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**MANU**facturing eco**S**ystem of **QUA**lified **R**esources  
**E**xchange

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D6.6

Final Evaluation of Results

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**LIST OF ABBREVIATIONS**

Acronym	Description
WP	Work package
DP	Digital platform
EDM	Ecosystem Data Manager
ERP	Enterprise Resource Planning
CRM	Customer Relationship Manager
DoA	Description of Action
KPI	Key performance indicator
RFQ	Request for quotation
RFP	Request for proposal
GUI	Graphical user interfaces
SUS	System usability scale

## 1 EXECUTIVE SUMMARY

This deliverable presents the validation process undertaken in the last months of the MANU-SQUARE project. The logic implemented for this validation process not only focuses on the demonstrator use-cases outlined in the Description of Action, but also on state-of-the-art literature about the implementation and growth of digital platform ecosystems, as a means of ensuring the future of MANU-SQUARE.

After a brief introduction in § 2, § 3 details the overall two-step process adopted for the validation activities. A first phase, the “Evaluation of Onboarding and Characterization” phase, leveraged all the industrial partners of the project as the first testers of the various components of the MANU-SQUARE platform. An early stage of this process was conducted with in-person meetings during which the various interfaces and functionalities were exhaustively tested and feedback gathered, with subsequent iterations happening virtually due to travel restrictions. This process was essential for restructuring the development and integration activities that had just ended with WP4 and moved to WP6 with T6.1 and the newly created T6.6. This involvement of the industrial partners also allowed them to get familiar with the platform from an end-user perspective and, hence, to contribute as a point of dissemination and user acquisition.

§ 4 and § 5 comprise the core of the report and describe the results obtained in both the manufacturing sector demonstrator and the silk and cosmetics demonstrator. As each of these demonstrators is accompanied by its own independent report (*D6.2 Silk and cosmetics demonstrator* and *D6.3 Manufacturing sector demonstrator*), this report does not go into detail into the developed activities, but: (1) summarizes the obtained results, by recovering the key success indicators as defined in T1.3 Business processes and *D6.5 Validation process definition*; and (2) summarizes the resulting platform feedback on business and technical level.

§ 6 summarizes the tools created for tracking the KPIs previously defined and highlights how technical and confidentiality constraints limited the amount of data that could be recovered from usage of the platform. Nonetheless, several KPIs were tracked, and their evaluation is presented, following the metrics for evolution that had been identified setup in *D6.5 Validation process definition*.

On a general level, the feedback gathered from the two demonstration scenarios and the defined metrics for evolution paint the picture of a platform that on a technical level encompasses the complete processes defined in WP1 of the project, but that at this point lacks the ecosystem of users to overcome the chicken and the egg problem of implementing digital platforms, and thus still, going forward, will require a team actively pushing for the engagement and onboarding of users. Furthermore, it is recommended to improve the superficial user interface and the user’s experience testing done as a way to foster the growth in the medium to long term.

## 2 INTRODUCTION

Digital platforms (DP) such as MANU-SQUARE present a new blueprint for how the market is arranged and how value is generated from products to services. The transition towards platforms for the industrial sectors has not been without challenges, however. The high dependence on network externalities and its multi-sided nature (Eisenmann, Parker, & Van Alstyne, 2006) move DPs away from traditional linear supply-chains, which follow a more straightforward and predictable set of principles, and that companies have grown accustomed to dealing with. The breaking down of this pipeline mentality is also relevant in the definition of metrics and measured for DPs. While a manager of a pipeline modelled business is more concerned with the flow of value from one end of the pipeline to the other, a platform centred business model implies the creation, sharing, and delivery of value throughout the ecosystem (Parker, Alstyne, & Choudary, 2016).

Due to their complexity, the implementation of these new socio-technical constructs should be thought of as more analogous to a process than to an event. Where in an event, the results can be traced back to a specific act or circumstance, a process has more to do with a cumulative, long-term set of efforts. As with any continuous effort, it is essential to keep track of your direction to know where you are headed and to guide your path.

WP 6 has the overarching goal of the actual demonstration of the MANU-SQUARE platform with two demonstrator pilots, as well as with the community scenarios and the business model. *D6.5 Validation process definition* was the first document on this work and aimed at laying out the groundwork of defining the platform success criteria, the methods of evaluation and KPIs that best fit the different use case scenarios of the platform.

### 2.1 Aim and Scope of the Task

This report follows the guidelines previously defined in *D6.5 Validation process definition* for the validation of the MANU-SQUARE platform as a whole, taking into consideration the alterations introduced by the Addendum to the Periodic Report of month 29 and the related amendment (No. AMD-761145-17). As initially defined, this process was divided into two distinct types of metrics: evolution metrics and, the more commonly used in software development projects, the metrics of implementation performance.

The work described in this deliverable leveraged the companies that are part of the MANU-SQUARE consortium to test and validate the different tools, services, and interfaces developed throughout the entirety of the project.

### 2.2 Relation with Other Tasks

The work of Task 6.5 results from the combination of the efforts of all the previous tasks for the conceptual, business and technological development of the MANU-SQUARE platform.

From WP1, T6.5 gets the conceptual development of the platform. T1.2 & T1.4 have analysed and summarized requirements of the platform, by describing both the envisioned functionalities and how they should be implemented. T1.3 meanwhile delivered a detailed description of both the demonstration scenarios with as-is and to-be business processes and started, foundationally, the work that this deliverable has picked up by defining early validation scenarios.

WP4 encompasses the bulk of the technical development of the platform (aggregating the work of WP2 & WP3). From this WP, we gather the inner workings of the platform and its logic.

WP5 develops the multi-sided, service-oriented business model that supports the commercial use of the MANU-SQUARE platform. The validation of this strategic element is a crucial component of WP6. Notably, WP5's T5.2 has already presented an early business model validation framework mainly based on performance metrics.

This deliverable starts from the guidelines defined in *D6.5 Validation process definition* to report on the results achieved with the validation of the MANU-SQUARE platform. Along these months, Task 6.5 put into action a set of activities here detailed in order to feed WP7 (T7.1 & T7.2) with recommendations for the improvement of individual tools and the overall business model of the platform.

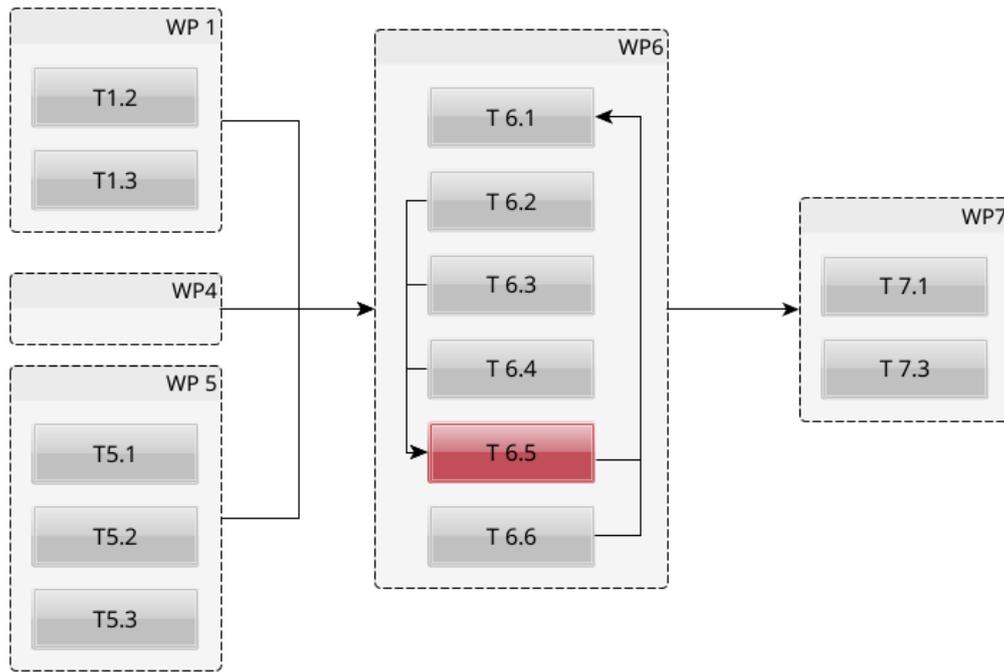


Figure 1 Relationships between T6.5 and other tasks

### 2.3 Outline

The rest of the document is structured as follows:

- § 3 details how the validation process was carried out, and how the guidelines defined in *D6.5 Validation process definition* were put into action;
- § 4 develops the validation process of the demonstration scenarios at the industrial partner for the manufacturing technologies industry. The main focus is on performance metrics;
- § 5 develops the cross-sectorial MANU-SQUARE demonstration scenario, involving the industrial partners from the textile & cosmetics industry. The main focus on performance metrics;
- § 6 establishes the validation process of the remaining components of the MANU-SQUARE ecosystem. These employ the evolution metrics previously conceptualized to expand on the validation framework defined in previous tasks of WP 1 and WP 5;
- § 7 contains some concluding remarks.

### 3 VALIDATION PROCESS

The validation process, conducted from the user’s perspective, conducted in the last months of the MANU-SQUARE project can be divided into two distinct phases: (1) evaluation of onboarding of users; and (2) focused validation scenarios. Both these phases leveraged all the industrial partners of tasks T6.2 and T6.3.

#### 3.1 Evaluation of Onboarding and Characterization

The process of onboarding and characterization of companies is crucial for the success of the platform. This first phase of the validation process was the first effort aimed at getting the platform in the hands of the end users, so that both interfaces and functionalities could be tested and validated, and initial feedback generated before the release of the platform to early adopters.

These efforts, started in the second month of T6.5, were initially conducted with face-to-face meetings with partners from JPM, testing the onboarding, resource and capacity description functionalities, and services corresponding with the manufacturing sector demonstrator (Figure 2). Later, it continued remotely with TRUDEL and SANI testing also onboarding, resource and capacity description functionalities (that, at this point, incorporated many of the improvements brought by the first validation test with JPM), as well as the Idea Manager service, the main tool used in the silk and cosmetics demonstrator.

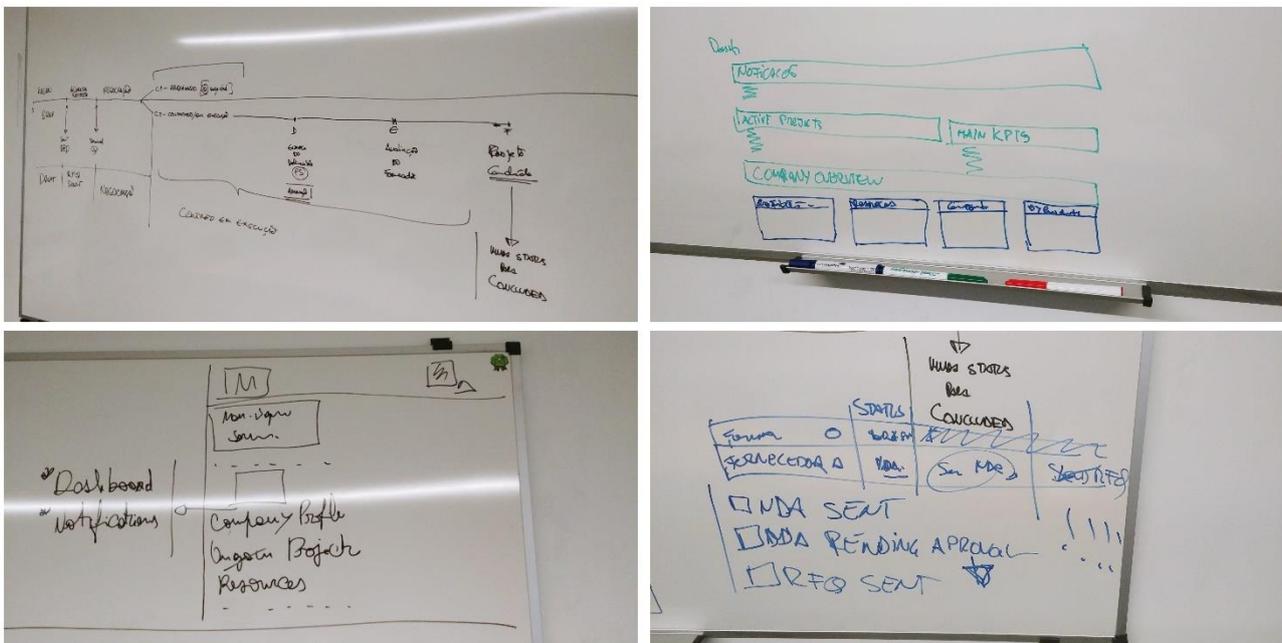


Figure 2 First validation session with JPM

Starting right after the development efforts of WP4, these first sessions proved very useful in identifying many of the deficiencies that needed to be solved before the initial release of the platform to external users.

Figure 3 depicts an extract of the bug, errors and improvements shared report that were produced as the main outcome of these sessions. Additionally, the input from the industrial partners on the state of the platforms’ tools and services was essential for the drafting of the M29 addendum to the periodic report. As such, more detailed descriptions of the development efforts that resulted from these validation efforts are described both in the M29 report as well as in *D6.7 Platform final integration*, the new deliverable that focuses on the integration efforts.

## D6.6 – Final Evaluation of Results

Where	Who	Bug/Improvement	Priority	Status	Dev Comments	Who reply
Companies selection m	Elias	To add a with "view profile details (as for the quotation) allowing to see all the details of the company	3	NotSolved		
Companies selection m	Elias	To add hide/remove company hide/remove company	3	Check		
Companies selection m	Elias	To update attributes and labels according with the suggestion from JPM	3	Solved		
Companies selection m	Elias	Company base has to be updated in Company address	1	Solved		
Companies selection m	Elias	View profile has to be added il view profile o il punteggio sotto "reputation" dovrebbero consentire di accedere al reputation profile che ha mostrato Mario (bisogna accordarsi con loro)	3	NotSolved		
Companies selection m	Elias	To add a small sentence in order to explain what the table means and that, with a click, it is	3	Solved		
Companies selection m	Elias	To add delivery confirmation in order to avoid to sent a RFQ	3	Solved		
Create RFQ	Elias	Get labels and not attribute/process keys (request from Marko)	3	NotSolved		
Create RFQ	Elias	To close all the drop down menu.		Solved		
Create RFQ	Elias	To add the info point as agreed in supplier selection type	1	Solved	Please specify the text	Automatic candidates selection: suppliers who will receive your RFQ are selected by the platform. Thanks to its intelligent ranking, the best percent of
Create RFQ	Elias	There is a bug on the attribute material, which value becomes //manusquare.project.eu/industrial-manusquare#.	2	Check		
Create RFQ	Elias	Insertion of processes of the same type generate some errors, substituting the values.	2	Check		
Create RFQ	Elias	Companies selection automatic goes to manual.	2	Solved		
Create RFQ	Elias	After attaching a file if click in the name the file will be deleted... It should be only if we click on the "X" and a confirmation should be required.	2	NotSolved		
Create RFQ	Elias	To use labels and not attribute/process keys (request from Marko)	2	NotSolved		
Create RFQ	Elias	"Terms of Service, Privacy Policy, and Non Disclosure Agreement." No link provided.	2	Check		
Create RFQ	Elias	To integrate the NDA management as agreed with JPM, Pedro, Henrique. Mandatory drop down menu with 3 options: NDA not required; MANU-SQUARE NDA; Custom NDA.	2	NotSolved		
Create RFQ	Elias	When I insert a new certification, the focus is lost.	1	Solved		
Create RFQ	Elias	To allow the next button working, project name, delivery date, rfq deadline and supplier selection type must be completed.	1	Solved		
Create RFQ	Elias	"Include processes" has to be "add a new process"	1	Solved		
Create RFQ	Elias	Certifications list diventa Supplier certifications list	1	Solved		
Create RFQ	Elias	Add a new certification	1	Solved		

Figure 3 Extract of the shared file created during the user's evaluation with features and bug tracker

### 3.2 Focused Validation Scenarios

After the initial set of tests, and the refactoring of the validation scenarios with the M29 addendum, work was started on supporting the validation efforts of T6.2 and T6.3, while gathering feedback on the different tools, services, and interfaces.

Due to the nature of the two demonstration scenarios and the sub-tasks defined in both *D6.5 Validation process definition* and the M29 task restructuring (Figure 4 and Figure 5), T6.5 played different roles in each demonstrator. In the case of the silk and cosmetics demonstrator, the work further described in § 5, was undertaken in a much more hands-off approach that was required for the demonstration of T6.3. This is mostly due to the fact that I-HUB, in the role of Innovation Manager, was part of the project development process, but also due to the peer-to-peer nature of the processes that the Idea Manager facilitates. In this sense, for this scenario, most of the work was related with gathering feedback on the tool and functionalities as well as answering the questions regarding the integration of the tool in the overall MANU-SQUARE ecosystem and business model, that were listed in *D6.5 Validation process definition*.

On the other hand, in T6.3, the two scenarios of the manufacturing sector demonstrator, required a more active intervention. While a more detailed report of these activities can be found in *D6.3 Manufacturing sector demonstrator*, it is important to note that some changes were made to these scenarios, as foreseen in the M29 risk assessment. For the first scenario, that sees JPM as customer, a change was needed in the way the platform is used by the organization to better fit ongoing processes. With this change, we were better able to reflect the real needs of the company getting an overall benefit. For the second scenario, that sees JPM as supplier, no direct RFQs were received by JPM from the community. This means that the backup plan was triggered, and all the validation was done with INESC on the other side (as client, and generator of the RFQ). In this sense, all the results pertaining to this scenario, detailed in § 4, should be taken with this factor into consideration.

### D6.6 – Final Evaluation of Results

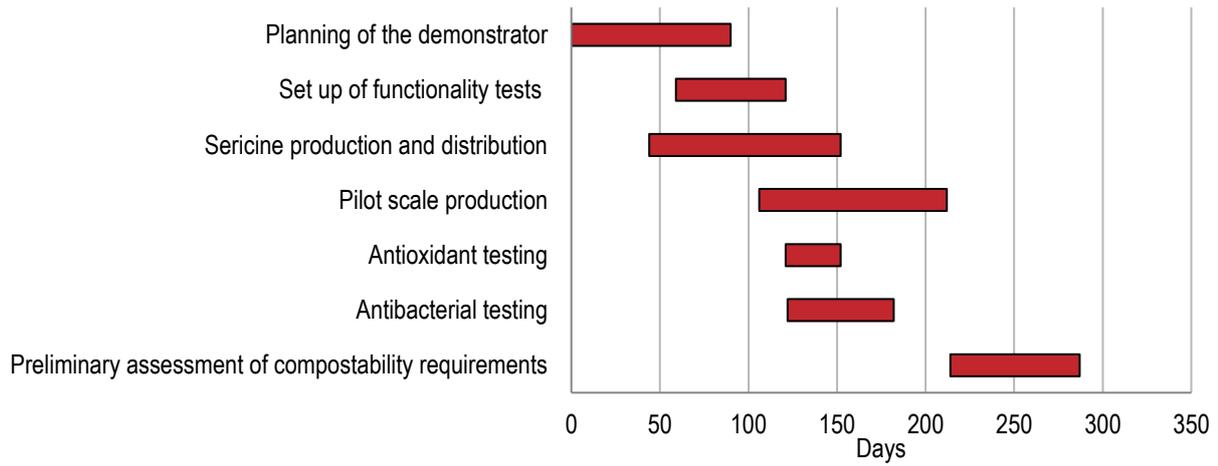


Figure 4 Gantt chart of Task 6.2 (days are counted from M29)

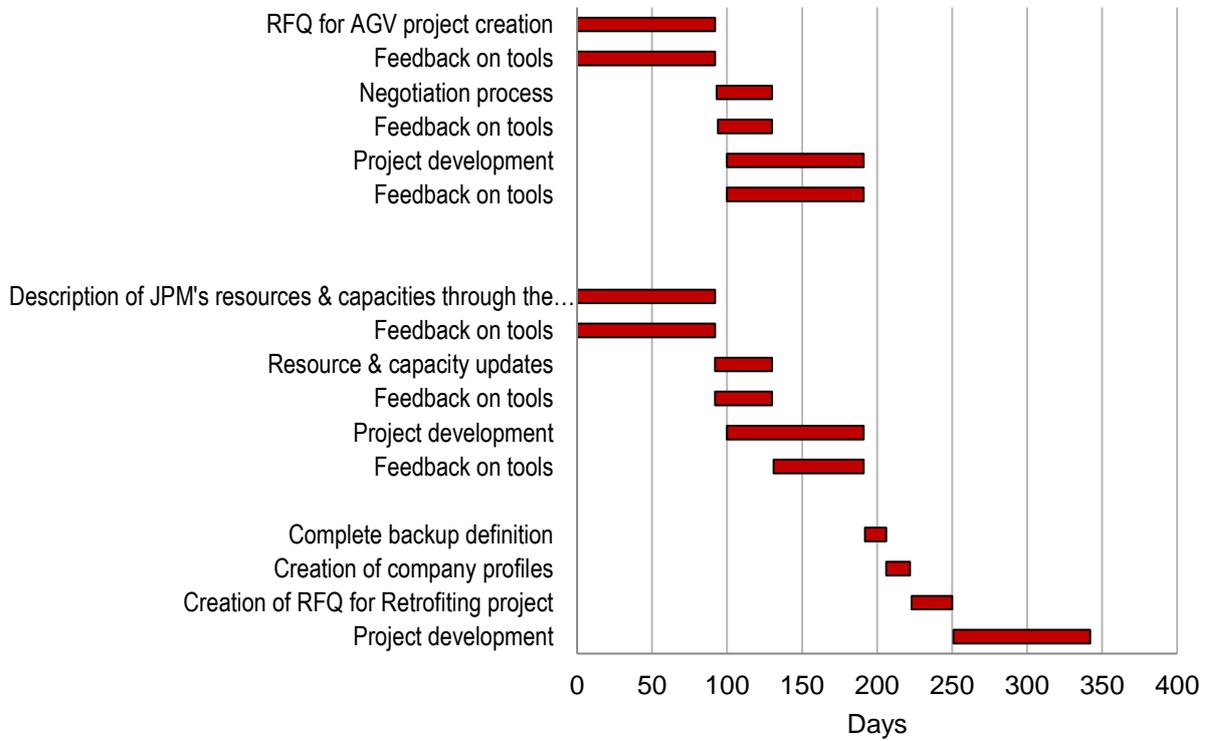


Figure 5 Gantt chart of Task 6.3 (days are counted from M29)

## 4 MANUFACTURING SECTOR DEMONSTRATOR

This chapter presents the validation scenario for the identified demonstration scenarios of the industrial partner from the manufacturing technologies industry.

### 4.1 Demonstration scenario 1 - New product development

The first demonstration scenario sees JPM as a customer in the MANU-SQUARE platform. While initial descriptions of the task see JPM as intending to develop a new automated guided vehicle (AGV) for the food processing industry, the alteration to the MANU-SQUARE project scheduling implied that, to better reflect the ongoing needs of the company this needed to be changed. In this sense, a process comprising the computerized numerical control (CNC) turning of a specific metal component was to be subcontracted, due to current internal availability.

As identified by JPM, the main pain-points for this process were:

- time-consuming supplier validation process;
- the high volume of, sometimes not standard, documentation that needs to be transacted;
- traceability and accountability of the transacted documentation;
- lack of precise information on suppliers' capabilities for the *Evaluation, Negotiation & Deal* step of the process, leading to long decision times;
- the trustworthiness of the available information on suppliers' capabilities.

#### 4.1.1 Validation process & success indicators

The definition of success criteria for the first demonstration scenario of the manufacturing sector takes as a base the work developed in T1.3. These performance metrics focus on the main pain-points presented by the organization in its procurement for Request for Quotation (RFQ) process (also detailed in T1.3). Furthermore, these contribute to the achievement of two MANU-SQUARE target impacts defined in the DoA:

- Increasing responsiveness of collaborative value networks, through effective mechanisms for demand-supply matching. This impact targets the following measurable goal: “–30% time-to-market for new product-service thanks to the acceleration and the implementation of first-time-right solutions promoted by the platform” [MG2.2 in the DoA];
- Reducing the time-to-market, by reducing the time spent for the RFQ process steps and procurement lead time. This impact targets the following measurable goal: “+10% new product-service concepts brought to the market thanks to the platform support provided from conception to production” [MG2.1 in the DoA].

The first success criterion targets the improvement of the results obtained by the procurement department for the RFQ process, conducted by the internal departments of JPM. As the subcontracting process created by JPM (and further described in *D6.3 Manufacturing sector demonstrator*) was among the first to be conducted in the platform, all the resulting potential suppliers did not have an attached reputation score to the specific process to influence the procurement process. The selection had to rely on the supplier profile created by each company. Subsequent testing of the production capacity sharing service demonstrated that the reputation score for both JPM and the selected supplier were reflected according to the given scores. Furthermore, and because JPM chose to manually select the companies that received the RFQ, from the resulting 4 potential suppliers returned by the matchmaking tool, 3 were selected as potential suppliers, with the remaining one not being chosen due to past interactions. All the resulting companies had the capabilities and restrictions initially defined by the JPM RFQ so we can consider this success criteria as achieved.

The second success criterion evaluates the completeness of the platform-driven RFQ process. The entire process detailed in *D6.3 Manufacturing sector demonstrator* was carried out on-platform, guided only by the internal documentation and tooltips, with minimal interaction from the platform owners. The optional handling of the payment process was however, handled outside the MANU-SQUARE platform. Both companies have in place tools to handle this specific point of the process. This point reinforces the feature of allowing users to integrate into the MANU-SQUARE workflow third-party,

specific tools that extend the core functionalities, such as payment handling. Overall, payments handling is seen as an optional step in the production capacity sharing service, hence, we can consider this second success criteria as achieved.

The last success criterion is directly related to the efficiency that the production capacity sharing service and its coupling with all the tools of the MANU-SQUARE ecosystem for the procurement process. After the initial creation of the RFQ, and the automatic returning of matches by the matchmaking tool that, as mentioned above, returned a set of 4 companies, the internal procurement processes involved both the Procurement and the Production departments. Although this process took one week to be completed, it is important to note that, due to the RFQ geographical restrictions, all the companies were known by JPM at some capacity. This implies that *some* of the resources and capabilities of the potential suppliers were known by JPM, but the retrieval of others, more specific and directly related to JPMs’ RFQ and even other aspects such as certifications, were easy acquired and taken into consideration. Overall, given the two-week target defined in *D6.5 Validation process definition*, we can consider this success criteria as achieved, but further validation, with different requirements needs to be produced to ascertain its validity.

Table 1 summarizes the success criteria achieved by the demonstrator.

Success criteria	Description	Target	Result achieved
Increasing accuracy of the matchmaking functionality	This criterion targets improvement of the results obtained from the procurement for RFQ process. Due to the incomplete information about the suppliers, and the variability of skills and needs from JPM, acquiring new suppliers is a task that is time and resource-consuming.	90% accuracy of the supplier validation	The initial RFQ creation process conducted by JPM resulted in a selection of 4 potential suppliers. All of these potential suppliers had complete profiles that fuelled the internal procurement processes, but none had a complete reputation score, since no transaction had occurred up until that point. Further (fictional) validation tests, produced the relevant scores. We can consider this success criterion as achieved.
Making the steps of the RFQ process platform-driven	This criterion targets maximizing the usage of the MANU-SQUARE platform for performing the RFQ process steps, including the document sharing management.	The entire RFQ process	The subcontracting process used for this validation scenario was conducted in its entirety on the platform, with the only exception of the option step of payment handling. This required direct communication between the two companies. We can consider this success criterion as achieved.
Reducing the procurement process lead time	This criterion targets reducing the procurement process lead time, shortening the time spent for acquiring a new supplier to the JPM network. The acquirement process includes searching and finding capable suppliers, managing the RFQ process, and validating the certifications, reputation, and financial status of the information.	Less than 2 weeks to go through the steps for validating and integrating the supplier (from current 3-4 weeks)	The procurement process for this scenario, conducted by different internal JPM departments took one week to be completed and resulted in the selection of two potential suppliers (that received the RFQ). We can consider this success criterion as achieved.

Table 1 Synthesis of success criteria for the demonstration scenario 1

## 4.2 Demonstration scenario 2 - Market coverage extension

This second demonstrator was designed to show how the MANU-SQUARE platform is able to support JPM in satisfying complex customized high-value manufacturing orders in a short time by making it able to identify adequate available capability and consequently set up an adaptive extended product-service business model, covering the whole value chain. JPM becomes one of the companies populating the database of MANU-SQUARE service providers, thus offering their services and available production capacity for retrofitting activities of already installed manufacturing equipment around Europe. This scenario will provide another point of view as to how JPM establishes connections with its customer and suppliers and how the platform can become attractive to businesses which have available unused capacity.

The main pain-point brought up from this perspective were:

- the current limited capacity for sales prospecting available to JPM;
- the inability for JPM to describe and advertise its capabilities in a required manner, due to intellectual property and industrial secrets protection
- the high volume of documentation (bill of materials, CAD files, etc) that needs to be kept up-to-date and that arrives through various channels.

### 4.2.1 Validation process & success indicators

The definition of success criteria for the second demonstration scenario of the manufacturing sector also takes as a base the work developed in T1.3. These performance metrics, despite being concerned with the further platformization of the RFQ process, should also focus the under-utilization of capacity and the reduction of time-to-market goals. Like in the first demonstration scenario, the second case contributes to three MANU-SQUARE target impacts defined in the (DoA):

- Increasing the number of innovative business solutions, through expanding the market opportunities and business inquiries. This impact targets the following measurable goal: “+10% new product-service concepts brought to the market thanks to the platform support provided from conception to production” [MG2.1 in the DoA].
- Increasing capacity utilization [MG1.2], through addressing the unused capacity for retrofitting resources (e.g. machines, space). This impact targets the following measurable goal: “+20% reuse of unused manufacturing capacity achieved through the trade opportunity granted by the platform” [MG1.2 in the DoA];
- Reducing time-to-market, by reducing the time spent for the RFQ process steps. This impact targets the following measurable goal: “-30% time needed for the RFQ process thanks to the characterised information availability allowing to pre-screen the offer factually” [MG1.1 in the DoA].

Like for demonstration scenario 1, the first success criterion for the second scenario concerns the completeness of the market coverage extension process in the MANU-SQUARE platform. The backup scenario that was used (and described both in § 3.2 and further documented in *D6.3 Manufacturing sector demonstrator*), comprised the entire process initially defined in *D1.3 Business processes and early validation scenarios*. As this process was conducted mainly for demonstration purposes, no payment process was necessary and as such, this was not managed by the platform itself. In this sense, and with the complete coverage of the defined functionalities, we can consider this success criterion as achieved.

The second success criterion could not be organically replicated. Although more details on this can be found in *D6.4 Community-driven demonstrator*, the size of the MANU-SQUARE community was not able to generate leads that matched both the resources and capabilities made available by JPM through the platform. In this sense, the backup scenario was activated and the functionalities and feedback on tools and processes was conducted with a simulated process between JPM and INESC. As such, we cannot consider this success criterion as realistically achieved, but only as achieved by the process of reality simulation. As described in *D6.5 Validation process definition* and *D6.4 Community-driven demonstrator*, the community component is essential for much of the MANU-SQUARE success, and the successful conduction of this demo scenario in particular. With the backup process, we were able to validate that functionalities and workflows are aligned with JPMs’ business processes, but this is a process that needs to be validated with a wider set of companies in order to ensure its wide application.

Table 2 summarizes the success criteria achieved by the demonstrator.

Success criteria	Description	Target	Result achieved
Making the steps of the RFQ process platform-driven	This criterion targets maximizing the usage of the MANU-SQUARE platform for performing the RFQ process steps, including the document sharing management.	The entire RFQ process	Both the process of description of resources and capabilities, the backup demonstration scenario was entirely conducted in-platform. We can consider this success criterion as achieved.
Increasing the number of business queries	This criterion targets increasing the number of business queries from the customers for retrofitting and refurbishing business.	15% increase in the number of business queries from the market.	The current size of the MANU-SQUARE user ecosystem was not able to produce the business queries necessary to validate this criterion. For validation purposes, the backup scenario was used.

Table 2 Synthesis of success criteria for the demonstration scenario 2

### 4.3 Platform Feedback

The two scenarios of the manufacturing sector demonstrator saw JPM playing both the role of customer and supplier in the MANU-SQUARE platform (Figure 6 shows a screenshot taken from one of the platform pages created during the demonstrator). Feedback from users of different departments saw different functionalities as the most relevant. While the procurement department listed the “growing database of companies” and “centring the procurement in a single tool, and having the report instantly” as the most attractive features, the production department listed the capacity to “request subcontract[ing] operations of machining, painting, surface treatment (...)” as the most attractive feature. This highlights how the different functionalities of the MANU-SQUARE platform can be integrated into different phases of the companies’ business models, to satisfy different needs. It is also relevant to note that these two user groups point to the difficulty in “convincing partners to leave the traditional method [of subcontracting] and choosing [the MANU-SQUARE platform]”.

Other challenges highlighted how the platform needs to cater more to “finding solutions in a short period of time”, adopting functionalities such as direct notification systems that can speed up the RFQ process and allow for a more flexible process, and how the implemented reputation system should be made more transparent to end users. At this stage, end-user documentation and guidance on how the reputation score should be interpreted is limited and JPM pointed out that a lack of trust in this system can compromise lead times.

Other feedback that falls in line with the community validation scenarios described in *D6.4 Community-driven demonstrator*, pointed to the difficulty in “aligning the vocabulary” in a manner that is not restrictive. While this functionality is provided by the semantic components of the platform, its continuous maintenance and update is important to ensure that the defined ontology and vocabularies remain relevant and usable by end-users.

While further detail of the gathered feedback and actionable points can be found in *D6.3 Manufacturing sector demonstrator*, the overall reception of the platform in the various departments of MANU-SQUARE was positive, with users acknowledging the value of the platform and its different services.

## Production Capacity Sharing

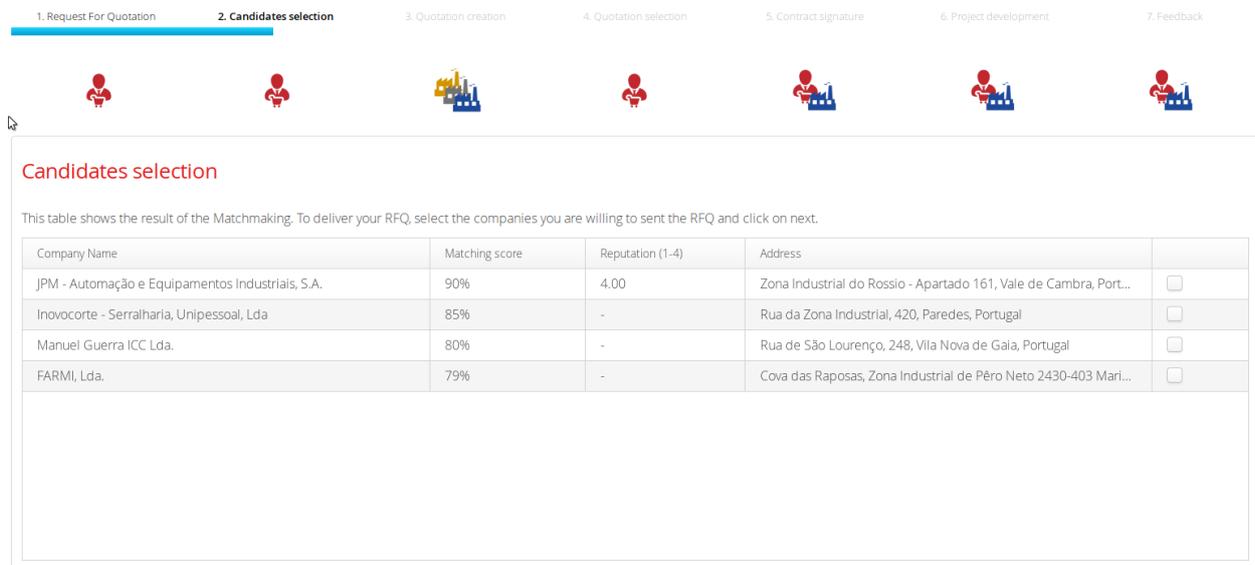


Figure 6 Candidate selection phase of the second demo scenario

#### 4.3.1 System Usability Scale

As described in *D6.5 Validation process definition* for testing of the usability of the different platform elements, the System Usability Scale (SUS)<sup>1</sup> was employed due to its simplicity and its effectiveness even on a small scale of users. In the SUS, users are asked to rank 10 questions according to a scale that ranges from *Strongly Agree* to *Strongly disagree* that will later be evaluated in accordance with the system's methodology.

For JPM, this testing was conducted with two elements that were responsible for interfacing with the MANU-SQUARE platform the most: first, JPM's financial director from the upper management side, and second, the "Supply Chain Manager" from the production side. The results were retrieved after the two previous scenarios were concluded, to ensure that respondents had familiarity with the platform.

Guidelines for interpreting results (Sauro, 2011) point to converting results of the questionnaire into a new number, adding together the points for all odd-numbered questions (x) with the points for all even-numbered questions (y), and then multiplied by 2.5 (so that SUS Score = (x + y) x 2.5) to convert the original scores of percentile ranking between 0-40 to 0-100. These new numbers are generated according to the rationale that the total score is 100 and each of the questions has a weight of 10 points.

For each odd-numbered question, **corresponding to positive tones**, such as strongly agree, the maximum 10 points is added. On the other hand, "strongly disagree" gets the minimum points of 0 (1 is subtracted to the odd-numbered questions to ensure this). The multiplication by 2.5 is done after, to ensure that the maximum is 10 for each question.

The reverse process is done for the even-numbered questions in a **negative tone**. Even-numbered questions get the minimum 0 points and "strongly disagree" gets 0 points as well (by subtracting the points of each question from 5, we ensure that minimum is 0). After which, multiplying by 2.5, we ensure that the maximum is 10 for each question.

The same guidelines point to a SUS score above 68 would be considered above average and anything below 68 is below average, meaning that a score of 68 corresponds to the 50<sup>th</sup> percentile.

<sup>1</sup> <https://www.usability.gov>

Figure 7 sums up the effect of the scoring system on the outcome percentiles.

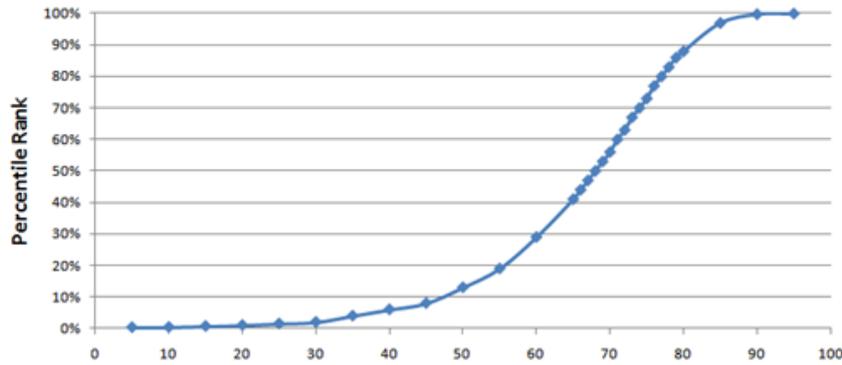


Figure 7 SUS percentile ranks (Sauro, 2011)

Table 3 and Table 4 present the results of the questionnaires with Table 3 corresponding to the user who followed the project development process closely, and Table 4 to the user who was later introduced to the platform and its services. Both respondents fall into the 50<sup>th</sup> percentile, with the user that did not followed developments closely achieving the highest score of both demonstration scenarios. Although the depth of the test is not enough to reach a definite conclusion, we position that, for user introduced to the platform at a later development stage, being from a production department accustomed to technical descriptions of the manufacturing process, it was easier to navigate the interfaces and understand the rationale behind the system design.

Additionally, it is important to note that both respondents do not score the integration of the system very highly and both give neutral answers when asked if the system is “cumbersome to use”. These factors point to streamlining the platform UX workflows in order to facilitate not only the overall use of the platform but also to unify the MANU-SQUARE experience in its distinct set of services and tools.

	1	2	3	4	5
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1. I think that I would like to use this system frequently.				X	
2. I found the system unnecessarily complex.		X			
3. I thought the system was easy to use.				X	
4. I think that I would need the support of a technical person to be able to use this system.		X			
5. I found the various functions in this system well integrated.		X			
6. I thought there was too much inconsistency in this system.		X			
7. I would imagine that most people would learn to use this system very quickly.				X	
8. I found the system very cumbersome to use.			X		
9. I felt very confident using the system.			X		
10. I needed to learn a lot of things before I could get going with this system.		X			
<b>Total</b>	<b>65</b>				

Table 3 SUS questionnaire of user who followed platform development

	1	2	3	4	5
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1. I think that I would like to use this system frequently.				X	
2. I found the system unnecessarily complex.		X			

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3. I thought the system was easy to use.				X	
4. I think that I would need the support of a technical person to be able to use this system.		X			
5. I found the various functions in this system well integrated.			X		
6. I thought there was too much inconsistency in this system.			X		
7. I would imagine that most people would learn to use this system very quickly.				X	
8. I found the system very cumbersome to use.			X		
9. I felt very confident using the system.				X	
10. I needed to learn a lot of things before I could get going with this system.		X			
<b>Total</b>	<b>67.5</b>				

Table 4 SUS questionnaire of user who did not followed platform development

## 5 SILK AND COSMETICS DEMONSTRATOR

This chapter presents the validation scenario for the cross-sectorial textile and cosmetics industry.

### 5.1 Cross-sectorial demonstration scenario - New product development and waste utilization

The demonstration scenarios in textile & cosmetics industry embed TRUDEL and SANI, in a multi-sectorial way. SANI currently produces cleansing wipes distributed through large retailers all around Europe. The company has already implemented a differentiation strategy starting from its foundation: no synthetic fibres but just cotton-based products in order to assure a better environmental and safety profile than low-cost competitors. In the last few years two phenomena further changed the market context: on the one hand, economic downturn facilitated the diffusion of low-cost (synthetic) products, and, on the other hand, Far-East manufacturers started producing also cotton-based cleansing wipes (with lower costs than their European competitors).

SANI aims at developing a new product addressing the above-mentioned market emerging needs, thus supporting further differentiation potential from low-cost (also cotton-made) solutions. Initial investigations performed off-line allowed to identify a potential innovation manager (I-HUB) providing the knowledge for product and process (re-)design and a provider of an interesting bio-compatible and green material (sericin, coming from silk yarns processing) able to functionalize SANI non-woven fabrics. Sericin is a by-product/waste of production processes of TRUDEL. In this respect, this case also demonstrates a waste utilization scenario for TRUDEL.

The process started with TRUDEL producing sericin as a by-product, which is stabilized by a technical service provider and certified. SANI's cotton pad products are then assembled with sericin for development of a new product, usually involving another subcontractor for the required capacity and technological capability. The innovation manager (I-HUB) supports the whole process in designing it, building the contacts, supervising, and providing the required know-how.

#### 5.1.1 Validation process & success indicators

The definition of success criteria for the cross-sectorial textile demonstrator takes as a base the work developed in T1.3. The performance measures employed show the MANU-SQUARE's capability of generating innovative ideas for new product development, configuring the corresponding value chain, and acquiring the required value chain actors, while at the same time integrating innovation managers. This demonstration scenario further contributes to the achievement of the following MANU-SQUARE target impacts listed in the DoA:

- Increasing the number of new textile-cosmetics products designed, developed and prototyped within the MANU-SQUARE ecosystem. This impact targets the following measurable goal: “+10% new product-service concepts brought to the market thanks to the platform support provided from conception to production” [MG2.1 in the DoA].
- Increasing the number of new (external) manufacturers, distributors, suppliers involved in the new textile-cosmetics value networks. This impact targets the following measurable goal: “-30% time needed for the RFQ process thanks to the characterised information availability allowing to pre-screen the offer factually” [MG1.1 in the DoA].
- Reducing the time required to the innovation manager for establishing the novel value network. This impact targets the following measurable goal: “-30% time-to-market for new product-service thanks to the acceleration and the implementation of first-time-right solutions promoted by the platform” [MG2.2 in the DoA].

The first success criterion targets the number of innovation opportunities in the textile & cosmetics products. As defined in the M29 addendum risk analysis, the size and composition of the MANU-SQUARE community would be essential for the achievement of this criterion. During the development of T6.6, the companies that interacted with the challenge initially posed by SANI were I-HUB, providing the guidance for the description and development of the process, are INESC, mainly focused on testing the different functionalities of the platform and not taking part to the demonstrator trials or value chain itself, and TRUDEL, a key intervenient in the process that provides the raw materials essential for the trials. Similarly to the results achieved by the second scenario of the manufacturing sector, a wider community of companies with distinct profiles would be needed to achieve this result. In this sense, this validation criterion was not achieved.

The second success criterion is related with the development of value chain networks for the companies involved in the demonstrator. As detailed in the *D6.2 Silk and cosmetics demonstrator*, the work developed in this demonstrator lead to a big cooperation effort between the three companies that intend to keep up this work in the future for the development of this process but also new and innovative projects. As such, we can consider this success criterion as achieved.

The last two success criteria directly relate to the effectiveness of the innovation process and the number of generated innovative results. The three in-depth trials described in *D6.2 Silk and cosmetics demonstrator* that evaluated the potential of producing cotton pads, enriched with sericin (waste product from silk industry) and curcumin (natural extract aimed at imparting antibacterial properties) lead to a better understanding of the anti-bacterial properties of these materials. Furthermore, paths for improving the achieved results were defined involving the three companies. We can consider these success criteria as achieved.

Table 5 summarizes the success criteria achieved by the demonstrator.

Success criteria	Description	Target	Result achieved
Increasing the number of innovation opportunities targeting textile & cosmetics products	Increasing the number of innovation opportunities relating to the stabilization of the sericin, the design and development of new cosmetic complex, and the application to the wet wipes	Increase by 5% the received innovation opportunities	The challenge posed by SANI and guided by I-HUB, got responses from both TRUDEL and INESC. While these were sufficient to test and validate the functionalities of the platform, the number of companies in the platform and their sector of activities did not allow for the complete achievement of this criterion.
Facilitating the establishment of the innovation value chain	Defining and structuring the innovation value chain network, including the innovation manager, as well as increasing the number of potential value chain actors that can be accessed	At least 3 new value networks, involving TRUDEL and/or SANI	The platform supported the communication between SANI and TRUDEL, supported by I-HUB that played an important role in establishing the value chains. These now in place chains will be used in the future to continue the testing on this particular process and on other innovative ones. We can consider this success criterion as achieved.
Increasing the effectiveness of the innovation process	Increasing the effectiveness of the innovation process in terms of success rate of the innovation opportunities	At least 2 innovation opportunities successfully developed from design to prototype	As detailed in D6.2, this validation scenario led to the development and prototyping in three distinct trials. We can consider this success criterion as achieved.
Increasing number of generated innovative results	Creating new innovative results	Create at least one innovative result	The trials described in D6.2 led to a better understanding of the antibacterial properties of the tested materials, as well as defined paths for improving the achieved results. We can consider this success criteria as achieved.

Table 5 Synthesis of success criteria for the silk and cosmetics demonstrator

## 5.2 Platform Feedback

Through the silk and cosmetics demonstrator we mainly focused on the functionalities provided by the Idea Manager tool triggered by a challenge post published by SANI (Figure 8).

The feedback gathered from the three companies involved in the demonstrator are positive and very much in line with the feedback recovered by CSEM in the community scenarios. The companies point to the maturity of the tool, with the core functionalities implemented and ready to be used by all the users of the MANU-SQUARE platform, but they also point out that a closer integration in the larger set of MANU-SQUARE tools would be advisable. Small details such as the logging out when a user backs form the Idea Manager to the remaining services, the difference in styling and user experience, and the non-conformity of the user profile and the notification system, contribute to this lack of integration and make the use of the two services cumbersome.

Further details of the gathered feedback and actionable points can be found in *D6.2 Silk and cosmetics demonstrator*.

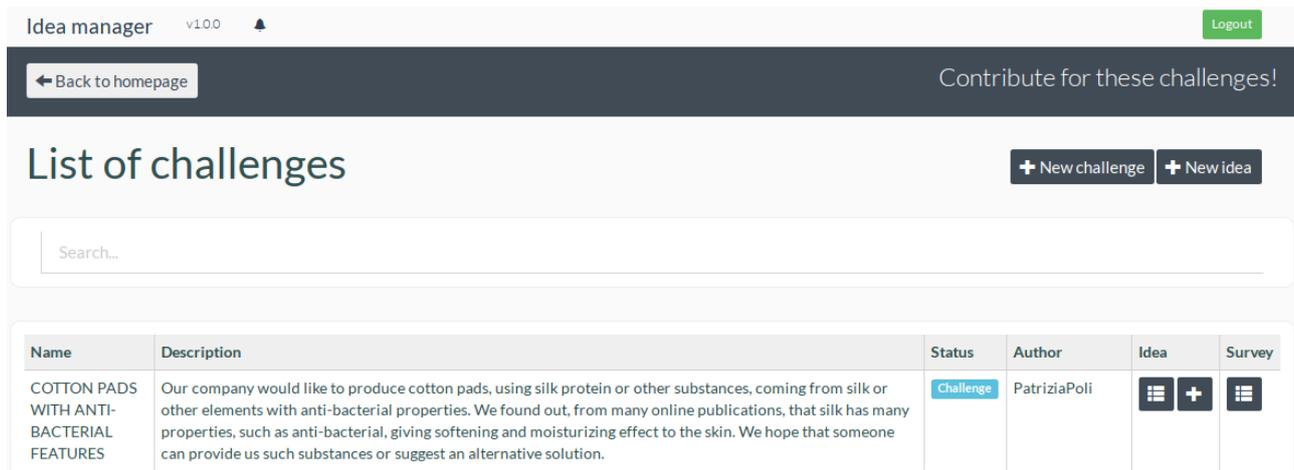


Figure 8 Initial challenge by SANI

### 5.2.1 System Usability Scale

As defined in *D6.5 Validation process definition*, SUS was also used in the cross-sectorial textile and cosmetics scenario for the testing of the usability elements of the platform due to its simplicity and its effectiveness even on a small scale of users. In this particular scenario, as mimicking the methodology used in the previous demo scenario, the 10 questions (enumerated in § 4.3.1), were answered by two users of the MANU-SQUARE platform from SANI: one user who followed the development process of the platform, and another user, from the sales department, who only interacted with the platform in this demonstration stage. This allowed us some, although limited, insight into the perspective of users who better understand the platform, its functionalities and services, and users that, in a normal setting, would be using the platform in their work context.

Table 6 and Table 7 present the results of the questionnaires, with Table 6 corresponding to the user who followed the project development process closely, and Table 7 to the user who was introduced to the platform. The overall results are not completely positive for the usability and user experience of the platform. While the score of the first user still places it in the 50<sup>th</sup> percentile, taken into the context of a user that followed the project and its development, this should be considered a low score. Neutral answers in questions relating the “confidence in using the system” or on how users need to learn a lot of things before using the platform to its full potential point to the complexity and non-intuitiveness of some components of the platforms’ interfaces and user experience overall. A neutral answer in the integration of the different components of the platform is also in line with the feedback provided in *D6.2 Silk and cosmetics demonstrator*, in how the Idea Manager has some integration points with the remaining services of the MANU-SQUARE platform that could be improved.

The results of the user with less experience with the platform and project itself reflect this lack of refinement even further, with a poor score of 62.5. Again, we notice the preponderance on the lack of integration, a neutral answer pointing to how cumbersome the use of the platform can be.

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One important takeaway is that, despite the not very favourable overall SUS scores, both users score “would like to use this system frequently” with a positive score, which points to an understanding of the underlying value that the platform, its ecosystem and services. Going forward, and with the core functionalities of the platform and its many systems stabilized, greater emphasis should be placed on the development of the overall user experience and user engagement.

It is important to note that these results should be taken into context. Only a limited number of questionnaires were performed and, as such, results are not normalized and follow research that point to a result of 68 as being on the 50<sup>th</sup> percentile. A wider range study would need to be performed on different types of users to have a more significant result.

	1	2	3	4	5
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1. I think that I would like to use this system frequently.				X	
2. I found the system unnecessarily complex.		X			
3. I thought the system was easy to use.			X		
4. I think that I would need the support of a technical person to be able to use this system.		X			
5. I found the various functions in this system well integrated.			X		
6. I thought there was too much inconsistency in this system.		X			
7. I would imagine that most people would learn to use this system very quickly.				X	
8. I found the system very cumbersome to use.		X			
9. I felt very confident using the system.			X		
10. I needed to learn a lot of things before I could get going with this system.			X		
<b>Total</b>	<b>68</b>				

Table 6 SUS questionnaire of user who followed platform development

	1	2	3	4	5
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1. I think that I would like to use this system frequently.				X	
2. I found the system unnecessarily complex.		X			
3. I thought the system was easy to use.		X			
4. I think that I would need the support of a technical person to be able to use this system.		X			
5. I found the various functions in this system well integrated.		X			
6. I thought there was too much inconsistency in this system.		X			
7. I would imagine that most people would learn to use this system very quickly.				X	
8. I found the system very cumbersome to use.			X		
9. I felt very confident using the system.				X	
10. I needed to learn a lot of things before I could get going with this system.		X			
<b>Total</b>	<b>62,5</b>				

Table 7 SUS questionnaire of user who did not followed platform development

## 6 MANU-SQUARE ECOSYSTEM DEVELOPMENT

This chapter summarizes the validation scenarios for the wider ecosystem of the MANU-SQUARE platform.

A set of 27 KPIs specific to the MANU-SQUARE ecosystem development was defined in *D5.2 Multi-sided service-oriented business model* and *D6.5 Validation process definition*. These were composed of 4 categories: (1) usage metrics; (2) transaction metrics; (3) business metrics; (4) user satisfaction metrics.

As defined in *D6.5 Validation process definition*, the bulk of the work for the tracking and validation of these indicators was led by CSEM and is reported in *D6.4 Community-driven demonstrator*.

### 6.1 Tools and Method of Evaluation

A key aspect in tracking KPIs evolution was the implementation of the KPI Dashboard as a module available to the MANU-SQUARE project team. Of the 62 KPIs of interest to measure the performance and evolution of the MANU-SQUARE platform identified in *D6.5 Validation process definition*, 8 basic KPIs are tracked in the dashboard. The dashboard concept displays the traffic development on the different service modules over time. Due to technical constraints, it was not possible to extract more dynamic information from user sessions automatically, such as activity time on the platform. No user content can be assessed, all data stays confidential, which is in line with the platform's data privacy policy. Table 8 lists the KPIs tracked by the dashboard and Figure 9 shows the total number of registered users as an example KPI tracked by the dashboard, lifted from the *D6.4 Community-driven demonstrator analysis*.

Dashboard KPI	Definition
Total users	Total number of users registered on the platform. Users that are needed to test the live environment or to navigate in it are excluded.
Total number of capacity sharing projects	Total number of production capacity sharing projects created on the platform. This includes projects in all the stages of the business process flow, from new RFQ to closed projects.
Total number of innovation management projects	Total number of Innovation Capabilities Sharing projects created on the platform. This includes projects in all the stages of the business process flow, from new RFP to closed projects.
Total number of by-product projects	Total number of By-product Sharing projects created on the platform. This includes projects in all the stages of the business process flow, from new RFQ to closed projects.
Total number of resources currently on the platform	Total number of resources described through the platform dedicated to production capacity sharing (e.g., CNC machines, 3D printers, etc.). It counts only currently available resources. If a user deletes resource or sets a resource to "Not Available", this KPI decreases by 1.
Total number of Innovation Managers currently on the platform	Total number of innovation managers currently registered on the platform.
Total number of by-products currently on the platform	Total number of by-products defined through the platform. Only currently available resources are counted. If a user deletes or sets a resource to "Not Available", this KPI decreases by 1.

Table 8 List of KPIs made available by the KPI dashboard and described in *D6.4 Community-driven demonstrator analysis*

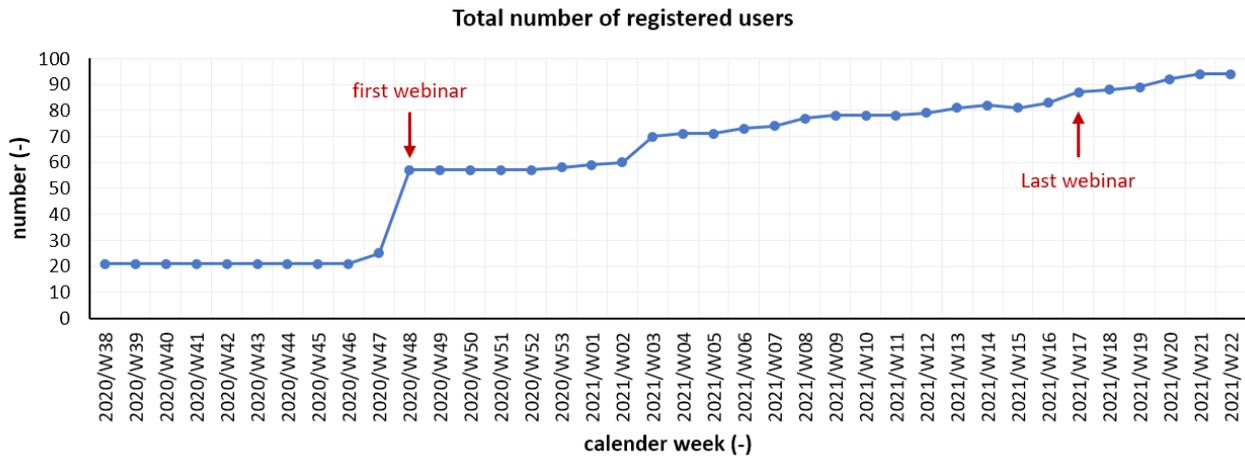


Figure 9 Example KPI recovered from the dashboard recovered from D6.4 - Evolution of total number of users registered in the platform

Along with the KPI dashboard, other two logs were maintained during the validation process, providing more information about the evolution of the development and integration of the technical systems of the platform: (1) a version change log; and (2) a bug tracking log.

The version change log, with a sample shown in Figure 10, kept track of the different releases of the different tools, major changes and fixes applied. At the time of this report submission, this document describes 12 major version bumps that encompass all the modular tools of the platform.

Tool	Release	Date	Comment
GUI+Orchestrator	12.0	25/01/2021	completed proj dialog
GUI+Orchestrator	11.0	15/01/2021	registration fixed
GUI+Orchestrator	10.0	13/01/2021	sust tool path fixed + merge
GUI+Orchestrator	9.0	07/10/2020	Delete Basic-Non-Disclosure-Agreement (3).pdf + rm integrated + gui fix prod
GUI+Orchestrator	8.0	11/09/2020	new release after testing
GUI+Orchestrator	7.0	09/09/2020	merge innovation
GUI+Orchestrator	6.0	22/06/2020	version for tutoring
GUI+Orchestrator	5.0	16/06/2020	capacity sharing stable for testing
GUI+Orchestrator	4.0	17/04/2020	integrated MM and many fixes
GUI+Orchestrator	3.0	01/02/2020	gui + orch dockerized
GUI+Orchestrator	2.0	23/10/2019	integration
GUI+Orchestrator	1.0	13/08/2019	initialize GUI
Semantic Engine	0.2	25-11-2019	Docker-compose with LOGGING_PATH. ProcessType, AttributeType, CertificationType, MaterialType taxonomies updated. No dummy data.
Semantic Engine	0.3	10-12-2019	Migrated to rdf4j 3.0.3. Process most used attributes and material loaded
Semantic Engine	0.4	20-02-2020	Added labels for suggested attribute values. MODE supports equivalence between concepts.
Semantic Engine	0.5	20-02-2020	Added labels for suggested attribute values -v2.
Semantic Engine	0.8	26-03-2020	added unit of measures into ontology. aggregation on unsorted concepts for GET taxonomies
Semantic Engine	0.9	03-04-2020	fixed issues with @id and hasValue
Semantic Engine	1.0	22-04-2020	more on adjust json-ld to edm
Semantic Engine	1.1	25-06-2020	add includeLabels param into GET graph. Refactor initial data
Semantic Engine	1.2	22-07-2020	extended Id schema to support innovation management profiles. extended ontology
Semantic Engine	1.3	09-09-2020	minor fixes on ontology
Semantic Engine	1.4	11-09-2020	bugfix with sectors
Semantic Engine	1.5	12-09-2020	bugfix
Semantic Engine	1.6	05-11-2020	byproducts support
Semantic Engine	1.7	22-12-2020	fix material suggestions
Matchmaking	0.1	23.11.2019	First release of capacity sharing MM, change of container registry path.
Matchmaking	0.2	02.12.2019	Replaced Neo4J with Guava graph processing, bugfix.

Figure 10 Sample of version and changes tracking log

Figure 11 depicts a sample of one of the bug tracking logs, used to guide the work of WP 6. Similar to the changelog previously described, this log encompasses all the tools and services of the platform and served as reporting tool for the work of the demonstration scenarios. At the time of this report submission, this document tracks 375 bugs and recommendations with 70.4% (totalling 264) marked as solved, and 29.6% (totalling 111) marked as not solved yet.

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Where	Bug/Improvement	Prima/dopo Inn. Mngt	Priorità	error in the filled data	Data reporting	Data solved
Edit company profile	Company certification singola istanza non viene salvata	si	4	Solved	2020/02/10	2020/02/25
General	Rimuovere shortcut perchè gestiti male, evitare anomalie	si	3	Solved	2020/02/10	2020/02/25
RFQ	Fix space below language	si	3	Solved	2020/02/10	2020/02/25
Login	Spazio seconda riga testo eu	si	3	Solved	2020/02/10	2020/02/25
Reset Password	Verifica se funziona (non va in locale/docker)	si	3	Solved	2020/02/10	2020/02/25
Register	2 utenti registrati con la stessa mail, è possibile? Non deve essere possibile	si	3	Solved	2020/02/10	2020/02/25
User profile	Verify Phone (by regex)	si	3	Solved	2020/02/10	2020/02/25
RFQ1	Add a new process missing message when press + and empty	si	3	Solved	2020/02/10	2020/02/25
RFQ1	Select how you want to choose supplier candidates: automatic dà un'eccezione	si	3	Solved	2020/02/10	2020/02/25
Companies selection manual	Si dovrebbe consentire l'apertura dello stesso profilo solo una per volta (e.g. Se (sbagliando) faccio doppio click invece che click mi si aprono due profili uguali). Problema sia di click preso multiplo che di back next che aggiunge altri elementi che multiple listener	si	3	Solved	2020/02/10	2020/02/25
RFQ	Companies selection automatic goes to manual. Manual restituisce le company, Automatic va a RFQ-2 senza suggerire niente	si	3	Solved	2020/02/10	2020/02/25
RFQ	After attaching a file if click in the name the file will be deleted... It should be only if we click on the "X" and a confirmation should be required.	si	3	Solved	2020/02/10	2020/02/25
RFQ	Se aggiungo un processo non esistente nella lista e clicco su + non appare la tabella degli attributi (ho provato con Printing e non appare. Con milling sembrerebbe di sì) Probabilmente perchè mancano suggestion	si	3	Solved	2020/02/10	2020/02/25

Figure 11 Sample of bug tracking log

## 6.2 Business Model Metrics for Evolution

As defined in *D6.5 Validation process definition*, the work developed for the validation of the MANU-SQUARE platform focused on short-term metrics. We consider that, given the short 10-month period of implementation of this validation and evolution plan, short-term metrics would be more impactful in the development of the project (both during this 10-month period where more fundamental adjustments can be made to technical components and to the business model, and for the following period after the end of the project).

Additionally, as previously described and further outlined in *D6.4 Community-driven demonstrator*, the general nature of the measures retrieved by the platform made some of the defined indicators unviable to measure and track. Many of these metrics rely on capturing user activity from the platform, which, due to these technical and confidentiality aspects were not possible to measure in the time span of the demonstration activities. In this sense, many of the usage, transaction, business and user satisfaction metrics are not able to be measured.

The more generic and broad indicators, tracked by the tools previously described, such as active user, and total number of projects, were, however, able to be used for evaluation of the defined short-term metrics of evolution. Table 9 summarizes the defined indicators chosen as measurement proxies of the metrics and their measured results in the timeframe between 02/2021 and 05/2021.

These results paint a picture of a platform where the ecosystem of users, companies in the MANU-SQUARE case, has still to reach the critical size to overcome the chicken and the egg problem as defined by (Tiwana, 2013). This could be reached by providing the right incentives to keep users engaged in the platform and its functionalities. Although the dissemination activities were able to gather a considerable number of companies (external to the project) in the platform (67), the effort should be put on keeping these users active. With a total of 26 resources and capabilities created and described (0.4 per company) and 4 innovation managers, a small number of users became eligible to receive RFQs and RFPs, and thus start generating value from the MANU-SQUARE services.

On the other hand, the more technical KPIs and feedback recovered from the demonstrators depict a set of tools and functionalities that are very valid for the companies that get to know and use them. Although some key aspects require improvement, such as a communication and notification system, and the user experience and integration of some tools in particular, the overall development activities delivered on the functionalities and features initially defined in WP1.

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A further point, demonstrated by the hosting company outage that happened at the end of March and caused the entire MANU-SQUARE platform to be inaccessible for one week, calls for the redundancy of the hosting and backup services. The technical architecture adopted for the MANU-SQUARE tools allows to easily move infrastructures and recover from failures, granted that all data is backed up. This should be leveraged to ensure that the services remain available with minimal downtime.

Metric	Measure	Indicator	Result
Resilience	Failure recovery time	$\sum$ (platform time spent with non-working tool/total number tool failures)	During the validation period, the only time any of the platforms' tools were unavailable was during a hosting provider outage. The recovery process took one week on their side. All data was recovered.
Scalability	Average projects by user	No. of projects created / no. of users [%]	<b>22.3%</b> (21 / 94)
Latency	Platform latency evolution	$\sum$ (average time for matchmaking calculation/ total number of users)	<b>Instant</b> During the entire validation period, the matchmaking tool provided results near instantly. No degradation in performance was experienced by end users.
Composability	Effort per change	$\sum$ (person-hours spent on changes to the platform/total number of changes)	<b>0.48</b> (33 / 69) Estimate based on the allocation of effort of partners involved in development and integration activities of T6.6.
Stickiness	Change in hours per user session over time	$\sum$ (time spent by single users)/(Tot.no.accesses-tot.no.bounces)	Not measurable.
Stickiness	Change in number of sessions	Tot.no.accesses-tot.no.bounces	Although technical limitations prevent a detailed overview of this indicator, the analysis of the logs from the KPI dashboard show that new platform users tend to not login 10 days after initial registration. This points to the low stickiness of the platform.

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Platform synergy	Platform integrations	Tot. no. of integrations [no.]	Medium-term metric. The development activities undertaken during the project focused on the stabilization of the core MANU-SQUARE functionalities to allow for ecosystem establishing and growth. In this sense, no third-party integrations were pursued.
Plasticity	Features per release	Tot. no. of new feature/Tot. No. of releases [no.]	<b>5,75</b> (69 / 12) Results obtained from changelog document. Multiple bugfixes considered as 1 new feature.
Durability	Active users over time	Tot. no. of unique access/month [no.]	<b>101</b> (404 / 4)
Durability	Number of tools feature releases	Tot. no. of new features [no.]	<b>69</b> Multiple bugfixes considered as 1 new feature.

Table 9 Metrics and measures for evolution - 02/2021 to 05/2021

## 7 CONCLUSION

The concept of multi-sided markets that gathers consumers and producers together in the same environment has been around for a long time, coexisting in many industries with traditional product and service offerings. Despite being information intensive, the manufacturing sector and, for the most part, the industrial sector, have remained closed to digital platform offerings. The efforts of the MANU-SQUARE project resulted in a set of tools and services that appeal to the day-to-day necessities of the procurement, production, and innovation departments of organizations. The two demonstrator scenarios here reported supported, in a first phase, the aligning of the developers' actions with the initial set of functionalities and business processes, and in the tail end of the project, in generating comments and feedback on how the different tools and services can be improved to achieve commercial success.

The user-driven validation efforts generated positive results on the main workflows of the platform such as the onboarding process, the description of resources, the creation of RFQs and in the Innovation Management tool. Nonetheless, some shortcomings were identified, mainly concerning the user experience of the platform.

User experience, that comprises factors such as visual and interactive design, engagement, and usability of the platform, is a critical point in retaining customers. While industrial users are traditionally thought to be more prone to overlook UX issues to favour functionality of design, the pervasiveness of digital platforms has elevated this standard and it is now a major point of competition. As illustrated in the, although superficial, validation through the SUS and reinforced in the other validation test of the WP6 the improvement of the MANU-SQUARE UX could serve to improve user engagement and the overall stickiness of the platform. Other aspects such as the integration between the different services of the platform and a robust notification and communication system should also be taken into consideration.

Other important point for improvement of the user experience lies in the facilitation offered by a proactive platform helpdesk. Other platforms in adjacent sectors, identified in WP5, are able, for example, to actively provide person-to-person support to companies if the platform notices the user left a project halfway complete. Engaging with user on this level might prove essential for overcoming the critical mass of users needed for the generation of constant stream of business through the platform. Even though the platform has been excellent in providing real-time answers whenever users encountered any issue with the use of the services, a shift from reactive to proactive support could even more facilitate the uptake by the users.

## 8 REFERENCES

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