating alternative suppliers based on criteria such as cost, quality, lead time, reliability, and availability, generating recommendations for optimal suppliers, integrating with existing supplier databases and procurement systems, providing real time data updates on supplier performance, and enabling Purchase Managers to make informed decisions during disruptions		the availability and reliability of supplier data, potential challenges in integrating with existing procurement systems, the need for accurate and up -to-date decision parameters for supplier evaluation, user proficiency in using the supply chain management system, and the dependency on external factors affecting supplier performance			

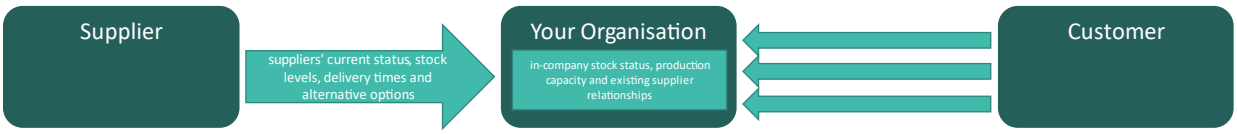

FIGURE 26 MIC USER STORY #17

Figure 27 focuses on user story and the requirements of the Quality Manager. It emphasizes the importance of monitoring and analyzing production data to perform forecasting and other improvement decisions. It includes KPIs such as improving on-time delivery and reducing inventory levels.

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ID	18	Pilot #1 MIC			
Identification (role):		Quality Manager	Functional Requirements:		Priority:
Performance (KPI):			R18.1	management of historical data	M
improvement in identification of potential risks & disruptions:		60% - 70%	R18.2	scenario analysis	M
reduction of quality incidents, including order errors		20%- 25%	R18.3	visualization and analysis of quality incidents in relation to manufacturing conditions	M
improved partner relationships, increase in customer satisfaction, improvement in stock reduction, improvement of ontime delivery:		5%-10%			
User story:	As a Quality Manager, I want to collect and analyse production-related data, so that I can perform an improved decision -making and propose improvement measures, with the data gathering and analysis provided by the IMC.				
Operational:		Limitations:			
The implementation must include robust data collection mechanisms compatible with various data sources and formats. The analysis tools should support statistical analysis, data visualization, trend identification, and correlation analysis. The platform must ensure data accuracy, reliability, and security throughout the data gathering and analysis processes.		Privacy and security concerns related to sensitive production data need to be addressed to ensure compliance with regulations and industry standards.			

FIGURE 27 MIC USER STORY #18

The information on Figure 28 describes the requirements of the Logistics Manager. It focuses on real-time monitoring of delivery status and identifying and notifying about disruptions. KPIs include improving on-time delivery and increasing customer satisfaction through better information provision.

ID	19	Pilot #1 MIC			
Identification (role):		Logistics Manager	Functional Requirements:		Priority:
Performance (KPI):			R19.1	scenario analysis	M
to implement at least 10 -15% of environ. aspects considered as criteria in supplier assessment and selection:		5% - 10%	R19.2	analysis of contracted transportation partners information	M
increase in customer satisfaction, improved partner relationships		5%- 10%	R19.3	analysis of alternative transportation partners information	M
improvement of on-time delivery:		10%-15%			
User story:	As a Logistics Manager, I want to find optimal logistics providers based on decision parameters, so that I can select the mos t suitable transportation option, with the supply chain management system of the IMC.				
Operational:		Limitations:			
The implementation must include a comprehensive database of logistics providers, including their capabilities, coverage areas, service levels, and performance metrics. The solution should provide transparent criteria for the ranking and selection process to facilitate user understanding and decision-making.		Privacy and security considerations regarding the handling of sensitive transportation data need to be addressed to ensure compliance with regulations and industry standards.			

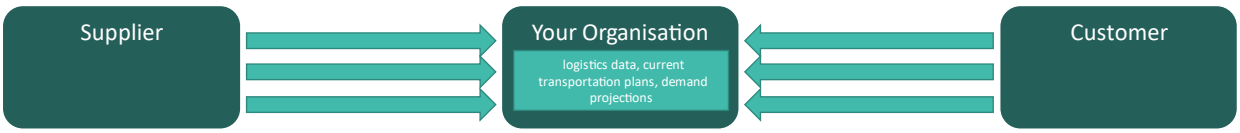

FIGURE 28 MIC USER STORY #19

Figure 29 details the requirements for the Quality Manager who wants to simulate internal disruptions to evaluate corrective actions. It emphasizes the need for a simulation tool that defines disruption parameters and provides analytical capabilities to assess impacts. Performance indicators include a improvement in risk identification and a reduction in quality incidents.

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ID	20	Pilot #1 MIC			
Identification (role):		Quality Manager	Functional Requirements:		Priority:
Performance (KPI):			R20.1	adapter to relevant simulation tools	M
improvement in identification of potential risks & disruptions:		60%-70%	R20.2	generation of fictional disruption and scenario data	M
reduction of quality incidents, including order errors:		20%-25%	R20.3	scenario analysis	M
User story:	As a Quality Manager, I want to perform simulations of internal disruptions, so that I can evaluate corrective actions before hand,, with the simulation functionalities provided by the IMC.				
Operational:		Limitations:			
It should enable users to define simulation parameters, including disruption severity, duration, and affected resources. The solution must provide analytical capabilities to assess the impact of disruptions on production schedules, quality metrics, and resourc utilization.		The effectiveness of the simulation tool depends on the accuracy of input data and the realism of the simulation models.			

FIGURE 29 MIC USER STORY #20

The next user story describes the needs of the Production Manager who wants real-time notifications about deviations in work cycle times and proposals for corrective actions. The notifications should be configurable to adapt to different parameters of the threshold. The information is displayed in Figure 30.

ID	21	Pilot #1 MIC			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R21.1	real-time visibility into the status of each work, including completion, post-process, and the number of pieces produced	M
improvement in identification of potential risks & disruptions:		60%-70%	R21.2	dashboard or interface that provides a comprehensive overview of all ongoing work	M
reduction of quality incidents, including order errors:		20%-25%	R21.3	comparison of practical and planned project work and notification functionality for deviations	M
improvement of on-time delivery, increase in customer satisfaction		5%-15%			
User story:	As a Production Manager, I want to get notifications about deviations in relation to the cycle time of the operational workin g center, and obtain proposals, so that I can take actions to meet the schedule, with the simulation and notification functionalities provided by the IMC.				
Operational:		Limitations:			
Notifications should be configurable based on predefined threshold parameters set by Production Managers.It should offer actionable proposals for corrective actions, along with insights into potential outcomes.		Implementing corrective actions may require coordination with various departments and stakeholders, potentially leading to delays in execution.			

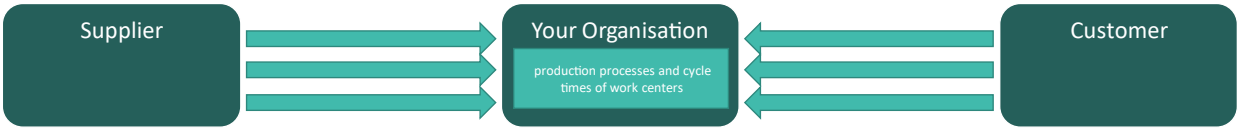

FIGURE 30 MIC USER STORY #21

Figure 31 outlines the requirements for the Purchase Manager aiming to buy and offer environmentally certified products. It highlights the need for integrating databases about environmental certifications and increasing customer satisfaction. The goal is to consider of environmental aspects in supplier selection criteria.

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ID	22	Pilot #1 MIC			
Identification (role):		Purchase Manager	Functional Requirements:		Priority:
Performance (KPI):			R22.1	Integration of databases about environmental certifications	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5%-10%			
to implement at least 10 -15% of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%			
User story:	Purchase Manager: I want to buy and offer to my clients products with environmental certifications such as PEFC				
Operational:		Limitations:			
the solution should streamline the procurement process without compromising on environmental standards.		One potential restriction could be limited availability of products with environmental certifications, which may impact the variety or quantity of products that can be offered to clients. Additionally, the implementation may require additional resources for certification verification and database management.			

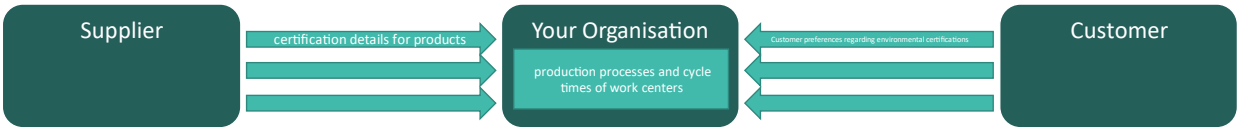

FIGURE 31 MIC USER STORY #22

Figure 32 addresses the Purchase Manager's need for environmental information about products. Functional requirements include interfaces for visualizing environmental data and databases for environmental information. The goal is to ensure accurate and accessible environmental information for decision-making.

ID	23	Pilot #1 MIC			
Identification (role):		Purchase Manager	Functional Requirements:		Priority:
Performance (KPI):			R23.1	interface to visualize environmentalinformations	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5%-10%	R23.2	database for environmentalinformations	M
to implement at least 10 -15% of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%			M
User story:	Purchase Manager: I want to know environmental information of products I offer to my clients.				
Operational:		Limitations:			
environmental information for all products is accurate, up-to-date, and easily accessible to the Purchase Manager		One potential restriction could be the availability and accuracy of environmental data for all products offered by the company. Ensuring data completeness and reliability may require collaboration with suppliers and additional resources for data verification.			

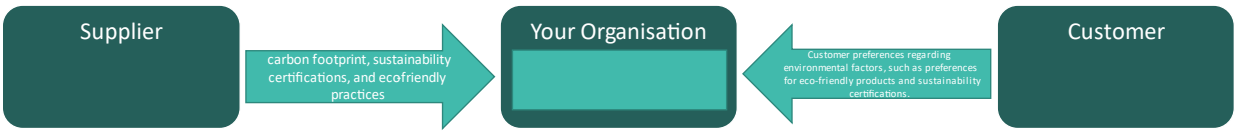

FIGURE 32 MIC USER STORY #23

Figure 33 focuses on the Environmental Manager's requirements for tracking and managing environmental certifications. It includes real-time monitoring, certification verification, and integration with supplier data to maintain compliance and improve sustainability.

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ID	24	Pilot #1 MIC			
Identification (role):		Environmental Manager	Functional Requirements:		Priority:
Performance (KPI):			R24.1	supplier suggestion based on environmental certification	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5%-10%	R24.2	real time track and trace capabilities for materials/products	C
to implement at least 10 -15% of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%	R24.3	database for environmentalinformations	M
User story:	Environmental Manager: I want to keep the chain of custody PEFC certification for my products (buy certified materials and tr ack and trace them to buy certified products)				
Operational:		Limitations:			
The implementation must comply with PEFC certification standards and requirements for maintaining the chain of custody. It should also adhere to data privacy and security regulations to safeguard sensitive information related to certification.		One potential restriction could be the need for extensive collaboration and data sharing with suppliers to verify certification status and ensure accurate tracking and tracing of materials/products throughout the supply chain			

FIGURE 33 MIC USER STORY #24

Another user story from the Environmental Manager is shown in Figure 34 which states the wish to reduce the generated waste, especially hazardous one. It stresses the importance of waste tracking, identifying processes with high waste generation, and complying with environmental regulations.

ID	25	Pilot #1 MIC			
Identification (role):		Environmental Manager	Functional Requirements:		Priority:
Performance (KPI):			R25.1	interface for waste tracking	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5%-10%	R25.2	identification of processes with most waste generation incl. analysis of waste generated because of failures	C
to implement at least 10 -15% of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%	R25.3	facilitation of companies with waste as raw material (second life) as customer	S
User story:	Environmental Manager: I want to reduce the amount of waste generated, specially the hazardous ones.				
Operational:		Limitations:			
The implementation must comply with environmental regulations and standards governing waste management and disposal. It should also adhere to health and safety regulations to ensure proper handling of hazardous waste materials.		Potential restrictions may include the need for investment in new technologies or infrastructure for waste management, as well as challenges associated with changing established processes and supplier relationships to accommodate waste reduction measures.			

FIGURE 34 MIC USER STORY #25

Other requirements for the Environmental Manager are to calculate the organizational carbon footprint using Digital Twin technology. It highlights the need for an interface to display environmental KPIs and to comply with upcoming regulatory requirements for carbon footprint reporting. The performance indicators include an increase in customer satisfaction and an improvement in MICUNA's production environmental profile, as stated in Figure 35.

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ID	26	Pilot #1 MIC			
Identification (role):		Environmental Manager	Functional Requirements:		Priority:
Performance (KPI):			R26.1	interface and analysis functions for environmental KPIs	M
increase in customer satisfaction (information on environ. performance:		5%-10%	R26.2	display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications	M
to implement at least of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%	R26.3	get and process external data regarding carbon footprint	M
Improvement of environ. profile of MICUNA's production (carbon footprint):		1%-2%			
User story:	Environmental Manager: I want to calculate the organisational carbon footprint of my company. Scope 1 and 2 (mandatory from 2025) with the Digital Twin tech.				
Operational:		Limitations:			
The implementation must comply with regulatory requirements related to carbon footprint reporting, particularly Scope 1 and 2 emissions, which are mandatory from 2025/6/7		Potential restrictions may include the need for investment in data infrastructure, sensors, and software systems to suppor the implementation of Digital Twin technology. Additionally, ensuring data accuracy and completeness may pose challenges, as well as the need for ongoing maintenance and updates to the system. The accuracy of the carbon footprint data provided by the suppliers could also be a limitation			

FIGURE 35 MIC USER STORY #26

The focus of the next user story is about the Environmental Manager to calculate and reduce the carbon footprint of transportation. It emphasizes the integration of different transportation options with their carbon footprints and the need to comply with environmental regulations. More details are shown in Figure 36.

ID	27	Pilot #1 MIC			
Identification (role):		Environmental Manager	Functional Requirements:		Priority:
Performance (KPI):			R27.1	display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications	M
increase in customer satisfaction (information on environ. performance:		5%-10%	R27.2	integration of different transportation options with their carbon footprint	M
to implement at least of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%	R27.3	get and process external data regarding carbon footprint	M
Improvement of environ. profile of MICUNA's production (carbon footprint):		1%-2%			
User story:	Environmental Manager: I want to calculate and reduce the carbon footprint of transport: supply chain and distribution.				
Operational:		Limitations:			
The implementation must comply with relevant environmental regulations governing carbon emissions in transportation. It should also adhere to industry standards for sustainable transportation practices.		Potential restrictions may include the need for collaboration with external transportation partners, data privacy considerations, and initial investment in technology and infrastructure for data collection and analysis.			

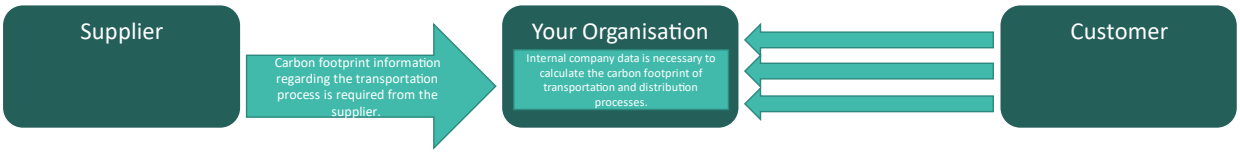

FIGURE 36 MIC USER STORY #27

Figure 37 details the environmental manager's focus on increasing the use of renewable materials and reducing packaging. KPIs include customer satisfaction and improvements in the environmental profile of production. The implementation must comply with environmental regulations and address potential challenges like material availability and cost.

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ID	28	Pilot #1 MIC			
Identification (role):		Environmental Manager	Functional Requirements:		Priority:
Performance (KPI):			R28.1	percantage of renewable material used for produced products visualised	C
increase in customer satisfaction (information on environ. performance:		5%-10%			
to implement at least of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%			
Improvement of environ. profile of MICUNA's production (carbon footprint):		1%-2%			
User story:	Environmental Manager: I want to increase the % of renewable materials used and reduce the amount of packaging				
Operational:		Limitations:			
The implementation must comply with relevant environmental regulations governing material sourcing and packaging standards. It should also align with sustainability certifications and guidelines for renewable material usage and packaging waste reduction.		Potential restrictions may include limitations in the availability and cost of renewable materials, technical challenges in redesigning packaging, and resistance to change from stakeholders accustomed to existing processes and materials.			

FIGURE 37 MIC USER STORY #28

Figure 38 illustrates the environmental manager's objective to increase the percentage of recycled materials used in production. It highlights operational requirements to align with sustainability standards and manage potential limitations such as technical challenges and stakeholder resistance.

ID	29	Pilot #1 MIC			
Identification (role):		Environmental Manager	Functional Requirements:		Priority:
Performance (KPI):			R29.1	facilitation of companies with waste as raw material (second life) as supplier	S
increase in customer satisfaction (information on environ. performance:		5%-10%			
to implement at least of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%			
Improvement of environ. profile of MICUNA's production (carbon footprint):		1%-2%			
User story:	Environmental Manager: I want to increase the % of recycled materials				
Operational:		Limitations:			
The implementation must comply with relevant environmental regulations governing material sourcing and packaging standards. It should also align with sustainability certifications and guidelines for renewable material usage and packaging waste reduction.		Potential restrictions may include limitations in the availability and cost of renewable materials, technical challenges in redesigning packaging, and resistance to change from stakeholders accustomed to existing processes and materials.			

FIGURE 38 MIC USER STORY #29

Figure 39 focus is on the product developer's need to evaluate different product design alternatives based on environmental information provided by suppliers. KPIs include improvements in customer satisfaction and the integration of environmental aspects into supplier assessments. Operational requirements emphasize data exchange and impact assessments.

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ID	30	Pilot #1 MIC			
Identification (role):		Product Developer	Functional Requirements:		Priority:
Performance (KPI):			R30.1	display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications	M
increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance:		5%-10%	R30.2	integration of different production route options with their carbon footprint	M
to implement at least 10 -15% of environ. aspects considered as criteria in supplier assessment and selection		5%-10%	R30.3	scenario evaluation	M
User story:	As a Product Developer, I want to evaluate different product design alternatives, using the environmental information provide d by my suppliers, with the proposal simulations supported by the IMC.				
Operational:		Limitations:			
The implementation must ensure seamless integration with supplier systems for data exchange, adhere to data privacy and security standards, and provide accurat and reliable environmental impact assessments		Potential restrictions may include the availability and quality of environmental data provided by suppliers, technical challenges in integrating diverse data sources, and resistance to change from traditional design processes.			

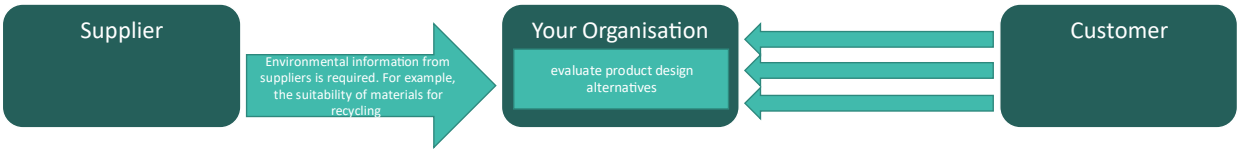

FIGURE 39 MIC USER STORY #30

Figure 40 shows the requirements of the Production Manager regarding biomass supply. It highlights the necessity of sourcing biomass from external companies and ensuring continuous supply. KPIs include improving the environmental profile of production and controlling the current biomass stock.

ID	31	Pilot #1 MIC			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R31.1	calculation of needed biomass	S
to implement at least of environ. aspects considered as criteria in supplier assessment and selection:		5%-10%	R31.2	control and inform about current stock of biomass	S
Improvement of environ. profile of MICUNA's production (carbon footprint):		1%-2%	R31.3	facilitation of companies with waste as raw material (second life) as supplier	S
User story:	As a Production Manager, I want to ensure the supply of biomass to the furnace, even from external companies.				
Operational:		Limitations:			
The implementation must meet criteria related to reliability, scalability, and efficiency to guarantee a feasible solution. This includes ensuring continuous biomass supply, minimizing disruptions, optimizing logistics, and complying with safety and regulatory standards.		Potential restrictions may include the availability and cost of biomass from external suppliers, transportation logistics challenges			

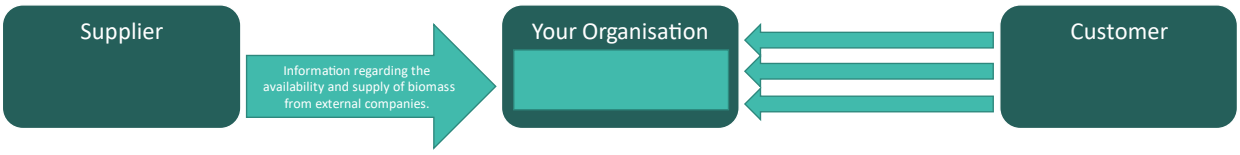

FIGURE 40 MIC USER STORY #31

3.2.2. Specific requirements for Pilot #2

The first user story outlines the performance metrics and requirements for the Purchase Manager focusing on supplier evaluation. It includes the need for analyzing supplier information, considering factors such as geographical location, costs, and carbon footprint to optimize raw material sourcing. In Figure 41 more information is stated.

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ID	1	Pilot #2 AID			
Identification (role):		Purchase Manager	Functional Requirements:		Priority :
Performance (KPI):			R1.1	analysis of contracted supplier information and capabilities	M
No direct impact. In combination with other requirements: Reduction in low -cost AM parts / Improvement in the part lead time in low -cost productions:		20% - 50%	R1.2	analysis of alternative supplier information and capabilities	M
Improvement in carbon footprint of components (including materials, production and delivery):		5%- 10%	R1.3	Analytical suggestions for new suppliers (best option regarding different points)	M
Improvement in OEE:		5-20%			
User story:	As a Purchase Manager, I want to identify suppliers of raw materials and consumables by getting alternatives (e.g., based on geographical location, costs, carbon footprint), so that I can select the most appropriate one to get the supply, with the supply chain management functionalities of the IMC.				
Operational:		Limitations:			
The alternatives should be evaluated through at least following criteria: geographical location, costs, carbon footprint and the quality standards defined by AIDIMME. A recommendation should be provided		Gathering necessary supplier related data could be difficult			

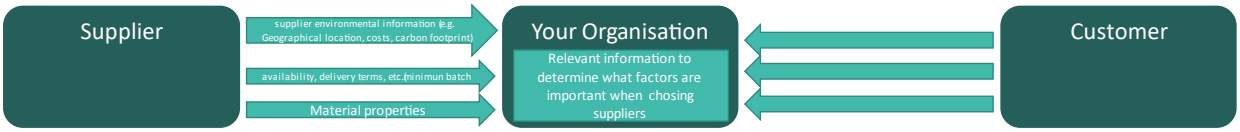

FIGURE 41 AID USER STORY #1

Figure 42 describes the needs of a Purchase Manager for managing material usage. It highlights the importance of historical data analysis to forecast material requirements and prevent stockouts, ensuring a smooth supply chain.

ID	2	Pilot #2 AID			
Identification (role):		Purchase Manager	Functional Requirements:		Priority :
Performance (KPI):			R2.1	management and analysis of historical data	M
Improvement in the part lead time in low -cost productions:		25% - 50%	R2.2	analysis of current project data and forecast of material usage including factors like seasonal fluctuations	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25%- 50%	R.2.3	stockout prediction and alert system	M
User story:	As a Purchase Manager, I want to foresee expenses of raw materials and consumables by retrieving historical data, so that I c an antipate to a stockout, with the supply chain management functionalities of the IMC.				
Operational:		Limitations:			
the solution should provide preliminary alerts when possible stockout is observed.		Gathering necessary own data could be difficult			

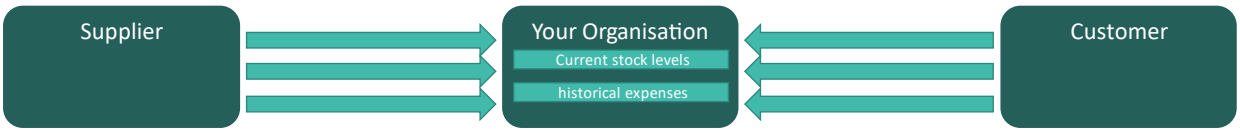

FIGURE 42 AID USER STORY #2

The next user story details the requirements for the Purchase Manager to monitor and address supply chain disruptions. The necessity of real-time alerts and processing information about disruptions from various sources, including suppliers and customers, is emphasized in Figure 43.

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ID	3	Pilot #2 AID			
Identification (role):		Purchase Manager	Functional Requirements:		Priority:
Performance (KPI):			R3.1	Get and process environmental disruptions incl. social, political and physical, e.g. relevant trade barriers	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25% - 50%	R3.2	Get and process disruption information from supplier/ customer	M
Improvement in the part lead time in low -cost productions:		25%- 50%	R.3.3	real-time monitoring and alert system	M
Improvement in OEE:		5-20%			
User story:	As a Purchase Manager, I want to identify the potential disruptions or patters or risks that may affect the supply chain, so that I can antipate to supply complications, with the machine learning, digital twin and AI analytics provided by the IMC.				
Operational:		Limitations:			
Proposed solutions should be aimed to tackle those disruptions by ensuring every and each of the links of the supply chain (feedstock, spare parts..)		data quality and data access			

FIGURE 43 AID USER STORY #3

Figure 44 presents the functional requirements for an Engineering Manager, focusing on the need for material data from suppliers and internal characterization. The KPIs include improvements in handling critical events, part lead times, and overall equipment effectiveness (OEE). The IMC platform should store and analyze material specifications, ensuring traceability and foreseeing potential issues with raw materials.

ID	4	Pilot #2 AID			
Identification (role):		Engineering Manager	Functional Requirements:		Priority:
Performance (KPI):			R4.1	material data from supplier and internal characterisation	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25% - 50%	R4.2	material data import to own internal system	M
Improvement in the part lead time in low -cost productions: 25% - 50% Improvement in OEE:		5%- 20%	R4.3	storage and analysis of materials specifications based on historical data (incidences)	M
User story:	As an Engineering Manager I would like to have traceability of the material feedstocks, when a batch of material is received, the IMC platform should store information about the batch in terms of: number of batch, specs, and even characterization if performed and provide with statictics to foresee possible issues in the raw material.				
Operational:		Limitations:			
ensure that batch information is accurately recorded and retrievable from the IMC platform. should facilitate easy access to batch data, adhere to data storage standards, and support the integration of characterization data if available.		training staff on the new system, ensuring data privacy and security measures are in place, and addressing potential compatibility issues with existing software or hardware infrastructure.			

FIGURE 44 AID USER STORY #4

The Purchase Manager needs a real-time warehouse management system with monitoring capabilities to track inventory and manage supplier delivery dates, regarding Figure 45. This includes alert systems for re-defined thresholds, aiding in supply chain risk management and improving lead times and operational equipment efficiency.

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ID	5	Pilot #2 AID			
Identification (role):		Purchase Manager	Functional Requirements:		Priority:
Performance (KPI):			R5.1	warehouse management system including real -time monitoring	M
Improvement in the part lead time in low -cost productions:		25% - 50%	R5.2	connection to supplier delivery dates	M
Improvement in OEE:		5-20%	R5.3	alert system related to pre -defined thresholds	M
User story:	As a Purchase Manager, I want to identify the potential disruptions or patters or risks that may affect the supply chain, so that I can anticipate to supply complications, with the machine learning, digital twin and AI analytics provided by the IMC.				
Operational:		Limitations:			
ensure real -time synchronization of warehouse data, user -friendly interface, accurate inventory tracking, customizable alert thresholds, and robust reporting functionalities.		system compatibility issues with existing warehouse management software, data accuracy challenges, potential resistance to change from users, and resource constraints for system implementation and maintenance.			

FIGURE 45 AID USER STORY #5

The Production Planner requires tools to forecast unexpected events that could affect additive manufacturing demand, such as disruptions in supply chains. Early indicators and predictive analytics will help in adapting production to meet sudden increases in demand, enhancing overall efficiency and responsiveness. This need is pictured in Figure 46.

ID	6	Pilot #2 AID			
Identification (role):		Production Planner	Functional Requirements:		Priority:
Performance (KPI):			R6.1	Get and process environmental disruptions, e.g. relevant trade barriers, with analysis of early indicators	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25% - 50%			
User story:	As a Production Planner, I would like to have a predictive tool to forecast unexpected events / trends when additive manufact uring will be highly demanded.; ie: when the Covid19 poped up, a massive amount of medical devices as: face masks, protective shields, mask pipes.. were needed and both production and development could hav e been adapted if we have had indicators.				
Operational:		Limitations:			
incorporate robust data collection mechanisms, accurate predictive models, scalable infrastructure for handling large datasets, integration capabilities with existing production planning systems, ensure data security and compliance with relevant regulations.		data availability and quality issues, the complexity of forecasting for unpredictable events, the need for continuous model refinement, and potential challenges in integrating predictive analytics into existing production planning workflows			

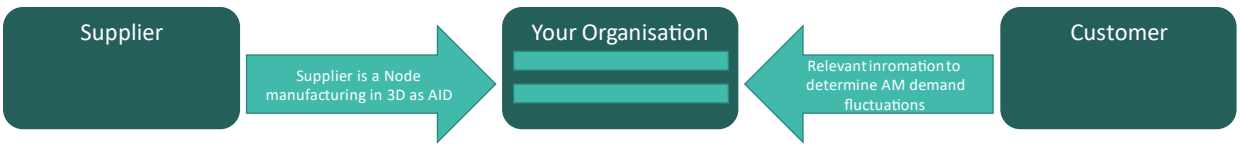

FIGURE 46 AID USER STORY #6

The Order Manager's requirements focus on integrating existing software into a centralized platform for order management to avoid disruptions such as incorrect manufacturing or finishing errors. The objectives include improving carbon footprint, lead times in low-cost productions, and overall equipment effectiveness. Details are shown in Figure 47.

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ID	7	Pilot #2 AID			
Identification (role):		Order Manager	Functional Requirements:		Priority:
Performance (KPI):			R7.1	integration of already used softwares in IMC or IMC needs order management functions itself	C
Improvement in carbon footprint of components (including materials, production and delivery):		5% - 10%			
Improvement in the part lead time in low -cost productions:		25%- 50%			
Improvement in OEE:		5-20%			
User story:	As an Order Manager, I want to improve the order management, so that I can avoid order disruptions (e.g., wrong manufactured pieces, wrong number, wrong finishings), with the use of one single centralised platform instead of several ones (e.g., ERP, Excel).				
Operational:		Limitations:			
ensure seamless integration with existing systems and data sources, support for diverse order types and formats, scalability to accommodate growing order volumes, data integrity and security measures, compliance with relevant standards and regulations, and user training and support provisions.		data migration and system integration efforts, potential resistance to change from users accustomed to existing workflows, challenges in ensuring data accuracy and consistency across systems, and resource constraints for implementation and ongoing maintenance.			

FIGURE 47 AID USER STORY #7

Figure 48 focuses on the Engineering Manager's requirement for maintaining an overview of warehouse inventory, including order quantities and delivery dates. It highlights the necessity of real-time data on stock levels and incoming shipments to optimize inventory management, aiming to improve overall efficiency and reduce the risk of stockouts.

ID	8	Pilot #2 AID			
Identification (role):		Engineering Manager	Functional Requirements:		Priority:
Performance (KPI):			R8.1	notifications about historical problems and mistakes with same/ slightly different parts	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25% - 50%	R8.2	data base where we can upload refernece s, feedback about how each reference was manufactured and feedback about distortions / deformations if observed	S
Improvement in the part lead time in low -cost productions:		25%- 50%			
Improvement in OEE:		5-20%			
User story:	As an engineering manager I would like to have an automated response / advice upon geometries that are potentially risky in t erms of distortions / deformations or potential fail. This trends could be foreseen based on previous experencies / feedback gathered from the process and from previous produced parts. thus the IMC could integrate predictive tools based on experiences.				
Operational:		Limitations:			
Ideally, the analysis of a 3D model should generate enough ouputs to assess wheter or not this geometry has potentially risky features.		Relevant criteria necessary to determine wether product is risky			

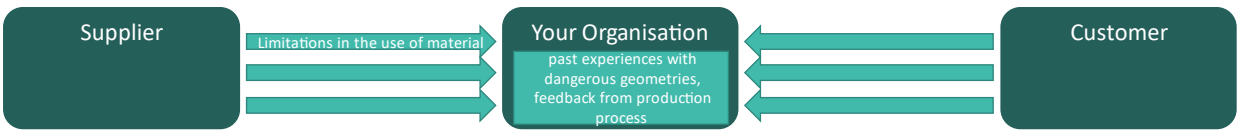

FIGURE 48 AID USER STORY #8

Figure 49 addresses the requirements for real-time monitoring of production machines to enhance workflow optimization for production planners. It emphasizes the necessity of an alert system to handle unexpected downtimes and machine issues, aiming to improve part lead times and overall equipment efficiency. The user story illustrates a production planner's need to stay updated on machine statuses, such as downtimes and bottlenecks, to effectively replan build jobs using the IMC's management functionalities.

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ID	9	Pilot #2 AID			
Identification (role):		Production Planner	Functional Requirements:		Priority:
Performance (KPI):			R9.1	real-time monitoring of production machines	M
Improvement in the part lead time in low -cost productions:		25% - 50%	R9.2	implementation of alert system for unexpected downtimes or issues	M
Improvement in OEE:		5-20%	R9.3	support system for optimal workflow for production planning	M
User story:	As a Production Planner, I want to be aware of the status of the production machines (e.g., downtimes, workloads, bottlenecks , etc.), so that I can replan the build jobs working in an optimal way, with the management functionalities provided by the IMC.				
Operational:		Limitations:			
Machine relevant data: downtime, workloads, bottlenecks, etc.		Gathering of necessary information to predict bottlenecks, limited access to machine APIs			

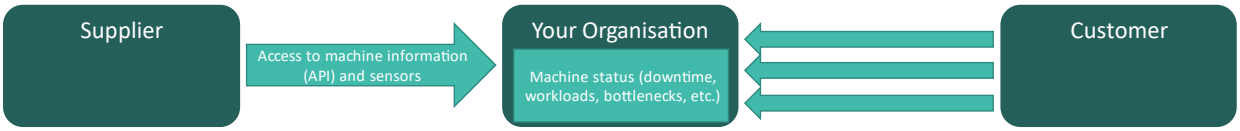

FIGURE 49 AID USER STORY #9

The focus in Figure 50 is on the Production Planner's need for dynamic delivery forecasts. The slide discusses the improvement of delivery schedules based on job queue and order demand, leveraging historical data for better production planning. Improved KPIs are against unwanted critical events and in part lead time.

ID	11	Pilot #2 AID			
Identification (role):		Production Planenr	Functional Requirements:		Priority:
Performance (KPI):			R11.1	generate dynamic delivery forecasts based on the job queue, order demand, and new order entries	M
Improvement in carbon footprint of components (including materials, production and delivery):		5%-10%	R11.2	analysis of historical delivery and production data	M
Improvement in the part lead time in low -cost productions:		25%- 50%			
Improvement in OEE:		5%-20%			
User story:	As a Production Planner, I want to get delivery forecasts based on the job queue, the order demand, and the entry of new orde rs, so that I can improve the delivery and production schedule, with the management functionalities provided by the IMC.				
Operational:		Limitations:			
Job queue, order demand and entry of new orders should be considered					

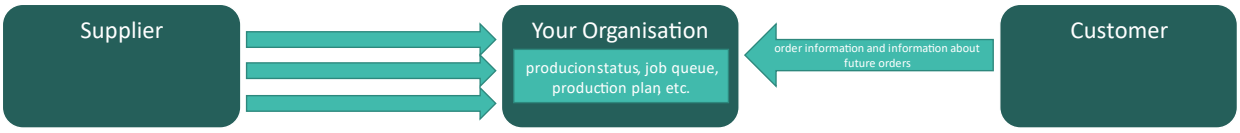

FIGURE 50 AID USER STORY #11

The requirements from the Production Planner center on managing and assigning tasks to work teams. It highlights the importance of tracking human resource availability and adapting to potential disruptions to ensure efficient workflow management. Details are written in Figure 51.

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ID	12	Pilot #2 AID			
Identification (role):		Production Planenr	Functional Requirements:		Priority:
Performance (KPI):			R12.1	manage and assign tasks to different work teams	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25%-50%	R12.2	human resources availability tracking and account for possible disruptions like illness	M
			R12.3	functionality for dynamic task reassignment based on real -time availability and disruptions,	M
User story:	As a Production Planner, I want to get delivery forecasts based on the job queue, the order demand, and the entry of new orde rs, so that I can improve the delivery and production schedule, with the management functionalities provided by the IMC.				
Operational:		Limitations:			
		Illness can not be predicted			

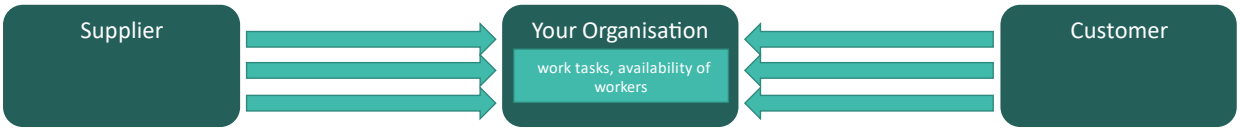

FIGURE 51 AID USER STORY #12

The next requirements in Figure 52 emphasize the need for real-time visibility into the status of work. It details how the Production Planner can improve work management by tracking the completion and post-process stages, as well as the number of pieces produced. The implementation would have an impact for unwanted critical events and part lead time.

ID	13	Pilot #2 AID			
Identification (role):		Production Planner	Functional Requirements:		Priority:
Performance (KPI):			R13.1	real-time visibility into the status of each work, including completion, post-process, and the number of pieces produced	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25%-50%			M
Improvement in the part lead time in low -cost productions:		25%-50%			M
User story:	As a Production Planner, I want to be aware of the status of every work (e.g., it is done, it is in postprocess, number of pi eces produced) not only the manufactuturing technician, so that I can improve the work management, with the management functionalities provided by the IMC.				
Operational:		Limitations:			

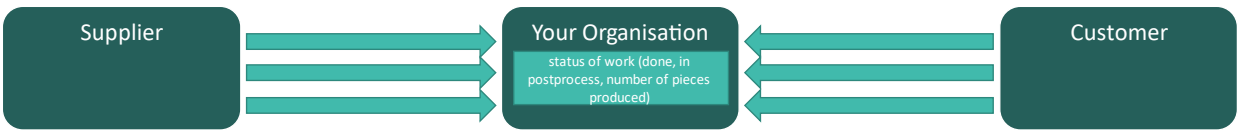

FIGURE 52 AID USER STORY #13

Figure 53 describes the Production Manager's need to create and manage part specification data sheets. It includes details such as part 3D screenshots, customer information, material technology, and quality control features to prevent disruptions.

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ID	14	Pilot #2 AID			
Identification (role):		Production Manager	Functional Requirements:		Priority :
Performance (KPI):			R14.1	interface for creating and managing part specification data sheets including 3D screenshot, customer details, part name, material, technology, quantity to be produced, and special finishes/features for post -processes and quality control	M
Reduction in low -cost AM parts:		20%-30%			
Improvement in the part lead time in low -cost productions:		25%-50%			
Improvement in OEE / Improvement in carbon footprint of components (including materials, production and delivery):		5%-10% / 20%			
User story:	As a Production Manager, I would like to have a tool to create a "part specification data sheet" for each order that is proce ssed, this data sheet should include crucial information about each 3D model as: part 3D screenshot, customer, part name, material, technology, number of parts to be produced, special finishes / features to be controlled in p ost processes / quality control with the management functionalities provided by the IMC.This "part specification data sheet" should be controlled by the production manager but aims to support the machine technicians to avoid eventual disruptions as: wrong finishes / quality checks, number of parts produced..				
Operational:		Limitations:			

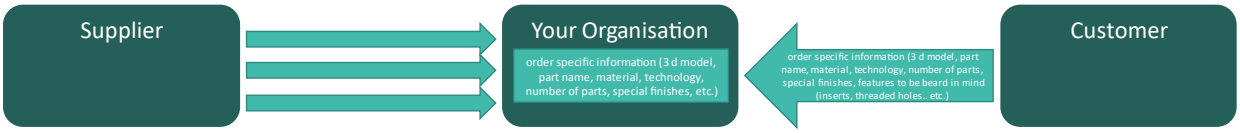

FIGURE 53 AID USER STORY #14

User story #15 in Figure 54 outlines the functionality required by the Manufacturing Technician for arranging build jobs based on priority. It includes the need for an intelligent tool to dynamically adjust the production plan according to delivery terms and other factors.

ID	15	Pilot #2 AID			
Identification (role):		Manufacturing Technician	Functional Requirements:		Priority :
Performance (KPI):			R15.1	information overview about build jobs based on priority, considering agreed delivery terms	M
No direct impact. In combination with other requirements: Improvement in the part lead time in low -cost productions:		25%-50%	R15.2	functionality to dynamically adjust the production plan	M
Improvement in the part lead time in low -cost productions: (decreases lead time depending on priority of the orders)		25%-50%			
User story:	As a Manufacturing Technician, I would like to have a smart tool to support me when arranging the build jobs. Currently we receive orders every day that are addressed based on a term delivery agreed between the Order manager and the customer, this priority is reflected in the planification excel file. Having a smart tool provided by the IMC to organize the production would be helpful.				
Operational:		Limitations:			
		Needs to also take other aspects into account: supplier delivery, machine downtime, etc.			

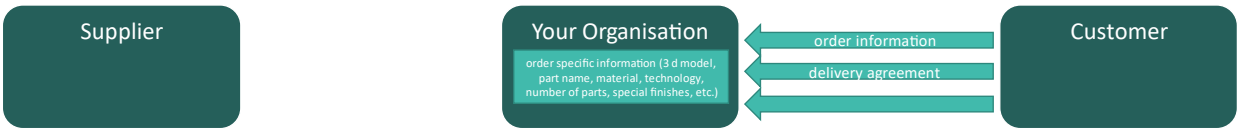

FIGURE 54 AID USER STORY #15

Figure 55 discusses the integration of real-time machine data and log files for the Production Manager. It highlights the importance of analyzing this data to troubleshoot build failures and improve overall equipment efficiency.

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ID	16	Pilot #2 AID			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R16.1	integration capabilities for realtime machine data and log files	M
Reduction in low -cost AM parts:		20%-30%	R16.2	analysis of information gathered during the processes (log file) to ease troubleshooting when certain build fails.	M
Improvement in the part lead time in low -cost productions:		25%-50%			
Improvement in OEE:		5%-20%			
User story:	As a Production Manager, I want to get integrated information about the overall production process (e.g., realtime machine data, Log files, etc.), so that I can anticipate to manufactuing failures, with the machine learning, digital twin and AI analytics provided by the IMC.				
Operational:		Limitations:			
		Log files are very detailed and provide a huge amount of information to be managed.			

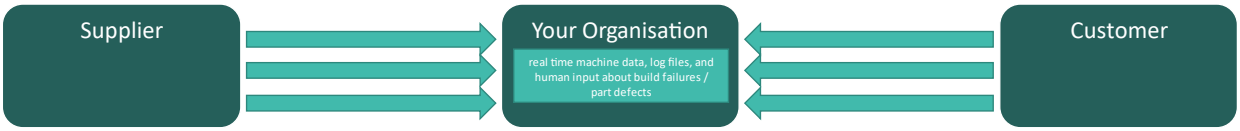

FIGURE 55 AID USER STORY #16

Figure 56 outlines the functional requirements for the Production Manager, focusing on receiving notifications when defects or issues are identified during quality control. Key performance improvements include reducing critical events and improving lead times by integrating quality control information. This enhances the overall product lifespan by facilitating easier access to replacement parts.

ID	17	Pilot #2 AID			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R17.1	notifications for when machine technicians identify defects or issues during quality control of parts	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25%-50%	R17.2	integration of quality controlinformations	M
Improvement in the part lead time in low -cost productions:		25%-50%	R17.3	This user story should be linked to row 8 as defects / issues should be registered for each	M
potential product lifespan extension by easy and reduced cost access to replacement parts (reparability increased at use location)		15%			
User story:	As a Production Manager, I want torecieve warnings when machine technicians perform quality control over the parts to be shipped and defects / issues are identifiedhis feedback should trigger alarms to review and reschedule if needed the parts, with the management functionalities provided by the IMCollect data and automatically generate QC reports and statictics				
Operational:		Limitations:			
Connection to quality control process		Warning system of this nature should already exist? Technicians should have clear instructions on what is acceptable and what is not			

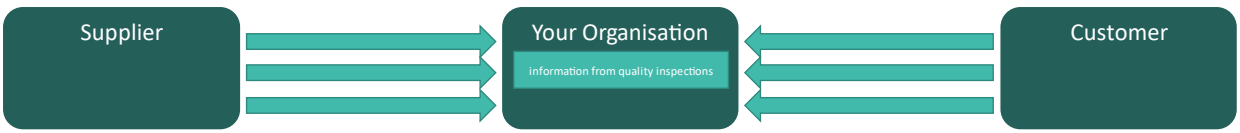

FIGURE 56 AID USER STORY #17

The requirements in Figure 57 detail the needs for the Production Planner, emphasizing the need for notifications about machine disruptions. It highlights performance improvements in reducing critical events and lead times through better disruption management, such as rescheduling builds or outsourcing production. This helps in addressing bottlenecks and maintaining smooth production workflows.

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ID	18	Pilot #2 AID			
Identification (role):		Production Planner	Functional Requirements:		Priority:
Performance (KPI):			R18.1	notifications about machine disruptions	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25%-50%	R18.2	Provide solutions to tackle those disruptions bysuggesting: build reschedule / production addressed by otherpartners.	M
Improvement in the part lead time in low -cost productions:		25%-50%			
Reduction in low-cost AM parts:		20%-30%			
User story:	As a Production Planner, I want to be aware of machine breaks, so that I can take appropriate actionsaccelaratingthe response ahead of these problems, thosespones may affect internally (reschedule the build), or externally (outsourcing) with the management functionalities provided by the IMC.				
Operational:		Limitations:			

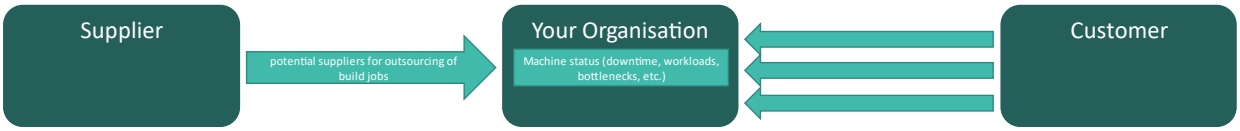

FIGURE 57 AID USER STORY #18

The next user story details focuses on the Logistics Manager's need for up-to-date delivery statuses from suppliers. It underscores the importance of having a system that provides real-time updates and notifications of any changes, thereby improving lead times and production management. This integration aims to optimize logistics planning and execution processes. This is detailed in Figure 58.

ID	19	Pilot #2 AID			
Identification (role):		Logistics Manager	Functional Requirements:		Priority:
Performance (KPI):			R19.1	real-time information from supplier for monitoring of deliveries	S
Improvement in the part lead time in low -cost productions:		25%-50%	R19.2	interface for providing the information	S
			R19.3	change notification	S
User story:	As a logistics manager, I want to be aware of the status of the deliveries, so that I can improve the delivery and productionmanagement, with the management and notification functionalities provided by the IMC.				
Operational:		Limitations:			

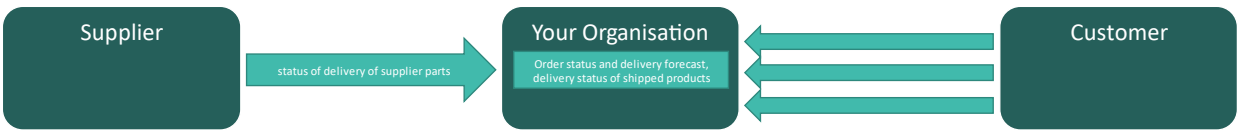

FIGURE 58 AID USER STORY #19

The requirements in Figure 59 describe the Logistics Planner's wish for automated label generation and parcel tracking capabilities. It aims to improve environmental sustainability by reducing the carbon footprint and enhancing parcel traceability. These features are designed to ensure efficient and accurate shipping operations, minimizing the chances of parcel misdirection.

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ID	20	Pilot #2 AID			
Identification (role):		Logistics Planner	Functional Requirements:		Priority:
Performance (KPI):			R20.1	automatic label generation	C
Improvement in carbon footprint of components (including materials, production and delivery)		5%-10%	R20.2	parcel traceability	C
Reduction in low-cost AM parts:		20%-30%			
User story:	Shipping is eventually a source of disruptions. As a logistic planner, I would like to have traceability of each parcel; Currently the labels are generated manually (in a specific labelling software), however, once the order isplaced I understand that labels could be processed automatically based on each company specificationsin(some occasions we found issues as the company have more than one operating center and parts were sent to the wrong direction).				
Operational:		Limitations:			

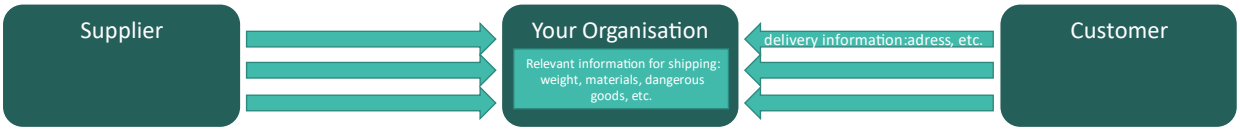

FIGURE 59 AID USER STORY #20

Figure 60 addresses the needs of a Customer Assistant, who requires comprehensive access to product and manufacturing data. It aims to improve the customer experience by enhancing information visualization and minimizing critical events during the 3D printing process. This ensures that customers receive detailed and accurate information about their orders, leading to higher satisfaction and fewer errors.

ID	21	Pilot #2 AID			
Identification (role):		Customer Assistant	Functional Requirements:		Priority:
Performance (KPI):			R21.1	access to relevant product and manufacturing information	S
Improvement against unwanted critical events that may happen on the 3D printing process:		25%-50%	R21.2	interface forvisualisationof information	M
Improvement in the part lead time in low -cost productions:		25%-50%			
Reduction in low-cost AM parts:		20%-30%			
User story:	As a Customer Assistant, I want to provide reliable information about the piece to be manufactured (e.g., reliable 3D representation, measurement units, valid graphic format, too heavy files, low faceted representation, several shells, etc.) in the offer to the customer, so that potential deviations may be foreseen, with the management functionalities provided by the IMC.				
Operational:		Limitations:			
When issues / defects are identified in certain 3D Models, the customer shoud receive clear and concise information about the fixed part before proceed with the manufacturing					

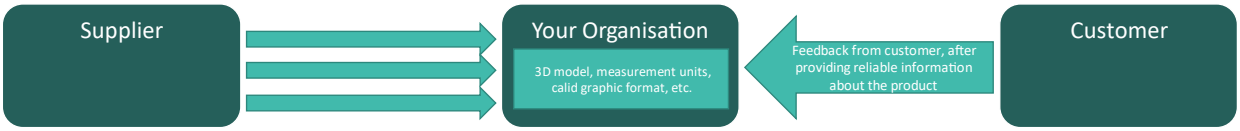

FIGURE 60 AID USER STORY #21

For the Engineering Manager, traceability of changes throughout the service process and clear documentation of modifications is needed. Performance improvements are aimed at reducing lead times for low-cost productions. The user story highlights the engineering manager's requirement for straightforward communication with customers about modifications, ensuring transparency and alignment to avoid mistakes. This is illustrated in Figure 61.

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ID	22	Pilot #2 AID			
Identification (role):		Engineering Manager	Functional Requirements:		Priority:
Performance (KPI):			R22.1	traceability of changes through the service process	M
Improvement in the part lead time in low -cost productions:		25%-50%	R22.2	interface with clear documentation and visibility of any modifications made	M
User story:	As an engineering manager I would like to have a straightforward communication with the customer in certain orders where due to: shape, size, special features, part functionality are not clear. Having traceability of each modification (if done).				
Operational:		Limitations:			
Once the 3D model is reviewed by the engineering team, the customer shoud receive clear and concise information about the fixed part before proceed with the manufacturing					

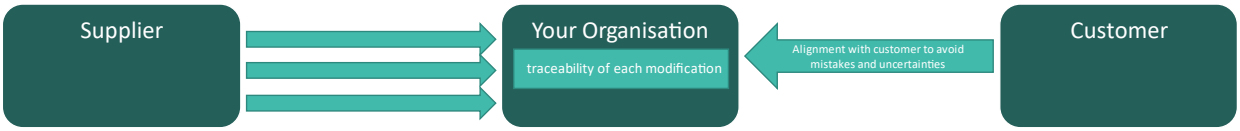

FIGURE 61 AID USER STORY #22

The requirements for the Customer Assistant in Figure 62 focus on providing customers with material and machine design guidelines. It addresses the need to communicate process limitations effectively, especially for customers new to additive manufacturing, to set reliable expectations.

ID	23	Pilot #2 AID			
Identification (role):		Customer Assistant	Functional Requirements:		Priority:
Performance (KPI):			R23.1	Customer should have quick access to "material+machine" design guidelines and limitations	S
Improvement against unwanted critical events that may happen on the 3D printing process:		25%-50%	R23.2	if the part provided by the customer presents geometries that are not feasible for the process (i.e wall thickness)	S
Improvement in the part lead time in low -cost productions:		25%-50%			
Reduction in low -cost AM parts:		20%-30%			
User story:	As a Customer Assistant, I want to notify process limitations to the customer (e.g., especially when it is the first time that the customer uses additive manufacturing), so that the client can get reliable expectations based on the limitation's awareness, with the communication functionalities provided by the IMC				
Operational:		Limitations:			
Instructions should be clear and understandable to non -experts. Limitations should be understandable to people who have not previously used the product.		Sometimes, the person who is asking / ordering parts does not have technical knowledge about the part itself. Thus information should reach the right person (design engineers)			

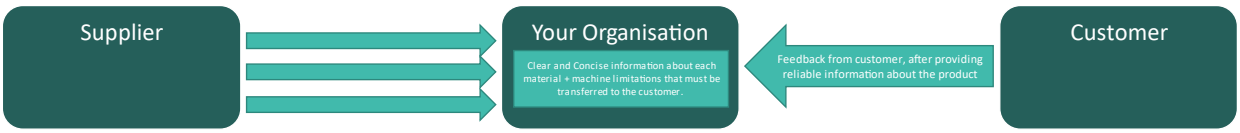

FIGURE 62 AID USER STORY #23

In Figure 63, the Customer Assistant provides the need for real-time monitoring of production machines for a Customer Assistant. The importance of keeping customers informed about the status of their orders and any potential production capacity issues is emphasized. This could Improve against unwanted critical events.

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ID	24	Pilot #2 AID			
Identification (role):		Customer Assistant	Functional Requirements:		Priority:
Performance (KPI):			R24.1	real-time monitoring of production machines	M
Improvement against unwanted critical events that may happen on the 3D printing process:		25%-50%			
User story:	As a Customer Assistant, I want to be aware of the status of every work (e.g., it is done, it is in postprocess, number of pieces produced) so that I can improve the work management. This information will be used to keep the customer updated about the status of the job queue and the machine availability (with control of the Order Manager to forecast based on client and needs), so that the client can be aware of the production capacity before requesting an order, with the management functionalities provided by the IMC.				
Operational:		Limitations:			
accurate information about each order status, set alarms when unexpected events arise to update the status and react upon them					

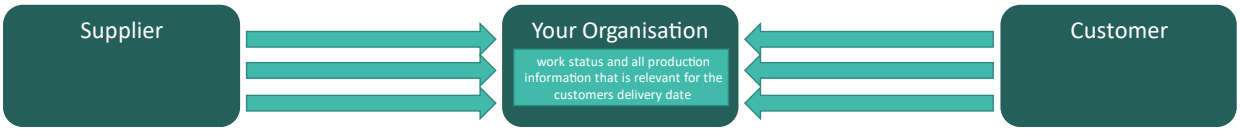

FIGURE 63 AID USER STORY #24

Again for the Customer Assistant, Figure 64 highlights the requirement for real-time monitoring and alert systems to inform customers about machine failures. It underscores the need for timely communication and possible solutions to address any issues that arise.

ID	25	Pilot #2 AID			
Identification (role):		Customer Assistant	Functional Requirements:		Priority:
Performance (KPI):			R25.1	real-time monitoring and alert system	M
			R25.2	information flow to customer	S
User story:	As a Customer Assistant, I want to provide information to the customer about machine failures, so that they can be aware of t his problem as soon as possible, with the management functionalities provided by the IMC.				
Operational:		Limitations:			
Machine failure information should be followed by possible solutions					

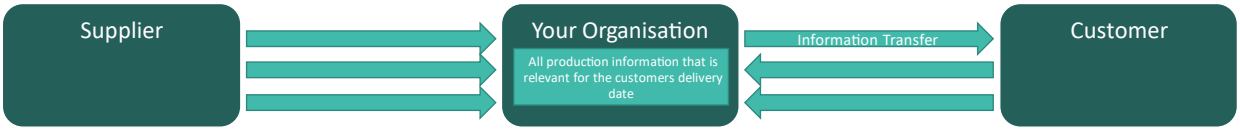

FIGURE 64 AID USER STORY #25

The next user story describes the requirement for a Customer Assistant to connect with transportation partners. It emphasizes the need for an interface to provide customers with real-time delivery status and traceability of their packages. This helps with unwanted critical events and is detailed in Figure 65.

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ID	26	Pilot #2 AID			
Identification (role):		Customer Assistant	Functional Requirements:		Priority:
Performance (KPI):			R26.1	connection to transportation partner	S
Improvement against unwanted critical events that may happen on the 3D printing process:		25%- 50%	R26.2	interface for customer for delivery status	S
User story:	As a Customer Assistant, I want to share information about the delivery status with the customers, so that the client can be aware of the reception of the items and better manage their supply processes, with the management and notification functionalities provided by the IMC.				
Operational:		Limitations:			

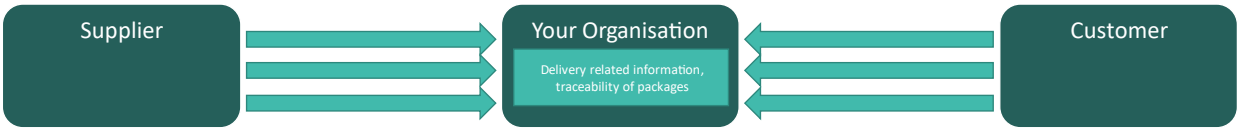

FIGURE 65 AID USER STORY #26

The focus of the user story in Figure 66 is on the Purchase Manager's need for sustainability information from suppliers. The figure details the requirements for collecting and analyzing data on recycled materials, carbon footprint, and other environmental factors to calculate the organization's environmental profile.

ID	27	Pilot #2 AID			
Identification (role):		Purchase Manager	Functional Requirements:		Priority:
Performance (KPI):			R27.1	Interface at supplier and own organisation side for sustainability information input (e.g. content of recycled, renewable materials, carbon footprint or even environmental product declaration)	M
Improvement in carbon footprint of components (including materials, production and delivery):		5%- 10%	R27.2	Interface at own organisation and customer side for visualization of sustainability information	S
Reduction in energy consumption:		2 – 10 % (g)20 – 30%	R27.3	Information flow system	M
User story:	As a Purchase Manager, in research projects or for customers, we need to know sustainability information related to raw materials or consumables that are being used in the Additive manufacturing process mainly (content of recycled, renewable materials, carbon footprint or even environmental product declaration. this will be used to calculate our own environmental profile for our customers.				
Operational:		Limitations:			
accurate data collection and analysis of sustainability information for raw materials and consumables and own processes					

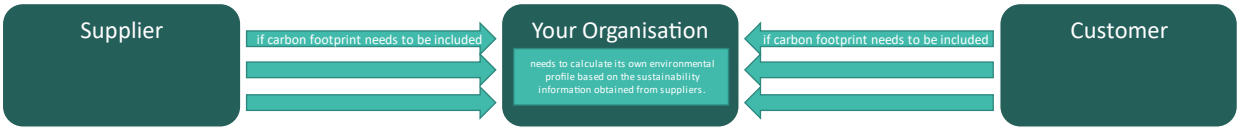

FIGURE 66 AID USER STORY #27

For the focus of waste management, the Production Manager requires in Figure 67 functionalities for managing inventory of waste materials and exploring industrial symbiosis opportunities to reduce waste and potentially lower costs. This plan may be limited through market demand.

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ID	28	Pilot #2 AID			
Identification (role):		Production Manager	Functional Requirements:		Priority :
Performance (KPI):			R28.1	manage inventory of waste materials generated during the production process, including metal or polymer powders and support structures and to find potential industrial symbiosis options (companies near me to use mu waste as a raw material)	S
Improvement of waste management generated by my production processes and potential cost reduction.			R28.2	Connection with a local platform on industrial symbiosis	S
User story:	As Production Manager, we generate part of the material used as waste (metal or polymer powders and support structures. we wo uld like to sell them (industrial symbiosis)				
Operational:		Limitations:			
ensure efficient management of waste materials inventory, accurate pricing based on market conditions, secure communication channels for interacting with buyers, and reliable tracking of sales transactions		The effectiveness of the solution may be limited by market demand for waste materials, regulatory constraints on the sale of certain materials, and logistical challenges in coordinating transactions with buyers			

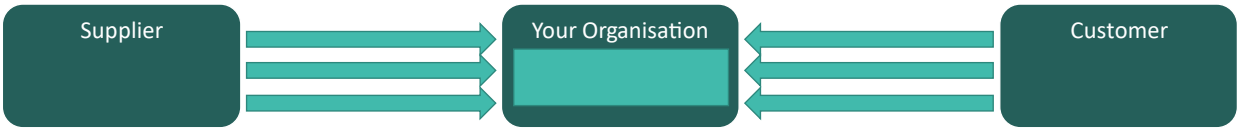

FIGURE 67 AID USER STORY #28

Figure 68 describes the need for automatic calculation of energy demand and other environmental KPIs for a Production Manager. It emphasizes the importance of accurate calculations to improve the carbon footprint and efficiency of production processes.

ID	29	Pilot #2 AID			
Identification (role):		Production Manager	Functional Requirements:		Priority :
Performance (KPI):			R29.1	automatic energy demand (and other environmental KPIs) calculation related to production processes and materials	M
Improvement in carbon footprint of components (including materials, production and delivery):		5%-10%			
User story:	As Production Manager, i would like to have a tool to calculate the energy demand and related product carbon footprint and another environmental infor mation, considering (raw materials used (type and amount), depending on the specific production batch, process efficiency).				
Operational:		Limitations:			
ensure accurate calculation of energy demand and carbon footprint, taking into account variations in raw material composition and process efficiency across different production batches		the complexity of integrating the solution with existing manufacturing systems			

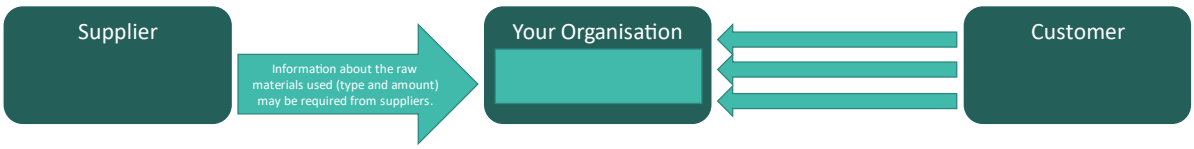

FIGURE 68 AID USER STORY #29

The Customer Assistant needs an interface for real-time communication about work status and production information relevant to delivery dates, shown in Figure 69. This system will improve customer service by providing timely updates and enhancing overall operational transparency.

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ID	30	Pilot #2 AID			
Identification (role):		Customer Assistant	Functional Requirements:		Priority:
Performance (KPI):			R30.1	display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications	M
Improvement in carbon footprint of components (including materials, production and delivery):		5%-10%	R30.2	integration of different transportation options with their carbon footprint	M
			R30.3	scenario evaluation (decentralized production	M
User story:	As a Customer Assistant, i would like to provide to my clients environmental information from our products but also the transportation carbon footprint that can be avoided by decentralized production vs their current logistic processes. Also for replacement parts.				
Operational:		Limitations:			
capable of integrating with existing systems to access relevant product and transportation information		complexity of integrating with existing systems			

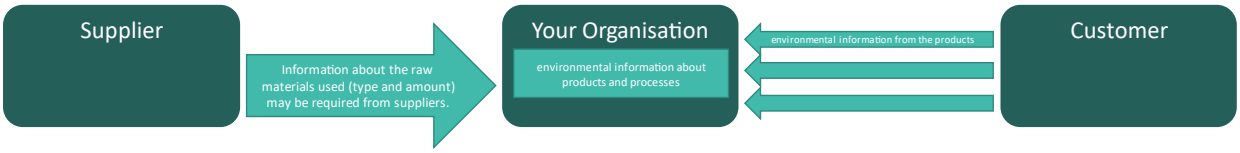

FIGURE 69 AID USER STORY #30

Figure 70 highlights the need to automate the generation of delivery notes based on feedback from manufacturing technicians, linking this process to the ERP system. This integration aims to reduce the lead time for parts in low-cost productions and to improve the carbon footprint of components. The operational requirements include accurate feedback capture and data consistency within the ERP system, with potential challenges in system integration.

ID	31	Pilot #2 AID			
Identification (role):		Production Planner	Functional Requirements:		Priority:
Performance (KPI):			R31.1	integration of ERP in IMC	M
Improvement in the part lead time in low -cost productions:		25%-50%	R31.2	interface for generating automatically delivery notes	C
Improvement in carbon footprint of components (including materials, production and delivery):		5%-10%			
User story:	As a production planner, I would like to automate the generation of delivery notes based on the feedback given by the manufac turing technician. this must be linked to our ERP.				
Operational:		Limitations:			
Accurately capture feedback from manufacturing technicians.Integrate with the company's ERP system to ensure data consistency and integrity.		complexity of integration with the ERP system, potential technical issues during implementation			

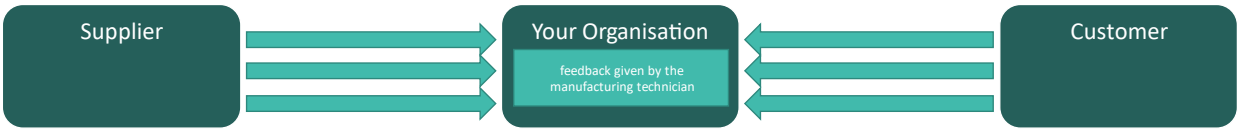

FIGURE 70 AID USER STORY #31

3.2.3. Specific requirements for Pilot #3

The first user story of the third pilot is pictured in Figure 71. The Managing Director needs support for audit planning and verification of document completeness to ensure smooth process certification. This involves timely availability and accessibility of documentation from suppliers, aiding in compliance with regulatory standards and enhancing the certification process. The aim is to ensure that all necessary documents are complete and readily available for audits.

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ID	1	Pilot #3 BUD			
Identification (role):		Managing Director	Functional Requirements:		Priority:
Performance (KPI):			R1.1	support in audit plan	S
			R1.2	check and support completeness of necessary documents	M
User story:	As a managing director, I would like an audit plan so that my processes are certified. The availability of documents should b e checked in good time. (Documents from the supplier)				
Operational:		Limitations:			
accessibility of documents					

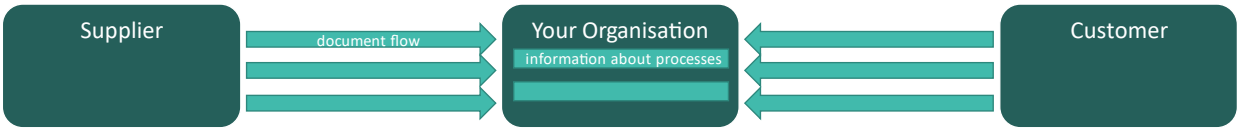

FIGURE 71 BUD USER STORY #1

Figure 72 focuses on the Managing Director's need to track the composition of purchased parts to meet legal and customer sustainability requirements. The system should provide detailed supplier information on materials used, facilitating compliance with environmental regulations and sustainability standards. This helps in maintaining transparency and accountability in the supply chain.

ID	2	Pilot #3 BUD			
Identification (role):		Managing Director	Functional Requirements:		Priority:
Performance (KPI):			R2.1	interface for supplier	S
			R2.2	integration of ingredients of purchased parts	M
			R2.3	links to necessary legal and customer requirements	M
User story:	As a managing director, I would like an overview of the ingredients of my purchased parts in order to be able to fulfill legal and customer requirements for sustainability				
Operational:		Limitations:			
accurate information from suppliers, sustainability requirements should be known		quality of information relies on suppliers, could be difficult if there are many sub -suppliers			

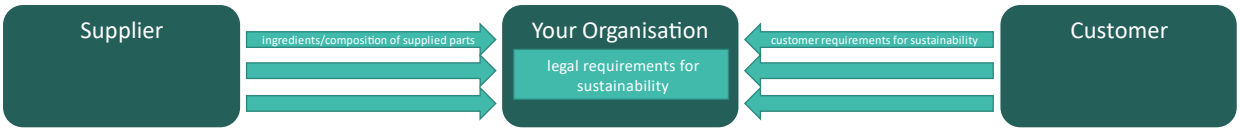

FIGURE 72 BUD USER STORY #2

The Project Manager requires an interface that connects directly to the customer to streamline production processes and improve delivery performance. This includes tracking project orders, managing adjustments, and ensuring that production timelines are met, which is presented in Figure 73. The goal is to reduce production times and enhance the accuracy and reliability of on-time deliveries.

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ID	3	Pilot #3 BUD			
Identification (role):		Project Manager	Functional Requirements:		Priority:
Performance (KPI):			R3.1	Connection to customer	S
Reduction of the production time		~ 60%	R3.2	Interface for project orders	M
Improvement of on-time delivery rate		~ 10%	R3.3	Tracking of changes and adjustments	M
User story:	As a project manager, I want a direct link to the customer so that I can make changes to the order and adjustments quickly				
Operational:		Limitations:			

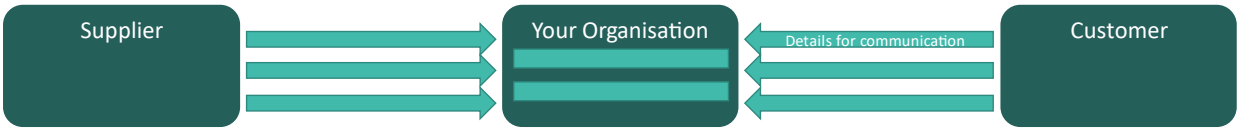

FIGURE 73 BUD USER STORY #3

Another user story from the Managing Director, shown in Figure 74, aims to track products throughout their life cycle to support recycling initiatives and the secondary market. The system should gather detailed product information and calculate value for companies using waste as raw material, promoting sustainable practices and optimizing resource utilization. This helps in creating a circular economy by ensuring product traceability.

ID	4	Pilot #3 BUD			
Identification (role):		Managing Director	Functional Requirements:		Priority:
Performance (KPI):			R4.1	product tracking	M
			R4.2	value calculation regarding tracking	M
			R4.3	facilitation of companies with waste as raw material (second life) as customer	C
User story:	As a managing director, I want to track my products in order to serve the secondary market, buy back products and keep the old products in circulation through recycling				
Operational:		Limitations:			
information about product needs to be gathered throughout entire life cycle		product information throughout entire life -cycle necessary			

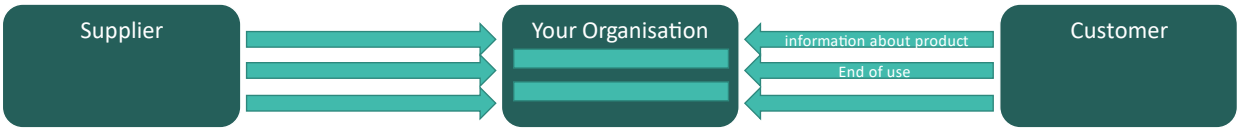

FIGURE 74 BUD USER STORY #4

According to Figure 75, the Production Manager needs a notification system for non-certified parts to ensure compliance and improve delivery reliability. This involves evaluating and certifying product parts and materials, ensuring that only certified components are used in production. The objective is to minimize disruptions and enhance the quality and reliability of the production process.

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ID	5	Pilot #3 BUD			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R1.1	notification function	M
Improvement of on-time delivery rate		~10%	R1.2	evaluation of certification of product parts and materials	M
Reduction in identification of potential disruptions		~35%			M
User story:	As a production manager I would like to receive a warning for non -certified parts				
Operational:		Limitations:			
necessary information to determine whether part is certified or not		Evaluation could be difficult			

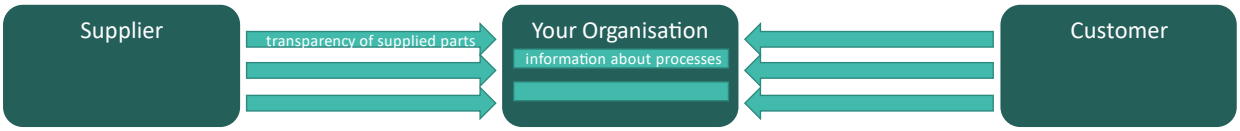

FIGURE 75 BUD USER STORY #5

Figure 76 outlines the need for real-time order monitoring for a Project Manager. The key performance indicators (KPIs) to be improved include the on-time delivery rate and the reduction in the identification of potential disruptions. This will be achieved by providing an interface to monitor deliveries in real-time and notify about any changes.

ID	6	Pilot #3 BUD			
Identification (role):		Project Manager	Functional Requirements:		Priority:
Performance (KPI):			R6.1	real-time information from supplier for monitoring of deliveries	S
Improvement of on-time delivery rate		~10%	R6.2	interface for providing the information	M
Reduction in identification of potential disruptions		~35%	R6.3	change notification	M
User story:	As a project manager, I want real -time order monitoring so that I can constantly check the status of the delivery.				
Operational:		Limitations:			
relevant information to determine delivery status needs to be determined		Gathering all necessary information, accuracy of information			

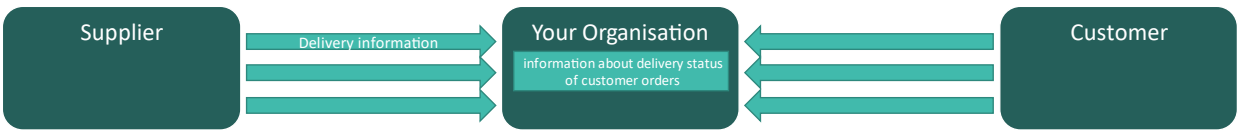

FIGURE 76 BUD USER STORY #6

For the Logistics Manager, Figure 77 details the requirement for real-time delivery monitoring and the evaluation of alternative transportation partners. The focus is on enhancing the on-time delivery rate and reducing disruptions by analyzing and suggesting new transportation options based on various metrics like routes, rates, and delivery frequencies.

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ID	7	Pilot #3 BUD			
Identification (role):		Logistics Manager	Functional Requirements:		Priority:
Performance (KPI):			R7.1	real-time information from supplier for monitoring of deliveries	M
Improvement of on-time delivery rate		~10%	R7.2	analysis of alternative transportation partners information (routes per kg, package or pallet, pickup and delivery frequencies, as well possible restrictions)	S
Reduction in identification of potential disruptions		~35%	R7.3	Analytical suggestions for new transportation partners (best option regarding different points)	S
User story:	As a logistics manager I would like to have an overview of all transportation services.				
Operational:		Limitations:			
needs to compare all transportation services, and take requriments into account when chosing one					

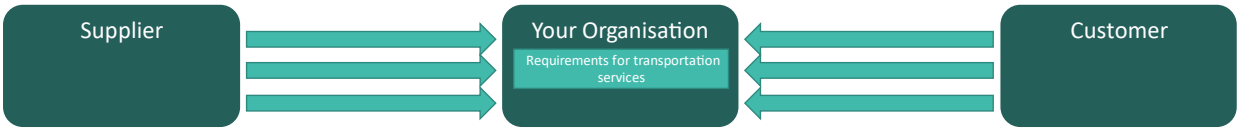

FIGURE 77 BUD USER STORY #7

The Managing Director requires real-time supplier data for monitoring deliveries, stated in Figure 78. Key improvements targeted include reduction in production time, better assessment capabilities to drive enhancements, a reduction in stored capital, and an improvement in on-time delivery rates. The system should offer a unified view of performance metrics, enabling easy identification of production delays and error tracking.

ID	8	Pilot #3 BUD			
Identification (role):		Managing Director	Functional Requirements:		Priority:
Performance (KPI):			R8.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the production time		~60%	R8.2	assessment of relevant information and should be able to derive improvements	M
Reduction of the stored capital / Reduction in identification of potential disruptions		~30% / ~35%			
Improvement of on-time delivery rate		~10%			
User story:	As managing director, I would like to have a single view for performance measurements in order to be able to see production t imes, central error overview for production and commissioning clearly and to derive improvements.				
Operational:		Limitations:			
		Data related limitations			

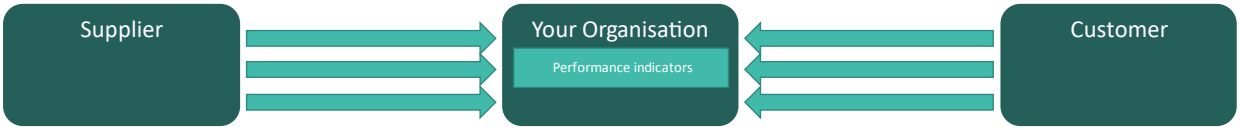

FIGURE 78 BUD USER STORY #8

For the Supply Chain Manager, real-time supplier delivery information is crucial. Expected outcomes are a significant reduction in reshuffling after unforeseen events, enhanced analysis of both current and potential customers, and a comprehensive overview of customers using standard machines. This tool aims to streamline customer tracking and improve continuity in case of customer turnover, according to Figure 79.

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ID	9	Pilot #3 BUD			
Identification (role):		Supply Chain Manager	Functional Requirements:		Priority:
Performance (KPI):			R9.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the reshuffling of an SC after an unforeseen event which leads into a breakage		from ca. 8 to 2 months	R9.2	analysis of contracted customers	S
			R9.3	analysis of potential (new) customers	M
User story:	As a supply chainmanager I would like an overview of customers with standard machines to find out about potential other customers when a customer leav				
Operational:		Limitations:			
		Data related limitations			

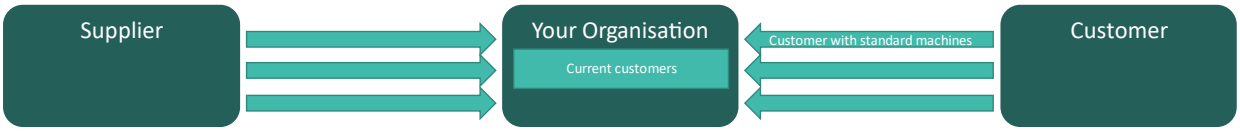

FIGURE 79 BUD USER STORY #9

Figure 80 addresses the Managing Director's requirement for a unified system for sites in Portugal and Berlin to avoid information asymmetries and enhance collaboration. The emphasis is on real-time supplier information and overcoming data-related limitations.

ID	10	Pilot #3 BUD			
Identification (role):		Managing Director	Functional Requirements:		Priority:
Performance (KPI):			R10.1	real-time information from supplier for monitoring of deliveries	M
User story:	As a managing director, I would like one system for both sites (Portugal and Berlin) to avoid information asymmetries and improve collaboration.				
Operational:		Limitations:			
		Data related limitations			

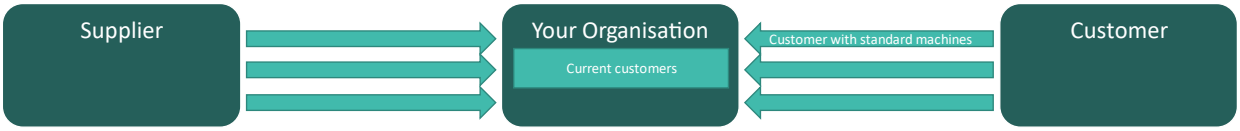

FIGURE 80 BUD USER STORY #10

Feedback on processes and products is crucial for a Managing Director. Figure 81 highlights the need for a feedback sheet and an overview interface to continuously improve products and processes. Real-time information from suppliers is also a key component.

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ID	11	Pilot #3 BUD			
Identification (role):		Managing Director	Functional Requirements:		Priority:
Performance (KPI):			R11.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the production time		~60%	R11.2	feedback sheet	M
Reduction of the stored capital		~30%	R11.3	overview interface for own organisation with results	M
Improvement of on-time delivery rate / Lifespan extension of the machine		~10%			
User story:	As Managing Director, I would like feedback on the processes and products so that we can continuously improve our products and processes				
Operational:		Limitations:			
		Data related limitations			

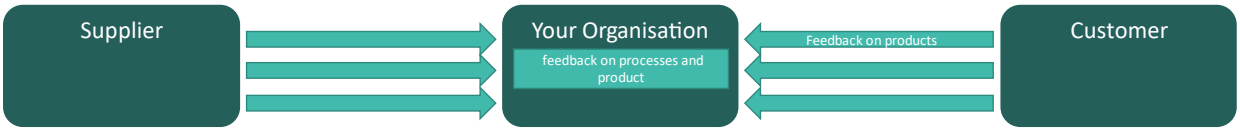

FIGURE 81 BUD USER STORY #11

The production manager requires a system for real-time supplier delivery monitoring and automated synchronization of changes. This would enable seamless notification of all involved parties regarding updates, ensuring smoother project execution and alignment with specifications. It is detailed in Figure 82.

ID	12	Pilot #3 BUD			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R12.1	real-time information from supplier for monitoring of deliveries	M
Improvement in identification of potential disruptions		~35%	R12.2	notification system for necessary changes in construction or production because of repetetive failures	M
Lifespan extension of the machine		~10%	R12.3	connection to improvement/ KPI view	M
User story:	As a production manager I would like an Interactive QM system that sends Error notifications via QM system both to Portugal and to the customer				
Operational:		Limitations:			
relevant error information, e.g. machine downtime		specific error notifications need to be identified			

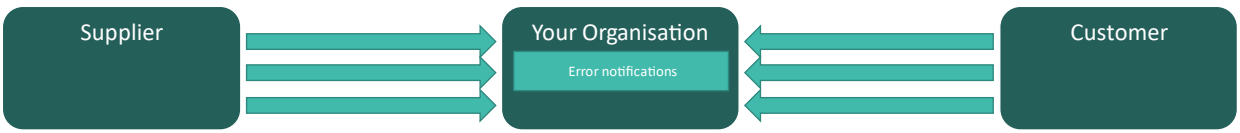

FIGURE 82 BUD USER STORY #12

For a Procurer, real-time supplier information is essential to monitor deliveries and reduce supply chain disruptions. Requirements in Figure 83 include a centralized view for making purchases and managing forecasts, along with improving on-time delivery rates and reducing stored capital.

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ID	13	Pilot #3 BUD			
Identification (role):		Procurer	Functional Requirements:		Priority:
Performance (KPI):			R13.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the reshuffling of an SC after an unforeseen event which leads into a breakage		from ca. 8 to 2 months	R13.2	connection to supplier delivery dates	M
Reduction of the production time		~60%	R13.3	connection to project/ order view to manage forecast	M
Improvement of on-time delivery rate / Reduction of the stored capital		~10% / ~30%			
User story:	As a procurer, I would like a centralized view to make purchases for all plants, see stock levels, etc.				
Operational:		Limitations:			
Centralized view should include all relevant information for making purchases (stock levels, etc.)					

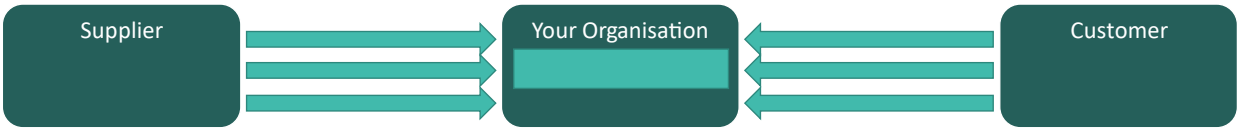

FIGURE 83 BUD USER STORY #13

The Project Manager requires real-time supplier information for monitoring deliveries and managing project forecasts. Figure 84 discusses improving on-time delivery rates and reducing stored capital by integrating stock management with project management tools.

ID	14	Pilot #3 BUD			
Identification (role):		Project Manager	Functional Requirements:		Priority:
Performance (KPI):			R14.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the stored capital		~30%	R14.2	connection to project/ order view to manage forecast	M
Improvement of on-time delivery rate		~10%	R14.3	view of already montaged parts for possiblecrosswork of parts (one machine is missing part a and c which takes months to deliver, another machine is missing part b which is already built into the first machine. This could be demontaged and integrated into the second machine to finish it)	S
Reduction in identification of potential disruptions		~35%			
User story:	As a project manager, I would like the integration of the stock management system with the project management tool, availabil of parts (online and in real time)				
Operational:		Limitations:			
centralized view for project management related information					

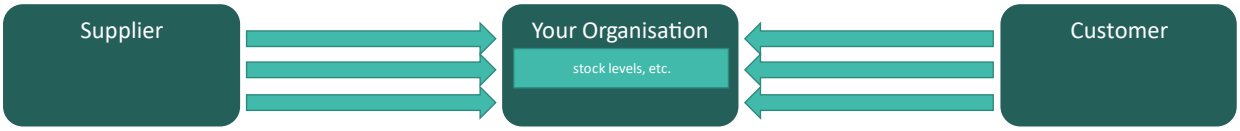

FIGURE 84 BUD USER STORY #14

Figure 85 highlights the need for a centralized view linking missing parts to projects for the Production Manager. The focus is on reducing production time and improving on-time delivery rates through better project management.

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ID	15	Pilot #3 BUD			
Identification (role):		Production Manager	Functional Requirements:		Priority:
Performance (KPI):			R15.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the production time		~60%			
Improvement of on-time delivery rate		~10%			
User story:	As a production manager I would like to be able to link missing parts to projects.				
Priority:					
Operational:		Limitations:			
centralized view for project management related information					

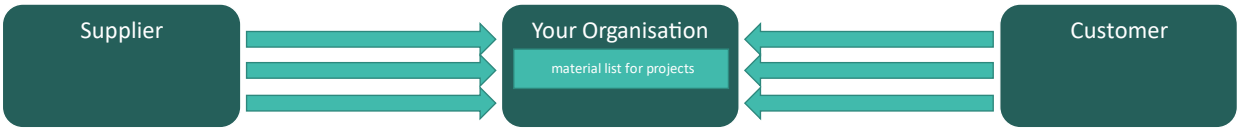

FIGURE 85 BUD USER STORY #15

Other Project Manager's requirements are detailed, focusing on real-time supplier information to manage production schedules effectively in Figure 86. The KPIs include reducing reshuffling times and improving delivery rates. The user story stresses the importance of centralized information for managing projects and anticipating disruptions.

ID	16	Pilot #3 BUD			
Identification (role):		Project Manager	Functional Requirements:		Priority:
Performance (KPI):			R16.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the reshuffling of an SC after an unforeseen event which leads into a breakage		from ca. 8 to 2 months	R16.2	comparison of practical and planned project work and notification functionality for deviations	M
Improvement of on-time delivery rate		~10%			
Reduction in identification of potential disruptions		~35%			
User story:	As a project manager, I would like automated notifications in the event of potential project delays				
Operational:		Limitations:			
asessment of all relevant information, especially production and supplier related		identification of relevant information for project delays			

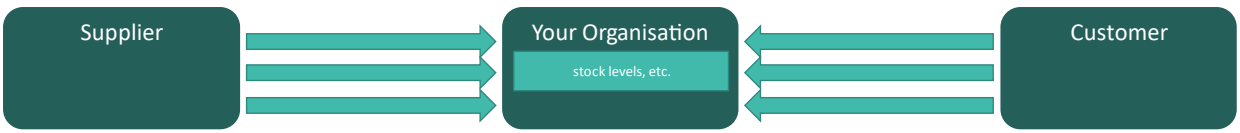

FIGURE 86 BUD USER STORY #16

According to Figure 87, the Managing Director requires real-time tracking of project status to identify and address cost and time-relevant issues promptly. This system should provide comprehensive visibility into project milestones, progress, and potential bottlenecks, supporting informed decision-making. The aim is to enhance project management efficiency and reduce production time.

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ID	17	Pilot #3 BUD			
Identification (role):		Managing Director	Functional Requirements:		Priority:
Performance (KPI):			R17.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the production time		~60%	R17.2	comparison of practical and planned project work and notification functionality for deviations	M
Reduction of the stored capital / Reduction in identification of potential disruptions		~30-35%	R17.3	inclusion of cost and time relevant KPIs connected to project and orders	M
Improvement of on-time delivery rate		~10%			
User story:	As managing director, I want a realtime project status trackingin order torecognize time and costrelevant as soon as possible.				
Operational:		Limitations:			
similar to US 16		identification of relevant information for project delays			

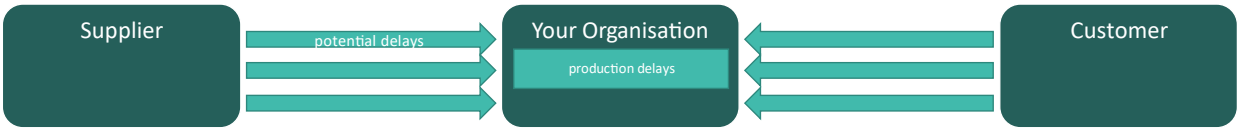

FIGURE 87 BUD USER STORY #17

For a Project Manager, Figure 88 highlights the need for an interactive overview for all project participants to share information. The KPIs focus on reducing supply chain disruptions and improving delivery rates. The user story underscores the importance of a centralized platform for effective project collaboration.

ID	18	Pilot #3 BUD			
Identification (role):		Project Manager	Functional Requirements:		Priority:
Performance (KPI):			R18.1	real-time information from supplier for monitoring of deliveries	M
			R18.2	automaticalsynchronization of changes	M
			R18.3	notification system for other involved parties for changes	M
User story:	As a project manager, I would like to have a link to the specificationsin order tobe able to synchronize subsequent changes.				
Operational:		Limitations:			

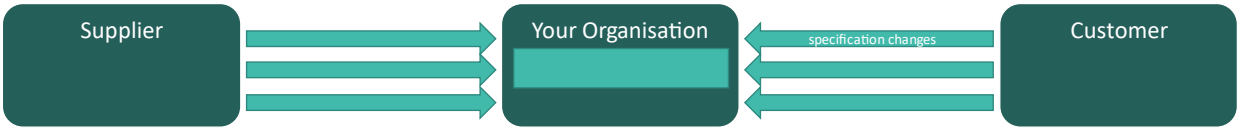

FIGURE 88 BUD USER STORY #18

Another Project Manager's perspective is given in Figure 89, focusing on the reduction of supply chain disruptions and optimized production planning. The KPIs emphasize reducing reshuffling times and improving on-time delivery rates. The user story highlights the importance of tools for workflow optimization and customer prioritization during disruptions.

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ID	19	Pilot #3 BUD			
Identification (role):		Project Manager	Functional Requirements:		Priority:
Performance (KPI):			R19.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the reshuffling of an SC after an unforeseen event which leads into a breakage		from ca. 8 to 2 months	R19.2	support system for optimal workflow for production planning, especially in disruptive situations (establishment of different rules)	M
Improvement of on-time delivery		~10%	R19.3	customer priotirization (e.g. one machine is missing part a and c which takes months to deliver, another machine is missing part b which is already built into the first machine. This could be demontaged and integrated into the second machine to finish it)	M
Reduction in identification of potential disruptions		~35%			
User story:	As a project manager, I would like to have a Capacity/storage tool to evaluate project postponement/bringing forward in case of customer prioritization				
Operational:		Limitations:			
similar to US16					

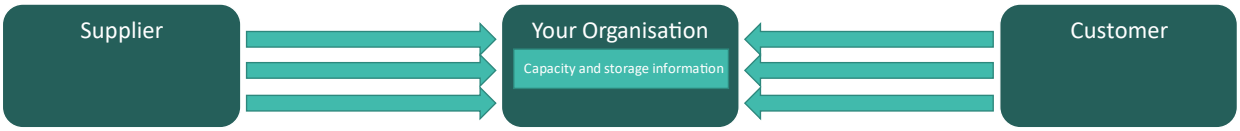

FIGURE 89 BUD USER STORY #19

The next requirements address the needs of the Supply Chain Manager, focusing on obtaining real-time delivery information from suppliers and automated status updates. The KPIs include reduction in production time and improvement in on-time delivery rates. The user story shown in Figure 90 underscores the need for reliable delivery status information and regular automated inquiries to suppliers.

ID	20	Pilot #3 BUD			
Identification (role):		Supply Chain Manager	Functional Requirements:		Priority:
Performance (KPI):			R20.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the production time		~60%	R20.2	change notification	M
Improvement of on-time delivery		~10%	R20.3	automated delivery status request to supplier	M
Reduction in identification of potential disruptions		~35%			
User story:	As a supply chainmanager I would like to receive information on the Delivery status of suppliers and send automated Regular inquiries about the delivdate				
Operational:		Limitations:			
Reliable information needs to be gathered from suppliers		quality of information strongly depends on suppliers			

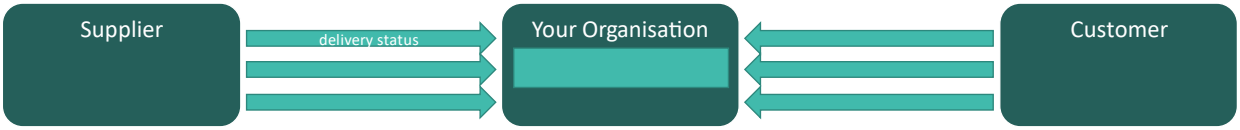

FIGURE 90 BUD USER STORY #20

From the view of the Project Manager, Figure 91 details the need for interactive project overviews to facilitate information sharing among all project participants. The KPIs emphasize reducing supply chain disruptions and improving delivery times. The user story highlights the importance of a centralized view for all involved to share and access project-related information.

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ID	21	Pilot #3 BUD			
Identification (role):		Project Manager	Functional Requirements:		Priority:
Performance (KPI):			R21.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the reshuffling of an SC after an unforeseen event which leads into a breakage		from approx. 8 to 2 months	R21.2	all relevant participants should be able to share and get information	M
Improvement of on-time delivery rate / Reduction of the production time		~10% - 60%			M
Reduction in identification of potential disruptions		~35%			
User story:	As a project manager, I would like an interactive project overview so that everyone involved in the project can share the information there.				
Operational:		Limitations:			
All information should be available in one centralised view					

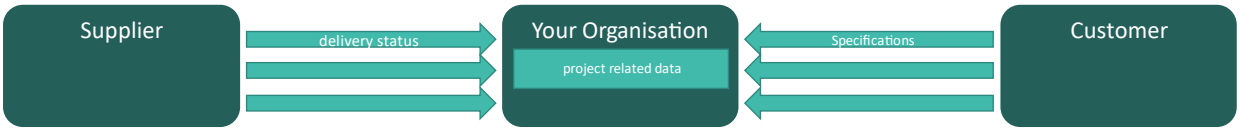

FIGURE 91 BUD USER STORY #21

Figure 92 outlines the needs of the Manager of the Application Center, focusing on integrating supplier information and employee availability for planning. The KPIs involve monitoring deliveries and optimizing room and employee schedules. The user story emphasizes the importance of a centralized view for efficient planning and resource management.

ID	22	Pilot #3 BUD			
Identification (role):		Manager of Application Cente	Functional Requirements:		Priority:
Performance (KPI):			R22.1	real-time information from supplier for monitoring of deliveries	M
			R22.2	integration of appointments, employee availability	M
User story:	As manager of the application center, I would like a view for planning the room availability, appointments and also for employee management				
Operational:		Limitations:			

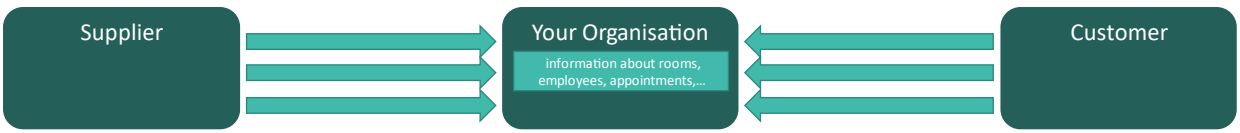

FIGURE 92 BUD USER STORY #22

The following requirements of the Service Employee are focusing on managing spontaneous service calls through an integrated overview of resources. The KPIs include extending machine lifespan and optimizing service operations, displayed in Figure 93. The user story stresses the need for comprehensive visibility into parts and employee availability to enhance service response.

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ID	23	Pilot #3 BUD			
Identification (role):		Service Employee	Functional Requirements:		Priority:
Performance (KPI):			R23.1	real-time information from supplier for monitoring of deliveries	M
Lifespan extension of the machine		~10%			
User story:	As a service employee, I would like to have an overview of parts, employees, cars, service cars, etc. for spontaneous service calls.				
Operational:		Limitations:			

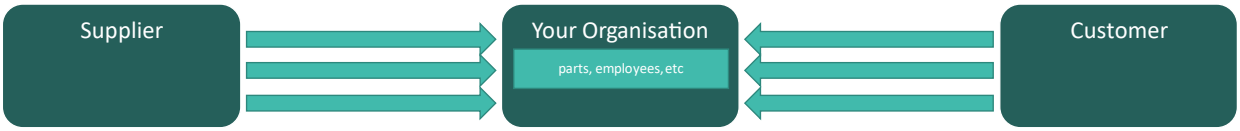

FIGURE 93 BUD USER STORY #23

For the Project Manager, Figure 94 details the requirements for tracking changes and statuses in orders to manage potential disruptions. The KPIs emphasize reducing supply chain disruptions and improving project management. The user story highlights the importance of tracking changes across locations to ensure project continuity.

ID	24	Pilot #3 BUD			
Identification (role):		Project Manager	Functional Requirements:		Priority:
Performance (KPI):			R24.1	real-time information from supplier for monitoring of deliveries	M
Reduction in identification of potential disruptions		~35%	R24.2	notification system for changes	M
User story:	As a project manager, I want to be able to track changes and statuses in orders, (in Berlin or Portugal)				
Operational:		Limitations:			
Special emphasis should be placed on changes					

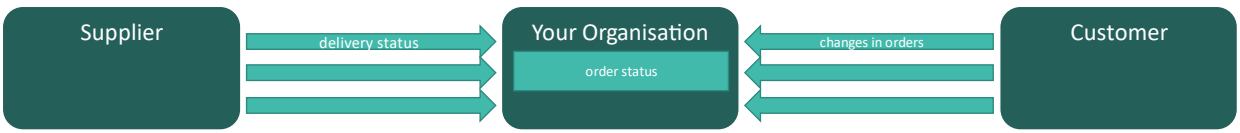

FIGURE 94 BUD USER STORY #24

Figure 95 targets the needs of the Managing Director for real-time project status tracking and optimization proposals. The KPIs include reducing production time and improving on-time delivery. The user story underscores the need for a streamlined overview of projects with AI-supported optimization advice to enhance decision-making.

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ID	25	Pilot #3 BUD			
Identification (role):		Managing Director	Functional Requirements:		Priority:
Performance (KPI):			R25.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the production time		~60%	R25.2	optimization proposals regarding different KPIs	M
Improvement of on-time delivery		~10%			
Reduction in identification of potential disruptions		~35%			
User story:	As managing director, I would like a simple but real-time overview of all relevant projects with AI-supported optimization				
Operational:		Limitations:			
should be simple and only show most important data with optimization advice		identification of most important factors			

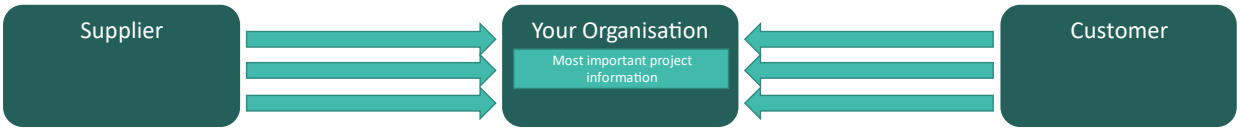

FIGURE 95 BUD USER STORY #25

Figure 96 highlights the Designer's requirements are detailed, focusing on the need for a centralized view to manage project changes and notifications. The KPIs include reducing supply chain disruptions and improving project management efficiency. The user story highlights the need for a unified platform for tracking changes and ensuring project alignment.

ID	26	Pilot #3 BUD			
Identification (role):		Designer	Functional Requirements:		Priority:
Performance (KPI):			R26.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the reshuffling of an SC after an unforeseen event which leads into a breakage		from ca. 8 to 2 months	R26.2	notification system for changes	M
Reduction in identification of potential disruptions		~35%			
User story:	As a designer, I want to have a central view where I and everyone else involved can see changes in the project.				
Operational:		Limitations:			
All information should be available in one centralised view					

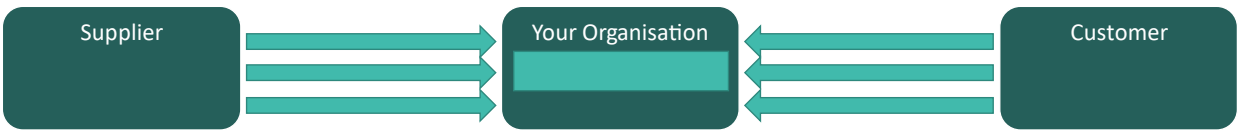

FIGURE 96 BUD USER STORY #26

Figure 97 outlines the requirements for the Service Employee, focusing on real-time information for managing service appointments and resource availability. The KPIs involve monitoring deliveries and optimizing service schedules. The user story emphasizes the importance of having an overview of parts, employees, and service cars for effective service management.

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ID	27	Pilot #3 BUD			
Identification (role):		Service Employee	Functional Requirements:		Priority:
Performance (KPI):			R27.1	real-time information from supplier for monitoring of deliveries	S
			R27.2	automatical notifications to customer and organisation to plan necessary maintenance appointments	M
User story:	As a service employee, I want plannable service assignments to automatically be prepared by informing customers about				
Operational:		Limitations:			

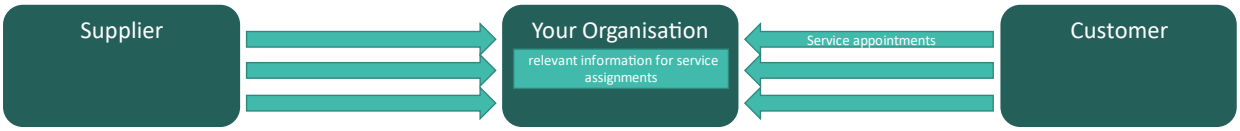

FIGURE 97 BUD USER STORY #27

For the sales manager, real-time supplier delivery data is essential for making informed offers. The system should provide a cost and time overview of purchased parts, allowing for optimal supplier selection and improved offer accuracy. Details are presented in Figure 98.

ID	28	Pilot #3 BUD			
Identification (role):		Sales Manager	Functional Requirements:		Priority:
Performance (KPI):			R28.1	real-time information from supplier for monitoring of deliveries	M
Improvement of on-time delivery rate		~10%	R28.2	interface for facilitate offers	M
User story:	As a sales manager, I would like a cost/time overview for all relevant purchased parts in order to be able to make offers				
Operational:		Limitations:			
possibility of comparing different suppliers and chosing optimal one					

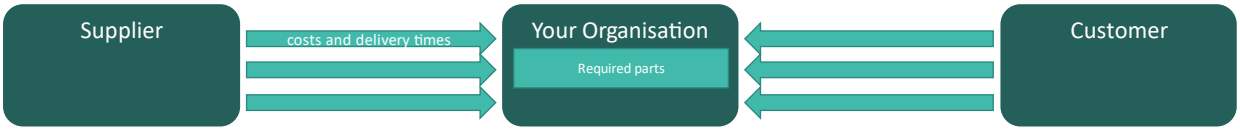

FIGURE 98 BUD USER STORY #28

The worker needs a notification function for order changes, ensuring they are aware of any updates promptly, detailed in Figure 99. Real-time supplier data and a streamlined communication system will improve production efficiency and reduce disruptions.

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ID	29	Pilot #3 BUD			
Identification (role):		Worker	Functional Requirements:		Priority:
Performance (KPI):			R29.1	real-time information from supplier for monitoring of deliveries	M
Reduction of the production time		~60%	R29.2	notification system for changes	M
Improvement of on-time delivery rate		~10%			
Reduction in identification of potential disruptions		~35%			
User story:	As a worker, I would like to have a notification function for changes in the order so that I am made aware of changes				
Operational:		Limitations:			
possibility of comparing different suppliers and chosing optimal one					

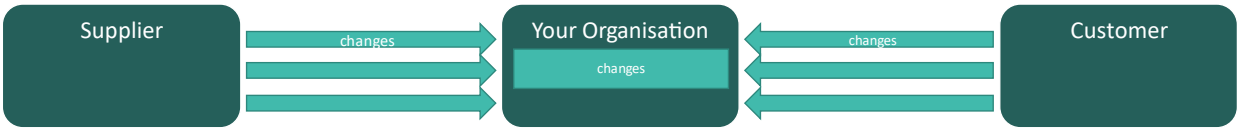

FIGURE 99 BUD USER STORY #29

3.3. GENERIC REQUIREMENTS

For the generic requirements, the mapping of the specific requirements took place first. The requirements of all pilots were categorized in the following categories, which resulted from the user story content:

- Simulation capabilities (SC)
- Warning and notification (WN)
- Logistics management (LM)
- Disruption monitoring (DM)
- Manufacturing management (MM)
- Analytical capabilities (AC)
- Production management (PM)
- Environmental management (EM)
- Sales and Service tracking (ST)
- Project management (PJ)

In the following, the generic requirements are presented. The based mapping of the requirements will be shown in the annex.

The requirements for simulation capabilities, displayed in Table 1, focus on creating and managing manufacturing simulations. This includes the ability to simulate manufacturing plans and sequences, adapt to plant-specific scenarios, and create simulations for disruptive scenarios by adjusting various parameters. It also involves the representation of results from simulations and the analysis of data derived from these simulations to improve manufacturing resilience and suggest improvements.

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ID	Requirement
SC_1	Manufacturing simulation that includes manufacturing plans and sequences, adapter to plant stimulation, vistable (layout planning software), etc.
SC_2	Ability to create simulations of fictional disruptive scenarios through adjusting different parameters
SC_3	Results representation from implemented simulations and analysis of the data derived from t he simulations.
SC_4	Analysis of the disruptive scenario and suggestions for manufacturing and resilience improvement

TABLE 1 GENERIC REQUIREMENTS IN THE TOPIC OF SIMULATION CAPABILITIES

This category for warning and notification outlines the need for an alert system based on predefined thresholds, with capabilities to change these thresholds as necessary. It emphasizes real-time monitoring of machine functions and instant alert capabilities. Notifications should be sent automatically or manually about machine dysfunctions, production order deviations, supplier transportation disruptions, and predictive warnings for possible stockouts and discrepancies in production data. The requirements are presented in Table 2.

ID	Requirement
WN_1	Alert system which functions via pre defined thresholds and ability to change those thresholds.
WN_2	Real time monitoring of machine functions with live machinery data and instant alert capabilities.
WN_3	Automatic or manual upload (through technician) notification of machine disfunctions, disruptions and downtimes to all involved parties (production management, logistics management, manufacturing management)
WN_4	instant notification of production orders and/or product deviation to all involved parties(prod uction management, logistics management, manufacturing management)
WN_5	Notification system for disruptions or changes in supplier transportation
WN_6	Predictive warnings for possible stockout, discrepancies between current and historical production data and differences between planned and current project work.
WN_7	Notification to all involved parties of changes made to parts, manufacturing orders and discrepancies on quality control.

TABLE 2 GENERIC REQUIREMENTS IN THE TOPIC OF WARNING AND NOTIFICATION

Requirements for Logistics management in Table 3 focus on real-time monitoring and tracking of delivery statuses, with automated requests for updates from suppliers. It includes the comparison of scheduled

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and actual delivery statuses with instant notifications of deviations. Additionally, it calls for an overview of all transportation partners, their delivery statuses, and carbon footprints, along with an interface for easy access to historical data, tracking information, and delivery notes.

ID	Requirement
LM_1	Real time monitoring of delivery status (tracking, delivery dates, shipped products) with automatic request for information update by the supplier.
LM_2	Automated comparison of scheduled and real delivery status with instant deviation and/or delay notification to all the parties involved (logistics, manufacturing, SCM)
LM_3	Overview of all transportation partners and their delivery status (tracking, delivery dates, parcel traceability) , as well as their carbon footprint on each parcel transportation to choose the best option or offer different alternatives that suits the customer needs.
LM_4	interface for easy access of different information (historical data, tracking, carbon footprint, delivery notes) and overview of delivery status.

TABLE 3 GENERIC REQUIREMENTS IN THE TOPIC OF LOGISTICS MANAGEMENT

The functionalities regarding disruption monitoring should manage internal and external disruptions (environmental, social, political, etc.) under predefined rules with automated updates and real-time monitoring. It includes analysis and suggestions for preventive actions against supply chain disruptions, an alert system for potential and current disruptions, and automated information gathering with manual upload capabilities. The requirements are shown in Table 4.

ID	Requirement
DM_1	Platform for managing internal and external disruptions (environmental, social, political, customer/supplier, etc.) under predefined rules with automated updates and real time monitoring.
DM_2	Analysis and suggestions for preventive actions against disruptions on the supply chain (usage of historical data, internal data, market trends, planned and current workloads, etc)
DM_3	Alert system for possible and current disruptions/deviations with the information provided by the customer/supplier and internal data.
DM_4	Automated information gathering and processing with manual upload feature.

TABLE 4 GENERIC REQUIREMENTS IN THE TOPIC OF DISRUPTION MONITORING

The requirements for manufacturing management, listed in Table 5, involve real-time monitoring and updating of current and future manufacturing plans. It includes managing manufacturing sequences and parts-related data with manual and automated uploads. The system should also provide an interface for quality management, collecting feedback from customers and internal departments, and offering an overview of current working machines and historical data for troubleshooting and improvement assessment.

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ID	Requirement
MM_1	Real time monitoring and overview of current and future manufacturing plans with automated or manual updates.
MM_2	Overview of manufacturing sequences established by predefined criteria. (delivery dates, machine downtimes, etc.)
MM_3	interface for managing parts related data (materials, 3D prints, data sheets, technology, quantity, etc.) with manual and automated uploads based on historical data, customer information, supplier information and internal data.
MM_4	interface for quality management with alert system for distortions/deformations and feedback collection from customers and internal departments.

TABLE 5 GENERIC REQUIREMENTS IN THE TOPIC OF MANUFACTURING MANAGEMENT

Analytical capabilities involve the analysis of transportation routes, suppliers, and scenarios generated by simulation capabilities. It includes evaluating different scenarios based on predefined KPIs and optimization proposals. The system should forecast project developments and disruptions using internal and external data, and provide visualization, analysis, and suggestions on quality control based on predefined thresholds, like listed in Table 6.

ID	Requirement
AC_1	Analysis of current transportation routes and suggestions for alternative transportation methods (decentralized transportation/production, different routes, etc.) based on predefined parameters (costs, time, carbon footprint, routes, rates per kg, etc.)
AC_2	Analysis of current contracted suppliers and generation of alternative suggestions based upon predefined thresholds (costs, product quality, delivery time, etc.)
AC_3	Analysis of the scenarios generated by the simulation capabilities of the IMC.
AC_4	Analysis of different current scenarios regarding predefined KPI's and optimization proposals (minimize machine use time, prioritize larger orders, minimize delivery times, prioritize orders of some references, manufacturing cost, delivery time, etc.)
AC_5	interface for results overview and evaluation of analysis made.
AC_6	Forecast of project development and/or project disruption based on internal and external data (historical data, seasonal fluctuations, workloads, machine capacity, order queues, etc.)and optimization suggestions.
AC_7	Visualization, analysis and suggestions on quality control based on pre defined thresholds (historical data, quality incidents, supplier information, customer feedback, etc.)

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TABLE 6 GENERIC REQUIREMENTS IN THE TOPIC OF ANALYTICAL CAPABILITIES
(THESE REQUIREMENTS ENCOMPASS THE ANALYTICAL CAPABILITIES OF THE IMC NEEDED BY THE THREE INDUSTRIES. NONETHELESS, EACH ANALYTICAL CAPABILITY MUST BE INTEGRATED TO THE RESPECTIVE INTERFACE OR MODULE)

The interface for production management should provide an overview and real-time monitoring of production machines and orders. It includes features for dynamic adjustments in production planning, task assignment, employee management, and project overview. It should also integrate current software and ERPs, allow adjustments to production plans and projects, and analyse historical data for project assignment. The generic requirements for this category are shown in Table 7.

ID	Requirement
PM_1	Overview and real time monitoring of production machines (workloads, orders in progress, etc.)
PM_2	interface for visibility of production orders overview with automatic synchronization and dynamical adjustments features
PM_3	interface for production planning, task assignment, employee management and project overview.
PM_4	Overview of supply chain and projects status and connections between them including supplier information, warehouse status, machine operations, etc.
PM_5	integration of current software and ERPs.
PM_6	interface with adjustment features into production planning and individual projects regarding different KPIs
PM_7	Historical data analysis and automated assignment into relevant projects, departments.
PM_8	Platform to manage quality reports, feedback information and suggestions made by the analytical capabilities.

TABLE 7 GENERIC REQUIREMENTS IN THE TOPIC OF PRODUCTION MANAGEMENT

Environmental management requirements, listed in Table 8, include an interface to display environmental information of products and manage waste tracking and optimization. It should track product parts and material certifications and provide an overview of environmental factors in the supply chain. The system should also suggest better environmental practices based on predefined thresholds and other relevant data.

ID	Requirement
EM_1	interface for overview and display of environmental information of products.input (from supplier) and output (for customer).

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EM_2	interface for waste tracking, management and optimization suggestions (display of waste generation through failures, waste per production order, companies with waste as raw material, industrial symbiosis, etc.)
EM_3	Tracking and overview of product parts and materials certifications predefined points (percentage of renewable materials, carbon footprint, etc.)
EM_4	Display and overview of environmental factors among the supply chain, regarding predefined thresholds and KPIs and opportunities for improvement.
EM_5	Suggestions for better environmental practices regarding predefined thresholds (energy consumptions, supplier information, carbon footprint, seasonal fluctuations, weather forecasts, etc.)

TABLE 8 GENERIC REQUIREMENTS IN THE TOPIC OF ENVIRONMENTAL MANAGEMENT

The interface for Sales and service tracking, with requirements shown in Table 9, should manage service orders and appointments, track changes and service dates, and monitor available workers and equipment. It should display current customers and products, manage new offers, and provide an interface for customer information, including delivery status, service appointments, and design guidelines.

ID	Requirement
ST_1	Platform to manage service orders and appointments.(maintenance notification, track of changes and service dates, worker and service equipment available)
ST_2	Display of current customers and products, potential new customers and facility to manage new offers made.
ST_3	interface for information to customer (delivery status, service appointments, changes made, notifications, design guidelines)

TABLE 9 GENERIC REQUIREMENTS IN THE TOPIC OF SALES AND SERVICE TRACKING

Project management requirements, listed in Table 10, focus on predicting and notifying delays in ongoing projects based on predefined parameters. It includes real-time monitoring and tracking of project status through supplier information and internal data. Additionally, it provides an overview of all parties involved in the project and access to project information.

ID	Requirement
PJ_1	Prediction and notification of delays on ongoing projects by predefined parameters (delivery dates, manufacturing orders, machine downtimes)
PJ_2	Real time monitoring and tracking of project status through supplier information upload and internal data.
PJ_3	Overview of parties involved on the project and access to project information.

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TABLE 10 GENERIC REQUIREMENTS IN THE TOPIC OF PROJECT MANAGEMENT

3.4. MO²GO INTEGRATION

To gain the result of connecting the objects in MO²GO, the list of specific requirements with all the provided information is uploaded in a for that purpose designed webapp in MO²GO, which is shown in Figure 100. The requirements, the identification (role) and the user story are stored as an object in the model and are manually assigned to each other as shown and described in Figure 7. Part of a user story are the identification and the functional requirements.

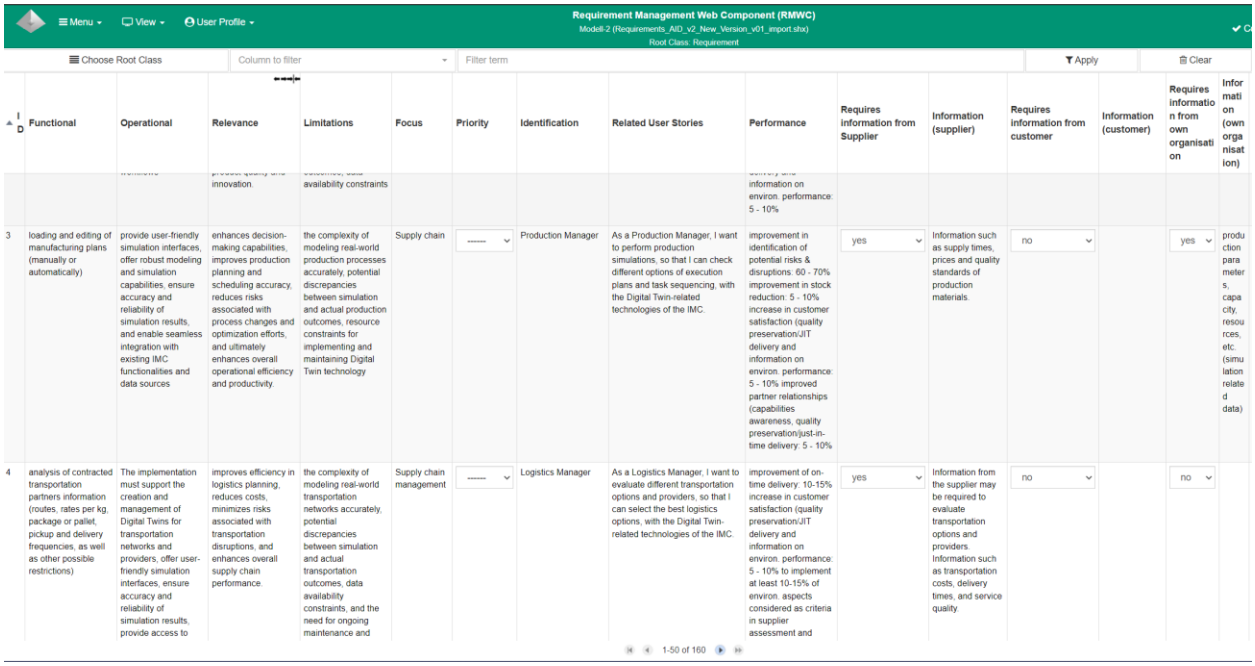

FIGURE 100 INTERFACE OF THE WEBAPP FOR REQUIREMENTS

The interface where it is done with is displayed in Figure 101. This interface is opened for one selected user story. The left side shows all objects inside the information model. The requirements and roles are then marked and assigned to the user story. This is repeated for all user stories of all three pilots.

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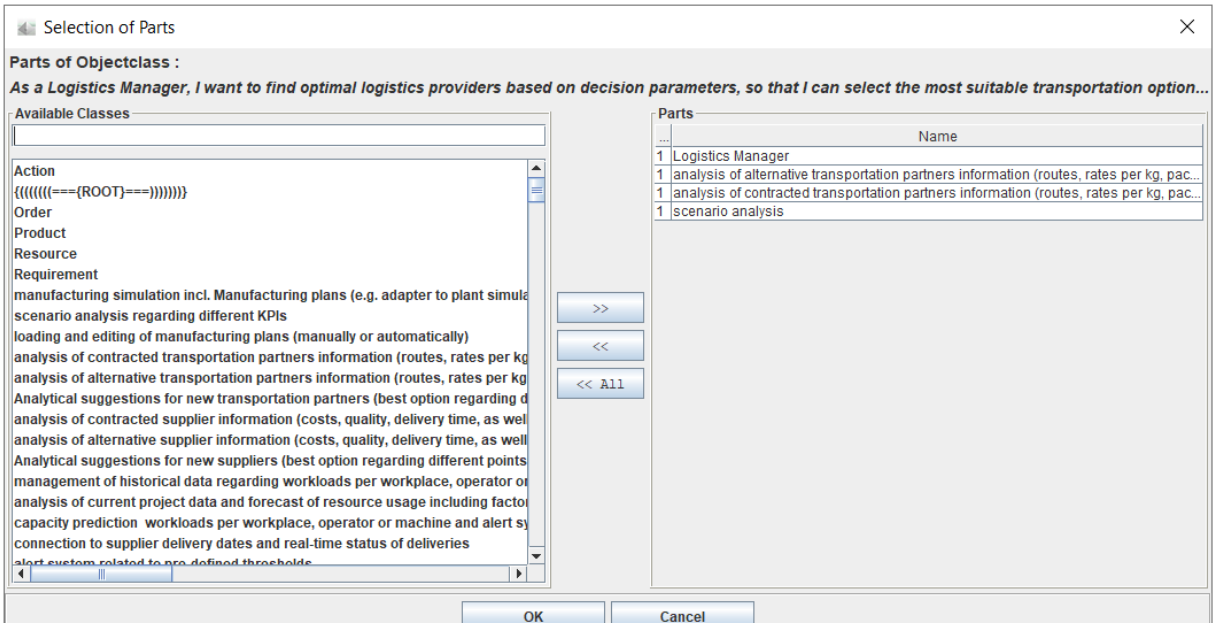

FIGURE 101 SELECTIONS OF PART FOR AN EXAMPLE USER STORY

The other information is stored as attributes to the User stories, requirements, and roles. This is shown in Figure 102. Operational requirements, Limitations, Relevance, Priority and the required information flow can be found connected. By selecting the User story, it is now possible to have an overview of all the relevant information and connections.

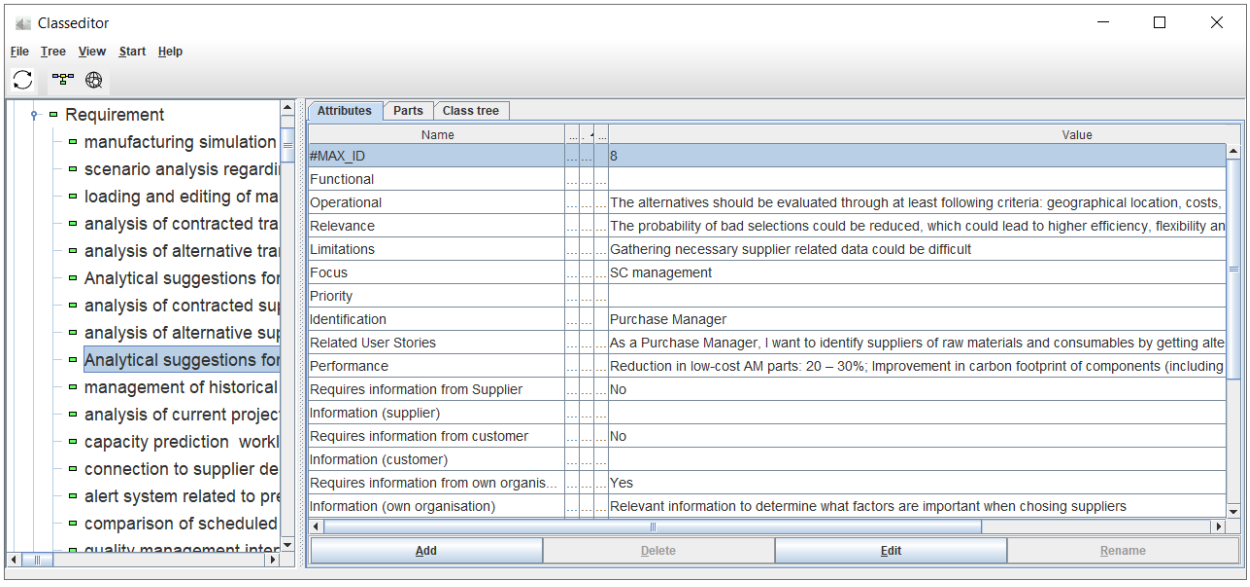

FIGURE 102 INFORMATION MODEL WITH THE ATTRIBUTES

The benefit is, to be able to show the connection between requirements, user stories and identification. The top part of Figure 103 shows one requirement with all user stories, that are connected to the requirement. The bottom part of the figure displays all the user stories, that are related to the logistics manager.

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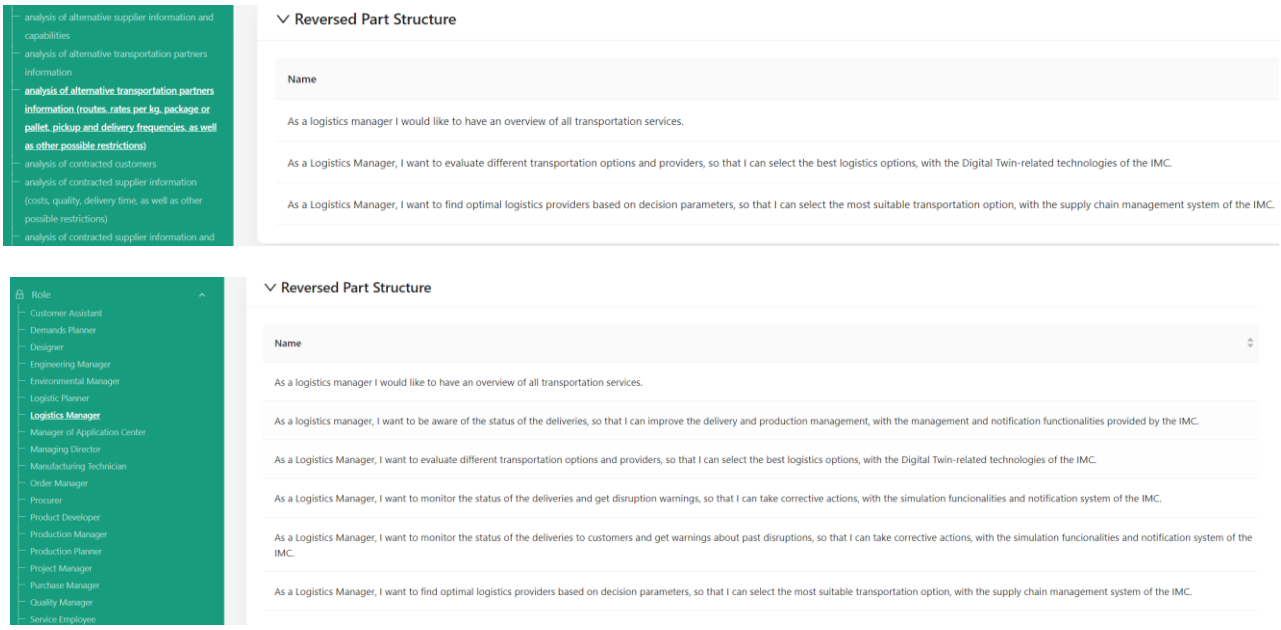

FIGURE 103 VIEW OF PART STRUCTURE

4. CONCLUSION

This deliverable summarizes the activities regarding elicitation of requirements for an intelligent manufacturing custodian for a resilient supply chain for three pilot partners in different branches. The first chapter gave an overview of the document, the context and the objectives. Afterwards, different methodologies and approaches on handling different pilots in requirements engineering were presented together with general state of the art of requirements. With that input, a deep dive into the applied method including necessary technologies was performed. The third chapter presented the results of the requirements engineering. Firstly, the pilot scenarios were introduced to get a scope of the partners. After that, the specific requirements of each pilot as well as the generic requirements of all pilots were stated.

The next steps will include the prioritisation of the requirements as well as the enclosure of the requirements to the project scope. Reducing the desirable wishes of the pilot partners to realistic tasks inside of the project topics will concrete the expectation to the development team. Even if the necessary information from supplier and customer per user story were pointed out, the connection and information flow between the different user stories needs to be elicited to guarantee a consistent project solution.

5. APENDIX

The annex is filled with complementary content of the deliverable, which is not core of the task.

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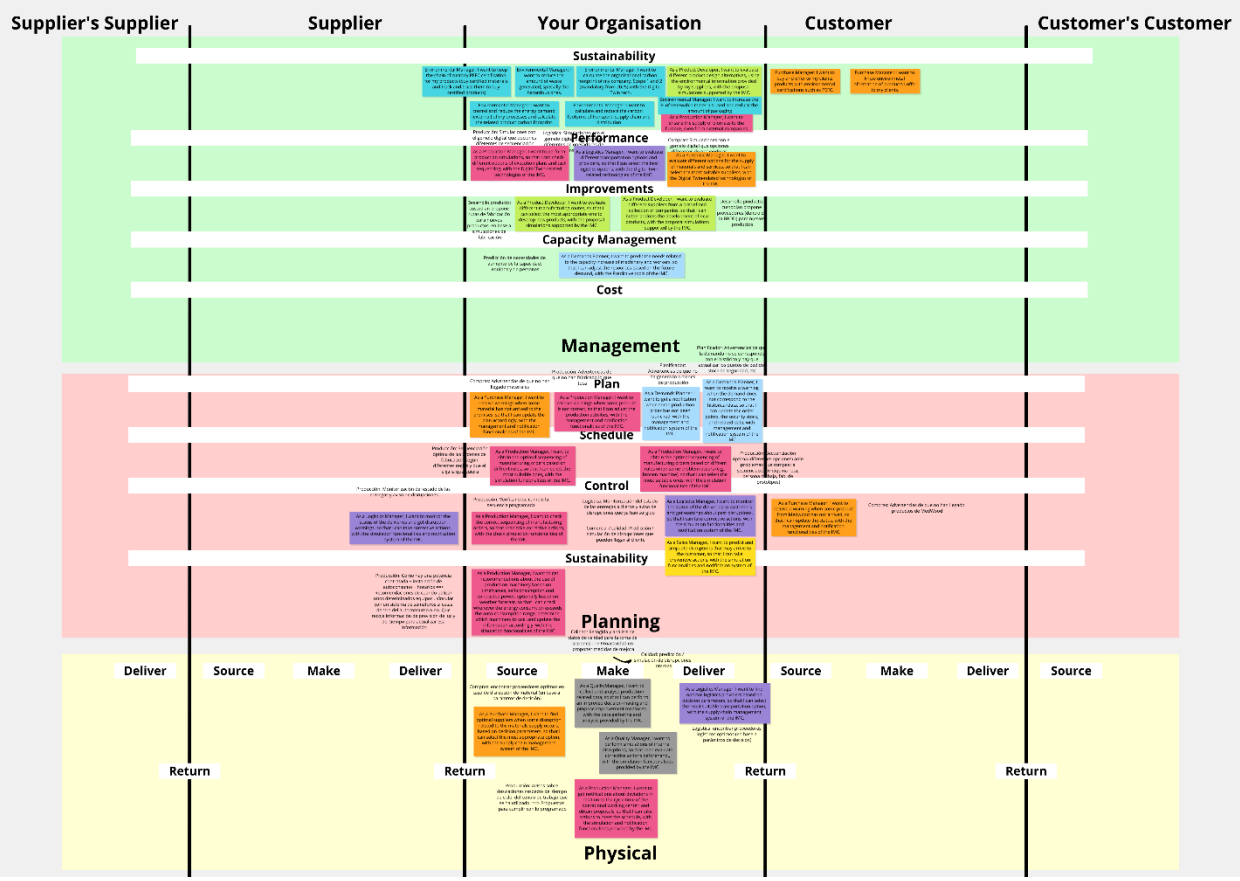

ANNEX 1 CONCEPTBOARD WITH USER STORIES FROM MICUNA

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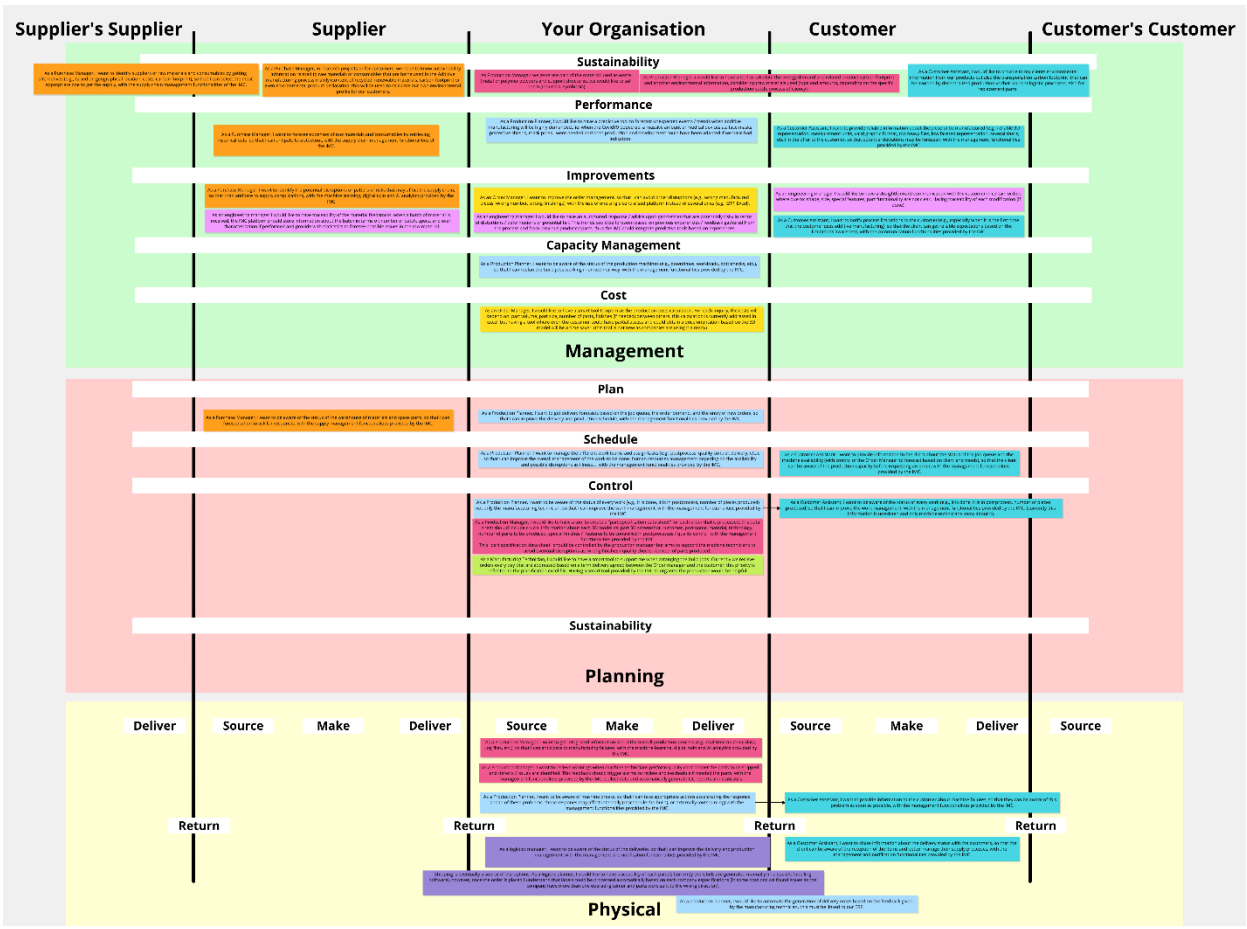

ANNEX 2 CONCEPTBOARD WITH USER STORIES FROM AIDIMME

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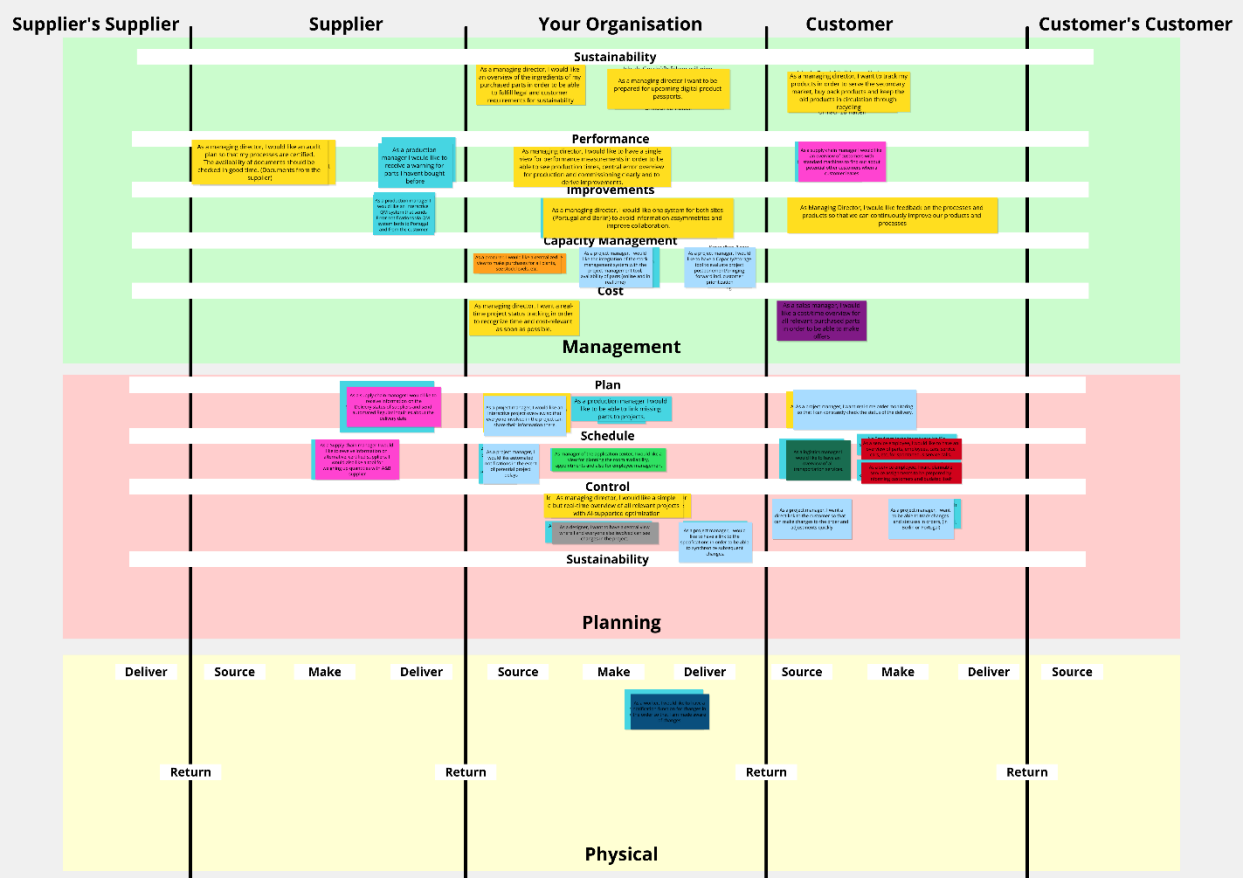

ANNEX 3 CONCEOTBOARD WITH USER STORIES FROM BUDATEC

ID	Requirement
MIC_1_1	*manufacturing simulation incl. Manufacturing plans (e.g. adapter to plant simulation, vistable etc.)*
MIC_4_1	*manufacturing simulation incl. Manufacturing plans (e.g. adapter to plant simulation, vistable etc.)*
MIC_14_3	*connected sequencing simulation tool*
MIC_20_1	*adapter to relevant simulation tools*
MIC_20_2	*generation of fictional disruption and scenario data*
MIC_20_3	*scenario analysis*

ANNEX 4 GATHERED REQUIREMENTS FOR SIMULATION CAPABILITIES

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ID	Requirement
MIC_7_2	*alert system related to pre-defined thresholds*
MIC_8_3	*deviation notification*
MIC_9_2	*deviation notification*
MIC_10_3	*alert for discrepancies between historical data and current demand*
MIC_12_2	*implementation of alert system for unexpected downtimes or issues*
MIC_15_2	*alert system related to issues and disruption during transportation process*
AID_2_3	*stockout prediction and alert system*
AID_5_3	*alert system related to pre-defined thresholds*
AID_8_2	*notifications about historical problems and mistakes with same/ slightly different parts*
AID_9_2	*implementation of alert system for unexpected downtimes or issues*
AID_17_1	*notifications for when machine technicians identify defects or issues during quality control of parts*
AID_18_1	*notifications about machine disruptions*
AID_25_1	*real-time monitoring and alert system*
BUD_5_1	*notification function*
BUD_12_2	*notification system for necessary changes in construction or production because of repetitive failures*
BUD_16_2	*comparison of practical and planned project work and notification functionality for deviations*
BUD_17_2	*comparison of practical and planned project work and notification functionality for deviations*
BUD_18_3	*notification system for other involved parties for changes*
BUD_24_2	*notification system for changes*
BUD_29_1	*real-time information from supplier for monitoring of deliveries*
BUD_29_2	*notification system for changes*

ANNEX 5 GATHERED REQUIREMENTS FOR WARNING AND NOTIFICATION SYSTEM

ID	Requirement
MIC_7_1	*connection to supplier delivery dates and real-time status of deliveries*
MIC_7_3	*comparison of scheduled and real delivery status*
MIC_13_2	*comparison of delivery planning with execution*
MIC_15_1	*connection to transportation partners*

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MIC_15_3	*management of historical data*
MIC_30_2	*integration of different production route options with their carbon footprint*
MIC_24_2	*real time track and trace capabilities for materials/products*
AID_5_2	*connection to supplier delivery dates*
AID_19_1	*real-time information from supplier about deliveries*
AID_19_2	*interface for providing the information*
AID_20_1	*automatic label generation*
AID_20_2	*parcel traceability*
AID_26_1	*connection to transportation partner*
AID_30_2	*integration of different transportation options with their carbon footprint*
BUD_6_1	*real-time information from supplier for monitoring of deliveries*
BUD_6_2	*interface for providing the information*
BUD_6_3	*change notification*
BUD_7_1	*real-time information from supplier for monitoring of deliveries*
BUD_8_1	*real-time information from supplier for monitoring of deliveries*
BUD_9_1	*real-time information from supplier for monitoring of deliveries*
BUD_10_1	*real-time information from supplier for monitoring of deliveries*
BUD_13_1	*real-time information from supplier for monitoring of deliveries*
BUD_13_2	*connection to supplier delivery dates*
BUD_20_1	*real-time information from supplier for monitoring of deliveries*
BUD_20_2	*change notification*
BUD_20_3	*automated delivery status request to supplier*

ANNEX 6 GATHERED REQUIREMENTS FOR LOGISTICS MANAGEMENT

ID	Requirement
MIC_12_3	*support system for optimal workflow for production planning, especially in disruptive situations (establishment of different rules)*

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MIC_13_1	*Get and process external disruptions and from customer/ supplier, e.g. relevant trade barriers*
MIC_13_3	*real-time monitoring and alert system*
MIC_17_1	*Get and process environmental disruptions, e.g. relevant trade barriers*
MIC_17_2	*Get and process disruption information from supplier/ customer*
MIC_17_3	*real-time monitoring and alert system*
MIC_21_3	*comparison of practical and planned project work and notification functionality for deviations*
AID_3_1	*Get and process external disruptions incl. social, political and physical, e.g. relevant trade barriers*
AID_3_2	*Get and process disruption information from supplier/ customer*
AID_3_3	*real-time monitoring and alert system*
AID_6_1	*Get and process external disruptions, e.g. relevant trade barriers, with analysis of early indicators such as market trends, external events, and historical data*
BUD_16_1	*real-time information from supplier for monitoring of deliveries*

ANNEX 7 GATHERED REQUIREMENTS FOR DISRUPTION MONITORING

ID	Requirement
MIC_1_3	*loading and editing of manufacturing plans (manually or automatically)*
MIC_6_1	*management of historical data regarding workloads per workplace, operator or machine*
MIC_8_1	*quality management interface incl. quality alert system*
MIC_8_2	*real-time status and control of production*
MIC_11_1	*loading of sequencing of manufacturing orders (manually or automatically)*
MIC_14_1	*functionality to verify the sequencing of manufacturing orders against predefined criteria*
AID_4_1	*material data from supplier and internal characterisation*
AID_4_2	*material data import to own internal system*
AID_8_1	*availability of uploading references, feedback about how each reference was manufactured and feedback about distortions / deformations if observed*
AID_14_1	*interface for creating and managing part specification data sheets including 3D screenshot, customer details, part name, material, technology, quantity to be produced, and special finishes/features for post-processes and quality control*

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AID_15_1	*information overview about build jobs based on priority, considering agreed delivery terms*
AID_16_1	*integration capabilities for real-time machine data and log files*
AID_16_2	*analysis of information gathered during the processes (log file) to ease troubleshooting when certain build fails.*
AID_21_1	*access/visualize to relevant product and manufacturing information*
BUD_14_3	*view of already montaged parts for possible crosswork of parts (one machine is missing part a and c which takes months to deliver, another machine is missing part b which is already built into the first machine. This could be demontaged and integrated into the second machine to finish it)*
BUD_19_3	*customer priotirization (e.g. one machine is missing part a and c which takes months to deliver, another machine is missing part b which is already built into the first machine. This could be demontaged and integrated into the second machine to finish it)*

ANNEX 8 GATHERED REQUIREMENTS FOR MANUFACTURING MANAGEMENT

ID	Requirement
MIC_1_2	*scenario analysis regarding different KPIs*
MIC_2_1	*analysis of contracted transportation partners information (routes, rates per kg, package or pallet, pickup and delivery frequencies, as well as other possible restrictions)*
MIC_2_2	*analysis of alternative transportation partners information (routes, rates per kg, package or pallet, pickup and delivery frequencies, as well as other possible restrictions)*
MIC_2_3	*Analytical suggestions for new transportation partners (best option regarding different points)*
MIC_3_1	*analysis of contracted supplier information (costs, quality, delivery time, as well as other possible restrictions)*
MIC_3_2	*analysis of alternative supplier information (costs, quality, delivery time, as well as other possible restrictions)*
MIC_3_3	*Analytical suggestions for new suppliers (best option regarding different points)*
MIC_4_2	*scenario analysis regarding different KPIs*
MIC_5_1	*analysis of contracted supplier information (costs, quality, delivery time, as well as other possible restrictions)*
MIC_5_2	*analysis of alternative supplier information (costs, quality, delivery time, as well as other possible restrictions)*
MIC_5_3	*Analytical suggestions for new suppliers (best option regarding different points)*
MIC_6_2	*analysis of current project data and forecast of resource usage including factors like seasonal fluctuations regarding workloads per workplace, operator or machine*
MIC_6_3	*capacity prediction workloads per workplace, operator or machine and alert system*
MIC_10_2	*analysis of current project data and forecast of material usage including factors like seasonal fluctuations*

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MIC_11_2	*scenario analysis regarding different KPIs (minimize machine use time, prioritize larger orders, minimize delivery times, prioritize orders of some references, manufacturing cost, delivery time, etc.)*
MIC_16_1	*analysis of current project data and forecast of resource usage, including factors like seasonal fluctuations*
MIC_16_2	*optimization proposals regarding different KPIs*
MIC_18_2	*scenario analysis*
MIC_18_3	*visualization and analysis of quality incidents in relation to manufacturing conditions*
MIC_19_1	*scenario analysis (logistics)*
MIC_19_2	*analysis of contracted transportation partners information*
MIC_19_3	*analysis of alternative transportation partners information*
MIC_26_1	*interface and analysis functions for environmental KPIs*
MIC_27_3	*scenario evaluation (decentralized transportation etc.)*
MIC_30_3	*scenario evaluation (product development)*
AID_1_1	*analysis of contracted supplier information and capabilities*
AID_1_2	*analysis of alternative supplier information and capabilities*
AID_1_3	*Analytical suggestions for new suppliers (best option regarding different parameters)*
AID_2_2	*analysis of current project data and forecast of material usage including factors like seasonal fluctuations*
AID_4_3	*analysis of materials specifications based on historical data (incidences)*
AID_11_1	*generate dynamic delivery forecasts based on the job queue, order demand, and new order entries*
AID_11_2	*analysis of historical delivery and production data*
AID_18_2	*Provide solutions to tackle those disruptions by suggesting: build reschedule / production addressed by other partners.*
AID_30_3	*scenario evaluation (decentralized production etc.)*
BUD_7_2	*analysis of alternative transportation partners information (routes, rates per kg, package or pallet, pickup and delivery frequencies, as well as other possible restrictions)*
BUD_7_3	*Analytical suggestions for new transportation partners (best option regarding different points)*

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BUD_25_2	*optimization proposals regarding different KPIs*

ANNEX 9 GATHERED REQUIREMENTS FOR ANALYTICAL CAPABILITIES

ID	Requirement
MIC_9_1	*order management functionalities*
MIC_10_1	*management of historical data*
MIC_12_1	*real-time monitoring of production machines*
MIC_14_2	*order and task overview*
MIC_18_1	*management of historical data*
MIC_21_1	*real-time visibility into the status of each work, including completion, post-process, and the number of pieces produced*
MIC_21_2	*dashboard or interface that provides a comprehensive overview of all ongoing work*
AID_2_1	*management and analysis of historical data*
AID_5_1	*warehouse management system including real-time monitoring*
AID_7_1	*integration of already used softwares in IMC or IMC needs order management functions itself*
AID_9_1	*real-time monitoring of production machines*
AID_9_3	*support system for optimal workflow for production planning*
AID_12_1	*manage and assign tasks to different work teams*
AID_12_2	*human resources availability tracking and account for possible disruptions like illness*
AID_12_3	*functionality for dynamic task reassignment based on real-time availability and disruptions, ensuring efficient workflow management*
AID_13_1	*real-time visibility into the status of each work, including completion, post-process, and the number of pieces produced through a comprehensive dashboard*
AID_15_2	*functionality to dynamically adjust the production plan*
AID_17_2	*integration of quality control informations*
AID_24_1	*real-time monitoring of production machines. Comprehensive dashboard*
AID_31_1	*integration of ERP in IMC*
AID_31_2	*interface for generating automatically delivery notes*
BUD_8_2	*assessment of relevant information and should be able to derive improvements*

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BUD_11_1	*real-time information from supplier for monitoring of deliveries*
BUD_11_2	*feedback sheet*
BUD_11_3	*overview interface for own organisation with results*
BUD_12_1	*real-time information from supplier for monitoring of deliveries*
BUD_12_3	*connection to improvement/ KPI view*
BUD_13_3	*connection to project/ order view to manage forecast*
BUD_14_1	*real-time information from supplier for monitoring of deliveries*
BUD_14_2	*connection to project/ order view to manage forecast*
BUD_15_1	*real-time information from supplier for monitoring of deliveries*
BUD_17_1	*real-time information from supplier for monitoring of deliveries*
BUD_17_3	*inclusion of cost and time relevant KPIs connected to project and orders*
BUD_18_1	*real-time information from supplier for monitoring of deliveries*
BUD_18_2	*automatical synchronization of changes*
BUD_19_1	*real-time information from supplier for monitoring of deliveries*
BUD_19_2	*support system for optimal workflow for production planning, especially in disruptive situations (establishment of different rules)*
BUD_22_1	*real-time information from supplier for monitoring of deliveries*
BUD_22_2	*integration of appointments, employee availability*

ANNEX 10 GATHERED REQUIREMENTS FOR PRODUCTION MANAGEMENT

ID	Requirement
MIC_16_3	*integration of energy consumption, self-consumption, weather forecasts*
MIC_22_1	*integrate enviromental information about suppliers (certifications, etc)*

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MIC_23_1	*interface to visualize environmental informations*
MIC_23_2	*environmental information management*
MIC_24_1	*supplier suggestion based on environmental certification*
MIC_24_3	*environmental information management*
MIC_25_1	*interface for waste tracking*
MIC_25_2	*identification of processes with most waste generation incl. analysis of waste generated because of failures*
MIC_25_3	*facilitation of companies with waste as raw material (second life) as customer*
MIC_26_2	*display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications*
MIC_26_3	*get and process external data regarding carbon footprint*
MIC_27_1	*display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications*
MIC_27_2	*integration of different transportation options with their carbon footprint*
MIC_28_1	*percentage of renewable material used for produced products visualised*
MIC_29_1	*facilitation of companies with waste as raw material (second life) as supplier*
MIC_30_1	*display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications*
MIC_31_1	*calculation of needed biomass*
MIC_31_2	*control and inform about current stock of biomass*
MIC_31_3	*facilitation of companies with waste as raw material (second life) as supplier*
AID_27_1	*Interface at supplier and own organisation side for sustainability information input (e.g. content of recycled, renewable materials, carbon footprint or even environmental product declaration)*
AID_27_2	*Interface at own organisation and customer side for visualization of sustainability information*
AID_27_3	*Information flow system*

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AID_28_1	*manage inventory of waste materials generated during the production process, including metal or polymer powders and support structures and to find potential industrial symbiosis options (companies near me to use mu waste as a raw material)*
AID_28_2	*Connection with a local platform on industrial symbiosis*
AID_29_1	*automatic energy demand (and other environmental KPIs) calculation related to production processes and materials*
AID_30_1	*display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications*
BUD_4_3	*facilitation of companies with waste as raw material (second life) as customer*
BUD_5_2	*evaluation of certification of product parts and materials*

ANNEX 11 GATHERED REQUIREMENTS FOR ENVIRONMENTAL MANAGEMENT

ID	Requirement
AID_22_1	*traceability of changes through the service process*
AID_22_2	*repository with documentation and visibility of any modifications made*
AID_23_1	*Customer should have quick access to "material+machine" design guidelines and limitations*
AID_25_2	*information flow to customer*
AID_26_2	*interface for customer for delivery status*
BUD_3_1	*Connection to customer*
BUD_3_2	*Interface for project orders*
BUD_3_3	*Tracking of changes and adjustments*
BUD_4_1	*product tracking*
BUD_4_2	*value calculation regarding tracking*
BUD_9_2	*analysis of contracted customers*
BUD_9_3	*analysis of potential (new) customers*
BUD_23_1	*real-time information from supplier for monitoring of deliveries*

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BUD_27_1	*real-time information from supplier for monitoring of deliveries*
BUD_27_2	*automatical notifications to customer and organisation to plan necessary maintenance appointments*
BUD_28_1	*real-time information from supplier for monitoring of deliveries*
BUD_28_2	*interface for facilitate offers*

ANNEX 12 GATHERED REQUIREMENTS FOR SALES AND SERVICE TRACKING

ID	Requirement
BUD_21_1	*real-time information from supplier for monitoring of deliveries*
BUD_21_2	*all relevant participants should be able to share and get information*
BUD_24_1	*real-time information from supplier for monitoring of deliveries*
BUD_25_1	*real-time information from supplier for monitoring of deliveries*
BUD_26_1	*real-time information from supplier for monitoring of deliveries*
BUD_26_2	*notification system for changes*

ANNEX 13 GATHERED REQUIREMENTS FOR PROJECT MANAGEMENT

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