REMODEL - Robotic tEchnologies for the Manipulation of cOmplex DeformablE Linear objects

Deliverable 8.2 – STAKEHOLDER ANALYSIS AND MAPPING

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1 Executive Summary

This document contains a market analysis, in order to identify other stakeholders, as well as a sectorial analysis and the use cases in order to develop a map the stakeholder community to develop dissemination and communication activities tailored for the single stakeholder group.

This deliverable contains a stakeholder analysis in order to:

- Identify other stakeholders in addition to those included during proposal preparation;
- Create a large database of stakeholders that will be periodically informed about the main project outcomes;
- Develop dissemination and communication activities tailored for the single stakeholder group.

2 Introduction

This market analysis allows REMODEL partners to identify other stakeholders interested in REMODEL results. The identified stakeholders have been categorized according to their characteristics, interests, attitude, influence and relevant knowledge.

Market analysis identifies segments but also application sectors, this is performed through a participatory sense to extract the knowledge of the market by each partner based on their previous experience and liaisons.

Every use case and its impact within each sector has been analyzed, the most important competitors, which are robotic companies, have been identified, and each of REMODEL's KER has been evaluated.

3 Market analysis

3.1 Market sectors

The project has as one of its objectives, to serve external stakeholders through its dissemination and communication channels and even possibly offer its solution through REMODEL distribution channels. Identification and hierarchy of external stakeholders is key, and the methodology to achieve them is presented below.

The tool selected to address and prioritized external stakeholders according to their interest level in the project and influence or power, is the Power-Interest Grid.

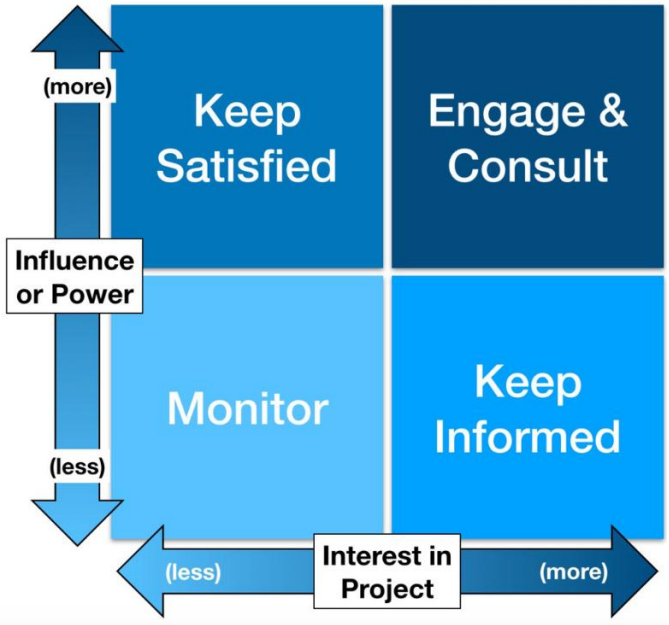

Figure 1. Stakeholder Power-Interest Grid

The power-interest grid has entry fields for two of the most important analysis factors: level of power over the project (Influence) and the level of interest the stakeholder has in the project[1].

Both values are somewhat subjective, but nevertheless should be considered binary choices.

Then, once we have a stakeholder's power and interest determined, we can plot these two factors together on a simple 2×2 grid, with interest spanning left to right,

[1] Mark H. Warner | The Project Management Blueprint

and influence rising bottom to top. Plotting a stakeholder's influence and interest in this manner will help focus our attention and interactions with them in an appropriate manner:

- **Low Power, Low Interest**. Stakeholders with both low power and interest shouldn't be ignored, but you also should not spend inordinate amounts of time communicating with them. Often, simply periodically monitoring them is sufficient; i.e., primarily to ensure that neither their power nor interest levels have materially changed.
- **Low Power, High Interest**. Because of their relatively low influence abilities, these stakeholders can do little harm to your project, but still are interested in the progress or ultimate result of the work your team is performing. Typically, just keeping them informed and updated on the project is sufficient. For example, ensuring they have access to a public page of your website—and then updating that page regularly—is enough interactions. You can also periodically send out newsletters or press releases to these types of stakeholders. Examples of these stakeholders include community groups and others that may be affected by the outcome of your project.
- **High Power, Low Interest**. The stakeholders that reside in the upper left-hand corner of the grid are those that the partners need to strive to keep satisfied. Because they have power over project it is necessary ensure their needs are fulfilled.
- **High Power, High Interest**. The stakeholders in the upper-right corner of the grid are those that must not only keep satisfied, but also actively engage with and consult. These are the "big dog" stakeholders that can/will exert major influence over the project on a regular basis.

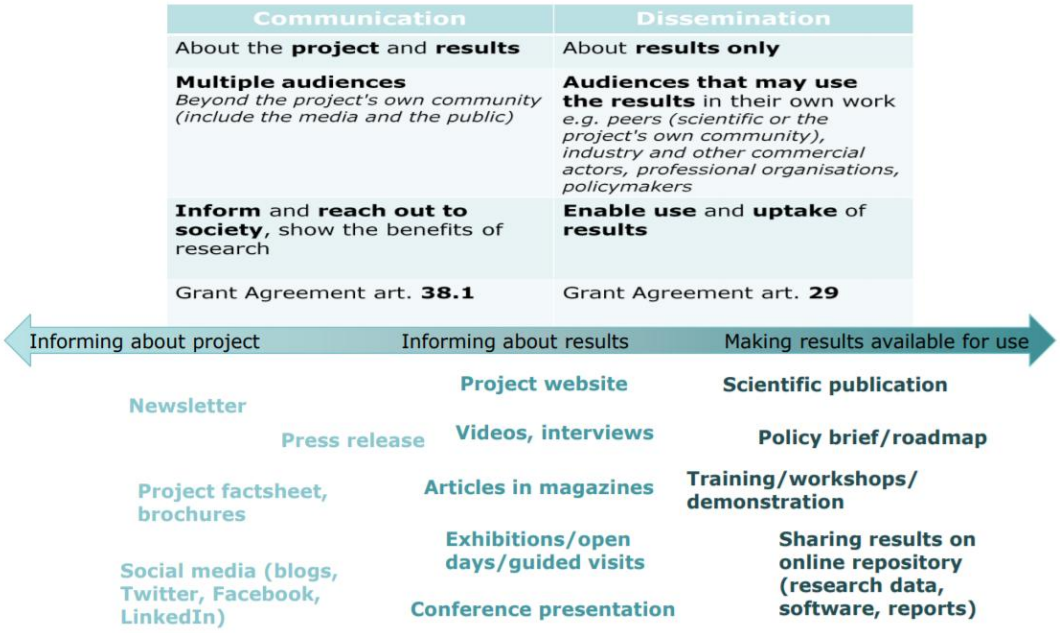

Figure 2. Communication vs Dissemination vs Exploitation Stakeholder Targets

3.2 Sectorial applications

Within the REMODEL project, developing robots able to manipulate flexible materials such as DLOs means optimize a manufacturing processes where the best attributes of robot (i.e. high speed, accuracy, strength and repeatability for less skilled tasks) and humans (i.e. physical dexterity, cognitive reasoning, creativity) are exploited at their best. This means that the robot must be embedded with the ability of detecting and managing the initial and final configuration of the object to manipulate, introducing suitable models and identification techniques of objects and materials, devoted perception systems based on vision, proximity and tactile sensors, as well as manipulation algorithms and tools able to deal with DLOs.

Looking into the switchgear market scenario, the key participants in global switchgear market focus on introducing new technologies and innovative products at competitive prices together with new application in order to distinguish themselves from that of the competitors. Major players reigning over the global switchgear market include Schneider Electric SA (France), Mitsubishi Electric Corporation (Japan), Siemens AG (Germany), ABB Ltd. (Switzerland), Powell Industries Inc. (U.S.), Eaton Corporation (Ireland) and General Electric Company (U.S.), among others. It is then clear that several key players in the switchgear market are in Europe. The region is currently focusing on upgrade and replacement of its aging infrastructure, improving grid reliability, implementing smart grids for satisfying the increasing demanding of energy in an efficient way to reduce the cost and to leverage renewable energy sources, and conversion of overhead lines into underground cables driving the demand for underground distribution equipment including pad mounted switchgears. U.K. and France are the fastest growth markets in the region with a Compound Annual Growth Rate (CAGR) of 8.2% and 8.9% respectively, during 2015-2020. Looking at the global situation, China accounts for the largest share in the world's switchgear market and this is expected to increase at a CAGR of 10.8% between 2013 and 2020, reaching a share of 19.2% by 2020. According to Markets and Markets1, the global switchgear market is expected to grow from USD 89.40 Billion in 2016 to USD 144.41 Billion by 2021, at a CAGR of 10.07% from 2016 to 2021. Increasing investments in transmission and distribution network development and growing need for efficient and reliable power are driving the global switchgear market. The market, based on end-user, is expected to be dominated by the transmission and distribution utilities segment, followed by manufacturing and process industries and commercial and residential infrastructure respectively.

The actual demand of European manufacturing companies is to remain competitive and to possibly increase their competitiveness with respect to manufacturers coming from regions with lower labor-cost, and to this end the only way is, other than delivering new value-added products into the market, to introduce innovation in the production process to increase the productivity and the product quality, without affecting or possibly improving the work quality of the people involved into the process. For European stakeholders to remain competitive in this market, the introduction of innovative technologies to reduce the production cost and increase at the same time the product quality is of paramount importance.
Moreover, looking to the actual scenario of research projects, the feeling is that this very important industrial sector has not received the required attention yet, since the involved problems are very challenging, therefore no solution to problem of DLOs manipulation and switchgear wiring has still been proposed or deeply investigated in

research projects. Increasing the flexibility of industrial robots and providing faster and more intuitive automation systems are important goals for future production systems.

3.2.1 Automotive

Robotics technology in automotive manufacturing is quite common and well-known. However, the situation seems to be different, when it comes to the assembly shop. The automation level at assembly shop, so in the place where almost every single activity has been doing manually (by hand), very often does not exceed 3-5%. Regarding to this numbers at body and paint shop this factor amounts usually almost always over 80%. That means, that there is a huge challenge to automate manual activities, especially where is not a big level of repetitiveness. It requires very complex robotic systems and algorithms. Application of robotic systems helps automotive factories to manufacture products in shorter time, to save money in long term perspectives and to be more competitive at the global market. What is more, there is not the ready-made robotic solution, which may use to automate the processes of wiring harness arrangement.

REMODEL Partners involved in the sector are: VWP, PUT

3.2.2 Aerospace

The application of robotics technology in aerospace manufacturing is relatively new and the rate of technology adoption has remained slow compared with other manufacturing sectors. However, increasing global demand for aerospace products of high and consistent quality at higher production rates and a widening skill gap within the workforce have encouraged the deployment of flexible automation solutions and collaborative systems. The introduction of industrial collaborative robots combined with updated robot safety standards in recent years have broadened the potential of robotic applications in complex environments and make their deployment possible in conjunction with manual processes.

REMODEL Partners involved in the sector are: ELIMCO, TECNALIA

3.2.3 Medical

Hose manipulation for medical applications consists in the execution of quality checks on a flexible tube (hose) by grasping it at the output of the extruder and manipulate it in different ways. A large set of medical activities implies the use of hoses to deliver liquids or gases or execute suction of blood and other organic fluids through vacuum pumps. These hoses are usually made of silicone or other plastic polymers, and they are characterized by large deformability and limited stiffness. Due to obvious sterility requirements, these medical devices are almost always single-use. For this reason, they are produced in very large numbers by specialized companies and several quality checks must be executed inside a clean room. Very limited cases apart, the inspection processes are performed manually or in an assisted way by means of devoted tools. The main obstacles toward the automation of this process are represented by the limited cost per item, the variety of length, size and thickness together with the compliance of the material that makes difficult to hold the hoses during the inspection, to cut them properly and to insert the go, not-go gauges. These obstacles make automatic machines devoted to this this task economically difficult to

sustain for SMEs, not advantageous in terms of speed, difficult to update and to adapt to the variety of products. Due to the lack of commercial solutions for the automation of this manufacturing activity, it is interesting to exploit the REMODEL dual-arm robot equipped with proper auxiliary tools to execute the aforementioned task, in such a way to reduce the worker psychophysical stress due to this repetitive task and to speed up the production by moving the workers to more qualified activities.

REMODEL Partners involved in the sector are ENKI, UNIBO and UCLV

3.2.4 Manufactures

The specific objective for this use case is to investigate the wiring automation of the most common and repetitive connection types present in a switchgear, eventually during night shifts, in such a way to speed up the production and reduce the worker physical stress due to these repetitive and uncomfortable tasks. Despite some automatic switchgear wiring solutions are available on the market, their applicability is still very limited due to the reduced flexibility, programming time and cost, then feasible for large scale and relatively simple products only, but not economically justified for small lots or single items, especially in the SMEs' market. From the investigation carried out by IEMA, it comes out that despite the very large number of switchgear layouts, the 65% of the wiring involves the same component and connection types. Moreover, about 50% of the time is spent by the workers to read the product documentation. It follows that there is large margin to improve this situation by introducing innovative methods and technologies and bring them to the market.

REMODEL Partners involved in the sector are IEMA, UNIBO, UCLV and TUM

3.2.5 Clothing and footwear sector

The textile, clothing and footwear sector is an important part of the European manufacturing industry, playing a crucial role in the economy and social well-being in many regions of Europe.
According to data from 2013, there were 185000 companies in the industry employing 1.7 million people and generating a turnover of €166Bn. The sector accounts for a 3% share of value added and a 6% share of employment in total manufacturing in Europe. The sector in the EU is based around small businesses. Companies with less than 50 employees account for more than 90% of the workforce and produce almost 60% of the value added. The REMODEL technology, and in particular the DLOs manipulation ability, allows its applicability also in textile manufacturing, with a large potential impact on European sector growth and competitiveness.

3.2.6 Other sectors

The bimanual manipulator technology developed in REMODEL has interesting features that allow the easy adaptation to other application fields. For example, Europe has a leading position in intra-logistics and warehousing processes.

Nevertheless, it is necessary to look at the trend in these fields in the rest of the world.
In USA and China, a great rising attention is observed for the introduction of robotic technologies to automate some of the in-store processes in the retail market, and a huge market opportunity in extending the handling capabilities to deformable objects actually exists. Most of these processes involves the performance of very similar handling tasks which can be summarized in two fundamental actions: a pick task and a stow task.
Amazon, despite it is already able to quickly package and ship millions of items to customers all over the globe, launched the Amazon Picking Challenge 2017 and Robocup 2016 both for Pick and Stow tasks. The objective consists of the realization of a robotic platform able to perform a pick task to remove target items from a shelf and place them in a tote, and a stow task to take target items from a tote and place them into the shelf. The goal of these challenges is to strengthen the ties between the industrial and academic robotic communities and promote shared and open solutions to some of the big problems, i.e. automatic picking/stowing items from/on shelves, in unstructured automation. Amazon affirms that the pursuit of solutions to these challenges will open new markets for the exploitation of robotic technologies into the logistics retail domain. The set of items used in the Amazon Picking Challenge is constituted by 40 popular objects. It may include books, cubic boxes, clothing, soft objects, and irregularly shaped objects. The challenge concerns the number of manipulated items, their mechanical properties, their recognition in the scene and the limited workspace. For all these challenges, REMODEL results can provide high impacts: e.g., the develop of a gripper with integrated force/tactile sensors allows the estimation of object mechanical properties (e.g., friction, deformability) useful for the safe manipulation of different objects; the combination of data coming from different sensors (e.g., cameras, tactile and proximity sensors) allow the safe motion also in limited workspace, where objects are very close, and the compensation of uncertainties in the scene; the scene recognition algorithms can be used for the correct recognition of objects to be picked or stowed.
Practically, with a few modifications, the REMODEL bimanual manipulation system could participate in Amazon Picking Challenge with good results, and as a consequence lead high impacts also in the intra-logistics and warehousing fields.

Agriculture, and more in general food production, represents the oldest and one of the most important economic activities. The global population is currently at approximately 7 billion people and farms around the world produce about 360 million tons of food annually. With global population expected to expand to 9.8 billion by 2050, agricultural productivity should increase by more than 30% to be able to adequately sustain the new population.7 DLOs manufacturing in the food production sector, particularly in the packaging phase, will contribute through an increase in productivity, to match the increase in the global population. The short supply of agricultural labor and rising labor costs for skilled, semi-skilled and unskilled agricultural jobs is also creating substantial opportunities for agricultural robots. Again

using the average hourly labor costs pegged at €24.6 in the EU,8 and a total of 9.8 million people employed in agriculture in Europe,9 we can estimate that the EU uses approximately €241 million annually in labor cost associated with the agricultural sector. The REMODEL ability of deformable object manipulation can be exploited to develop robotic platforms for the preparation, processing and packaging of foods of any kind.

3.3 Use cases

3.3.1 UC1 - Switchgear wiring

Reference market: Looking into the switchgear market scenario, the key participants in global switchgear market focus on introducing new technologies and innovative products at competitive prices together with new application in order to distinguish themselves from that of the competitors. Major players reigning over the global switchgear market include Schneider Electric SA (France), Mitsubishi Electric Corporation (Japan), Siemens AG (Germany), ABB Ltd. (Switzerland), Powell Industries Inc. (U.S.), Eaton Corporation (Ireland) and General Electric Company (U.S.), among others. It is then clear that several key players in the switchgear market are in Europe. The region is currently focusing on upgrade and replacement of its aging infrastructure, improving grid reliability, implementing smart grids for satisfying the increasing demanding of energy in an efficient way to reduce the cost and to leverage renewable energy sources, and conversion of overhead lines into underground cables driving the demand for underground distribution equipment including pad mounted switchgears. U.K. and France are the fastest growth markets in the region with a Compound Annual Growth Rate (CAGR) of 8.2% and 8.9% respectively, during 2015-2020. Looking at the global situation, China accounts for the largest share in the world's switchgear market and this is expected to increase at a CAGR of 10.8% between 2013 and 2020, reaching a share of 19.2% by 2020. According to Markets and Markets , the global switchgear market is expected to grow from USD 89.40 Billion in 2016 to USD 144.41 Billion by 2021, at a CAGR of 10.07% from 2016 to 2021. Increasing investments in transmission and distribution network development and growing need for efficient and reliable power are driving the global switchgear market. The market, on the basis of end-user, is expected to be dominated by the transmission and distribution utilities segment, followed by manufacturing and process industries and commercial and residential infrastructure respectively.

The actual demand of European manufacturing companies is to remain competitive and to possibly increase their competitiveness with respect to manufacturers coming from regions with lower labor-cost (Imp1), and to this end the only way is, other than delivering new value-added products into the market, to introduce innovation in the production process to increase the productivity and the product quality, without affecting or possibly improving the work quality of the people involved into the process (Imp2). It is then clear that, for European stakeholders to remain competitive

in this market, the introduction of innovative technologies to reduce the production cost and increase at the same time the product quality is of paramount importance. Moreover, looking to the actual scenario of research projects, the feeling is that this very important industrial sector has not received the required attention yet, since the involved problems are very challenging, therefore no solution to problem of DLOs manipulation and switchgear wiring has still been proposed or deeply investigated in research projects. Increasing the flexibility of industrial robots and providing faster and more intuitive automation systems are important goals for future production systems.

Positioning: IEMA is present in the industrial automation area since 1979, producing electrical and electronic systems for automatic machines, from the design to the production plant. The current switchgear wiring process is completely manual. The REMODEL objective for this use case is to show the robotized placement of already prepared cables on the switchgear. These manufacturing activities can be carried out by bimanual manipulators, due to the need of moving and holding in place the cables while the other arm, equipped with proper tools perform the connection on the components. Dedicated tools must be developed to grasp, manipulate and route the cables during the manufacturing. This will allow to speed up the production and reduce the worker psychophysical stress due to these repetitive tasks.

Financial data and metrics: The IEMA production is analyzed considering the 2018 data and the estimated production achievable with the REMODEL technology. Table reports the consequence of a reduction of the wiring time of 30% due the introduction of the REMODEL technology, with respect to the overall wiring time. In Table , it is supposed that the overall person hours are constant, and then that the time saved for the wiring can be reused for producing additional switchgears. Table shows that a reduction of the wiring time of about 30% generates an additional sales volume of 5M€, with an increase with respect to the “conventional” manufacturing of about 43%. Taking into account the cost of 10 robotic systems to satisfy the production requests, The net income increases by about 35%.

Table 1: Estimated IEMA sales increment due to the introduction of the REMODEL technology.

KPIs	Unit	IEMA 2018 production	Estimated with REMODEL	Gain
Annual production	Items/year	650	930	280
Mean cost per unit	Euro/item	€ 18,000	€ 18,000	€ 0
Mean production time	Person hours	200	160	-40
Mean time for wiring	Person hours	130	90	-40
Wiring time reduction	%	--	30.76%	30.76%
Overall wiring time	Person hours	84500	84500	0
Wiring time over total production time	%	65.00%	52.94%	-12.06%
Mean salary of wiring operators	Euro/hour	€ 25	€ 27	€ 2
Mean cost of wiring	Euro/item	€ 3,250	€ 2,430	-€ 820
Mean wiring cost per unit	%	18.00%	13.50%	-4.50%
Mean time to market	Days	36	26	-10
Time to market reduction	%	--	27.77%	27.77%

Index of delivery delay / non-compliance at the final test	Estimated time /Actual time	7.00%	2.00%	-5.00%
Traceability of wiring and tests	--	Absent	Full traceability	Full traceability
Robots for the production	Items	--	10	10
Cost of the robotized system	Euro / Items	--	€ 100,000	€ 1,000,000
Sales volume	Euro/year	€ 11,700,000	**€ 16,740,000**	**€ 5,040,000**
Sales increase	%	--	**43.08%**	**43.08%**
Net income	Euro/year	€ 11,700,000	**€ 15,740,000**	**€ 4,040,000**
Net income increase	%	--	**34.53%**	**34.53%**

Obviously, the REMODEL technology will provide additional benefits in terms of traceability and quality of the products and, most important for the point of view of improving the market position, will allow a time to market reduction of 10 days, with a gain slightly higher than 27%. By considering the IEMA business volume with respect to the European switchgear market, the competitiveness gained thanks to the REMODEL technology and the expect growth of the sector, we anticipate that the commercialization of our technology will result in a high uptake by industry, generating thousands of new jobs in switchgear manufacturing by the year 2025.

3.3.2 UC2 - Wiring harnesses manufacturing

Reference market: is a very time-consuming work that is mostly performed manually on pin boards. Existing manual or semi-automated manufacturing techniques for wiring harnesses are characterized by highly labor-intensive operations and thus are very sensitive in terms of quality assurance. All these circumstances significantly impact the productivity and economic factors. Solving the problems by outsourcing the manufacturing to countries with cheap labor is no longer acceptable. To avoid this, the producers are looking for a fully automated production of wire harnesses to replace the manual one.

3.3.2.1 UC2 - Wiring harnesses manufacturing for aerospace industry

Positioning: ELIMCO is an SME specialized in the field of aerospace wiring harness manufacturing, The current process is completely manual, and divided into two main steps. The REMODEL objective for this use case is to show the robotized placement of already prepared cables on the pin boards. These manufacturing activities can be carried out by bimanual manipulators, due to the need of holding in place some part of the cables during the manipulation of the remaining part to preserve the desired shape and arrangement. Dedicated tools must be developed to grasp and manipulate cables during the manufacturing. This will allow to speed up the production and reduce the worker psychophysical stress due to these repetitive tasks.

Financial data and metrics: From the specific analysis on the 2018 production carried out by ELIMCO and reported in below table, a reduction of the actual production time by about 31% it is expected thanks to the possibility of exploiting robots to manufacture pre-assembled products. This result can be achieved considering the robot can work also during nighttime. ELIMCO expected in this way a reduction of the time to market by 2 days can be achieved. Considering the cost of 2 robotic platforms needed to cover the ELIMCO production, the net income is expected to increase by about 24%.

Table 2: Estimated ELIMCO sales increment due to the introduction of the REMODEL technology

KPIs	Unit	ELIMCO 2018 production	Estimated with REMODEL	Gain
Annual production	Items/year	1001	1301	300
Mean cost per unit	Euro/item	€ 3,107	€ 3,107	€ 0
Mean production time	Person hours	35	29,2	-20
Mean time for wiring	Person hours	28	23,3	-20
Wiring time reduction	%	--	31%	31%
Overall wiring time	Person hours	52075	52075	0
Wiring time over the production time	%	80.00%	68.00%	-12.00%
Mean salary of wiring operators	Euro/hour	€ 25	€ 27	€ 2
Mean cost of wiring	Euro/item	€ 2,555	€ 1,965	-€ 590
Mean wiring cost per unit	%	20.00%	14.50%	-5.50%
Mean time to market	Days	15	13	-2
Time to market reduction	%	--	15%	15.00%
Index of delivery delay / non-compliance at the final test	Estimated time /Actual time	7.00%	2.00%	-5.00%
Robots for the production	Items	--	2	2
Cost of the robotized system	Euro / Items	--	€ 100,000	€ 200,000
Sales volume	Euro/year	€ 3,110,000	**€ 4,042,000**	**€ 932,000**
Sales increase	%	--	**30.00%**	**30.00%**
Net income	Euro/year	€ 3,110,000	**€ 3,842,000**	**€ 732,000**
Net income increase	%	--	**23.54%**	**23.54%**

3.3.2.2 UC2 - Wiring harnesses manufacturing for automotive industry

Positioning: The Company ELVEZ d.o.o., is the Manufacturer of specialized products for automotive industry, electrical and mechanical engineering, and white goods manufacturers. The expected impact of REMODEL in this use case is to enable the assembling and grouping of cable harness subassemblies to create the final product by utilizing the specialized jigs for manufacturing a particular model (each model of cable harness may have 2 million pieces required to be produced). The idea is to utilize the same set of jigs interchangeably for both human and robotized assembly. Dual arm robots are required for performing bimanual manipulation of the DLOs to guide them through the jigs. Additional development of specialized tools to perform the taping and guiding the DLOs are to be developed in the project. The implementation of REMODEL would ensure an increase production rates, and worker productivity by reducing psychophysical stresses on them due to repetitive actions.

Metrics: From understanding the previous time studies, production data and the OECD framework test conducted by ELVEZ for producing a particular model of wire harness assembly is provided in the table below. The production cycle time is expected to improve by about 4 s, as the robotic system would have better operational repeatability and monitoring capabilities (availability of tape, harness, etc) as compared to a human operator. The presence of smart sensory feedback systems can reduce the number of defective assemblies and reconfiguring between the various cable harnesses to be produced just involves a quick change in the user interface of the developed software for REMODEL. The OECD job quality index currently shows shortcomings with respect to ergonomics, which can be overcome by REMODEL as human operators get supervisory roles.

Table 3 Current Production trends in ELVEZ and the anticipated improvements made by REMODEL

KPIs	Current status	Benefits generated by REMODEL
Production cycle time	44 s	40 s
Product defects	2006 ppm	1000 ppm
Reconfiguration time	1 h	10 m
OECD job quality index	Right arm overloaded, static posture	No arm overload, dynamic employment

3.3.3 UC3 – Wiring harness assembly

Reference market: the process of mounting wiring harness inside the car cockpit is labor intensive and requires workers to hold and move groups of cables with are have and exerting the forces on operators hand when being manipulated. The process is described in terms of the outcomes but it is not described as the sequence of movements.

Positioning: VWP is a part of the VW group and is producing commercial cars. The main emphasis in the project is on assembly shop in particular on wiring harness manipulation for the cockpit assembly. Currently this process is performed totally by humans only using passive mass compensation when moving the wiring harness from the boxes on to the cockpit plate. After placing the harness on a plate the branches are put into the predefined holes and mountings.

Financial data and metrics: The specific objective for this use case is to demonstrate the ability of the REMODEL platform of arranging the branches of the wiring harness properly after it is dropped on the metal plate and before the installation of the cockpit rigid parts. The target performance is to save 10 seconds of the time usually spent by the workers in the execution of these tasks.

The production of the cars at VWP (Antoninek) is on average 180 000 cars per year. Therefore 10 seconds saving per car means 500 hours per year of time saving on this particular assembly task.

3.3.4 UC4 – Hose packing

Reference market: The Quality Check is one of the crucial steps to take into account during the design and production of biomedical devices. In some cases, under International Standards or for Client's requests, in order to assure an elevate production level, the quality check on extruded microtubes for medical applications may be up to the 100% of the products. This guarantees a quasi-total perfection in the produced devices, but this process requests a huge amount of human effort, since the quality check per se is very time consuming.
In ENKI's Extrusion lines several different quality checks are performed both directly in-line and off-line, in particular a laser check for outer diameter sizes, ultrasound check for inner diameter thickness and eccentricity, pass through probe, visible and tactile inspection.

Positioning: ENKI srl is an SME born in 2002 as an OEM engineering, designing and prototyping company specialized in medical devices ranging from class 1 to class 3 thanks to its skills in microtubes extrusion carried out in clean room. Over the years it

has developed and enlarged enhancing the capability and flexibility in extrusion and adding the skills in micro-components moulding, the braided tubes manufacturing and the forming of balloons for dipping e blow moulding. Afterwards came the OEM manufacturing of finished devices and semi-finished products in clean room ENKI is certified according to ISO 9001:2015 and ISO 13485:2016 standard by TÜV Rheinland. The production environments are class 10.000 ISO 7 and ISO 8 clean rooms. For ENKI's standards we guarantee to our Customers a minimum of checks at Microscopic Dimensions Control of the 5%. The average production rate in ENKI is around 2.5s per tube (considering a standard length and averaged extrusion parameters), this means in one hour of work the Extruder produces 1440 tubes. With a 5% (minimum) quality check the operators have 72 tubes to control. For one operator, the quality check operation at the Microscopic Dimension Control performed on a bi-lumen tube (one of the fastest since there are only 12 measurements to do) it takes around 5min to perform the entire operation. This means that, more or less, it takes an entire working day of one operator to perform the quality check of just an hour of extruded tubes. The current quality check is completely manual. The REMODEL objective for this use case is to show the robotized preparation of samples for quality checks. These manufacturing activities can be carried out by a robotic manipulator. Dedicated tools must be developed to grasp, manipulate and cut the tubes for the preparation of the samples for quality check. This will allow to speed up the production and reduce the worker psychophysical stress due to these repetitive tasks.

Financial data and metrics: The consortium objective is to obtain a robotic system capable to perform at least the automatic samples preparation for the quality checks on analysis of a bilumen tube, that cover more or less the 60% of ENKI's production. However, the flexible platform our development is targeting will give the possibility to extend, in the next years, the REMODEL capabilities to the entire ENKI's production. The following table analyses the benefits introduced by the robotic technology.

Table 4 Current Production trends in ENKI and the anticipated improvements made by REMODEL

	Actual Status	With REMODEL	3-years perspective
Annual Microtubes Production	1900800	1900800	1900800
Annual bi-lumen Production	1140480	1140480	1140480
Minimum QC Required	95040	95040	95040
Annual Operators Hours for QC	7920	3168	0
Annual Man Hours for bi-lumen QC	4752	0	0
Annual Man Hours for other tubes QC	3168	3168	0
Annual Robot Hours for QC	0	475.2	792
Annual Robot Hours for bi-lumen QC	0	475.2	475.2
Annual Robot Hours for other tubes QC	0	0	316.8
Person for in-line QC	6	2+1*	1*
Time required for each QC	5 min	30 s	30 s

3.4 Competitors

3.4.1 Top Robotics companies worldwide

According to a recently released report[2], the main industrial robotics companies are the following:

Mitsubishi Electric

Since 1980, this company has introduced a wide range of robotic systems armed with productivity that helps in high speed and precision performance in manufacturing. Mitsubishi extended its range of compact SCARA and articulated arm robotics with the addition of Codian Robotics' exclusive delta style robots.
HQ: Tokyo, Japan | Founded: 1921 | Revenues/2017: USD$ 11.9 billion
Key Products: MELFA FR Series, RV-F-D series, RP series, Ceiling Type RH-FRHR series, SCADA MC Works64

ABB (ASEA Brown Boveri)

From the time it pioneered the world's first all-electric microprocessor-controlled robot and the world's first industrial paint robot in the late 1960s and early 1970s, ABB remains a technology and market leader in robotics with over 300,000 robots sold to customers all over the world. Today, ABB is still one of the world's largest industrial robotics companies.
HQ: Zurich, Switzerland| Founded: 1883 | Revenues/2017: USD$ 6.9 billion
Key products: IRB 910SC SCARA, IRB 14000 YuMi, IRB 5500-22 – FlexPainter, IRB 5500-25 – Elevated rail, IRB 6660 for pre-machining, IRB 6660 for press tending.

B+M Surface Systems GmbH

B+M, as a world's leading robot manufacturer, provides fully automated painting application systems and painting plants for surfaces with high-quality standards. From feasibility studies to design, installation and service, BM's industrial robots help customers at every stage with a customized approach.
HQ: Eiterfeld, Germany | Founded: 1992 | Revenues/2017: USD$ 4.4 billion
Key Products: T1 X5 series painting robots, T2 X5 series, Adhesive Dosing Systems.

Omron Adept Technologies

This is the largest US-based industrial robotics company. The company's intelligent automation products include mobile robots, industrial robots and other automation equipment, applications software, machine vision, and systems. In 2015, the Omron Corporation acquired Adept Technology Inc. to create this entity.
HQ: Kyoto, Japan | Founded: 1948 | Revenues/2017: USD$ 3.05 billion
Key Products: Cobra, eCobra, Hornet, Quattro, Sysmac Delta, Viper.

FANUC Robotics

Covering a diverse range of industries and applications, FANUC Robotics offers more than 100 models of industrial robots that are easy to operate and provide great flexibility. FANUC has never taken its market dominance for granted and has been dynamically working on smarter & flexible solutions, particularly those that incorporate AI
HQ: Oshino, Japan | Founded: 1958 | Revenues/2017: USD$ 1.7 billion

[2] www.technavio.com

Key products: Fanuc CR Series of Collaborative Robots, Fanuc Robot R2000iC Series, M-20iB/25 Series of Articulated Robots, M-1/2/3 Series of Delta-Robots, SCARA Series.

Yaskawa

This is another Japanese brand that has led the industrial robotics industry since the first launch of its all-electric industrial robot Motoman in 1977. With more than 300,000 Motoman robots, 18 million inverter drives and 10 million servos and 18 million installed globally, Yaskawa have successfully commercialized optimum robots for various uses including arc welding, assembly, dispensing, material handling, material removal, material cutting, packaging industry, and spot welding.
HQ: Kitakyushu, Japan | Founded: 1915 | Revenues/2017: USD$ 1.5 billion
Key Products: VA1400 for arc welding, HP20F for assembly, ES Series for Machine Tending, G Series for pick and pack, MH225 for spot welding.

Kuka

German industrial giant Kuka is one of the world's largest producers of robotics that is used to manufacture automobiles, characterised by its signature bright-orange crane-like bots. KUKA Robotics offers a fully integrated range of automated robotics, control technology, and customized software solutions. Since 2004, automation and robotics have been the company's primary focus, and non-core areas have been closed or sold. In 2016, Kuka, a company whose robots already grace several factory floors was acquired by Midea Group, the Chinese household company for USD$3.9 billion.
HQ: Augsburg, Germany | Founded: 1898 | Revenues/2017: USD$ 1.4 billion
Key Products: KR AGILUS series: KR 30/60 F series: KR QUANTEC F series, QUANTEC for palletizing, AGILUS (Hygiene Machine variant), shelf-mounted robots, press-to-press robots.

Epson robots

This pioneering company first entered the North and South American Market in 1984 as the EPSON Factory Automation Group. Originally founded to support automation needs, EPSON quickly became prominent in many of the largest manufacturing sites throughout the world. Over the past three decades, EPSON Robots has been leading the automation industry for small parts assembly products and has introduced several industry firsts including compact SCARA robots, PC based controls, and much more.
HQ: California, USA | Founded: 1984| Revenues/2017: USD$ 1.4 billion
Key Products: G-Series, RS-Series, LS-Series and T-Series SCARA Robots.

Kawasaki

With over 160,000 robotics installed worldwide, the Japan-based Kawasaki is a leading provider of industrial robots and automation systems with a broad product portfolio. Kawasaki robotics was the first in Japan to commercialize the industrial robots. Since then, they have developed several robots as a domestic pioneer and have contributed to growth in many industry verticals through automation and labor-saving systems. In 2015, the company began sales of duAro, an advanced, dual-arm SCARA robot that can work alongside humans.
HQ: Wixom, Michigan, USA | Founded: 1896 | Revenues/2017: USD$ 1.3 billion
Key Products: duAro Scara Robot, K Series Robots for Painting, Y Series for Pick and Place, B Series for Spot Welding, RA020N for arc welding, M Series for medical and pharmaceuticals.

Staubli

This is a global mechatronics solution provider, rooted in a proud heritage of engineering, with three core activities: Connectors, Robotics and Textile. Since 1892 when it was founded, the Staubli Group has expanded both geographically and technologically. With the acquisition of Unimation – a prominent vendor in industrial robotics industry– Staubli continued its dynamic path into the most advanced and innovative industrial sectors. The company has launched a new range of collaborative robots and is investing further into its software business.

HQ: Horgen, Switzerland | Founded: 1892 | Revenues/2017: USD$ 1.26 billion

Key Products: TS80, TX Series, RX Series, TX2 Series, TP90, CS Series.

Durr

Based in southern Germany, Durr is a leading mechanical and plant engineering firm with outstanding automation expertise joined forces with Kuka, another giant in automation technology sector to develop an integrated solution for automated paint application. In 2017, the company's painting robot business achieved new records in incoming orders, and sales, despite intense competition. The growing demand for the Dürr robot can be attributed to the growing ongoing automation of vehicle paint technology.

HQ: Bietigheim-Bissingen, Germany | Founded: 1895 | Revenues/2017: USD$ 724 million

Key Products: EcoRCMP control for painting applications, EcoRS 30 L 16S, EcoRS 16, EcoGun 1D.

Denso Corporation

This trendsetter started developing industrial robots in 1967 and in the early 1980s. The company developed 4-axis and 6-axis industrial robots that have unlimited freedom of movement. Today, DENSO subsidiary DENSO WAVE develops high-productivity robots, designed to maximize the efficiency of operations in the manufacturing of engineered products including automobiles and medical instruments. Denso Wave has been growing over many years, the company has brought to execution a compact body that allows the robot's operation amid the equipment used to perform manufacturing operations.

HQ: Kariya, Japan | Founded: 1949 | Revenues/2017: USD$ 564 million

Key Products: VM, VP and VS Series 5-and 6-Axis Robots, VS-050S2 Medical Robots, HS Series SCARA Robots.

Nachi-Fujikoshi

This is a Michigan-based company that spans a broad range of manufacturing fields including machining products such as tools, and ultra-precision machines as well as robotic systems for reducing power consumption and automating production lines. Owned by the Nachi Fujikoshi Corp, Nachi Robotic Systems boasts an impressive product lineup of industrial robots, integrated vision systems, and cutting-edge technology. The company recently introduced MZ12 robot to the market that is capable of transporting 12 kgs, which has the major demand in electronics and EMS sector.

HQ: Novi, Michigan, USA | Founded: 1928 | Revenues/2017: USD$ 325 million

Key Products: Compact MZ Series, WING SLICER Type EZ series, SR Series for Spot Welding, FlexGui.

Comau Robotics

Partner of SHERLOCK and part of the world's largest automotive groups and one of the prominent suppliers of industrial robots and robotized processes, Comau Robotics is a market leader. The company has launched a wide range of innovative products, perhaps most importantly the largest collaborative robots on the market. Their industrial robots are designed and developed to be integrated into applications where accuracy, speed, repeatability, and flexibility are of most importance.

HQ: Grugliasco, Italy | Founded: 1973 | Revenues/2017: USD$ 287 million

Key Products: REBEL-S SCARA, RACER ROBOT, STANDARD ROBOTS NS Series, HOLLOW WRIST ARC.

Universal Robots

This company is renowned for developing safe, flexible and easy-to-use robotic arms that serve a range of industries, including food and tobacco production, metal and machining, automotive and subcontractors, pharma and chemistry, furniture and equipment and scientific and research industries. This Danish company develops lightweight industrial robots that streamline and most importantly automate repetitive industrial processes. These robots are most commonly used for injection, molding, pick-and-place, CNC, quality inspection, packaging and palletizing, assembly, machine tending, and gluing and welding applications.

HQ: Odense, Denmark | Founded: 2005 | Revenues/2017: USD$ 170 million

Key Products: Collaborative Arm UR3, Collaborative UR5, and Collaborative UR10 robot arms.

Wittmann Battenfeld Group

This conglomerate is a global leader in the manufacturing of robots, injection molding machines, and peripheral equipment for the plastics sector. Austria-based auxiliary equipment maker maxed out its recently extended robotic manufacturing competences in 2017, shipping more than 5,000 robots last year. To capitalize on the growing interest in robotics and automation systems, Wittmann released several innovative products in 2017, including the Primus 16 and Primus 14 robots for standard pick-and-place applications.

HQ: Vienna, Austria | Founded: 1983 | Revenues/2017: USD$ 145 million

Key Products: Primus 14 and 16 for pick and place, W853 pro-robot, R9 robot control system, W808 Servo Robot, W818 Optimal Robot.

Yamaha

In the year 1981, Yamaha Motors acknowledged the challenge to develop a completely new breed of industrial robots. Since then, this Japanese giant has provided a range of cutting-edge industrial robots to the marketplace that is unsurpassed for speed, payload, and dependability. The current industrial robot line-up is the culmination of more than three decades of experience in YAMAHA's own manufacturing plants and thousands of others around the world. Yamaha Robotics has the capability to provide Cartesian systems in several configurations, as well as exclusive 2-axis YP high-speed pick and place models.

HQ: Iwata, Japan | Founded: 1887 | Revenues/2017: USD$ 88.6 million

Key Products: Liner Conveyor Modules LCM-X, Single axis robots GX series, Articulated Robots YA Series, SCARA Robots, Clean Robots.

IGM

With more than 3000 successful welding robot systems operational worldwide, IGM is the only manufacturer from Austria to specialize in industrial robots developed for arc

welding in heavy mechanical applications. IGM welding robots are used in fields such as wheel-bearing production and mechanical digger, locomotive and rolling stock construction and boiler manufacturer, bridge construction and shipbuilding along with applications in mobile cranes and forklift trucks.
HQ: Wisconsin, USA | Founded: 1983 | Revenues/2017: USD$ 59 million
Key Products: RTE 400 series, RTE 499 welding robot.

Siasun Robot and Automation
This is one of the world's leading robotics manufacturers and major suppliers of high-tech industrial* robots systems and automation owned by Chinese Academy of Services. It is one of the top 10 leading industrial robotics companies in Chinese robotic industry, thanks to its most comprehensive industrial robotic product line. Included in the brand's product offerings are automated guided vehicles, intelligent logistics equipment, laser equipment, rail transportation equipment, automated assembly and test production products, energy equipment, and special equipment.
HQ: Shanghai, China | Founded: 2000 | Revenues/2017: USD$ 38.2 million
Key Products: High Load Vacuum Robot, Siasun Collaborative Robot, SR4C Robot, SRBD1100 Parallel Robot, SR36A.

Rethink Robotics
One of the early collaborative industrial robotics companies, Rethink Robotics has been grabbing a lot of interest lately. The company helps robot makers meet the challenges of an agile economy with an integrated workforce, combining safe, trainable, and cost-effective robotics with skilled labor. Its Baxter robot, powered by Intera, an advanced software platform, provides world-class manufacturers in automotive, plastics, electronics, consumer goods and more, a workforce multiplier that optimizes labor.
HQ: Massachusetts, USA | Founded: 2008 | Revenues/2017: USD$ 20 million
Key Products: Baxter (robot), Baxter Research Robot, Intera software platform, Sawyer (cobot).

Schunk
With more than two decades of experience in mechatronics, Schunk has become one of the world's most important providers of mobile gripping systems for industrial robotics. The company's mechatronic lightweight arms, grippers, gripping hands, modular systems, and the rotary modules from SCHUNK has already set a benchmark today in several applications. Schunk is consistently expanding its module program for gripping systems with the simple aim to further simplify operation and control.
HQ: Lauffen am Neckar, Germany | Founded: 1945 | Revenues/2017: USD$ 19 million
Key Products: LWA 4D Lightweight Arm, LWA 4P, SDH 3-finger servo-electric gripping hand, EGP-FWA parallel gripper.

3.4.2 Cobots strong forecast

The global collaborative robots market size has been valued3 at USD 649.1 million in 2018 and is projected to expand at the CAGR of 44.5%, from 2019 to 2025.

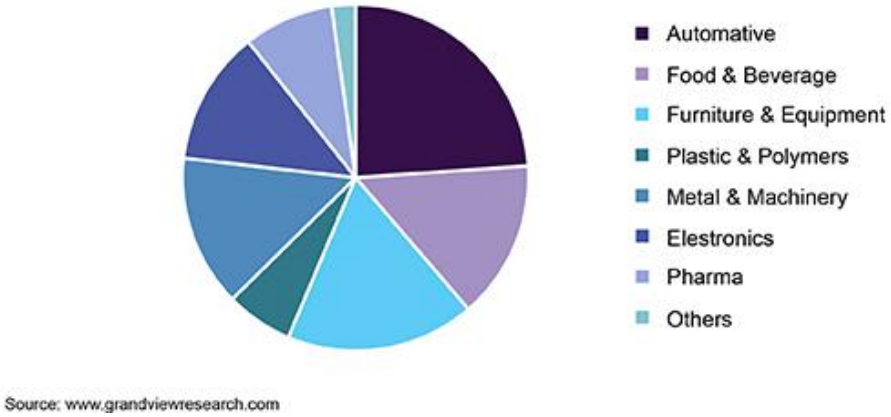

Figure 3 Global collaborative robots market share per industry (2018, %)

The growing adoption in the Small and Medium Enterprises (SMEs) and investments in automation of manufacturing processes are the key factor driving the growth. Emergence of robots working along with humans in areas like smart parts assembly and electronics product assembly further fuels the demand and the ability of cobots to work effectively with employees in an uncaged environment has led to an increased installation in the industry .Increasing demand for performing tasks requiring higher payload capacity is expected to contribute to the rising demand.

The key players offering exclusive products and supplies include ABB Group; DENSO Robotics; EPSON Robots; Energid Technologies Corporation; F&P Robotics AG; Fanuc Corporation; KUKA AG; MRK-Systeme GmbH; Precise Automation, Inc.; Rethink Robotics, Inc.; Robert Bosch GmbH; Universal Robots A/S; Yaskawa Electric Corporation; MABI AG; Techman Robot by Quanta Storage, Inc.; Franka Emika GmbH; AUBO Robotics Inc.; and Comau S.p.A.

To gain a competitive edge in the market, players have entered into partnerships for the expansion of their product portfolio. For example, in 2018, KUKA AG through its subsidiary KUKA Robotics Korea Co. Ltd. entered into a strategic partnership with the Hyundai Robotics-a robotics division of Hyundai Heavy Industries Holdings. The partnership has assisted the latter in extending its product portfolio in Korean geographies.

[3] https://www.grandviewresearch.com/industry-analysis/collaborative-robots-market

3.4.3 REMODEL KERs evaluation and market positioning

No	Exploitation Results	Value proposition	Main competitors
1	**CAD Platform for flexible robotics programming**	Add to TECNALIA's skill-based system the different skill instances to use the 2D design that together with 3D-based skills can generate program robots. Mainly targeting end users and integrators. Potential customers: AIRBUS, CAF, IKUSI. Using this platform, it will be possible program the robot will be more intuitive, it is not necessary to be an expert, and the program will be created faster.	Don't exist for this kind of Industry, may be some integrators or software developers would be the main competitors
2	**Dual arm manipulation of deformable linear objects in Aeronautical Industry**	Development of libraries and high-level skills for Kuka LBR iiwa robots for manipulation of DLOs. These skills and functionalities will be added to TECNALIA's easy programming framework. Mainly targeting end users and integrators. Potential customers: AIRBUS, CAF, IKUSI. This KER will allow programming of complex manipulation tasks with DLO and use of high-level robot functionalities from intuitive interface.	No manipulation packages available nowadays
3	**Generation of robot planning from product CAD files for switchgear wiring**	The product design can be directly used to drive the robot along the switchgear wiring, without the need of programming each operation. This allows the robotic platform to be used by experts on the switchgear design and not on robotics. IEMA is interested in implementing this solution inside the production process to complete the LOF (Line Of Future) infrastructure; in a second time is interested in commercializing this kind of solutions to third parties.	Don't exist for this kind of Industry, may be some integrators or software developers would be the main competitors
4	**Manipulation tools for deformable linear objects**	Robotic manipulation tools are usually designed for general tasks or specific operations. No general solutions are available on the market for the manipulation of deformable linear objects. Therefore, there exist significant possibilities for the creation and commercialization of tools suited for this kind of tasks.	Don't exist for this kind of Industry. Manufactures of robotic grippers and tools would be the main competitors.

5	**Dual arm robotic platform for switchgear wiring**	Robotic bimanual platforms for switchgear wiring do not exists in the market. Therefore, there exist significant possibilities for the creation and commercialization of tools suited for this kind of tasks.	Don't exist for this kind of Industry. Robot manufacturers would be the main competitors.
6	**Manipulator for Quality Checks in Extrusion Processes in biomedical industry**	The Quality Check is one of the crucial steps to take into account during the design and production of biomedical devices. In some cases, under International Standards or for Client's requests, in order to assure an elevate production level, the quality check on extruded microtubes for medical applications may be up to the 100% of the products.	No commercial solution exists to automatize that quality check. Robotic system integrators would be the main competitors.
7	**Dual arm robotic platform for Automotive Industry**	The utilization of dual arm Yaskawa robot (15 DoF), capable of handling the payload of the Automatic tool exchangers, the taping gun and DLO manipulating fingers, is the proposed manipulator. Teaching by demonstration is the preferred mode for providing generic macro motions, by using sensory glove and leap device. Redesigned spot taping gun to provide taping for grouping the individual cable harness.	No complete competitors for this cumulative platform. However, the individual elements (for example, automated taping machine) has very expensive alternatives.
8	**CAD Platform Interface to provide the system planner, the layout and product inputs**	Development of a software package that is based on the geometry of the mounting platform (e.g. a switchgear, an assembly platform or a car cockpit) and on the product data (geometry of the cables/connectors, final layout…) is able to dynamically generate a plan with an intelligent system planner. This planner will determine the sequence of actions to execute, from a predefined list of skills, based on the information extracted by this CAD Platform software. Potential customers are any company dedicated to mounting or assembling activities, with a non-fixed sequence of operations (depending on the layout and the involved components), in any kind of industry.	There isn't a generic package that for any use case, according to the inputs of the process, is able to extract useful information for the planner, to dynamically select the sequence of operations.
9	**Integrated dual arm manipulation system for interconnection systems**	The integration of Kuka LBR iiwa robots for manipulation of DLOs with the acquired programming skills of TECNALIA within relevant environments such as a DLO manufacturing facility will	There are some academic papers which involve the design of new robots and systems. No

	automatic manufacturing process.	prove the feasibility of this application towards a full automatization of the process. This know-how will be added to ELIMCO's capabilities increasing the implementation of innovative techniques in the aerospace industry. This KER will reduce the number of highly sensitive manual operations needed in the manufacturing of DLOs, improving the working conditions of the plant workers.	actual application of commercial products and their integration and demonstration in real manufacturing environments.
10	**Automated robot / sensor calibration toolkit**	An automatic system to perform the calibration of relative transformation between sensor Reference Frame and robot Reference Frame. With the automated procedure the configuration of the robotic system can be changed quickly and recalibrated on the spot. The calibration doesn't require any additional hardware such as calibration target but uses the features of the perceived environment. The system will support various types of range and depth sensors.	Similar approaches were investigated in different research activities but to our best knowledge none of them provides full 6DoF calibration between the robot and sensor base. Also, the industrial solutions do not offer vendor-independent calibration routines.
11	**Bimanual manipulation system for wiring harness manipulation.**	The availability of different perception data and DLO models allows the development of innovative manipulation strategies which will consider cable physical properties (shape, elasticity, dimensions). New control approaches will be developed by using innovative available systems. These novel solutions can be the basis for future commercial modules.	Do not exist solutions for the bimanual manipulation of wiring harness. Only some scientific papers present solution with single cables and simple configurations
12	**Interactive perception module exploiting vision and touch**	The integration of tactile sensors into commercial grippers and/or into suitably designed end-effectors allows to exploit innovative contact data (tactile image) for environment interaction. The developed tactile sensors can be customized in terms of sensitive area size and shape. Together with tactile sensors the integration of proximity sensors in the same end-effector can be used to improve the available data during the interaction. At the end of the project the integration of tactile, proximity and vision in a single smart end-effector allows to obtain an advanced and modular perception system.	There is no commercial solution with tactile, proximity and vision systems integrated. In some papers, a partial integration is presented.

4 Communication strategy

Based on the goals of REMODEL consortium has identified the following stakeholders as being the main target groups for dissemination and communication:

International Platforms and Initiatives

- European Factories of the Future Research Association – EFFRA: Develop innovative technologies for DLOs manipulation in line with the EFFRA priorities. The formal participation of UNIBO to EFFRA can facilitate the dissemination of results among members, also through specific workshops/events.
- EU Robotics AISBL: UNIBO, UCLV, TECNALIA, TAU, PUT and TUM are members of EU Robotics and can disseminate project results among partners and link with other projects/initiatives promoted by this association.

Industry

- CAPIEL: Demonstration of the project results on UC1
- Automotive sector: Demonstration of the project results on UC2 and UC3
- Aerospace sector: Demonstration of the project results on UC2
- Medical consumables: Demonstration of the project results on UC4
- Appliance manufacturers: Demonstration of the project results on UC2, provide support for the development of specific solutions
- Clothing and footwear sector: Provide support for the development of specific solutions based on REMODEL technologies

Research Institutes and Universities

- Research Institutes and Universities, EUCA, IFAC, SIDRA, IEEE R&A: Disseminate innovation contents of REMODEL, promote the research in the field of bimanual and DLOs manipulation. Promote the research on material modeling and robotic perception.

Workers

- Employment & Training Societies, Health Workers Association Unions: Mitigate barriers to the introduction of new technologies, improve collaborative robotics, Improve OECD job quality index, provide specific training for REMODEL

The dissemination and communication plan have been prepared in D8.3, in order to show and communicate the developed result to these stakeholders. We intend to use:

- Exhibition stands and demos
- Public project presentation
- Publications in relevant scientific journals

- Participation in non-project workshops, forums and/or events
- Production of newsletters, leaflets, posters, etc.
- Special sessions organization
- Publications on social media
- Opening of PhD positions
- Organization of a conference
- Organization of a workshop
- Press release
- Non-scientific and non-peer-reviewed publication (popularized publication)
- Exhibition
- Training
- Website
- Communication Campaign (e.g. Radio, TV)
- Participation to a conference
- Participation to a workshop
- Participation to an event other than a conference or workshop
- Video/film
- Brokerage event
- Pitch event
- Trade fair

	Name and type of audience
A&T Automation and Testing	Industry and Scientific community
Innovabiomed	Industry and Scientific community
ACM/IEEE International Conference on Human-Robot Interaction (HRI)	Industry and Scientific community
EU Robotics Forum 2020	Industry and Scientific community
IEEE International Conference on Robotics and Automation (ICRA)	Industry and Scientific community
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)	Industry and Scientific community
IEEE International Conference on Automation Science and Engineering (CASE)	Industry and Scientific community
IEEE International Conference on Mechatronics (ICM)	Industry and Scientific community
IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)	Industry and Scientific community

	Name and type of audience
International Conference on Mechatronics, Robotics and Automation (ICMRA)	Industry and Scientific community
IEEE International Conference on Control, Automation, Robotics (ICCAR)	Industry and Scientific community
International Conference on Informatics in Control, Automation, and Robotics (ICINCO)	Industry and Scientific community
Workshop on Robot Motion and Control (ROMOCO)	Industry and Scientific community
IEEE International Conference on Industrial Cyber-Physical Systems (ICPS)	Industry and Scientific community
IFAC Symposium on Robot Control (SYROCO)	Industry and Scientific community
IFAC World Congress	Industry and Scientific community
Hannover Messe (Hanover Fair) 2020	Industry and Scientific community
Feria internacional de la máquina herramienta (BIEMH)	Industry and Scientific community
Automatica 2020	Industry and Scientific community
Automatica 2022	Industry and Scientific community
SPS Drives Parma	Industry and Scientific community
Special Session on „Cyber-Physical Systems for Deformable Manipulation“	Industry and Scientific community
Flexible Automation and Intelligent Manufacturing International Conference FAIM 2020	Industry and Scientific community
https://sevilla.bciaerospace.com/es/	Industry and Scientific community

Due to the situation of Public Health Emergency reported by WHO due to the covid-19 coronavirus outbreak, many events have been cancelled or postponed.

5 Conclusions

This deliverable aims to create a large database of stakeholders that will be periodically informed about the main project outcomes and to develop dissemination and communication activities tailored for the single stakeholder group.

This deliverable reports a market analysis to identify the stakeholders for the industrial sectors targeted in this project. An analysis of the industrial sectorial and the use cases is performed in order to develop a map the stakeholder community and dissemination and communication activities tailored for the single stakeholder group.

The identified stakeholders have been categorized according to their market sector, interests, attitude, influence and relevant knowledge. Market analysis identifies segments but also application sectors. This analysis is performed through a participatory sense by all the partners, in particular industrial ones, to extract the knowledge of the market by each partner based on their previous experience and liaisons. Every use case and its impact within each sector has been analyzed, the most important competitors, which are robotic companies, have been identified, and each of REMODEL's KER has been evaluated.

The market analysis here reported will allow REMODEL partners to identify other stakeholders interested in REMODEL results.