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GREEN-R – DEVELOPMENT OF GREEN ROADS MANAGEMENT SKILLS

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The project GREEN-R – Development of Greenway Management Skills, supported by the Erasmus+ programme, aims to strengthen green skills and promote sustainable practices in road infrastructure construction. It addresses the growing need for environmentally responsible approaches, particularly in resource management, material recycling, waste reduction, and energy efficiency.

As part of the project, professional training sessions were organized in BITEM, LENDI GROUP, ESKAVATORI MK, and BV INZENERING, involving engineers, technical staff, machinery operators, and company representatives engaged in infrastructure construction and maintenance.

The interactive, practice-oriented sessions enabled participants to exchange experiences, discuss practical challenges, and explore sustainable infrastructure solutions. Particular emphasis was placed on recycling and reusing road construction materials, construction waste management, resource efficiency, and modern sustainable engineering technologies.

The project emphasized the importance of continuous professional education and practical skills in modernizing the construction sector and aligning it with European environmental standards. Participants recognized green practices as both an environmental responsibility and an opportunity to improve efficiency, reduce costs, and enhance competitiveness.

Keywords: green roads, Erasmus+ project, training, sustainable engineering



1. INTRODUCTION

In recent years, environmental protection, climate change, and sustainable development have become increasingly important topics within the construction and infrastructure sectors. Road construction and maintenance activities require large amounts of materials, energy, machinery, and fuel, while at the same time generating significant quantities of construction waste and environmental impact. Because of this, modern European policies increasingly emphasize sustainable infrastructure development, circular economy principles, recycling of construction materials, and efficient resource management.

The growing need for environmentally responsible construction practices requires not only modern technologies, but also new professional competencies and practical skills among engineers, technical staff, and construction companies. Continuous education and exchange of experience are therefore essential for improving sustainability within the infrastructure sector.

2. PROJECT ACTIVITIES

Within this context, the project GREEN-R – Development of Greenway Management Skills, supported through the Erasmus+ programme, aims to strengthen green skills and promote sustainable engineering practices in road infrastructure and construction [1]. The project focuses on practical education, professional cooperation, and development of competencies related to modern environmental standards and sustainable infrastructure management [2].

As part of the project activities, several professional trainings and workshops were successfully organized in the companies BITEM, LENDI GROUP, ESKAVATORI MK, and BV INZENERING. The trainings involved engineers, technical staff, machinery operators, and company representatives directly engaged in infrastructure construction and maintenance activities.

The educational sessions were organized as interactive workshops that encouraged discussions, exchange of experiences, and analysis of practical examples from everyday engineering practice. Participants discussed real challenges related to sustainable construction, environmental protection, and implementation of modern engineering approaches within local conditions.



Figure 1. Training session in company BITEM, Skopje

Particular attention was devoted to recycling and reuse of materials in road construction. Modern engineering practices increasingly rely on recycled asphalt, reuse of aggregates, and rational management of construction materials as important elements of sustainable infrastructure development. Participants discussed the environmental and economic benefits of recycling processes, as well as the challenges associated with introducing such practices into the domestic construction sector.

Construction waste management was another important topic addressed during the trainings. Discussions focused on methods for waste reduction, material separation, storage, transportation, and reuse, together with the importance of integrating waste management principles already during project planning and organization. Participants emphasized that proper resource management can significantly improve operational efficiency, reduce costs, and minimize environmental impact [3] [4].



Figure 2. Training session in company LENDI GROUP, Skopje

The project also explored topics related to energy efficiency, optimization of construction processes, and better construction site organization. Participants discussed how modern technologies, digital tools, and improved operational planning can contribute to reducing unnecessary fuel and energy consumption while improving the overall efficiency of infrastructure works.

One of the key values of the GREEN-R project is its contribution to professional education and human capital development. Continuous improvement of professional knowledge and practical competencies is becoming increasingly important due to rapid technological and regulatory changes within the engineering sector. Through the project activities, participants gained access to modern concepts, practical approaches, and European experiences that can support future modernization of the infrastructure sector [5].



Figure 3. Training session in company ESKAVATORI MK, Skopje

The participating companies demonstrated strong interest in adopting sustainable and environmentally responsible practices within their operations. The project activities confirmed that awareness regarding environmental protection and sustainable resource management is steadily increasing among professionals within the construction industry. Participants recognized that green engineering practices are becoming increasingly important not only because of environmental obligations, but also because they contribute to improved competitiveness and long-term sustainability of companies.



Figure 4. Training session in company BV INZENERING, Bitola

An important aspect of the project is its contribution to regional cooperation and professional networking. GREEN-R creates opportunities for exchange of knowledge, experiences, and good practices among engineers, experts, and companies from

different professional environments. Such cooperation supports gradual alignment with European standards and promotes long-term development of sustainable infrastructure practices [5] [6].

The project demonstrates that sustainable transformation within the construction sector requires continuous education, cooperation, innovation, and gradual integration of environmental principles into everyday engineering practice. By combining professional training, practical implementation, and exchange of experience, GREEN-R contributes to the development of a more modern, efficient, and environmentally responsible construction sector.



Figure 5. Visit of company CESTING in Croatia

At a time when climate change, environmental protection, and rational resource management are becoming global priorities, initiatives such as GREEN-R represent an important contribution not only to the engineering profession and participating companies, but also to society as a whole and future generations.



Figure 6. Visit of Recycling Yard in Gjakovo, Croatia

3. ANALYSIS OF THE RESULTS FROM THE QUESTIONNAIRES CONDUCTED WITHIN THE PROJECT

3.1. INTRODUCTION

Within the framework of the Erasmus+ project GREEN-R, educational workshops were organized and implemented in four companies operating in the construction sector in the Republic of North Macedonia. The workshops were focused on improving the knowledge and practical skills of employees in the areas of sustainable waste management, circular economy, recycling, and reduction of negative environmental impacts.

The trainings were carried out in the companies BITEM, LENDI GROUP, ESKAVATORI MK, and BV INZENERING. Participants were actively involved through discussions, practical examples, and presentations related to modern European practices for green construction and sustainable construction waste management.

In order to evaluate the effectiveness of the implemented activities, questionnaires were distributed to participants after the completion of the workshops. The purpose of the survey was to provide a realistic insight into the participants' level of satisfaction, the relevance of the presented topics, the clarity of the presentations, and the potential application of the acquired knowledge in everyday work.

In addition, the analysis represents an important part of the activities foreseen in the project application, particularly regarding the monitoring of training results, identification of strengths and weaknesses in current practices, and assessment of the long-term effects of the training on reducing CO₂ emissions and promoting the principles of circular economy.

3.2. METHODOLOGY

The analysis was prepared on the basis of data collected from questionnaires completed by participants attending the workshops. The questionnaires were anonymous in order to allow participants to express their opinions and attitudes freely and objectively.

A total of 55 valid questionnaires were processed within the analysis. A quantitative approach was used for data processing, including statistical analysis of responses and calculation of average scores, percentage distributions, and evaluation frequencies.

The evaluation was conducted using a scale from 1 to 5, where:

- 1 represented a very low level of satisfaction or usefulness,
- 5 represented a very high level of satisfaction or usefulness.

In addition to general questions related to the quality of the workshops, individual thematic modules were also analysed, including:

- waste management,
- waste selection and sorting,
- waste transportation and storage,
- recycling and reuse,
- waste prevention and reduction,
- environmental and health protection.

The results were analysed in order to identify key trends, the level of acceptance of the training content by participants, and potential areas where additional training and improvements may be required.

3.3. ANALYSIS OF RESULTS

Overall Satisfaction with the Workshops

The results of the questionnaires indicate an exceptionally high level of satisfaction with the implemented workshops. The average overall workshop score was 4.93 out of a maximum of 5.00, indicating a very positive perception among participants.

It is particularly significant that all respondents provided scores of 4 or 5, without any negative evaluations. Such results indicate that the workshop content was well accepted and that participants recognized its practical value.

During the workshops, a high level of participant engagement was observed, especially during discussions related to real-life situations from construction sites, waste management practices, and opportunities for reusing construction materials.

Relevance of the Content

One of the most important indicators in this type of training is the relevance of the topics to the practical work of participants. The average score for content relevance was 4.55.

This result demonstrates that the majority of participants considered the topics directly applicable to their daily work. Special interest was shown in topics related to:

- waste sorting,

- recycling of construction materials,
- reduction of unnecessary waste,
- environmental protection,
- practical measures for sustainable construction.

Discussions with participants revealed that some workers had previously lacked formal education in the field of circular economy, but after the workshops they demonstrated increased interest in applying such practices.

Clarity and Quality of Presentations

The clarity of the presentations received an average score of 4.95, representing one of the highest results in the entire analysis.

This indicates that the lectures were structured in a clear and practical manner, adapted to the profile of the participants. The use of real examples from construction practice, field photographs, and concrete situations encountered in everyday work was particularly positively evaluated.

According to comments from several participants, the practical approach significantly contributed to a better understanding of the topics and easier connection between theoretical concepts and real working processes.

Usefulness and Applicability of the Materials

The average score for the usefulness and applicability of the materials was 4.85. The majority of participants stated that the materials could be directly applied in their everyday work.

Particularly positively evaluated were:

- practical examples,
- visual presentations,
- manuals and handbooks,
- concrete recommendations for waste handling,
- measures for reducing environmental impacts.

These results indicate that the training content did not remain only at a theoretical level but provided real practical value to participants.

Evaluation of Trainers

The trainers received an average score of 4.91, which represents an exceptionally high result.

Participants positively evaluated the communication skills of the trainers, their willingness to answer questions, and their ability to explain complex topics in a simple and understandable manner.

An especially important aspect was that the trainings were not conducted exclusively as traditional presentations, but rather as interactive workshops with active participant involvement.

From education to practical application

Contributing to the qualification of workers for a circular economy in the construction sector.

From knowledge gained during training and the use of materials to responsible conduct on the construction site.

Across all 4 construction companies supporting the project, workers reported a significant to very significant increase in knowledge—an overall increase of 59.62%.

Knowledge is being applied in daily work (88.46%).

Changes are visible in practice, most notably regarding procedures for environmental protection, health, and safety.

The training also influenced work organization: changes were introduced or proposed in 85.71% of cases, with a partial to significant impact on operational organization reported by 92.50%.

The primary obstacles to implementation are organizational: translating knowledge into practice requires time, support, and available resources.

Workers require practical and professional support—specifically, support tailored to concrete tasks and individual construction sites (on-site).

What the surveys collectively indicate: tracking waste quantities and material usage is essential for performance in environmental protection.

Conclusion from the analysis of training results: Moving toward lasting change

Workers report applying their knowledge and changing their daily work practices.

Lasting change requires support from the employer, clear explanations, precise tasks, and the monitoring of results.

Which practice will we standardize at the next construction site, and how will we monitor its performance.

3.3. ANALYSIS OF THEMATIC MODULES

Module: Introduction to Waste Management

This module received an average score of 4.77. Participants showed strong interest in the basic principles of modern waste management, especially regarding legal obligations and practical measures on construction sites.

Module: Waste Selection and Sorting

This module received a score of 4.74. Some participants pointed out that in practice there are limitations related to infrastructure and construction site organization; however, they still expressed interest in gradually introducing improved practices.

Module: Waste Transportation and Storage

The module received a score of 4.87. Participants particularly emphasized the importance of proper waste storage in order to reduce risks to the environment and workers' health.

Module: Recycling and Reuse

The topic of recycling and reuse received an average score of 4.79. During discussions, it was observed that the greatest interest existed in the reuse of construction materials and reduction of costs through more rational use of resources.

Module: Waste Prevention and Reduction

This module received a score of 4.74. Some participants stated that companies still do not have sufficiently developed internal procedures for waste minimization, although there is willingness to gradually introduce better practices.

Module: Environmental and Health Protection

With an average score of 4.89, this module was among the highest-rated topics. Participants demonstrated strong awareness of the need for improved environmental protection, as well as the connection between waste management, occupational safety, and health protection.

3.4. KEY TRENDS AND FINDINGS

The analysis of the results reveals several clearly identifiable trends.

First, there is evident demand for this type of education within the construction sector. A significant number of participants had previously not had the opportunity to systematically familiarize themselves with the principles of circular economy and modern waste management.

Second, the results show that a practical approach has a significantly greater impact than traditional theoretical lectures. Participants most positively evaluated topics connected to real examples from everyday work.

Third, an increased willingness among workers to implement more sustainable practices was observed, especially in the areas of waste sorting and material reuse.

On the other hand, the analysis also revealed certain limitations. Some participants believe that the practical implementation of certain measures also depends on company support, availability of equipment, and organization of work processes.

3.5. LONG-TERM EFFECTS AND KNOWLEDGE RETENTION

In accordance with the project activities foreseen within the Erasmus+ project, special attention was dedicated to the long-term effects of the implemented trainings.

Based on the obtained results and participant feedback, it can be concluded that the workshops have the potential to contribute to:

- increased awareness of sustainable waste management,
- gradual introduction of circular practices,
- reduction of waste quantities,
- improvement of waste sorting processes,
- reduction of negative environmental impacts,
- reduction of CO₂ emissions through more efficient resource use.

In addition, it was observed that some participants expressed interest in further education and additional practical training after completion of the workshops.

Such interest represents a positive indicator that the acquired knowledge did not remain

solely theoretical, but rather created a foundation for gradual changes in behaviour and working habits.

3.6. CONCLUSION

The results of the conducted analysis indicate that the implemented Erasmus+ workshops successfully achieved their primary objectives.

Participants demonstrated a high level of satisfaction with the quality of the workshops, the relevance of the topics, and the manner of presentation. Particularly significant is the fact that topics related to circular economy, waste management, and environmental protection were recognized as practically useful and applicable.

The analysis confirms the need for continuation of this type of education within the construction sector, especially in the context of European policies related to green transition, reduction of CO₂ emissions, and sustainable resource management.

Furthermore, the results indicate that such trainings can contribute not only to improving the individual knowledge of workers, but also to gradual changes in organizational practices within companies.

Based on the obtained results, it can be concluded that the project activities have the potential to create long-term positive effects towards the development of greener, more sustainable, and more efficient practices in the construction sector.

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