CROCEMS

COLLABORATIVE ROBOTICS FOR CIRCULAR ECONOMY IN MANUFACTURING SECTORS

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

Analysis on current needs for manufacturing sectors waste management

Content

1.Introduction

Effective waste management is essential to the future sustainability of manufacturing sectors. Across industries, companies are increasingly recognizing the value of Circular Economy practices that turn waste streams into resources, reduce environmental impact, and promote long-term resilience.

This report, Analysis on Current Needs for Manufacturing Sectors Waste Management, aims to provide an in-depth understanding of the existing needs and challenges within waste management in manufacturing by drawing on real-world success cases.

This report presents insights gathered through a detailed questionnaire distributed to a diverse group of stakeholders, primarily manufacturing companies, who are actively engaged in or interested in improving their waste management practices.

This report will explore the results of these analyses and discussions, providing a comprehensive overview of current needs in waste management for the manufacturing sector. By sharing these insights, we aim to foster the adoption of best practices and encourage more sustainable and circular approaches across the industry.

2. Analysis of results

2.1. Module 1 – collaborative robotics basics. modular design & behaviour (HKA/CETEM)

Table 1. Importance of the following concepts – M1

	Not important	Important	Very important	Strong
Robotics components		9	8	3
Automation technology and collaborative robots		1	10	9
Ability to read, understand and modify technical designs	3	4	6	6
Ability to quote different software is suitable for the robot cell's task	2	6	8	4

Table 2. Level to which each skill or competence is developed by training programmes for workers in your field - M1

	Not important	Important	Very important	Strong
Robotics components	2	6	8	3
Automation technology and collaborative robots	1	3	11	4
Ability to read, understand and modify technical designs	3	4	8	4
Ability to quote different software is suitable for the robot cell's task	3	6	8	2

Additional important concepts to consider:

- Programming & Electronics

- Benefits of implementing collaborative robots

- Electric components and electro-pneumatics

- Machine learning

- Economic (added) value of improved robotic processes

Table 3. Rank below the two most important concepts according to your opinion NOW – M1

	Most important	2nd Most important
Robotics components	4	4
Automation technology and collaborative robots	8	6
Ability to read, understand and modify technical designs	5	5
Ability to quote different software is suitable for the robot cell's task	1	4

Table 4. Rank below the two most important concepts according to your opinion IN THE FUTURE – M1

	Most important	2nd Most important
Robotics components	4	1
Automation technology and collaborative robots	5	6
Ability to read, understand and modify technical designs	5	7
Ability to quote different software is suitable for the robot cell's task	4	4

Identify jobs connected to this module in your company:

- Production, innovation department

- Software developer with robotics background

- Technician and R&D Project Development

- Project Development

- IT Responsible, COM (Chief Operational Manager)

- R&D Engineers (Collaborative Robotics)

- Engineering Department. Responsible for implementation, programming and maintenance.

2.2. Module 2 – Sustainability & Circular Economy in manufacturing sectors (ATMOTERM/CETEM)

Table 5. Importance of the following concepts – M2

	Not important	Important	Very important	Strong
Global standards for sustainability reporting		5	8	6
Environmental policy	1	5	6	6
Environmental management monitoring		4	5	10
Corporate social responsibility	1	2	7	9
Circular Economy processes and waste management processes		1	9	9

Table 6. Level to which each skill or competence is developed by training programmes for workers in your field- M2

	Not important	Important	Very important	Strong
Global standards for sustainability reporting	1	3	9	6
Environmental policy		7	7	5
Environmental management monitoring	1	5	5	8
Corporate social responsibility		5	4	10
Circular Economy processes and waste management processes		5	5	9

Additional important concepts to consider:

- Collaborative Robots on Circular Economy; uses and benefits

- Reverse logistics operations

- Health and care

- Sustainable development reporting

Table 7. Rank below the two most important concepts according to your opinion NOW – M2

	Most important	2nd Most important
Global standards for sustainability reporting	4	1
Environmental policy	1	1
Environmental management monitoring	1	6
Corporate social responsibility	3	5
Circular Economy processes and waste management processes	8	3

Table 8. Rank below the two most important concepts according to your opinion IN THE FUTURE – M2

	Most important	2nd Most important
Global standards for sustainability reporting	4	-
Environmental policy	1	1
Environmental management monitoring	3	6
Corporate social responsibility	2	7
Circular Economy processes and waste management processes	7	4

Identify jobs connected to this module in your company:

- Quality Department, Environmental Department

- Technician

- General Direction & Quality

- ESG Responsible

- Project Manager

- Sustainability Manager

2.3. Module 3 – Lean Robotics Methodology (HKA/TUWIEN)

Table 9. Importance of the following concepts – M3

	Not important	Important	Very important	Strong
Maintain control system for automate equipment		6	9	5
Monitor automated machines	1	5	10	4
Perform machine maintenance	1	4	10	5
Approve and adjust engineering design	1	9	10	

Table 10. Level to which each skill or competence is developed by training programmes for workers in your field- M3

	Not important	Important	Very important	Strong
Maintain control system for automate equipment	1	4	12	2
Monitor automated machines	2	4	11	3
Perform machine maintenance	2	5	9	4
Approve and adjust engineering design	2	7	10	1

Additional important concepts to consider:

- None

Table 11. Rank below the two most important concepts according to your opinion NOW – M3

	Most important	2nd Most important
Maintain control system for automate equipment	10	3
Monitor automated machines	3	5
Perform machine maintenance	4	7
Approve and adjust engineering design	2	4

Table 12. Rank below the two most important concepts according to your opinion IN THE FUTURE – M3

	Most important	2nd Most important
Maintain control system for automate equipment	8	4
Monitor automated machines	5	5
Perform machine maintenance	4	5
Approve and adjust engineering design	2	5

Identify jobs connected to this module in your company:

- Production, Innovation Department

- Head of Robotics Department

- Production Management

- COO (Chief Operational Officer)

- Researchers and consultants

2.4. Module 4 – Circular Business Models for waste management (DEUSTO/TUWIEN)

Table 13. Importance of the following concepts – M4

	Not important	Important	Very important	Strong
Concept of circular business models		3	7	9
Value creation mechanism in circular business model innovation		3	7	9
Circular Economy strategies		3	6	10

Table 14. Level to which each skill or competence is developed by training programmes for workers in your field- M4

	Not important	Important	Very important	Strong
Concept of circular business models	1	2	8	8
Value creation mechanism in circular business model innovation	1	2	9	7
Circular Economy strategies		3	10	6

Additional important concepts to consider:

- Cost Model of CE Approach

Table 15. Rank below the two most important concepts according to your opinion NOW – M4

	Most important	2nd Most important
Concept of circular business models	3	2
Value creation mechanism in circular business model innovation	7	4
Circular Economy strategies	6	11

Table 16. Rank below the two most important concepts according to your opinion IN THE FUTURE – M3

	Most important	2nd Most important
Concept of circular business models	4	2
Value creation mechanism in circular business model innovation	7	5
Circular Economy strategies	5	9

Identify jobs connected to this module in your company:

- Quality Department, Environmental Department

- General Direction

- CEO, CFO

- Researchers and consultants

Module 5 – Circular strategy mapping & value networks for waste management (DEUSTO/TUWIEN)

Table 17. Importance of the following concepts – M5

	Not important	Important	Very important	Strong
Characteristics of Waste		6	9	4
Business management principles		2	10	7

Table 18. Level to which each skill or competence is developed by training programmes for workers in your field- M5

	Not important	Important	Very important	Strong
Characteristics of Waste	1	6	8	4
Business management principles		4	10	5

Additional important concepts to consider:

- None

Table 19. Rank below the two most important concepts according to your opinion NOW – M5

	Most important	2nd Most important
Characteristics of Waste	1	14
Business management principles	14	2

Table 20. Rank below the two most important concepts according to your opinion IN THE FUTURE – M3

	Most important	2nd Most important
Characteristics of Waste	1	15
Business management principles	15	1

Identify jobs connected to this module in your company:

- Marketing and Business Department

- Researchers and consultants

Module 6 – Product development cycle & ecodesign (CETEM/TUWIEN)

Table 21. Importance of the following concepts – M6

	Not important	Important	Very important	Strong
Socio-economic trends in the sector		7	8	5
Market research		4	7	9
Product life cycle	1	3	9	7
Product comprehension		5	12	3

Table 22. Level to which each skill or competence is developed by training programmes for workers in your field- M6

	Not important	Important	Very important	Strong
Socio-economic trends in the sector	1	5	7	7
Market research	1	6	7	7
Product life cycle	1	4	8	7
Product comprehension		8	8	4

Additional important concepts to consider:

- Case studies with useful examples

Table 23. Rank below the two most important concepts according to your opinion NOW – M6

	Most important	2nd Most important
Socio-economic trends in the sector	4	4
Market research	6	6
Product life cycle	6	6
Product comprehension	3	2

Table 24. Rank below the two most important concepts according to your opinion IN THE FUTURE – M3

	Most important	2nd Most important
Socio-economic trends in the sector	4	4
Market research	6	6
Product life cycle	6	6
Product comprehension	3	2

Identify jobs connected to this module in your company:

- Quality department, Environmental Department

- Researchers and consultants

3. Conclusions

3.1. Module 1

The results for M1 showed at first stage that skills related to technical design and different **software's** were not the most important. Then, we could see at the second stage that these points were ranked as Most Important skills (Technical Design, 5) and second most important skill (Different **software's**, 4, as well as Robotics components, 4). In this sense, we could ensure that all learning outcomes are of great relevance for this M1.

3.2. Module 2

According to the first stage results, environmental policy and CSR were the only two rated as 'Non important'. Then, in the second stage that some respondents suggested these as the most important learning outcomes, and as CSR got 5 points while environmental policy just one. On the other side the importance of the concept of environmental policy and CSR were rated from the majority as very important or strong (12 votes responsible 16 votes). In this sense, we consider that having basic environmental policy and CSR knowledge would be a great resource for the learners.

3.3. Module 3

For this M3 we are pretty sure that all Learning Outcomes are of great relevance. As we could see, all outcomes have had one 'Non important' vote, while all of them also have points for 'Most Important' (Maintain control systems) and '2nd Most Important' (Triple draw which shows the level of relevance and equality).

3.4. Module 4

Module 4 has very relevant outcomes concerning Circular Economy and Business Models Innovation. In this sense, the most important outcomes now were considered value creation mechanisms and circular economy strategies, which highlights the interest from the wide public to know in-depth how to start performing circular business models.

This module's items have the highest scores from the importance perspective. Points 2 and 3 have been considered of great importance both today and in the future. Point one has a lower score but it should not be ruled out because it sets the basis for the other points. It should be stressed that both points are related to practical issues. Point four custom, in particular, cost model of CE approach, can be clearly connected to module 2, point five.

3.5. Module 5

For M5, the analysis is not complex. We have a clear definition that business management principles are the most important outcomes while characteristics of waste are the second one. This shows great

interest in how to start performing circular models rather than to know their waste characteristics. The explanation could be that companies know about their waste, but they do not know how to manage to extract value from it.

Point two receives the highest score but point 1 is clearly connected to it and we consider that to characterize waste is a previous step to define business management principles.

3.6. Module 6

M6 shows that Market research and Product life cycle are both the most and second most relevant learning outcomes for this Module. In this sense, market research could enable companies to access to better materials or renewal materials even recycled materials for performing industrial symbiosis. Then, concerning the product life cycle it will help to ensure sustainability by providing a longer life cycle and design proper to disassembly and recycle the product when necessary.