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

Deliverable 8.6 – Interme-diate Data Management Plan

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Document History

Version	Date (DD/MM/YYYY)	Created/Amended by	Changes
1	30/04/2020	UNIBO	First version
2	09/04/2021	UNIBO	First draft of Intermediate DMP
3	28/04/2021	UNIBO	Revised draft of Intermediate DMP
4	30/04/2021	UNIBO	Final Intermediate DMP version

Scheduled Data Management Plan (DMP) Updates

The DMP is a document that evolves during the lifespan of the project and registers all relevant changes in the life-cycle of all the research data sets of REMODEL project. Updated versions of the DMP have already been planned (see table below). Moreover, this document will be updated whenever important changes in the data or the data management policy occur.

Issue	Expected by project month (M)
Initial DMP	M6
Intermediate DMP	M18
Final DMP	M36

Partner Acronyms

Partner extended name (**country**)	**acronym**
Alma Mater Studiorum-Università di Bologna (Italy)	UNIBO
Università degli studi della Campania Luigi Vanvitelli (Italy)	UCLV
I.E.M.A. SRL (Italy)	IEMA
Fundacion Tecnalia Research & Innovation (Spain)	TECNALIA
Elimco Aerospace SRL (Spain)	ELIMCO
Tampereen Korkeakoulusaatio sr (Finland)	TAU
Technische Universitaet Muenchen (Germany)	TUM
Politechnika Poznanska (Poland)	PUT
Elvez, proizvodnja kabelske konfekcije in predelava plasticnih mas doo (Slovenia)	ELVEZ
Volkswagen Poznan sp z o.o (Poland)	VWP
ENKI (Italy)	ENKI

Content

The Data Management Plan (DMP)

The DMP is a document that provides details regarding all the research data collected and generated within the REMODEL project. In particular, it explains the way research data are handled, organized, licensed and made openly available to the public, and how they will be preserved after the project is completed. The DMP also provides motivations when versions or parts of the project research data cannot be openly shared on account of third-party copyright issues, confidentiality or personal data protection requirements or when open dissemination could jeopardize the project achievements.

This DMP reflects the current state of the art of the REMODEL project. However, the details and the final number of the project data sets may vary during the course of research. The variations will be recorded in updated versions of this DMP.

1 Data Summary

REMODEL will enable new production environments, where the manufacturing of complex products composed of multiple wires and cables by means of dual-arm robots is not only possible, but fully integrated with the product design chain. This result will be achieved by exploiting the result of a previous project called WIRES[1], were basic tools for the manipulation of electric wires have been developed. Moreover, new perception and interaction capabilities will be embedded into the robot to be effective in the industrial manufacturing scenario.

REMODEL will bring new opportunities to human-intensive labor manufacturing processes like the one dealing with cables and wires, where the routing and fitting tasks are calling for advanced handling techniques. The REMODEL robotic ability will impact several production scenarios in which human work is widely adopted due to the complexity in the objects, materials and manipulation tasks, characterized unpredictable initial configuration as well as large deformability and plasticity. Activities involving mass production, such as wiring harness manufacturing for automotive and appliances, are moving outside Europe due to the high labour cost and to the repetitiveness of the tasks that produces high psychophysical stress in the workers. In other cases, such as the switchgear wiring and the wiring harness manufacturing for the aerospace sector, the need of increasing production flexibility, reliability and traceability of the product as well as reduce costs and time to market implies the adoption of innovative tools to maintain proper competitiveness and answer the market requests. To proof the effectiveness of the REMODEL outcomes, four industrial manufacturing use cases provided by the industrial partners and covering five different domains, i.e. the production and assembly of wiring harnesses in the automotive and the aerospace field, the switchgear wiring and the manufacturing of medical consumables, will be developed.

[1] WIRES – Wiring Robotic System for Switchgears, http://echord.eu/wires.html

The project is collecting and generating several type of data:

1. Experimental and observational data;

2. Data from surveys, questionnaires, interviews and focus groups.

Research teams have agreed to convert research data from proprietary formats to well-known and documented open formats in order to facilitate accessibility and reusability (Tab.1).

Table 1 - Summary of data format

Type of data	Formats used during data processing	Formats for sharing reuse and preservation
Textual data	Plain text (.txt) and/or Rich Text Format(.rtf)	Plain text (.txt) and/or Rich Text Format(.rtf)
Tabular data with minimal metadata	Rosbag (.bag), comma-separated value (.csv), plain text (.txt), pointcloud data format (.pcd)	Rosbag (.bag), comma-separated value (.csv), plain text (.txt), point-cloud data format (.pcd)
Image data	TIFF (.tif) and/or JPEG (.jpeg)	TIFF (.tif) and/or JPEG (.jpeg)
Video data	MPEG-4 (.mp4)	MPEG-4 (.mp4)
CAD files	Platform dependent format: STEP (.stp), X3D (.x3d)	Platform dependent format: STEP (.stp), X3D (.x3d)
Script files	.cpp, .h	.cpp, .h

Documentation files explaining all relevant details regarding data collection, processing methodologies and quality assurance are deposited along with the data sets in .odt, .rtf or .pdf format.

Moreover, during the course of the project, existing data from different sources will be re-used. Specifically, REMODEL generated data will be compared with the experiments and data collected during previous projects, e.g. the WIRES project[2]. However, all the existing data necessary to be reused are specifically reported in the tables containing the detailed explanation of the datasets (see *Annex I*).

The data produced can be of interest to different potential users. They may include every person, body, corporation, company or institution interested in carrying out research in the same field of the REMODEL project.

The size of the data is is still uncertain at this stage of the project, it is expected to do not exceed 5 TB.

[2] WIRES – Wiring Robotic System for Switchgears, http://echord.eu/wires.html

2 FAIR Data

This DMP follows the EU guidelines[3] and describes the data management procedures according to the FAIR principles[4]. The acronym FAIR identifies the main features that the project research data must have in order be findable, accessible, interoperable and re-useable, allowing thus for maximum knowledge circulation and return of investment.

2.1 Making data findable, including provisions for metadata

At the moment of publication of project results, each research team deposit and describe the relative underlying data sets in institutional or public data repositories that can attribute persistent unique identifiers (i.e. DOI) to the deposited items. Partners are strongly recommended to use the persistent unique identifiers to cite the data sets as underlying data within their research publications. The chosen data repositories support standard descriptive metadata to ensure data sets indexing and discoverability. In particular, they support Dublin Core and DataCite Metadata Schema. Moreover, they comply with the OpenAIRE 3.0 requirements for data archives. As a consequence, the project data sets will be visible via the OpenAIRE portal, facilitating project reporting procedures.

(See Table 2 for the list of the chosen data repositories).

Specific keywords derived, when possible, from thesauri and controlled vocabularies are associated to each data set to enhance semantic discoverability.

REMODEL research data are organized in data sets, which are named collections of data units with the same focus and scope. In this DMP are suggested the following common rules for data set naming in order to improve data visibility, discoverability, citation and permanent online tracking. The recommended data set title structure consists of:

> *PROJECT ACRONYM. WPnumber. WP title or description specifying WP aims. Tasknumber. Task title. Description specifying Task aims. Version number*

Example:

> *REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_2. Assessment Of Potential Application Barriers And Facilitators. Survey New Organizational Factors. v0*

[3] Guidelines on FAIR Data Management in Horizon 2020 (Version 3.0, 26 July 2016), http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf
[4] The FAIR data principles (Force11 discussion forum), https://www.force11.org/group/fairgroup/fairprinciples

The version number of the data set will be added at the end of the title in case of data revisions to help identifying the data set updates (see *Annex I* for data set names, unique identifiers and descriptions).

The DMP recommends also the following rules for file naming:

- for data set file(s)

  [PROJECT ACRONYM]_WPnumber_Tnumber_coverage or other content specifications_date (YYYYMMDD)_vn.file extention

  Example:

  REMODEL_WP2_T2_2_survey_new_organizational_factors_20200531_v0.txt

- for readme file(s)[5]

  [PROJECT ACRONYM]_WPnumber_Tnumber_coverage or other content specifications_date (YYYYMMDD)_vn_README.file extention

  Example:

  REMOD-EL_WP2_T2_2_survey_new_organizational_factors_20200531_v0_README.txt

WPnumber means "work package number" Tnumber is "task number", and vn is the "version number" (in case of data revisions or updates).

2.2 Making data openly accessible

As a guiding principle, REMODEL seeks to make research data openly available, whenever possible, in order to allow dissemination, validation and re-use of research results. To this purpose, all the files are converted to standard and well-documented (and possibly open) formats or, when not possible, widely used proprietary formats; moreover, the data sets are deposited together with all relevant documentation and explanation.

Restrictions to access are applied only in the following cases:

- when collected data belongs to third party which have denied permission for sharing them on account of confidentiality and proprietary issues;
- protection of personal data of key informants involved in surveys, interviews, and case studies.

[5] A "README" file is a document containing relevant information about data set authorship, terms of reuse and responsibilities, explaining data set content and structure, collection procedures and analysis (such as file specifics, methodologies, codebooks of variables, data sources, and further necessary notes). (See Annex II to visualize the suggested README file template).

(reasons will be explained in the accessibility details relating to each data set described in *Annex I*);

As a consequence, all possible and legitimate actions and strategies are adopted to allow data sharing including:

- obtaining copyright permissions from third party data owners to be allowed to re-use, reproduce and distribute the collected data;
- converting the files to standard open formats;
- providing all relevant documentation and explanation for the data and the data sets;
- obtaining the consent of informants involved in surveys, interviews, and case studies, and anonymizing and aggregating the data;
- in case of copyright on raw data derived, collected or elaborated from pre-existing data-bases or from other original sources (i.e. papers, journal articles, book chapters, reports, video and audio sources), collected data are made available if the reproduction and sharing are allowed by expressed permission of the right holders or by applicable copyright exceptions and exemptions. Specifically, reproductions and communication of brief excerpts of texts and of other protected works are permitted for illustration purposes for scientific research, provided that the source, including the author's name, is acknowledged and provided that the use does not conflict with the exploitation of the original source and does not unreasonably prejudice the legitimate interests of right holders. Otherwise, only aggregate data resulting from the analysis are openly published. Anyway, when the sources are freely available on-line in their original repositories, but direct reproduction is not allowed, a detailed account on how the data set was created from the original data is provided, together with the specification of open repositories from where the original data sets are available. Raw data consisting in fulltexts are not be made available without copyright holders' permission.

For data that fall under some of the restrictions described above and for which it is not possible to take any action to make them shareable, EU allows complete closure or restricted access to them. REMODEL DMP indicates the versions or parts of the data sets that cannot be freely shared providing the specific motivations in *Annex I*.

At the time of publication of results, researchers deposit the project data that can be shared in a data repository in order to guarantee their discoverability, access and preservation beyond the project end.

The data repositories chosen by partners are both institutional and public repositories (see Table 2). They guarantee long term preservation and attribute valid DOIs as persistent unique identifiers to the archived data sets. They support open licenses and different access levels. Finally, they adopt descriptive metadata standards as required by the OpenAIRE Guidelines and allow cross-linking between publications and the relevant data sets (see Table 2).

Each different data set is deposited by the team that is responsible for the data collection and management in the repository of their choice.

Table 2 – Summary of repositories.
The following table shows the repositories for data sets publication and preservation chosen by REMODEL partners

Partner	Repository name	Type	Permanent ID	OpenAIRE compatibility	Catalogued in R3data?
UNIBO	AMS Acta	Institutional	DOI	OPENAIRE DATA (FUNDED, REFERENCED DATASETS)	https://www.re3data.org/repository/r3d100012604
TAU	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468
IEMA	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468
TECNALIA	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468
TUM	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468
UCLV	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468
PUT	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468
ELVEZ	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468
VWP	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468
ENKI	ZENODO	Multi-disciplinary	DOI	OPENAIRE BASIC (DRIVER OA)	https://www.re3data.org/repository/r3d100010468

For each deposited data set, all relevant documentation explaining data collection procedures and analysis (such as codebooks, methodologies, etc.) are made available along with the data, in order to guarantee intelligibility, reproducibility and the validation of the project findings. Moreover, the deposited documentation specifies the tools and software recommended to reproduce and reuse the data, when necessary. (See Tab.3 for examples of tools and software enabling reuse of the dataset)

2.3 Making data interoperable

All data sets are described using standard descriptive metadata, such as Dublin Core and DataCite Metadata Schema, in order to ensure metadata interoperability for indexing and discoverability. All relevant documentation explaining codebooks, users' manuals, data collection procedures and analysis is made available along with the data in order to guarantee intelligibility, reproducibility and the validation of the project findings.

To allow data exchange and re-use among researchers, institutions, organisations, countries, etc., partners agree to convert all shareable data from proprietary formats and to make them available in well-known and documented (possibly open) formats (see Tab.1 for details) or, when not possible, in well-known propriety formats, as much as possible compliant with available (open) software applications. In case particular software is used in data processing, full explanation and instructions are included in the deposited documentation (a summary of the tools and software necessary to reuse of data sets is described in Tab.3).

Table 3 – Summary of tools and software for enabling re-use of the data sets

Tools/software
Robot Operating System (ROS)[6]
Matlab[7]
Python[8]
FreeCAD[9]
Meshlab[10]
OpenOffice[11]
Microsoft Office[12]
VLC media player[13]

2.4 Increase data re-use (through clarifying licences)

REMODEL distributes the shareable data by adopting licenses that allow re-use of the data and of the data sets in their entirety by other scholars and stakeholders. The data sets are made available, unless otherwise stated, under Creative Commons Attribution 4.0 Internationa (CC BY 4.0[14]) license.

In general, data are made openly available as underlying data necessary to validate the research results immediately at the time of publication of public reports and scientific papers. Data are given full citation from official project publications and web site and they are made available through the chosen institutional or public data repositories compliant with OpenAIRE requirements[15]. (See Table 2)

It is possible that an embargo period may be applied to some data sets to allow full exploitation of research results by the partners. Embargoes applied to the datasets are specified in the descriptive tables.

The research data that are made openly available are deposited in open formats in institutional/multi-disciplinary OpenAIRE-compatible repositories that guarantee long term preservation to archived items, therefore they will be re-usable by third parties after the end of the project.

Back-up copies of the research data that cannot be shared and cannot be deposited in institutional or public data repositories are locally stored by each partner.

[6] ROS, https://www.ros.org/
[7] Matlab, https://it.mathworks.com/products/matlab.html
[8] Python, https://www.python.org/
[9] FreeCAD, https://www.freecadweb.org/
[10] MeshLab, http://www.meshlab.net/
[11] OpenOffice, https://www.openoffice.org/
[12] Microsoft Office, https://www.office.com/
[13] VLC, https://www.videolan.org/
[14] CC BY 4.0 license, https://creativecommons.org/licenses/by/4.0/
[15] OpenAIRE, *For Data Providers* https://www.openaire.eu/intro-data-providers

The quality of the data is carefully assured by specifying, in the documentation of the dataset released in the official repository, the method and the instrumentation used to acquire them. Additionally, the actions for the deposit of clear, clean and documented data in the dataset will be ensured as a data quality process.

2.5 Allocation of resources

Making data FAIR requires an investment of money and researchers' time. In REMODEL case, cost of data preservation after the project end are null because the chosen repositories do not apply fees for archiving and data curation.

During the project, the OneDrive cloud storage solution provided by UNIBO is used to share data among partners. In any case, no personal information is stored in the cloud, and institutional solutions will be preferred. (onedrive provided by unibo)

Costs related to data management and documentation, conversion of proprietary data files into standard (open) formats, and deposit procedures (e.g. data management, preparation of the datasets descriptive documentation, of the conversion of data files to open formats and data sets self-archiving procedures) can be estimated about 3-5% of the amount of Person-Months assigned to each Partner for the research activities. Moreover, the activities related to the DMP (such as providing guidance on data management and open access issues, coordinating the Partners, and preparing the DMP) will cost about 1 Person-Months a year for the whole duration of the project.

Responsible for data management are the data sets creators who are generally the team leaders directly involved in research data organization and collection (see Table 4). Researchers are encouraged to identify themselves with the unique persistent identifier ORCID. Registration is free of charge for researchers and allows for automated linkages between the researched identity and his research activities and outputs.

Moreover, partners are encouraged to identify and cite all contributors (See Tab.4) participating in data management activities, specifying their roles according to a given standard vocabulary (DataCite Metadata Schema).

Table 4 – Summary of research team leaders responsible for the data sets and team members involved in the data sets collection and management.

Team	Member	ORCID ID (if available)	Role
UNIBO	**Gianluca Palli**	0000-0001-9457-4643	Project coordinator
	Roberto Meattini	0000-0003-0085-915X	Project member
	Wendwosen Bellete Bedada		Researcher
	Alessio Caporali		Researcher
	Davide Chiaravalli		Researcher
	Daniele De Gregorio *		Researcher
	Claudio Melchiorri		Project member

Team	Member	ORCID ID (if available)	Role
	Kaylan Takada		Researcher
	Riccardo Zanella		Researcher
TAU	**Saigopal Vasudevan**		Project member
	Pablo Malvido Fresnillo		Project member
IEMA	**Maurizio Indovini**		Project member
TECNALIA	**Maite Ortiz de Zarate**		Researcher
	Aitor Ibarguren		Project member
ELIMCO	**Juan Manuel Alonso**		Project member
TUM	**Arne Peters**	0000-0002-0620-3154	Project member
UCLV	**Pirozzi Salvatore**	0000-0002-1237-0389	Project member
	Andrea Cirillo		Researcher
	Marco Costanzo		Researcher
	Gianluca Laudante		Researcher
PUT	**Krzysztof Walas**		Project member
	Kicki Piotr		Project member
ELVEZ	**Ziga Gosar**	0000-0003-0872-0355	Project member
VWP	**Pawel Lembicz**		Project member
	Kalota Lukasz		Project member
ENKI	**Nicolò Bontempi**	0000-0002-8371-8805	Project member
	Alice Dotta		Project member

Team Leader

*** Eyecan.ai Srl**

Keys for "Role" column: Data Collector (such as survey conductors, interviewers…), Producer (person responsible for the form of a media product), Project Member (a researcher indicated in the GA), Researcher (an assistant to one of the authors who helped with research, data collection, processing and analysis but is not part of team indicated in the GA), Research Group (the name of a research institution or group that contributed to the data set).

(See *Annex I* for details about data management responsibilities related to each project data set).

2.6 Data security

At each institution, research data are stored in computers, laptops, intranets or hard-drives accessible through institutional password periodically modified according to national law provisions for data security and protected by regularly updated antiviruses. None of the project data is left inadvertently available. As a general principle, all materials that could lead to an identification of the person (e.g. informed consent) are stored separately from actual data (i.e. results of surveys, etc.), and processing operations are carried out only by the duly authorized research staff. All the research materials stored in computers are subject to regular backup in order to safeguard them from accidental losses.

The OneDrive cloud storage solution provided by UNIBO is adopted for data sharing among research teams (in any case, no personal information is stored in them). In this case, as well, all the data will be password protected and regular backup ofhe data is performed to ensure data recovery. In addition, all Partners are asked to keep local updated copies of all their files.

Long term preservation of public data is ensured by the chosen data repositories that have specific preservation policies. UNIBO AMS Acta, for example, guarantees long term preservation to the archived materials also thanks to a deposit agreement with the National Central Library in Florence. Zenodo policy ensures that the items will be retained for the lifetime of the repository and in case of closure, best efforts will be made to integrate all content into suitable alternative institutional and/or subject based repositories.

2.7 Ethical aspects

Ethical aspects are mainly related to the management of the personal information, which are stored and treated in compliance with the GDPR by all the partners, in accordance to what reported in the project deliverables D9.1 and D9.2. In particular, all the collected data and surveys are anonymized (where necessary for the presence of personal information) and the people involved in surveys are informed about the purpose of the research and are asked their written consent to the data treatment within the project. Moreover, no personal data are transferred among the partners. The results are in any case anonymized, transferred and published in aggregated form. All the anonymized and aggregated data generated during the REMODEL project will be uploaded on a data repository at the time of publication of results or at the project end, in accordance with H2020 specifications.

3 Data sets overview

The following table (Tab.5) offers an overview of the data sets expected from the project which are described more in detail in *Annex I*. It will be updated according to DMP changes and variations.

Table 5 – Data sets list.
Table acronyms and abbreviations: n°= data set progressive number, PP = project phase (starting month-ending month), CT = creator team in charge of curating the data set, C=collected, G=generated, A=available, IP=in progress, NYA=not yet available.

n°	WP	TASK or SUBTASK	PP	CT	DATA SET title	SOURCE	STATUS

n°	WP	TASK or SUBTASK	PP	CT	DATA SET title	SOURCE	STATUS
1	WP2	sT2.2.1	6-48	UNIBO	REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_2. Assessment Of Potential Application Barriers And Facilitators. Survey Potential barriers and mitigation strategies. v0	G	A
2	WP2	sT2.2.3 st2.2.5	6-48	UNIBO	REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_2. Assessment Of Potential Application Barriers And Facilitators. Survey New Organizational Factors. v0	G	NYA
3	WP2	sT2.2.2 sT2.2.4 sT2.2.6	6-48	UNIBO	REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_2. Assessment Of Potential Application Barriers And Facilitators. Survey Training Procedures. v0	G	NYA
4	WP2	sT2.3.1	3-48	UNIBO	REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2.3. Performance Criteria and Performance Evaluation. Survey Initial Assessments of Application Performance. v0	G	A
5	WP2	sT2.3.2 sT2.3.3	3-48	UNIBO	REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_3. Assessment Of Potential Application Barriers And Facilitators. Survey Job Quality. v0	G	NYA
6	WP2	sT2.3.4	3-48	UNIBO	REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2.3. Performance Criteria and Performance Evaluation. Survey Initial Assessments of System Performance. v0	G	A
7	WP2	sT2.5.1	1-48	TAU	REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_5. Safety Implementation Testing And Evaluation. Evaluating The Response Times And Efficiency Of The Implementation. v0	G	NYA

n°	WP	TASK or SUBTASK	PP	CT	DATA SET title	SOURCE	STATUS
8	WP2	sT2.5.2	1-48	UNIBO	REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_5. Safety Implementation Testing And Evaluation. Evaluating The Response Times And Efficiency Of The Implementation. v0	G	NYA (in finalization and/or waiting for repository secretariat approval)
9	WP3	sT3.1.1	3-38	IEMA	REMODEL. WP3. User And System Interface. T3_1. CAD Platform Interface. CAD For UC1. v0	G	NYA
10	WP3	sT3.2.1	3-48	TAU	REMODEL. WP3. User And System Interface. T3_2. User Interface. Evaluation Of The User Interface. v0	G	NYA
11	WP3	sT3.3.1	9-48	TECNALIA	REMODEL. WP3. User And System Interface. T3_3. Teaching By Demonstration Of Skills For New Assembly References And Tasks. Evaluation Of Robotic Cable Assembly Skills. v0	G	NYA
12	WP3	sT3.3.2	9-48	UNIBO	REMODEL. WP3. User And System Interface. T3_3. Teaching By Demonstration Of Skills For New Assembly References And Tasks. Evaluation of physical human-robot interaction modalities.	G	A
13	WP4	sT4.1.1	2-48	TUM	REMODEL. WP4. Vision Based Perception. T4_1. Implementation Of The Multilevel Camera System. Evaluation Of The Vision System. v0	G	NYA
14	WP4	sT4.2.1	2-48	TUM	REMODEL. WP4. Vision Based Perception. T4_2. 3D Dynamic Environment Mapping. HW and SW design And Evaluation Of The Dynamic Mapping. v0	G	NYA
15	WP4	sT4.2.2	2-48	UNIBO	REMODEL. WP4. Vision Based Perception. T4_2. 3D Dynamic Environment Mapping. Loop Dataset. v0	G	NYA (in finalization and/or waiting for repository secretariat approval)

n°	WP	TASK or SUBTASK	PP	CT	DATA SET title	SOURCE	STATUS
16	WP4	sT4.3.1	6-44	UNIBO	REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Wire Detection. v0	G	NYA
17	WP4	sT4.3.2	6-44	UNIBO	REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Cable Tracking. v0	G	NYA
18	WP4	sT4.3.3	6-44	UNIBO	REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Electric Wires Dataset: Training and Test sets for Image Segmentation. v0	G	A
19	WP4	sT4.4.1	2-48	TUM	REMODEL. WP4. Vision Based Perception. T4_4. Functional Component Detection. Evaluation Of Component Recognition. v0	G	NYA
20	WP5	sT5.1.1	8-48	UNIBO	REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_1. Planner Architecture. Planner Design. v0	G	NYA
21	WP5	sT5.2.1	1-30	UCLV	REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_2. Cable Grasping. Evaluation Of Cable Grasping. v0	G	NYA
22	WP5	sT5.2.2	1-30	UNIBO	REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_2. Cable Grasping. Identification and Grasping of Deformable Objects. V0	G	A
23	WP5	sT5.3.1	1-36	PUT	REMODEL. WP5. Cable Manipulation Planning Execution Interactive Perception. T5_3. Bimanual Wire And Cable Manipulation. Bimanual Cable Manipulation. v0	G	NYA

n°	WP	TASK or SUBTASK	PP	CT	DATA SET title	SOURCE	STATUS
24	WP5	sT5.3.2	1-36	UNIBO	REMODEL. WP5. Cable Manipulation Planning Execution Interactive Perception. T5_3. Bimanual Wire And Cable Manipulation. Spline Manipulation Simulation. v0	G	A
25	WP5	sT5.4.1	10-46	UNIBO	REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_4. Wiring Harness Manipulation. Manipulation Of Harness. v0	G	NYA
26	WP5	sT5.5.1	13-46	PUT	REMODEL. WP5. Cable Manipulation Planning Execution Interactive Perception. T5_5. Interactive Perception. Evaluation Of Tactile Vision System. v0	G	NYA
27	WP6	sT6.1.1	1-48	TAU	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_1. Development Of Robotic Platforms. Design And Testing Of The Robotic Platforms. v0	G	NYA
28	WP6	sT6.2.1	1-40	UCLV	REMODEL. WP6. Sensory Systems and Mechatronic Tools. T6-2. Development and Optimization of Sensory System Components. Data for characterization of the tactile sensor. v0	G	A
29	WP6	sT6.2.2	1-40	UNIBO	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_2. Evaluation of a deformable skin tactile sensor. v0	G	A
30	WP6	sT6.3.1	2-36	UNIBO	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_3. Cable Grasping And Connection Tool. Grasping End-Effector. v0	G	NYA
31	WP6	sT6.3.2	2-36	UNIBO	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_3. Cable Grasping And Connection Tool. Wire Connection End-Effector. v0	G	NYA
32	WP6	sT6.4.1	3-40	UNIBO	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_4. Cable Rooting Tool. Design Rooting Tool. v0	G	NYA

n°	WP	TASK or SUBTASK	PP	CT	DATA SET title	SOURCE	STATUS
33	WP7	sT7.1.1	9-48	IEMA	REMODEL. WP7 Development And Evaluation Of Robot Abilties. T7_1. Switchgear Cabling Use Case. Evaluation UC1. v0	G	NYA
34	WP7	sT7.2.1	9-48	ELVEZ	REMODEL. WP7. Development And Evaluation Of Robot Abilties. T7_2. Wiring Harness Manufacturing Use Case. Evaluation Of UC2. v0	G	NYA
35	WP7	sT7.3.1	9-48	VWP	REMODEL. WP7. Development And Evaluation Of Robot Abilties. T7_3. Wiring Harness assembly Use Case. Evaluation Of UC3. v0	G	NYA
36	WP7	sT7.4.1	9-48	ENKI	REMODEL. WP7. Development And Evaluation Of Robot Abilties. T7_4. Wiring Harness assembly Use Case. Evaluation Of UC4. v0	G	NYA

Annex I: Data sets tables

The analytic descriptions of the expected data sets of REMODEL project are reported in this Annex organized by work-packages.

WP2 – Safety, System Requirements and Performance Evaluation

This WP is the basis for all the other technical WPs since it aims to analyze the applications and to define their requirements. The use cases will be deeply investigated to understand the planning and control parameters that need to be considered to solve the problems at hand. Moreover, OECD Job Quality Index will be measured as well as production time and cost before and after technology implementation to verify production improvements. Suitable surveys will be carried out for the evaluation of economic aspects. Another important aspect in this WP is the definition of safety requirements, to ensure the system will remain always safe during operation.

Lead: TECNALIA

Participants: UNIBO, UCLV, IEMA, TECNALIA, ELIMCO, TAU, TUM, PUT, ELVEZ, VWP, ENKI

Months: 1-48

Potential users for the data sets of this WP include every person, body, corporation, company or institution interested in carrying out research in the same field of the REMODEL project.

1	**Available**	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_2. Assessment Of Potential Application Barriers And Facilitators. Survey Potential barriers and mitigation strategies. v0**
DOI		http://doi.org/10.6092/unibo/amsacta/6414
Version		v0
Team in charge		UNIBO
Creator		**Gianluca Palli** (UNIBO)
Contributors		**Maurizio Indovini** (IEMA), **Juan Manuel Alonso** (ELIMCO), **Ziga Gosar** (ELVEZ), **Pawel Lembicz** (VWP), **Alice Dotta** (ENKI)
Contact Person		**Gianluca Palli** (UNIBO, gianluca.palli@unibo.it)
Contents		The dataset contains the anonymous and aggregated data related to the surveys for the potential barriers and mitigation strategies for the implementation of the innovation and automation strategies originated in the framework of REMODEL project and presented in the deliverable "D2.2 - Potential barriers and mitigation strategies".

1	Available	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_2. Assessment Of Potential Application Barriers And Facilitators. Survey Potential barriers and mitigation strategies. v0**
Data format		.ods
Data volume		2.6 MB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related deliverable/s		D2.2 - Potential barriers and mitigation strategies
Related publication/s		not yet available

2	Not yet available	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_2. Assessment Of Potential Application Barriers And Facilitators. Survey New Organizational Factors. v0**
DOI		Not yet available
Version		The different versions of the dataset (expected at M36, M48) will be handled by means of dataset versioning (v1, v2)
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.it)
Contents		The dataset will contain data to evaluate potential risks for the considered use cases, obtained from anonymous surveys conducted among workers. Specifically, workers will be asked to fill in multiple choices and/or open responses questionnaires that will be prepared to evaluate actual and define new organizational factors (e.g. perceived control, role ambiguity, work engagement, colleague and supervisor support, job satisfaction, job strain) that could facilitate usability, acceptability and acceptance, and the implementation of new working solutions.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf).
Data volume		Not yet available (~MB)
Accessibility		Surveys will be conducted in total compliance with the ethical aspects and the GDPR (refer to Sec, 2.7 of this document). Only anonymized data will be preserved in repository, available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		not yet available

3	Not yet available	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_2. Assessment Of Potential Application Barriers And Facilitators. Survey Training Procedures. v0**
DOI		Not yet available

Version	The different versions of the dataset (expected at M6, M36, M48) will be handled by means of dataset versioning (v0, v1, v2)
Team in charge	UNIBO
Creator/s	Not yet available
Contributor/s	Not yet available
Contact Person/s	**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.it)
Contents	The dataset will contain data to evaluate potential risks for the considered use cases, obtained from anonymous surveys conducted among workers. Specifically, workers will be asked to fill in multiple choices and/or open responses questionnaires that will be prepared to evaluate training procedures that could facilitate or hamper usability, acceptability and acceptance, and the implementation of new working solutions.
Data format	Textual data: plain text (.txt) and/or Rich Text Format(.rtf)
Data volume	Not yet available (~MB)
Accessibility	Surveys will be conducted in total compliance with the ethical aspects and the GDPR (refer to Sec, 2.7 of this document). Only anonymized data will be preserved in repository, available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s	Not yet available

4	**Available**	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2.3. Performance Criteria and Performance Evaluation. Survey Initial Assessments of Application Performance. v0**
DOI		http://doi.org/10.6092/unibo/amsacta/6651
Version		v0
Team in charge		UNIBO
Creator		**Gianluca Palli** (UNIBO)
Contributors		**Maurizio Indovini** (IEMA), **Juan Manuel Alonso** (ELIMCO), **Ziga Gosar** (ELVEZ), **Pawel Lembicz** (VWP), **Alice Dotta** (ENKI)
Contact Person		**Gianluca Palli** (UNIBO, gianluca.palli@unibo.it)
Contents		The dataset contains the anonymous and aggregated data related to the surveys for the initial assessment of application performance originated in the framework of REMODEL project, and presented in the deliverable "D2.3 - Initial assessments of application performance".
Data format		.ods
Data volume		2.54 MB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related deliverable/s		D2.3 - Initial assessments of application performance
Related publication/s		not yet available

5	**Not yet available**	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_3. Assessment Of Potential Application Barriers And Facilitators. Survey Job Quality. v0**
DOI		not yet available
Version		The different versions of the dataset (expected at M6, M36, M48) will be handled by means of dataset versioning (v0, v1, v2)
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.it)
Contents		The dataset will contain data to evaluate the non-quality costs, non-safety costs and production time as well as indicators related to the quality of jobs/work environments of the considered use cases . The data will be obtained from anonymous surveys (multiple choices and/or open responses) filled by the workers.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf).
Data volume		Not yet available (~MB)
Accessibility		Surveys will be conducted in total compliance with the ethical aspects and the GDPR (refer to Sec, 2.7 of this document). Only anonymized data will be preserved in repository, available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		Not yet available

6	**Available**	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2.3. Performance Criteria and Performance Evaluation. Survey Initial Assessments of System Performance. v0**
DOI		http://doi.org/10.6092/unibo/amsacta/6652
Version		v0
Team in charge		UNIBO
Creator		**Gianluca Palli** (UNIBO)
Contributors		**Maurizio Indovini** (IEMA), **Juan Manuel Alonso** (ELIMCO), **Ziga Gosar** (ELVEZ), **Pawel Lembicz** (VWP), **Alice Dotta** (ENKI)
Contact Person		**Gianluca Palli** (UNIBO, gianluca.palli@unibo.it)
Contents		The dataset contains the data used for the initial assessments of system performance of participants to REMODEL project. The data consist of Key Performance Indicators (KPIs) of the participants' 2019 production, collected through a survey.
Data format		.ods

6	Available	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2.3. Performance Criteria and Performance Evaluation. Survey Initial Assessments of System Performance. v0**
Data volume		2.6 MB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related deliverable/s		D2.5 - First Assessment of System Performance
Related publication/s		

7	Not yet available	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_5. Safety Implementation Testing And Evaluation. Evaluating The Response Times And Efficiency Of The Implementation. v0**
DOI		Not yet available
Version		v0
Team in charge		TAU
Creator/s		**Saigopal Vasudevan** (TAU); **Pablo Malvido Fresnillo** (TAU)
Contributor/s		not yet available
Contact Person/s		**Saigopal Vasudevan** (TAU, saigopal.vasudevan@tuni.fi); **Pablo Malvido Fresnillo** (TAU, pablo.malvidofresnillo@tuni.fi)
Contents		The dataset will contain data to evaluate potential risks for the considered use cases, obtained from anonymous surveys conducted among workers. Specifically, workers will be asked to fill in multiple choices and/or open responses to evaluate a safety controller characterized by the higher priority with respect to the other controllers that will constantly monitor and supervise the robot activities, and to promptly react to safety critical situations in the proper way. The safety controller will be implemented as a low-level maximum-priority software package, isolating all the other components from the manipulators hardware and filtering the commands and requests coming from the other planners/controllers with the general objective of preserving the safety in all the working conditions, in particular with respect to the human operators.
Data format		Textual data: plain text (.txt) and/or Reach Text Format(.rtf)
Data volume		Not yet available (~MB)
Accessibility		Surveys will be conducted in total compliance with the ethical aspects and the GDPR (refer to Sec, 2.7 of this document). Only anonymized data will be preserved in repository, available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

8	**Not yet available** (in finalization and/or waiting for repository secretariat approval)	**REMODEL. WP2. Safety System Requirements And Performance Evaluation. T2_5. Safety Implementation Testing And Evaluation. Safety_oriented_appliance_operation. v0**
DOI		Not yet available (in finalization and/or waiting for repository secretariat approval)
Version		v0
Team in charge		UNIBO
Creator/s		**Wendwosen Bellete Bedada** (UNIBO), **Gianluca Palli** (UNIBO)
Contributor/s		UNIBO
Contact Person/s		**Wendwosen Bellete Bedada** (wendwosen.bedada2@unibo.it)
Contents		A source code of local path planner that implements safety constraint within the standard ROS navigation stack; videos demonstrating Tiago robot arm movement in an energy efficient way using task priority control to operate appliance.
Data format		<to be defined in the final DMP M18>
Data volume		<to be defined in the final DMP M18>
Accessibility		Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		W. B. Bedada, R. Kalawoun, I. Ahmadli and G. Palli, "A Safe and Energy Efficient Robotic System for Industrial Automatic Tests on Domestic Appliances: Problem Statement and Proof of Concept", in Procedia Manufacturing, vol. 51, 2020, pp. 454-461, doi: 10.1016/j.promfg.2020.10.064.

WP3 – User and System Interface

This WP is devoted to design, develop and test the interface between the robotic platform, developed in T6.1, and, on one side, the user, and on the other side, the CAD platform. A software package to extract the information about the wiring sequence, cables routing and component nominal location (fitting) from the CAD design files will be provided by the WIRES experiment. This package will be extended to extract the information about the wiring harness geometry and structure, which is required for performing aforementioned cabling tasks. This WP will include testing and validation of those interfaces on the use case scenarios.

Lead: TAU

Participants: UNIBO, IEMA, TECNALIA, ELIMCO, TAU, TUM, PUT, ELVEZ, VWP, ENKI

Months: 3-48

Potential users for the data sets of this WP include every person, body, corporation, company or institution interested in carrying out research in the same field of the REMODEL project.

9	**Not yet available**	**REMODEL. WP3. User And System Interface. T3_1. CAD Platform Interface. CAD For UC1. v0**
DOI		Not yet available
Version		v0
Team in charge		IEMA
Creator/s		**Maurizio Indovini** (IEMA)
Contributor/s		Not yet available
Contact Person/s		**Maurizio Indovini** (IEMA, indovinim@iemasrl.com)
Contents		This data set will contain CAD data in x3d format and associated metadata in the form of text files generated by the EPLAN P8 platform about the test switchgear used for the evaluation and development of UC1. This data set is intended for the demonstration of the CAD platform interface package. A software package to extract the information about the wiring sequence, cables routing and component nominal location (fitting) from the CAD design files will be provided by the WIRES experiment. This task will permit the extraction of the information about the wiring geometry and structure from the EPLAN P8 software, and will be interfaced with the robot task planners and the User Interface. The possibility of selecting during the post-processing of the product design for the generation of the robot activity plan which part of the manufacturing can be executed by the robot will be considered in the experiments. This selection can be eventually edited by means of the User Interface developed in T3.2. At TRL 4, the ROS package available for switch-

9	Not yet available	REMODEL. WP3. User And System Interface. T3_1. CAD Platform Interface. CAD For UC1. v0
		gear design will be extended to extract the information about the wiring harness geometry and structure. The integration with the robot task planners and the User Interface will be carried out. Laboratory tests will be executed on a couple of design samples from all the use cases. The methodology will be extended to wiring harness manufacturing and assembly. At TRL 5, the integration with the design chain carried out by the companies and validation against their design procedures. Execution of tests with new products along the whole design chain for the automatic generation of the robot task list considering the constraints and the interfaces of the CAD software. At TRL 6, demonstration of the CAD platform interface package in the design procedure carried out by the industrial partners. Execution of tests considering timing and constraints of the real production environment. This data will be useful internally for the development of the specific use case and to the general community working on the implementation of robotized manufacturing activities. To the best of the consortium knowledge, there are no available datasets of that kind. Specific experiments are needed due to the lack of knowledge in the specific field and application scenario.
Data format		CAD data: EPLAN P8 software data format, x3d file format, XML file format, csv data format
Data volume		Not yet available (~MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

10	Not yet available	REMODEL. WP3. User And System Interface. T3_2. User Interface. Evaluation Of The User Interface. v0
DOI		Not yet available
Version		v0
Team in charge		TAU
Creator/s		**Saigopal Vasudevan** (TAU); **Pablo Malvido Fresnillo** (TAU)
Contributor/s		Not yet available
Contact Person/s		**Saigopal Vasudevan** (TAU, saigopal.vasudevan@tuni.fi); **Pablo Malvido Fresnillo** (TAU, pablo.malvidofresnillo@tuni.fi)
Contents		This data set will contain: (1) data from anonymous surveys conducted to check the usability of the user interfaces by the workers; (2) simulations and experimental data provided by software platforms adopted for the implementation of the different use cases. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final platform selection. The intended goals are: (1) to perform tests to evaluate the usability of the interface; (2) demonstration of the User Interface in the design procedure

10	Not yet available	REMODEL. WP3. User And System Interface. T3_2. User Interface. Evaluation Of The User Interface. v0
		carried out by the companies. The User Interface system will be composed of a touch screen multimedia device and will be designed to enable the operator to teach the robot about the task to be performed by composing macro-actions that can also be taught to the robot when new procedures enter in the manufacturing process. Another helpful element will be the possibility to monitor the advance of the assembly process. In this way, at the end of the assembly an activity report can be produced. Furthermore, at system runtime, the precise knowledge of the state of the assembly process allows the project designer to decide about possible process modifications and the impact on the product manufacturing in response to a customer request. Wearable solutions will be investigated, including the use of a 10-inch tablet, that the user can wear attached to the forearm to allow a simple interaction and usage without creating any obstacle to the other worker activities. The possibility of editing which part of the manufacturing can be executed by the robot from the task plan generated during the post-processing of the product design (T3.1) will be considered. At TRL 4, laboratory tests will be executed to evaluate the usability by involving specialized workers in suitable surveys. How to specialize the user interface for the different use cases will also be evaluated. At TRL 5, Integration with the other system components and the design chain carried out by the companies and validation against their design procedures. Execution of communication tests with the CAD platform and the robotic system in the industrial environment. At TRL 6, demonstration of the User Interface in the design procedure carried out by the companies. Execution of tests considering timing and constraints of the real production environment. Specialized workers will be involved in suitable surveys to evaluate the interface usability. The control by the user of the robot task sequence will be tested. This data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects. To the best of the consortium knowledge, there are no available datasets of that kind. Specific experiments are needed due to the lack of knowledge in the specific field and application scenario.
Data format		Textual data: plain text (.txt, .csv) and/or Rich Text Format (.rtf); tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv); Image data: TIFF (.tif) and/or JPEG (.jpeg); Video data: MPEG-4 (.mp4).
Data volume		Not yet available (~MB)
Accessibility		The data will be available under Creative Commons Attribution (CC BY) 4.0 license (Survey data will be collected in anonymized form.)
Related publication/s		Not yet available

11	Not yet available	REMODEL. WP3. User And System Interface. T3_3. Teaching By Demonstration Of Skills For New Assembly References And Tasks. Evaluation Of Robotic Cable Assembly Skills. v0
DOI		Not yet available
Version		v0
Team in charge		TECNALIA
Creator/s		**Aitor Ibarguren** (TECNALIA)
Contributor/s		**Maite Ortiz de Zarate** (TECNALIA)
Contact Person/s		**Aitor Ibarguren** (TECNALIA, aitor.ibarguren@tecnalia.com)
Contents		This dataset will contains experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection carried out by ELIMCO. Data will include robots' joint states, poses and IO activation used for automatic extraction of task parameters. Mathematical models of the objects and of the manipulations strategies. Mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for this use case. The intended goals are: (1) a first evaluation consisting in simulating the execution of skills (assembly of PINs, positioning of cables and key components on the manufacturing table); (2) demonstration of the skills on an experimental platform; (3) experimental evaluation of different scenarios corresponding to the selected use case. The robot will be programed using a skill-based system. Some skills are preprogramed in the robot and new skills can be created from the combination of already existing ones. This ability is particularly useful since in most of the cases the manufacturing tasks are not fully coded in the product design. This is the case of wiring harness manufacturing or assembly, in which even though the shape of the final product is given by the design, the sequence and the manipulation tasks to achieve the final product are managed entirely by the operator that manufactures the product itself, usually driven by its personal experience and by the requirement of the subsequent operations along the task. TECNALIA has already developed a skill-based system that will be used as a basis for this task. In order to execute the operations by the robot, and based on the developments implemented in tasks T3.1 and T3.2, the different skill-instances need to be combined and transformed into an executable program for the robot system. This will be performed through an easy programming framework in which the operator will teach by demonstration the robot by indicating some key positions and trajectories in order to do the parameterization of the different skill instances and adapt itself to each harness model. The key parameters need to be identified in each skill program and their variability from one harness model to another needs to be studied and evaluated. This approach enables a large adaption to different kinds of products in an easy and rapid manner necessitating few programming efforts. At TRL 4, a first evaluation consisting in simulating the execution of skills (assembly of PINs, positioning of cables and key components on the manufacturing table) getting the cable assembly process key info from CAD (task 3.1) will be done. The

	parameters that are variable for the assembly of one harness to another are identified inthe program as parameters that the operator can teach the robot; also, the parameter that could ease the assembly task. This includes information such as cable characteristics (colors, lengths...) and connector's information. Then the assembly sequence must be generated through a specific HMI of the CAD software, selecting the different components and clicking where to assemble them. At TRL 5, there is a concrete execution and implementation of the skills on an experimental platform. This implies the export of key data to the robot controller. The good execution of the sequence relies on the robot ability to locate the different cables, generate correct trajectories, and decide on end-effector tool changing if necessary. The robot should be provided in this case with a certain degree of autonomy in order to change and adapt its assembly plan when needed in order to successfully achieve the task. Safety strategies will be implemented when the robot human distance becomes too close. During this step, operators will test in a laboratory environment different teach by demonstration strategies in order to evaluate their intuitiveness. At TRL 6, different scenarios and tests corresponding to the selected use case will be validated and experimentally tested. The operator should be able to teach the robot new skills in a HW/SW environment that correspond to the use case requirements. The ability to automatically generate a skill network to execute a task by combining available skill instances will be evaluated.
Data format	Textual data: plain text (.txt, .csv) and/or Rich Text Format (.rtf); tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv); Image data: TIFF (.tif) and/or JPEG (.jpeg); Video data: MPEG-4 (.mp4).
Data volume	not yet available (~MB/GB)
Accessibility	If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s	Not yet available

12	**Available**	**REMODEL. WP3. User And System Interface. T3_3. Teaching By Demonstration Of Skills For New Assembly References And Tasks. Evaluation of physical human-robot interaction modalities. v0**
DOI		http://doi.org/10.6092/unibo/amsacta/6642
Version		v0
Team in charge		UNIBO
Creator/s		**Roberto Meattini** (UNIBO), **Davide Chiaravalli** (UNIBO), **Gianluca Palli** (UNIBO) and **Claudio Melchiorri** (UNIBO)
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.it)
Contents		The datasets contain the data related to the experiment was carried out involving four subjects1 – named U1, U2, U3, U4 – in a series of physical and muscle strength training tasks, related to the publication: R. Meattini, D.

12	**Available**	**REMODEL. WP3. User And System Interface. T3_3. Teaching By Demonstration Of Skills For New Assembly References And Tasks. Evaluation of physical human-robot interaction modalities. v0**
		Chiaravalli, G. Palli and C. Melchiorri, "sEMG-Based Human-in-theLoop Control of Elbow Assistive Robots for Physical Tasks and Muscle Strength Training," in IEEE Robotics and Automation Letters, vol. 5, no. 4, pp. 5795-5802, Oct. 2020. (DOI: 10.1109/LRA.2020.3010741)
Data format		.txt
Data volume		18 MB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		R. Meattini, D. Chiaravalli, G. Palli and C. Melchiorri, "sEMG-Based Human-in-the-Loop Control of Elbow Assistive Robots for Physical Tasks and Muscle Strength Training", in IEEE Robotics and Automation Letters, vol. 5, no. 4, pp. 5795-5802, 2020, doi: 10.1109/LRA.2020.3010741.

WP4 – Vision-based Perception

This WP will support the high level decision processes in REMODEL through the perception of dynamic information, such environment reconstruction, real time cable tracking for manipulation activities, as well as detection of the current assembly task configuration and component localization. Moreover, the vision system will be exploited to address the safety requirements defined in T2.4, to detect safety areas, change operational modes accordingly, adapt the robot speed and perform robot stopping functions.

Lead: TUM

Participants: UNIBO, IEMA, TECNALIA, ELIMCO, TUM, PUT, ELVEZ

Months: 2-48

Potential users for the data sets of this WP include every person, body, corporation, company or institution interested in carrying out research in the same field of the REMODEL project.

13	Not yet available	**REMODEL. WP4. Vision Based Perception. T4_1. Implementation Of The Multilevel Camera System. Evaluation Of The Vision System. v0**
DOI		not yet available
Version		v0
Team in charge		TUM
Creator/s		**Arne Peters** (TUM)
Contributor/s		Not yet available
Contact Person/s		**Arne Peters** (TUM, arne.peters@tum.de)
Contents		The dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. The intended goals are: (1) test regarding the throughput of the system and accuracy; (2) evaluation of the system in unstructured environment; (3) demonstration of the setups of the individual use cases. The robust implementation of a vision system for full perception of the human-robot environment is a fundamental issue in human-robot collaborative tasks. This is more the case in a dynamic changing environment as in REMODEL project. A multi-level computer vision will be implemented: ambient cameras, robotic manipulator and a close-range camera attached to end-effectors. Commer-

13	Not yet available	REMODEL. WP4. Vision Based Perception. T4_1. Implementation Of The Multilevel Camera System. Evaluation Of The Vision System. v0
		cial low-cost 3D cameras, industry grade 3D sensors (e.g. Roboception rc_visard) and laser scanners will be used to that purpose together with conventional 2D cameras. The development of software modules based on open source software like the OpenCV and PCL libraries to interface the cameras with planner and controller activities will be performed. Vision data will be used for online correction of position, orientation, alignment, obstacle recognition and motion planning. The vision data coming from the end-effector camera will be merged with the tactile images to estimate position and orientation of grasped wires. The vision data will be also used by the safety controller in T2.5 as main information to prevent unintentional collisions. The 3D cloud points will be then used as inputs in the recognition algorithms of T4.3 and T4.4. At TRL 4, a ROS packages for collecting data from number of sensors and for calibration of the multi-sensor system will be developed. Initial test regarding the throughput of the system and accuracy of calibration are performed on different hardware variants in the controlled laboratory environment. Hardware configuration for the further development on the higher TRL is selected. At TRL 5, continued development and evaluation of the system will be carried out in less controlled environment. Controlled disturbances, such as changing lighting conditions, physical impact to the sensors, changes in the setup of the workcell, corresponding to potential situations in the real working environment, are introduced to increase the robustness of the continuous calibration method. At TRL 6, the proposed vision system is integrated with the demonstration setups of the individual use cases. Iterative tweaking of the initial design is performed based on the date from the continuous calibration system and feedback from the active vision component. The system is tested and deployed in semi unconstrained environment – under monitoring but without direct control and predictability of the disturbances. The results will be compared with similar datasets available in literature. However, specific experiments are needed due to the lack of knowledge in the specific field and application scenario.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf); tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv); Image data: TIFF (.tif) and/or JPEG (.jpeg); Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		not yet available (~MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

14	Not yet available	REMODEL. WP4. Vision Based Perception. T4_2. 3D Dynamic Environment Mapping. HW and SW design And Evaluation Of The Dynamic Mapping. v0
DOI		Not yet available

Version	v0
Team in charge	TUM
Creator/s	**Arne Peters** (TUM)
Contributor/s	Not yet available
Contact Person/s	**Arne Peters** (TUM, arne.peters@tum.de)
Contents	This dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. The intended goals are: (1) test of the system in controlled laboratory conditions; (2) test of the system with controlled disturbances; (3) demonstration of the system integrated in the use cases. This task deals with data fusion to build the 3D environment mapping for the purpose of robot manipulation in a dynamically changing environment. Optimization based bundle adjustment will be used for the initial estimation of the structure of the environment. The data from the static ambient sensors will be supported by measurements form the camera attached to the end-effector. Model based approach will be used to detect and verify position of the rigid components (e.g. car cockpit placed in the fixtures) and will be combined with the results of the cables detection and tracking (T4.3) to ensure proper understanding of the dynamic scene containing both rigid and flexible components. Different kinds of cameras can be used. For instance, we consider to monitor the overall workcell with mutiple RGB-D camera, allowing to detect intrusions and the rough position of target objects, which will then be scanned using a high resolution eye-in-hand sensor. The calibration of the overall vision system is performed and a point cloud fusion algorithm will be applied in order to provide a unique point cloud with full human-robot perception environment avoiding occlusions. The data redundancy from the several 3D sensors with different overlapping fields of views allows a complete perception of the human activity, robot motions and environment's objects. As the efficiency of this system for human activity perception may highly increase if it was well adapted for the applied industrial tasks, the placement of these sensors should takes into consideration the executed task, the field of work of the human operators and its possible movements, in addition to the workspace of the robotic platform. Furthermore, a calibration of the different cameras to determine the relative pose between them is done. Based on the pre-definition of tasks and the human working area, it will be possible to limit the generated point cloud and limit the search area in the 3D scene of the worker. Some algorithms will be developed in order to extract the differentiation elements from one iteration to another. Only the modified elements will be taken into account in the 3D scene, implying very reduced execution times and increased system safety. At TRL 4, different cameras will be compared the most suitable one will be chosen. The most suitable sw/hw configuration will be selected and the ROS package will be developed. The calibration will

	also be performed. Model fitting of the known parts of the environment (based on the CAD data of the parts and workcell) is integrated. The system is tested in controlled laboratory conditions – under known lighting conditions in uncluttered environment. Development at this stage focuses on the well-structured car cockpit and switchgear wiring scenarios. At TRL 5, the system is extended to cope with controlled disturbances – intrusions in the working area, presence of flexible object, changing lighting conditions. Segmentation between rigid and flexible, and static and dynamic objects is integrated. System is integrated with the industrial use cases demonstrators; Different cameras and illumination systems can be tested to achieve suitable efficiency for the industrial use cases that have been selected. At TRL 6, the system is integrated with the demonstration lines of the use cases. Iterative tweaking of the individual use cases is performed along with tests in the semi controlled environment. The results of those test may influence implementation of T4.1 and lead to minor redesign of the workcells. The 3D dynamic environment mapping will be tested in the same industrial environment in terms of software architecture as the used cases. Different scenarios will be tested and a performance evaluation will be performed. The results will be compared with similar datasets available in literature. However, specific experiments are needed due to the lack of knowledge in the specific field and application scenario.
Data format	Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume	Not yet available (~MB/GB)
Accessibility	If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s	Not yet available

15	**Not yet available** (in finalization and/or waiting for repository secretariat approval)	**REMODEL. WP4. Vision Based Perception. T4_2. 3D Dynamic Environment Mapping. Loop Dataset. v0**
DOI		Not yet available (in finalization and/or waiting for repository secretariat approval)
Version		v0
Team in charge		UNIBO
Creator/s		**Riccardo Zanella** (UNIBO), **Gianluca Palli** (UNIBO)
Contact Person/s		**Riccardo Zanella** (UNIBO), riccardo.zanella2@unibo.it

15	**Not yet available** (in finalization and/or waiting for repository secretariat approval)	**REMODEL. WP4. Vision Based Perception. T4_2. 3D Dynamic Environment Mapping. Loop Dataset. v0**
Contents		Experimental dataset. The dataset is divided into 2 datasets: “Loop Dataset 2018” and “Loop Dataset Synthetic 2018”. Each dataset contains a list of "scans" folders, each of which with an images subfolder containing .jpg pictures. For each "scans" folder there is a scan_XX.txt file with Ground Truth labels.
Data format		Type of data: textual data, tabular data with minimal metadat. Data format: plain text (.txt) and/or Reach Text Format(.rtf).
Data volume		<to be defined in the final DMP M18>
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		De Gregorio, D., Zanella, R., Palli, G., & Di Stefano, L. (2020). Effective Deployment of CNNs for 3DoF Pose Estimation and Grasping in Industrial Settings.

16	**Not yet available**	**REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Wire Detection. v0**
DOI		Not yet available
Version		v0
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unbo.it)
Contents		The dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. The intended goals are: (1) test of the system on a partially cabled switchgear and with a robot during cable manipulation; (2) validation in an industrial platform; (3) demonstration in production scenarios. The ability if the robot to be able to recognize wires and cables in the environment. The goal of this subtask is therefore to develop a method for determining the position of a wire in an image and to classify it according to type. For example, a deep Convolutional Neural Network (CNN) may be used for this purpose. The wire

	manipulation tools will be exploited to simplify the wire recognition and grasp point detection. TECNALIA has developed laser and vision based pattern detection and tracking techniques that can be used for cables detection and positioning in case of REMODEL project. At TRL 4, the related ROS package will be developed; the comparison of camera and selection of a suitable hardware configuration will be carried out; 3D shape recognition with 2D cameras and multiple viewpoints will be evaluated; the identification of cable parameters for deformation model refinement will be performed; the testing on a partially cabled switchgear will be reported; the testing with a robot during cable manipulation will be realized. At TRL 5, the implementation in an industrial platform will be evaluated based on: the validation against multiple configurations and light conditions; the link with the connection database to associate detected cables with connections; the evaluation of realtime performance; the extension to cable portion detection (not end-to-end only) and wiring harness with multiple branches. At TRL 6, the performance on a wired switchgear will be evaluated.
Data format	Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume	Not yet available (~MB/GB)
Accessibility	If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s	Not yet available

17	**Not yet available**	**REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Cable Tracking. v0**
DOI		Not yet available
Version		v0
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unbo.it)
Contents		This dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. In particular, the generated data are related to a cable real time tracking sys-

17	Not yet available	REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Cable Tracking. v0
		tem development and testing with the purpose of both parameterizing the cable deformation models and perform wire manipulation activities will be provided in this deliverable. At TRL 4, the related ROS package will be developed; the comparison of camera and selection of a suitable hardware configuration will be carried out; 3D shape recognition with 2D cameras and multiple viewpoints will be evaluated; the identification of cable parameters for deformation model refinement will be performed; the testing on a partially cabled switchgear will be reported; the testing with a robot during cable manipulation will be realized. At TRL 5, the implementation in an industrial platform will be evaluated based on: the validation against multiple configurations and light conditions; the link with the connection database to associate detected cables with connections; the evaluation of realtime performance; the extension to cable portion detection (not end-to-end only) and wiring harness with multiple branches. At TRL 6, the performance of tracking wires on a wired switchgear will be evaluated, based on: performance evaluation of tracking wires and cables in a wiring harness; integration into the demonstration lines and system tuning; demonstration during the cabling of multiple switchgears; demonstration during the routing of wires and cables in car components. (production scenario.)
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		Not yet available (~MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

18	Available	REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Electric Wires Dataset: Training and Test sets for Image Segmentation. V0
DOI **URL**		http://doi.org/10.6092/unibo/amsacta/6654 [AMS Acta] https://www.kaggle.com/zanellar/electric-wires-image-segmentation [Kaggle]
Version		v0
Team in charge		UNIBO
Creator/s		**Riccardo Zanella** (UNIBO), **Alessio Caporali** (UNIBO), **Kalyan Takada** (UNIBO), **Daniele De Gregorio** (Eyecan.ai Srl), **Gianluca Palli** (UNIBO)
Contact Person/s		**Riccardo Zanella** (UNIBO, riccardo.zanella2@unibo.it)

18	**Available**	**REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Electric Wires Dataset: Training and Test sets for Image Segmentation. V0**
Contents		The dataset contains data for semantic segmentation of electric wires with domain independence, generated in the framework of REMODEL project. The dataset is automatically generated using chroma-key technique and contains 57300 images (where 28650 are RGB images and the other 28650 are the corresponding ground truth binary masks).
Data format		.jpg, .png
Data volume		39 GB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		R. Zanella, A. Caporali, K. Tadaka, D. De Gregorio and G. Palli, "Auto-generated Wires Dataset for Semantic Segmentation with Domain-Independence", 2021 International Conference on Computer, Control and Robotics (ICCCR), 2021, pp. 292-298, doi: 10.1109/ICCCR49711.2021.9349395.

19	**Not yet available**	**REMODEL. WP4. Vision Based Perception. T4_4. Functional Component Detection. Evaluation Of Component Recognition. v0**
DOI		Not yet available
Version		v0
Team in charge		TUM
Creator/s		**Arne Peters** (TUM)
Contributor/s		Not yet available
Contact Person/s		**Arne Peters** (TUM, arne.peters@tum.de)
Contents		The dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. The intended goals are: (1) test of ROS package for the component recognition; (2) tests involving disturbances corresponding to the real conditions (e.g. lighting changes); (3) test of the system integrated with the actual demonstrators of the use cases. This activity will to provide algorithms for visual recognition of the task configuration, tools and components. The method developed in the WIRES experiment (using a single camera looking at the components from the top) will be extended in the different use cases. Data fusion of the information coming from the multi-camera vision system will be performed taking into account all the source of uncertainties, with the objective of increasing the resolution of the space reconstruction to reduce sys-

	tematic errors during the robot operations. A human detection component will be included to cope with intrusions and resulting occlusions. A depth sensor or multiple 2D views will be exploited to provide the relative position between the robotic arm and components detected by the recognition algorithm, and the use of close view camera mounted on the end effector will be evaluated to increase the measurement accuracy. An active vision approach will be used to guide the end effector camera to positions providing maximal information gain in case the initial recognition is doubtful. This information is required by the planning functionalities developed in WP5 and for the manipulation of cables accomplished in WP7. Online training will be considered in order to configure the robot to work with a specific type of hardware without the need of specific reprogramming. At TRL 4, a ROS package for the component recognition will be developed basing the on the results of the WIRES project. Its performance will be evaluated using different cameras in a limited laboratory environment. Comparative analysis of the recognition rate and pair-wise error analysis for similar components will be performed to guide further development of the active vision aspect. Most of the development and test will use a partially assembled switchgear used previously in the WIRES project. At TRL 5, further development and tests in the controlled environment will involve deliberately introduced disturbances corresponding to the real conditions (e.g. lighting changes). The test setup will be based on the cockpit and connector assembly use cases. The system will be integrated with the components databases and the human-machine interface for semi-supervised components recognition. Initial integration with the pose tracking system will be done to support recognition of identical components. At TRL 6, the system will be integrated with the actual demonstrators of the use cases. Databases of components relevant to the individual use cases are developed and the training for the active vision component is performed. The components recognition system is evaluated under semi-controlled environmental conditions corresponding to the real conditions of the pilot use cases. The results of the active vision components recognition may lead to reengineering the workcell in case of repeating failures caused e.g. by unreachability of certain positions. . The results will be compared with similar datasets available in literature. However, specific experiments are needed due to the lack of knowledge in the specific field and application scenario.
Data format	Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume	Not yet available (~MB/GB)
Accessibility	If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0) license
Related publication/s	Not yet available

WP5 – Cable Manipulation Planning, Execution And Interactive Perception

The objective of this work package is to develop a planner able to manage the robot activities along the manufacturing process of the considered use cases and all control algorithms needed for the DLOs grasping and manipulation. The planner will manage all the action sequence and the associated trajectories to manipulate the wires, cables, hoses and wiring harness. A first version based on proper integration of state of the art solutions will be implemented. Then, dedicated solutions will be investigated to address particular problems such also wiring harness manipulations and improve the performance. The system will maintain a database of the manufacturing state and remaining activities along the whole manufacturing process. Specific control algorithms will be developed for the different planned subtasks, such as the grasping phase and the manipulation phase. The algorithms will exploit the data fusion of all sensors integrated into the robotic platforms. Moreover, we will extend our work by relying on the Interactive Perception paradigm, where we can exploit forceful interaction with the environment to obtain robust perceptually guided manipulation.

Lead: PUT

Participants: UNIBO, UCLV, IEMA, TECNALIA, TAU, TUM, ELIMCO, TUM, PUT, ELVEZ

Months: 3-48

Potential users for the data sets of this WP include every person, body, corporation, company or institution interested in carrying out research in the same field of the REMODEL project.

20	**Not yet available**	**REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_1. Planner Architecture. Planner Design. v0**
DOI		Not yet available
Version		v0
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unbo.it)
Contents		This dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models for the different use cases. The ROS middleware will be exploited and the components of the system will be precisely

20	Not yet available	**REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_1. Planner Architecture. Planner Design. v0**
		defined together with their interfaces. REMODEL partner TECNALIA will focus on the continuous testing and validation of the planner. The process will consist in reporting test results both in simulation and with the real robot that will progressively show more complex planning challenges. At TRL 4, the ROS based planning system will be developed. The system will be tested in laboratory at least by three REMODEL partners. At TRL 5, the ROS based planning system will be able to cope with changes in movement speed and sudden stops of the robot caused by the input from the safety system. The planner will be tested in an industrial platform. The planner will be interfaced with the controllers of the robotic platforms selected for the use cases. The correctness of the interfacing and data transfer will be validated. At TRL 6, the ROS based planning system will be tested in the semi-controlled environment at end-user sites.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4)
Data volume		Not yet available (~MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

21	Not yet available	**REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_2. Cable Grasping. Evaluation Of Cable Grasping. v0**
DOI		Not yet available
Version		v0
Team in charge		UCLV
Creator/s		(UCLV)
Contributor/s		(UNIBO); (PUT)
Contact Person/s		**Pirozzi Salvatore** (UCLV, salvatore.pirozzi@unicampania.it)
Contents		This dataset will contains: (1) experimental data such as voltages corresponding to tactile map during the grasping and manipulation of a deformable linear object. Experimental data provided by the automation and robotic platforms adopted for the implementation of this task. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection carried out by UCLV and the other REMODEL partners; (2) mathematical models of the objects and of the manipulations strategies; (3) mechanical models in the form of CAD files of the tactile sensors implemented in this task. The tactile data are used to estimate orientation, position and shape of DLOs along the

	grasped area; demonstrate and test the sensorized fingers and the on-board camera integrated into a commercial gripper; results of sensorized fingers and on-board camera integrated in the final grasping tools for all use cases. In this experimental activity, control algorithms exploiting tactile and vision data for the grasping of the DLOs considered in REMODEL use cases will be developed. The vision system will be used to recognize the DLOs to grasp and its feedback will be used with vision control algorithms to implement an approaching phase. After the grasp, the tactile sensor feedback will be used to evaluate the grasp quality. In particular, the tactile sensor data and contact map will be used to evaluate the position and the orientation of the wire with respect to the end-effector frame. The control approaches developed in previous projects only for standard wires will be generalized to DLOs with different diameters and deformability. For example, while the deformability of a cables along the direction of the grasping force (i.e., the direction orthogonal with respect the cable length) can be neglected, for medical hoses has to be considered in order to avoid high deformations. For this purposes, the interaction forces for impedance/force control algorithms, slipping detection and avoidance algorithms will be estimated from the tactile data. Additionally, the actual length and weight of DLOs will be not limited and they can affect the grasping robustness during the robot movements. In REMODEL the grasping force will also tackled into account and monitored during all the grasping and manipulation phases to avoid the object slippage. To this aim, how to apply techniques recently developed for standard objects to DLOs for the torsional moment control will be investigated. The accuracy of the grasping features estimation can be improved by using also camera information and data fusion based on the use of Extended Kalman Filter (EKF) and Bayesian sensor fusion methods. In particular, the camera mounted on the robot end-effector and the tactile data will be fused in order to optimize the estimation of the DLOs part immediately outside the grasped area. After the grasping, it is also fundamental to estimate how the tip of the DLO end is positioned with respect to the grasping area. Since the on-board camera will work on a lane orthogonal to the tactile map plane, the fusion of these data can be exploited for the extraction of needed info. This activity will allow a feedback to the planner. At TRL 4, the tactile data are used to estimate orientation, position and shape of DLOs along the grasped area. The procedure is validated in laboratory with a single sensorized finger mounted on a workbench and with different DLOs. The on board camera is tested for the recognition of the DLOs end position. ROS packages have been released to verify these reconstructions. At TRL 5, the sensorized fingers and the on-board camera are integrated together into a commercial gripper. A single ROS node is released for the acquisition and elaboration of sensor data. The sensorized gripper is mounted on a standard industrial robot and the estimation of grasped wire features is validated by using the robot to repeat the same grasping task a high number of times. At TRL 6: Sensorized fingers and on-board camera are integrated in the final grasping tools for all use cases. For each robotic platforms the requested grasping features are estimated for different DLOs. Specific experiments are needed due to the lack of knowledge in the specific field and application scenario. These data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects.

	The collected data will be compared with the experiments and data collected during previous projects, i.e. the WIRES project[16], and reported in: - Palli, Gianluca; Pirozzi, Salvatore, A Tactile-Based Wire Manipulation System for Manufacturing Applications, «ROBOTICS», 2019, 8, pp. 46 - 58, https://doi.org/10.3390/robotics8020046 - De Gregorio, Daniele; Zanella, Riccardo; Palli, Gianluca; Pirozzi, Salvatore; Melchiorri, Claudio, Integration of robotic vision and tactile sensing for wire-terminal insertion tasks, «IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING», 2019, 16, pp. 585 – 598, https://doi.org/10.1109/TASE.2018.2847222 - Zanella R.; De Gregorio D.; Pirozzi S.; Palli G., DLO-in-hole for assembly tasks with tactile feedback and LSTM networks, in: 2019 6th International Conference on Control, Decision and Information Technologies, CoDIT 2019, Institute of Electrical and Electronics Engineers Inc., 2019, pp. 285 - 290, https://doi.org/10.1109/CoDIT.2019.8820399 (atti di: 6th International Conference on Control, Decision and Information Technologies, CoDIT 2019, Le Conservatoire National des Arts et Metiers (Cnam), fra, 2019) - Pirozzi, S., Natale, C. Tactile-Based Manipulation of Wires for Switchgear Assembly (2018) IEEE/ASME Transactions on Mechatronics, 23 (6), art. no. 8458233, pp. 2650-2661, https://doi.org/10.1109/TMECH.2018.2869477. - Cirillo, A., De Maria, G., Natale, C., Pirozzi, S. Design and Evaluation of Tactile Sensors for the Estimation of Grasped Wire Shape (2017) IEEE/ASME International Conference on Advanced Intelligent Mechatronics, AIM, art. no. 8014065, pp. 490-496, https://doi.org/10.1109/AIM.2017.8014065.
Data format	Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume	Not yet available (~ MB/GB)
Accessibility	If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s	Not yet available

22	**Available**	**REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_2. Cable Grasping. Identification and Grasping of Deformable Objects. v0.**
DOI		http://doi.org/10.6092/unibo/amsacta/6659
Version		v0
Team in charge		UNIBO
Creator/s		**Alessio Caporali** (UNIBO), **Gianluca Palli** (UNIBO)

[16] WIRES – Wiring Robotic System for Switchgears, http://echord.eu/wires.html

22	Available	REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_2. Cable Grasping. Identification and Grasping of Deformable Objects. v0.
Contact Person/s		**Alessio Caporali** (UNIBO,alessio.caporali2@unibo.it)
Contents		The dataset contains the source code utilized during the experiments carried out concerning the optimal identification of grasping poses in clothes, associated to the related publication: A. Caporali and G. Palli, "Pointcloud-based Identification of Optimal Grasping Poses for Cloth-like Deformable Objects," 2020 25th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), Vienna, Austria, 2020, pp. 581-586, doi: 10.1109/ETFA46521.2020.9211879.
Data format		.pcd, .cpp, .h, .txt
Data volume		27.2 MB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		A. Caporali and G. Palli, "Pointcloud-based Identi-fication of Optimal Grasping Poses for Cloth-like Deformable Objects", 2020 25th IEEE Internation-al Conference on Emerging Technologies and Fac-tory Automation (ETFA), 2020, pp. 581-586, doi: 10.1109/ETFA46521.2020.9211879.

23	Not yet available	REMODEL. WP5. Cable Manipulation Planning Execution Interactive Perception. T5_3. Bimanual Wire And Cable Manipulation. Bimanual Cable Manipulation. v0
DOI		Not yet available
Version		v0
Team in charge		PUT
Creator/s		**Kicki Piotr** (PUT)
Contributor/s		**Paweł Lembicz** (VWP)
Contact Person/s		**Krzysztof Walas** (PUT, krzysztof.walas@put.poznan.pl)
Contents		The dataset contains: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of Bimanual Cable Manipulation at TRL4, TRL5, TRL6. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection carried out by VW partner; (2) mathematical models of the objects and of the manipulations strategies; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for this use case. The intended goals are: (1) test the ability to arrange wires and cables along predefined paths; (2) prove robust manipulation and validation in relevant environment; (3) demonstration of managing the cable shape. To extend the developed system toward other application domains, the control of the DLO shape over their entire length and all along the manipulation process is required. This control requires solving the inverse kinematic problem for DLOs,

	including multiple and distributed contact points and external forces, which is a complex mathematical problem. In order to execute manipulation tasks, perception at run-time will be strongly exploited. The wire tracking ability developed in T4.2 will be used both for providing sensor information to the grasping and manipulation control algorithms and to provide feedback about the task execution to the planner developed in T5.1. The proximity sensors will be used during the manipulation activities in order to implement short range obstacle avoidance algorithms since to reach the expected TRLs the manipulation has to be implemented in relevant industrial scenarios: in some use cases (e.g., switchgear assembly and wiring harness assembly) the manipulation of wires and cables very near to other components is essential. The objective is to develop methods to adapt the known models to the REMODEL use cases, as well as using machine learning techniques to embed cable manipulations capabilities into the robot. The identification of the wire parameters and the selection of generic wiring scenarios will be used to improve the robot motions and the wiring accuracy. Safety constraints will be taken into account using the primitives developed in T2.4. Managing the cable shape is an important industrial challenge that enables potential applications on different domains, such as aerospace, automotive, switchgear manufacturing etc. Online identification of the wire and cable parameters will be investigated as well as manipulation techniques based on machine learning. At TRL 4, the ability to arrange wires and cables along predefined paths is tested in a laboratory environment. This includes also the exploitation of bimanual manipulation to an arrangement of wires in and out of the wire collectors in case of switchgear wiring and to hold them on wire holders in case of wiring harness manufacturing. A specific ROS package is released. The sensitivity of the proximity sensors is tested in order to evaluate if it is sufficiently high for the restricted working area of the REMODEL use cases. ROS node is released for the proximity sensor. At TRL 5 the information about the wire parameters are integrated to allow a more robust manipulation and validation in relevant environment. The routing of a wire and a cable is implemented in a simplified scenario, by using an industrial robot equipped with the tools developed in WP6. The proximity signals are evaluated during the routing of the sample cable. At TRL 6, the cable shape management will be demonstrated in a relevant environment. Integration also with grasping algorithms is implemented and released in order to test the complete task, where the manipulation is robust if the DLOs grasp is continuously monitoring and maintained in a correct and known pose. This data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects to define proper strategies for the hose handling. To the best of authors knowledge, such type of dataset is not already available. The bimanual manipulation of the cable is an unexplored research topic yet, hence no such dataset exists.
Data format	Documentation: plain text (.txt) and/or Rich Text Format(.rtf) Numerical data and code: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) and/or .png Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)

Data volume	Not yet available (~ MB/GB)
Accessibility	If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s	Not yet available

24	**Available**	**REMODEL. WP5. Cable Manipulation Planning Execution Inter-active Perception. T5_3. Bimanual Wire And Cable Manipulation. Spline Manipulation Simulation. v0**
DOI		http://doi.org/10.6092/unibo/amsacta/6650
Version		v0
Team in charge		UNIBO
Creator		**Gianluca Palli** (UNIBO)
Contact Person		**Gianluca Palli** (UNIBO, gianluca.palli@unibo.it)
Contents		The dataset contains the data generated in the framework of REMODEL project related to the simulation of the spline based manipulation and presented in the publication: G. Palli, "Model-based Manipulation of Deformable Linear Objects by Multivariate Dynamic Splines," 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS), Tampere, Finland, 2020, pp. 520-525, doi: 10.1109/ICPS48405.2020.9274730.
Data format		.txt
Data volume		2.57 MB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		G. Palli, "Model-based Manipulation of Deforma-ble Linear Objects by Multivariate Dynamic Splines", 2020 IEEE Conference on Industrial Cy-berphysical Systems (ICPS), 2020, pp. 520-525, doi: 10.1109/ICPS48405.2020.9274730.

25	**Not yet available**	**REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_4. Wiring Harness Manipulation. Manipulation Of Harness. v0**
DOI		Not yet available
Version		v0
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.ti)
Contents		The dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly

	used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. Intended goal: tests about the development of a specific manipulation strategy to manage complex wiring harnesses composed by multiple cables and different branches will be reported in this deliverable. Dual arm manipulation will be largely exploited to group or to separate properly the branch as desired by the manufacturing task. At TRL 4, laboratory evaluation of the sub-tasks, i.e. taking a complex wiring harness from the assembly jig and put it into a box (UC4), take the wiring harness out from the box (or from its storage in general) and connect it (UC2) or arrange/route it along the desired path considering obstacles (UC3). Manipulation of single wiring harness branches for the arrangement on supports and introduction in holes will be evaluated. Bimanual manipulation will be tested to separate entangled branches. At TRL 5, evaluation of using bimanual manipulation to pull the cable through the hole, separate entangled branches and route them along the desired path based on the perception system; testing in the relevant environment. At TRL 6, evaluation of the integration of safety features and demonstration in the final evaluation testbed.
Data format	Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume	Not yet available (~ MB/GB)
Accessibility	If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s	Not yet available

26	**Not yet available**	**REMODEL. WP5. Cable Manipulation Planning Execution Interactive Perception. T5_5. Interactive Perception. Evaluation Of Tactile Vision System. v0**
DOI		Not yet available
Version		v0
Team in charge		PUT
Creator/s		**Kicki Piotr** (PUT)
Contributor/s		**Paweł Lembicz** (VWP)
Contact Person/s		**Krzysztof Walas** (PUT, krzysztof.walas@put.poznan.pl)
Contents		The dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly

26	**Not yet available**	**REMODEL. WP5. Cable Manipulation Planning Execution Interactive Perception. T5_5. Interactive Perception. Evaluation Of Tactile Vision System. v0**
		used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection carried out by VW partner; (2) mathematical models of the objects and of the manipulations strategies; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for this use case. The intended goals are: (1) the tactile-vision system for interactive perception tested in a laboratory setting; (2) the system will be tested in a relevant environment; (3) improved interactive perception with an internal model of cable parameters to provide faster system response will be demonstrated. The data will consist of experimental observations. While providing the industry grade vision and planning system working in sense-plan-act methodology we will concurrently perform research on interactive perception exploiting subproducts from WP4, WP5 and WP6. In particular, based on T4.3 we will provide a single interaction system which will improve vision by bending cable with the robotic arm to provide information on physical properties of the cable from a predefined set of cables. Next, we will develop a system which will interact in the loop: cable bending, observing deformation with the camera to estimate physical parameters of the cable. On top of that, we will add multimodal interactive perception by adding tactile information and contact map T6.2. This will enable a faster estimation of the parameters than vision alone. Finally, we will focus on building an internal representation of the physics of the cables so the robotic system seeing a cable might have prior on its physical properties and then only confirm it through purposeful and deliberate selected interaction point. At TRL 4, tactile-vision system for interactive perception tested in a laboratory setting for different wires. At TRL 5, tactile-vision based system for interactive perception with internal cable parameters representation tested in a relevant environment. At TRL 6, improved interactive perception with an internal model of cable parameters to provide faster system response will be demonstrated in a relevant environment. This data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects to define proper strategies for the hose handling. To the best of authors knowledge, such type of dataset is not already available. The manipulation of the harness is an unexplored research topic yet, hence no such dataset exists. .
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: PNG (.png) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4)
Data volume		not yet available (~ MB/GB)
Accessibility		The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		not yet available

WP6 – Sensory Systems And Mechatronic Tools

Commercial anthropomorphic robot arms, selected among those available in the partner laboratories, must be integrated with advanced mechatronic tools and sensory systems to tackle REMODEL use cases. To this aim, this WP is devoted to the development of the sensory system components and the mechatronic tools, necessary for the achievement of REMODEL objectives. For all devices the low-level needed firmware will be developed in this WP together with ROS packages to make available data for control algorithms developed in WP5. Moreover, this WP will tackle the mechanical integration of the developed devices into the robotic platforms for all use cases described in WP7. Specific tests for the evaluation of all developed tools will be executed using simplified testbeds and the feedback from these tests at different TRL levels will be used to optimize and finalize the integration process, before the end of the third year.

Lead: UCLV

Participants: UNIBO, UCLV, IEMA, TECNALIA, ELIMCO, TAU, TUM, PUT, VWP, ENKI

Months: 1-48

Potential users for the data sets of this WP include every person, body, corporation, company or institution interested in carrying out research in the same field of the REMODEL project.

27	**Not yet available**	**REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_1. Development Of Robotic Platforms. Design And Testing Of The Robotic Platforms. v0**
DOI		Not yet available
Version		v0
Team in charge		TAU
Creator/s		**Saigopal Vasudevan** (TAU); **Pablo Malvido Fresnillo** (TAU)
Contributor/s		Not yet available
Contact Person/s		**Saigopal Vasudevan** (TAU, saigopal.vasudevan@tuni.fi); **Pablo Malvido Fresnillo** (TAU, pablo.malvidofresnillo@tuni.fi)
Contents		The dataset will contain: (1) simulations and experimental data provided by measurement systems, automation and robotic platforms adopted for the implementation of the different use cases. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final platform selection; (2) mathematical models of the objects and of the manipulations strategies; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. The intended goals

27	Not yet available	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_1. Development Of Robotic Platforms. Design And Testing Of The Robotic Platforms. v0
		are: (1) test of the ROS packages; (2) test of hardware and software interfaces of the robotic platforms; (3) test of overall integrated system and safety requirements. Manipulators will be selected by the partners involved in the development of technical WPs, among the available ones, in order to reduce the platform footprint and then the impact on the actual manufacturing scenario. A dual arm configuration with fixed base will be considered for all use cases described in WP7. In particular, the following dual arm platforms will be initially provided: - 1. UC1 platform (T7.1) – UNIBO and UCLV; - 2. UC2 platform for aerospace domain (T7.2) – TECNALIA; - 3. UC2 platform for automotive domain (T7.2) – TAU and UNIBO; - 4. UC3 platform (T7.3) – VW, TUM, PUT and TAU; - 5. UC4 platform (T7.4) – PUT and TUM. - The cameras composing the vision systems developed in WP4 will be integrated as well into the robotic platforms. For the grippers, the use of commercial components will be evaluated first to reduce the cost and simplify the development, but suitable solutions will be investigated in T6.3 in case commercial ones will not fit with the application requirements. The sensory system developed in T6.2 will be integrated into the robotic platforms. At TRL 4: The robotic platforms are selected for each use case by evaluating workspace and accuracy. ROS packages to control the dual arm platforms are released, and tested in laboratory within a PC-based ROS network. The ROS packages to communicate with the vision system developed in WP4, the mechatronic tools and sensory system developed in this WP are released. The system and safety requirements defined in WP2 are verified. At TRL 5, the hardware and software interfaces of the robotic platforms are released according to the specifications indicated by the industrial partners, to allow the integration in their systems. For each platform, the whole functionalities are tested with sensorized commercial grippers, by grasping wires, cables and hoses from a known position in a structured scene. The same grasping is performed with a high number of repetitions to evaluate system performance. Also, the HW/SW interface with the vision system, the mechatronic tools and the sensory systems are verified in the industrial controlled scenario. At TRL 6, all developed components in WP4 and this WP are integrated into the robotic platforms. The robotic platforms are fully integrated from HW/SW point of view into the scenario prepared by the industrial partners. The system and safety requirements are tested in this relevant scenario. The workspace and accuracy are verified by checking that all necessary components in the scene are reachable with a sufficient accuracy. All requirements are tested during: cabling of a wire into a switchgear; routing of a cable in car or airplane components; a wiring harness manufacturing; grasping of a medical hose. This data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects. To the best of the consortium knowledge, there are no available datasets of that kind. Specific experiments are needed due to the lack of knowledge in the specific field and application scenario.

27	Not yet available	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_1. Development Of Robotic Platforms. Design And Testing Of The Robotic Platforms. v0
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		Not yet available (~ MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

28	Available	REMODEL. WP6. Sensory Systems and Mechatronic Tools. T6-2. Development and Optimization of Sensory System Components. Data for characterization of the tactile sensor. v0.
DOI		https://doi.org/10.5281/zenodo.4680553
Version		v0
Team in charge		UCLV
Creator/s		**Andrea Cirillo** (UCLV), **Marco Costanzo** (UCLV), **Gianluca Laudante** (UCLV), **Salvatore Pirozzi** (UCLV)
Contact Person/s		**Gianluca Laudante** (UCLV, gianluca.laudante@unicampania.it), **Salvatore Pirozzi** (UCLV, salvatore.pirozzi@unicampania.it)
Contents		The datasets contain the data related to the experiments carried out for the tactile sensor characterization, related to the publication: A. Cirillo, M. Costanzo, G. Laudante, and S. Pirozzi, "Tactile Sensors for Parallel Grippers: Design and Characterization," Sensors, vol. 21, no. 5, art. 1915, Mar. 2021. (DOI: 10.3390/s21051915)
Data format		.txt
Data volume		73 MB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		A. Cirillo, M. Costanzo, G. Laudante and S. Pirozzi, "Tactile Sensors for Parallel Grippers: Design and Characterization", Sensors, vol. 21, 2021, 1915, doi: 10.3390/s21051915.

29	Available	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_2. Evaluation of a deformable skin tactile sensor. v0
DOI		http://doi.org/10.6092/unibo/amsacta/6641

29	Available	REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_2. Evaluation of a deformable skin tactile sensor. v0
Version		v0
Team in charge		UNIBO
Creator/s		**Roberto Meattini** (UNIBO), **Davide Chiaravalli** (UNIBO), **Gianluca Palli** (UNIBO) and **Claudio Melchiorri** (UNIBO)
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.it)
Contents		The dataset contains the data related to three different types of data acquisitions, on which we trained and tested the an artificial neural network (ANN). The procedure for the training and testing of the ANN is realized for each combination of inflated air and vertical force levels, by means of a nested cross-validation (CV). In detail, the CV is composed by two nested loops. The first data acquisition is composed by the output of the Inertial Measurement Unit (IMU) while the robotic manipulator UR5 is pressing on its surface with a metal stick end-effector on a grid on 42 different locations (namely: the 42-locations-session); the data acquired during this process from the tactile sensor are labeled based on the Cartesian position of the robot, therefore associating the signals with 42 different classes. The second data acquisition is related to the IMU data when the robot is pressing on the tactile sensor by means of a linear-like end-effector, applying the orientations of 0°, 30°, 60°, 90°, 120° and 150° (namely: the 6-orientations-session); in this case, the signals are labeled according to 6 classes, that corresponds to the six orientations of the linear region of contact points. Finally, the third data acquisition is built in the same way of the second, but considering the orientations of the linear region of contact points related to 0°, 45°, 90° and 135° (namely: the 4-orientations-session), corresponding to the labeling of the signals according to 4 classes. For each type of data acquisition, we repeated the experiment two times, and, for each of this repetition, we acquired the data for 3 levels of vertical force applied on the tactile sensor – 0.5 N, 1 N and 2 N (using the information from the force sensor at the base of the tactile sensor) – and 3 levels of inflating air – 5 ml, 7 ml and 10 ml (measured by using a syringe). In this way, we obtained a total amount of 54 datasets (27 datasets for the first session, and 27 datasets for the second session.) The data is related to the publication: Y. Iwamoto, R. Meattini, D. Chiaravalli, G. Palli, K. Shibuya and C. Melchiorri, "A Low Cost Tactile Sensor for Large Surfaces Based on Deformable Skin with Embedded IMU," 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS), Tampere, Finland, 2020, pp. 501-506, doi: 10.1109/ICPS48405.2020.9274737.
Data format		.txt
Data volume		2.58 MB
Accessibility		Data available under Creative Commons Attribution (CC BY) 4.0 license.
Related publication/s		Y. Iwamoto, R. Meattini, D. Chiaravalli, G. Palli, K. Shibuya and C. Melchiorri, "A Low Cost Tactile Sensor for Large Surfaces Based on Deformable Skin with Embedded IMU", 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS), 2020, pp. 501-506, doi: 10.1109/ICPS48405.2020.9274737.

30	Not yet available	**REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_3. Cable Grasping And Connection Tool. Grasping End-Effector. v0**
DOI		Not yet available
Version		v0
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.it)
Contents		The dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. Intended goal: the tools developed in WIRES and a 2D low-cost camera for close view on target objects will be integrated and tested into the robotic platforms at the beginning of the project, in order to initially perform wire manipulation and grasps. This allows to evaluate an end effector ready at the first year of the project, and use obtained data to optimize the final end effectors for REMODEL use cases in WP7. The other platforms will be equipped and tested with commercial parallel grippers and sensors in T6.2. On the basis of the first experiments feedback, performed with these platforms, for the use cases in WP7, where needed, a specific optimized end-effector will be tested. The following main aspect will be optimized taking into account the characteristics of the manipulators and the application requirements defined in T2.1: 1) gripper jaws shape, dimensions and mobility; 2) actuators typology and allocation; 3) force/motion transmission system; 4) electronics for low-level controller and interfaces with sensors and actuators; 4) number of necessary Degrees-of- Freedom. Open source software, like the Linux and ROS environment, will be used for the implementation of the controller communication interface. At TRL 4, the data related to the end-effector available from WIRES and already tested @TRL4 for switchgear assembly are considered. In REMODEL, the capabilities in terms of workspace, max gripping force, accuracy in positioning and velocity are evaluated in laboratory, taking into account all use cases tackled in this project. For use cases, where needed, an optimized version is released. Updated ROS packages are released and tested in a PC-based ROS network. All hw/sw characteristics are compared with the system requirements defined in WP2. At TRL 5, the tools are integrated into a robotic platform both from hardware and software point of view. All communication features with the industrial interfaces are correctly tested and verified. At TRL 6: the finalized grasping tools are integrated into all robotic platforms. Hardware and software interfaces are finalized and verified.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf)

30	Not yet available	**REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_3. Cable Grasping And Connection Tool. Grasping End-Effector. v0**
		Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		Not yet available (~ MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		not yet available

31	Not yet available	**REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_3. Cable Grasping And Connection Tool. Wire Connection End-Effector. v0**
DOI		Not yet available
Version		v0
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.it)
Contents		This dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. Intended goal: the test of the grasping platforms in the wire connection manipulation problem will be reported in this deliverable. At TRL 4, ROS packages are released and tested in a PC-based ROS network. All hw/sw characteristics are compared with the system requirements defined in WP2. At TRL 5, the capabilities evaluated @TRL4 are evaluated during the grasp of a wires, a cable and a hose from a known well-structured position. At TRL 6, grasping and connection of a wire into a switchgear mechanical component, manipulation of a cable in car or airplane components, a wiring harness manufacturing; grasping of a medical hose will be tested.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)

31	Not yet available	**REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_3. Cable Grasping And Connection Tool. Wire Connection End-Effector. v0**
Data volume		Not yet available (~ MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

32	Not yet available	**REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_4. Cable Rooting Tool. Design Rooting Tool. v0**
DOI		Not yet available
Version		v0
Team in charge		UNIBO
Creator/s		Not yet available
Contributor/s		Not yet available
Contact Person/s		**Roberto Meattini** (UNIBO, roberto.meattini2@unibo.it)
Contents		This dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection for the different use cases; (2) mathematical models of the objects and of the cables and objects to be observed; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for the different use cases. Intended goal: data related to a specific routing tool that will be designed and tested will be reported in this deliverable. This tool should simplify the routing among two connections, when the wire or cable to manipulate is too long to be manipulated by the dual arm platform equipped with two grasping tools. The main idea is to use an actuated double-belt system able to collect the wire inside a storing pulley and release it in a controlled way. This system will be implemented and tested on UC1 and UC2 scenarios. Design adaptation will be considered to fit with the requirements of the specific use case. At TRL 4, a prototype of the routing tool will be implemented. The ROS package to control the tool is released. The rolling and unrolling phases are verified on a workbench. The tests will be performed with a wire of limited length and diameter. At TRL 5, the routing tool is tested into a robotic platform both from hardware and software point of view. The communication interface are released and verified. The tool is tested with different wires and cables. Maximum length, diameter and flexibility of the deformable linear object that can be rolled and unrolled are evaluated, on the basis of system requirements of each use cases. A simplified routing task is executed starting from a wire already connected at one end. At TRL 6, the robotic platform with the integrated tool is tested in a complete routing task, both for the switchgear assembly case and wiring harness manufacturing. Both the rolling and unrolling phases are tested for a sequence of routing with wires of dif-

32	**Not yet availa-ble**	**REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_4. Cable Roo-ting Tool. Design Rooting Tool. v0**
		ferent lengths and diameters, within a switchgear partially already cabled.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		Not yet available (~ MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		not yet available

WP7 – Development And Evaluation Of Robot Abilities

In this WP, the test plants resembling the selected use cases to evaluate the project across different development steps the robotic components and abilities will be implemented. Moreover, smaller technological bricks will be developed and tested in-house by the different partners. Finally, the implementation of final demonstrators will be carried out for validating the entire project outcomes. All the system components will be based on the ROS communication middleware to simplify the integration.

Lead: UNIBO

Participants: UNIBO, UCLV, IEMA, TECNALIA, ELIMCO, TAU, TUM, PUT, ELVEZ, VWP, ENKI

Months: 9-48

Potential users for the data sets of this WP include every person, body, corporation, company or institution interested in carrying out research in the same field of the REMODEL project.

33	**Not yet available**	**REMODEL. WP7 Development And Evaluation Of Robot Abilties. T7_1. Switchgear Cabling Use Case. Evaluation UC1. v0**
DOI		Not yet available
Version		v0
Team in charge		IEMA
Creator/s		**Maurizio Indovini** (IEMA, indovinim@iemasrl.com)
Contributor/s		Not yet available
Contact Person/s		**Maurizio Indovini** (IEMA, indovinim@iemasrl.com)
Contents		This dataset will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection carried out by IEMA; (2) mathematical models of the objects and of the manipulations strategies; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for this use case. Intended goal: This data set will report the experiments carried out to test and validate the robotic platform developed in T6.1 in a laboratory testbed at TRL4. A switchgear sample will be used to extended the WIRES results to the wiring of the a considerable part of the connections using the tools developed in T6.3 and T6.4. The integration of the robotic platform in the IEMA factory and the related experimental data will be added to this data set at TRL5, considering the constraints of the design chain and the production line. The integration with the Komax Z630 crimping and wire preparation machine available at IEMA will be

33	Not yet available	REMODEL. WP7 Development And Evaluation Of Robot Abilties. T7_1. Switchgear Cabling Use Case. Evaluation UC1. v0
		considered to properly collect the wires and providing them to the robot in such a way they can be easily grasped. Suitable tests will be executed to evaluate application constraints in terms of execution time, robotic platform footprint and safety with respect to human operators. At TRL 6, the plant robotic platform will be properly tuned and the use-case demonstration will be executed by cabling of some switchgear samples on the IEMA production line. The entire pipeline from the product design until the completion of the robot task list will be executed. All the experimental data generated and collected during these phases will be collected in this data set. Specific experiments are needed due to extend the knowledge in the specific field and application scenario. This data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects to define proper strategies for the wire handling. The experiments will be oriented at extending the data sets generated during the previous WIRES project[17] and published in: 1. Palli, Gianluca; Pirozzi, Salvatore, A Tactile-Based Wire Manipulation System for Manufacturing Applications, «ROBOTICS», 2019, 8, pp. 46 – 58, https://doi.org/10.3390/robotics8020046. 2. De Gregorio, Daniele*; Zanella, Riccardo; Palli, Gianluca; Pirozzi, Salvatore; Melchiorri, Claudio, Integration of robotic vision and tactile sensing for wire-terminal insertion tasks, «IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING», 2019, 16, pp. 585 – 598, https://doi.org/10.1109/TASE.2018.2847222. 3. Busi, M.; Cirillo, A.; De Gregorio, D.; Indovini, M.; De Maria, G.; Melchiorri, C.; Natale, C.; Palli, G.; Pirozzi, S., The WIRES Experiment: Tools and Strategies for Robotized Switchgear Cabling, «PROCEDIA MANUFACTURING», 2017, 11, pp. 355 – 363, https://doi.org/10.1016/j.promfg.2017.07.118.
Data format		Textual data: plain text (.txt) and/or Reach Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		Not yet available (~ MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

34	Not yet available	REMODEL. WP7. Development And Evaluation Of Robot Abilities. T7_2. Wiring Harness Manufacturing Use Case. Evaluation Of UC2. v0
DOI		Not yet available

[17] WIRES – Wiring Robotic System for Switchgears, http://echord.eu/wires.html

34	Not yet available	REMODEL. WP7. Development And Evaluation Of Robot Abilities. T7_2. Wiring Harness Manufacturing Use Case. Evaluation Of UC2. v0
Version		v0
Team in charge		ELVEZ
Creator/s		**Ziga Gosar** (ELVEZ)
Contributor/s		Not yet available
Contact Person/s		**Ziga Gosar** (ELVEZ, Ziga.Gosar@elvez.si)
Contents		This data set will contain: (1) experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection carried out by ELVEZ; (2) mathematical models of the objects and of the manipulations strategies; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for this use case. The main goal of this data set is to collect all the data related to the experimental tests carried out in laboratory testbeds at TRL4 on the robotic platform developed in T6.1 for the wiring harness assembly. Suitable emulations of the tasks the robotic platform must accomplish in the industrial scenario will be executed in order to evaluate the ability of the robot of using a easywiring table. The integration with the ELVEZ production line and the data related to the experiments needed for this activity will be collected in this data set at TRL5. The final evaluation of the wiring harness manufacturing use case and the related experimental data collected during this phase will be generated at TRL6. This data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects to define proper strategies for the wiring harness assembly. To the best of the consortium knowledge, there are no available datasets of that kind. Specific experiments are needed due to the lack of knowledge in the specific field and application scenario.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf); Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		Not yet available (~ MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

35	Not yet available	REMODEL. WP7. Development And Evaluation Of Robot Abilties. T7_3. Wiring Harness assembly Use Case. Evaluation Of UC3. v0
DOI		Not yet available

35	Not yet available	REMODEL. WP7. Development And Evaluation Of Robot Abilties. T7_3. Wiring Harness assembly Use Case. Evaluation Of UC3. v0
Version		v0
Team in charge		VWP
Creator/s		**Pawel Lembicz** (VWP)
Contributor/s		Not yet available
Contact Person/s		**Kalota Lukasz** (VWP, lukasz.kalota@vw-poznan.pl)
Contents		The data will consist of: (1) experimental measurements taken by proper sensors, instruments or directly generation by the automation systems and robots developed and introduced in the experimental setup; (2) mathematical models of the objects and of the manipulations strategies; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for this use case. The goal of this data set is to collect the results of the experimental tests performed on the robotic platform developed in T6.1 for the manipulation of the wiring harness in laboratory testbeds set up both at PUT and at UNIBO at TRL4. After this phase, the integration of the wiring harness installation testbed in the VW production line and the related experimental data will be generated at TRL5. Finally, the experimental results related to the test plant for the evaluation of the wiring harness installation use case will be set up at the VW factory will be collected to demonstrate the REMODEL abilities at TRL6 for the UC3. This data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects to define proper strategies for the wiring harness manipulation. To the best of authors knowledge there is no such dataset. The manipulation of the harness is not yet very popular research topic, hence no such dataset exists. Therefore, specific experiments are needed due to the lack of knowledge in the specific field and application scenario.
Data format		Textual data: plain text (.txt) and/or Rich Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		Not yet available (~ MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

36	Not yet available	REMODEL. WP7. Development And Evaluation Of Robot Abilties. T7_4. Wiring Harness assembly Use Case. Evaluation Of UC4. v0
DOI		Not yet available
Version		v0

36	Not yet available	REMODEL. WP7. Development And Evaluation Of Robot Abilties. T7_4. Wiring Harness assembly Use Case. Evaluation Of UC4. v0
Team in charge		ENKI
Creator/s		**Nicolò Bontempi** (ENKI)
Contributor/s		Not yet available
Contact Person/s		**Nicolò Bontempi** (ENKI, researcher_designer_technologist@enkisrl.com)
Contents		This data set will contain: (1) simulations and experimental data provided by sensors, measurement systems, automation and robotic platforms adopted for the implementation of this use case. The ROS framework will be mainly used to collect data at TRL4, while the hardware and software platform adopted at TRL5 and TRL6 depend on the final selection carried out by ENKI; (2) mathematical models of the objects and of the manipulations strategies; (3) mechanical models in the form of CAD files of the robotic platform and of the specific tools implemented for this use case. This data set will report the experiments carried out to test and validate the dual-arm robotic platform developed in T6.1. The integration of the wiring hose manipulation testbed in the ENKI production line will be considered, and suitable tests will be executed exploiting the manipulation ability developed in T5.2 and T5.3 to test the hose handling capabilities. The demonstration of the hose manipulation and quality inspection will be carried out in the laboratory first (TRL4), therefore the integration with the ENKI production line will be considered (TRL5) and suitable on field tests will be executed. Finally, the evaluation of the hose handling and quality inspection use case and the related experimental data collected during this phase will be generated at TRL6. This data will be useful internally for the development of the specific use case and to the general community working on the manipulation of deformable linear objects to define proper strategies for the hose handling. To the best of the consortium knowledge, there are no available datasets of that kind. Specific experiments are needed due to the lack of knowledge in the specific field and application scenario.
Data format		Textual data: plain text (.txt) and/or Reach Text Format(.rtf) Tabular data with minimal metadata: rosbag (.bag) and/or comma-separated value (.csv) Image data: TIFF (.tif) and/or JPEG (.jpeg) Video data: MPEG-4 (.mp4) CAD files: STEP (.stp) and/or X3D (.x3d)
Data volume		Not yet available (~ MB/GB)
Accessibility		If personal information will be present, it will be censored. The data will be available under Creative Commons Attribution (CC BY) 4.0 license
Related publication/s		Not yet available

Annex II: "README" file template

A "README" file is a document that is deposited with each dataset, containing relevant information about data set authorship, terms of reuse and responsibilities, explaining data set content and structure, collection procedures and analysis (such as file specifics, methodologies, codebooks of variables, data sources, and further necessary notes). The template of the README file used by REMODEL partners is shown here.

README file

Data Set Title: **"[insert title as defined in the DMP]"**

Data Set Author/s: **Name Surname** (Affiliation), ORCID (if available);
[Add one or more creators, if present]

Data Set Contributor/s: **Name Surname** (Affiliation), ORCID (if available);
[Add one or more contributors, if present. Otherwise, cancel this line]

Data Set Contact Person/s: **Name Surname** (Affiliation), ORCID (if available), email;
[Add one or more contact person]

Data Set License: this data set is distributed under a **(INSERT LICENSE)**
[Insert the chosen license as indicated in the DMP: e.g. "this data set is distributed under a Creative Commons Attribution 4.0 International (CC BY 4.0) license, https://creativecommons.org/licenses/by/4.0/"]

Publication Year: **(insert YEAR)**

Project Info: **[insert PROJECT ACRONYM] ([project full title],** funded by European Union, Horizon 2020 Programme. Grant Agreement num. **[insert grant agreement number]**; **[insert project website url]**

Data set Contents

The data set consists of:

[Indicate the files that compose the dataset and their name and format.

WE STRONGLY SUGGEST YOU TO FOLLOW THE EXAMPLES PROVIDED FOR THE FILE NAMING, MATCHING THE DATASET FILENAME WITH THE README ONE

In the following examples the data sets were composed by only one file. In case the dataset consists of more files you can name them as described and put them in a compressed folder. In this case readme file name should match the compressed folder name]

EXAMPLE1

- 1 textual qualitative file saved in .rtf format
  "**ProjectAcronym_WP3_T3-2_ItalyInterviews_20161221_v01.rtf**"
  [structure of the filename "ProjectAcronym_insert WP number_insert Task number, e.g. T3.2_ insert Content Describing Keywords_insert date YYYYMMDD_insert version, if needed.format"

Suggested format:
-for textual qualitative data .rtf or .txt
-for tabular quantitative and qualitative data .csv
avoid proprietary formats such as .doc/.docx and .xls/.xlsx]

- 1 README file
  "**README_ProjectAcronym_WP3_T3-2 _ItalyInterviews_20161221_v01.rtf**"
  [Same naming as the dataset file. Preferred format .rtf/.txt, allowed format .pdf]

EXAMPLE2

- 1 tabular quantitative file saved in .csv format
  "**ProjectAcronym_WP7_T7.3_Questionnaire_Sweden_20170905.csv**"
- 1 README file
  "**README_ProjectAcronym_WP7_T7-3_Questionnaire_Sweden_20170905.rtf**"

Data set Documentation

Abstract

….

[Insert a brief abstract describing the content of the dataset]

Content of the files:

- file **[Insert filename]** contains ...

[Provide a brief description of the content of the file/s. This is an example of how you could start]

- file **[Insert filename]** contains ...
- …

File specifics

…

[Provide useful info regarding file conversion etc… (Optional)

Please indicate instruction/technical info in order to allow potential users to correctly visualize and reuse your data (e.g. specific software, …).

In case of data converted in open formats it could be useful to provide some further information. For example if you deposit for long term preservation a .csv file derived from an excel you can describe the conversion. Here is an example of description of conversion using libre office calc software:

To create the .csv files, "LibreOffice Calc" version: 5.1.4.2 (portable) was used, with the following specifics:
•Character set Europa occidentale (Windows-1252/WinLatin1)
•Field delimiter « , » (comma)
•Text delimiter « " » (quotes)]

Notes

…

[Related to the whole dataset or to single files of a multi-file dataset (Optional)]

Data sources

…

[Optional]

Methodologies

…

[If necessary to understand how to reuse data]

Codebook of variables

…

[If necessary to understand the meaning of the variables]

Instructions, examples and footnotes in should be deleted from final version

Annex III: Open Access status of project publications

In the following table it is reported the updated list describing the open access status of the project publications and the underlying data sets.

Table 7 - Open access status of REMODEL publications and data sets.

Publication	Link to Repository	Status	Underlying data
A. Peters, A. Schmidt and A. C. Knoll, "Extrinsic Calibration of an Eye-In-Hand 2D LiDAR Sensor in Unstructured Environments Using ICP", in IEEE Robotics and Automation Letters, vol. 5, no. 2, pp. 929-936, 2020, doi: 10.1109/LRA.2020.2965878.	https://zenodo.org/record/3817196	Open Access, indexed in OpenAIRE	Not yet available (in finalization and/or wait-ing for repos-itory secre-tariat approv-al)
R. Meattini, D. Chiaravalli, G. Palli and C. Melchiorri, "sEMG-Based Human-in-the-Loop Control of Elbow Assistive Robots for Physical Tasks and Muscle Strength Training", in IEEE Robotics and Automation Letters, vol. 5, no. 4, pp. 5795-5802, 2020, doi: 10.1109/LRA.2020.3010741.	http://hdl.handle.net/11585/768135	Open Access, indexed in OpenAIRE	Meattini, Roberto; Chiaravalli, Davide; Palli, Gianluca; Melchiorri, Claudio (2020) *REMODEL. WP3. User And System Interface. T3_3. Teaching By Demonstration Of Skills For New Assembly References And Tasks. Evaluation of physical human-robot interaction modalities. v0*. University of Bologna. DOI 10.6092/unibo/amsacta/6642.
G. Palli, "Model-based Manipulation of Deformable Linear Objects by Multivariate Dynamic Splines", 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS), 2020, pp. 520-525, doi: 10.1109/ICPS48405.2020.9274730.	http://hdl.handle.net/11585/796312	Embargo (accessible after June 4, 2021), not yet indexed in OpenAIRE	Palli, Gianluca (2021) *REMODEL. WP5. Cable Manipulation Planning Execution Inter-active Perception. T5_3. Bimanual Wire And Cable Manipulation. Spline Manipulation Simulation. v0*. University of Bologna. DOI 10.6092/unibo/amsacta/6650.

Publication	Link to Repository	Status	Underlying data
Y. Iwamoto, R. Meattini, D. Chiaravalli, G. Palli, K. Shibuya and C. Melchiorri, "A Low Cost Tactile Sensor for Large Surfaces Based on Deformable Skin with Embedded IMU", 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS), 2020, pp. 501-506, doi: 10.1109/ICPS48405.2020.9274737.	http://hdl.handle.net/11585/785153	Embargo (accessible after June 4, 2021), not yet indexed in OpenAIRE	Meattini, Roberto; Chiaravalli, Davide; Palli, Gianluca; Melchiorri, Claudio (2020) *REMODEL. WP6. Sensory Systems And Mechatronic Tools. T6_2. Evaluation of a deformable skin tactile sensor. v0*. University of Bologna. DOI 10.6092/unibo/amsacta/6641.
W. B. Bedada, R. Kalawoun, I. Ahmadli and G. Palli, "A Safe and Energy Efficient Robotic System for Industrial Automatic Tests on Domestic Appliances: Problem Statement and Proof of Concept", in Procedia Manufacturing, vol. 51, 2020, pp. 454-461, doi: 10.1016/j.promfg.2020.10.064.	http://hdl.handle.net/11585/796314	Open Access, not yet indexed in OpenAIRE	Not yet available (in finalization and/or wait-ing for repos-itory secre-tariat approv-al)
A. Caporali and G. Palli, "Pointcloud-based Identification of Optimal Grasping Poses for Cloth-like Deformable Objects", 2020 25th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), 2020, pp. 581-586, doi: 10.1109/ETFA46521.2020.9211879.	http://hdl.handle.net/11585/796278	Open Access, not yet indexed in OpenAIRE	Caporali, Alessio; Gianluca, Palli (2020) *REMODEL. WP5. Cable Manipulation Planning Execution And Interactive Perception. T5_2. Cable Grasping. Identification and Grasping of Deformable Objects. v0*. University of Bologna. DOI 10.6092/unibo/amsacta/6659.
R. Zanella, A. Caporali, K. Tadaka, D. De Gregorio and G. Palli, "Auto-generated Wires Dataset for Semantic Segmentation with Domain-Independence", 2021 International Conference on Computer, Control and Robotics (ICCCR), 2021, pp. 292-298, doi: 10.1109/ICCCR49711.2021.9349395.	http://hdl.handle.net/11585/816515	Embargo (accessible after August 10, 2021), not yet indexed in OpenAIRE	Zanella, Riccardo; Caporali, Alessio; Tadaka, Kalyan; De Gregorio, Daniele; Palli, Gianluca (2020) *REMODEL. WP4. Vision Based Perception. T4_3. Cable Detection And Tracking. Electric Wires Dataset. Training and Test sets for Image Segmentation. v0*. University of Bologna. DOI 10.6092/unibo/amsacta/6654.

Publication	Link to Repository	Status	Underlying data
W. M. Mohammed, P. Malvido Fresnillo, S. Vasudevan, Ž. Gosar and J. L. Martinez Lastra, "An Approach for Modeling Grasping Configuration Using Ontology-based Taxonomy", 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS), 2020, pp. 507-513, doi: 10.1109/ICPS48405.2020.9274760.	http://urn.fi/URN:NBN:fi:tuni-202012098637	Open Access, not yet indexed in OpenAIRE	Not yet available (in finalization and/or wait-ing for repos-itory secre-tariat approv-al)
W. M. Mohammed, M. Nejman, F. Castaño, J. L. Martinez Lastra, S. Strzelczak and A. Villalonga, "Training an Under-actuated Gripper for Grasping Shallow Objects Using Reinforcement Learning", 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS), 2020, pp. 493-498, doi: 10.1109/ICPS48405.2020.9274727.	http://urn.fi/URN:NBN:fi:tuni-202012098636	Open Access, not yet indexed in OpenAIRE	Not yet available (in finalization and/or wait-ing for repos-itory secre-tariat approv-al)
A. Cirillo, M. Costanzo, G. Laudante and S. Pirozzi, "Tactile Sensors for Parallel Grippers: Design and Characterization", Sensors, vol. 21, 2021, 1915, doi: 10.3390/s21051915.	https://zenodo.org/record/4672281	Open Access, indexed in OpenAIRE	Andrea Cirillo, Marco Costanzo, Gianluca Laudante, & Salvatore Pirozzi. (2021). *REMODEL. WP6. Sensory Systems and Mechatronic Tools. T6-2. Development and Optimization of Sensory System Components. Data for characterization of the tactile sensor*; Zenodo. http://doi.org/10.5281/zenodo.4680553

Gold Open Access
Green Open Access