NARRATE

Regenerative Resilient Smart Manufacturing Networks

# D1.2 PILOT ANALYSIS

**2024/05/31**

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Call: HORZON-CL4-2023-TWIN-TRANSITION-01 • Topic: HORIZON-CL4-2023-TWIN-TRANSITION-01-07 • Type of action: HORIZON Research and Innovation Actions

UK Research and Innovation

UK Research and Innovation, Horizon Europe Guarantee.

Grant Agreement No.: 101138094
Topic: HORIZON-CL4-2023-TWIN-TRANSITION-01-07
Call: HORIZON-CL4-2023-TWIN-TRANSITION-01
Type of action: HORIZON-RIA

# D1.2 PILOT ANALYSIS

| | |
|---|---|
| Work package | WP 1 |
| Task | T1.2 |
| Due date | 31/05/2024 |
| Submission date | 31/05/2024 |
| Deliverable lead | AIDIMME |
| Version | 0.6 |
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| Abstract | This deliverable describes the prioritization of requirements from the pilots' perspective, the KPIs considered for the validation, and the methods to be applied during the validation, including a tentative plan for the deployment and execution of the pilots. |
| Keywords | Pilot analysis, Requirements' prioritization, Pilot-based KPIs, Pilot validation, Validation criteria, Requirements Traceability Matrix, User Acceptance Testing, Execution plan |

Project co-funded by the European Commission in the HORIZON Programme

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| Nature of the deliverable: | R |
| Nature of the deliverable: | PU |



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## DOCUMENT REVISION HISTORY

| Version | Date | Description of change | List of contributor(s) |
|---|---|---|---|
| 0.1 | 2024/04/25 | Definition of the Table of Contents | AID / FhG |
| 0.2 | 2024/05/07 | Introduction and MoSCoW methodology | AID |
| 0.3 | 2024/05/17 | Validation criteria and Deployment and Execution Plan | AID |
| 0.4 | 2024/05/22 | Update in document structure, inputs on prioritization of requirements and KPIs | AID / MED / FhG |
| 0.5 | 2024/05/28 | Addressing of comments after internal review, overall additions in the requirements prioritization, picture improvement, and addition of appendix | AID / MED / BUD / SAG / F6S |
| 0.6 | 2024/05/29 | Final version | AID |
| 0.61 | 2024/05/30 | Submitted version. Co-ordinator check. Content not modified. | AID |



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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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| 8 | MEDWOOD SL | MED | ES |
| 9 | DHL EXEL SUPPLY CHAIN SPAIN SL | DHL | ES |
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# ABBREVIATIONS

| | |
|---|---|
| WP | Work Package |
| BB | Building Block |
| DED | Deliverable Expectation Document |
| EC | European Commission |
| JIT | Just-In-Time |
| KPI | Key Performance Indicator |
| MaaS | Manufacturing as a Service |
| MoSCoW | Must, Should, Could, Won't have, as described in the prioritization methodology |
| MSx | Milestone x |
| Mx | Month x |
| PDMM | Pilot Digital Maturity Model |
| QA | Quality Assurance |
| RFP | Request For Proposal |
| RTM | Requirement Traceability Matrix |
| SCOR | Supply Chain Operations Reference model |
| SMN | Smart Manufacturing Network |
| SC | Supply Chain |
| TC | Test Case |
| Tx.x | Task x.x |
| UAT | User Acceptance Testing |
| UC | Use Case |
| UR | User Requirement |
| US | User Story |
| WP | Work Package |



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# EXECUTIVE SUMMARY

The purpose of this document is the analysis of three different pilots (furniture production, multi-sector 3D printing and semiconductor manufacturing) with the final goal of enhancing manufacturing agility and supply chain resilience. This pilot analysis is conducted through two main activities. On the one hand, the requirements collected from the pilots' users based in user stories are revisited and prioritized according to the particular needs and expectations of each pilot. This prioritization provides a clearer picture about the aims of the industrial partners which is a valuable resource at any moment during the implementation and deployment phases. On the other hand, the identification of specific KPIs for each pilot case corroborates the expectations from the users and enables the measurement of the impact produced by NARRATE in the pilot real environments and particular industrial ecosystems. Both, the requirements prioritization through the MoSCoW technique and the KPIs will play a decisive role in the future filtering and selection of requirements, which will be also based on the NARRATE scope and the required alignment to the Manufacturing-As-A-Service (MaaS) enhancing supply chain resilience in response to unexpected disruptions taking into account the environmental aspects on any decision within manufacturing ecosystems.

The last part of this report is focused on the definition of the criteria for the pilot validation, and the proposal of a plan for the deployment and execution of the NARRATE technological solutions. For the validation criteria, the aim is at providing handy mechanisms to perform an optimal analysis of the offered functionalities to determine the proper fulfilment of the demanded requirements. Therefore, the suggested validation process follows the Requirement Traceability Matrix (RTM) including the definition and execution of specific test cases, which can be used to determine the scope of application of the available functionalities, and how they are expected to be operated. At the same time, the recommended traceability approach enables to keep both pilot users and developers on track about the status of the expected functionalities and the corresponding validation process following the Pilot Digital Maturity Model (PDMM) in NARRATE helping assess the level of technological advancement in the pilots and guide them toward higher levels of digital integration and innovation Updates, adjustments, and fixes can be reported to keep all the involved partners on track and take actions accordingly. The deployment and execution plan introduced in this report - which will be refined and more detailed in future activities - is the basis for the scheduling of the software releases to be realized during the project, as well as the corresponding testing and validations from the pilots' side.



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# 1. INTRODUCTION

## 1.1. PURPOSE AND SCOPE

The purpose of this deliverable D1.2 Pilot Analysis is to report the activities carried out regarding the analysis of the pilots, the criteria for the validation of the implemented solutions, and the preparation of a tentative workplan to guide the implementation of the pilots, which are validated later in WP5. Information from pilot partners needs to be collected to cover the planning and setting up of the scenarios, so this is the basis for the validation.

To this end, the pilot requirements are revisited considering the point of view of the pilots, so the industrial partners can perform a prioritization process according to their needs and expectations, which will be later evaluated by the technical partners. Indeed, the pilots are also revisited and KPIs generated as a mechanism for the future evaluation of the impact.

Furthermore, the validation criteria proposal is presented to perform the assessment of the implementation and evaluate the results regarding the impact on the industrial pilots.

The technical partners have been involved in the elaboration of the execution plan according to the implementations to be delivered and the expectations from the pilot cases.

## 1.2. RELATION TO OTHER DELIVERABLES

The activities reported in this deliverable D1.2, which is also core of the milestone MS1, are strongly related to those performed in D1.1 Project Requirements [1], which includes the elicitation, formalization, and integration of the pilot requirements, also presenting the pilots with those requirements that may be specific to each one. This work is followed by the energy efficiency, circularity, and environmental sustainability requirements as well as the architectural requirements in WP1.

The validation criteria and execution plan presented in D1.2 is used as the basis for the activities to be performed in WP5 " Pilot Analysis, Experimentation & Validation" and therefore the corresponding deliverables:

- D5.1 Pilot planning report - early pilot demonstrator (a) (which reports the pilot planning with the early demonstrator)
- D5.2 Pilot Implementation – R2 with final release of modules (which reports the pilot Implementation with final release of modules)
- D5.3 Final pilot evaluation with final release of platform (which reports the final evaluation of the pilot with the final release of the platform), and
- D5.4 Pilot planning report - early pilot demonstrator. Choice of one pilot to demonstrate modules (b) (which Includes the pilot planning report with one pilot demonstrator)

so, all the planning and evaluation activities depend to some extent on the proposed timelines and validation criteria presented in this document.

Furthermore, the execution and deployment plan presented in this D1.2 deliverable is closely related to the digital technology roadmap included in deliverable D8.2 NARRATE technology roadmap [2]. This roadmap is divided into five phases and determines the activities, milestones, timing, and related deliverables for each phase establishing responsibilities and implementation teams. It should be reminded that the main objective in task T1.2 and reported in this D1.2 deliverable is O1.3 Project pilot analysis, validation and set up from WP1.



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## 1.3. STRUCTURE OF THE DOCUMENT

This report aims at providing a clear structure of the contents related to the activities performed in task T1.2 " Pilot Analysis, Set Up & Validation Criteria". Therefore, from this Introduction on, the next section presents the prioritization of the requirements performed from the pilots' perspective, including a brief summary of the pilots, a short presentation of the MoSCoW methodology [4] adopted for the prioritization process, and main conclusions about this process. Then, KPIs based on the pilot applications are presented, also describing the base of its selection for the impact measurement. After this, the validation criteria propose a mechanism to evaluate the level of fulfillment of the implementations in relation to the pilots' needs and expectations coming from user stories and requirements. Then an execution timeline and a deployment plan are proposed as first guidelines to cover the implementation, the setting up, and the evaluation of the industrial scenarios through the adoption of the platform. Finally, overall conclusions about the performed activities are presented.

# 2. SHORT REMINDER OF THE PILOTS

Below, a short reminder of the three NARRATE pilots is included. A brief description of each industrial environment is provided, focusing on the expectations of each pilot. It should be noted that the pilot analysis performed in this deliverable D1.2 is carried out basically through the work reported in the prioritization process, and the KPI definition for each pilot.

## 2.1. PILOT #1 - IMPROVING AUTOMATION & SUPPLY-CHAIN RESILIENCE IN THE FURNITURE INDUSTRY BY MEDWOOD

MEDWOOD produces furniture for children as well as child support pieces, leading the Spanish market and positioned in the fourth place as largest children furniture manufacturer at European Level. Recently, the company has expanded to the production of polishing and melanin as well as logistics. However, considering the focus of the pilot, DHL is expected to participate in the pilot. MEDWOOD is an SME with limited digital technology support for supply chain (SC) management, what often leads to inefficiencies, delays, or poor visibility and transparency regarding its Internal and outsourced activities. Challenges related to delivery dates, resilience, and reactions when disruption occur should be considered to become competitive in the market. MEDWOOD is a custom-driven company that manages a wide variety of suppliers and customers, which can be direct customers and sub-contractors.



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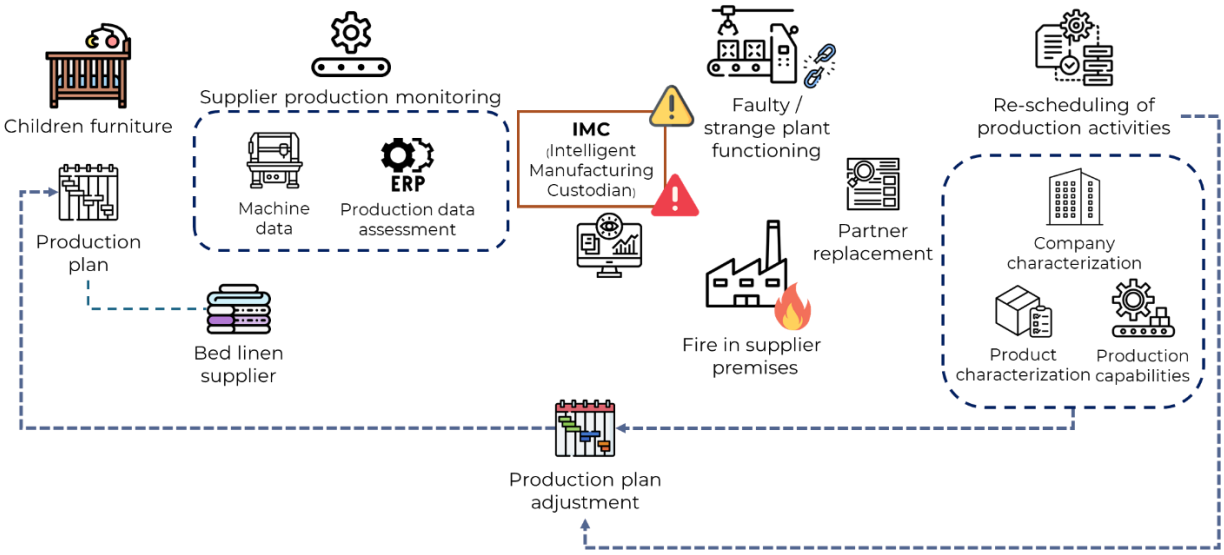


FIGURE 1: WORKFLOW OF THE FURNITURE PILOT

Any adjustment in the SC caused by delays from the supplier side, or updates in the demand from the customer side requires much effort and takes long, what is exacerbated by the low level of communication available through the entire SC.

Therefore, for the MEDWOOD pilot perspective, the NARRATE project should cover two main aspects. On the one hand, the optional monitoring of some suppliers would Increase the awareness of any anomaly in the SC, enabling the company to react accordingly. On the other hand, the company needs to find substitute partners (e.g., for the supply of materials) when some delay in the delivery is detected. The supporting historical data (e.g., from DHL) would increase the overall efficiency of this process. In the selection of the possible options to be provided by the technology. In the project, the sustainability criteria must be followed to the maximum extent possible.

## 2.2. PILOT #2 - PRINTING NETWORK AS-A-SERVICE TO IMPROVE RESILIENCE & MITIGATE UNEXPECTED DISRUPTIONS BY AIDIMME

AIDIMME is the research institute for metal, wood, furniture, packaging, and construction technology, what also covers additive manufacturing technologies, which are the focus of the proposed pilot. This is a private and non-profit organization. The pilot starts from the actual challenges in the management of orders in the 3D printing department, so they are handled with basic software which is not often suitable enough to that end. Disruptions (e.g., broken machine or failure, deformations, and distortions in manufactured components), often occur due to the complexity of this production technology and the variety of parameters and thermal processes. This leads to an inefficient management which does not adapt to dynamic changes as expected. It should be noted that additive manufacturing requires the construction of products in small batch sizes, following the same or different geometry in one single product step. The new planned model approach is based on the decentralization of the production with the so-called hubs in a 3D printing network for the customers to outsource the manufacturing process.



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FIGURE 2 3D-PRINTING BUSINESS MODELS INCLUDING PRINTING NET IN EUROPE

The expectation of the AIDIMME pilot is based on the possibility to manage not only the own but the contracted machinery over the 3D printing network to have improved mechanisms to react when disruptions occur. This would enable the redirection of the production according to multiple criteria (e.g., the geographical location, the availability of materials, etc.) following undoubtedly sustainability criteria.

It should be pointed that AIDIMME does not offers MaaS as such, so the goal in the pilot is to create the nodes network to become more efficient in adverse situations (e.g., working overloads, collapsed machine), meeting the proposed deadlines and avoiding a negative impact for the customer.

## 2.3. PILOT #3 - ESTABLISHING A NEW RESILIENT SUPPLY CHAIN FOR BUDATEC

BUDATEC GmbH is an industrial SME that implements hardware for automation systems. The company has considered topics related to the efficiency of energy and resources, modules in the Industry 4.0 scope, an energy management demonstrator that includes the monitoring of the management of dynamic processes and the concept for flexible soldering production lines. Actually, BUDATEC needs to decide on major strategic orders in a short term, what impacts on the company at a long-term. In particular, large orders and standardized processes must be followed while reacting dynamically to unexpected events at the same time. The non-substitutable elements are delivered in a period of up to one year. The production design together with the general shortage of supplied parts leads to an insufficient production area, so the production will be expanded to a second location.



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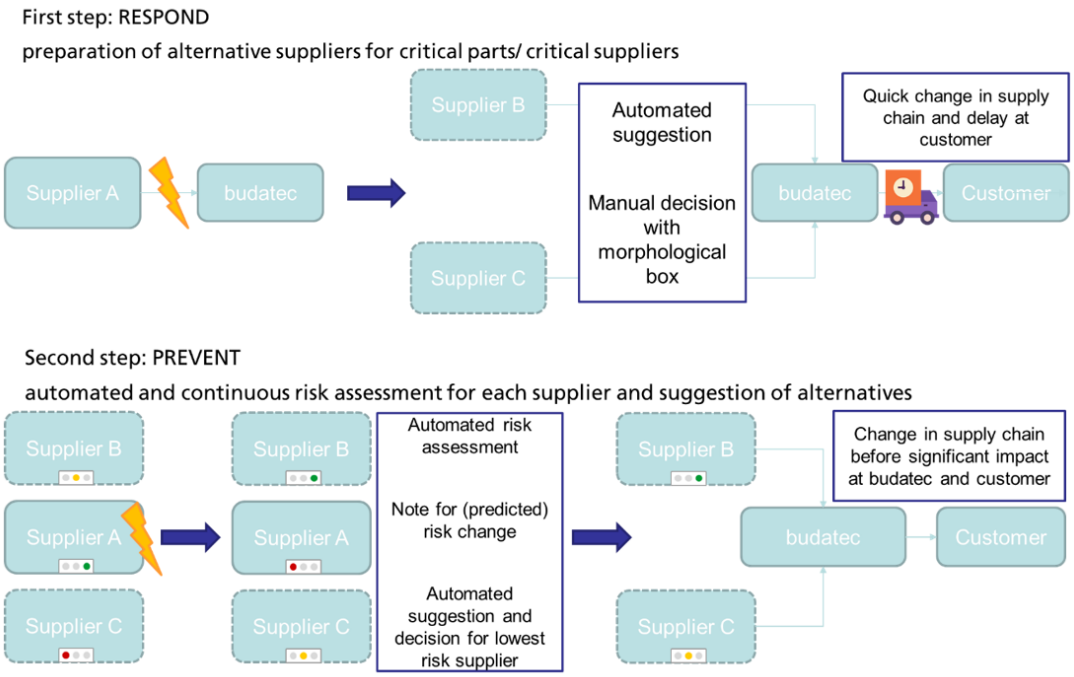


FIGURE 3 WORKLOW OF THE FUNCTIONALITY EXPECTED FROM BUDATEC

Therefore, a system to enable the anticipation facing unforeseen events at the supplier side, suggesting solutions for potential delivery problems (also considering new suppliers), and focused on the critical parts (e.g., non-substitutable parts with a long delivery term) would become a high value resource.

# 3. PRIORITIZATION OF THE REQUIREMENTS

For the definition of the User Requirements (UR), a list of User Stories (US) was collected first. The USs structure was defined following a quite simple syntax, as can be seen in the top are of Figure 4: Definition procedure of the User Stories gathered from the pilots below.

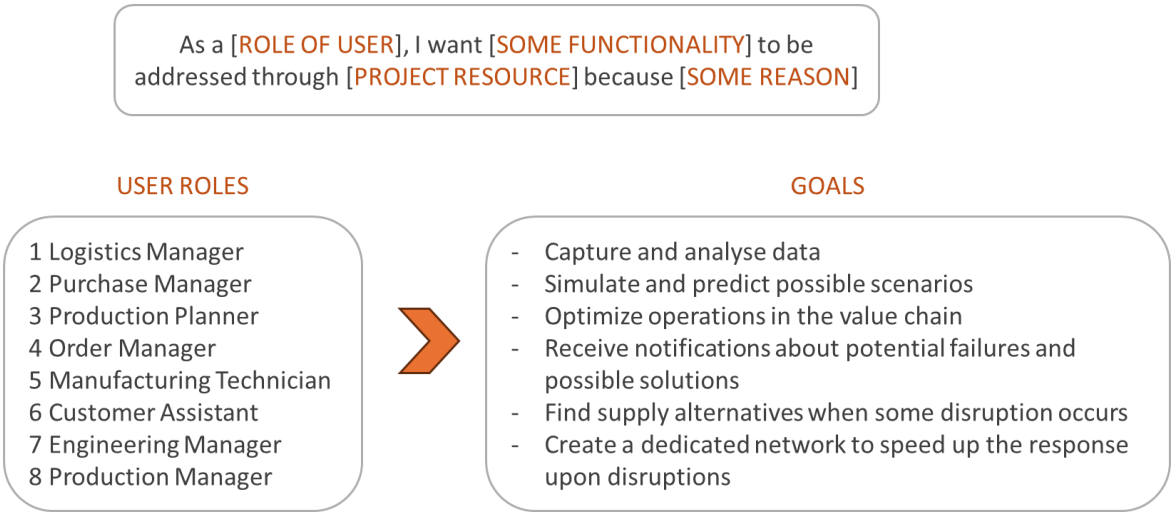


FIGURE 4: DEFINITION PROCEDURE OF THE USER STORIES GATHERED FROM THE PILOTS



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Each US has a main type of user (Role) who demands a given functionality. For each pilot, the most relevant roles (on the left side of the picture above) were detected while elaborating the USs. The goals (some examples are depicted on the right side of the picture above) are defined considering the expected functionality and the reason of such expectation.

Once the USs were elaborated, the URs were defined, so for each US, one or more requirement was identified. This process is documented in the parallel NARRATE deliverable D1.1 Project Requirements [1].

## 3.1. MOSCOW METHODOLOGY

The MoSCoW prioritization technique represents four priority groups focusing on the prioritization of the requirements (the o's in the MoSCoW acronym are added to make the word pronounceable.

This technique was introduced in 1994 by Dai Clegg of Oracle UK as a simple method to classify the requirements into a priority order, by quickly understand the opinion from the users about the relevance of each requirement, which is classified as follows:

- "**MUST** have" (mandatory): for those requirements to represent those essential requirements to be managed by the system.
- "**SHOULD** have" (high priority): for those requirements which are important but could be somehow skipped to be managed at least for a while.
- "**COULD** have" (desired but not necessary): for those requirements which add business benefits but are not essential.
- "**WILL NOT** have" (potentially delayed): for those requirements which can be skipped or proposed for future releases.

The MoSCoW technique enables the developers to focus on the most important requirements from the users' perspective, adjusting the software delivery to a specific time constraint. The MoSCoW priorities are often labelled by developers with colours (e.g., green for "MUST", purple for "SHOULD", yellow for "COULD" and pink for "WON'T".

The stakeholders prefer MoSCoW with negotiation considering it the most practical and logical method. However, considering that users often are not able to capture the real value of a requirement in this approach, it is recommended avoid working on this individually but on a group-wide basis, using sticky cards and taking notes [3].

The MoSCoW method can be also used in the Agile project management methodology, which breaks the system development into small sections called iterations. Each iteration is focused on completing specific elements of the project in work sessions called sprints (these usually last 2-4 weeks).

MoSCoW method together with the Agile methodology can be used to determine which elements (including tasks, requirements, products, and user stories) need to be prioritized by the development team, and which can be put on hold. This enables quick deployments, a more efficient use of the resources, an increase in the flexibility and adaptability when facing changes, and a quicker detection of issues.

Although this technique presents some drawbacks, like the prioritization of requirements within the same category, and the subjective interpretation of the importance of the requirements raised when a collective leadership is excluded in the decision-making process, the MoSCoW technique is easy to use and understand, enables users to assign resources to each of the four categories (allowing an effective management of the resources and optimizing the productivity analysis), and ensures that a minimum viable product is produced [4].



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## 3.2. CONCLUSIONS ON REQUIREMENTS PRIORITIZATION

Below, some considerations about the outputs of the prioritization are included for each pilot. The aim of this section is to provide a concise and valuable description of the expectations of each pilot regarding the NARRATE project.

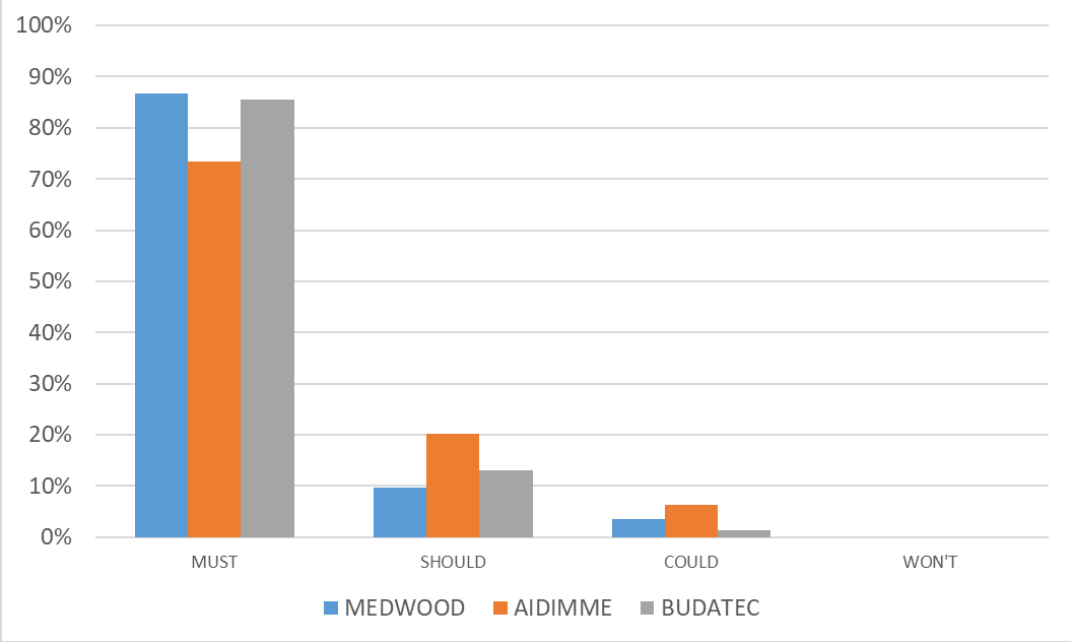


FIGURE 5: DISTRIBUTION OF REQUIREMENTS FOR EACH PILOT FOLLOWING THE MOSCOW PRIORITIZATION

The Figure 5 above summarizes the amount of MUST, SHOULD, COULD and WON'T have requirements for each pilot, revealing a similar distribution of priorities among the 3 pilots.

### 3.2.1. Prioritization in Pilot #1 - MEDWOOD

Overall, from the perspective of MEDWOOD, the priority is the generation of proposals, alternatives, and solutions to enable an efficient and effective decision-making in the company. In this regard, the optimization systems and the simulation of production, purchase, and logistics plans should guide in this decision-making process. Similarly, the monitoring, anticipation, and notification (these ones focused on deviations and disruptions) mechanisms are highly relevant.

The roles in the company for which these functionalities are considered of greater importance are mainly related to production, purchases, and logistics, and the associated decisions have two important impacts. On the one hand, they affect both the medium/long-term and the short-term, regarding customer orders that must be delivered within a few weeks. On the other hand, the demand planning, the product development, and the quality and environmental aspects, where the action range belongs to the medium-term must be also considered.

The Figure 6 below shows the distribution of the priorities for the different user roles involved in the MEDWOOD pilot.



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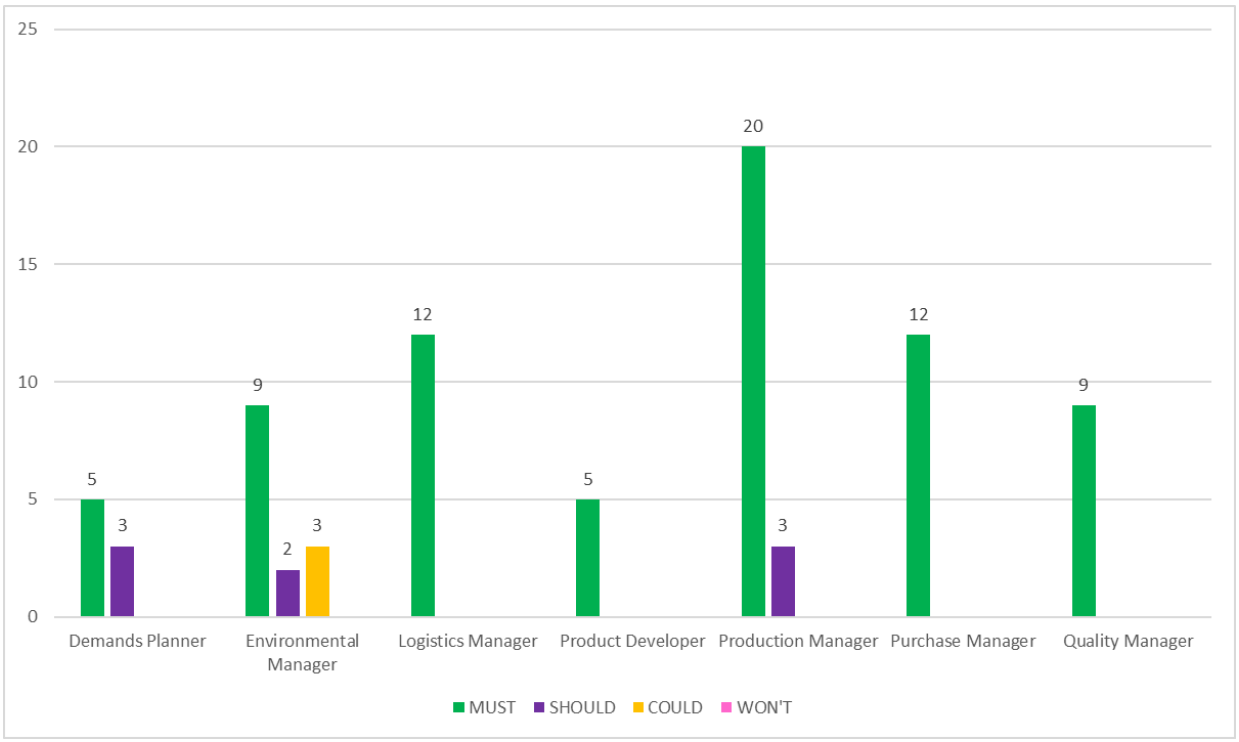


FIGURE 6: REQUIREMENTS PRIORITIES AMONG THE DIFFERENT ROLES IDENTIFIED IN THE MEDWOOD PILOT

The complete list of requirements of MEDWOOD with the corresponding prioritization and User Roles can be found in Annex 1.

### 3.2.2. Prioritization in Pilot #2 - AIDIMME

From the point of view of AIDIMME, the most priority aspects for the pilot are the following:

- To centralise the information management: from the order reception to the order delivery, in order to avoid errors associated to the human factor which are produced due to the use of diverse information systems. This centralization can be supported by dashboard interfaces that provide a clear vision of the tasks to the different actors to whom the information is targeted.
- To promote a platform of collaborators (outsourcing), expandable from new needs of the customers, and that enable the redirection the tasks according to relevant parameters (e.g., materials, availability, job queues).
- To analyse alternative suppliers of raw materials and consumables that are used in the different manufacturing processes, proposing new supply partners, and managing the traceability of materials received, in order to avoid potential disruptions in the supply chain and in the stock (for raw materials, consumables, and spare parts), through a control and monitoring system for the warehouse, as well as a notification system to send warnings when the quantities available are under the predefined thresholds.
- To analyse and to map process variables (in real time or through log files) in order to predict or to warn about some malfunction in the process, enabling the efficient taking of actions in front of disruptions that may affect the SC, through the integration of capacities for the gathering of machinery information (e.g., retrieved in real time) and the collection of management information (e.g., extracted from log files).

The Figure 7 below shows the distribution of the priorities for the different user roles involved in the AIDIMME pilot.



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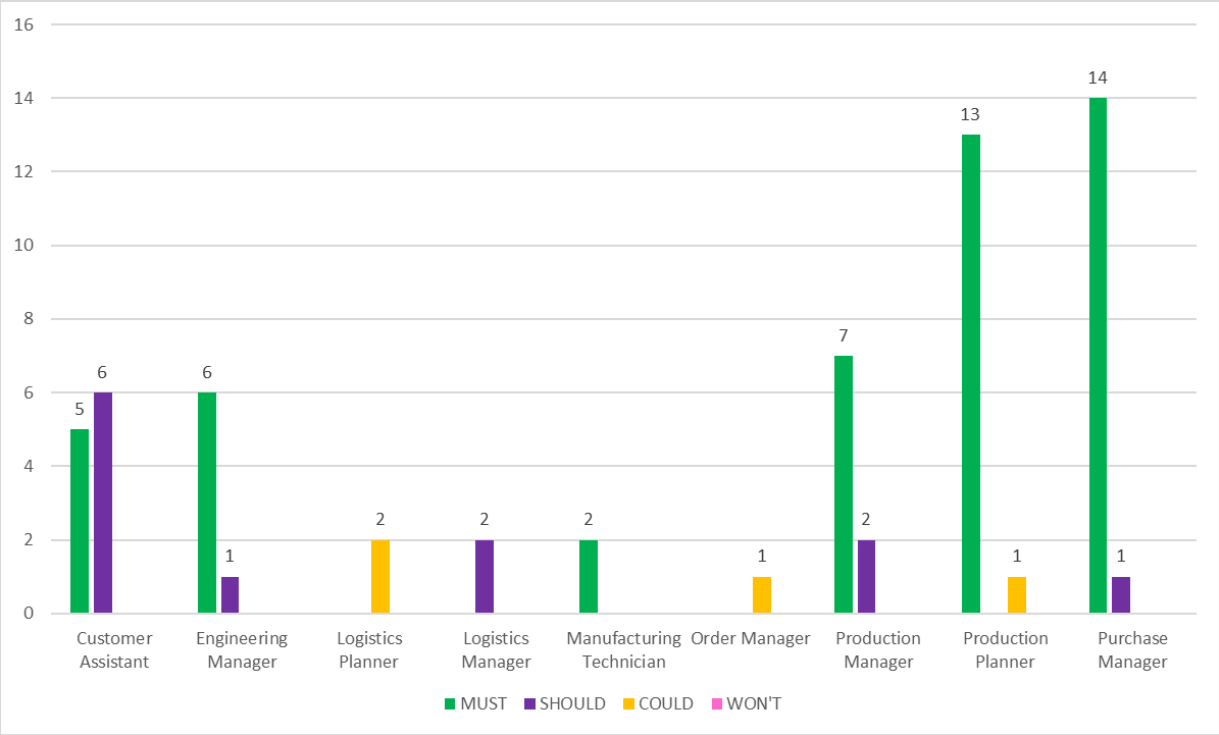


FIGURE 7: REQUIREMENTS PRIORITIES AMONG THE DIFFERENT ROLES IDENTIFIED IN THE AIDIMME PILOT

The complete list of requirements of AIDIMME Indicating its prioritization and User Roles can be found in Annex 2. It should be noted that during the requirement gathering, the name used for pilot partner #1 MEDWOOD (MED) was still MICUNA (MIC), so to avoid any confusion the encoding MIC has been kept in the annex.

### 3.2.3. Prioritization in Pilot #3 - BUDATEC

From the point of view of BUDATEC, the General Manager expects from NARRATE to present safe supply chains, the sustainability, and market advantages. This applies to markets that have already been developed as well as new markets for new technologies and processes. For these requirements, systematic procedures and routines must be developed that are both scientific and practicable. The management at BUDATEC and the leading managers involved are the relevant roles responsible for these functions. Support is provided by scientific staff with expert knowledge in the areas of sustainability, reliability, and practicability.

The Figure 8 below shows the distribution of the priorities for the different user roles involved in the BUDATEC pilot.



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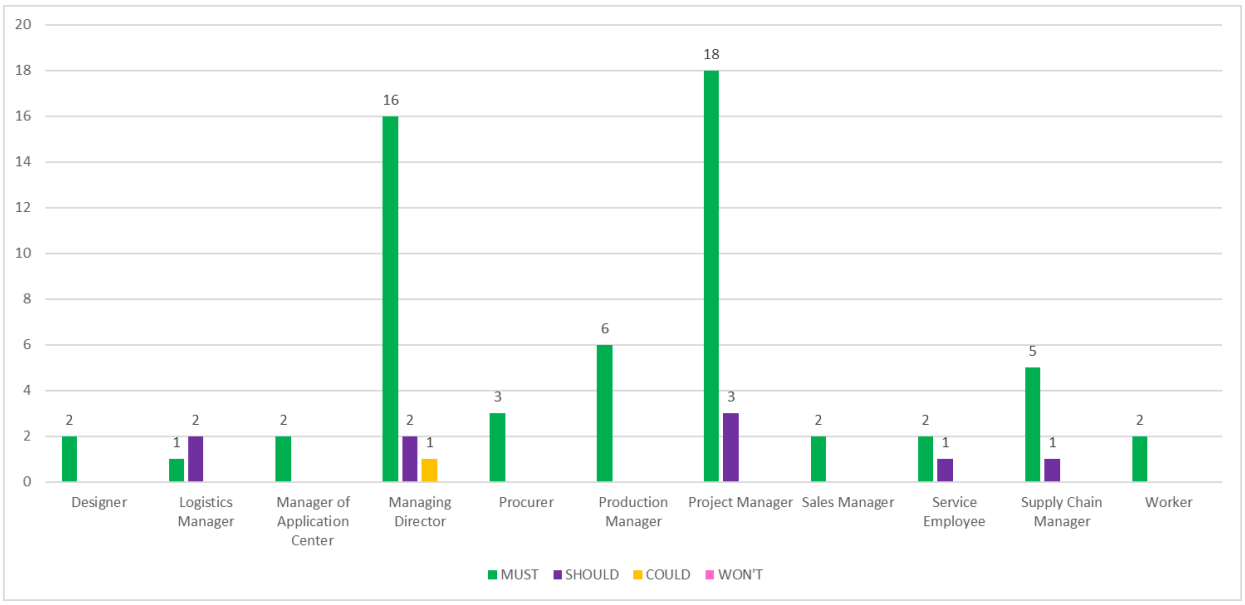


FIGURE 8: REQUIREMENTS PRIORITIES AMONG THE DIFFERENT ROLES IDENTIFIED IN THE BUDATEC PILOT

The complete list of requirements of BUDATEC with the corresponding User Roles and prioritization can be found in Annex 3.

# 4. DEFINITION OF PILOT-BASED KPIS

## 4.1. KPIS ELICITATION METHODOLOGY

The defined KPIs enable the measurement and analysis of the impact of NARRATE in the different pilots, so they allow to determine whether or to what extent the main goals of the pilots' validation have been achieved. A detail description of the purpose of KPIs can be found in D1.1 Project Requirements [1]. KPIs presented in D1.1 are retrieved from the project proposal, with some additions from the Supply Chain Operations Reference (SCOR) model annotated in the Concept Board used to elaborate the USs.

This model allows to evaluate the SC for effectiveness and efficiency of sales and operational planning, intending to help standardize the process and create a measurable way to track the results. This model works across industries using common definitions that apply to any SC process [5].

Deliverable D8.2 [2] includes a list of selected indicators related to cost and operational Improvements, also indicating the estimated improvement through NARRATE. They are:

- Improvement in the identification of potential risks and disruptions: ~30%
- Improvement of time dedicated to recover the full functionality after a disruption: ~20%
- Improvement of the on-time delivery rate: ~15
- Reduction of greenhouse gas emissions and energy consumption in production: ~10%
- Reduction of waste generation by lead supplier or lead supplier in the SC: ~10

And a small set of specific KPIs for the three pilots:

- Improvement in the stock reductions: ~5 - 10%
- Increase in the customer satisfaction (quality preservation / just-in-time (JIT) delivery and information on environmental performance): ~5 - 10%
- Extension of machine lifespan: ~10%.



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It should be noted that these have been identified as detected common necessities, and indeed, some of these KPIs can be again found over this section as relevant indicators for some pilots.

## 4.2. KPI LIST BY PILOTS

Below, the list of KPIs with its corresponding expected values is introduced. Moreover, for each pilot, the involvement of requirements for each KPI is represented in simple graphs. This allows to evaluate to what extent each KPIs becomes affected by the User Requirements requested from the pilot users.

### 4.2.1. KPIs in Pilot #1 - MEDWOOD

The table below shows the KPIs and its expected values for the MEDWOOD pilot.

| KPI Name | Expected Value (~) |
|---|---|
| Improvement in identification of potential risks & disruptions | 60 - 70% |
| Improvement of on-time delivery | 10-15% |
| Improvement in stock reduction | 5 - 10% |
| Increase in customer satisfaction (quality preservation/JIT delivery and information on environ. performance | 5 - 10% |
| Improved partner relationships (capabilities awareness, quality preservation/just-in-time delivery | 5 - 10% |
| Implement at least 10-15% of environ. aspects considered as criteria in supplier assessment and selection | 5 - 10% |
| Reduction of quality incidents, including order errors | 20 - 25% |
| Improvement of environ. profile of MEDWOOD's production (carbon footprint) | 1 - 2% |

TABLE 1 : KPI LIST OF THE MEDWOOD PILOT

The figure below shows this relationship between KPIs and Requirements in the MEDWOOD pilot in a graphical way. This reveals the percentage of User Requirements (URs) that have impact on each of the identified KPIs. A total amount of 83 URs identified for the MEDWOOD pilot are considered for the generation of such relationship.



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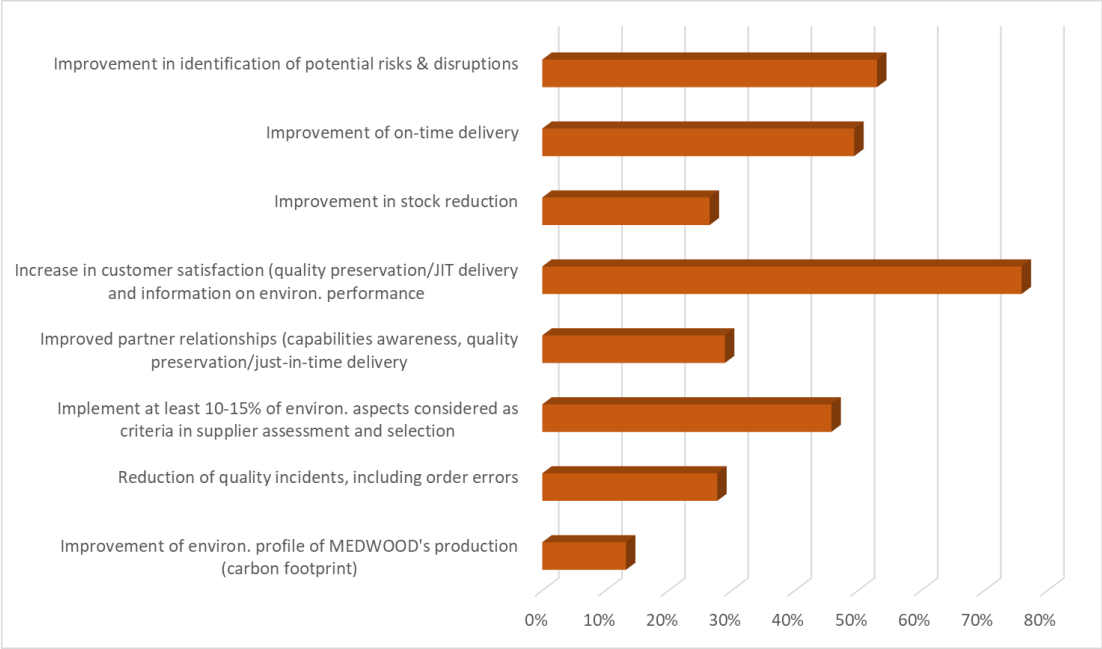


FIGURE 9: RELATIONSHIP BETWEEN KPIS AND USER REQUIREMENTS IN THE MEDWOOD PILOT

### 4.2.2. KPIs in Pilot #2 - AIDIMME

The table below shows the KPIs and its expected values for the AIDIMME pilot.

| KPI Name | Expected Value (~) |
|---|---|
| Reduction in low-cost AM parts | 20 - 30% |
| Improvement in carbon footprint of components (including materials, production, and delivery) | 5 - 10% |
| Improvement in OEE | 5 - 20% |
| Improvement in the part lead time in low-cost productions | 25 - 50% |
| Improvement against unwanted critical events that may happen on the 3D printing process | 25 - 50% |
| Potential product lifespan extension by easy and reduced cost access to replacement parts (reparability increased at use location) | 15% |
| Reduction in energy consumption | 2 - 10 % |
| Improvement of waste management generated by production processes and potential cost reduction | 5% |

TABLE 2 : KPI LIST OF THE AIDIMME PILOT

Regarding those KPIs related to circularity, the main generated residues during the production processes in the AIDIMME pilot are copper, titanium and polyamide 12, so the reuse of some of these elements is



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being actually addressed. However, there are other materials which are not managed yet. They are mainly the supporting structures and the failed pieces, which are useless or not functional. In addition, the management of residues in stainless steel and aluminium (which mean round 10-15% of the total amount of generated waste) is being analysed.

In particular, the last KPI (improvement of waste management generated by production processes and potential cost reduction) refers to the percentage of generated waste materials produced in the additive manufacturing processes which are expected to be managed in different ways (e.g., selling to other parties for reuse, reallocation, etc.).

The figure below shows the relationship between KPIs and Requirements in the AIDIMME pilot in a visual manner, showing the percentage of URs having impact on each KPI, considering a total amount of 64 URs in the AIDIMME pilot.

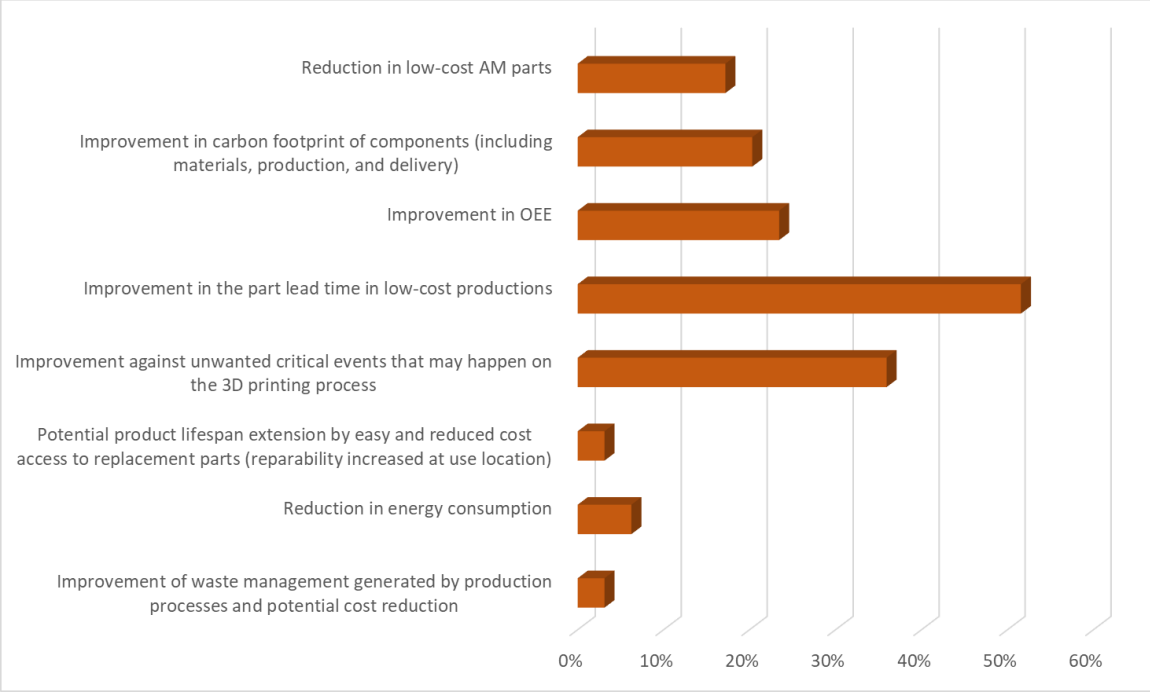


FIGURE 10: RELATIONSHIP BETWEEN KPIS AND USER REQUIREMENTS IN THE AIDIMME PILOT

### 4.2.3. KPIs in Pilot #3 - BUDATEC

The table below shows the KPIs and its expected values for the BUDATEC pilot.

| KPI Name | Expected Value (~) |
|---|---|
| Reduction of the production time | 60% |
| Improvement of on-time delivery rate | 10% |
| Reduction in identification of potential disruptions | 35% |
| Reduction of the stored capital | 30% |
| Lifespan extension of the machine | 10% |



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| | |
|---|---|
| Reduction of the reshuffling of a Supply Chain (SC) after an unforeseen event which leads into a breakage | 8 - 2 months |

TABLE 3 : KPI LIST OF THE BUDATEC PILOT

The figure below illustrates the relationship between KPIs and Requirements in the BUDATEC, Indicating the percentage of URs impacting on each KPI, based on a total amount of 69 URs.

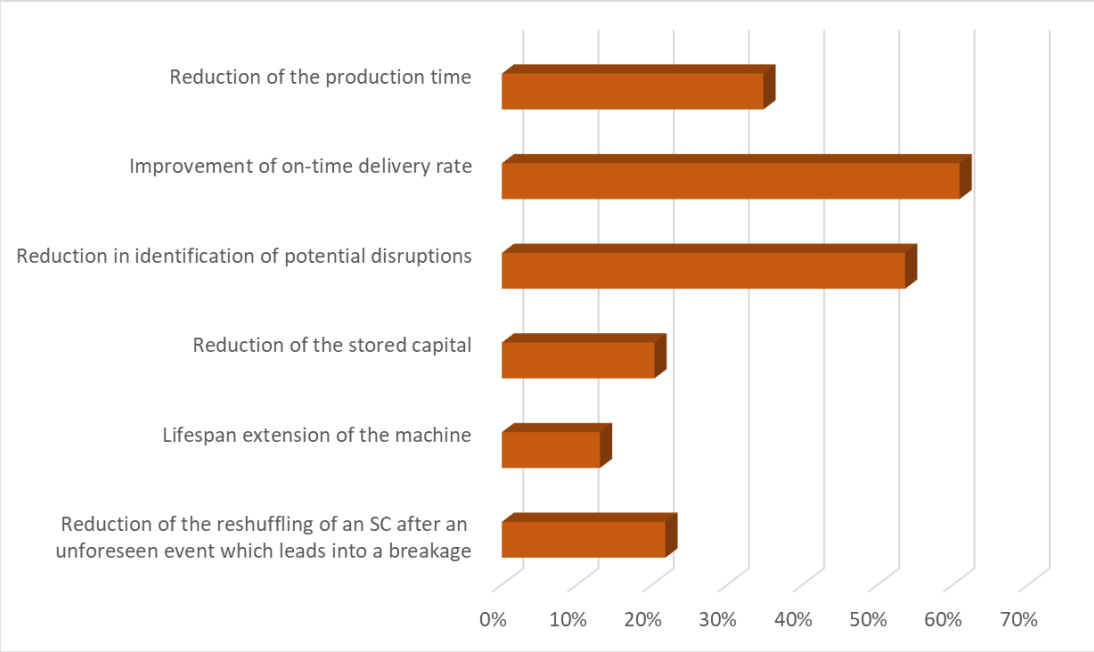


FIGURE 11: RELATIONSHIP BETWEEN KPIS AND USER REQUIREMENTS IN THE BUDATEC PILOT

# 5. VALIDATION CRITERIA

The proposed resources and approaches for the assessment and validation of the pilots are described below. On the one hand, the Requirement Traceability Matrix (RTM) is proposed to provide a track of the availability of the expected functionalities, the status of the tests, and the validation results. On the other hand, the User Acceptance Testing (UAT) is proposed to define specific test cases with the goal of facilitate the evaluation process of requirements and functionalities.

## 5.1. REQUIREMENT TRACEABILITY MATRIX (RTM)

The traceability of requirements enables developers and users to track the requirements and ensure that they are appropriately fulfilled. This is important, so any new decision related to the project development may change and impact these requirements. To this end, the transparency of the RTM allows a better understanding of this potential impact [6].

The Requirement Traceability Matrix (RTM) can be represented in a document or tool that managers (in the scope of NARRATE, users and developers are stakeholders who are potentially managers that need to be aware of the development progress) use to track all the development progresses achieved to fulfil the project requirements. This resource confirms whether the pilot requirements have been fulfilled and can be used to monitor the deliveries by a traceable digital thread for each demand during the whole project development's cycle. The RTM lists the requirements together with the tests and its corresponding results,



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as well as supporting information to document any detected issue. To sum up, the RTM is used to validate that every user requirement (UR) has been checked through Test Cases (TCs) so that no functionality has been left during the validation activities.

The essential aspects of the RTM are the following:

- **Requirements fulfilment**: the traceability follows the life of a requirement, from its definition and continuing through its fulfilment, ensuring that the requirement meets the original goals.
- **Adequate testing**: the requirement traceability helps to identity what items need to be tested, improving the test coverage by mapping the TCs back to its corresponding requirements, as part of the Quality Assurance (QA) activities.
- **Decision making**: the traceability of requirements can be used as a decision-making resource during the development life cycle, so the RTM helps to understand how the requirements may impact the product design, and to analyse the impact of any requirements' update in the development process.
- **Overall management**: the traceability reveals the progress level, enabling a better management of the scope of the requirements so, if the requirements are linked to specific tests, it becomes easier to understand how to meet these requirements and perform a proper delivery.

The RTM displays test scenarios with the corresponding execution status for various functionalities, as well as incorporate ad-hoc change requests or updates, what becomes particularly useful during the validation process and provides valuable information to manage efforts depending on new expectations. Furthermore, the RTM diminishes the risk of defects and missed objectives, so managers can evaluate, identify, and mitigate threats before they could turn into critical issues [6].

## 5.2. USER ACCEPTANCE TESTING (UAT)

The User Acceptance Testing (UAT) is the phase of software development where the end users test the functionalities of the software. The test aims at determining the level of acceptability of the software in real-time, considering its efficiency to provide the expected solutions to the target users. This testing can be done not only when the software is delivered, but also when any update or new integration is completed. There are five types of UAT:

- **Contract acceptance** testing: the software is tested after the development phase against a specific set of predetermined criteria, which mainly consist of a set of specifications agreed on a contract. This type of UAT is mostly suitable for contract-based product development.
- **Regulation acceptance** testing: the software is tested to check if this meets the proper regulations or compliances. This mainly applies when the solutions are particularly designed to meet specific government regulations or compliances.
- **Operational acceptance** testing: this UAT process includes a batch of operational efficiency checks, such as product workflow checking, security scanning, backup plans, maintenance, etc. This is also called "product acceptance testing" or "operational readiness testing", so this operability checking determines how successful the solution will be in providing the intended functionalities, ensuring its optimal operational efficiency.
- **Alpha & beta** testing: the alpha testing is executed in the product development environment, while the beta testing is performed in the users' environment. This way, the internal staff does the alpha testing to find out any issue before the solution is released to the target audience. The beta testing is performed after taking feedback from the alpha testing, and it is executed by a group of users. Both tests are done before the solution is released to the target audience, ensuring a competitive product development.
- **Black box** testing: this is considered a type of functional testing, where specific product functionalities are tested to determine whether they meet the user requirements. Unlike the



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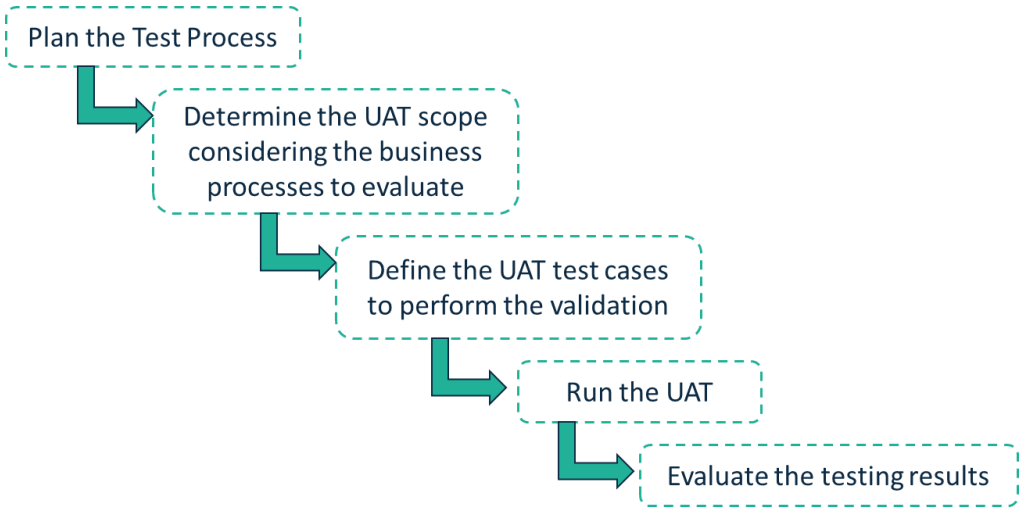
other types of UAT, in the black box testing the testers do not check the internal structure of the code but just emphasize the product functionalities.

It should be noted that one critical goal of the UAT process is that focuses on the areas that not addressed by a quality assurance testing, which is more focused on bugs and errors. The UAT is more focused on checking the efficiency and acceptability of the solution for the target users [7].

FIGURE 12: MAIN STEPS IN THE UAT PROCESS




The Figure 12 above shows the most important steps to be followed in the UAT approach. The planning of the test process determines who will be the testers of the cases (e.g., profile, role, required skills, etc.) and the tentative schedule for the testing. Once the plan is created, the scope needs to be determined, to allocate the effort of the testing on those functionalities that become more critical from a business or productive perspective. This step is highly supported by the performed requirements' definition and its corresponding prioritization. Next task is focused on the definition of proper TCs, what becomes particularly important to achieve a quality validation, so this should provide a short and clear description of each expected functionality, what also eases the validation process for the involved testers. When these steps have been completed, the testers perform the UAT reporting the results. In the proposed validation approach, this is done through the RTM, with optional additional documentation attached. Finally, the results are reviewed and evaluated from both users and developers to take the corresponding actions (e.g., for detected issues the development teams could reproduce the problem to find the root cause, take corrective actions, and do an additional testing before submitting a new release of the component).

## 5.3. THE VALIDATION METHODOLOGY IN PLACE

For the elaboration of the RTM, a first traceability matrix template will be created, to later add the user requirements and tentative test cases. If there is additional documentation, or comments, these will be added to the matrix to keep a track and support the monitoring of the fulfilment. The TCs are executed to validate the requirements, and the results are generated and documented.

At this point, it should be noted what information it is recommended to be somehow included in the RTM:

- Number (or ID), Name, and brief Description of each requirement.
- Tasks ID (or test scripts) associated to each requirement.
- Verification results, reporting the completion process.



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As a particular example, the Figure 13 below shows an excerpt sample of RTM containing the information about requirements (in the left side), and the information about the test cases (In the right side). This information is very important so, on the one hand, the TCs should be well defined to test the expected functionality demanded in the corresponding requirement and, on the other hand, a proper definition of these TCs provides a quality guide for the testers on how to perform the testing and obtain valuable conclusions. In this regard, the proposed validation also considers the report of problems found during the testing, what enables the tracking of the progress related to the solving of detected Issues that could become a critical bottleneck during the validation process.

FIGURE 13: EXAMPLE OF RTM WITH SOME REQUIREMENTS FROM THE MEDWOOD PILOT

| Req. ID | Req. Description | Implem. Status | Test Case ID | Test Case Description | Test Status | Test Result | Defective | Defect Description |
|---|---|---|---|---|---|---|---|---|
| R2.3 | Analytical suggestions for new transportation partners | In progress | T2.3 | Verify the user retrieves a list of suggested carriers | Yet To Start | -- | -- | -- |
| R6.1 | Management of historical data regarding workloads per workplace, operator or machine | Completed | T6.1 | Verify the system provides log information about workloads | In progress | -- | -- | -- |
| R12.2 | Implementation of alert system for unexpected downtimes or issues | Completed | T12.2 | Verify the user gets some notification when some issue occurs | Fulfilled | Pass | No | -- |
| R24.2 | Real time track and trace capabilities for materials/products | Completed | T24.2 | Verify the system provides RT information about capabilities | Fulfilled | Fail | Yes | The dialog does not show any information |

Sometimes a clear distinguished representation of functional requirements (FR) and the corresponding business requirements (BR) Is considered during the execution of the test cases. However, the description of the requirements in NARRATE already include the expected functionality to be provided by the platform. Also, the Request For Proposal (RFP) document (that mainly describes the project and its expectations) and the Deliverable Expectation Document (DED) (a short document that identifies the scope, content, and criteria for each delivery), both documents which are sometimes used in this traceability matrix, are not going to be used in this validation process given the nature of the project, so this is not much focused on the delivery of solutions to be directly deployed in production stage.

Regarding the execution of the UAT, it should be noted that the proposed testing is mainly aligned with a black box UAT, so this will be focused on the functional aspects of the platform to determine to what extent the user requirements are fulfilled by the technological solutions.

At this point it is worth nothing that, besides the performed prioritization, the list of requirements reported by the different pilots in this requirements elicitation phase is just considered as an initial wish list that will be refined and filtered later based on ad-hoc discussions. Therefore, those requirements which remain out of the scope of the NARRATE project, or out of the Manufacturing as a Service (MaaS) domain will be discarded, for the benefit of those which are really aligned with the NARRATE expectations.

# 6. DEPLOYMENT AND EXECUTION PLAN

Task T1.2 is fundamental to ensure a good execution in the validation actions within WP5. Having the requirements of the pilot stories, identifying their priorities and KPIs to be able to plan the execution of the pilots. The work plan and timeline are based on the **NARRATE Technology Roadmap** defined in D8.2 [2]. The Technology Roadmap serves as a blueprint & navigational tool, offering detailed insights and



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procedural clarity to progress through the intricacies of technology development and implementation, ensuring absolute alignment with the goals and objectives of the project.
The Roadmap Phases naturally evolve from the project milestones, tasks & the corresponding deliverables associated with each specific roadmap stage.
In addition, the Smart Manufacturing Network (SMN) is considered a *connected and self-orchestrated ecosystem linked end-to-end with programmable MaaS capabilities that can withstand disruptions*, and it means the evolution of the SC operations resulting of the integration of an IMC into a SC network [2].

**Phase 1: Foundation Establishment [M1-M9] - Milestones: 1 & 2**

a. Define Project Vision, Objectives, pertinent Data and KPIs **[D1.1, FHG, M6], [D1.3, AID, M9]**
b. Identify Key Digital Technologies and Solutions **[D1.1, FHG, M6]**
c. Pilot Analysis, User Story Development, and Pilot Setup **[D1.2, AID, M6]**
d. System Architecture Design **[D1.4, SERV, M9/18]**

**Phase 2: Design of Digital Building Blocks [M10-M15] - Milestones: 3**

a. Analysis & Design of Disruption Resilience Strategies **[D2.1, BUL M15]**
b. Design of Production Contextualization & Interoperability **[D3.1 SERV M15]**
c. Digital Twin Design **[D3.2, SERV, M15]**
d. Design of Knowledge Model using Digital Twin Technology **[D3.2, SERV M15]**
e. Design of Resilience, Sustainability & Circularity Stress Testing Scenarios **[D4.1, SAG, M15]**
f. Design of End-to-end AI-driven Visibility Model & Decision Support System **[D4.2, NUN, M15]**

**Phase 3: Development & Early Demonstration of Building Blocks [M16-M24] - Milestones: 4**

a. Disruption Resilience Strategy & Tool **[D2.4, BUL M24]**
b. Early SMN Knowledge Model using a Neuro-symbolic Decision Support System **[D3.3, NUN M24]**
c. Early Automated Workflows & Process Orchestration **[D3.4, FHG, M24]**
d. Development of Production Contextualization Services **[D3.6, SERV, M24]**
e. Early Production Planning & Process Routing System & Algorithms **[4.3, INSA, M24]**
f. Early Intelligent Logistics and Warehousing System **[4.4, DHL, M24]**
g. Early Pilot Demonstration **[D5.1, AID, M18]**
h. Early Integration of Intelligent Manufacturing Custodian & AI Platform - (Release R1) **[D6.1, SYN, M24]**

**Phase 4: System Integration, Testing & Verification [M25-M30] - Milestones: 5 & 6**

a. Continuous Pilot Experimentation & Pilot Demonstration **[D5.4, AID M27]**
b. Risk Identification & Monitoring Tool **[D2.2, SAG, M30]**
c. Supplier & SMN Risk Assessment Tool **[D2.3, BUL, M30]**
d. Knowledge Model using Digital Twin Technology **[D3.7, SERV, M30]**
e. SMN Knowledge Model using a Neuro-symbolic Decision Support System **[D3.8, NUN, M30]**
f. Automated Workflows & Process Orchestration **[D3.9, FHG, M30]**
g. Resilience, Sustainability & Circularity Stress Testing Scenarios **[D4.6, SAG, M30]**
h. Development of end-to-end AI-driven visibility model & support DSS **[D4.7, NUN, M30]**

**Phase 5: Final Release & Rollout of Platform & Intelligent Manufacturing Custodian [M31-M36] - Milestones: 5 & 6**

a. Security & Privacy Services **[D3.5, INSA, M33]**
b. Reconfiguration of Production **[D4.5, INSA, M33]**
c. Production Planning & Process Routing System & Algorithms **[D4.8, INSA, M33]**
d. Intelligent Logistics and Warehousing System **[D4.9, DHL, M33]**
e. Intelligent MfG Custodian & AI Platform Full Prototype (Release R2**) [D6.2, NUN, M33]**
f. Pilot Implementation with Final Modules in Release R2 **[D5.2, AID, M33]**



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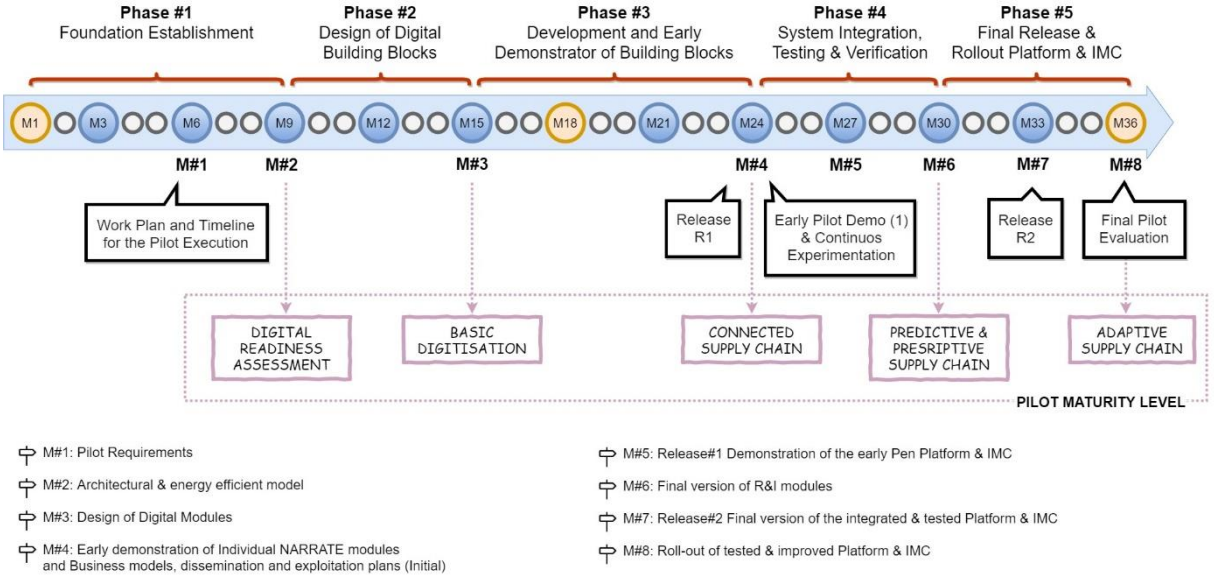
g. Intelligent MfG Custodian & AI Platform Testing, Evaluation and Rollout Release R2 **[D6.3, NUN, M36]**
h. Final Pilot Evaluation with Platform Rollout **[D5.3, DHL M36] [D6.3, NUN, M36]**

A Pilot Digital Maturity Model (PDMM) will help assess the level of technological advancement in the pilots and guide them toward higher levels of digital integration and innovation. The PDMM tailored specifically for the NARRATE smart manufacturing network, encompassing five maturity levels associated with the five roadmap stages. These PDMM levels are (as described in D8.2 [2]):

- **Pre-Digitisation**: Steps toward designing and building a robust and adaptive SC that can withstand disruptions and challenges.
- **Basic-Digitisation**: Design and basic automation and computerization of manual processes, connectivity between supply-chain systems and machines.
- **Connected Supply Chain**: Connectivity between SC partner facilities and Integration of data.
- **Predictive & Prescriptive Supply Chain**: Enhanced supply chain resilience, visibility, and coordination.
- **Adaptive Supply Chain**: Dynamic and agile SC that anticipates and responds to external disruptions, reshaping of the Supply Chain through adaptive analytics.

The following Figure 14: Workplan based on the NARRATE technology roadmap shows the workplan and timeline according to the Technology Roadmap and the PDMM in a simple and visual manner.

FIGURE 14: WORKPLAN BASED ON THE NARRATE TECHNOLOGY ROADMAP




As mentioned in D8.2 [2], the NARRATE Building Blocks will research and develop for a resilient connected and autonomous resilient supply chain ecosystem through:

- Real-time Visibility
- Data Contextualization
- Data Integration and Analytics
- Risk Management
- Predictive Modelling
- Collaboration and Communication
- Automated Decision Support



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- Continuous Improvement
- Adapting Planning and Execution
- Compliance and Regulatory Management
- Customer Experience

The input received from the pilot users in Phase 2 for the design of each Digital Building Block will be fundamental. Information will be requested whenever required so that all pilot users' points of view will be considered later in Phase 3 for the Development of the Building Blocks and Early Demonstrator.
During WP5, those Building Blocks will be validated by the pilot users in the NARRATE platform Release #1 and #2 through the different tools used in WP2, WP3, WP4 and WP6.

In M24 we will have the Early Pilot Demonstration in Release #1 of the platform partially integrating the Building Blocks (BB), the tools, the IMC, and the AI platform where one pilot demonstrator will be selected to show the expected functionalities defined at the beginning of the project. The three pilots will give their feedback to be considered for the final platform release.

# 7. CONCLUSIONS

In this deliverable, the requirements collected and reported in D1.2 have been prioritized using the MoSCoW methodology, and the KPIs reviewed and related to the requirements of each pilot. A proposal for the pilots' validation has been presented, with the prominence of RTM and UAT as main techniques, finally introducing a tentative deployment and execution plan for the pilots' validation. It is noted that the prioritization of requirements task often requires a close review of the requirements to extract the right expected functionality from the user perspective, to avoid misconceptions. Also, the establishment of relationships between KPIs and requirements should be done carefully to not overlook considerations embodied in the pilots' requirements.

Next steps include the filtering and refining of the requirements for each pilot through dedicated discussions, to select those which are in the MaaS domain of the NARRATE project. Another important following action is the generation of specific Use Cases (UCs) covering at least some of the most important functionalities from the users' perspective, initially focusing on one of the proposed pilots. The formalization of these UCs will enable an improved understanding of the users' expectations and how this is expected to be fulfilled by the platform.



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# 8. APENDIX

This annex contains complementary information for this deliverable.



| ID | Requirement | Focus | Priority | User Role | Related User Stories |
|---|---|---|---|---|---|
| **MIC_1_1** | manufacturing simulation incl. Manufacturing plans (e.g. adapter to plant simulation, vistable etc.) | Supply chain | M | Production Manager | As a Production Manager, I want to perform production simulations, so that I can check different options of execution plans and task sequencing, with the Digital Twin-related technologies of the IMC. |
| **MIC_1_2** | scenario analysis regarding different KPIs | Supply chain | M | Production Manager | As a Production Manager, I want to perform production simulations, so that I can check different options of execution plans and task sequencing, with the Digital Twin-related technologies of the IMC. |
| **MIC_1_3** | loading and editing of manufacturing plans (manually or automatically) | Supply chain | M | Production Manager | As a Production Manager, I want to perform production simulations, so that I can check different options of execution plans and task sequencing, with the Digital Twin-related technologies of the IMC. |
| **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) | Supply chain management | M | Logistics Manager | As a Logistics Manager, I want to evaluate different transportation options and providers (FROM MEDWOOD TO CUSTOMERS), so that I can select the best logistics options, with the Digital Twin-related technologies of the IMC. |
| **MIC_2_2** | analysis of alternative transportation partners | Supply chain management | M | Logistics Manager | As a Logistics Manager, I want to evaluate different transportation options and providers (FROM MEDWOOD |



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| | information (routes, rates per kg, package or pallet, pickup and delivery frequencies, as well as other possible restrictions) | | | | TO CUSTOMERS), so that I can select the best logistics options, with the Digital Twin-related technologies of the IMC. |
| **MIC_2_3** | Analytical suggestions for new transportation partners (best option regarding different points) | Supply chain management | M | Logistics Manager | As a Logistics Manager, I want to evaluate different transportation options and providers (FROM MEDWOOD TO CUSTOMERS), so that I can select the best logistics options, with the Digital Twin-related technologies of the IMC. |
| **MIC_3_1** | analysis of contracted supplier information (costs, quality, delivery time, as well as other possible restrictions) | Supply chain management | M | Purchase Manager | As a Purchase Manager, I want to evaluate different options for the supply of materials and services, so that I can select the most suitable suppliers, with the Digital Twin-related technologies of the IMC. |
| **MIC_3_2** | analysis of alternative supplier information (costs, quality, delivery time, as well as other possible restrictions) | Supply chain management | M | Purchase Manager | As a Purchase Manager, I want to evaluate different options for the supply of materials and services, so that I can select the most suitable suppliers, with the Digital Twin-related technologies of the IMC. |
| **MIC_3_3** | Analytical suggestions for new suppliers (best option regarding different points) | Supply chain management | M | Purchase Manager | As a Purchase Manager, I want to evaluate different options for the supply of materials and services, so that I can select the most suitable suppliers, with the Digital Twin-related technologies of the IMC. |
| **MIC_4_1** | manufacturing simulation incl. Manufacturing plans (e.g. adapter to plant simulation, vistable etc.) | Supply chain | M | Product Developer | As a Product Developer, I want to evaluate different manufacturing routes, so that I can select the most appropriate one to develop new products, with the proposal simulations supported by the IMC. |
| **MIC_4_2** | scenario analysis regarding different KPIs | Supply chain | M | Product Developer | As a Product Developer, I want to evaluate different manufacturing routes, so that I can select the most appropriate one to develop new products, with the proposal simulations supported by the IMC. |



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| **MIC_5_1** | analysis of contracted supplier information (costs, quality, delivery time, as well as other possible restrictions) | Supply chain | M | Product Developer | As a Product Developer, I want to evaluate different suppliers from a predefined collection of companies, so that I can better address the development of new products, with the proposal simulations supported by the IMC. |
| **MIC_5_2** | analysis of alternative supplier information (costs, quality, delivery time, as well as other possible restrictions) | Supply chain | M | Product Developer | As a Product Developer, I want to evaluate different suppliers from a predefined collection of companies, so that I can better address the development of new products, with the proposal simulations supported by the IMC. |
| **MIC_5_3** | Analytical suggestions for new suppliers (best option regarding different points) | Supply chain | M | Product Developer | As a Product Developer, I want to evaluate different suppliers from a predefined collection of companies, so that I can better address the development of new products, with the proposal simulations supported by the IMC. |
| **MIC_6_1** | management of historical data regarding workloads per workplace, operator or machine | Supply chain management | M | Demands Planner | 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 demand, with the Predictive tools of the IMC. |
| **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 | Supply chain management | M | Demands Planner | 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 demand, with the Predictive tools of the IMC. |
| **MIC_6_3** | capacity prediction workloads per workplace, operator or machine and alert system | Supply chain management | M | Demands Planner | 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 demand, with the Predictive tools of the IMC. |



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| **MIC_7_1** | connection to supplier delivery dates and real-time status of deliveries | Supply chain | M | Purchase Manager | 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. |
| **MIC_7_2** | alert system related to pre-defined thresholds | Supply chain | M | Purchase Manager | 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. |
| **MIC_7_3** | comparison of scheduled and real delivery status | Supply chain | M | Purchase Manager | 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. |
| **MIC_8_1** | quality management interface incl. quality alert system | Supply chain | M | Production Manager | As a Production Manager, I want to receive warnings when some product is not correct, so that I can adjust the production activities, with the management and notification functionalities of the IMC. |
| **MIC_8_2** | real-time status and control of production | Supply chain | M | Production Manager | As a Production Manager, I want to receive warnings when some product is not correct, so that I can adjust the production activities, with the management and notification functionalities of the IMC. |
| **MIC_8_3** | deviation notification | Supply chain | M | Production Manager | As a Production Manager, I want to receive warnings when some product is not correct, so that I can adjust the production activities, with the management and notification functionalities of the IMC. |
| **MIC_9_1** | order management functionalities | Supply chain | M | Demands Planner | 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. |



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| **MIC_9_2** | deviation notification | Supply chain | M | Demands Planner | 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. |
| **MIC_11_1** | loading of sequencing of manufacturing orders (manually or automatically) | Supply chain | M | Production Manager | As a Production Manager, I want to obtain the optimal sequencing of manufacturing orders based on diffrent rules, so that I can select the most suitable ones, with the simulation funcionalities of the IMC. |
| **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.) | Supply chain | M | Production Manager | As a Production Manager, I want to obtain the optimal sequencing of manufacturing orders based on diffrent rules, so that I can select the most suitable ones, with the simulation funcionalities of the IMC. |
| **MIC_12_1** | real-time monitoring of production machines | Supply chain | M | Production Manager | As a Production Manager, I want to obtain the optimal sequencing of manufacturing orders based on diffrent rules when some problem occurs (e.g., broken machine), so that I can select the most suitable ones, with the simulation funcionalities of the IMC. |
| **MIC_12_2** | implementation of alert system for unexpected downtimes or issues | Supply chain | M | Production Manager | As a Production Manager, I want to obtain the optimal sequencing of manufacturing orders based on diffrent rules when some problem occurs (e.g., broken machine), so that I can select the most suitable ones, with the simulation funcionalities of the IMC. |
| **MIC_12_3** | support system for optimal workflow for production planning, especially in disruptive situations (establishment of different rules) | Supply chain | M | Production Manager | As a Production Manager, I want to obtain the optimal sequencing of manufacturing orders based on diffrent rules when some problem occurs (e.g., broken machine), so that I can select the most suitable ones, with the simulation |



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| | | | | | funcionalities of the IMC. |
| **MIC_13_1** | Get and process external disruptions and from customer/ supplier, e.g. relevant trade barriers | Supply chain | M | Logistics Manager | As a Logistics Manager, I want to monitor the status of the deliveries (TO MEDWOOD) and get disruption warnings, so that I can take corrective actions, with the simulation funcionalities and notification system of the IMC. |
| **MIC_13_2** | comparison of delivery planning with execution | Supply chain | M | Logistics Manager | As a Logistics Manager, I want to monitor the status of the deliveries (TO MEDWOOD) and get disruption warnings, so that I can take corrective actions, with the simulation funcionalities and notification system of the IMC. |
| **MIC_13_3** | real-time monitoring and alert system | Supply chain | M | Logistics Manager | As a Logistics Manager, I want to monitor the status of the deliveries (TO MEDWOOD) and get disruption warnings, so that I can take corrective actions, with the simulation funcionalities and notification system of the IMC. |
| **MIC_14_1** | functionality to verify the sequencing of manufacturing orders against predefined criteria | Supply chain | M | Production Manager | As a Production Manager, I want to check the correct sequencing of manufacturing orders, so that I can take corrective actions, with the check simulation funcionalities of the IMC. |
| **MIC_14_2** | order and task overview | Supply chain | M | Production Manager | As a Production Manager, I want to check the correct sequencing of manufacturing orders, so that I can take corrective actions, with the check simulation funcionalities of the IMC. |
| **MIC_14_3** | connected sequencing simulation tool | Supply chain | M | Production Manager | As a Production Manager, I want to check the correct sequencing of manufacturing orders, so that I can take corrective actions, with the check simulation funcionalities of the IMC. |
| **MIC_15_1** | connection to transportation partners | Supply chain | M | Logistics Manager | As a Logistics Manager, I want to monitor the status of the deliveries TO CUSTOMER and get warnings about past |



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| | | | | | disruptions, so that I can take corrective actions, with the simulation funcionalities and notification system of the IMC. |
| **MIC_15_2** | alert system related to issues and disruption during transportation process | Supply chain | M | Logistics Manager | As a Logistics Manager, I want to monitor the status of the deliveries TO CUSTOMER and get warnings about past disruptions, so that I can take corrective actions, with the simulation funcionalities and notification system of the IMC. |
| **MIC_15_3** | management of historical data | Supply chain | M | Logistics Manager | As a Logistics Manager, I want to monitor the status of the deliveries TO CUSTOMER and get warnings about past disruptions, so that I can take corrective actions, with the simulation funcionalities and notification system of the IMC. |
| **MIC_16_1** | analysis of current project data and forecast of resource usage, including factors like seasonal fluctuations | Supply chain | M | Production Manager | 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 funcionalities of the IMC. |
| **MIC_16_2** | optimization proposals regarding different KPIs | Supply chain | M | Production Manager | 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 funcionalities of the IMC. |
| **MIC_16_3** | integration of energy consumption, self-consumption, | Supply chain | M | Production Manager | As a Production Manager, I want to get recommendations about the use of production machinery based on timeframes, self- |



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| | weather forecasts | | | | 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 funcionalities of the IMC. |
| **MIC_17_1** | Get and process environmental disruptions, e.g. relevant trade barriers | Supply chain management | M | Purchase Manager | 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. |
| **MIC_17_2** | Get and process disruption information from supplier/ customer | Supply chain management | M | Purchase Manager | 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. |
| **MIC_17_3** | real-time monitoring and alert system | Supply chain management | M | Purchase Manager | 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. |
| **MIC_18_1** | management of historical data | Supply chain | M | Quality Manager | 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. |
| **MIC_18_2** | scenario analysis | Supply chain | M | Quality Manager | 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 |



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| | | | | | provided by the IMC. |
| **MIC_18_3** | visualization and analysis of quality incidents in relation to manufacturing conditions | Supply chain | M | Quality Manager | 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. |
| **MIC_19_1** | scenario analysis | Supply chain management | M | Logistics Manager | As a Logistics Manager, I want to find optimal logistics providers (FROM SUPPLIERS TO MEDWOOD) based on decision parameters, so that I can select the most suitable transportation option, with the supply chain management system of the IMC. |
| **MIC_19_2** | analysis of contracted transportation partners information | Supply chain management | M | Logistics Manager | As a Logistics Manager, I want to find optimal logistics providers (FROM SUPPLIERS TO MEDWOOD) based on decision parameters, so that I can select the most suitable transportation option, with the supply chain management system of the IMC. |
| **MIC_19_3** | analysis of alternative transportation partners information | Supply chain management | M | Logistics Manager | As a Logistics Manager, I want to find optimal logistics providers (FROM SUPPLIERS TO MEDWOOD) based on decision parameters, so that I can select the most suitable transportation option, with the supply chain management system of the IMC. |
| **MIC_20_1** | adapter to relevant simulation tools | Supply chain | M | Quality Manager | As a Quality Manager, I want to perform simulations of internal disruptions, so that I can evaluate corrective actions beforehand,, with the simulation functionalities provided by the IMC. |
| **MIC_20_2** | generation of fictional disruption and scenario data | Supply chain | M | Quality Manager | As a Quality Manager, I want to perform simulations of internal disruptions, so that I can evaluate corrective actions beforehand,, with the simulation functionalities provided by the IMC. |



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| **MIC_20_3** | scenario analysis | Supply chain | M | Quality Manager | As a Quality Manager, I want to perform simulations of internal disruptions, so that I can evaluate corrective actions beforehand,, with the simulation functionalities provided by the IMC. |
| **MIC_21_1** | real-time visibility into the status of each work, including completion, post-process, and the number of pieces produced | Supply chain | M | Production Manager | As a Production Manager, I want to get notifications about deviations in relation to the cycle time of the operational working center, and obtain proposals, so that I can take actions to meet the schedule, with the simulation and notification functionalities provided by the IMC. |
| **MIC_21_2** | dashboard or interface that provides a comprehensive overview of all ongoing work | Supply chain | M | Production Manager | As a Production Manager, I want to get notifications about deviations in relation to the cycle time of the operational working center, and obtain proposals, so that I can take actions to meet the schedule, with the simulation and notification functionalities provided by the IMC. |
| **MIC_21_3** | comparison of practical and planned project work and notification functionality for deviations | Supply chain | M | Production Manager | As a Production Manager, I want to get notifications about deviations in relation to the cycle time of the operational working center, and obtain proposals, so that I can take actions to meet the schedule, with the simulation and notification functionalities provided by the IMC. |
| **MIC_22_1** | integrate enviromental information about suppliers (certifications, etc) | Supply chain | M | Purchase Manager | Purchase Manager: I want to buy and offer to my clients products with environmental certifications such as PEFC |
| **MIC_23_1** | interface to visualize environmental informations | Supply chain | M | Purchase Manager | Purchase Manager: I want to know environmetal information of products I offer to my clients. |
| **MIC_23_2** | environmental information management | Supply chain | M | Purchase Manager | Purchase Manager: I want to know environmetal information of products I offer to my clients. |



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| **MIC_24_1** | supplier suggestion based on environmental certification | Supply chain | M | Environmental Manager | Environmental Manager: I want to keep the chain of custody PEFC certification for my products (buy certified materials and track and trace them to buy certified products) |
| **MIC_24_3** | environmental information management | Supply chain | M | Environmental Manager | Environmental Manager: I want to keep the chain of custody PEFC certification for my products (buy certified materials and track and trace them to buy certified products) |
| **MIC_25_1** | interface for waste tracking | Supply chain | M | Environmental Manager | Environmental Manager: I want to reduce the amount of waste generated, specially the hazardous ones. |
| **MIC_26_1** | interface and analysis functions for environmental KPIs | Supply chain management | M | Environmental Manager | 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. |
| **MIC_26_2** | display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications | Supply chain management | M | Environmental Manager | 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. |
| **MIC_26_3** | get and process external data regarding carbon footprint | Supply chain management | M | Environmental Manager | 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. |
| **MIC_27_1** | display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications | Supply chain management | M | Environmental Manager | Environmental Manager: I want to calculate and reduce the carbon footprint of transport: supply chain and distribution. |
| **MIC_27_2** | integration of different transportation options with their carbon footprint | Supply chain management | M | Environmental Manager | Environmental Manager: I want to calculate and reduce the carbon footprint of transport: supply chain and distribution. |



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| **MIC_27_3** | scenario evaluation (decentralized transportation etc.) | Supply chain management | M | Environmental Manager | Environmental Manager: I want to calculate and reduce the carbon footprint of transport: supply chain and distribution. |
| **MIC_30_1** | display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications | Supply chain | M | Quality Manager | As a Product Developer, I want to evaluate different product design alternatives, using the environmental information provided by my suppliers, with the proposal simulations supported by the IMC. |
| **MIC_30_2** | integration of different production route options with their carbon footprint | Supply chain | M | Quality Manager | As a Product Developer, I want to evaluate different product design alternatives, using the environmental information provided by my suppliers, with the proposal simulations supported by the IMC. |
| **MIC_30_3** | scenario evaluation | Supply chain | M | Quality Manager | As a Product Developer, I want to evaluate different product design alternatives, using the environmental information provided by my suppliers, with the proposal simulations supported by the IMC. |

ANNEX 1 LIST OF REQUIREMENTS FROM MEDWOOD INDICATING THE PRIORITIZATION

| ID | Requirement | Focus | Priority | User Role | Related User Stories |
|---|---|---|---|---|---|
| **AID_1_1** | analysis of contracted supplier information and capabilities | SC management | M | Purchase Manager | 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. |
| **AID_1_2** | analysis of alternative supplier information and capabilities | SC management | M | Purchase Manager | 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 |



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| | | | | | supply chain management functionalities of the IMC. |
| **AID_1_3** | Analytical suggestions for new suppliers (best option regarding different parameters) | SC management | M | Purchase Manager | 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. |
| **AID_2_1** | management and analysis of historical data | SC management | M | Purchase Manager | As a Purchase Manager, I want to foresee expenses of raw materials and consumables by retrieving historical data, so that I can antipate to a stockout, with the supply chain management functionalities of the IMC. |
| **AID_2_2** | analysis of current project data and forecast of material usage including factors like seasonal fluctuations | SC management | M | Purchase Manager | As a Purchase Manager, I want to foresee expenses of raw materials and consumables by retrieving historical data, so that I can antipate to a stockout, with the supply chain management functionalities of the IMC. |
| **AID_2_3** | stockout prediction and alert system | SC management | M | Purchase Manager | As a Purchase Manager, I want to foresee expenses of raw materials and consumables by retrieving historical data, so that I can antipate to a stockout, with the supply chain management functionalities of the IMC. |
| **AID_3_1** | Get and process external disruptions incl. social, political and physical, e.g. relevant trade barriers | SC management | M | Purchase Manager | 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. |
| **AID_3_2** | Get and process disruption information from supplier/ customer | SC management | M | Purchase Manager | 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. |



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| **AID_3_3** | real-time monitoring and alert system | SC management | M | Purchase Manager | 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. |
| **AID_4_1** | material data from supplier and internal characterisation | Supply chain | M | Engineering Manager | 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 staticstics to foresee possible issues in the raw material. |
| **AID_4_2** | material data import to own internal system | Supply chain | M | Engineering Manager | 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 staticstics to foresee possible issues in the raw material. |
| **AID_4_3** | analysis of materials specifications based on historical data (incidences) | Supply chain | M | Engineering Manager | 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 staticstics to foresee possible issues in the raw material. |
| **AID_5_1** | warehouse management system including real-time monitoring | Supply chain | M | Purchase Manager | As a Purchase Manager, I want to be aware of the status of the warehouse of materials and spare parts, so that I can foresee when to ask for resources, with the supply management functionalities provided by the IMC. |



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| **AID_5_2** | connection to supplier delivery dates | Supply chain | M | Purchase Manager | As a Purchase Manager, I want to be aware of the status of the warehouse of materials and spare parts, so that I can foresee when to ask for resources, with the supply management functionalities provided by the IMC. |
| **AID_5_3** | alert system related to pre-defined thresholds | Supply chain | M | Purchase Manager | As a Purchase Manager, I want to be aware of the status of the warehouse of materials and spare parts, so that I can foresee when to ask for resources, with the supply management functionalities provided by the IMC. |
| **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 | SC management | M | Production Planner | As a Production Planner, I would like to have a predictive tool to forecast unexpected events / trends when additive manufacturing 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 have been adapted if we have had indicators. |
| **AID_7_1** | integration of already used softwares in IMC or IMC needs order management functions itself | Supply chain | C | Order Manager | 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). |
| **AID_8_2** | notifications about historical problems and mistakes with same/ slightly different parts | Supply chain | S | Engineering Manager | As an engineering manager I would like to have an automated response / advice upon geometries that are potentially risky in terms 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 |



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| | | | | | experiences. |
| **AID_8_1** | availability of uploading references, feedback about how each reference was manufactured and feedback about distortions / deformations if observed | Supply chain | M | Engineering Manager | As an engineering manager I would like to have an automated response / advice upon geometries that are potentially risky in terms 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. |
| **AID_9_1** | real-time monitoring of production machines | Supply chain | M | Production Planner | 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. |
| **AID_9_2** | implementation of alert system for unexpected downtimes or issues | Supply chain | M | Production Planner | 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. |
| **AID_9_3** | support system for optimal workflow for production planning | Supply chain | M | Production Planner | 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. |
| **AID_11_1** | generate dynamic delivery forecasts based on the job queue, order demand, and new order entries | Supply chain | M | Production Planner | As a Production Planner, I want to get delivery forecasts based on the job queue, the order demand, and the entry of new orders, so that I can improve the delivery and production schedule, with the management functionalities provided by the |



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| | | | | | IMC. |
| **AID_11_2** | analysis of historical delivery and production data | Supply chain | M | Production Planner | As a Production Planner, I want to get delivery forecasts based on the job queue, the order demand, and the entry of new orders, so that I can improve the delivery and production schedule, with the management functionalities provided by the IMC. |
| **AID_12_1** | manage and assign tasks to different work teams | Supply chain | M | Production Planner | As a Production Planner, I want to manage the different work teams and assign tasks (e.g., postprocess, quality control, delivery, etc.), so that I can improve the overall management of the work to be done. human resources management depeding on the availability and possible disruptions as illness... with the management functionalities provided by the IMC. |
| **AID_12_2** | human resources availability tracking and account for possible disruptions like illness | Supply chain | M | Production Planner | As a Production Planner, I want to manage the different work teams and assign tasks (e.g., postprocess, quality control, delivery, etc.), so that I can improve the overall management of the work to be done. human resources management depeding on the availability and possible disruptions as illness... with the management functionalities provided by the IMC. |
| **AID_12_3** | functionality for dynamic task reassignment based on real-time availability and disruptions, ensuring efficient workflow management | Supply chain | M | Production Planner | As a Production Planner, I want to manage the different work teams and assign tasks (e.g., postprocess, quality control, delivery, etc.), so that I can improve the overall management of the work to be done. human resources management depeding on the availability and possible disruptions as illness... with the management functionalities provided by the IMC. |



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| **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 | Supply chain | M | Production Planner | 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 pieces produced) not only the manufactuturing technician, so that I can improve the work management, with the management functionalities provided by the IMC. |
| **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 | Supply chain | M | Production Manager | As a Production Manager, I would like to have a tool to create a "part specification data sheet" for each order that is processed, 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 postprocesses / quality control with the management functionalities provided by the IMC.<br>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.. |
| **AID_15_1** | information overview about build jobs based on priority, considering agreed delivery terms | Supply chain | M | Manufacturing Technician | 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. |
| **AID_15_2** | functionality to dynamically adjust the production plan | Supply chain | M | Manufacturing Technician | As a Manufacturing Technician, I would like to have a smart tool to support me when arranging the build jobs. Currently we recieve orders every day that are addressed based on a term |



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| | | | | | 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. |
| **AID_16_1** | integration capabilities for real-time machine data and log files | Supply chain | M | Production Manager | As a Production Manager, I want to get integrated information about the overall production process (e.g., real-time 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. |
| **AID_16_2** | analysis of information gathered during the processes (log file) to ease troubleshooting when certain build fails. | Supply chain | M | Production Manager | As a Production Manager, I want to get integrated information about the overall production process (e.g., real-time 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. |
| **AID_17_1** | notifications for when machine technicians identify defects or issues during quality control of parts | Supply chain | M | Production Manager | As a Production Manager, I want to receive warnings when machine technicians perform quality control over the parts to be shipped and defects / issues are identified. This feedback should trigger alarms to review and reschedule if needed the parts, with the management functionalities provided by the IMC. Collect data and automatically generate QC reports and staticstics |
| **AID_17_2** | integration of quality control informations | Supply chain | M | Production Manager | As a Production Manager, I want to recieve warnings when machine technicians perform quality control over the parts to be shipped and defects / issues are identified. This feedback should trigger alarms to review and reschedule if needed the parts, with the management functionalities provided by the IMC. Collect data and automatically generate QC reports and staticstics |



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| **AID_17_3** | This user story should be linked to row 8 as defects / issues should be registered for each part | Supply chain | M | Production Manager | As a Production Manager, I want to recieve warnings when machine technicians perform quality control over the parts to be shipped and defects / issues are identified. This feedback should trigger alarms to review and reschedule if needed the parts, with the management functionalities provided by the IMC. Collect data and automatically generate QC reports and staticstics |
| **AID_18_1** | notifications about machine disruptions | Supply chain | M | Production Planner | As a Production Planner, I want to be aware of machine breaks, so that I can take appropriate actions accelarating the response ahead of these problems, those respones may affect internally (reschedule the build), or externally (outsourcing) with the management functionalities provided by the IMC. |
| **AID_18_2** | Provide solutions to tackle those disruptions by suggesting: build reschedule / production addressed by otherpartners. | Supply chain | M | Production Planner | As a Production Planner, I want to be aware of machine breaks, so that I can take appropriate actions accelarating the response ahead of these problems, those respones may affect internally (reschedule the build), or externally (outsourcing) with the management functionalities provided by the IMC. |
| **AID_19_1** | real-time information from supplier about deliveries | Supply chain | S | Logistics Manager | As a logistics manager, I want to be aware of the status of the deliveries, so that I can improve the delivery and production management, with the management and notification functionalities provided by the IMC. |
| **AID_19_2** | interface for providing the information | Supply chain | S | Logistics Manager | As a logistics manager, I want to be aware of the status of the deliveries, so that I can improve the delivery and production management, with the management and notification functionalities provided by the IMC. |



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| **AID_19_3** | change notification | Supply chain | | Logistics Manager | As a logistics manager, I want to be aware of the status of the deliveries, so that I can improve the delivery and production management, with the management and notification functionalities provided by the IMC. |
| **AID_20_1** | automatic label generation | Supply chain | C | Logistic Planner | 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 is placed I understand that labels could be processed automatically based on each company especifications (in some ocasions we found issues as the company have more than one operating center and parts were sent to the wrong direction). |
| **AID_20_2** | parcel traceability | Supply chain | C | Logistic Planner | 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 is placed I understand that labels could be processed automatically based on each company especifications (in some ocasions we found issues as the company have more than one operating center and parts were sent to the wrong direction). |
| **AID_21_1** | access/visualize to relevant product and manufacturing information | Supply chain | S | Customer Assistant | 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 |



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| | | | | | functionalities provided by the IMC. |
| **AID_22_1** | traceability of changes through the service process | Supply chain | M | Engineering Manager | 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). |
| **AID_22_2** | repository with documentation and visibility of any modifications made | Supply chain | M | Engineering Manager | 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). |
| **AID_23_1** | Customer should have quick access to "material+machine " design guidelines and limitations | | S | Customer Assistant | 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 limitations awareness, with the communication functionalities provided by the IMC. |
| **AID_23_2** | if the part provided by the customer presents geometries that are not feasible for the process (i.e wall thickness) | | S | Customer Assistant | 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 limitations awareness, with the communication functionalities provided by the IMC. |
| **AID_24_1** | real-time monitoring of production machines. Comprehensive dashboard | Supply chain | M | Customer Assistant | 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 |



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| | | | | | 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. |
| **AID_25_1** | real-time monitoring and alert system | Supply chain | M | Customer Assistant | As a Customer Assistant, I want to provide information to the customer about machine failures, so that they can be aware of this problem as soon as possible, with the management functionalities provided by the IMC. |
| **AID_25_2** | information flow to customer | Supply chain | S | Customer Assistant | As a Customer Assistant, I want to provide information to the customer about machine failures, so that they can be aware of this problem as soon as possible, with the management functionalities provided by the IMC. |
| **AID_26_1** | connection to transportation partner | Supply chain | S | Customer Assistant | 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. |
| **AID_26_2** | interface for customer for delivery status | Supply chain | S | Customer Assistant | 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. |
| **AID_27_1** | Interface at supplier and own organisation side for sustainability information input (e.g. content of recycled, renewable materials, carbon | Supply chain | M | Purchase Manager | 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 |



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| | footprint or even environmental product declaration) | | | | (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. |
| **AID_27_2** | Interface at own organisation and customer side for visualization of sustainability information | Supply chain | S | Purchase Manager | 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. |
| **AID_27_3** | Information flow system | Supply chain | M | Purchase Manager | 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. |
| **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) | Supply chain | S | Production Manager | As Production Manager, we generate part of the material used as waste (metal or polymer powders and support structures. we would like to sell them (industrial symbiosis) |
| **AID_28_2** | Connection with a local platform on | Supply chain | S | Production Manager | As Production Manager, we generate part of the material |



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| | industrial symbiosis | | | | used as waste (metal or polymer powders and support structures. we would like to sell them (industrial symbiosis) |
| **AID_29_1** | automatic energy demand (and other environmental KPIs) calculation related to production processes and materials | Supply chain | M | Production Manager | As Production Manager, i would like to have a tool to calculate the energy demand and related product carbon footprint and another environmental information, considering (raw materials used (type and amount), depending on the specific production batch, process efficiency). |
| **AID_30_1** | display environmental information related to products, such as carbon footprint, recycled content, and sustainability certifications | Supply chain | M | Customer Assistant | 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. |
| **AID_30_2** | integration of different transportation options with their carbon footprint | Supply chain | M | Customer Assistant | 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. |
| **AID_30_3** | scenario evaluation (decentralized production etc.) | Supply chain | M | Customer Assistant | 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. |
| **AID_31_1** | integration of ERP in IMC | Supply chain management | M | Production Planner | As a production planner, I would like to automate the generation of delivery notes based on the feedback given by the manufacturing technician. this must be linked to our ERP. |
| **AID_31_2** | interface for generating automatically | Supply chain management | C | Production Planner | As a production planner, I would like to automate the generation of delivery notes based on the feedback given by the |



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| | delivery notes | | | | manufacturing technician. this must be linked to our ERP. |

ANNEX 2 LIST OF REQUIREMENTS FROM AIDIMME INDICATING THE PRIORITIZATION

| ID | Requirement | Focus | Priority | User Role | Related User Stories |
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| **BUD_1_1** | support in audit plan | Supply chain | S | Managing Director | As a managing director, I would like an audit plan so that my processes are certified. The availability of documents should be checked in good time. (Documents from the supplier) |
| **BUD_1_2** | check and support completeness of neccessary documents | Supply chain | M | Managing Director | As a managing director, I would like an audit plan so that my processes are certified. The availability of documents should be checked in good time. (Documents from the supplier) |
| **BUD_2_1** | interface for supplier | Supply chain management | S | Managing Director | 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 |
| **BUD_2_2** | integration of ingredients of purchased parts | Supply chain management | M | Managing Director | 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 |
| **BUD_2_3** | links to necessary legal and customer requirements | Suppli chain | M | Managing Director | 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 |
| **BUD_3_1** | Connection to customer | Supply chain | S | Project Manager | As a project manager, I want a direct link to the customer so that I can make changes to the order and adjustments quickly |
| **BUD_3_2** | Interface for project orders | Supply chain | M | Project Manager | As a project manager, I want a direct link to the customer so that I can make changes to the order and adjustments quickly |



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| **BUD_3_3** | Tracking of changes and adjustments | Supply chain | M | Project Manager | As a project manager, I want a direct link to the customer so that I can make changes to the order and adjustments quickly |
| **BUD_4_1** | product tracking | Supply chain | M | Managing Director | 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 |
| **BUD_4_2** | value calculation regarding tracking | Supply chain | M | Managing Director | 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 |
| **BUD_4_3** | facilitation of companies with waste as raw material (second life) as customer | Supply chain | C | Managing Director | 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 |
| **BUD_5_1** | notification function | Supply chain | M | Production Manager | As a production manager I would like to receive a warning for non-certified parts |
| **BUD_5_2** | evaluation of certification of product parts and materials | Supply chain | M | Production Manager | As a production manager I would like to receive a warning for non-certified parts |
| **BUD_6_1** | real-time information from supplier for monitoring of deliveries | Supply chain | S | Project Manager | As a project manager, I want real-time order monitoring so that I can constantly check the status of the delivery. |
| **BUD_6_2** | interface for providing the information | Supply chain | M | Project Manager | As a project manager, I want real-time order monitoring so that I can constantly check the status of the delivery. |
| **BUD_6_3** | change notification | Supply chain | M | Project Manager | As a project manager, I want real-time order monitoring so that I can constantly check the status of the delivery. |
| **BUD_7_1** | real-time information from supplier for monitoring of deliveries | Supply chain management | M | Logistics Manager | As a logistics manager I would like to have an overview of all transportation services. |



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| **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) | Supply chain management | S | Logistics Manager | As a logistics manager I would like to have an overview of all transportation services. |
| **BUD_7_3** | Analytical suggestions for new transportation partners (best option regarding different points) | Supply chain management | S | Logistics Manager | As a logistics manager I would like to have an overview of all transportation services. |
| **BUD_8_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Managing Director | As managing director, I would like to have a single view for performance measurements in order to be able to see production times, central error overview for production and commissioning clearly and to derive improvements. |
| **BUD_8_2** | assessment of relevant information and should be able to derive improvements | Supply chain | M | Managing Director | As managing director, I would like to have a single view for performance measurements in order to be able to see production times, central error overview for production and commissioning clearly and to derive improvements. |
| **BUD_9_1** | real-time information from supplier for monitoring of deliveries | Supply chain management | M | Supply Chain Manager | As a supply chain manager I would like an overview of customers with standard machines to find out about potential other customers when a customer leaves . |
| **BUD_9_2** | analysis of contracted customers | Supply chain management | S | Supply Chain Manager | As a supply chain manager I would like an overview of customers with standard machines to find out about potential other customers when a customer leaves . |



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| **BUD_9_3** | analysis of potential (new) customers | Supply chain management | M | Supply Chain Manager | As a supply chain manager I would like an overview of customers with standard machines to find out about potential other customers when a customer leaves . |
| **BUD_10_1** | real-time information from supplier for monitoring of deliveries | Supply chain management | M | Managing Director | As a managing director, I would like one system for both sites (Portugal and Berlin) to avoid information asymmetries and improve collaboration. |
| **BUD_11_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Managing Director | As Managing Director, I would like feedback on the processes and products so that we can continuously improve our products and processes |
| **BUD_11_2** | feedback sheet | Supply chain | M | Managing Director | As Managing Director, I would like feedback on the processes and products so that we can continuously improve our products and processes |
| **BUD_11_3** | overview interface for own organisation with results | Supply chain | M | Managing Director | As Managing Director, I would like feedback on the processes and products so that we can continuously improve our products and processes |
| **BUD_12_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Production Manager | 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 |
| **BUD_12_2** | notification system for necessary changes in construction or production because of repetetive failures | Supply chain | M | Production Manager | 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 |
| **BUD_12_3** | connection to improvement/ KPI view | Supply chain | M | Production Manager | 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 |



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| **BUD_13_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Procurer | As a procurer, I would like a centralized view to make purchases for all plants, see stock levels, etc. |
| **BUD_13_2** | connection to supplier delivery dates | Supply chain | m | Procurer | As a procurer, I would like a centralized view to make purchases for all plants, see stock levels, etc. |
| **BUD_13_3** | connection to project/ order view to manage forecast | Supply chain | M | Procurer | As a procurer, I would like a centralized view to make purchases for all plants, see stock levels, etc. |
| **BUD_14_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Project Manager | As a project manager, I would like the integration of the stock management system with the project management tool, availability of parts (online and in real time) |
| **BUD_14_2** | connection to project/ order view to manage forecast | Supply chain | M | Project Manager | As a project manager, I would like the integration of the stock management system with the project management tool, availability of parts (online and in real time) |
| **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) | Supply chain | S | Project Manager | As a project manager, I would like the integration of the stock management system with the project management tool, availability of parts (online and in real time) |
| **BUD_15** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Production Manager | As a production manager I would like to be able to link missing parts to projects. |



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| **BUD_16_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Project Manager | As a project manager, I would like automated notifications in the event of potential project delays |
| **BUD_16_2** | comparison of practical and planned project work and notification functionality for deviations | Supply chain | M | Project Manager | As a project manager, I would like automated notifications in the event of potential project delays |
| **BUD_17_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Managing Director | As managing director, I want a real-time project status tracking in order to recognize time and cost-relevant as soon as possible. |
| **BUD_17_2** | comparison of practical and planned project work and notification functionality for deviations | Supply chain | M | Managing Director | As managing director, I want a real-time project status tracking in order to recognize time and cost-relevant as soon as possible. |
| **BUD_17_3** | inclusion of cost and time relevant KPIs connected to project and orders | Supply chain | M | Managing Director | As managing director, I want a real-time project status tracking in order to recognize time and cost-relevant as soon as possible. |
| **BUD_18_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Project Manager | As a project manager, I would like to have a link to the specifications in order to be able to synchronize subsequent changes. |
| **BUD_18_2** | automatical synchronization of changes | Supply chain | M | Project Manager | As a project manager, I would like to have a link to the specifications in order to be able to synchronize subsequent changes. |
| **BUD_18_3** | notification system for other involved parties for changes | Supply chain | M | Project Manager | As a project manager, I would like to have a link to the specifications in order to be able to synchronize subsequent changes. |
| **BUD_19_1** | real-time information from supplier for monitoring of | Supply chain | M | Project Manager | As a project manager, I would like to have a Capacity/storage tool to evaluate project postponement/bringing |



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| | deliveries | | | | forward incl. customer prioritization |
| **BUD_19_2** | support system for optimal workflow for production planning, especially in disruptive situations (establishment of different rules) | Supply chain | M | Project Manager | As a project manager, I would like to have a Capacity/storage tool to evaluate project postponement/bringing forward incl. customer prioritization |
| **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) | Supply chain | M | Project Manager | As a project manager, I would like to have a Capacity/storage tool to evaluate project postponement/bringing forward incl. customer prioritization |
| **BUD_20_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Supply Chain Manager | As a supply chain manager I would like to receive information on the Delivery status of suppliers and send automated Regular inquiries about the delivery date |
| **BUD_20_2** | change notification | Supply chain | M | Supply Chain Manager | As a supply chain manager I would like to receive information on the Delivery status of suppliers and send automated Regular inquiries about the delivery date |
| **BUD_20_3** | automated delivery status request to supplier | Supply chain | M | Supply Chain Manager | As a supply chain manager I would like to receive information on the Delivery status of suppliers and send automated Regular inquiries about the delivery date |
| **BUD_21_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Project Manager | As a project manager, I would like an interactive project overview so that everyone involved in the project can share their information there. |



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| **BUD_21_2** | all relevant participants should be able to share and get information | Supply chain | M | Project Manager | As a project manager, I would like an interactive project overview so that everyone involved in the project can share their information there. |
| **BUD_22_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Manager of Application Center | As manager of the application center, I would like a view for planning the room availability, appointments and also for employee management |
| **BUD_22_2** | integration of appointments, employee availability | Supply chain | M | Manager of Application Center | As manager of the application center, I would like a view for planning the room availability, appointments and also for employee management |
| **BUD_23_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Service Employee | As a service employee, I would like to have an overview of parts, employees, cars, service cars, etc. for spontaneous service calls. |
| **BUD_24_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Project Manager | As a project manager, I want to be able to track changes and statuses in orders, (in Berlin or Portugal) |
| **BUD_24_2** | notification system for changes | Supply chain | M | Project Manager | As a project manager, I want to be able to track changes and statuses in orders, (in Berlin or Portugal) |
| **BUD_25_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Managing Director | As managing director, I would like a simple but real-time overview of all relevant projects with AI-supported optimization |
| **BUD_25_2** | optimization proposals regarding different KPIs | Supply chain | M | Managing Director | As managing director, I would like a simple but real-time overview of all relevant projects with AI-supported optimization |
| **BUD_26_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Designer | As a designer, I want to have a central view where I and everyone else involved can see changes in the project. |
| **BUD_26_2** | notification system for changes | Supply chain | M | Designer | As a designer, I want to have a central view where I and everyone else involved can see changes in the project. |



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| **BUD_27_1** | real-time information from supplier for monitoring of deliveries | Supply chain | S | Service Employee | As a service employee, I want plannable service assignments to automatically be prepared by informing customers and budatec |
| **BUD_27_2** | automatical notifications to customer and organisation to plan necessary maintenance appointments | Supply chain | M | Service Employee | As a service employee, I want plannable service assignments to automatically be prepared by informing customers and budatec |
| **BUD_28_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Sales Manager | As a sales manager, I would like a cost/time overview for all relevant purchased parts in order to be able to make offers |
| **BUD_28_2** | interface for facilitate offers | Supply chain | M | Sales Manager | As a sales manager, I would like a cost/time overview for all relevant purchased parts in order to be able to make offers |
| **BUD_29_1** | real-time information from supplier for monitoring of deliveries | Supply chain | M | Worker | As a worker, I would like to have a notification function for changes in the order so that I am made aware of changes |
| **BUD_29_2** | notification system for changes | Supply chain | M | Worker | As a worker, I would like to have a notification function for changes in the order so that I am made aware of changes |

ANNEX 3 LIST OF REQUIREMENTS FROM BUDATEC INDICATING THE PRIORITIZATION



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