ESMERA - European SMEs Robotics Applications

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Summary

This paper presents the ESMERA (European SMEs Robotics Applications) project, which addresses the "ICT-27-2017: Systems abilities, SME & benchmarking actions, safety certification" Call, with a special emphasis on the Small and Medium Enterprises (SMEs)-based research on new robotics technologies. The project focuses on European SMEs that are oriented towards the development of novel robotic technologies and in need of both technical and business support to accelerate the transfer of their ideas to market. In contrast to previous approaches, ESMERA builds upon Competence Centers (CCs) and its experienced project partners offer technologies for real-life industrial problems. This value is achieved by involving SMEs able to develop solutions addressing these problems and supporting them through the entire chain, from idea to marketable product.

1 Introduction

Although the European manufacturing industry is one of the leading ones in the world, it is suffering from constant decline in terms of the share of value added (2000 – 18.8%, 2015 - 15%) and employment (2000 – 17.5%, 2015 – 14.1%). At the same time, it remains a key sector contributing a disproportionately large share of business R&D (64%) and European exports (66%) [1]. The biggest chance to regain competitiveness, to slow down offshoring (and even stimulate reshoring), and to bring the value-added share to the H2020 goal of 20% lies in embracing the Industry 4.0 revolution, massive digitization of industry and adoption of advanced manufacturing technologies – including robotics [2]. In fact, according to McKinsey's report [3], doubling the digitization rate of the European industry between 2015 and 2025 – including the lagging-behind manufacturing sector – could bring an additional €2.5 trillion of gross domestic product (GDP), bringing it 10% above baseline projections.

Europe's scientific excellence owed to its universities and research centers has rarely fed into creating technology groups and industries to match the rivals in the US and Asia. To increase their role in technology development, investments in Robotics and Artificial Intelligence (AI) for start-ups working on disruptive technologies are recently gained importance [4]. And yet, the 2020 global market value for robotics is estimated around €80 billion creating a great opportunity for growth in multiple technological and cross sectoral areas [5]. To strengthen links between the industry and the research institutes, to compete with the rivals in all over the word and to advance the European robotics sector, the ESMERA project acknowledges the opportunity to mobilize companies and assists them in overcoming the infamous Valley-of-Death [6], which prevents Key Enabling Technology (KET) products, and services to be transferred into the marketplace. These technologies involve but are not limited to: novel robotic structures, mobile robots, aerial robots, manipulators, sensing technologies, gripping and actuation mechanisms, and navigation and control.

Beyond large industries and research centers, ESMERA also involves SMEs often thought of as the backbone of the European industry. In particular, robot-developing SMEs, albeit being innovative, have not reached their full market potential, yet. Therefore, ESMERA aims at increasing their contribution to the robotics industry and thereby to the development of European industry in general.

The main idea behind ESMERA consists in supporting SMEs within Europe in materializing, testing and promoting robotic technologies through i) providing industrial challenges defined by leading EU companies and encouraging SMEs to compete by developing solutions addressing these real-life problems, ii) engaging a number of Competence Centers (CCs) supporting, development, evaluation, and testing on novel robotic technologies, iii) supporting SMEs with direct financial support through a cascade funding mechanism during their product development, iv) offering technical and business support throughout the entire value chain from idea to marketable product and v) involving industrial associations and networks that can directly promote the developed solutions to their members, addressing a wide range of industrial sectors and application areas. Special emphasis is given to step changes for problem-specific robotic capabilities to be advanced: con-

figurability [7-11], interaction capability [12-14], decisional autonomy in terms of context-awareness [15-17], and dependability [18].
The paper is organized as follows: Section II explains the methodology followed in ESMERA and describes the key elements of the project. Section III concludes this paper and discusses future work.

2 Methodology

The ESMERA consortium consists of four research institutes and universities: Laboratory for Manufacturing Systems & Automation, University of Patras (LMS), The French Alternative Energies and Atomic Energy Commission (CEA), IK4 TEKNIKER and Technical University of Munich (TUM), and three industrial companies: R U Robots, Blue Ocean Robotics (BOR) and COMAU. The objective of the project is to set up a mechanism motivating and facilitating the research and development of robotics technologies by European manufacturing SMEs and to offer support from idea inception to the development of marketable product. The overall concept of the ESMERA project is illustrated in **Figure 1**.

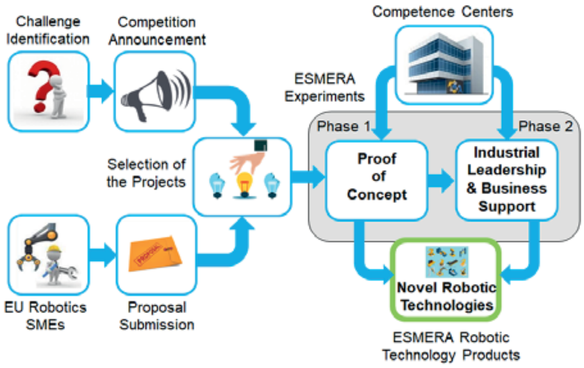

Figure 1 The ESMERA workflow

ESMERA relies on the three following mechanisms to achieve its goals: Challenges, Competence Centers, and Experiments. To emphasize that all project outcomes have a commercially viable route to market, and to inspire SMEs in focusing their development efforts towards addressing real-life problems, ESMERA introduces the notion of *challenges* which are problems obtained from leading EU companies in different production sectors. To address these challenges, ESMERA organizes one open call with two cut-off dates to find solutions to these problems. SMEs developing robotic technology propose their solutions to the challenges and submitted proposals by SMEs will be selected based on the following criteria: excellence of research/technology, socioeconomic impact and clarity of the business plan. The selected proposals for each cut-off are distributed to the CCs mapping the CC available infrastructure and expertise with the experiments' technological needs. The experimental part of ESMERA is divided into two phases: 1) proof of concept and 2) industrial leadership and business support. Experiments that successfully compete and qualify from Phase I are granted further financial support and mentoring by ESMERA facilitators, aiming to put novel robotic technologies on the market.

2.1 Challenges

Challenges originate from the needs of leading EU companies (called *Challenge Providers*) in different sectors that employ production processes that have not yet been, partially or fully, automated by robotics. ESMERA mainly focuses on the following challenge areas where new markets for robotic technologies may emerge: energy, manufacturing, agri-food and construction. Especially, the selected sectors represent a significant portion of the EU economy and related production activities. More specifically, i) the energy sector directly employs around 1.6 million people in EU and generates €250 billion to the economy, corresponding to 4% value added of the non-financial EU business economy [19], ii) the manufacturing sector employed 29.7 million persons and generated €1,630 billion of value added in 2013 and 9.2% of all enterprises in the EU-28's non-financial business economy were classified to manufacturing [20], iii) the construction industry provides 18 million direct jobs and contributes about 9% of EU's GDP [21], and iv) the European agri-food sector was the world's biggest exporter in 2014 with agri-food exports representing more than 7% of all goods exported and with a net surplus of €18 billion [22]. Considering that the major robot providers and system integrators have not yet managed to provide solutions for such cases, it generates a great opportunity for testing radically new concepts.

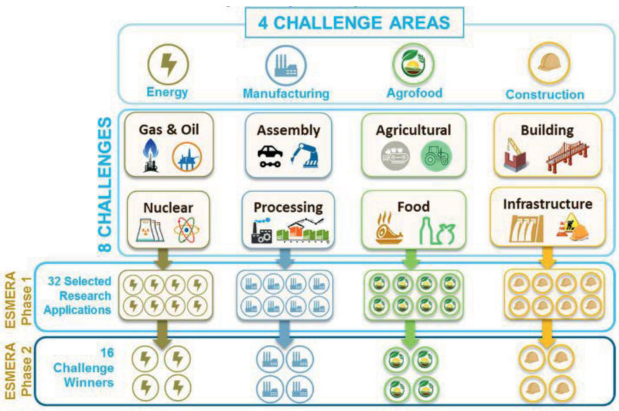

Figure 2 ESMERA Challenges and two-phase workflow

For each area, two challenges are defined, and each challenge represents a completely different operating environment where the proposed robotic solutions must prove their capability of performing the tasks defined by the challenge providers. In total, eight challenges from four different areas are offered as shown in **Figure 2**.

2.2 Competence Centers

Competence centers provide test environments for challenges and equipment to SMEs for their experiments, offer expert support for advising on deployment and fast assessment of robotics solutions, provide links with industrial associations and key robotics market players and support SMEs in terms of networking. During the experimental phase of ESMERA, each experiment is supported by at least one CC. The Center offers assistance in developing new technologies but does not participate in the evaluation in order not to interfere with the transparency of the evaluation process.
In the ESMERA project, four CCs located in different European countries (CEA (France), TUM (Germany), IK4 TEKNIKER (Spain), LMS (Greece)) are involved. Some CCs benefit from expertise gathered in other strongly related European projects such as ECHORD++ [23], HORSE [24], FOURBYTHREE [25], ROBO-PARTNER [26] and SMEROBOTICS [27]. ESMERA CCs mainly provide support in human-robot collaboration, modular robots, mobile platforms, autonomous ground vehicles, virtual reality, additive manufacturing, agile manufacturing and they have been involved in many research projects.

2.3 Experiments

Considering the quality of the proposals to the defined challenges, ideally, seven or eight competitors are involved in experiments part. In total, 32 experiments are selected for the first phase and each competitor perform their experiments for nine months with the assigned CC. In Phase I, *Proof of Concept*, each competitor can receive a funding up to 75k€ and it is expected to demonstrate the underlying approach to a solution up to technology transfer level (TRL) 5 to 6. At the end of Phase I, all research experiments are evaluated based on a set of common key performance indicators (KPIs) and 16 experiments among them are selected for Phase II. The second phase, *Industrial Leadership and Business Support*, offers support for finalizing and commercializing the product. During Phase II, the competitors undertake further research based on feedback from evaluators and improve their solutions. They are also encouraged to research the exploitation aspects associated with the challenge. They are also assisted by ESMERA partners on this stage to deploy their technologies on the market. Phase II also takes nine months and each competitor can receive a funding up to 125k€. At the end of the second phase, challengers demonstrate their solution in the same conditions as in Phase I, again with appropriate facilities and it is expected by them to demonstrate a solution up to TRL 8. The schematic representation of experiments can be seen in **Figure 3**.

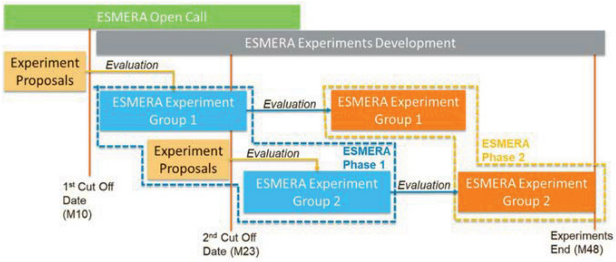

Figure 3 ESMERA Experiments

The last stage of the project is dedicated to analyzing the achieved impact at both the national and European levels. The impact analysis covers multiple aspects involving the benefits for industry, CCs, regions or countries as well as direct and indirect socio-economic impacts.

3 Conclusion and Future Work

This paper demonstrates the methodology and technical expertise behind the ESMERA project. The aim of the project is to advance the European involvement in Industry 4.0 by supporting SME's in developing and commercializing new solutions. To ensure that the developed products have a viable market, large enterprises across Europe have been contacted to identify possible problems that could be solved via robotic automatization.
All activities of ESMERA are geared towards SMEs developing robotic solutions. Promoting joint research and development initiatives between academia and industry via ESMERA contributes greatly to the development of a knowledge-based economy at the SME level. Most importantly, there will be special support for SMEs since ESMERA will conduct 32 experiments specifically designated for SMEs and thus give them the opportunity to work with leading research and technology development centers. The innovation outcome is useful for all end-user companies or organizations but specifically it has a high positive impact for SMEs by leveraging more efficient, high-quality, but low-cost solutions that are more sustainable for SMEs than today's solutions.
Research institutions have the opportunity to deepen and improve their scientific and technical competences related to robotics technologies. Indirectly, ESMERA contributes to improve manufacturing education and increase the enrolment of students and young engineers.

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