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

Deliverable 8.8 – PRELIMINARY EXPLOITATION PLAN

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1 Executive Summary

This document describes the strategy for the promotion of exploitation to be developed in WP8. The strategy contains the following steps:

- Market analyses to identify appropriate market segments and business strategies
- Identification of potentially exploitable results
- The development of specific business plans

This document is a preliminary Exploitation Plan and it will be updated along the project lifetime (D8.9 and D8.10). It is composed of specific exploitation actions to be implemented during and after the project.

The following objectives for the exploitation of the project results have been set:

- A business strategy for the project will be formulated in the form of a business plan detailing the business model for the REMODEL system (D8.10);

- The relevant stakeholders and their role in the project are being identified as well as the proper communication channels to reach them;

- An IP management strategy has been identified defining the consortium's IPR policies for knowledge and protection, ownership of various IPR and the timelines and conditions for its dissemination;

- A plan for the commercialization of the project results is being developed.

2 Introduction

The exploitation part of the project focuses on the economic and technical benefits within projects consortium based on the developed technologies of REMODEL project.

REMODEL addresses issues that are critical for the implementation of robotic systems able to manipulate wires, cables, and wiring harnesses. REMODEL outcomes are applicable to several industrial manufacturing activities that nowadays are manually executed, such as switchgear wiring, wiring harness manufacturing and assembly, manipulation of hoses for medical devices and many others.

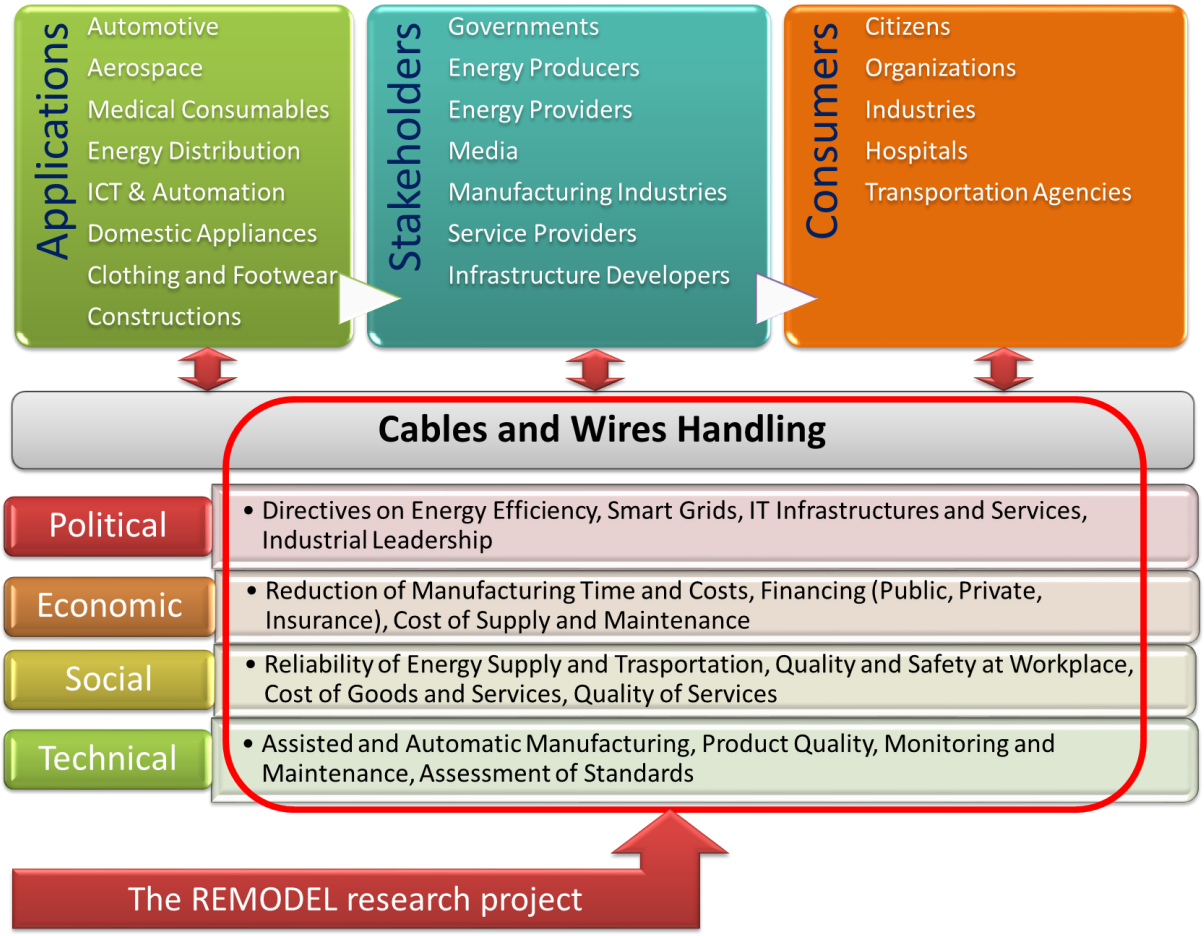

Figure 1: REMODEL expected impacts

These manufacturing activities are characterized by the execution of repetitive manipulation tasks, that cause psychophysical stress on the workers on the long term, reducing their efficiency, increasing absenteeism and lowering down the quality of the workplace. In view of the EU policy aiming at creating more safe and attractive workplaces, as well as increase the competitiveness and productivity of EU industries, REMODEL has a huge potential impact on several strategic sectors, going from automotive and aerospace industry, to civil engineering and industrial automation, to the production of medical consumables

3 REMODEL impacts

The impact and effectiveness of DLOs manipulation will be assessed in REMODEL by gathering performance metrics to ensure an increase of the OECD job quality index and productivity

Expected impact from the topic	Expected REMODEL impact
Imp1 Demonstrating the potential to bring back production to Europe	To achieve competitive and sustainable manufacturing in high-labor costs regions like Europe, performance must be radically increased by smart manufacturing systems. To this end, the REMODEL project will: • Reduce time to market from 10% to 27% depending on the use case; • Increase customization capabilities; • Introduce product documentation and traceability for better quality assessment.
Imp2 15% increase in OECD Job Quality Index through work environment and safety improvement	The REMODEL project will impact on job demands: • Reducing time pressure, which encompasses long working hours, high work intensity and working time inflexibility by assigning to the robot time-consuming tasks; • Reducing physical health risks through augmented ergonomics, by reducing exposition to hard work, e.g. painful/tiring positions, awkward postures, low-load high-frequency manual material handling and tool usage, by exploiting the robot DLOs manipulation. The REMODEL project will impact on job resources: • Release workers from repetitive and stressful tasks execution and move them to more qualified and decision-making activities; • Improving workers' self-efficacy in their job through a better exploitation of their competences in close relationship with robots' capabilities. The impact will be verified by quantitative risk assessment techniques that are required by regulations and standards on occupational safety (e.g. NIOSH LI, OCRA method, Strain Index, TACOs) and reduction of absenteeism rates.
Imp3 20% increase in productivity	Manufacturing tasks documentation and planning from product design results in: • From 10% to 30% of the manufacturing reduction time; • Possibility of robotized products pre-processing during nighttime for UC1, UC2 and UC4, potentially triple the production of partially assembled products to be reprocessed by workers during the working hours

3.1 Specific impact on UC1

To clarify how the REMODEL project addresses the impact on Imp1 and Imp3, the IEMA production is analyzed considering the 2018 data and the estimated production achievable with the REMODEL technology. Table 1 reports the consequence of a reduction of the wiring time of 30% (Imp3) due the introduction of the REMODEL technology, with respect to the overall wiring time. In Table 1, 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 1 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%. The Key Performance Indices (KPIs) shown in Table 1 will also be used as metrics in **T2.3** to evaluate the impact on Imp1 and Imp3 in UC1.

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 (Imp1), 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 (Imp1).

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[1], 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

[1] http://www.marketsandmarkets.com/Market-Reports/switchgear-market-1162268.html

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.

Table 2: Estimated expansion of the European switchgear market due to the REMODEL technology.

	Unit	Estimated European Market in 2021	Estimated with REMODEL technology	Gain
Annual production	Items/year	160000	228923	106667
Mean cost per unit	Euro/item	€ 18,000	€ 18,000	€ 0
Revenue	Euro/year	€ 2,880,000,000	**€ 4,121,000,000**	**€ 1,241,000,000**
Revenue increase	**%**	**--**	**43.08%**	**43.08%**

To provide a rough estimation of the REMODEL technology impact on the European switchgear market, in Table 2 the data computed on the basis of the IEMA production are extrapolated for the expected European market in 2021, assuming the all the other parameters will not change. This table highlights how the REMODEL technology, even neglecting other benefits and application scenario, can generate a revenue increase in the switchgear market of about 1.24B€, that is almost the actual level of the whole European switchgear market.

Figure 2: Lifecycle of a manufacturing product.

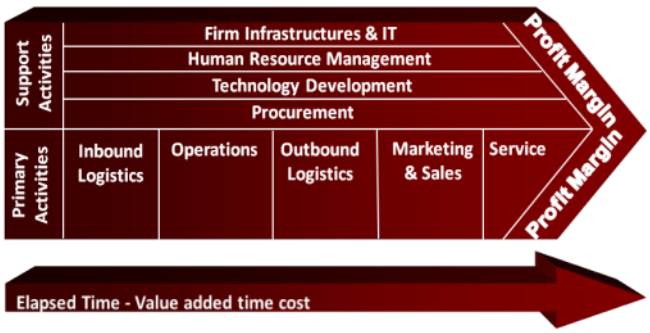

Figure 3: Value Chain in Manufacturing Industry.

It is clear that REMODEL will positively affect several aspects of the switchgear lifecycle depicted in Figure 2. In facts, the assembly phase apart, since it is the core of the REMODEL activity, the introduction of ICT and Robotics in the field generates additional information with respect to the conventional manufacturing that improves both the quality control and the maintenance phases. Consequently, this added value in turn increases competitiveness and affects positively the marketing. Also looking at the manufacturing industry value chain schematized in Figure 3, among the primary activities clearly the REMODEL technology affects the Operations, Marketing, Service and reduce significantly the time to market, as shown in Table 1, but it affects also Support Activities by creating innovative production infrastructures and new technology development. Therefore, the REMODEL technology can be seen both as a differentiation advantage and a cost advantage. The data reported in Table 1 shows that the wiring is by large the major source of cost along value chain in switchgear manufacturing.

The following table summarizes the specific REMODEL impact on UC1:

Expected impact from the topic	Expected REMODEL impact
Imp1 Demonstrating the potential to bring back production to Europe	• Time to market reduced from 36 to 26 days, with a decrease of 27% • Job salary raised from 25€ to 27€ • Full wiring traceability • Percentage of non-compliance reduced from 7% to 2% • Increases customization capabilities
Imp2 15% increase in OECD Job Quality Index through work environment and safety improvement	• Reduce stress on wrist torsion due to the use of screwdrivers • Reduce back bending, crouch down and arm stretch up to reach connection points • Reduce time pressure on repetitive activities • Increase the employment on more qualified activities such as product testing, quality assessment, product design and installation
Imp3 20% increase in	• Manufacturing time reduced by 30% • Sales volume increased by 43%

productivity	• Net income increased by 35%

3.2 Specific impact on UC2

Cables as the central power and signal interface element of the ICT establish links between several devices and electronic systems. Since the complexity of ICT systems is growing rapidly, the manufacturing techniques of cable harnesses become more and more important and sometimes even critical. For European manufacturing industry to thrive amongst global competitors, it is necessary to overcome various barriers to growth, such as awareness of robotics technology capabilities, user concerns about system complexity, cost of ownership and return on investment, flexibility and adaptation of systems to changing needs.

3.2.1 Wiring harnesses manufacturing for aerospace industry

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 3: 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%**

3.2.2 Wiring harnesses manufacturing for automotive industry

The REMODEL project will provide robotic technologies able to reduce the human effort and improve productivity of conventional automotive assembly lines, improving at the same time the product quality and reduce costs of complex parts manufacturing such as automotive wiring harnesses, thereby increasing the overall long term competitiveness of the EU's automotive sector.
ELVEZ evaluates the REMODEL short term benefits on job quality for its workers will be:
• Human strain factors limit the wiring harnesses productivity to 615 parts per shift with 2 workers. With introduction of the REMODEL technology the production is expected to rise 675 parts per shift with less stress and strain on workers' body, increasing the OECD job quality index. REMODEL will also enable pre-processing of products during nighttime;
• With REMODEL, ELVEZ can increasing flexibility in training new personnel. This also shorten the time to market of wiring harness manufacturing to our customers' small batch requests;
• Average yearly absence of work because of illness and exhaustion is 2,6%. With REMODEL, ELVEZ expect to lower down this amount to 1,8%;
• REMODEL will enable the collection of production data and manufacturing documentation and tracking. Based on this information, the planning of production and changes in manufacturing procedures can be predicted well in advance;
• REMODEL will provide constant process monitoring, enabling faster reaction to product changes, defects and mistakes. This implies also a significant reduction of the production line stop time.

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

The following table summarizes the specific REMODEL project impact on UC2.2.

Expected impact from the topic	Expected REMODEL impact
Imp1 Demonstrating the potential to bring back production to Europe	• Product defects reduced from 2006 ppm to 1000 ppm • Reconfiguration time reduced from 1 hour to 10 minutes • Full product traceability • Time to market reduced by 15% • Increases customization capabilities
Imp2 15% increase in OECD Job Quality Index through work environment and	• Reduce stress due to back bending and arm stretching to arrange the wires and cables on the pin board • Reduce time pressure on repetitive activities • Increase the employment on more qualified activities such

safety improvement	as product design and testing, quality assessment
Imp3 20% increase in productivity	• Manufacturing time reduced by 10% • Production of wiring harnesses • Production increased by 30% considering the overnight product preprocessing

3.3 Specific impact on UC3

UC3 is representative of the dual nature of the use of robots in the automotive sector. This sector (both on the final assembly line and on the supply chain) presents high penetration of robotics in some operations (such as welding) but low levels of automation in complex tasks such as assembly or tasks involving flexible components. The rise of collaborative robots (or robots for safe close operation) opened interesting perspectives to address these operations, but there is still need for more effectiveness in terms of adaptability to the constraints imposed by the environment, variability of the tasks and the objects to manipulate or even unpredictable behavior of the materials - such as in case of object deformability. Moreover, for these robots to became truly effective, the need for easier and intuitive programming to enable their use to non-expert operators is of paramount importance.

In VW plant 750 Transporter and Caddy vehicles are produced every day – namely 630 Caddy and 120 Transporter. Each of them comes in a big number of diverse options, which increased the complexity of the process. Moreover, with Transporter being the bigger car, a worker needs more time to finish the assembly tasks in tact time than in the case of Caddy. This becomes problematic, since the task time is equal for every car, regardless of the model, and amounts 102 seconds. The factory produces in 3 shifts work system – from Monday at 6am to Saturday till 10pm. Each section of assembling line is divided into tasks covered by small teams. Each year approximately 200 000 cars go from the factory to the global market. VWP provides solutions for family and above all - small and big enterprises (individual customers order). From this evaluation, it is clear that by saving just few seconds along the cockpit assembly line, a significant impact on the production can be generated. Moreover, it is clear that the activity carried out by the robot reduces the psychophysical stress on the workers due to execution of these repetitive activities and reduces the risks of musculoskeletal disorders. The following table summarizes the specific REMODEL project impact on UC3.

Expected impact from the topic	Expected REMODEL impact
Imp1 Demonstrating the potential to bring back production to Europe	• Improve product quality • Limit defects and stop of the production line reducing the average cost • Full product traceability • Increases customization capabilities of the production

	line
Imp2 15% increase in OECD Job Quality Index through work environment and safety improvement	• Reduce stress due to back bending, crouch down and arm stretching to arrange the wiring harness on the cockpit metal plate • Reduce time pressure on repetitive activities • Increase the employment on more qualified activities such as product design and testing • Limit the potential injuries due to working on a moving assembly line
Imp3 20% increase in productivity	• Cockpit assembly time can be reduced by 10% • Production can be increased by 20% by implementing two robotized lines • Improved product quality will reduce the downtime of the line contributing to increased productivity

It is as well very important to add that the year 2020 is crucial for the state of project, that the new model (Caddy 5) will be released to global market. It means that the robotic platform must be developed on the basis of new model, which could not be took into a consideration during proposal preparation (due to trade secret).

The best scenario for Volkswagen Poznan as an End User is to create and develop such the robotic solution which can be implemented in mass production and it will work as good as human. Additionally Volkswagen wants to obtain substantial reduction of tact time (cockpit assembly time), which may make possible to save worker on this station (increase in productivity).

3.4 Specific impact on UC4

ENKI is now suffering a significant shortage of the manpower for their production in general. In order to sustain their business ENKI needs to move workers from highly repetitive, low added value tasks, like hose handling to more independent and flexible roles. Due to the nature of the material and the type of operation it has not been possible so far by using traditional robotization approaches.

The methods for reliable and efficient manipulation of flexible materials developed in REMODEL will allow to perform the manipulation with at least the same speed and allow ENKI to allocate employees to different roles. Moreover, this will increase the traceability of production, increase the quality by reducing the number of mishandled hoses and reduce contamination risk, by excluding humans from the final stage of the process. On top of that, the highly repetitive and tiresome task will be eliminated, thus contributing to increased work comfort.

The following table summarizes the specific REMODEL project impact on UC4.

Expected impact from the topic	Expected REMODEL impact
Imp1 Demonstrating the potential to bring back production to Europe	• Full product traceability • Increases customization capabilities • Reduced dependence on low added value tasks performed by humans
Imp2 15% increase in OECD Job Quality Index through work environment and safety improvement	• Reduce time pressure on repetitive activities • Increase the employment on more qualified activities such as customer care, product design and testing, quality assessment
Imp3 20% increase in productivity	• Production increased by 20% thanks to the possibility of moving workers to more demanding activities • Reduced number of faulty products

The polymeric microtubes extruded are the fundamentals of the realization of the devices produced in ENKI: catheters, drains and electric stimulators are just some examples. The worldwide standards imposes very restrictive quality checks (QC), that for some devices may arise up to 100% of controls.
This means that for ENKI the percentage of time invested in QC is important and it takes a non neglectable part of the time of several operators.

ENKI has decided to focalize its attention on the most difficult and dime consuming QC operation performed: the microscopic control of the extruded tube. Briefly, the Operators randomly takes directly after the cooling a microtube, he/she performs a cut with a blade in order to have clean ends, and place one of the extremity under a microscope in order to perform the analysis of the dimensions and tolerances of the tube, that are in the range of the hundreds of microns. For example, in a mono lumen tube the operator measures: 3 outer diameters, 3 inner diameters and 4 thicknesses. In a bi-lumen tube the operator measures: 3 outer diameters, 4 thicknesses, 2 principal diagonals for each lumen and the spacer between the lumen. So from the 10 measurements taken for a single lumen tube the measurements for a bilumen are increased to 12. For a 25-lumens tube the number of the measurements is exponentially increased.

The automation of this QC is crucial for saving time and increase the quality levels of the company.
The Actual state of art of the microscopic QC is that considering an averaged ENKI's extrusion production, ENKI produces 1440 microtubes per hour. The minimum QC from standards in this case is 5%. This means that ENKI has to check 72 tubes per hour.
For a trained Operator it takes almost 5min to perform all the operation to complete the quality check (take the microtube, perform the right cut, focalize the microscope, measure the tolerances), this means that it takes 6 hours to perform the QC on the 5% of 1 hour of extruded tubes.

We estimate that the automation platform will do the QC evaluation, with the same precision as the Operator, but with a reduced time (i.e. 30 seconds). In particular we

estimate that with a total time of 30s for the QC, ENKI will be able to arise the percentage of QC up to 10% (assuring to ENKI's client a better control on the extruded product). We have to consider also that this platform will free an operator allow him/her to perform different tasks.

4 Market analysis

This is an initial market analysis to show a preliminary identification fo principal stakeholders and their specific interest in REMODEL.

4.1 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.

4.2 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

4.3 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.

4.4 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

5 Exploitation strategy

Universities, RTDs and companies have different ways of modeling, structuring and presenting their exploitation plans.

The academic and research partners' will contribute to the exploitation plan according to their mission **research, education and knowledge transfer**. In particular, they will

- *explore new research directions* leading to high impact research. The achievements reached in the project will foster investigation of new research directions and will stimulate ideas for new scientific opportunities in their respective fields of expertise and interaction with national and international research groups;

- *improve scientific and technological knowledge to be transmitted to students*. This achievement is considered fundamental for the development and the prestige of the respective institutions and for the capability to attract high quality students especially at Master degree and PhD course level. The organization of new professional Master curricula is in the interest of the group at national and International levels;

- *stimulate innovation* (including support to spin-off/start-up companies). The acquisition of the competence targeted by the project allow to promote and support new industrial initiatives in the field, in particular start-up and SMEs. The academic and research partners will also participate to local activities to transfer the knowledge built in the REMODEL project to industrial partners for further commercialization.

The relationships established among the research groups involved in the project will create new opportunities for long term collaborations and support for young researchers' mobility to perform studies in this field.

Project partners are involved at different title in commercial activities and will find an agreement on how to manage IPR and commercial issues (the first step of the agreement has been signed in the Consortium Agreement at the beginning of the project, while the final step will be the conclusive exploitation agreement at the end of the project). A preliminary collection has been made by the REMODEL consortium on the exploitation results and it is presented as follows

5.1 Exploitation results

A list of exploitable results has been defined and will be updated during the entire life of the project.

Each exploitable result is specifically described in terms of innovativeness, competitive advantages, public acceptance, legal requirements, costs and price. This section proposes a preliminary description of the REMODEL exploitable results by considering the following aspects:

- Innovativeness introduced compared to already existing Products/Services
- Unique Selling Point (competitive advantages)
- Product/Service Market Size
- Market Trends/Public Acceptance

- Product/Service Positioning
- Legal or normative or ethical requirements
- Competitors and Customers
- Cost of Implementation (before Exploitation)
- Time to market, including further additional research and development work
- Foreseen Product/Service Price
- Mid-term market objectives
- Adequateness of Consortium Staff
- External Experts/Partners to be involved
- Which partner contributes to what (main contributions in terms of know-how, patents, etc.)
- Partner/s involved expectations

During the first 6 months of the project 12 Exploitable Results have been identified:

No	Exploitation Results	Main Exploiter(s)
1	CAD Platform for flexible robotics programming	TECNALIA
2	Dual arm manipulation of deformable linear objects in Aeronautical Industry	TECNALIA
3	Generation of robot planning from product CAD files for switchgear wiring	IEMA, UNIBO
4	Manipulation tools for deformable linear objects	UNIBO, UCLV
5	Dual arm robotic platform for switchgear wiring	IEMA, UNIBO
6	Manipulator for Quality Checks in Extrusion Processes in biomedical industry	ENKI
7	Dual arm robotic platform for Automotive Industry	TAU, UNIBO, ELVEZ
8	CAD Platform Interface to provide the system planner, the layout and product inputs	TAU, UNIBO
9	Integrated dual arm manipulation system for interconnection systems automatic manufacturing process.	ELIMCO
10	Automated robot / sensor calibration toolkit	TUM
11	Bimanual manipulation system for wiring harness manipulation.	PUT, UNIBO, UCLV, TAU
12	Interactive perception module exploiting vision and touch	UNIBO, UCLV, TAU, TUM

To clearly visualize the routes for exploitation of each result, a template has been structured to define the ER in detail and characterize it against its exploitation potential

Exploitable result No 1: CAD Platform for flexible robotics programming Reported by: TECNALIA	
Describe the innovation content of result	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.
Who will be the customer?	Mainly targeting end users and integrators. Potential customers: AIRBUS, CAF, IKUSI,
What benefit will it bring to the customers?	1. Program the robot is more intuitive, so it not necessary to be an expert 2. Program faster
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over price
Who are the competitors for this result?	Don’t exist for this kind of Industry
How fast and in what ways will the competition respond to this result?	Never less than three years
Who are the partners involved in the result?	TECNALIA
Who are the industrial partners interested in the result (partners,	ELIMCO

sponsors, etc. …)?	
Have you protected, or will you protect this result? How? When?	Software license
Pictures:	

Exploitable result No 2: Dual arm manipulation of deformable linear objects in aeronautical industry **Reported by: TECNALIA**	
Describe the innovation content of result	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.
Who will be the customer?	Mainly targeting end users and integrators. Potential customers: AIRBUS, CAF, IKUSI,
What benefit will it bring to the customers?	1. Programming of complex manipulation tasks with DLOs 2. Use of high-level robot functionalities from intuitive interface
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over price
Who are the competitors for this result?	No DLO manipulation packages available nowadays
How fast and in what ways will the competition respond to this result?	Never less than three years

Who are the partners involved in the result?	TECNALIA
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	ELIMCO
Have you protected, or will you protect this result? How? When?	Software license
Pictures:	

Exploitable result No 3: Generation of robot planning from product CAD files for switchgear wiring Reported by: UNIBO	
Describe the innovation content of result	Interpretation of the 3D product design and description files for the planning of the robot operations to perform the wiring of switchgears.
Who will be the customer?	Mainly targeting end users and integrators. Potential customers: ABB, Anchor Electricals, Epsol, Schneider Electric, Siemens, Orecco Electric, SGC, Eaton
What benefit will it bring to the customers?	No need of robot reprogramming to change from a product to another one.
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over price
Who are the competitors for this result?	Don’t exist for this kind of Industry
How fast and in what ways will the competition respond to this result?	Never less than three years
Who are the partners involved in the result?	UNIBO, IEMA, TAU
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	IEMA

Have you protected, or will you protect this result? How? When?	Software license
Pictures:	

Exploitable result No 4: Manipulation tools for deformable linear objects Reported by: UNIBO	
Describe the innovation content of result	Specific tools for the manipulation of deformable linear objects are not present on the market, only custom solutions for specific applications can be found.
Who will be the customer?	Any company involved in the manufacturing of deformable linear objects or manufacturing products in which deformable linear objects are constitutive components.
What benefit will it bring to the customers?	Simplify the implementation of robotic manufacturing applications involving the manipulation of deformable linear objects
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over price
Who are the competitors for this result?	Don’t exist for this kind of Industry
How fast and in what ways will the competition respond to this result?	Never less than three years
Who are the partners involved in the result?	UNIBO, UCLV
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	IEMA, ELIMCO, ELVEZ, VW, ENKI

Have you protected, or will you protect this result? How? When?	A patent application will be submitted to protect these results
Pictures:	

Exploitable result No 5: Dual arm robotic platform for switchgear wiring **Reported by: UNIBO**	
Describe the innovation content of result	A commercial automatic platform for the switchgear wiring does not exist. The proposed solution will exploit a dual arm robotic platform to perform switchgear wiring
Who will be the customer?	Mainly targeting end users and integrators. Potential customers: ABB, Anchor Electricals, Epsol, Schneider Electric, Siemens, Orecco Electric, SGC, Eaton
What benefit will it bring to the customers?	1. Reduced time to market 2. Higher customization 3. Lower product cost 4. Higher quality and traceability
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over price
Who are the competitors for this result?	Don’t exist for this kind of Industry
How fast and in what ways will the competition respond to this result?	Never less than three years
Who are the partners involved in the result?	UNIBO, IEMA
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	IEMA

Have you protected, or will you protect this result? How? When?	A patent application will be submitted to protect these results
Pictures:	

Exploitable result No 6: Manipulator for Quality Checks in Extrusion Processes in biomedical industry **Reported by: ENKI**	
Describe the innovation content of result	Change the Quality Check actually performed in line in ENKI's Extrusion with an automatic device
Who will be the customer?	ENKI Companies producing medical consumables
What benefit will it bring to the customers?	● Quality Check Faster ● Quality Check improvements
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will guarantee an innovative QC and a better device quality.
Who are the competitors for this result?	Don't exist for this kind of Industry
How fast and in what ways will the competition respond to this result?	Never less than three years
Who are the partners involved in the result?	TUM, UNIBO, PUT,UCLV, ENKI
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	ENKI
Have you protected, or will you protect this result? How? When?	
Pictures:	

Exploitable result No 7: Dual Arm Robotic platform for Automotive Industry Reported by: TAU, UNIBO, ELVEZ	
Describe the innovation content of result	The current production process of wire harness assemblies is manual. The focus of TAU is to construct a dual arm industrial robot station and enable it to perform bimanual manipulation of the DLOs, and by enabling the programming by an intuitive teach by demonstration and expand on the existing knowledge.
Who will be the customer?	Potential for having all automotive manufacturers and suppliers who produce equipment on a large scale. Automotive Manufacturers: VW, Volvo, GM, etc. Suppliers: ELVEZ and similar
What benefit will it bring to the customers?	● Programming of complex manipulation tasks with DLOs ● Use of high-level robot functionalities from intuitive interface
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over price
Who are the competitors for this result?	There are no competitors for DLO manipulation
How fast and in what ways will the competition respond to this result?	At least in 3 years
Who are the partners involved in	TAU, ELVEZ, UNIBO

the result?	
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	ELVEZ, VWP (VWP has similar use case, but is not directly involved)
Have you protected, or will you protect this result? How? When?	A patent application will be submitted to protect these results
Pictures:	

Exploitable result No 8: CAD Platform Interface to provide the system planner, the layout and product inputs **Reported by: TAU**	
Describe the innovation content of result	An intelligent module of the developed software implementation to extract relevant information from the layout, the handled product and the points of interaction in the physical system. And, providing the information in the format required by the planner module.
Who will be the customer?	Primary targets for exploiting the knowledge of this model would be end users and integrators of automation systems.
What benefit will it bring to the customers?	Enables for dynamic changes in different models of the same product for manufacturing
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over price
Who are the competitors for this result?	There are no competitors for DLO manipulation
How fast and in what ways will the competition respond to this result?	At least in 3 years
Who are the partners involved in the result?	UNIBO, IEMA, PUT, TUM, VW, ELVEZ, ELIMCO, TECNALIA
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	IEMA, ELVEZ, VW, ELIMCO

Have you protected, or will you protect this result? How? When?	The preliminary developments were made by UNIBO and similar Software license would be a good solution.
Pictures:	

Exploitable result No 9: Integrated dual arm manipulation system for interconnection systems automatic manufacturing process. Reported by: ELIMCO	
Describe the innovation content of result	Now days interconnection systems manufacturing process in aerospace industry has a high handmade dependence due to inherent normative regulations. ELIMCO objective is to implement an optimized integrated dual arm manipulation system for interconnection systems automatic manufacturing process with a flexible programming platform for robotics to demonstrate that the technology is able for an entire manufacturing certification process.
Who will be the customer?	ELIMCO, ARIBUS, BOEING, LATELEC, LABINAL, ALESTIS, AERNNOVA etc.
What benefit will it bring to the customers?	On quality, on time and on cost improvements.
When is the expected date of achievement in the project (mm/yy)?	10/2023
When is the time to market (mm/yy)?	Initial calculation by M36
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M36
What is the approximate price range of this result / price of licenses?	Initial calculation by M36
What is the market size in M€ for this result and relevant trend?	Initial calculation by M36
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over quality, cost and on time feasibility.
Who are the competitors for this result?	Don’t exist for this kind of Industry
How fast and in what ways will the competition respond to this result?	Never less than three years

Who are the partners involved in the result?	TECNALIA
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	IEMA, ELVEZ, VW, TAU.
Have you protected, or will you protect this result? How? When?	Hardware and software usability license
Pictures:	

Exploitable result No 10: Automated robot / sensor calibration toolkit **Reported by: TUM**	
Describe the innovation content of result	A collection of software tools to calibrate 1) the extrinsic pose of eye-in-hand depth sensors, 2) the kinematic chain of a robot and 3) the extrinsic poses of multiple robot arms without relying on external calibration objects.
Who will be the customer?	Automation industry, as well as large industrial companies having their own in-house system integration / production automation unit.
What benefit will it bring to the customers?	The system will allow an automated self-calibration of a multi-robot setup equipped with eye-in-hand sensors. It will significantly reduce the time required for the initial calibration as well as re-calibration after maintenance or repairs, and avoid cost of specific calibration hardware or calibration objects and calibration objects.
When is the expected date of achievement in the project (mm/yy)?	Around M18
When is the time to market (mm/yy)?	Initial calculation by M20
What are the costs to be incurred after the project and before exploitation?	Initial calculation by M20
What is the approximate price range of this result / price of licenses?	Initial calculation by M22
What is the market size in M€ for	Initial calculation by M22

this result and relevant trend?	
How this result will rank against competing products in terms of price / performance?	There are no similar products on the market yet.
Who are the competitors for this result?	LEONI advantec TCP (requires specific hardware)
How fast and in what ways will the competition respond to this result?	Not clear yet.
Who are the partners involved in the result?	TUM
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	IEMA, ELVEZ, VWP, ELIMCO
Have you protected, or will you protect this result? How? When?	Due to a lack of software patents in the EU we can only try to protect our knowledge by NDAs
Pictures:	

Exploitable result No 11: Bimanual manipulation system for wiring harness manipulation. **Reported by: PUT**	
Describe the innovation content of result	Arranging wires and cables along predefined paths using robotic bimanual manipulation. Currently such task at the assembly line are done manually.
Who will be the customer?	Automotive industry, car manufacturers – assembly lines.
What benefit will it bring to the customers?	Programmable and repeatable process of arranging wiring harnesses, e.g. in cockpit assembly line.
When is the expected date of achievement in the project (mm/yy)?	04/23

When is the time to market (mm/yy)?	*Initial calculation by M36*
What are the costs to be incurred after the project and before exploitation?	*Initial calculation by M36*
What is the approximate price range of this result / price of licenses?	*Initial calculation by M36*
What is the market size in M€ for this result and relevant trend?	*Initial calculation by M36*
How this result will rank against competing products in terms of price / performance?	It will compete favoring high performance over price
Who are the competitors for this result?	There are no competitors for DLO manipulation
How fast and in what ways will the competition respond to this result?	At least in 2 years
Who are the partners involved in the result?	PUT, UNIBO, UCLV, TAU
Who are the industrial partners interested in the result (partners, sponsors, etc. …)?	VWP, ELVEZ (ELVEZ has similar use case, but is not directly involved)
Have you protected, or will you protect this result? How? When?	Initially will be kept as the know-how. If patentable, a patent application will be submitted to protect these results.
Pictures:	

Exploitable result No 12: Interactive perception module exploiting vision and touch **Reported by: PUT**	
Describe the innovation content of result	The proposed module is joining the vision and touch in single framework. The solution breaks with the sense-plan-act paradigm.
Who will be the customer?	Integrators of the robots on the assembly lines. Producers of the robots building eco-systems around their manipulator, e.g. UR+.
What benefit will it bring to the customers?	The customers will obtain system capable of fusing touch and vision data. Currently these two sensing modalities are mainly disjoint in the robotic systems.
When is the expected date of achievement in the project (mm/yy)?	09/23
When is the time to market (mm/yy)?	*Initial calculation by M36*
What are the costs to be incurred after the project and before exploitation?	*Initial calculation by M36*
What is the approximate price range of this result / price of licenses?	*Initial calculation by M36*
What is the market size in M€ for this result and relevant trend?	*Initial calculation by M36*
How this result will rank against competing products in terms of price / performance?	It will compete favoring price over price
Who are the competitors for this result?	Other robotics start-ups working on perception systems.
How fast and in what ways will the competition respond to this result?	At least in 2 years
Who are the partners involved in the result?	UNIBO, UCLV, TAU, TUM
Who are the industrial partners	VWP, ELVEZ, ELIMCO, IEMA, ENKI, robotics

interested in the result (partners, sponsors, etc. …)?	start-ups,
Have you protected, or will you protect this result? How? When?	Initially will be kept as the know-how. If patentable, a patent application will be submitted to protect these results.
Pictures:	

5.2 Individual Exploitation Plan.

REMODEL aspires to narrow the gap between research and industry by transferring that latest R&D results in robotics towards various industrial sectors. Each partner will pursue different actions to maximize the benefit from the project outcomes.

The role of the REMODEL partners can be segmented into different roles according to their organization profile, that is:

- End users which represents the market needs and provide the product requirements to be satisfied by the REMODEL project;
- Research and academic partners that may carry out new research activities built upon REMODEL results. This includes research institutes, laboratories attached to schools and universities.

This section is dedicated to presenting partners' individual intentions, describing already available exploitation channels as well as future activities that are now being designed.

5.2.1 UNIBO Individual Exploitation Plans

Objectives	UNIBO aims to be a partner for the implementation of the latest technologies for switchgear wiring and wiring harness manufacturing and manipulation. This will lead to advanced and innovative solutions in the manipulation of deformable objects for our current and future research, other than giving us the possibility of expanding the applicability of the methods to other theoretical and applicative fields.
Audience	UNIBO is cooperating with a network of industries having shown large interest in robotic manipulation of deformable linear objects. This network of companies will be exploited for the exploitation of REMODEL's results.

Environments	● Italy:
	  ○ Confindustria
	● Europe:
	  ○ Focus on Conferences and fairs
	  ○ European Robotics forum
	● Fairs:
	  ○ SPS Parma
	  ○ EuroDrive
	  ○ Automatica (Germany)

Subjects	The main topics of interest for exploitation by UNIBO include: ● robotic applications for industrial manufacturing ● special-purpose mechatronic tools for manipulation ● dual arm manipulation of deformable objects
Magazines, Scientific journals and news	UNIBO is very active in scientific publication of research results. The main journals and conferences are: ● IEEE Transactions on Robotics; ● International Journal of Robotics Research ● IEEE Transactions on Automation Science and Engineering ● IEEE Transactions on Mechatronics ● Robotics and Computer-Integrated Manufacturing ● IEEE International Conference on Robotics and Automation (ICRA) ● IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) ● IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)

Demonstrators	UNIBO is already working on the REMODEL switchgear wiring use case and on the creation of relevant promotion material that will be then used to promote exploitation of the results ● Physical demonstrator in IEMA site ● Videos on UNIBO youtube video with the implemented demonstrators ● Social media and public web of the project ● Demonstrator for fairs and conferences

5.2.2 UCLV Individual Exploitation Plans

Objectives	In REMODEL, UCLV will optimize the sensing system for DLOs manipulation. In particular, advanced and optimized prototypes of sensorized fingers will be developed for different parallel gripper, commercial and customized. The sensors will be tactile and proximity. The sensor data will be used to develop control algorithms for the safe grasping and manipulations of deformable linear objects. Both hardware and software will be exploited for other projects with industrial impact, development of spin-off and new patents.
Audience	The results will be mainly presented to the scientific and academic community, in particular to the robotic community, which already demonstrated a high interest in sensing systems for manipulation of deformable objects. UCLV will present the prototypes also to spin-off and SME in order to start future collaboration in order to realize commercial products. This interaction will be mainly developed within fairs and forums.
Environments	National associations (e.g., SIDRA, I-RIM) during annual meetings. International fairs (e.g. AUTOMATICA, MECSPE) International Conferences
Subjects	Main topics: ● Development of tactile/force sensors ● Development of sensor-based control strategies for grasping of deformable linear objects Data interpretation algorithms for reconstruction of forces and shapes
Magazines, Scientific journals and news	UCLV will use scientific journals related to the robotic and mechatronic communities. National and local journal will be used to reach also generic public. Press conference will be an additional channel for the exploitation of results.
Demonstrators	UCLV are realizing sensorized fingers for all use cases. Initial demonstrations will be implemented in our laboratories and the capabilities of realized prototypes will be shown. After these preliminary testes the sensorized fingers will be integrated in the robotic platforms prepared by the involved partners in each use case. A demonstrator with a commercial robotic arm equipped with a sensorized parallel gripper will be prepared @UCLV to show all characteristics of the proposed sensing system in simplified scenario with respect to use cases prepared in laboratories of industrial partners.

5.2.3 IEMA Individual Exploitation Plans

Objectives	IEMA aims to use the automation platform developed in the REMODEL project to improve production of electric switchgears for automatic machines. The solution will be integrated in the LOF project that IEMA started in 2018 to automatize switchgears assembling.
Audience	Partner companies of IEMA are interested in this technology, and customers of IEMA will receive faster time to market response and quality when the technology will be ready.
Environments	Italian and European customers, fairs: • SPS Drives Parma • Hannover Fair • Automatica
Subjects	The main topics of interest for exploitation by IEMA include: ● Automatization Capabilities for integration with LOF Process. ● Reduction of production time ● Increment of quality
Magazines, Scientific journals and news	Publication on websites, magazines and journals in automation field • Robotics and Autonomous Systems • Robotics and Computer Integrated manufacturing • Journal of intelligent manufacturing • IEEE Transactions on Automation Science and Engineering
Demonstrators	Automation of the cable unloading from the Komax machine Physical demonstrator in IEMA plant of the robotized switchgear cabling Application of the developed Technology to other products
Expected Added Value	Improvement of wiring process, reduction of time to market, higher product quality Integration in plant already existing automation (LOF)

5.2.4 TECNALIA Individual Exploitation Plans

Objectives	TECNALIA aims to be a partner for the implementation of the latest technologies for wiring manipulation. This will lead to advanced and innovative solutions in wire manipulation for our current and potential customers, many of whom have already shown their interest.
Audience	TECNALIA customers have shown interest in robotic wire manipulation. The TECNALIA relation with industrial companies in Europe is one of its business models that will be used for the exploitation of REMODEL's results.
Environments	● Spain: ○ Basque Country: Asociacion de Máquina Herramienta ○ Hisparob: Asociación Española de robótica ● Europe: ○ Focus on Conferences and fairs. ○ European Robotics forum ● Fairs: ○ Bienal Máquina Herramienta. BIEMH (Spain) ○ Innorobo (France) ○ Automatica (Germany)
Subjects	The main topics of interest for exploitation by TECNALIA include: ● Industrial robotic applications for manufacturing ● Flexible programing ● Dual arm manipulation of deformable linear objects
Magazines, Scientific journals and news	TECNALIA has already been involved in several publications in magazines and industrial journals in both SPAIN and EU level. ● Spain ○ Empresa XXI: Focus in Spanish manufacturers. ○ El PAIS, El Mundo, Spanish new papers. ● Europe ○ EURONEWS
Demonstrators	TECNALIA is already working on the REMODEL aeronautic wiring harnesses manufacturing use case and the creation of relevant promotion material that will be then used to promote exploitation of the results ● Physical demonstrator in TECNALIA site – replication of use case. ● Videos on TECNALIA youtube video with the implemented demonstrators. ● Social media and public web of the project

5.2.5 ELIMCO Individual Exploitation Plans

Objectives	ELICMO objective is to be an End User of the Robotic Platform (UC2) created and developed during REMODEL project. The objective 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.
Audience	ELIMCO has a very good reputation with the local industries. Additionally, different aeronautical stakeholders expressed interest in robotic manipulation of deformable objects.
Environments	● Spain: ○ Andalucía: Andalucía Aerospace Cluster ○ Spanish Association of Defense, Security, Aeronautical and Space Technologies. ● Europe: ○ Focus on Conferences and fairs. ○ European Robotics forum ● Fairs: International Paris Air show. Le Bourget
Subjects	The main topics of interest for exploitation by ELIMCO include: ● Industrial robotic applications for manufacturing ● increase of productivity ● Dual arm manipulation of deformable linear objects assurance of high quality and correctness
Magazines, Scientific journals and news	ELIMCO has already been involved in several publications in magazines and industrial journals in both SPAIN and EU level. ● Spain ○ ABC, Diario de Sevilla, Spanish new papers.
Demonstrators	ELIMCO is already working on the REMODEL aeronautic wiring harnesses manufacturing use case and the creation of relevant promotion material that will be then used to promote exploitation of the results ● Physical demonstrator in ELIMCO infrastructures. Social media and public web of the project
Expected Added Value	Improvement of assembling process – reduction of time. Increase of automation degree in assembly shop. Maintaining of the same high or even higher quality and correctness level of assembled wiring harnesses.

5.2.6 TAU Individual Exploitation Plans

Objectives	TAU intends to be a prime contributor towards the development of intelligent systems capable of DLO manipulation. TAU will be focusing on providing technical aide to industrial queries and also implementing research outcomes and concepts in future coursework for students.
Audience	TAU has a very good reputation with the local industries and universities along with numerous international tie-ups. Additionally, TAU has technical faculties where new incoming students could benefit from learning new technology right at its source.
Environments	● Finland: ○ SUOMEN ROBOTIIKKAYHDISTYS ry (Robotics society in Finland) ● Europe: ○ Consultancy services for end users ○ Re-using developed methodologies for relevant research ● Fairs: ○ Alihankinta: Sub-contracting fair (Finland) Smart Factory & Future Technologies- Paviljonki (jyväskylä, Finland)
Subjects	ɔpics of special interest to TAU are the following: ● Creating a generic CAD interface for obtaining the inputs from all the use cases and generating the targets, trajectories and operation sequences for the robotic solutions. ● Create a generic interface for the users to access the system, based on authorization. ● Focus on creating ontological models to represent process and the selection criteria of equipment. Develop a methodology for teaching by demonstration of a dual-armed industrial robot.
Magazines, Scientific journals and news	TAU has already been involved in several publications in magazines and research journals in both Finland and EU level. ● Finland ○ FinTech Magazine ○ Aamulehti, Helsingin Sanomat (Finnish Newspapers) ● Europe EURONEWS ● Research Journals Robotics and Autonomous Systems Robotics and Computer Integrated manufacturing Journal of intelligent manufacturing
Demonstrators	TAU is working on the wiring harness manufacturing for the automotive sector use case and would creating relevant promotional content for industries and assignments for use in teaching in FAST-Lab ● Creating the physical platform on TAU premises in FAST-Lab and designing the structure to be implemented at the industrial partner's site. Social media posts and updating the university's FAST-Lab webpage with

	information regarding REMODEL.

5.2.7 TUM Individual Exploitation Plans

Objectives	Within REMODEL, TUM intends to be a principal contributor of the perception-related tasks. More specifically, the target is to provide valuable information regarding real-time scene reconstruction and objects tracking to the other elements of the system such as manipulation or planning. A more general target is to investigate the capabilities of tracking of deformable and small-scale objects in highly dynamic environment. Eventually, the results are intended to be extrapolated in various industries for challenging manipulation tasks.
Audience	TUM is well-known for its very high scientific output which attracts multiple industrial partners. One of the high priorities of TUM is to transfer the research output and knowledge to the industry. This is realized e.g. by offering the facilities for experience and knowledge exchange as a Competence Centre. We plan to demonstrate the technologies developed in REMODEL to guests and visitors from industry to accelerate their way into production. Additionally, TUM is known as “the entrepreneurial university” and puts high priority on supporting the spin-offs, by that ensuring influential knowledge transfer. Finally, TUM provides lectures and workshops for Bachelor and Master students that are based on the results of the most recent research.
Environments	TUM’s surrounding offers an extremely strong ecosystem for the development of new technologies, composed by from two universities supported by Germany’s excellence (TUM, LMU), leading research facilities (including DLR, multiple Fraunhofer institutes, MPG), robot and automation companies (e.g. Franka Emika, KUKA) and end users, reaching form large enterprises (e.g. Audi, BMW) to many SMEs. We will display our results on both, international tradefairs (e.g. Hannover Messe and Automatica in Munich) as well as at International forums (e.g. European Robotics Forum [ERF]). Moreover we plan to present our results at the international scientific events and magazines mentioned listed in section “Magazines, Scientific journals and news”.
Subjects	The following subjects will be primarily investigated by TUM within REMODEL: investigation of appropriate sensory system for dynamic perception tasks sensor and robot-sensor calibration real-time mapping and segmentation of dynamic 3D environment real-time tracking of deformable and small-objects e.g. cables or connectors detection and functional recognition of components.

Magazines, Scientific journals and news	TUM's chair of Robotics, Artificial Intelligence and Real-time Systems has a long history of publishing in conferences and journals hosted by the IEEE Robotics and Automation Society (RAS), including those with the highest impact factors in the field of robotics. The chair is aiming to present our results in International Conference on Robotics and Automation (ICRA) and International Conference on Intelligent Robots and Systems (IROS) as well as in Transactions on Robotics (T-RO) the Robot and Automation letters (RA-L). As of today, the first manuscript was accepted for RA-L publication with a featured presentation at ICRA 2020 in Paris. Based on our major involvement in WP4 (Vision-based Perception), the following conferences and journals will be considered which are geared to image processing and computer vision, namely: ● International Conference on Computer Vision (ICCV) ● European Conference on Computer Vision (ECCV) Transactions on Pattern Analysis and Machine Intelligence (TPAMI)
Demonstrators	TUM's chair of Robotics, Artificial Intelligence and Real-time Systems is already acting as a Competence Centre in Robotics and the scope of the HORSE / L4MS projects. In the context of REMODEL already existing human-robot-collaboration workspace will be used with a second KUKA LBR iiwa to both test and demonstrate the technologies developed in the project. The investigation will focus on the perception based aspects of the REMODEL use-cases and allow to evaluate different sensors according to the requirements of the application.

5.2.8 PUT Individual Exploitation Plans

Objectives	PUT within the scope of the project is focused on delivering the modules for bi-manual manipulation and interactive perception which will provide the framework for joint tactile vision sensing. Based on these modules the industrial partners might be convinced about the possibility of using robotic technologies in handling of deformable linear objects
Audience	PUT partners expressed interest in robotic manipulation of deformable objects. The PUT relation with industrial companies in Poland and beyond will be used for the exploitation of REMODEL's results.
Environments	● Poland: ○ Basque Country: Asociacion de Máquina Herramienta ○ Hisparob: Asociación Española de robótica ● Europe: ○ Focus on Conferences and fairs. ○ European Robotics forum ● Fairs: ○ ITM Europe (Poland) ○ Warsaw Industry Week (Poland) Automatica (Germany)
Subjects	The main topics of interest for exploitation by PUT include: ● Industrial robotic applications for manufacturing ● Dual arm manipulation of deformable linear objects Tactile-Vision and Interactive perception
Magazines, Scientific journals and news	PUT has already been involved in several publications in magazines and industrial journals in both Poland and EU level. ● Poland ○ sztucznainteligencja.org, controlingeering.pl ○ Polish National Radio and Television
Demonstrators	PUT is working on the REMODEL automotive wiring harnesses assembly use case and the creation of relevant promotion material that will be then used to promote exploitation of the results ● Physical demonstrator at PUT – replication of use case. ● Videos on PUT PPI LAB youtube video with the implemented demonstrators. Social media and public web of the project

5.2.9 ELVEZ Individual Exploitation Plans

Objectives	ELVEZ objective is to be an End User of the Robotic Platform (UC2) created and developed during REMODEL project. The innovative robotic platform designed during this project will be directly implemented in the assembling line of our wire harness production process. This will help to save an operating time of tasks and possibly to save a worker on this work station.
Audience	ELVEZ expressed interest in robotic manipulation of deformable objects. The ELVEZ relation with innovation institutes will be used for the exploitation of REMODEL's results. ELVEZ has an access to robotic solution, concerning knowledge, know-how and all results and developments as a part of internal rule “lessons learnt” for the new project. ELVEZ has a strong relation with Automotive Companies all over the Europe with whom we will share our results to become more competitive on the market.
Environments	● Slovenia: ○ Days of Innovation (Slovenia) ○ IRT3000 (Slovenia) ● Europe: ○ European Robotics forum ● Fairs: ○ IFAM (Slovenia) Automatica (Germany)
Subjects	The main topics of interest for exploitation by ELVEZ include: ● Industrial robotic applications for manufacturing ● Dual arm manipulation of deformable linear objects ● Tactile-Vision and Interactive perception-increase of automation degree in assembly shop ● reduce of tact time in order to save a worker on that work station (by replacement of worker by the robot) ● increase of productivity assurance of high quality and correctness (without damages) – like today in manually processes
Magazines, Scientific journals and news	ELVEZ is active also in scientific publication of research results. The main journals and conferences that they will focus on, are: ● IEEE Transactions on Robotics; ● International Journal of Robotics Research ● IEEE Transactions on Automation Science and Engineering ● Robotics and Computer-Integrated Manufacturing ● IEEE International Conference on Robotics and Automation (ICRA) ● IRT3000 ● Ventil ● Elektronika ● Mehatronika

	ELVEZ will describe and report all results and developments in internal concern press as well as will make a short presentation to our workers and members of management board.
Demonstrators	ELVEZ will present an every single progress – from robotic simulation to the real robotic station – to our workers, representatives of top management of ELVEZ as well as to their customers. ELVEZ may also promote this project and results in its social media e.g. LinkedIn, Facebook and maybe Youtube.
Expected Added Value	Robotization of assembling process – ergonomic workplace and reduction of tact time. Increase of robotization degree in assembly shop. Maintaining of the same high or even higher quality and correctness level of assembled wiring harnesses.

5.2.10 VWP Individual Exploitation Plans

Objectives	VWP objective is to be an End User of the Robotic Platform (UC3) created and developed during REMODEL project. The innovative robotic platform designed during this project will be directly implemented in the assembling line of our car cockpits. This will help to save a operating time of tasks and possibly to save a worker on this work station.
Audience	VWP is a part of Volskwagen AG, that means, that every single factory worldwide has an access to our robotic solution, concerning knowledge, know-how and all results and developments as a part of internal rule “lessons learnt”.
Environments	Internal Company’s Visitors and Press, VWP Workers, Members of VWP Management Board, Public content in VWP Social Media or Youtube
Subjects	The main subject of interest for exploitation by VWP is as follows: -increase of automation degree in assembly shop -reduce of tact time in order to save a worker on that work station (by replacement of worker by the robot) – increase of productivity -assurance of high quality and correctness (without damages) – like today in manually processes
Magazines, Scientific journals and news	VWP will describe and report all results and developments in internal concern press as well as will make a short presentation to our workers and members of management board. Any others publications at this time are not expected, but they may appear in another project phases and will be reported in Dissemination Monthly Report as well as to other consortium partners.
Demonstrators	VWP will present an every single progress – from robotic simulation to the real robotic station – to our workers, representatives of top management VWP as well as to other coworkers from Volkswagen AG. VWP may also promote this project and results in its social media e.g. LinkedIn, Facebook and maybe Youtube.
Expected Added Value	Improvement of assembling process – reduction of tact time (such big to save a worker on this work station). Increase of automation degree in assembly shop. Maintaining of the same high or even higher quality and correctness level of assembled wiring harnesses.

5.2.11 ENKI Individual Exploitation Plans

Objectives	ENKI aims to be an End User of the Automation Platforms developed during REMODEL project. The innovative solutions designed during this project will be directly implemented in the production chains of our extrusion line. This will help to save time in production, and it will guarantee an increment in the quality checks standards.
Audience	ENKI collaborators (customers and suppliers) have shown interest in the automation of biomedical production processes. ENKI has a strong relation with Biomedical Companies all over the world (mainly Europe, Unites States and Far-East Asia) with whom we will share our results and developments.
Environments	Congress and Exhibitors
Subjects	The main topics of interest for exploitation by ENKI include: ● The increment of the Quality Checks standards from a handmade QC to an automatic QC. ● Automatization Capabilities ● Automatization in biomedical field
Magazines, Scientific journals and news	ENKI thanks to its presence in past in different EU projects, could boast several publications in different research areas: ● Biomedical field ● Zero Defect Manufacturing Its Researchers and Project is may claim several publication and patents in Chemical/Physics Research Areas.
Demonstrators	ENKI is already working on creation of relevant promotion material that will be then used to promote exploitation of the results of its Use Case (4). ● Physical demonstrator in ENKI site – replication of use case. Social Media Contents

Expected Added Value	

5.3 Non-commercial exploitation

Non-commercial routes will be pursued for the exploitation of the project results. The consortium, or at least part of it will certainly apply for new projects both at the national, EU and international level, in order to enlarge the field of application of the project outcomes and increase the knowledge and interest about the robotic manipulation of deformable objects by the scientific community.

The REMODEL results will be taken as reference in order to contribute to the definition of new standards for the industrial applications that are the objective of the project. For example, since no standardized information is provided about the components is the assembly operations targeted by REMODEL, it could be possibly to propose the representation modality developed in REMODEL as a standard way to represent component data in order to automatize the related manufacturing activities. A similar can be foreseen for the representation of the operations involved in the manufacturing and assembly of wiring harnesses and products containing cables in general.

5.4 SMEs competitive advantage

REMODEL aims at emphasizing the potential competitive advantage that SMEs would gain through their participation to the project by exploiting the participation to fairs and other public events in order to increase the awareness about the project outcomes to potentially interested users. Moreover, we foreseen that several project outcomes will generate new innovative start-ups participated by the consortium members which main business will be both commercialization and servicing related to the novel technologies developed in REMODEL. This competitive advantage will be ensured by a suitable protection of the IPR related to the newly developed technologies along the whole project.

5.5 Business plan

The typical business model of the established industrial robot suppliers is to work closely together with system integrators. In this way, they can concentrate on the technology of the robot manipulator and controller, and the application-related know-how resides mostly with smaller companies doing the integration work.

This business model works well across many market domains, ranging from food & beverage to automotive. Future markets may need to review and adapt this way of working to accommodate new boundary conditions. Due also to the fact that many manufacturing industries have no robotic experts among their employees, the best business model could be based on distributing the developed technologies as services paid per use and maintained directly by the experts developing these solutions. Therefore, service providers and system integrators (SMEs) for enterprises working in the manufacturing sector, and in particular in the production of devices including cables and hoses, are likely to be generated by the project.

Considering this business model as the preferential solution, the consortium industrial partners will work together to come up with a business plan for the exploitation of the REMODEL technology. The business plan will detail the business model to be used

for revenue generation and the investment plan the consortium will adopt when engaging investors.

The business plan will also specify the further technological developments required for the project to reach the market. The business plan will be part of the final exploitation plan (D8.10).

The CANVAS model will be used for the exploitation results process. This model has been successfully applied in a wide range of contexts by private and public companies around the world and has become a common language allowing to describe and manage business models to elaborate new strategic alternatives.

The CANVAS model is a scheme in which nine elements are defined:

- Customer segments: The different groups of people or entities that the business aims at, in order to provide them a service or sell them a product.
- Value proposition: The set of products or services that provide value for the customer segments.
- Channels: The ways to reach different customers creating awareness, selling and delivering product and services.
- Customer relationships: They type of relationships a business establishes with each customer segment.
- Revenue streams: The revenue that is obtained from each segment.
- Key resources: The most important assets that the business needs to function.
- Key activities: The most important activities needed to the business works.
- Key partnerships: The suppliers and strategic partners that the business needs to function.
- Cost structure: All the costs in which the business model incurs to operate.

A description of CANVAS methodology is shown in the following table:

<table>
<tr>
<td rowspan="2">Key Partners
The network of suppliers and partners that make the business model work
“Who are our Key Partners? Who are our key suppliers? Which Key Resources are we acquiring from partners? Which Key Activities do partners perform?”</td>
<td>Key Activities
The most important things a company must do to make its business model work
“What Key Activities do our Value Propositions require?
Our Distribution Channels? Customer Relationships?
Revenue streams?”</td>
<td rowspan="2">Value Propositions
The bundle of products and services that create value for a specific Customer Segment
“What value do we deliver to the customer? Which one of our customer’s problems are we helping to solve? Which customer needs are we satisfying? What bundles of products and services are we offering to each Customer Segment?”</td>
<td>Customer Relationships
The types of relationships a company establishes with specific Customer Segments
“What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? How costly are they? How are they integrated with the rest of our business model?”</td>
<td rowspan="2">Customer Segments
The different groups of people or organizations an enterprise aims to reach and serve
“For whom are we creating value? Who are our most important customers?”</td>
</tr>
<tr>
<td>Key Resources
The most important assets required to make a business model work
“What Key Resources do our Value Propositions require?
Our Distribution Channels? Customer Relationships?
Revenue Streams?”</td>
<td>Channels
How a Company communicates with and reaches its Customer Segments to deliver a Value Proposition
“Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How are our Channels integrated? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?”</td>
</tr>
<tr>
<td colspan="2">Cost Structure
All costs incurred to operate a business model
“What are the most important costs inherent in our business model? Which Key Resources are most expensive? Which Key Activities are most expensive?”</td>
<td colspan="3">Revenue Streams
The cash a company generates from each Customer Segment (costs must be subtracted from revenues to create earnings)
“For what value are our customers really willing to pay? For what do they currently pay? How are they currently paying? How would they prefer to pay? How much does each Revenue Stream contribute to overall revenues?”</td>
</tr>
</table>

Using this methodology a preliminary business model Canvas for REMODEL has been created:

<table>
<tr>
<td rowspan="2">Key Partners

Industrial partners:
IEMA, VWP, ENKI, ELIMCO and ELVEZ will be the end users providing the use cases and to bring the solutions to the industry.

RTD partners:
UNIBO, UCLV, TECNALIA, TAU, TUM and PUT to advance robotics technologies TRL</td>
<td>Key Activities
Project period develops:
Manipulation devices and robotics platforms specialized of DLOs
3D environment reconstruction, part identification, localization and deforming tracking
Modeling, identification, prediction and tracking of DLO shape and behavior
Control algorithms based on perception data and DLO models
DLOs grasp and manipulation control by vision-tactile-proximity data fusion
Exploring interactive perception paradigm
Motion planning
Automated task planning
Teaching by demonstration and tutored learning of robot skills
After project end: Marketing, dissemination</td>
<td rowspan="2">Value Propositions

Development and combination of different technologies to provide to robotic manipulators with the ability of DLO manipulation.
Reduce time to market from 10% to 27% depending on the use case
Increase customization capabilities
Introduce product documentation and traceability for better quality assessment
15% increase in OECD Job Quality Index through work environment and safety improvement
20% increase in productivity</td>
<td>Customer Relationships

Services:
Solutions validation
Support
Customized engineering
Training</td>
<td rowspan="2">Customer Segments

Potential target clients are all industrial manufacturing involving DLOs manipulation:
Switchgear wiring
Wiring harness manufacturing
Wiring harness assembly
Hose packaging</td>
</tr>
<tr>
<td>Key Resources
Partners’ own physical resources, personnel for development, installations, testing and marketing
Financial resources</td>
<td>Channels
IEMA, VWP, ENKI, ELIMCO and ELVEZ internal plant technology managers
Commercial network and marketing
Exhibitions and fairs</td>
</tr>
</table>

			(national and international) • Project social media	

Cost Structure Cost for engineering and industrialization Marketing activities during and after the project Hardware/software cost	**Revenue Streams** Cost saving from competitive solutions Increase sales potencial due to innovative solutions Revenue for services

5.6 Communication activities

In addition to the dissemination activities described above, some general communication activities will be done from the beginning of the project to explain the innovation activity of REMODEL to the wide public of European citizens. They will remark that the REMODEL project focuses on developing bimanual coordinated manipulation of DLOs, DLO modeling and industrial automation of manufacturing process involving DLOs.

Communication activities aims at **raising awareness** about the addressed topics and promoting the project and its findings to various audiences. Measures for **public/societal engagement** are essential to enhance the project visibility, to sustain diffusion of the results to the public at large. The consortium will create a communication strategy that will specify how communication will be done both inside and outside the consortium (D8.3). A logo and a graphic charter has been created to bring a visual identity to the project. The communication activities will be summarized in D8.4. Table 2.2.5 recaps the communication measures for promoting the project with the associated objectives:

Table 2.2.5: Communication measures for promoting the project and associated objectives

Communication Tool	Target audience	Objective
Logo and graphic charter	All	Create a visual identity of the project
Project video	All	Present the project partnership, the main activities and objectives
Press releases	All	Awareness of Research activity in H2020
Brochure, flyers, posters	General Public	Awareness of Research activity in H2020; Create interest in Students, practitioners
Media: Tv, radio, press	General Public	Awareness of Research activity in H2020; Improving the public understanding of science
EU tools e.g. Cordis Wire	General Public	Improving the public understanding of science
Social media (Facebook, Twitter)	General Public; Students	Improving the public understanding of science; Awareness of Research activity in H2020
Professional networks (LinkedIn)	General Public; Professionals	Improving networking with professionals and communities; Enlarge the network in potential end users
Communication kit	All	Deliver overall information on the project's progress and results

The main channels for REMODEL dissemination of results will be the most relevant and high-impact factor journals, conference and events, such as those indicated in table 2.2.2.

Table 2.2.2: Main channels for REMODEL dissemination.

Publications/Events	Title of Journal/Conference
Scientific Technical Journals	IEEE Tran. on Robotics, IEEE Tran. on Automation Science and Engineering, IEEE Robotics and Automation Magazine, IEEE/ASME Tran. on Mechatronics, Robotics

	and Autonomous Systems, Journal of Intelligent Service Robotics, Artificial Intelligence Journal, Mechatronics (Elsevier), International Journal of Human Computer Interaction (IJHCI), IEEE Robotics and Automation Letters, Interaction Studies, Industrial Robot, International Journal of Robotic Research (IJRR), Sensors & Actuators A: Physical, IEEE Tran. on Automation Science and Engineering, IEEE Tran. on Pattern Analysis and Machine Intelligence, Advanced Robotics, Automatica, Robotica
Relevant Congresses, Conferences and Events	IEEE International Conference on Robotics and Automation (ICRA), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM), Conference on Artificial Intelligence (AAAI), IEEE International Conference on Automation Science and Engineering (CASE), ACM/IEEE International Conference on Human-Robot Interaction (HRI), IEEE RAS & EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob), IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), International Robotics Festival of Pisa, the Italian “Science Festival” of Genoa, or the European “Researcher’s Night”
Thematic Portals	EFFRA Innovation Portal

The project website has been set up by the end of month 3 (D8.1) for both consortium members’ and public access. The website will be actively maintained during and after (at least 2 years) the project period. The site will contain all relevant information of the project’s current activity and results. It will be used also as a dissemination channel, as all publications and public deliverables will be readily available.

5.7 Critical risks for implementation

Risk	Likelihood	Impact	Proposed risk-mitigation measures
Consortium risks - WPs involved: all			
Exit of a partner	Low	Loss of competences and delay in the planned activities	The Coordinator will monitor constantly the involvement of each partner by properly motivating the researchers. In case of early exit of a partner, the WP objectives will be suitably adapted to the contingency and the partners' workload will be properly reassigned to the remaining partners.
Divergence among partners on project running	Low	Delay in the planned activities	Consortium agreement rules every conflict situation. The research of consensus is the first objective. However, after a reasonable amount of time has been allowed to illustration and defence of conflicting positions, in order to avoid deadlock in project operational progress, the approval of a two-third majority of Partners will be considered conclusive.
Bad consortium communication	Medium	Delay in the planned activities	Improve team building among members; improve communication facilities; increase face to face or telephone communications when possible.
Management risks - WPs involved: WP1 and all			
Underestimation /overestimation of workload	Low	Congestion of the activities and delays in the planned progresses	The workload will be constantly monitored and, if needed, the objectives will be revised according to the actual status of the project and partners.
Inaccurate budget allocation	Low	Some partners may not have enough resources to carry on all the foreseen activities	Identify necessary re-allocations among partners and define a new budget distribution to be approved by the Scientific and Management Board and to be submitted to the Project Officer approval
Communication/Dissemination/Exploitation risks - WPs involved: WP8			
Dissemination strategy not appropriate	Low	Low visibility of the project results	Discuss among all the partners and redesign the dissemination strategy in order to reach the right result.
Exploitation strategy not appropriate	Medium	Inadequate exploitation at industrial level	Discuss among all the partners and redesign the strategy or the potential final market for the exploitable results.
Technical risks - WPs involved: WP3			
User Interface is not comfortable for	Low	Increased time and cost	Evaluate alternative solutions, such as larger touchscreen displays mounted on

production		for development	moveable supports.
Difficulties in defining robot operations for CAD	Low	Increased the information provided by the CAD platform	Integrate more information from the product design by setting a proper database of macro actions to be performed by the robot for the manufacturing, exploiting also tutored learning.
Reduced performance of tutored learning	High	Increase teaching time	Increase the number of hand-coded tasks. Introduce alternative teaching and programming methods.
Technical risks - WPs involved: WP4			
Difficulties in tracking wires, cables and components	Medium	Limitation in the robot task autonomy	Exploit different illumination and vision techniques, increase resolution and quality of the cameras, evaluate the use of laser scanners.
Light conditions limit the vision capabilities	Medium	Increase illumination system complexity and cost	The cameras will be equipped with a dedicated illumination system, also exploiting structured light, and proper motion strategies can be introduced for reconstructing the scene in cluttered environments before performing grasping and manipulation. The use of laser scanners will also be evaluated.
Poor resolution of environment and components reconstruction	Medium	Increase camera complexity and cost	Adopt higher-resolution cameras. Evaluate the use of laser scanners and laser rulers. Perform multi-stage scan and data fusion.
Technical risks – WPs involved: WP5			
Difficulties to plan robot tasks	Low	Bad planning of robot activities	Increase the effort to code and defined in the robotic platform simple rules, constraints, basic actions and skills.
Performance problem in motion planning	Medium	Impossibility to adapt the trajectory to the environment and task	Reduce the velocity of the robot, evaluate different placement of the robot base, modify the robot tools to simplify the action, develop devoted tools to execute specific tasks.
Complexity of planning the robot actions for long wire manipulation	High	Increase of the planning and execution time during the wire manipulation	Reduce the maximum wire length. Investigate alternative approaches for the wire modelling and the solution of the wire inverse kinematics, e.g. based on machine learning techniques. Develop hardware tools for simplifying the cable manipulation on the basis of the particular application.
Technical risks - WPs involved: WP6			
Optoelectronic force/tactile/proximity sensors do not fit all requirements	Low	Delay in the planned activities	Adoption of alternative technologies or evaluation of commercial solutions.

The end-effectors do not guarantee all expected functionality	Low	Delay in the planned activities	Evaluate alternative more-complex and/or commercial solutions to fit the requirements better.
Technical risks - WPs involved: WP7			
Limited performance in UC1	Medium	Reduced project impact	Redesign components and technologies, limit task variability introducing environment structuration, improve integration, reduce final TRL to stabilize the results.

5.8 Sustainability of the exploitation plan

In order to properly implement the business plan, sustainability strategies as well as commercial and non-commercial exploitation will be implemented after the end of the EC funding. The REMODEL industrial partners, or at least part of them, are certainly interested in investing directly for the commercial exploitation of the project outcomes not only for their internal use. Moreover, in order to ensure the medium- to long-term impact of the project, other financial sources, such as funding channels for commercial development and exploitation at national, EU and international level as well as bank loans and investment funds devoted to the development of innovative industrial technologies, will be exploited.

6 IPR management

6.1 Intellectual Property Rights (IPR)

Apart from the Guideline for IPR rules in Horizon 2020 projects (the Coordinator is in contact with the IPR Helpdesk Service organized by the EC) that will be the basis for the project IPR standards, more specific rules regulating each aspect of the property and protection needs have been defined in the Consortium Agreement (CA), specifically in section 8 (outcomes, ownership, transfer, dissemination etc.) and 9 (access rights).

The CA comply with the terms and conditions of the EC Grant Agreement (GA), and it is based on the DESCA model. the Consortium Agreement (CA), which will be continuously updated over the life of project.

6.2 Background

As a research project integrating different technologies that are available to partners, the project acknowledges the need to identify and protect the background and foreground knowledge and IPR.

Background means establish a clear picture of background intellectual property each partner is bringing to the project and to correlate the processes each partner will implement to assess and protect new intellectual property. This assessment is linked to the project's CA.

6.3 Protection of foreground

Foreground (i.e. results including IP generated during the project) shall be owned by the partner or partners who developed the results.

Each partner shall inform the project Coordinator and the project partners 4 weeks in advance of the filing of a patent application or of the dissemination of information in the public domain. Subject to the provisions of the GA and the CA any owner of any result shall be free to use such results and to commercialize it. In case of joint ownership each owner shall be free to use such results and commercialize it and to grant licenses to its affiliated entities in compliance with the provisions of the GA.

Results emerging from the project shall be made available free of charge to partners of the consortium for research purposes within the scope and duration of the project.

If a partner is not interested in filing a patent application or in maintaining a patent application for an invention achieved as result of the project, he/she shall offer his rights in the respective invention or patent application.

6.4 Access rights

As part of the CA, the rules and level of accessibility of the project have been discussed and agreed upon by universities, researchers and stakeholders or other third parties

6.5 Dissemination rules

Each disclosure of the results (publications, conferences, seminars, courses, etc.) will be coordinated by adopting precautionary IPR protection tools in order to not obstacle with preventive disclosures the possibility of protecting the achieved foreground.

6.6 Confidentiality

The CA is taken care of the beneficiaries “willing to protect the confidentiality of their and others” background as well as the information generated under the project (foreground)

7 Conclusions

The Exploitation Plan is being designed in order to multiply the impact of the proposed solutions and prepare the transition towards industrial and commercial applications.

The Exploitation Plan describe the activities to be undertaken in order to ensure the exploitation beyond the project itself. The exploitation strategy reflects and builds up as a result of sound analysis of the market trends, potential users, and financial sustainability.

The stakeholders are being identified and analyzed in terms of specific needs and objectives.

Key results of the project with a commercial potential may be protected by patents, copyright or trade secrets and therefore will be disseminated with due care.