LCAMP

Learner Centric Advanced Manufacturing Platform

ASSISTED JOBS

(Safety-ergonomics related)

WPN° 3 Observatory

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TKNIKA – Basque VET Applied Research Centre, CIFP Miguel Altuna LHII, DHBW Heilbronn – Duale Hochschule, Baden-Württemberg, Curt Nicolin High School, AFM – Spanish Association of Machine Tool Industries, EARLALL – European Association of Regional & Local Authorities for Lifelong Learning, FORCAM, CMQE: Association campus des métiers et des qualifications industrie du future, MV: Mecanic Vallée, KIC: Knowledge Innovation Centre, MADE Competence Centre Industria 4.0; AFIL: Associazione Fabbrica Intelligente Lombardia, SIMUMATIK AB; Association HVC Association of Slovene Higher Vocational Colleges; TSCMB:Tehniški šolski center Maribor, KPDoNE: Kocaeli Directorate Of National Education; GEBKİM OIZ and CAMOSUN college.

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GLOSSARY AND/OR ACRONYMS

AI - Artificial Intelligence
AM - Advanced Manufacturing
Cedefop - European Centre for the Development of Vocational Training
CoVE - Centres of Vocational Excellence
EAfA - European Alliance for Apprenticeships
EC - European Commission
ECVET - European Credit System for Vocational Education and Training
EntreComp - The Entrepreneurship Competence Framework
EQAVET - European Quality Assurance in Vocational Education and Training
EQF - European Qualifications Framework
ESCO - European Skills, Competences and Occupations
ETF - European Training Foundation
EU - European Union
HE - Higher Education
HVET - Higher Vocational Education and Training
I4.0 - Industry 4.0
KET - Key Enabling Technology
OECD - Organisation for Economic Cooperation and Development
SME - Small and Medium Enterprises
SWOT - Strengths, Weaknesses, Opportunities, Threats
TVET - Technical and Vocational Education and Training
VET - Vocational Education and Training
WBL - Work Based Learning

CONTENT TABLE

EXECUTIVE SUMMARY

Advanced Manufacturing (AM) and Higher Vocational Education and Training (HVET) need to update training, implement new technologies, and get quick access to data.

The causes behind these needs are technological factors (Industry 4.0), factors conditioned by education systems and education methodologies, social factors and environmental factors (the European Green Deal with its emphasis on the greening industry).

Under the CoVE initiative, the LCAMP project aims to support regional skill ecosystems and various stakeholders in providing new skills and implementing new or updated technologies in VET centres. LCAMP will tackle this by incorporating a permanent European Platform of Vocational Excellence for Advanced Manufacturing.

By collaborating across borders, LCAMP's goal is to support and empower regional Advanced Manufacturing CoVEs to become more resilient, innovative, and better equipped to train, upskill, and reskill young and adult students, to successfully face the digital and green transitions. We will help European regions and countries grow and be more competitive through their VET systems.

Therefore, the LCAMP OBSERVATORY is one of the services in the LCAMP platform. The observatory is led by the French cluster *Mecanic Vallée* and the French VET provider *Campus des Métiers et des Qualifications d'Excellence Industrie du Futur*.

This present document details the first results of the LCAMP Observatory, through the methodology that the LCAMP consortium used to set up and run the Observatory. We had set up a process cycle for the observation consisting of 5 stages:

- Stage 1: Diagnosis and priority
- Stage 2: Search and information gathering
- Stage 3: Information Analysis
- Stage 4: Creating value. Elaboration of LCAMP reports
- Stage 5: Dissemination and communication.

1. INTRODUCTION

The LCAMP observatory is one of the services of the LCAMP platform.

The LCAMP Observatory must be a reliable and easily accessible source of information and data for trainers, VET teachers, and professionals, updated on Digital / Advanced Manufacturing / Smart Industry, delivered through a multimedia and interactive platform -LCAMP platform-, that can be customized according to individual interests (Work in progress in WP8).

This observatory must feed other Work packages (WP), for instance, WP 5 on Learner Centric Training, or Open innovation Community in the WP4.

In a first document about methodology, are set up a process cycle for the observation consisting in 5 stages:

- Stage 1: Diagnosis and priority
- Stage 2: Search and information gathering
- Stage 3: Information Analysis
- Stage 4: Create value. Elaboration of LCAMP reports
- Stage 5: Disseminate-communicate.

Following this process cycle, are detailed the main aspects of the observation methodology:

- Identify reliable sources that we can find in Europe about Advanced Manufacturing.
- Classify and filter data gathered from different sources.
- Present several ways to collect data and to analyse them.
- Define the methods for the creation of annual reports.
- Validate process for those reports.

The observatory will publish periodical reports for VET and HVET target audiences about technology trends, labour market changes, skill needs, and occupations in Advanced Manufacturing. It is expected that SMEs, industry clusters and other associations will also find valuable information in the observatory.

The publication of a yearly report is planned.

- Report 1: June 2023,
- Report 2: June 2024,
- Report 3: June 2025.

This first annual report is gathering sub-reports written by around twenty different writers, from the main partners involved in the LCAMP project. 39 Topics were determined, and 22 TOPICS were analysed and worked on during this first period.

2. TOPICS ASSISTED JOBS (SAFETY-ERGONOMICS RELATED)

The purpose of this chapter is to present some of the development areas related to AM.

These are topics that concern all or some of the stakeholders

- CoVEs and VETs: teachers, trainers and heads of VET schools;
- Learners: students, active workers, job seekers;
- Companies;
- Policy makers and other stakeholders

2.1 INTRODUCTION

Since the appearance of Unimate, the first industrial robot, in 1961 in a General Motors factory in the United States, scientists, designers and other researchers have never ceased to find solutions to make people's work easier, safer and more effective. At the time, the idea was to replace humans for tedious, dangerous and repetitive tasks.

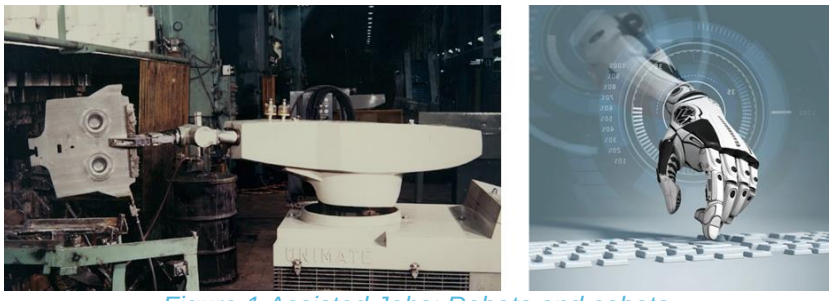

Figure 1 Assisted Jobs: Robots and cobots

After an active phase of partial or full automation of the production line in 2019, the number of industrial robots per 10,000 employees[1] was 346 in Germany, 277 in Sweden, 212 in Italy, 191 in Spain and 177 in France, but compared to Japan's rate of 855, there was still significant room for improvement. While the effort was maintained to roll out automation, sometimes the solution was not appropriate.

This is why, among other reasons, in recent years thought has also been given to how to facilitate collaboration between man and machine in order to assist and ensure the safety and health of people at their workplaces.

The concepts of cobots (collaborative robots) and collective protective equipment / personal protective equipment (CPE/PPE) then appeared. The formers are always intended to replace,

[1] PULSA Bols Vibrants, « Automatiser une ligne de production - Se poser les bonnes questions », *PULSA Bols Vibrants* (blog), 2019, https://www.pulsafrance.com/automatiser-une-ligne-de-production/.

but also to assist people, the latter being fixed collective protection aimed at removing or isolating from a risk (electricity, heat, etc.) or individual protection which complements the CPE to protect against risks:

- Mechanical : shocks, cuts, particle projections.
- Electrical : contact with live conductors.
- Biological : inhalation of biological agents.
- Chemical : inhalation of chemical agents, hand contact with chemicals.
- Auditory : constant and loud noise
- etc.

Fixed or mobile robots perform tasks to assist operators at their workstations. On demand, planned or not, they bring tools or materials, they take care of moving parts and other packages. But the major revolution is that they adapt to their environment and stop their activity as soon as someone enters their field of action. Collaboration is becoming increasingly important.

On the subject of safety, the evolution of PPE with exoskeletons[2], which has been booming in recent years, represents a solution for the future to reduce the risks of musculoskeletal disorders (MSD) and worker fatigue[3].

2.2 CONTEXTUALISATION

It is in industry, and more specifically on workstations with very heavy handling, that equipment is currently used the most.

Assisted handling[4] :
"The repetitive nature of physical work can become disabling for the worker, even if the load is light. And what about manual handling of heavy or bulky loads? This involves risks that can cost the employer dearly.
In a context where well-being at work is more than a fashion, but almost an obligation for the employer who wishes to keep his employees, the question of health and safety should not be taken lightly.
When we think of a production plant, what comes to mind is: automation, robotization, assisted handling. Lifting and handling systems such as overhead cranes, chain hoists and jib cranes are part of the industrial environment as we know it. But there are other high-performance systems: vacuum tube lifting systems that significantly reduce the workload. This is called assisted handling.
The actual capacities of the system vary depending on the nature of the load (sealed or porous product), the condition of the surface (cleanliness, roughness), the effective surface of the suction cup, the shape (dimensions) of the product and the deformation of the suction cup (influenced by the level of vacuum, the force exerted, the shape of the suction cup, the material of the suction cup).
Designed for use in high production, this vacuum lifting aid is ergonomic, as it respects the natural fluidity of the operator's movements. In addition, it considerably reduces the risk of injuries related to manual handling."

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[2] INRS, « Exosquelettes. Foire aux questions - Risques - INRS », INRS, s. d., https://www.inrs.fr/risques/exosquelettes/faq.html.
[3] Centre canadien d'hygiène et de sécurité au travail Gouvernement du Canada, « CCHST: Exosquelettes », 5 avril 2023, https://www.cchst.ca/oshanswers/safety_haz/exoskeletons.html.
[4] Pedlex, « Vers une manutention plus ergonomique », 1 décembre 2019, https://www.pedlex.com/index.php?route=extension/d_blog_module/post&post_id=50.

Novel exoskeleton chair supports factory workers[5]

"The worldwide first exoskeleton for the creation of ergonomic, age-neutral and low-fatigue workplaces in industry and for the reduction of physical strains in the ageing workforce

Workers no longer have to stand all day. A new chair straps to the body and is available for support as needed.

Workers in manufacturing and other industries routinely work long hours in a standing position. Standard office chairs may not be permitted because they can dangerously impede workers and machinery.

Although occasionally working standing up benefits health, standing for entire shifts has the opposite effect.

Specifically, it can cause injury, various kinds of strain including lower back pain, and hypertension. Furthermore, demographic and social changes mean that an increasing proportion of factory workers are of an older age group, especially unsuited to standing all day.

To combat these problems, the EU-funded Chairless Chair project developed an exoskeleton chair. Conventional industrial exoskeletons are worn on the upper body and augment workers' strength. The Chairless Chair is the first designed to be worn on the lower body to support workers' weight.

The current version, Chairless Chair 2.0 is actually the third product generation. It has been refined in collaboration with automobile manufacturers. The refinement has reduced the weight by more than 25 %, extended the height adjustment from 1.5 to 2 metres, and slimmed the design. The product has been optimised for fit. The newer version is safer and offers more freedom of movement. The straps, vest and seat pads have been redesigned and feature new textile materials. Such changes make the product more comfortable and durable.

The team has established the Chairless Chair as a well-known brand, especially among German car manufacturers. Next, researchers will be further refining the product in subsequent versions, while also seeking new markets.

The product benefits older workers but is not intended for them exclusively. It will benefit any worker having to stand all day, reducing the health consequences and lost productivity resulting from this mode of work."

A robot to protect the lives of motorway company employees developed in the Cantal[6]

"The company Europe Service[7], based in Aurillac (Cantal - France), is developing a robotic cone picker to improve the safety conditions of motorway company agents.

A robotic arm will place and remove cones and road signs from a construction site, without the need for an agent.

...

In collaboration with the motorway company APRR, Europe Service is currently developing "an E-cone carrier", says Aurélien Lafon. This is a truck that the CEO of this SME wants to run on electricity, with a robotic arm, which places and removes cones and road signs on a site without the need for an agent ...

For its official launch, planned for the end of the year, Aurélien Lafon has invited Jean Todt, the UN's road safety officer ...."

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[5] Cordis, « Novel Exoskeleton Chair Supports Factory Workers | Chairless Chair Project | Results in Brief | H2020 | CORDIS | European Commission », 31 octobre 2020, https://cordis.europa.eu/article/id/429162-novel-exoskeleton-chair-supports-factory-workers.

[6] La montagne, « Un robot pour protéger la vie des agents des sociétés d'autoroutes développé dans le Cantal - Aurillac (15000) », 4 juin 2023, https://www.lamontagne.fr/aurillac-15000/actualites/un-robot-pour-proteger-la-vie-des-agents-des-societes-d-autoroute-developpe-dans-le-cantal_14289670/.

[7] *E-Cône -Ramasseuse de cônes robotisée*, 2022, https://www.youtube.com/watch?v=tK6SumDEXCg.

Robotic technology for ship inspection[8]
"Faster, cheaper and safer, robotic and autonomous systems such as drones and crawlers are an attractive solution for ship inspections. The EU-funded ROBINS project set out to certify these systems and help establish them as a standard tool for ship surveyors."

Laser-assisted machining of challenging metals[9]
"To offer sheet metal forming in titanium- and nickel-based materials for heavy-duty aero engine components and other demanding applications, EU-funded scientists have set new boundaries in metal spinning."

Robotic extraction of asbestos fibres from buildings[10]
"Europe has paid a high price for asbestos, with over 100 000 related deaths. First in line in the fight to free buildings from asbestos contamination, workers in the construction sector could soon find a helping hand in the form of an AI-piloted robotic system."

Safer human-robot collaboration for workplaces of the future[11]
"The next generation of robots could be entering the workplace alongside humans, but this first needs some collaborative principles to be established. SYMBIO-TIC has developed a system for such a safe, dynamic, intuitive and cost-effective working environment.
Factories of the future will depend on the development of safe, cost-effective, hybrid assembly/packaging arrangements based on human-robot collaboration. However, the European manufacturing industry faces implementation challenges, which could be summarised as a lack of: adaptability, flexibility and vertical integration.
The team have already recorded active collision avoidance for worker protection and are currently developing a demonstrator, to be ready by mid-March 2019, which integrates all the modules and sub-systems together to showcase the full solution. This demonstrator will be located at Volvo Cars in Sweden, where it will assemble a mass balancing system (MBS) within a car, but outside of the regular production environment.

After this, the team will seek out new partners to advance the technology to a market-ready state.
The system will also maintain product quality, with humans remaining ultimately responsible for inspections and the necessary adjustments."

COMAN+ takes human-robot interaction to the next level[12]

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[8] Cordis, « Robot-Assisted Ship Inspections Sail towards Certification | ROBINS Project | Results in Brief | H2020 | CORDIS | European Commission », Cordis, 30 juin 2021, https://cordis.europa.eu/article/id/435257-robot-assisted-ship-inspections-sail-towards-certification.
[9] Cordis, « Laser-Assisted Machining of Challenging Metals | EASYFORM Project | Results in Brief | FP7 | CORDIS | European Commission », Cordis, 28 février 2015, https://cordis.europa.eu/article/id/159598-laserassisted-machining-of-challenging-metals.
[10] Cordis, « Robotic Extraction of Asbestos Fibres from Buildings | Bots2ReC Project | Results in Brief | H2020 | CORDIS | European Commission », Cordis, 30 novembre 2019, https://cordis.europa.eu/article/id/418003-robotic-extraction-of-asbestos-fibres-from-buildings.
[11] Cordis, « Safer Human-Robot Collaboration for Workplaces of the Future | SYMBIO-TIC Project | Results in Brief | H2020 | CORDIS | European Commission », Cordis, 31 mars 2019, https://cordis.europa.eu/article/id/251213-safer-humanrobot-collaboration-for-workplaces-of-the-future.
[12] Cordis, « COMAN+ Takes Human-Robot Interaction to the next Level | Interview | CORDIS | European Commission », Cordis, 15 octobre 2022, https://cordis.europa.eu/article/id/124821-coman-takes-humanrobot-interaction-to-the-next-level.

“Imagine a humanoid robot able to help industry workers carry heavy objects around or to assist doctors in their physiotherapy sessions. Such versatile robots will soon be a reality thanks to work under the EU-funded CogIMon[13] project.
Technology-wise, the scaled-up humanoid robot COMAN+ strengthens the world leading position of European research in the development of variable impedance actuation and compliant humanoid robots. We have also developed engineering tools for simulation and control of such robots and made them open source. Finally, we have created the technology to run robot controllers in VR and open new avenues for mixed-reality applications.
How did you proceed to demonstrate these technologies?
CogIMon has demonstrated for the first time two humanoid robots carrying objects together. The project has also shown how four compliant robot arms can collaborate to lift and move a heavy object in interaction with a human, devised new methods for soft robot catching, and created workpieces which have been finalists twice for the Kuka Innovation Award at the Hannover fair. Finally, we have developed a very promising application in physiotherapy, where virtual reality and robot control are combined to enable ball-catching training for patients.
We are going to demonstrate COMAN+ and these applications to the public and scientific community in the upcoming ICRA exhibition.
What’s been the feedback from industry so far?
Most of CogIMon’s work is rather fundamental and our humanoid robots are still far from making it into industrial applications. There is a lot of interest, but little direct feedback from concrete use cases.
However, successful participation in the innovation awards and the demonstration of advanced algorithms for compliance control have generated a lot of attention. The actuation units developed for COMAN+ are currently commercialised, and the first evaluation studies with real patients are being conducted for our physiotherapy application. The VR-robotics mixed-reality approach has also resulted in a new collaboration with an SME.”

2.3 OBJECTIVES / RESEARCH QUESTION / PROBLEM STATEMENT

2.3.1 OBJECTIVES

Research is now moving towards real collaboration between humans and robots in order to carry out a job together and where the robot will facilitate the human's task.
As far as PPE is concerned, exoskeletons are going to be democratised and probably improved. For more conventional PPE, the latest developments tend to use the IoT to enhance personal safety.

3.3.2. RESEARCH QUESTION:

It seems that the new technologies linked to digitalisation and big data will allow significant advances in both the field of cobots and that of safety at work.
However, it will be necessary to be careful not to be too intrusive (particularly for PPE), and to ensure that standards evolve at European level, in order to guarantee the proper functioning and legality of this new equipment.

[13] Cognitive Interaction in Motion

3.3.3. PROBLEM STATEMENT

Will the future be 'intelligent'?[14]
“Personal protective equipment (PPE) is reinventing itself. Innovative equipment, capable of interacting with the wearer and the environment, and becoming true intelligent personal protection systems (IPPS), is multiplying on the market. But what are we talking about? And how can we distinguish between a genuine prevention solution and something that is not?”

Intelligent personal protection systems (IPPS)
The legal classification of a personal protective system as PPE requires a CE marking, an instruction manual, but above all, it is subject to a declaration of conformity to EU Regulation 2016/425.
When the equipment only alerts to a risk and does not have the function of protecting against risks to the health or safety of the wearer, it cannot be called PPE, but simply IPS. Furthermore, collective protection measures must always be given priority, and the individual protection solution is only adopted when collective protection is not effective. Individual protection must be the ultimate solution.
T2S, the manufacturer of high visibility personal protective equipment has integrated electronics into its high visibility waistcoat. In addition to being better seen and seeing better, thanks to waterproof LEDs, the connected waistcoat helps avoid collisions between vehicles and pedestrians. As soon as the safety distance between the machine and the pedestrian is no longer respected, the latter is alerted, while a box placed in the machine warns the driver. This non-intrusive system leaves the driver in total control of the vehicle.

IPPS are subject to the regulations on radio equipment (RED - 2014/53), the Electromagnetic Compatibility Directive (EMC - 2014/30), the Machinery Directive (2006/42), and the General Data Protection Regulation (GDPR - 2016/67). In view of the very broad prospects for future use, it would seem appropriate to consider standardisation, through the creation of a European structure, with the aim of validating the real effectiveness of the equipment and also reassuring users.
The range of uses envisaged or already under study is very broad:

- Waistcoat: equipped with LEDs to be more visible, and with sensors that warn of a risk of collision;
- Textile (trousers or jacket): producing heat;
- Safety footwear: enabling geolocation, signalling loss of verticality or prolonged immobility, or warning of entry into a dangerous area;
- Caps: capable of detecting fatigue signals;
- Safety glasses: providing real-time information about the workspace;
- Gloves: which change colour in the presence of toxic products.

2.4 FINDINGS

The use of IoT will take PPE to a new level. Increased interaction between the wearer and the environment will enhance risk and accident prevention.

[14] « Visionneuse - Travail et Sécurité », Travail et Sécurité, octobre 2022, 26-27, https://www.travail-et-securite.fr/ts/pages-transverses/liseusePDF.html.

Tomorrow, connected and multifunctional PPE[15]

The use of connected objects, which is already widespread, should take PPE and other work clothing into a new era. Either in the research phase, or for the most advanced in the test phase, projects are transforming clothing to fight against extreme temperatures, or to report incidents and even to warn the emergency services. They are expected to be available within a few years. A number of developments are expected to be available in the next few years.

For example, on building sites where men work around moving machinery, an anti-collision parka will vibrate and light up if the pedestrian is less than ten metres from a vehicle, whose driver will have been warned of the danger by an audible alarm.

Another line of research is the alerting of the team leader, who will be able to use his or her smartphone to geolocate a person whose "intelligent" parka has reported a problem. The parka, which can be seen from 250 metres away, can also warm the wearer up if necessary.

For the time being, this equipment works thanks to batteries, recharged every night, and functional for a day's work. But the project to use fibres capable of producing energy should perhaps eventually allow the garment to be recharged while it is being worn.

The new generation of collaborative robotic systems has already brought humans and machines closer together, but tomorrow this collaboration should be increased.

Multitasking robots work hand-in-hand with operators [16]

ColRobot offers a new generation of collaborative robotic systems to the automotive and aerospace industries. These two sectors have to adapt to a growing need for flexibility, while managing large order books. There is no longer a one-size-fits-all production line; each product must be customised with the options chosen by the customer. This requires organisation, which led first of all to a high degree of automation of production lines where operators were totally absent. The latest developments in this field are moving towards better collaboration between robot and human, who share their workspace.

TRL7[17] **and beyond**

By 2018 the ColRobot project had reached TRL7, so Professor Gibaru thought it would take another two to three years of development before the consortium could deliver a usable product. "The cost of the solution is still very high from a hardware and software point of view, and adaptations and modifications to the demonstrator are needed before any industrial deployment can be considered.

At the same time, Thales Alenia Space and Renault were already considering integrating ColRobot solutions into new industrial applications.

To date, the industrial applications of the ColRobot project include:

- Electronic component assembly: the robotic systems developed in the project have been used to assemble electronic components efficiently and accurately, using force sensors to ensure the quality of the assembly.
- Industrial maintenance: the collaborative robots were used to perform maintenance and repair tasks in hazardous or difficult-to-reach industrial environments, reducing the risk to human workers.

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[15] Print and Prod, « Les EPI nouvelle génération - Comment évoluent-ils ? », Les EPI nouvelle génération - Comment évoluent-ils ?, 2 mars 2020, https://www.printandprod.com/epi-nouvelle-generation-evolution.html.

[16] Cordis, « Multitasking Robots Work Hand-in-Hand with Operators | ColRobot Project | Results in Brief | H2020 | CORDIS | European Commission », Cordis, 31 janvier 2019, https://cordis.europa.eu/article/id/251212-multitasking-robots-work-handinhand-with-operators.

[17] **Technology Readiness Levels**

- Quality control: robotic systems have been used to inspect the quality of finished products, using vision sensors and image processing algorithms to detect defects and anomalies.

These industrial applications of the ColRobot project demonstrate the potential of collaborative robotic systems to improve the efficiency and safety of production processes in the manufacturing industry.

Horizon 2020: New Robotics Projects 2021[18]

In this brochure the 24 new robotics projects launched in January 2021 are presented. These new Horizon 2020 projects work on robotics in application areas.
They have been selected from various call topics:

ICT-46-2020: Robotics in Application Areas and Coordination and Support
ICT-47-2020: Research and Innovation boosting promising robotics application
DT-ICT-12-2020: AI for the smart hospital of the future

Extract from this brochure, the DARKO project[19] (Dynamic Agile production Robots that learn and optimise Knowledge and Operations)
Call: H2020-ICT-2018-20
Duration: 1 January 2021 – 31 December 2024
Project: ID 101017274

OBJECTIVES

- O1: Time/energy efficient manipulation through pick & place in motion and throwing objects with inherently elastic manipulators and flexible end-effectors.
- O2: Efficiency and safety in human–robot coproduction through human motion prediction, learning and exploiting activity patterns, mutual communication of intent and riskaware planning.
- O3: Efficient deployment through failure-aware and failure-resilient mapping and localisation, semantic mapping and information transfer from heterogeneous map priors.
- O4: Risk-aware operation for safety and efficiency by principled, local and global risk assessment through predictive models that account explicitly for risk probabilities.

Figure 2 Assisted Jobs: DARKO (Horizon 2020 – New project 2021)

EXPECTED IMPACT

I1: Improved technical capabilities E.g.: AI-enabled 3D perception and scene understanding and dynamic manipulation capabilities for agile production, healthcare, agri-food, etc.

[18] Cordis, « Nouveaux projets de robotique dans le cadre du programme Horizon 2020 2021 | Bâtir l'avenir numérique de l'Europe », Cordis, 14 avril 2021, https://digital-strategy.ec.europa.eu/fr/library/horizon-2020-new-robotics-projects-2021.
[19] Ibid, 7.

I2: Demonstration of applications in logistics and agile production at TRL6 Integration and demonstration of DARKO in realistic settings: at a BSH (Bosch Siemens Home Appliances) warehouse and a permanent demonstrator at ARENA2036 (Stuttgart).

I3: Lowering of technical barriers within logistics and agile production Particularly: greater dependability, higher efficiency, increased safety in dynamic environments, planning considering predictions of people and other dynamics and risks.

3. CONCLUSIONS

These are the directions in which the latest trends in the field of work assistance are being integrated and generalised.

- The use of IoT will take PPE to a new level. Increased interaction between the wearer and the environment will enhance risk and accident prevention.
- The new generation of collaborative robotic systems has already brought humans and machines closer together, but tomorrow this collaboration should be increased.

Whether in the field of PPE or cobots, there is still work to be done, as evidenced by the 24 new robotics projects selected in April 2021 under the Horizon 2020 programme.

For the time being, human-robot cohabitation remains in the realm of science fiction, but the robot revolution is just beginning...

From Asimov to all around us: Welcome to the robot revolution[20]

In novels ("I, Robot" by Isaac Asimov) or science fiction films ("Bladerunner" by Ridley Scott), androids, sometimes impossible to identify except by superior strength, speed and agility, act like humans.

What would be the consequences for society if industrial and service automation were to continue and completely replace humans? Would we have to redefine what it means to be human if we were able to make beings like the replicants in "Bladerunner"? Fascinating as it is to ponder these philosophical conundrums, robotics research has not yet reached the point where we will have to tackle this subject any time soon.

But the projects that have been completed, or are currently being studied and developed, are pushing us in this direction. Robots already perform repetitive or menial tasks, they replace humans in dangerous tasks (difficult, toxic environments, etc.) or those requiring precision (surgical procedures performed by a robot under the supervision of a surgeon, sometimes remotely). Tomorrow we expect to see the presence of cobots in the field of services and personal assistance to increase.

While Japan and South Korea have been pioneers, the EU is taking an active part worldwide, with 32% of the supply and use in industrial robotics and about 63% in service robotics thanks to its expertise in interdisciplinary research on "intelligent robots".

The European Horizon 2020 project has a strong focus on robotics research, and the European partnership, SPARC, dedicated to robotics, is furthering the EU's effort in all sectors of society, science and economy. Between 2014 and 2020 SPARC was the largest civilian-funded robotics innovation programme in the world with €700 million in funding

Every year SPARC organises its annual European Robotics Forum where innovations in research, development and adoption of robotics in Europe are presented in 4 major areas

- **Industrial Robotics:** focused on the development of robots to perform repetitive and hazardous tasks in manufacturing environments. Research areas include robot flexibility, safety, computer vision and machine learning.
- **Service Robotics:** aims to develop robots capable of providing useful services to people, such as assistance to the elderly or disabled, environmental monitoring and

[20] Cordis, « From Asimov to All around Us: Welcome to the Robot Revolution | Research*eu Magazine | Issue 80 | CORDIS | European Commission », Cordis, mars 2019, https://cordis.europa.eu/article/id/401287-from-asimov-to-all-around-us-welcome-to-the-robot-revolution.

infrastructure maintenance. Research areas include human-robot interaction, mobility, autonomous navigation and sensory perception.

- **Medical robotics:** develops robots capable of assisting health professionals in medical tasks, such as surgery, rehabilitation and patient monitoring. Research areas include precision, safety, adaptability and communication with healthcare professionals.
- **Agricultural robotics:** adapting robots for agriculture, such as crop harvesting, crop condition monitoring and crop processing. Research areas include autonomous navigation, sensory perception and collaboration between robots.

These four research areas are considered priorities for SPARC and are intended to help Europe become a world leader in robotics.

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5. INDEX OF IMAGES

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