WP9 – Dissemination, Exploitation and Communication

D9.3 – Dissemination and Communication plan (revised)

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Summary

This deliverable is the revision of the plan describing the Dissemination and Communication activities to be carried out within Work Package 9 of the MERGING project. The present plan will be further revised, based on the same structure, at month 42 (D9.4 Dissemination and Communication Plan – Final). The final version will include a full report on the Dissemination and Communication results, and the planned actions to sustain dissemination and knowledge sharing beyond up to four years after the end of the project, as per article 29 of the Grant Agreement and per the DG Jean-Eric Paquet letter to all H2020 project on 15 April 2021.

[1] Contribution to the initial version of the Dissemination and Communication plan – D9.2

Executive summary

The deliverable D9.3 focusses on the Communication and Dissemination activities of the MERGING project, within the dedicated work package (WP9). It covers two major areas: **Dissemination**, focussed on the disclosure of project results to specific target groups, and **Communication**, aimed to promote the project and its impacts to wider – although still well-defined audiences. For each activity area, it describes: the goals, the targeted audience, the activities carried out from the project start to M30 and the planned activities for the rest of the project. Finally, it includes a section on collaborative activities with other H2020 projects funded by the same call, and a section on the evaluation criteria that will be used to re-asses and update the plan in a final iteration at M42.

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1. Introduction

1.1. Scope

The present document is the updated version of the Dissemination and Communication Plan for the MERGING project. It focusses specifically on:

- Expanding and refining the plan described in the initial version, deliverable D9.2
- Reporting on the actions carried out so far since the beginning of the project.

For both Communication and Dissemination, this document details the objectives, the key messages, the target audiences, the tools and actions already used and foreseen (website, social, leaflet, videos, press releases, journal publications, conference presentations, etc.) and a timeline of how they will be used to reach the desired goals.
A specific section is devoted to collaboration on communication and dissemination with the other projects funded under the same call than our project, i.e. H2020-NMBP-TR-IND-2018-2020 (Transforming European industry), under the topic DT-FOF-12-2019. The importance of such collaborative efforts is expected to grow over the rest of the project's duration, with beneficial synergies influencing not only the communication and dissemination impact of this project, but of the whole H2020 research topic.
In the last section, evaluation criteria (KPIs) for determining the success of the dissemination and communication actions are discussed. This will be especially relevant for the final assessment of these activities at the end of the project.

1.2. Definitions

In this plan, the terms "Dissemination" and "Communication" are used according to the prevalent definitions used by the European Commission with respect to Research and Innovation projects[2]. A brief reminder of the scope of the two terms follows.

Dissemination is defined as *the public disclosure of the results by any appropriate means, including by scientific publications in any medium.* It is focussed on **project results only**; it is addressed to audiences that may use the results in their own work e.g. peers (scientific or the project's own community), industry and other commercial actors, professional organisations, policymakers, etc., and it aims to *enable use and uptake of results.*
Its overall goals are:

- transfer of knowledge and results to the ones that can best make use of it;
- maximize the impact of research, enabling the value of results to be potentially wider than the original focus;
- ensure Open Access to publications (an underlying principle in H2020)

Communication is instead defined as the set of activities that focus on both the project itself and the results, that are addressed to multiple audiences beyond the project's own community (including the media and the public) and that aims to inform and reach out to society to show the benefits of research.

[2] https://ec.europa.eu/easme/sites/easme-site/files/h2020_energy_info_days_communication_dissemination_and_exploitation_presentations_all.pdf

2. Communication

2.1. Objectives

The following Objectives for Communication were defined in the Project Proposal.

- (O1) to involve young minds into digitisation, namely in the development of digital manufacturing technologies and their importance and impact onto the economy and society
- (O2) to promote gender equality, integrate gender dimension in R&I activities, promote career opportunities in robotics and manufacturing
- (O3) to achieve societal endorsement linked to R&I on digital manufacturing
- (O4) to achieve support of industry potentially open to the adoption of **MERGING** technology and solutions for the project, and for future initiatives linked to robotic solutions for manufacturing
- (O5) to mobilise the European Research Area for the adoption of knowledge generated in the project for the development of new technologies and applications
- (O6) to raise awareness among EC, Public Authorities and Policy Makers to foster cooperation in spreading the benefits of robotics manufacturing and contributing to regulatory process.

The six objectives listed above can be turned into operative principles for preparing content and guide the selection of Key messages for communication (see following paragraph); this means that the MERGING communication actions and products must put particular emphasis on:

- countering the perception that automation is associated to job loss, by highlighting the human/robot collaborative potential of solutions for soft objects manipulation;
- presenting robotisation as a beneficial, and ultimately more ethical and sustainable, alternative to job displacement towards low-wages country, in particular in sectors such as the textile industry where the problem is relevant and affects the public perception;
- framing the project as part of an overall European strategy for competitive, resilient and sustainable manufacturing, made even more urgent by the impact of the COVID-19 pandemic;
- providing lay audiences with the necessary technical background to capture the importance and innovative content of this technological effort;
- informing timely about the project's results, and insert these information in the news cycle so that they can be picked up by the news media

2.2. Key messages

The first step for a communication strategy is to define key messages that have to be conveyed through various media, and that should stick with the audience after any encounter with the project's communication. This is fundamental in order to achieve consistency in the communication.

The preliminary plan included in the project proposal outlined some general messages regarding:
KEY MESSAGE 1:
The relevance of MERGING results in our daily life
KEY MESSAGE 2:
The relevance of MERGING project in jobs creation, energy efficiency, citizen's security and life quality
KEY MESSAGE 3:
The MERGING project results and its impact beyond robotic industry

KEY MESSAGE 4:
(The potential for) Collaborating with robots and contribution to job quality improvement
KEY MESSAGE 5:
Career opportunities for women in robotics and automation derived from MERGING results.

These general messages can now be declined more precisely, in the form of brief statements / content points that can be used as "building blocks" in communication materials, presentations, press releases etc., and in general guide the communication.

KEY MESSAGE 6 (technology focus) :
MERGING will pioneer the use of robotics and Artificial Intelligence for manipulating flexible and fragile objects.
KEY MESSAGE 7 (areas of application) :
The solutions will be tested in the textile, food and transport industries, but will have potential for other industrial sectors.
KEY MESSAGE 8 (main expected outcome) :
MERGING aims to design a versatile, low cost and easy-to-use robotic solution that manufacturers can apply to support or automate tasks involving the handling of flexible or fragile objects.
KEY MESSAGE 9 (technology building blocks) :
The solution will consist of a new robotic dexterous gripper taking advantage of an integrated adaptive electro-adhesive skin. Control will include dedicated perception and supervision functions to adapt the system's response to the environment and to the object's behaviour, and abilities to make the human-robot or multi-robot co-manipulation of the flexible object safer, using Artificial Intelligence like Machine Learning.
KEY MESSAGE 10 (consortium) :
MERGING is a three-and-a-half years project coordinated by CEA (Commissariat a l'Energie Atomique et aux Energies Alternatives) in France, and involving academic and industrial partners from five countries.
KEY MESSAGE 11 (partners' role) :
The specific role of each individual partner in the project (relevant at the national/local level) is clearly defined.

2.3. Target audiences

The preliminary plan outlined in the project proposal already defined the most relevant target audiences for MERGING, namely:

- **Young Minds** (i.e. students)
- **Stakeholders** (industrial clusters and associations)
  E.g.: EFFRA, EuRobotics, Euratex/ETP Fibres Textiles Clothing, Text4IM, ERTRAC, ACARE, International Federation of Robotics, EUROPEN, etc.
- **Workers** (i.e. in particular those in the sectors where soft manipulation is relevant)
- **Women** (i.e. in relation to the under-representation of women and gender imbalance in the engineering sector)
  European Platform of Women in Science (EPWS), European Association of Women in STEM (WITEC)
- **European Research Area** (i.e. the general scientific community in Europe, who should be made aware of the potential for research and innovation in this sector)
- **Public in general**

This list remains valid, with the addition of:

- **Media**

  (i.e. journalists on print, online, Tv and radio, in particular those specialising in technology, AI, robotics, business and industry).

  Although the media can also be seen as a vector to reach targeted audience mentioned above, effectively engaging media professionals requires treating them as a separate audience with its own need and specificity.

2.4. Actions and tools

The MERGING communication plan leverages the following principal communication tools and actions:

- Public website
- Leaflet
- Presentations at public events promoted by industrial associations
- Publication of project information in EC platforms
- Publication of project information in national networks for research and innovation
- Press releases
- School visits to partners' facilities
- Joint initiatives with European associations for gender balance in science
- Short videos
- Project video
- Social network profiles and information publication

The following table presents an updated timeline of how these actions and tools are planned to be deployed over the course of the project in order to convey the key messages listed in section 2.2 to the key audiences listed in 2.4.

Action/tool	**Target Audience**	**Key Messages**	**Timing**
Website	Stakeholders / European Research Area / Public in general	2, 4, 6-10	M2 – M18
Website	All	2, 4, **5,** 6-10	M18-M30
Website	All	All	M30-M42
Leaflet	Stakeholders / European research area / public in general	2, 4, 6-10	M18-M42
Presentations at public events promoted by industrial associations	Stakeholders / European research area	2, 3, 4, 6-10	Up to M18
Presentations at public events promoted by industrial associations	Stakeholders / European research area	2, 3, 4, **5,** 6-10	M18-M30
Presentations at public events promoted by industrial associations	Stakeholders / European research area	All	M30-M42

Publication of project information in EC platforms	Stakeholders / European research area	All	M18 onwards
Publication of project information in national networks for research and innovations	Stakeholders, researchers, public in general	All	M18 onwards
Press releases	Media (and stakeholders / public in general via the media)	6-11	M1-M18
Press releases	Media (and stakeholders / women / public in general via the media)	All	M18-M42
School visits to partners' facilities	Young minds	1-5	M24 onwards*
Joint initiatives with European associations for gender balance in science	Women, Public in general, stakeholders	5	M30 onwards
Short videos shared via YouTube/website/social networks	Young minds, public in general, women	All	M30 onwards
Project final video	Young minds, stakeholders, European Research area	2, 4, 6-9	M40
Social media profiles (LinkedIn, twitter) and information publication	Stakeholders, Workers, European Research area, Women	All	M6 onwards

*depending on COVID-19 restrictions being lifted

A more detailed description of each tool/action is presented in the subsections below, including how they have been used over the first 30 months (where applicable) and plans for future use.

2.4.1. Public website

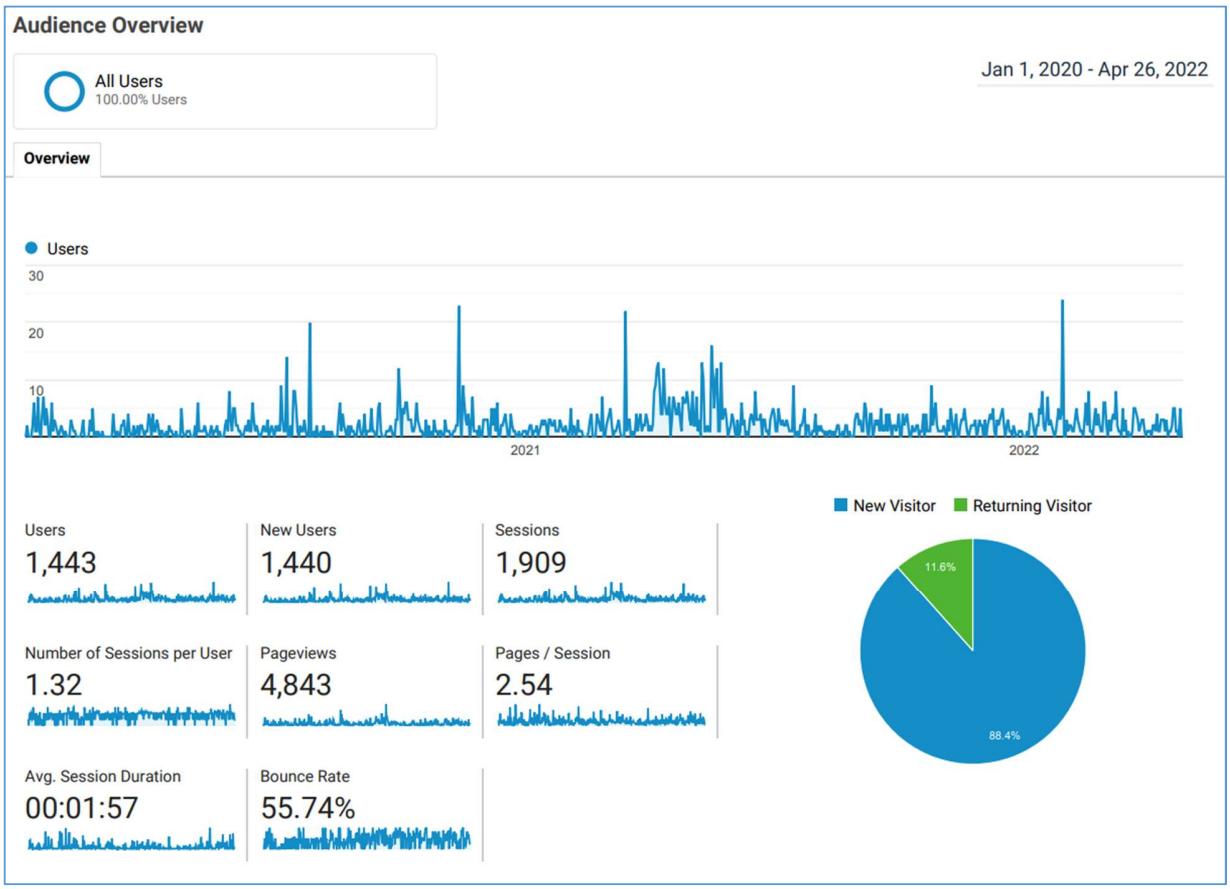
The main objective of the MERGING Public Web Portal is to promote the MERGING project via Internet. The aim is to achieve worldwide dissemination of the knowledge of the project, to publish news and information and to enable the communication between the project coordinator and everyone who is interested in the project. It was primarily developed for any person who wants to be informed for the content and the achievements of the MERGING project.

The MERGING public web portal can be reached at the link: http://www.merging-project.eu/
This portal has been developed and is maintained by Merging partner n°2, i.e. the Laboratory for Manufacturing Systems and Automation (LMS) of University of Patras (Greece). It is based on the open-source WordPress. WordPress is a flexible Content management/Portal solution that is easy to install, use, extend and maintain. A complete description of the structure and technical aspects of Merging website is provided in deliverable D 9.1 – Public website. It has been launched online by the end of Month 2 (December 2019).

Over the course of the first 30 months, the website has been used to present:

- the project's overall concept;
- the composition of the consortium and the role of each partner in the project;
- the structure (title and main topic of each WP) as well as the status of the main technical WPs that are ongoing or already completed;
- an overall presentation of the project in the form of a news story/press release that serves as reference extended description;
- news items about events, in particular presentations at conferences and workshops;
- the project leaflet, that can be downloaded from the website.

An overview of the traffic analytics for the first 30 months is shown in the figure below (from Google analytics).



General presentation and reference to MERGING has been also included on the CEA-LIST public website :

- On "Technological advances" page : https://list.cea.fr/en/april-30-2021-merging-an-european-project-coordinated-by-cea-list-for-the-manipulation-enhancement-of-flexible-objects-through-robotics/ (in English) and https://list.cea.fr/fr/30-avril-2021-merging-un-projet-europeen-coordonne-par-le-cea-list-pour-la-manipulation-dobjets-flexibles-en-robotique/ (in French)
- And on "Research programs in Smart robotics" page : https://list.cea.fr/en/page/smart-robotics/ (in English) and https://list.cea.fr/fr/page/robotique-intelligente/ (in French) (website updated in 04/2022)

2.4.2. Leaflet

A six-page leaflet was developed by EPFL, with collaboration from all partners. The leaflet presents the overall concept and fields of application, the technology building blocks, the use cases and the composition of the consortium. Texts and images were extensively discussed in several WP9 meetings. The leaflet can be downloaded from the website and is presented in Annex C.
An update to the leaflet is expected to take place during 2022 to reflect the change in composition of the consortium and to include a summary of the main results of the project.

2.4.3. Presentations at public events promoted by industrial associations

The main associations to be targeted by this action line include EFFRA, EuRobotics, Euratex/ETP Fibres Textiles Clothing, Text4IM, ERTRAC, ACARE, International Federation of Robotics, EUROPEN, etc.
This action line covers both Communication (focussed on the project itself) and Dissemination (focussed on result, see section 3).

2.4.3.1. Realized actions

For what concerns Communication during these 30 months, an opportunity to present the project was created and leveraged at the **European Robotics Forum 2021** organised by EuRobotics, which took place virtually from 13 to 15 April 2021, with over 800 registered participants.
Already in the 1st MERGING General Assembly meeting (in July 2020), following a suggestion from the Project Officer, the consortium started planning the organization of a **common workshop with the other 2 (later, 3) projects** funded under the same topic ("Handling of flexible materials"): APRIL, REMODEL and SOFTMANBOT. In November 2020, MERGING Consortium selected the European Robotics Forum 2021 as the most suitable venue. In parallel, from October 2020, SOFTMANBOT reached out to MERGING and to REMODEL to propose an internal discussion/have a round table discussing common topics, issues, solutions and way forward.
On our initiative, the four projects met online, agreed to combine the two ideas and collaborate in preparing a Workshop proposal for the European Robotics Forum, with the following outline:

- Joint workshop on "Soft robotic manipulation for the future of European factories" with the SoftManBot – Remodel – April projects, together with MERGING.
- Objectives: get to know each other, and have the opportunity to communicate and exchange, together and with the European robotic community, about fundamental needs in robotic developments and challenges, and eventually identify possible common technical work with our four projects.
- Format: Discussion style workshop / Presentation-oriented workshop
- Duration: 90 minutes (20' per project + 10' discussion)

The proposal was submitted to ERF by the 15 January 2021 deadline. It was accepted and the workshop was scheduled for 13 April, 11:20 CET (see the ERF programme at the following link : https://www.eu-robotics.net/robotics_forum/programme/programme/index.html). The final agenda and abstract is presented below:

> **TITLE :** *Soft objects robotic manipulation for the future of European factories*
>
> **MOTIVATION, OBJECTIVES, EXPECTED OUTCOMES**
> The handling of soft materials with robots will play a significant role in the factories of the future. The European Commission launched a dedicated call, under which four projects have been funded between 2019 and 2020 and are now working on the robotic manipulation of soft objects, which

presents many scientific and technological challenges. Use cases from the textile, electric, toy and food industries will be presented, describing current industrial situation, needs and specificity of a robotic cell, technological challenges and proposed approaches, and elements that can be applied to other cases. A final roundtable will discuss the changes in relative function and place of humans and robots in future European factories, and possibilities for standardization.

AGENDA :
11:20 : The Factories of the Future
Welcome and introduction from José Carlos Caldeira, Honorary Board Member, *EFFRA - European Factories of the Future Research Association*
11:25 : Robotic manipulation for the textile industry: the MERGING project
Dionisis Andronas, project technical manager of MERGING
Current industrial situation - needs and specificity of a robotic cell in this use-case - technological challenges and proposed approach - elements that can be applied to other cases.
11:40 : Robotic manipulation for the food industry: the APRIL project
Xenia Beltran, project coordinator of APRIL
Current industrial situation - needs and specificity of a robotic cell in this use-case - technological challenges and proposed approach - elements that can be applied to other cases.
11:55 : Robotic manipulation for the electric industry: the REMODEL project
Gianluca Palli, project coordinator of REMODEL
Current industrial situation - needs and specificity of a robotic cell in this use-case - technological challenges and proposed approach - elements that can be applied to other cases.
12:10 : Robotic manipulation for the toy industry: the SOFTMANBOT project Juan Antonio Corrales Ramón, project technical manager of SOFTMANBOT
Current industrial situation - needs and specificity of a robotic cell in this use-case - technological challenges and proposed approach - elements that can be applied to other cases.
12:25 : Final roundtable, questions and answers
Moderators: Marco Controzzi (Principal investigator, APRIL project), Leonard Engels (Dissemination manager, APRIL), Nicola Nosengo (Dissemination manager, MERGING project)
Synergies between the four projects; opportunities for standardisation; how the function and place of humans and robots will change in future European factories;

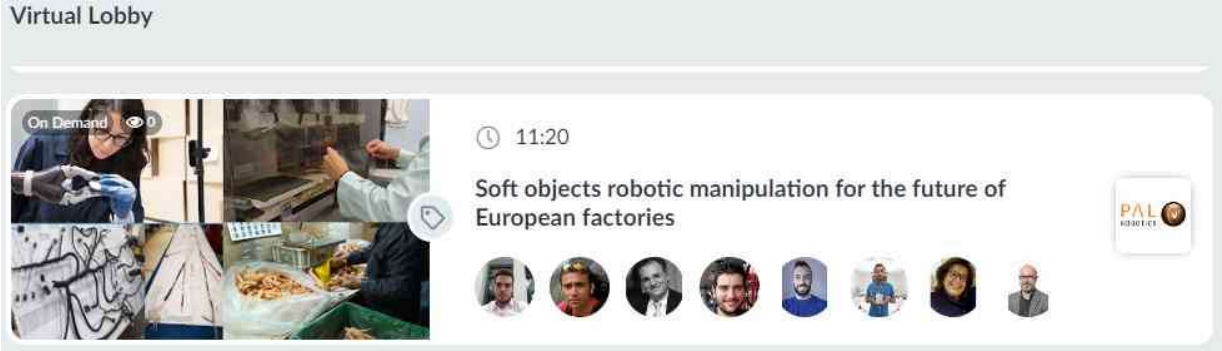
Information about the workshop was distributed through various communication channels, in order to maximise attendance:

- A news item was published on the CORDIS website, using the WIRE tool for contributions from H2020 projects (see also section 2.4.4) : https://cordis.europa.eu/event/id/148884-erf-2021-workshop-on-soft-objects-robotic-manipulation-for-the-future-of-european-factories
- The MERGING Twitter and LinkedIn profiles (see section 2.4.11) each published 2 posts about it, ahead of the event in addition to re-posting the information from the other 3 projects' profiles (a common presentation text had been agreed upon in advance). CEA LIST and Shadow Robot also posted information about the workshop from their own Twitter and LinkedIn profiles[3] and on the CEA LIST public website agenda page[4]. During the event, the MERGING Twitter profile was used for live-tweeting highlights from individual talks.

[3] https://www.linkedin.com/feed/update/urn:li:activity:6787770463738327040, https://twitter.com/CEA_List/status/1382004623599411203?s=20

[4] https://list.cea.fr/en/event/european-robotic-forum-erf-2021/ (in English) and https://list.cea.fr/fr/event/forum-robotique-europeen-erf-2021/ (in French)

The workshop was attended by about 125 participants (speakers included), representing higher education institutions, large companies, SMEs, Research and Technology Organisations. A complete list of participants, including affiliation and contact information is available but cannot be included in this public deliverable for privacy reasons.
The workshop remains available for on-demand viewing (video record) on the event's platform at the workshop's page, for ERF 2021 registered participants only.



This line of action will be continued in the future, and we plan to propose similar workshops at next editions of the European Robotics Forum (2022, 2023) as well as to IROS 2022. Because the next workshops are likely to present technical and scientific results in addition to the projects concepts, they are discussed in section 3 of this report.

Other participations of project partners in public events include:

Event type	**Timing**	**Audience**	**Partner involved**
Swiss Robotics Day 2021 Presentation on soft gripping technologies by prof. Herb Shea (https://swissroboticsday.ch/previous-editions/previous-srd2021/)	2021-2022	Swiss robotic industry, scientific community, general public : Almost 500 participants	EPFL

2.4.3.2. Planned actions

The following organisation of workshops/parallel events at conferences and industry forums are currently foreseen. The list is partial and will be updated depending on the details of the strength of individual results from the various work packages. Organisation of parallel events will continue for up to four years after the end of the project.

Event type	**Timing**	**Audience**	**Partner involved**
DigiHall days* (forecasted at CEA premises, probably moved to virtual event)	June 2022 *(to be confirmed),* Palaiseau (FR)	French industrial, stake holders, partners (scientific, media, investors, customers)	CEA

Conference on Industrial Technologies IndTech2022 https://indtech2022.eu/ CEA collaborative robot control demo-stand at the technology village *(to be confirmed)*	27-29 June 2022, Grenoble (FR)	European applied IA and technology researchers, industrial, stake holders, media, investors, customers	CEA *(to be confirmed)*
ERF2022 Participation to the 9th Hybrid Production Systems workshop - Part 2	30 June 2022, Rotterdam (NL)	European robotics researchers, industrial, stake holders, media, investors, customers	LMS
Swiss Robotics Day 2022	4-5 November 2022, Lausanne (CH)	Swiss robotic industry, scientific community, general public	EPFL
ERF 2023 Organization of a common Workshop for APRIL, REMODEL, MERGING and SOFTMANBOT	Spring 2023	Robotics industry, research policy, academia	ALL

As mentioned in the table above; MERGING will participate in the **9th Hybrid production systems workshop** which will be held at the **European Robotics Forum** (ERF 2022), taking place from 28 to 30 June in Rotterdam.
Held regularly at all editions of the European Robotics Forum since 2014, the workshop usually includes presentations from the projects from the Factories-of-the-Future research cluster on Human-Robot-Interaction. Other research projects and interested parties are also invited to present at the workshop.
Initially scheduled for March 2022 but then delayed because of the postponement of ERF 2022, at the time of writing this report, the workshop is scheduled for 11:20 am on 30 June.
The table below shows the current agenda and list of speakers. MERGING will be presented by Dr. Dionisis Andronas from LMS, and the workshop will be introduced and moderated by Dr. Sotiris Makris, also from LMS (MERGING partner).

Hybrid Production Systems – Part 1		
Dr. Sotiris Makris	***LMS-University of Patras***	***Overview and plan***
Dr. Iñaki Maurtua	TEKNIKER	PICKPLACE
Dr. Dimitrios Giakoumis	CERTH	HR-RECYCLER
Matteo Zanaroli	DATALOGIC	ROSSINI
Dr. Niki Kousi	LMS-University of Patras	ODIN
Dr. Fotis Dimeas	AUTH	COLLABORATE
Dr. Nestor Garcia	EURECAT	SHAREWORK

Hybrid Production Systems – Part 2		
Mohamed El-Shamouty	Fraunhofer-IPA	CARA
Unai Antero	TECNALIA	SHERLOCK

Hybrid Production Systems – Part 2		
Nikos Dimitropoulos	LMS-University of Patras	SHERLOCK
Dr. Christian Eitzinger	Profactor GmbH	DrapeBot
Dionisis Andronas	***LMS-University of Patras***	***MERGING***
Dr. Mohammad Alkhatib	SIGMA	SOFTMANBOT
Gianluca Palli	UNIBO	REMODEL
Dr. Xenia Beltran	UPM	APRIL

2.4.4. Publication of project information in EC platforms

The CORDIS website of the European Commission includes a news section that publishes summary of project results as well as important updated on H2020 projects, and allows projects to post updates through the WIRE service, where articles can be submitted, are vetted by CORDIS's editorial team and then published.
This opportunity was used:

- in April 2021 to advertise the workshop described in section 2.4.3.1 : https://cordis.europa.eu/event/id/148884-erf-2021-workshop-on-soft-objects-robotic-manipulation-for-the-future-of-european-factories
- in the spring of 2022 to communicate on the reached milestone related to the demonstration of the perception system.

Further publications will be used to highlight the upcoming start of the industrial pilots, beginning with the VDL one that is foreseen to be the first. Draft of the texts for the Selmark and VDL use cases are presented in Annex B. They will be updated and revised where necessary based on upcoming developments in WP7 and WP8, and disseminated before the start of the respective pilots after final approval from the consortium. Feedback from VDL and Selmark will be prioritized in order to ensure that no confidential information is disclosed. A similar text will be added for the Thimonnier use case.

This tool will be further used in the following months to highlight specific aspects of the projects. The following milestones can be used for scheduling the CORDIS articles:

Topic	**Timing**
Demonstration of the perception system	M31
Soft objects manipulation for the European automotive industry*	M32
Soft objects manipulation for the European textile industry*	M36
Soft objects manipulation for the European food packaging industry*	M36
Demonstration of Robot control	M33
Demonstration of the gripper and skin	M36
Final results	M42

**these three stories will not include yet detailed results from the use cases, nor confidential information, and aim to result in articles and stories highlighting the economic potential of automation in the respective sectors and a high-level view of the MERGING approach in each specific area.*

2.4.5. Publication of project information in national networks for research and innovations

CEA has already used (to advertise the workshop described in section 2.4.3.1), and will continue to leverage the communication network of Réseau C.U.R.I.E., that in France federates the professionals active in innovation, valorisation and technology transfer related to publicly-funded research. It gathers 190 institutions including universities, hospitals, research institutes, exploitation entities of the public research, INPI, IP practice, SMEs and large industries, and its communication network reaches several thousands people.
During the second half of the project, some information about MERGING will be included, when relevant, in Réseau C.U.R.I.E.'s newsletters; press releases will be targeted specifically at its members network; information will be disseminated through their social network profiles and through their public website. The table here below shows a tentative timing of such actions.

Action	**Timing**	**Target audience**
Information on MERGING-related events in Réseau C.U.R.I.E. Newsletters and social networks	from 2022, in parallel to communication through social media	more than 190 French research institutional members (French research universities, institutes, exploitation entities of the public research, INPI, IP practice, SMEs and large industries)
Press releases - Members of Réseau C.U.R.I.E.	from 2022, in parallel to direct institute press release	French public, medias, industrial, stake holders, investors, customers
Innovation news - Réseau CURIE on Twitter, Linkedin and Facebook	depending on results	professional and public audience
Innovation news - Réseau CURIE's large public website	depending on results	French public
Innovation news - Réseau CURIE's professional website	depending on results	French industrials

2.4.6. Press releases

An initial press release was prepared, upon request by members of the consortium, and published on the website in early 2020. The text had also the function to provide all partners with a reference text to be used for adapting individual press releases in other languages and aimed at national/local level media relations. The press release is available on the website here :
http://www.merging-project.eu/european-funded-project-aims-at-creating-a-robotic-platform-that-can-manipulate-soft-materials-in-industrial-environments/

Additionally, AIMEN and Selmark prepared a Spanish-language press release (http://aimenweb.ayco.net/sala-de-prensa/noticias?p=2) highlighting their role in the project, that resulted in 2 articles at the national level (ABC, EFE) and 8 articles at the regional media level.
The press release, initially published in the CEA LIST Newsletter n°2 (Mai 2021) (via https://track.mailing.ceatech.fr/wc.php?id=1188&l=69&c=783&m=296&md=&s=8d6e89f92ffdfb28f7353e1de21f79ae&lid=2149), and mentioning Merging project, has been relayed by the CEA press service.

Further articles at the national/regional level highlighting the role of individual partners include:

Topic	Publication	Timing
General article about Robots flexibility enhancement and Future Robotics in France, thanks to large institutional funding, mentioning the CEA coordination of the H2020 Merging project	L'Usine Nouvelle https://www.usinenouvelle.com/editorial/comment-la-robotique-industrielle-se-reinvente-pour-gagner-en-flexibilite.N1123439	15 sept. 2021 (revised version on 25 October 2021)

Note that other articles are planned by members of the consortium, e.g. in L'Usine Nouvelle and Républicain Lorrain.

The news story on the demonstration of the perception system presented in section 2.4.1, and the two news stories on the use-cases presented in section 2.4.4. will also be turned into press releases, with texts slightly adapted. The schedule of press releases is thus as follows.

Topic	Timing
Demonstration of the perception system	M30
Soft objects manipulation for the European automotive industry*	M32
Soft objects manipulation for the European textile industry*	M36
Soft objects manipulation for the European food packaging industry*	M36
Demonstration of Robot control	M33
Demonstration of the gripper and skin	M36
Final results	M42

**these three press releases will not include yet detailed results from the use cases, nor confidential information, and aim to result in articles and stories highlighting the economic potential of automation in the respective sectors and a high-level view of the MERGING approach in each specific area.*

A mailing list has been prepared for distributing the press releases, with over 30 selected contacts (not included here for privacy reasons) from publications including:

- AgriTrade news
- Digital Labels & Packaging magazine
- Manufacturing & Engineering Magazine
- New Electronics
- Food & Drink Technology
- Food Navigator
- Advanced Manufacturing – The Engineer
- The Manufacturer
- Industrie & Technologies
- Science & Vie Junior
- L'Esprit Sorcier
- Reseau c.u.r.i.e
- SwissInfo
- IEEE Magazine
- Wired
- the Economist
- AgriTrade news

- Digital Labels & Packaging magazine
- Manufacturing & Engineering Magazine
- New Electronics
- Food & Drink Technology
- Food Navigator
- Advanced Manufacturing – The Engineer

2.4.7. Joint initiatives with European associations for gender balance in science

MERGING has established a contact with the European Platform of Women Scientists (https://epws.org/). In a meeting with its President, Lucia Martinelli, we agreed to develop joint initiatives on women in robotics, including :

- Profiles of women scientists/engineers working on the MERGING research topic to be published on the EPWS website ("Latest Interviews" page). We have started gathering candidate women among Merging partners for these interviews.
- Organisation of a seminar on gender balance in robotics during 2023

2.4.8. School visits to partners' facilities

These activities have been delayed due to the restrictions linked to the COVID-19 pandemic during the first months of the project, will hopefully start in the school year 2022/2023. Projects partner will contact schools in its area (targeting students ages 14-19 y.o.) aiming to organise at least one visit to its premises during the school year, providing students with a general presentation and "invitation" to the topic of robotics and AI, and a technology demo focussed on the MERGING technologies.

2.4.9. Short videos

In the remaining timeline of the project (end of 2022-2023), short (1'-2') interviews will be recorded with consortium members to highlight specific aspects of the project (from accessible explanations of its technical aspects to its potential impact, as well as the societal and ethical aspects related to research on robotics and automation).
A list of potential interviewees from various partners has been prepared and will be used for producing the interviews. Interviews will be complemented with footage and still images from experiments and industrial use cases. Videos will be uploaded on a dedicated YouTube channel, referenced on the project public website, and shared via social networks (see section 2.4.11).

2.4.10. Project Video

A project video will be realised around month 40, counting that by that time the progressive easing of COVID-19 restrictions allows a film crew to travel, to visit individual partner's premises for shooting on site (both in the main research laboratories involved in the project and in the locations of the industrial use cases), and possibly to attend to a physical consortium meeting, for shooting interviews and moments of collective work in the consortium. The video will be about 5 minutes long, and will present the concept, building blocks, use cases and potential impact, with a content structure similar to the one used for the leaflet, adding a summary of the main outcomes and results.

2.4.11. Social network profiles

The MERGING Twitter profile is active at the link: https://twitter.com/MergingProject
The MERGING LinkedIn profile is active at the link: https://www.linkedin.com/company/merging-project

These profiles currently have 90 combined followers. They are both used to communicate quickly upcoming events, the publication of new content on the website, to signal important activities from individual partners (participation to conferences, publications, involvement in other projects that have some thematic links with MERGING contents, etc.). Like the website, they have been used to promote the participation of Merging project to ERF2021 and IROS 2021 / RoMaDO-RA workshop, among others, and were relayed for example by the public web site and social media of CEA LIST[5] [6].

The following partners are also individually active on social media:

Partner	**Active on**	**Combined number of followers**
CEA LIST	LinkedIn/Twitter	about 6,400
EPFL School of Engineering	LinkedIn/Facebook	ab. 4,400
CASP	LinkedIn/Twitter	ab. 90
VDL group	LinkedIn/Twitter/Facebook	over 50,000
Shadow	LinkedIn/Twitter/Facebook	over 10,000
Aimen	LinkedIn/Twitter/Facebook	over 18,000
Selmark	LinkedIn/Twitter/Facebook	over 100,000
LMS	LinkedIn/Twitter	ab. 800
Opteamum	LinkedIn/Twitter	ab. 280

To this day, the following announces about Merging project in general have been spread through CEA LIST social media :
LinkedIn (in French) : https://www.linkedin.com/feed/update/urn:li:activity:6793901601988874240 (with 726 impressions, and 30 engagements)
LinkedIn (in English) : https://www.linkedin.com/feed/update/urn:li:activity:6793902524706418688 (with 258 impressions, and 17 engagements)
Twitter (in French) : https://twitter.com/CEA_List/status/1388138268445843457 (with 656 impressions, and 7 engagements)
Twitter (in English) : https://twitter.com/CEA_List/status/1388138935726092290 (with 1277 impressions, and 17 engagements)

[5] https://www.linkedin.com/feed/update/urn:li:activity:6846746807670734848/ and https://twitter.com/CEA_List/status/1440985496017121280?s=20
[6] https://www.linkedin.com/posts/activity-6839214346988613632-6AsY

3. Dissemination

3.1. Objectives

The following Objectives for Dissemination were defined in the Project Proposal :

- (O1) to raise awareness and interest of potential users on the project results;
- (O2) to potentiate interaction with stakeholders and potential users to obtain key feedback to enhance exploitation opportunities of the MERGING results;
- (O3) transfer of knowledge among the partners;
- (O4) effective acquisition of new skills by users;
- (O5) to ensure a broad applicability of the project results taking into consideration regulations and standards;
- (O6) to foster MERGING technology acceptance by users.

3.2. Target audiences

The key audiences identified by the MERGING Dissemination plan include :

- Project partners
- Industry (hardware and software integrators, as well as robot manufacturers)
- Scientific Community
- Stakeholders
- Standardization Organisation
- High-level education (HLE)
- European robotics researchers and engineers, in general and in particular those working on Haptics, Robotics and Ergonomics
- Investors in robotics
- Customers

3.3. Tools and actions

In order to disseminate the project's *results*, the MERGING dissemination plan leverages the following principal tools and actions:

- Presentations at Scientific Conferences
- Publications in scientific and technical journals
- Organisation of events during scientific conferences, industrial forums and events promoted by Industrial Associations
- Workshop & Webcast
- Online training
- Participation to Trade Fairs
- Project website & Social Media

The following table presents an updated timeline of how these actions and tools are deployed over the course of the project in order to convey the key messages listed in section 2.2 to the key audiences listed in 2.3.

Action/tool	Target Audience	Key Messages	Timing
Presentations at Scientific Conferences	Industry/Scientific Community	Results, feature and performances of the MERGING solutions	M18 onwards
Publications in scientific and technical journals	Scientific Community	Project results	M18 onwards
Organisation of parallel events during scientific conferences , industrial forums, and events promoted by Industrial Associations	Industry, Scientific Community	Results, feature and performances of the MERGING solutions	M18 onwards
Project workshop & Webcast	Industry, scientific community, stakeholders	Results, feature and performances of the MERGING solutions	M42
Online training	Industry, high-level education	Results, feature and performances of the MERGING solutions	M36
Participation to Trade Fairs	Industry	Performance of MERGING solution in targeted applications	M36 onwards
Project website & Social Media	All	Project results (in addition to concept and goals, see "Communication" section)	M2 onwards

Within the frame of the Quality Management task of the project (WP1 – Management), an **internal review process** has been formalized for all partners to gain approval from the consortium before submitting journal publications or conference publications.

All publications follow the Open Access guidelines that are part of H2020. In addition to the publications in journals, Open Research Europe (https://open-research-europe.ec.europa.eu/) will also be considered for publications, in particular for papers at the end of the project describing the three use cases.

3.3.1. Presentations at Scientific Conferences

During the first 30 months, several presentation at a scientific conference were carried out :

1) MERGING partner LMS participated in the **8th Conference on Assembly Technology and Systems** (http://cirp-cats2020.com/), held from 29 September to 1 October 2020, by presenting a paper related to planning systems and flexible material modelling :

> *Title:* **On Modelling and Handling of Flexible Materials: A Review on Digital Twins and Planning Systems**
>
> *Authors:* Dionisis Andronas, George Kokotinis, Sotiris Makris
>
> *Abstract:*
>
> *In this paper, a series of studies dealing with flexible material manipulation in aspects of manipulation, modelling and scheduling are discussed. The main purpose of this work is to provide an overview of the existing technologies and their capabilities both in manufacturing and academia, that can be elaborated in autonomous flexible material handling using robotics. The*

particularities of flexible material handling require advanced control systems for simulating, monitoring and managing the deformation of plies. A simulation model for predicting and defining the status of manipulated fabrics is proposed. Digital representation of the production system, in the basis of Digital Twin, is intended for achieving real-time adaptation. A pioneer control and planning system, interconnected to the digital model, is proposed for orchestrating the manipulation process. Current limitations of the existing technologies in flexible material handling and modelling are outlined and discussed, towards the implementation of a Workcell controller for flexible material manipulation robotic cell.

2) MERGING partner LMS participated in the **26th International Conference on Emerging Technologies and Factory Automation**, IEEE ETFA2021, (https://iten.ieee-ies.org/events/2020/2021-etfa-ieee-26th-international-conference-on-emerging-technologies-and-factory-automation/), held from 7 September to 10 September 2021, by presenting a paper related to the model based co-manipulation planner:

Title: **Model-Based Robot Control for Human-Robot Flexible Material Co-Manipulation**

Authors: Dionisis Andronas, Emmanouil Kampourakis, Katerina Bakopoulou, Christos Gkournelos, Panagiotis Angelakis, Sotiris Makris

https://ieeexplore.ieee.org/document/9613235

Abstract:

Despite market importance and growth, manufacturing systems involving flexible materials, textiles and composites remain manual. Challenges related to flexible material deformation highlight limitations of robot cognition during fabric handling. This manuscript presents a model-based closed-loop control framework for seamless human-robot or multi-robot fabric co-manipulation. A mass-spring model is used for simulating ply distortion and generating optimal grasping points' spatial localization. The model is enhanced with real-time operator's handling actions, as captured from the implemented perception system. The proposed sensor and model-based controlling framework incorporates robot motion planners either for operator support, through non-rigid object co-manipulation, or synchronization of cooperative robots within fully automated tasks. An experimental setup is used for validating system's handling cognition during collaborative manipulation.

3) In September 2021, the MERGING project was present in two events at the **IEEE/RSJ International Conference on Intelligent Robots and Systems** (IROS 2021) in Prague, Czech Republic.

- On Monday, 27 September, the project was presented during the RoMaDO-RA (Robotic Manipulation of Deformable Objects: Challenges in Perception, Planning and Control for Real-World Applications) workshop. Diego Perez, from AIMEN and Dionisis Andronas from LMS contributed for MERGING project with an invited presentation on "Simulation for enhanced perception and planning". They also participated in the roundtable discussion about Future of Robotic Deformable Object Manipulation.
- On Wednesday, 29 September, the EPFL Merging team, comprising Krishna Digumarti, Vito Cacucciolo and Herbert Shea, presented a paper on "Dexterous textile manipulation using electroadhesive fingers" during the session on "Grippers and other end-effectors".

Title: **Dexterous textile manipulation using electroadhesive fingers**

Authors: Krishna Manaswi Digumarti, Vito Cacucciolo and Herbert Shea

https://ieeexplore.ieee.org/document/9636095

Abstract :

Handling of fabric is a crucial step in the manufacturing of garments. This task is typically performed by trained workers who manipulate one sheet at a time, thus introducing a bottleneck in the automation of the textile industry. This paper seeks to address the challenge of picking fabric up by proposing a new method of achieving ply-separation. Our approach relies on a finger-tip sized (2 cm ^{2}) electroadhesive skin to lift fabric up. A pinch-type grasp is then used to securely hold the separated sheet of fabric, enabling easy manipulation thereafter. The ability to successfully pick up and manipulate a variety of commercial fabrics with diverse materials, shapes, sizes and textures is demonstrated. The ability to handle fabrics 100s of times larger than the electroadhesive skin is unique to our approach. Additionally, we demonstrate the manipulation of non-flat fabrics, a challenge that has not been previously addressed by electroadhesive approaches. We believe that this method introduces a smarter way of handling flexible and limp materials, showing great potential towards automation of garment manufacturing.

4) The EPFL team presented a paper, in the form of an on-demand presentation, at the **SPIE Smart Structures & Non Destructive Evaluation Conference**, held between March and April 2022. As part of the Electroactive Polymer Actuators and Devices (EAPAD) Conference, Krishna Manaswi Digumarti, Michael Smith and Herbert R. Shea all from Ecole Polytechnique Fédérale de Lausanne (Switzerland), presented the following paper.

Title: **A variable stiffness soft gripper with integrated ion-drag pump**

Authors: Krishna Manaswi Digumarti, Michael Smith and Herbert R. Shea

https://spie.org/smart-structures-and-materials-nondestructive-evaluation-and-health-monitoring/presentation/Demo--A-variable-stiffness-soft-gripper-with-integrated-ion/12042-203

Abstract:

We present a compact prehensile soft gripper capable of rapidly varying its stiffness on demand. It can grasp and also manipulate objects that have complex shapes. For instance, it can grab a mug by the handle or around the body of the mug, providing a high level of versatility. The gripper consists of fluidic chambers within a silicone structure, with two compliant electrostatic clutches bonded to opposite external surfaces. Bending actuation is achieved by pressurizing the chambers using an integrated electrohydrodynamic 'ion-drag' pump, while simultaneously blocking one of the clutches. Once the object is grasped, the second clutch is blocked, greatly increasing the stiffness of the structure, and allowing the object to be manipulated. The use of the integrated ion-drag pump means the gripper has the advantages of pneumatic actuations, but without the need for an external compressor. The integrated electrostatic clutches allow for bi-directional bending, and for very low energy consumption to hold a position. We will demonstrate the gripper picking up a range of objects.

The following presentations at conferences are currently planned, or submitted and waiting for acceptance. Participations at conferences will continue for up to four years after the end of the project.

Partner	Title/topics	Venue/Journal	Status
EPFL	Slip Anticipation for Grasping Textiles Using a Soft Force Sensor	IROS 2022	Under review – notification of acceptance/rejection in June 2022
CEA	A Skills Programming Environment for Industrial Robots	IROS 2022	Under review – notification of acceptance/rejection in June 2022
CEA	Controller design of robotic assistant for the transport of large fragile parts	IROS 2022	Under review – notification of acceptance/rejection in June 2022
CEA	Use of a human-centered gesture analysis methodology for the specification of dexterous robotic grippers	IEEE RO-MAN 2022	Under review – notification of acceptance/rejection after 30 May 2022

Details and abstracts of submitted conference proposals are provided in Annex A.

3.3.2. Publications in scientific and technical journals

At the moment of writing this report, two articles directly related to the results of the project have been published in peer-reviewed journals (see below). These publications are related to the conference presentation previously mentioned in section 3.3.1.

> ***Andronas D., Kokotinis G. and Makris S., "On modelling and handling of flexible materials: A review on Digital Twins and planning systems", Procedia CIRP. 97. (2021). 447-452.***
>
> *doi: 10.1016/j.procir.2020.08.005*
>
> *Abstract:*
>
> *In this paper, a series of studies dealing with flexible material manipulation in aspects of manipulation, modelling and scheduling are discussed. The main purpose of this work is to provide an overview of the existing technologies and their capabilities both in manufacturing and academia, that can be elaborated in autonomous flexible material handling using robotics. The particularities of flexible material handling require advanced control systems for simulating, monitoring and managing the deformation of plies. A simulation model for predicting and defining the status of manipulated fabrics is proposed. Digital representation of the production system, in the basis of Digital Twin, is intended for achieving real-time adaptation. A pioneer control and planning system, interconnected to the digital model, is proposed for orchestrating the manipulation process. Current limitations of the existing technologies in flexible material handling and modelling are outlined and discussed, towards the implementation of a Workcell controller for flexible material manipulation robotic cell.*

> ***D. Andronas, E. Kampourakis, K. Bakopoulou, C. Gkournelos, P. Angelakis and S. Makris, "Model-Based Robot Control for Human-Robot Flexible Material Co-Manipulation", 26th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), 2021, pp. 1-8***
>
> *doi: 10.1109/ETFA45728.2021.9613235*

Abstract:

Despite market importance and growth, manufacturing systems involving flexible materials, textiles and composites remain manual. Challenges related to flexible material deformation highlight limitations of robot cognition during fabric handling. This manuscript presents a model-based closed-loop control framework for seamless human-robot or multi-robot fabric co-manipulation. A mass-spring model is used for simulating ply distortion and generating optimal grasping points' spatial localization. The model is enhanced with real-time operator's handling actions, as captured from the implemented perception system. The proposed sensor and model-based controlling framework incorporates robot motion planners either for operator support, through non-rigid object co-manipulation, or synchronization of cooperative robots within fully automated tasks. An experimental setup is used for validating system's handling cognition during collaborative manipulation.

Additionally, the EPFL team has published an article acknowledging the MERGING project in April 2022 in **Science Robotics**. The articles does not present technologies developed within the project, but is a study of the occupational impact of robotics and automation, including in the application sectors directly concerned by MERGING.

Antonio Paolillo, Fabrizio Colella, Nicola Nosengo, Fabrizio Schiano, William Stewart, Davide Zambrano, Isabelle Chappuis, Rafael Lalive, Dario Floreano. How to compete with robots by assessing job automation risks and resilient alternatives. Science Robotics, 2022; 7 (65)

DOI: 10.1126/scirobotics.abq5561

Abstract:

The effects of robotics and artificial intelligence (AI) on the job market are matters of great social concern. Economists and technology experts are debating at what rate, and to what extent, technology could be used to replace humans in occupations, and what actions could mitigate the unemployment that would result. To this end, it is important to predict which jobs could be automated in the future and what workers could do to move to occupations at lower risk of automation. Here, we calculate the automation risk of almost 1000 existing occupations by quantitatively assessing to what extent robotics and AI abilities can replace human abilities required for those jobs. Furthermore, we introduce a method to find, for any occupation, alternatives that maximize the reduction in automation risk while minimizing the retraining effort. We apply the method to the U.S. workforce composition and show that it could substantially reduce the workers' automation risk, while the associated retraining effort would be moderate. Governments could use the proposed method to evaluate the unemployment risk of their populations and to adjust educational policies. Robotics companies could use it as a tool to better understand market needs, and members of the public could use it to identify the easiest route to reposition themselves on the job market.

The following articles (see details in Annex A) have been submitted to journals for publication. The list will evolve and will be updated depending on the details of the strength of individual results from the various work packages. Publications will continue for up to four years the end of the project.

Partner	Title	Venue/Journal	Status
LMS	On deformable object handling: a model-based motion planner for human-robot co-manipulation	CIRP Annals Manufacturing Technology	Accepted To be presented by Dr. Makris at the 71st CIRP General Assembly (Bilbao, Spain, from August 21 to August 27, 2022)
EPFL	Shielded soft sensors for normal and shear force measurement	Nature Communications	Under revision

3.3.3. Project workshop & Webcast

A final seminar, the "MERGING Workshop" will be organized (and webcast) at M42 it will gather all stakeholders from several sectors (industry, education, standardization bodies, etc.), present the main results and expected gains of its deployment for the targeted markets and to provide a faster acceptance and integration of the project results in industrial value chain.

3.3.4. Online training

During the next period, a Training Plan (D9.4) will be developed and implemented, comprising the elaboration of suitable material for training and technology transfer and organization of the specific training activities during the project (internal seminars -simultaneously to the project meetings), so that the industrial partners can be fully confident about making use of the technology developed within project. Complementarily, a version of the training material excluding confidential information (D9.5), will be made available on-line to ensure training opportunities are widely available for EU workforce.
Work on the preparation of the online training has started, with internal meetings aimed at defining a format and calendar of the training. The consortium is currently considering a format based on seminars on key technology building blocks, to start from last quarter 2022. The topics foreseen are:

- **Gripper (WP3)**
- **Skin (WP3)**
- **Collaborative control (WP4)**
- **Perception (WP5)**
- **Workcell control (WP6)**
- **Standardisation (WP7)**

In parallel, input will be collected from industrial partners on specific training needs relative to each use-case. Three specific training seminars for the industrial use-cases, starting with the VDL one, will be organized starting from first quarter 2023. The exact timing, as well as the finalization of the related deliverable, will depend on the decision regarding a possible extension of the project.
The Training Plan document that will collect the content of the training seminars could thus have the following outline:

- **Gripper (WP3)**
- **Skin (WP3)**
- **Collaborative control (WP4)**
- **Perception (WP5)**
- **Workcell control (WP6)**
- **Standardisation (WP7)**

- **Technical / operational requirements for operation of the integrated solution (software, hardware, safety, security etc)**
- **Operational manual for the integrated solution, declined for the 3 use-cases**
- **Problem shooting**
- **Limitations**

The same contents, after removing all confidential information related to pending IP protection or non-disclosable information from the industrial partners, will be adapted into a light public version of the training plan, that will be disseminated through a dedicated document (D9.9) and could be proposed as a workshop for the 2023 European Robotics Forum.

3.3.5. Participation to Trade Fairs

In the final phase of the project, after M36, the project results will be presented at trade fairs and industry-related events, with a focus on the performance of MERGING solution in targeted applications. A list of potential participations is given in the table below. The list will evolve and will be updated depending on the details of the strength of individual results from the various work packages, and on the coherence with the trade fairs focus and calendars.

Industry field	**Event**
Manufacturing	World manufacturing Forum
	Smart Manufacturing Summit
	Global Industrie 2022 (France)
Robotics	LogiMat
	Global Robot Expo
	Production & Logistics Forum
	Hannover Messe
	Automatica
	Vision
	Robotics & Motion
	Sindex
Composites	JEC
Textile & clothing	ITMA
	Texworld
	Interfilier
	Lingerie Pro
Transport	Busworld
Packaging	All4pack
	Interpack
	Packinnove Machine

4. Clustering and collaboration with other projects

On the occasion of the preparatory meetings of the workshop at the European Robotics Forum 2021 (see section 2.4.3.1.), a fruitful collaboration with the H2020 projects APRIL, REMODEL and SOFTMANBOT has started. MERGING's initiative in organizing the common workshop was key in promoting this collaboration.

Discussions have been initiated with the other FoF projects (SOFTMANBOT, APRIL and REMODEL in particular, with the possible inclusion of DRAPEBOT) to organise a joint workshop at ERF 2023, that will most likely take place in the spring of 2023 (see paragraph 2.4.3.2). The workshop may be similar in structure to the one organised in 2021, but focussed on the dissemination of the results, rather than on the presentation of the methodologies and use-cases as in the previous one.

5. Assessment / evaluation criteria

The success of each action proposed in this plan will be measured by tracking over time, starting after the official launch of the website, the monthly evolution of the following indicators:

Indicator	**Target (M42)**	**Result (M30)**
Traffic on the website	>10,000 pageviews	4,800
Number of followers on social networks	>200 followers	>90
Number of project mentions on general media (TV, magazines, daily newspapers, online-only media portals...) and type (mentions, dedicated articles, interviews to Project members...)	>2 dedicated articles >20 mentions >5 interviews	
Number of papers accepted by scientific journals	>7 articles	4
Number of accepted papers/presentations at conferences and similar events	>7 papers >20 presentations	4 papers 1 presentation
Number of participants to online training	>100	n.a.
Number of attendees to final MERGING workshop/webcast	>100	n.a.
Number of parallel project events organised	>3 events	1
Number of attendances to trade fairs	>7 participations	
Number of stories/events organized with European platforms for women in science/stem	>2	n.a.

ANNEX A – Details on submitted articles in conferences and peer reviewed journals

Submitted articles in conferences

Title: Slip Anticipation for Grasping Textiles Using a Soft Force Sensor
Authors: *Euan Judd, Bekir Aksoy, Krishna Manaswi Digumarti , Herbert Shea , Dario Floreano*

Abstract
Robots using classical control have revolutionised assembly lines where the environment and manipulated objects are restricted and predictable. However, they have proven less effective when the manipulated objects are deformable due to their complex and unpredictable behaviour. The use of tactile sensors and continuous monitoring of tactile feedback is therefore particularly important for pick-and-place tasks using these materials. This is in part due to the need to use multiple points of contact for the manipulation of deformable objects which can result in slippage with inadequate coordination between manipulators. In this paper, continuous monitoring of tactile feedback, using a liquid metal soft force sensor, for grasping deformable objects is presented. The trained data-driven model distinguishes between successful grasps, slippage and failure during a manipulation task for multiple deformable objects. Slippage could be anticipated before failure occurred using data acquired over a 30 ms period with a greater than 95% accuracy using a random forest classifier. The results were achieved using a single sensor that can be mounted on the fingertips of existing grippers and contributes to the development of an automated pick-and-place process for deformable objects.

Title: A Skills Programming Environment for Industrial Robots
Authors: *G. Acher, B. Gradoussoff*

Abstract
Robotic manufacturing has been an increasingly active field for years but remains a major challenge in industry 4.0. While current technologies fulfill the requirements of largescale manufacturing, smaller batches with frequent process revisions are significantly harder to automatize. Reasons for this slower adoption arise from the limitations of PLC (both in terms of development time and limited capabilities), which are accentuated by its lack of reusability across tasks and hardware. This observation led to the paradigm of robotic skills, which designates high-level robot tasks. While skills are not yet associated with a fixed formalism or definition, previous work has spanned from trajectory inference and adaptation from batches of demonstrations, to high levels semantic-based frameworks. However, the former category lacks immediate usability and general robustness, whilst the latter requires significant setup effort regarding the work cell modeling. Our approach investigates a skills framework focusing on intuitive programming and task reuse. Moreover, we propose a flexible formalism that supports implementations of trajectory inference algorithms within skills, and new control methods, as we prefer facilitating incremental development over attempting to define a universal model from scratch [1]. Workflow is a critical aspect of this framework, therefore we considered multiple professions as potential end-users, to ensure smooth deployment, integration, and development. Researchers can develop advanced skills by enriching the robotic API, creating new skills or improving existing ones. By providing a skills library, the framework enables setting up more complex and representative experiments (instead of pick-and-place or peg-in-hole), thus better demonstrating capabilities, robustness, and limitations. Robot integrators benefit from an eased deployment. We propose a prototype standard robotic API to extend robot support to various brands and models. Moreover, we propose a workflow that does not require digital twins or simulation. Process and plant engineers need

deeper control over the skills and parameters. This feature is provided via pythonbased scripting that includes numerous convenience templates, functions and objects. Operators are the final users of the framework. In order to setup robotic tasks in the workcell context, they need control over skills management (parameterization and sequencing) as well as demonstrations (using cobots or motion capture). An execution monitor displays the current state of the robot and the task, and integrates common controls. These components are made accessible via a unified GUI.

Title: Controller design of robotic assistant for the transport of large fragile parts
Authors: *J. Dumora, J. Nicolas and F. Geffard*

Abstract
In this work, we propose a system that allows a human to perform transport of large part jointly with a robotic partner. Only forces (no torques) are applied by the dyad to transport the part like a Human Human dyad does. The human operator is leader of the dyad in order to handle the displacement of the part along a trajectory. The system consist in designing a active follower robotic partner. For that purpose, we propose to: - Allow rotations at the robot gripping point - Correct the part orientation, that correspond to an angle α at the robot gripping point by a displacement of the robot gripping point along a predefined trajectory

Title: Use of a human-centered gesture analysis methodology for the specification of dexterous robotic grippers
Authors: *F. Gosselin, T. Mokadim*

Abstract
The advent of robots in our daily life depends on their ability to navigate and intervene efficiently in our environment. Whether considering household or industrial applications, one of the most important functions they should have is the ability to grasp and manipulate a large amount of objects, tools and machines that can vary in form, size and weight, but share the fact that they were designed for humans and have functional elements, e.g. buttons or handles, fitted to the human hand. The development of biologically inspired anthropomorphic robotic hands thus appears as a natural research path to allow robots replicating these activities. Such devices however prove to be complex to design and control, and they remain in practice limited to date to laboratory experiments. They hardly reach a sufficient simplicity, robustness and cost allowing for their widespread adoption in our houses or factories and industrial robots still make use of simple bi-digital grippers or dedicated tools which in turn suffer a poor versatility. To overcome this situation, novel dexterous grippers are required, that are sufficiently versatile to adapt to various situations and objects yet simple enough and cost effective. This compromise is however difficult to achieve and the specification of such grippers is still an open issue. This paper introduces a human gesture analysis methodology that intends to contribute to fill this gap. After a presentation of our approach, we apply it in different contexts and show how it can be used to orient a robotic gripper design that will fit given use-case requirements.

Submitted articles in peer reviewed journals

Title: On deformable object handling: a model-based motion planner for human-robot comanipulation
Authors: *LMS*

Abstract:
Over the past decades, robotic automation and hybrid systems have been effectively been deployed in multiple industrial applications and sectors. However, manufacturing operations involving deformable objects are mostly preserved manual. Challenges originating from dynamic distortion

of flexible objects underline handicaps in robot cognition and dexterity. This paper presents a model-based motion planner for deformable object co-manipulation. The developed closed loop controlling framework interprets manipulation inputs into appropriate robot handling actions by simulating fabric's distortion through a mass-spring model in real-time. The planner incorporates tools for: a) rapid system commissioning and reconfiguration, b) grasping point localization updating, and c) perception of human handling actions towards operator support. An experimental setup inspired by automotive composite industry is used for validating system's performance during translational and rotational collaborative manipulation.

Title: Shielded soft sensors for normal and shear force measurement
Authors: *Bekir Aksoy, Yufei Hao, Giulio Grasso, Krishna Manaswi Digumarti, Vito Cacucciolo, and Herbert Shea*

Abstract:
Soft pressure and shear force sensors are essential to enable feedback in compliant systems such as soft grippers, wearable human-machine interfaces, and sensory skins. Capacitive readout is appealing for its high sensitivity and long-term stability. If unshielded, however, capacitive sensors are susceptible to electrical interference. We present shielded capacitive sensors capable of blocking any parasitic interference such as the proximity of moving conductive objects or external varying electric fields. A 5- electrode design is used for simultaneous shear force and normal force sensing, and for electrical shielding. We present two designs with a similar electrode configuration using different materials: a foam-based and micro-channel-based sensor. In the foam-based design, the sensing region is made of an ultrasoft silicone foam sandwiched between silicone-carbon composite electrodes. The microstructured design has microfluidic channels, some of which are filled with Eutectic gallium-indium (EGaIn) electrodes, while others are left empty to have localized deformation. Both designs are optimized for high force sensitivity in normal (2.77 mN/fF) and shear (0.23 mN/fF) directions while minimizing the change of the parasitic capacitances caused by shielding. The readout noise of the measurement equipment is around ±0.09 fF, corresponding to ±0.25mN of normal force and ±0.02mN of shear force. The calibrated sensor can pick up small forces down to sub mN while withstanding large forces (> 20 N) which makes them appealing for very large dynamic range. We show the sensors operating with no degradation even when 1.5 kV signal is applied to an electro-adhesive patch glued to the sensor. The sensors are made of compliant structural materials and shielding (54 µm) with total thickness less than 2 mm, enabling easy integration on curvilinear or deformable surfaces. The 15 mm x 15 mm sensors were used as sensory skins on robotics grippers, quantifying the grasping forces in different poses.

ANNEX B – Draft texts for press releases/stories on use cases

Selmark use case

How a new generation of robots can change the textile industry

Robots have transformed many areas of manufacturing, to the point that whole industries –from automotive to electronics and chemical – would now be unthinkable without them. But other sectors are far more resistant to automation, and yet could equally benefit from it.

The textile industry is a good example. For the European clothing sector, innovating through automation could be a way to increase competitiveness and reduce outsourcing, but there are huge challenges to overcome for automating the manipulation of textile materials. That is why MERGING, a European research project on soft robotics manipulation coordinated by CEA(>link) and involving 11 partners from industry and academia, has chosen the textile industry as one of its key use cases.

Textile and clothing are essential pillar in the European economy, involving around 160,000 companies employing over 1.5 million workers, with a turnover of 162 billion euros. Manufacturing processes are mostly manual, and in an effort to contain costs, businesses often end up outsourcing them to low-cost labor countries. As a result, Europe exports € 61bn worth of textile products, but imports € 109 bn – a trend that automation could help reverse.

Within MERGING, researchers and engineers from several institutions are working with SELMARK (>link), a leading manufacturer of lingerie based in Vigo (Spain), to develop a robotic system that can support human operators in the most repetitive and tiring tasks that happen before the stitching of the final product: in particular de-stacking textiles from storage, grasping, placing and unfolding them while avoiding wrinkling, measuring parts before cutting. These operations are impossible for traditional robotic manipulators designed for rigid objects, as they cannot easily adapt in real time to the unpredictable behavior of fabric. Total or partial automation of these tasks can promote the allocation of personnel to tasks that have more added value.

The MERGING solution combines various building blocks. At the basis there are two collaborative robot arms that can safely work close to humans. The arms are equipped with dexterous hands, and enhanced with EPFL(>link)'s electroadhesive skin, a technology that uses electric fields to make objects sticks to the hand. Stereo cameras provide perception and high precision tracking of textiles, that - together with computer models of fabric's behaviour, developed by AIMEN (>link) – allow to adapt the robot's movements in real time. All data are combined into LMS(>link)'s "digital twin", a digital representation of the working environment that allows to simulate movements before transmitting them to the actual control system. Programming by demonstration by CEA allows also unexperienced users to actually show the robot how to perform the required tasks, rather than programming every movement on a computer.

When all these technologies are combined, the robotic hands grasp a ply from the textile materials stack, carefully detaching it from the ones below. The ply is then placed on the thermoforming device, and if any wrinkle is detected by the perception system, the robot will use corrective actions to undo it. The robot then feeds the fabric to presses that give the material desired 3D shape (a cup, in the case of lingerie production), and places it on a stack of final parts.

MERGING started in late 2019 and is now more than halfway through its 3-and-a-half year work programme, perfecting the system's building blocks. In second half of 2022 it will start working on setting up the pilot demonstration at SELMARK premises, which will be overseen by IPC(>link).

The textile industry is only one of the three use cases explored by the projects, that will also apply similar technologies to food packaging and to the manipulation of fibres in the automotive industry.

VDL use case

Towards a new wave of automation in the automotive industry

The automotive sector was the first major application of industrial robots, and is still the main adopter of automation technologies, accounting for almost 30 % of all industrial robots that are currently operative worldwide. Yet, even in the automotive industry there are parts of the manufacturing process that are still difficult to automate, as is the case of the assembly of body panels made of glass fiber (GF) textile and foam for creating automotive panels. That is why MERGING, a European research project on soft robotics manipulation coordinated by CEA(>link) and involving 11 partners from industry and academia, has chosen the use of fibre composites in the automotive sector as one of its key use cases.

When used in the automotive sector, composites can provide increased strength and stiffness while also reducing the weight of vehicles up to 70% compared to metallic alloys. The possibilities to shape them are also limitless. They could play an important role in the future transportation industry, in particular when it comes to reducing fuel consumption and CO2 emissions.

However, fiber composites are still more expensive than light metallic alloys, and before they become cost-effective, a decrease up to 40% in production cost is required. That requires automation, but these materials pose several challenges to existing robotic solutions. Dry fibres are similar to conventional textile and thus, highly flexible and highly deformable. Foam blocks are less flexible, but fragile. The individual parts can be heavy and large, adding further challenges for manipulation.

Currently, manufacturing processes are consisted by a series of manual handling operations of flexible Glass Fiber (GF) textiles in addition to foam blocks. The complete workflow takes place on lay-up moulds where all types of GF textiles and foams are positioned before resin infusion. The dimensions of the mould itself limit operator access to all areas, resulting in fluctuations in the performance in terms of production rate and quality, in addition to ergonomic issues that can affect workers.

Within MERGING, researchers and engineers from several institutions are working with VDL Fibertech industries, a member of the VDL group and one of the Netherlands largest composite producers that operates in several markets. Together, they are developing a robotic system that can support human operators in the manufacturing of composite panels by performing grasping, manipulation and placement of textiles and foam blocks.

The envisioned solution proposes a hybrid cell where humans and two robots collaborate in fenceless environment. The building blocks of the system are robot arms that can safely work close to humans, equipped with grippers. Stereo cameras provide perception and high precision tracking of plies developed by AIMEN, that - together with computer models of the material's behaviour, developed by LMS (>link) – allow to adapt the robot's movements in real time. All data are combined into LMS(>link)'s "digital twin", a digital representation of the working environment that allows to simulate movements before transmitting them to the actual control system. Programming by demonstration and other control scheme all developed by CEA allow also unexperienced users to actually show the robot how to perform the required tasks, rather than programming every movement on a computer, or to work together with the robot in an easy and intuitive way.

MERGING started in late 2019 and is now more than halfway through its 3-and-a-half year work programme, perfecting the system's building blocks. In late 2022 it will start working on setting up the pilot demonstration at the VDL premises. LMS, CEA and AIMEN, helped by CASP (>link) and OPTEAMUM (>link), elaborate the robotic system installation layout, and support VDL in the implementation of the robot and gripper, which will be overseen by IPC(>link).

The composite industry is only one of the three use cases explored by the project, that will also apply similar technologies to food packaging and to the manipulation of textiles in the clothing industry.

ANNEX C – Project leaflet

MERGING

Manipulation Enhancement through Robotic Guidance and Intelligent Novel Grippers

A European project that aims at creating a robotic platform that can manipulate soft materials in industrial environments, by pioneering new robotic gripper and technologies with application of artificial intelligence

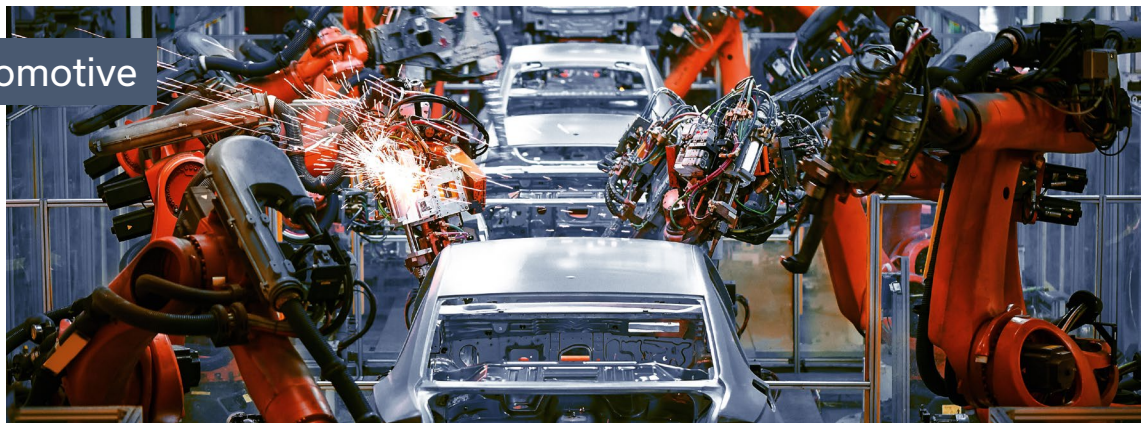
Project funded by the European Commission under the Horizon 2020 Framework Programme.
Grant Agreement 869963

The MERGING project aims to provide manufacturers with a versatile, easy-to-use and low-cost solution to automate or assist the handling of flexible and fragile objects. By addressing challenges such as handling of **soft materials** using robots, developing handling devices which are **intelligent and universally dexterous**, and making future robots capable of handling soft products while **controlling their level of deformation**, it will lead to disruptive innovations in many sectors.

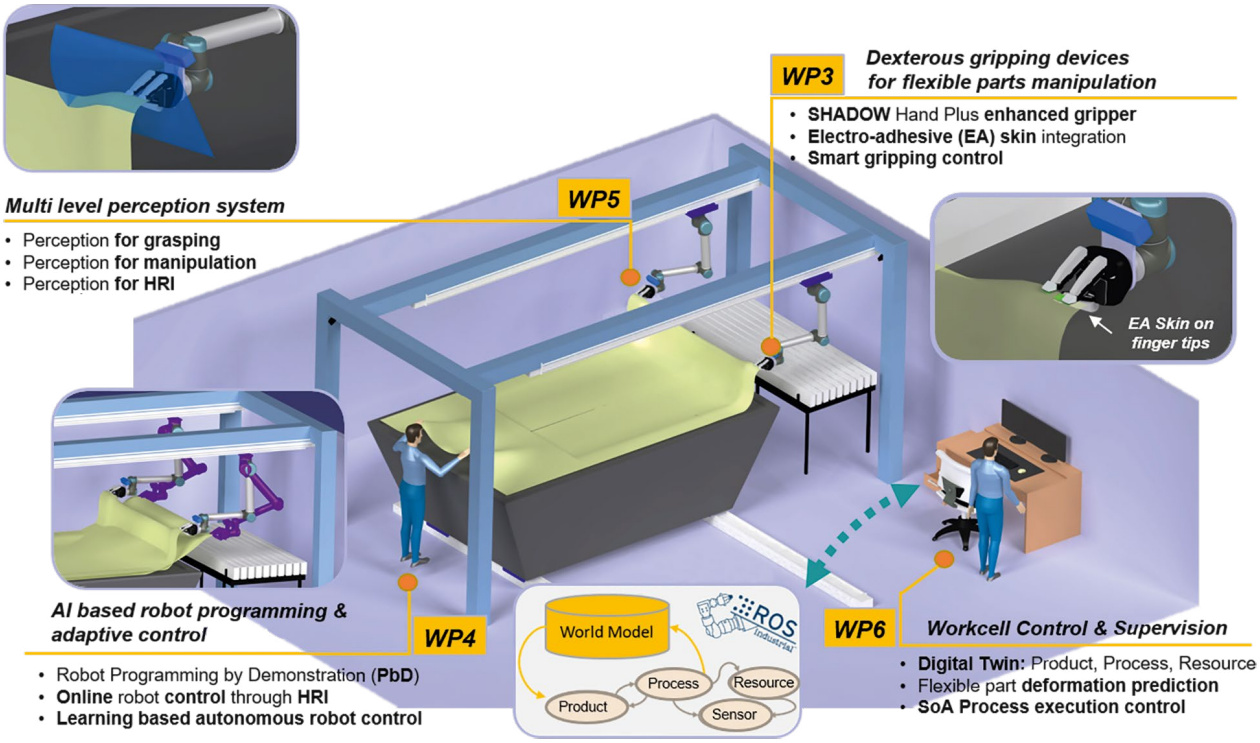
Textile and garment industry

Food packaging

Automotive



The MERGING building blocks



Dexterous gripping devices for flexible part manipulation
Integration of a multi-finger gripper equipped with an electro-adhesive skin that conforms to the objects to handle them without damaging them.

Multilevel perception system for environment understanding
Perceiving and recognition of human presence and activity, and other obstacles, and reasoning upon them — implementing a multi sensor approach for the detection of flexible parts and their manipulation monitoring.

AI based robot programming and adaptive control
Easy robot programming by manual demonstration, Human-Robot collaborative manipulation of large parts involving human intention prediction; learning-based autonomous control of the robot to adjust its behaviour based on the object and environment status.

MERGING workcell control & supervision
Communication and coordination among different kind of resources (robots, grippers, humans); flexible part deformation prediction; combination of the different sensors / sources of information for building a common scene (digital twin) to be used for decision making and robot behaviour adaptation.

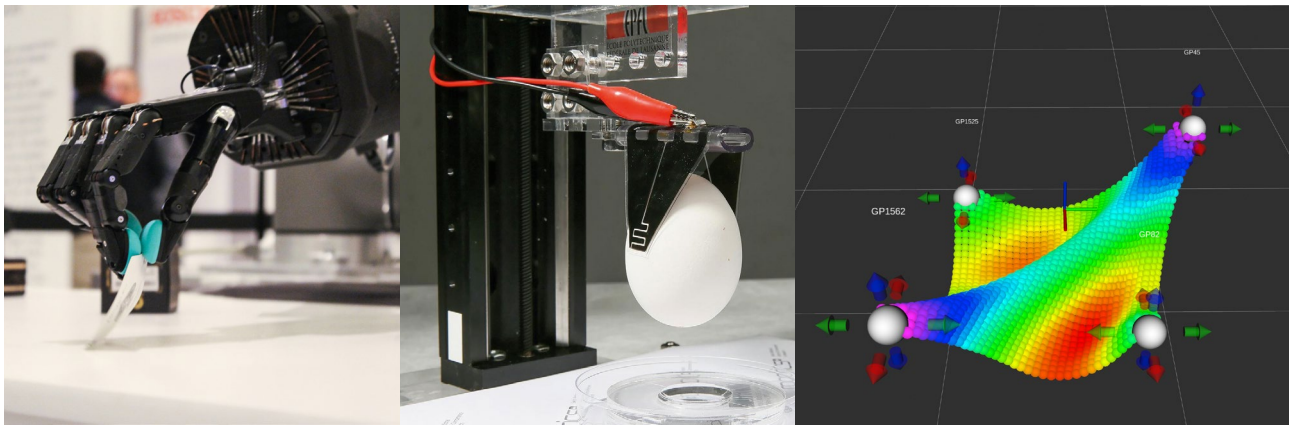
Concept

Current robots are mostly used for industrial applications, where they handle rigid objects and interact with them in repetitive operations. But a big part of the European and global industry is comprised of sectors where soft and flexible items are manipulated. Take for example the fabrication of garments, shoes or lingerie; the processing, canning, packaging or manipulation of food, and all sort of tasks in retail; the manipulation of glass fibre and carbon fibre fabrics for the manufacturing of composite parts of vehicles. All these materials do not behave in an entirely predictable way, due to their high flexibility, and can be easily damaged. Grasping and manipulating them requires a gentle grasp, fine and adaptive control of movements that is beyond the current state of the art in robotics.

The ambition of the MERGING project is to overcome these challenges and provide manufacturers with a turnkey robotic solution for such tasks.

It will consist of a **dexterous gripper** equipped with an adaptive **electro-adhesive skin**. Electro-adhesion will increase the attraction forces between the gripper fingers and the object. The skin will also have ability to conform to the objects to handle in order to rise the contact surface.

The autonomous robot behaviour will be empowered by supervision functions and real-time workcell representation, based on perception data and modelling.

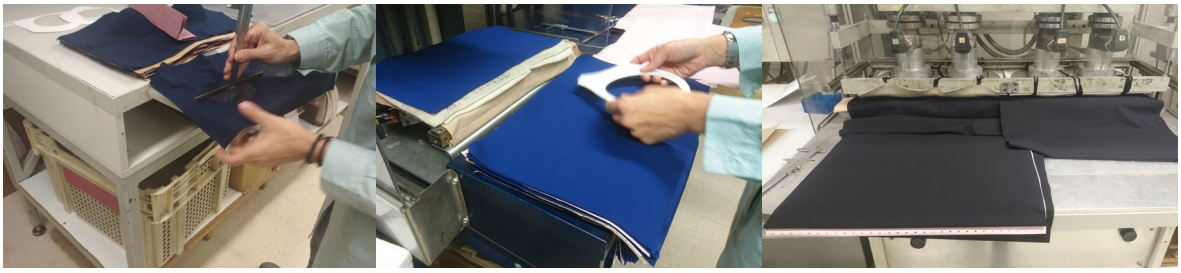


Three initial inspiration solutions to be merged into the MERGING platform: (left) Shadow Dexterous Hand, (center) EPFL's soft gripper based on electroadhesion, (right) flexible material modelling for robotic handling

We will carry out proof-of-concept studies in three different applications and sectors: fabric handling for lingerie manufacturing, technical fiber handling for composite panels for the automotive industry, plastic pouches handling for the packaging in food industry.

Pilot case 1
Manipulation for lingerie manufacturing

The use-case addresses the manufacturing of women lingerie, with the manipulation of fine textile parts during critical process steps, in particular the thermoforming process.



Key steps of the lingerie manufacturing process

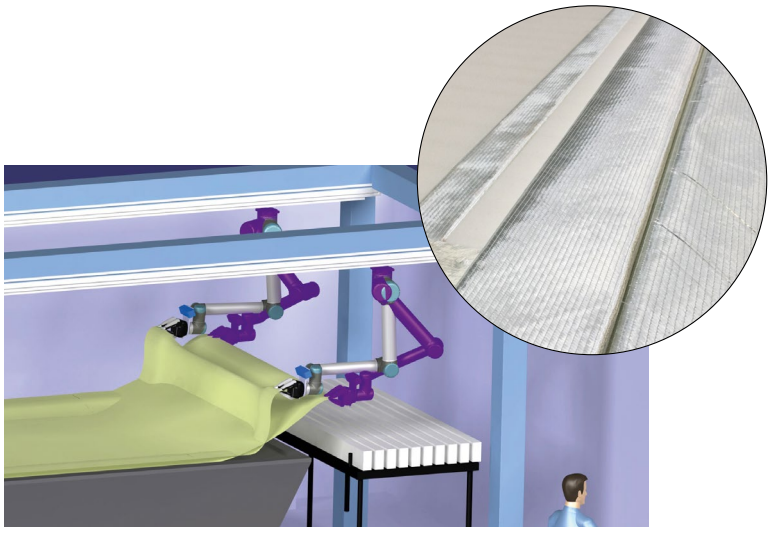
Pilot case 2
Manipulation for food packaging

Here we address the food packaging market, and more specifically the handling of soft plastic pouches. Empty pouches are manipulated for bin picking and placing into the input machine. Already filled pillow pouches are manipulated for optimal stacking into a transportation flexible bag.

The plastic pouches manipulated in the pilot case and the machinery where they have to be placed for filling

Pilot case 3
Manipulation for composite manufacturing

This case addresses challenges in the lay-up manufacturing process of automotive panels. Currently, this process consists in a series of manual operations of flexible glass fiber (GF) textiles in addition to foam blocks. The envisioned solution proposes a hybrid cell where humans and robots collaborate in fenceless environment.



The envisioned hybrid cell for flexible glass fiber for composite parts manufacturing

MERGING is a research and innovation project funded by the European Commission under the Horizon 2020 Programme. It runs from November 2019 to April 2023.

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Partners

- Commissariat à l'énergie atomique et aux énergies alternatives (CEA) – Coordinator
- University of Patras, Laboratory for Manufacturing Systems and Automation (LMS)
- Ecole polytechnique fédérale de Lausanne (EPFL)
- Asociación de Investigación Metalúrgica del Noroeste (AIMEN)
- Selección de Corsetería SLU (Selmark)
- VDL Fibertech Industries BV (VDL)
- Thimonnier
- The Shadow Robot Company España
- Centre technique industriel de la plasturgie et des composites (IPC)
- Symvouloi kai proionta logismikou AE (CASP)
- The Shadow Robot Company UK
- Opteamum

R&D / Academic organization • Technology provider • H/W integrator • S/W integrator • End user