COLLABORATIVE ROBOTICS FOR CIRCULAR ECONOMY IN MANUFACTURING SECTORS

[2021-1-ES01-KA220-VET-000034799]

CROCEMS Sustainability Plan

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them

Content

1.Introduction

The CROCEMS Project (Collaborative Robotics for Circular Economy in Manufacturing Sectors) was initiated to address the growing need for sustainable practices in manufacturing industries. With increasing emphasis on reducing waste, optimizing resource use, and improving environmental responsibility, the integration of Collaborative Robotics has emerged as a transformative solution.

CROCEMS aimed to:

- Equip manufacturing sectors with the knowledge and tools to adopt collaborative robotics in Circular Economy processes.
- Develop and deliver an Open Educational Resource (OER)-based MOOC that serves as a comprehensive training program.
- Foster a network of companies and stakeholders to facilitate knowledge exchange and collaboration.

The project successfully provided a platform for innovation, skill development and the practical application of collaborative robotics, laying the groundwork for sustainable practices in manufacturing industries.

The CROCEMS project started in February 2022 and is set to conclude in February 2025; however, to ensure its impact extends beyond the funding period, a sustainability plan has been created. Sustainability is critical to ensuring the project's long-term success and impact. Without sustainable strategies, the knowledge, resources, and networks established by CROCEMS risk becoming underutilized or obsolete. Sustainability ensures:

- Continuous Value Delivery: The MOOC, tools, and methodologies can remain accessible and relevant to new audiences.
- Adaptability and Evolution: Resources can be updated to reflect technological advances, legislative changes, and stakeholder needs.
- Ongoing Collaboration: The network of companies and stakeholders can continue to foster synergies and partnerships.
- Broader Adoption: Sustainable strategies help extend the project's reach, influencing more organizations to adopt collaborative robotics and Circular Economy practices.

By embedding sustainability principles into its outcomes, CROCEMS aligns with global goals for environmental responsibility and innovation.

The CROCEMS sustainability plan outlines a roadmap to maintain and expand the impact of the project beyond its funding period. This includes:

- Preservation of Outputs: Ensuring the MOOC, tools, and methodologies remain accessible and regularly updated.
- Promotion and Dissemination: Strategies for engaging new audiences, including SMEs, policymakers, and academic institutions.
- Resource Allocation: Identification of the human, financial, and technical resources required for sustained impact.
- Stakeholder Engagement: Maintaining and expanding the network of companies and organizations collaborating on collaborative robotics and Circular Economy initiatives.
- Future Initiatives: Exploring new funding opportunities and follow-up projects to build on the

project's foundations.

This plan serves as a guide for Consortium partners, stakeholders, and future collaborators to ensure the enduring relevance and utility of the CROCEMS Project's contributions.

2. Project Achievement and Outputs

The CROCEMS project has delivered several transformative outcomes that address the intersection of collaborative robotics and Circular Economy practices. Key achievements include:

- The development and implementation of an Open Educational Resource (OER)-based MOOC, offering an accessible, flexible and scalable learning platform.
- Creation of a robust network of companies, academic institutions, and stakeholders to foster synergies and promote the adoption of collaborative robotics in Circular Economy processes.
- Advancement in the practical understanding of how collaborative robotics can enhance sustainability in manufacturing sectors, reducing waste and improving resource efficiency.
- Comprehensive dissemination activities, including workshops, conferences and social media campaigns, which have significantly expanded the project's reach and influence.

These achievements not only fulfil the project's immediate objectives but also establish a strong foundation for its long-term impact.

The project's outputs are diverse and designed to address various aspects of the adoption and integration of collaborative robotics into Circular Economy practices:

Courses:

- A fully developed MOOC consisting of modular content covering topics such as the role of robotics in Circular Economy processes, implementation strategies and case studies.
- Training materials aligned with OER principles, ensuring free access and adaptability for diverse audiences.

Publications:

- Research conference proceedings and reports documenting project findings, available as open-access resources to maximize their dissemination.

Network:

- A dynamic Consortium of academic, industrial, and policymaking stakeholders aimed at fostering continued collaboration and innovation.

The outputs of the CROCEMS project hold significant value for a wide range of stakeholders:

- **Educational Value:** The MOOC equips learners with critical knowledge and skills, empowering them to drive sustainable practices in their organizations. Its OER license ensures it can be freely

used, adapted, and updated to remain relevant in the long term.

- **Practical Applicability:** The tools and frameworks provide actionable insights for companies looking to integrate collaborative robotics into their processes. These resources are designed to be adaptable to various industries, ensuring broad applicability.
- **Collaborative Potential**: The network created through the project is a valuable intangible asset, providing a platform for ongoing collaboration, knowledge exchange and innovation.
- **Future Readiness:** By documenting best practices and success stories, the project has created a foundation for future initiatives, including the development of new projects and policy recommendations.

The sustainability of these achievements and outputs relies on the proactive engagement of the Consortium and stakeholders to maintain, promote, and evolve the resources created, ensuring their continued relevance and impact in advancing Circular Economy practices through collaborative robotics.

3. Stakeholder engagement and impact

The success of the CROCEMS project has been significantly influenced by the active involvement of diverse stakeholders. These stakeholders, representing various sectors and expertise, played crucial roles throughout the project lifecycle:

Academic Institutions:

- Provided research expertise, ensuring the project's training materials were evidence-based and aligned with the latest advancements in collaborative robotics and Circular Economy practices.
- Facilitated dissemination by integrating project outcomes into academic curricula and outreach activities.

Manufacturing Companies:

- Acted as pilot users for the tools and methodologies developed in the project, providing real-world feedback on their applicability and effectiveness.
- Offered insights into the practical challenges and opportunities of integrating collaborative robotics into Circular Economy workflows.

Policymakers:

- Ensured the project aligned with regional, national and EU-level sustainability goals.
- Supported the dissemination of findings by promoting the project's outcomes in relevant regulatory and policy forums.

Technology Developers and Robotics Experts:

- Contributed to the technical design and feasibility analysis of collaborative robotic systems for sustainable manufacturing.
- Provided insights into future trends and advancements in robotics technologies.

General Public and Learners:

- Benefited from the open-access MOOC, gaining knowledge and skills for implementing collaborative robotics in sustainable practices.
- Participated in dissemination events, providing grassroots perspectives and increasing the project's reach.

The long-term impact of the CROCEMS project hinges on maintaining active stakeholder involvement beyond the funding period. The following strategies were identified to ensure sustained engagement:

Communication Channels:

- Continued use of the project website and social media platforms to share updates, new resources, and success stories.
- Regular newsletters highlighting the project's ongoing impact and opportunities for collaboration.

Collaborative Networks:

- Strengthening the Consortium's network by inviting new stakeholders to participate in future initiatives.
- Profiting the multiplier events and its participants to provide strategic input on the project's future developments.

Feedback Mechanisms:

- Implementing a feedback loop where stakeholders can share their experiences, challenges and suggestions for improvement regarding the project's resources.
- Hosting periodic virtual and in-person events to gather insights and share updates.

Capacity Building:

- Offering workshops, webinars and training sessions tailored to the specific needs of different stakeholder groups.
- Encouraging stakeholders to use and adapt the MOOC and other resources within their organizations and communities.

4. Sustainability strategies

To ensure the long-term success and impact of the CROCEMS project, a comprehensive set of strategies has been devised to maintain and enhance the project's outputs. These strategies encompass both immediate actions and a forward-looking vision to build on the project's achievements.

4.1. Approaches to maintain and enhance project outputs

- Integration into Existing Systems: The project's primary output, the MOOC, will be integrated into existing educational and training systems. Academic partners will work on incorporating the course content into their curricula, while industrial stakeholders will use the tools and resources for workforce training.
- Open Educational Resources (OER) Framework: The MOOC's OER license ensures that the materials remain freely available and can be updated or adapted for new contexts, enabling scalability and relevance over time.
- Regular Content Updates: To maintain the relevance of the training materials, periodic updates will be made to reflect advancements in collaborative robotics, changes in legislation and emerging Circular Economy practices.
- Knowledge Dissemination: Continued dissemination of project results will ensure broader awareness and uptake of the resources. This will involve presenting at conferences, publishing in academic and professional journals and leveraging social media and online platforms.
- Stakeholder Engagement: Regular communication with stakeholders through newsletters, webinars and networking events will help sustain interest and encourage the practical adoption of the project's outputs.

4.2. Specific Actions by Consortium Partners

Each Consortium partner has committed to specific actions to ensure the sustainability of the project:

DEUSTO:

- Incorporate the project's knowledge into final degree projects and other academic programs.
- Use the project's outcomes in future EU-funded initiatives, ensuring the methodologies and tools reach a broader audience.

CETEM:

- Host the MOOC on their e-learning platform (elearnia), making it accessible to their industry and academic networks.
- Continue promoting the project through social media campaigns, targeting manufacturing companies and policymakers.

ATMOTERM:

- Maintain the project's official website and social media channels for at least five years.
- Share project updates and success stories through their internal and external communication channels.

TUWIEN:

- Integrate the project's content into classroom activities and feature it on the university's website to reach students and researchers.
- Encourage students to apply the tools and methodologies in real-world projects and research.

HKA:

- Promote the project's outcomes on LinkedIn and other professional platforms.
- Utilize the resources in academic training and collaborative projects with industry partners.

4.3. Long-Term Visions and Goals

The sustainability strategy is underpinned by a clear long-term vision to expand the project's impact and establish CROCEMS as a benchmark in integrating collaborative robotics and Circular Economy practices:

- **Broader Adoption of Collaborative Robotics**: By providing accessible and practical resources, the project aims to enable companies across Europe to integrate collaborative robotics into their Circular Economy initiatives, thereby reducing waste, improving efficiency and fostering sustainability.
- **Development of New Initiatives:** The Consortium will seek funding for follow-up projects, such as Erasmus+ or Horizon Europe, focusing on practical implementation, success stories and a step-by-step guide for companies.
- **Building a Legacy of Knowledge:** The materials, tools, and networks created by CROCEMS will serve as a foundation for future research, training and policy development. By continuously engaging stakeholders, the project can adapt and evolve to address new challenges and opportunities.

By implementing these strategies, the CROCEMS project can ensure that its outputs remain impactful, relevant, and widely utilized, creating a lasting legacy of innovation and sustainability.

5. Resource management

To ensure the long-term sustainability of the CROCEMS project, it is essential to address the required resources across three key domains:

Human Resources:

- Subject matter experts to update the MOOC content, ensuring it reflects the latest trends and regulations in collaborative robotics and the Circular Economy.
- Technical personnel to maintain and enhance the project's website and digital platforms.
- Communication professionals to manage stakeholder outreach, dissemination activities and social media campaigns.

Financial Resources:

- Funding for periodic updates to the course materials, such as video production, content creation and translation services.
- Budget for attending conferences, hosting webinars, and organizing workshops to promote project outcomes.
- Resources for applying for follow-up grants or funding opportunities to sustain and expand the project.

Technical Resources:

- Hosting infrastructure for the MOOC platform and project website.
- Tools and software for content creation, such as video editing and graphic design platforms.
- Communication tools for stakeholder engagement, including mailing lists, webinar software and social media management tools.

Each Consortium partner will play a specific role in managing the resources needed for sustainability:

- DEUSTO: Responsible for academic integration, ensuring that the project's materials are used in student projects and applied research initiatives.
- CETEM: Sharing resources through their own e-learning platform (Elernia), apart from promoting the implementation of robotics for Circular Economy practices in their companies.
- ATMOTERM: Maintaining the project website and social media presence, ensuring visibility and engagement, apart from overseeing the MOOC's technical hosting.
- TUWIEN: Providing academic oversight and integrating the project into university curricula and research initiatives.
- HKA: Promoting the project on professional platforms and supporting outreach to industry stakeholders.

6. Promotion and Dissemination

6.1. Strategies for ongoing promotion of project outcomes

Regular updates will be provided to stakeholders through newsletters, webinars, and reports to keep them informed about new developments and opportunities.

Efforts will focus on reaching new audiences, such as SMEs, industry leaders and policymakers, by highlighting the practical applications of collaborative robotics and Circular Economy practices.

Documenting and sharing real-world examples of how the project's tools have been implemented successfully will serve as a compelling promotion tool.

6.2. Planned events, conferences and media campaigns

Upcoming Events:

- Attendance at an event in June to present the project outcomes.
- Participation in industry-specific conferences to showcase the MOOC and related resources.
- Hosting webinars and workshops focused on the project's impact and applications.

Media Campaigns:

- Regular updates on social media platforms, including LinkedIn and X, highlighting new resources, testimonials and success stories.
- Promotion through press releases and articles in industry journals.

Use of Digital Platforms

- The website will remain the central hub for accessing the MOOC, updates, and news. ATMOTERM will ensure the website is regularly updated and functional.
- Posts will be shared at least monthly on social media platforms to maintain visibility and engagement.

In addition, the MOOC will be hosted on platforms such as Elernia, with potential integration into broader educational networks.

7. Monitoring and Evaluation

1. Metrics for Assessing Sustainability of Project Outcomes

- Number of participants enrolling in the MOOC and completing the course.
- Website traffic, social media interactions, and participation in webinars.
- Number of organizations or institutions adopting the tools and methodologies.
- Qualitative feedback from stakeholders, including testimonials and surveys.

2. Frequency and Methods of Evaluation

- Conducting annual evaluations to assess progress and impact.
- Collecting feedback from stakeholders every six months to ensure their needs and expectations are being met.
- Regular meetings (biannual) to discuss progress, share updates and address challenges.

3. Reporting Mechanisms

- A comprehensive report will be prepared every two years, summarizing the project's impact, updates, and stakeholder engagement activities.
- Partners will provide yearly updates on their specific contributions to sustainability activities.
- Highlights from sustainability activities will be shared with stakeholders and the public through newsletters, press releases and social media.

8. Conclusions

The sustainability of the CROCEMS project rests on a robust framework of strategies and commitments designed to ensure its outputs and outcomes continue to deliver value long after the formal conclusion of the project. Central to these efforts is the ongoing maintenance and enhancement of the project's core achievement—the MOOC on collaborative robotics and Circular Economy—which serves as a vital resource for education, training and industry application. This is supported by a collaborative effort among Consortium partners, each taking on specific roles to uphold the project's visibility, relevance and impact.

Key sustainability strategies include the regular updating of course materials to reflect the latest technological and regulatory advancements, active participation in industry and academic events to promote the project, and the use of digital platforms to disseminate knowledge to a broad audience. The partners' commitment to maintaining the project's website and social media channels for at least five years reflects a deep dedication to ensuring accessibility and engagement.

The long-term vision for the project extends beyond maintaining its existing achievements. By seeking new funding opportunities, developing follow-up projects, and engaging additional stakeholders, the CROCEMS project aims to expand its scope and deepen its impact. The proposed development of a step-by-step implementation guide and the documentation of practical case studies underscore this commitment to facilitating the broader adoption of collaborative robotics and Circular Economy practices.

In conclusion, the legacy of the CROCEMS project lies in its ability to serve as a catalyst for innovation, education, and sustainability in the manufacturing sector. Through continued collaboration, strategic planning, and stakeholder engagement, the project's outcomes will not only endure but evolve, creating lasting value for industry, academia, and society as a whole. This sustainability plan represents a roadmap for achieving this vision, ensuring that the CROCEMS project remains a cornerstone of progress in the years to come.