

A REVIEW OF CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT DIGITAL TOOLS

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Abstract

Construction and demolition industry is accountable for a large percentage of all the waste streams generated in Europe. Becoming a subject of international discussions and raising public awareness has led to increasing efforts to identify methods to achieve 'green' goals. This paper makes an overview of best practices and digital tools for the construction and demolition waste management in European counties which have proven themselves as leaders in the subject. The main challenges in front of Bulgaria to achieve a similar state are pointed out, together with the initial steps to be taken towards developing more optimized waste management processes.

Keywords: construction and demolition, waste management, digital tools, best practices

JEL: F60, O33, Y40

Introduction

In 2016, the EU introduced the new European Protocol on construction and demolition waste (CDW) Management, with the aim of providing guidance and recommendations to the Member States of the Union. The target groups of the document include all participants in construction processes such as construction and investment project management and CDW management companies, as well as reconstruction companies, manufacturers of construction materials, all bodies and organizations responsible for the treatment, transportation and recycling of CDW; state and local administrative bodies and institutions; bodies certifying the quality of buildings, facilities and infrastructure, as well as potential buyers of recycled materials created on the basis of CDW. At the same time, current trends dictated by the circular economy in the construction sector are increasingly focusing on the introduction and implementation of digital tools to facilitate connections between different actors, support rapid decision-making and simplify documentation related to CDW management (Enkvist, Klevnäs, 2018). In this way the cost reduction related to it, the protection of the natural resources

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and the reduction of the ecological footprint of construction are achieved. Such tools are the digital platforms, which cover the process of CDW management, or essential parts of this process. The goal of this article is to make a benchmarking analysis of existing digital tools that support the CDW management processes in European countries that have met or even exceeded the set targets for waste prevention, recycling and recovery, pointing out their strengths and proving the research thesis that digitalizing particular segments of the process is a more efficient and successful strategy compared to covering the whole process at once. In addition, an overview of the current state of the problem in Bulgaria is made and suggestions are drawn how the country can adopt some of the discussed best practices.

Methodology

To gather a sufficient data base to support the research thesis, the author has chosen to make a literature review – a method used to systematically collect and synthesize former research on the topic. The review of latest literature and theory is leveraged to continuously build upon the present knowledge and theoretical frameworks.

A private case of the literature review is the so-called best practices analyses, which the author has incorporated in their research methodology to support building and proving the research thesis (Bretschneider, Marc-Aurele, Wu, 2004). A number of European examples of digital tools focused on optimizing a specific part of the CDW management process are examined, presently supporting the efforts of those countries to meet and exceed the set material recovery targets on international basis.

Theoretical background

More and more industries are turning to digital transformation to achieve the so-called “green goals” related to the need to adhere to legal requirements, on the one hand, and to create positive impact for their business, on the other. The construction industry is facing multiple challenges related to its digital transformation initiatives. Recent study shows that besides the economic factors, the quality of building products and materials is crucial for the uptake of circular economy solutions (Wahlström, Bergmans, Teittinen, and others, 2020, p. 3). Wahlström, M., Bergmans, J. and Teittinen, T. raise the thesis, that traceability systems, BIM and materials passports can all support pre-demolition audits for identifying reusable and recyclable construction products. With regards to BIM, the authors suggest that its use provides new possibilities for the future, raising efficiency in construction processes, especially material handling and

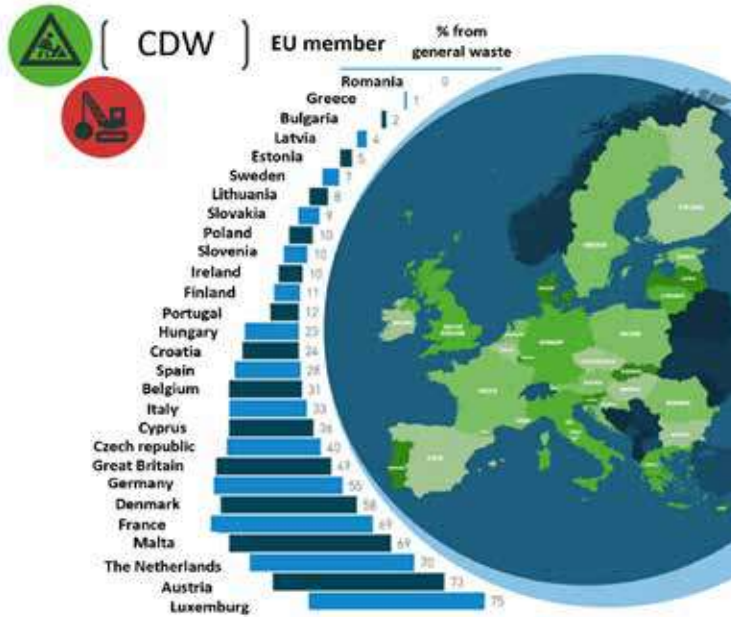
waste management (2020, p. 40). Further studies (Zima, Plebankiewicz and Wieczorek, 2020, p. 6) show that the BIM technology helps to reduce building material waste by making accurate measurements based on the BIM model, thus allowing to control the amount of material that should be used at a given stage of a construction project. With flexible purchasing and delivery management, waste unused materials can be reduced by both contractors and subcontractors.

Giorgi, S., Lavagna, M. and Campioli, A. (2018, p. 219) prescribe both legislative and non-legislative improvements for local authorities that could be initiated to achieve more optimized construction waste management processes. One of the non-legislative ones they point out is the use of mandatory building and material passports (for new construction): encouraging the use of Environmental Product Declaration (EPD) in order to facilitate the assessment of construction products and material sustainability, promoting recycled material. The authors state that one of the current problems is the high application of composite materials (not recyclable at end-of-life) used due to their high thermal performance in energy-efficient buildings or due to their recycled content. Such building and material passports can be related to BIM, or can exist on their own, depending on the level of digitalization of the construction sector in the country of interest.

EU Protocol for Construction and Demolition Waste Management

CDW accounts for one-third of all EU waste, resulting in the need to be managed and disposed of in the most rational, efficient, environmentally, and socially friendly way feasible (European Parliament, 2022). In the UK, for example, the building industry generates approximately 50% of landfill waste, or 70 million tons per year. However, an efficient CDW strategy still has constraints that limit recycling and reuse. Some of these difficulties include “lack of confidence in recycled materials” and confusion about how harmful their use would be for construction workers.

The image below (Figure 1) shows what percentage of the total amount of waste is generated by construction and demolition. It is interesting to note that the percentage in Bulgaria is only 2%, which puts the country at the bottom of the rankings (Dowd, 2019). The interpretation of this data may be ambiguous, and the initial explanation that it does not mean that a large amount of waste is not generated or that it is being recycled or reused should not be immediately accepted, because reality does not show this.



Source: AMCS Group

Figure 1: Percentage of CDW from the total amount of waste generated in all EU Member States

In general, the existing framework of the European Protocol on CDW management is related to recycling and now, reuse of waste is most often mentioned in non-mandatory regulations, such as EU programs, plans and documents at regional level related to circular economy. In 2011, the EU also launched “Resource Efficiency Roadmap for Europe”, which is directly linked to the EU’s 2020 strategy, and sets the following common targets for waste in the EU up to 2050 (European Commission, 2011; Pacheco-Torgal, Ding, Colangelo, Tuladhar, Koutamani, 2020):

- 65% of household waste to be recycled;
- 75% of packaging waste to be recycled;
- landfills should include not more than 10% of household waste;
- 70% of non-hazardous CDW to be recycled by 2020.

On this plan, Denmark, Sweden, Finland, Germany, and Austria have performed best so far, while Cyprus, Slovakia, Malta, Poland, and Lithuania have performed worst (Bulgaria is not mentioned but is supposed to be lower in the rankings – in the last 5 places since in quantitative terms, construction activities are not at the

same level as of those in larger economies). In December 2015, the European Commission published a strategy to build a circular economy in the EU titled “Closing the loop”. In this document, CDW is identified as a significant target to reduce the construction sector’s environmental impact, and reusing this waste is included in the proposed techniques (Interreg FCRBE, 2019). The document covers the establishment of standards for evaluating projects and waste in the pre-demolition phase, which led to the European Commission’s 2018 publication of “Guidelines for the waste audits before demolition and rehabilitation works of buildings” (Interreg FCRBE, 2019). Currently, EU member states can only voluntarily implement these guidelines (European Commission, 2018). The paper specifies that “the responsibility of the person in charge of the waste to familiarize themselves with the objects and substances to be disposed of, as well as the potential risk of contamination due to their harmful composition”. Therefore, it is proposed to make inventory of a building’s materials and elements before partial or complete demolition (European Commission, 2018). This independent auditor’s inventory combines field and documentary research to determine the type and amount of material remaining after demolition. Inert, non-inert, non-hazardous, and hazardous waste classifications should be used. In-depth classifications may include Eural codes and brief descriptions of each material/element (Interreg FCRBE, 2019).

The conclusion from reviewing the protocol is that the mentioned target for CDW does not offer a sustainable and sufficiently practical way to recover this waste, as the interpretation of the terms “waste” and “waste recovery” is sometimes ambiguous in the context in which it applies (Iacoboaia, Aldea, Petrescu, 2019). Also, the protocol does include a discussion and explanation of good practices in this regard, but not enough practical methods on how to implement and exploit these practices, especially in the context of different situations. It could serve as a guideline and the analysis of EU member states showcase that while some countries have successfully managed to put them in place and elaborate further in the context of digitalized CDW management, others still have a way to go.

Best CDW management practices in EU countries. Digital tools

As part of the EU’s ambition for a green future, sustainable economic and social development, the European Commission proposes a new action plan in 2020 to transform the European economy into a “circular” economy. The European Commission issued “Principles of Circular Economics in Building Design” in 2020. The article discusses the new circular design philosophy based on durability and adaptability, as well as reducing construction waste and managing it properly (European Commission, 2020). The document was developed using expert knowledge and opinions of CDW stakeholders. The

document aims to lower the construction industry's environmental impact and life-cycle expenses. The article's intended audience includes economic, political, legal, and technical organizations and individuals in the construction industry. The document is publicly available to all Member States and stakeholders, but it is only a recommendation, not a binding decision.

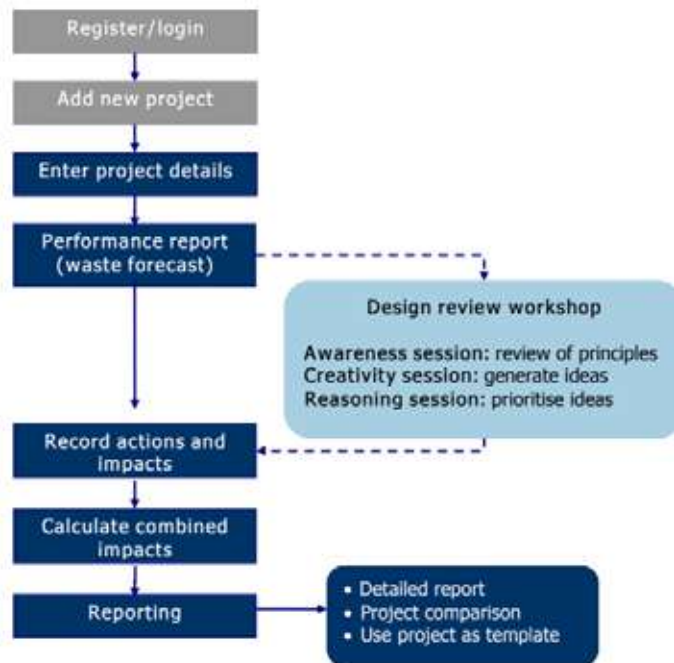
Several Western European countries have taken measures toward a long-term solution. Some EU member states can be given as examples of good practices in this process. Belgium has efficient CDW management, for example. Tracimat, a quality assurance system for recycling and treating selectively destroyed materials, is used throughout the Belgian construction sector. Tracimat permits selective destruction and offers certificates for tracked materials. This system of tracking and certification by an acknowledged non-governmental organization ensures resources will be judiciously collected, follows their flow from where they emerge to the entity that will process them, ensuring the quality of the end products. Tracing begins with identifying all materials to be released during deconstruction and demolition, then recording selective demolition data (Deloitte, 2015).

An independent, Tracimat-trained specialist prepares a pre-demolition audit. The audit covers hazardous and nonhazardous materials released during demolition, including kind, quantity, location, and selective destruction suggestions. This audit as part of the demolition construction tender gives the building owner information regarding hazardous streams that will be released, leading to a more accurate removal cost prediction (Deloitte, 2015).

Tracimat ensures to have the important data on the quantities, type and location of various materials that will be released soon during demolition activities by entering all materials from the inventory before the demolition into a database. The target is to have a complete overview of used materials in buildings, increasing the likelihood that those materials be reused in future construction projects or even in other industries (Deloitte, 2015).

Even though the UK is no longer part of the EU as of 01.01.2021, they have reported reaching a very good recycling rate of above 90%, thus meeting the targets of the European Directive applicable for them before that period. The UK construction industry recently published the "Routemap to Zero Avoidable Waste in Construction" – a strategy issued by Construction Leadership Council (CLC), Defra, BEIS, and the Green Construction Board (GCB) to improve waste management processes in the country and "increase efficiency, save carbon, and save cost". The Routemap aims to cut expenditures by 10% by 2030, eliminate CDW by 2040, and reduce soil to landfill by 75% by 2040. The approach is expected to incentivize public and private actors in the building industry to reduce CO₂ emissions and waste.

“Designing out Waste Tool for Buildings” (DoWT-B), supplied by the climate action NGO wrap, is one such digital tool. The tool focuses on early design phases, when waste can be avoided at source, and helps users find possibilities to minimize later waste. Inputting project parameters and design options into the tool generates a complete report with a waste forecast and waste prevention best practices.



Source: Wrap (2010).

Figure 2: Overview of the key steps of using the DoWT-B

Other solutions, like SmartWaste (delivered by Building Research Establishment Ltd.) are being provided by the private sector commercially, which can attract customers with enhanced functionality, such as the ability to record data in alignment with BREEAM requirements and provide reports to demonstrate where credits can be achieved, for integrated environmental management. It was found that many big companies have already incorporated such solutions as part of their construction waste management processes, with SmartWaste alone claiming to have diverted 14,055,214 tons of waste from landfill (data as of June 2022, BRE Ltd., 2022). The digitalization of other parts of the construction waste management process, such as contract management,

complex pricing, dispatching, route planning and optimization, is also covered by certain digital platforms. Such an example is the AMCS Platform by AMCS Group Ltd., an ERP solution specifically designed for the Waste Management and Recycling Sector.

These and a number of other countries offer good examples and practices for better utilization of CDW, which an East European country like Bulgaria can apply. The reasons why these practices are successful in those countries are due to the observance of the following principles:

- granting freedom of action and initiative to private organizations and companies in the introduction of new practices (of course, in harmony and joint action with the responsible administrative bodies and legislation).
- the digitalization of separate stages of the CDW management process.

Existing digital solutions in EU countries that have achieved high CDW recycling targets are diverse and targeted to a specific segment of the process and a specific problem: some are aimed at forecasting waste at the design stage, others – at contractors and recycling companies, others - at contractual relations and the use of recycled materials, etc. Many of the digital tools for CDW are also related to BIM and GIS, as well as building certification trends in the context of sustainable development (for example under the BREEAM system, in which the management of CDW has a significant share). These solutions don't try to digitize the complete process by centralizing and regulating it by a single entity, which would lead to inefficiencies and issues. Therefore, it is recommended for the business, that instead, independent enterprises or non-profit organizations should specialize in a given subject. This would create economically viable business models around these problems, leading to a more successful optimization of the overall process. Although this sounds like a more fragmented option than centralization in a single system, the author of this article believes that in private initiatives business models work better than the state bureaucratic approach, which can be cumbersome and imperfect.

CDW management in Bulgaria – overview

The building sector represents an important economic activity in Bulgaria. In Bulgaria, various public and private actors manage CDW. Bulgaria's National Waste Management Plan for 2021 – 2028 formulates general waste management action plans, points out challenges and objectives, and makes recommendations for reaching established targets and optimizing waste management practices using programs and action plans. CDW adopts the 'polluter pays' principle. According to the Waste Management Act, the party commissioning construction or demolition must prepare a CDW management strategy. In the new Waste Management Act (2021 – 2028), the national targets for reuse, recycling, and

other recovery of non-CDW materials, including backfilling activities utilizing waste to replace other resources, remained identical from the previous program period: “from 1 January 2020 and onward – as a minimum 70 per cent of the total weight of waste” (Deloitte, 2014).

The document furthermore explains that a national electronic system for the released, recycled, recovered and landfilled construction waste is not yet put into practice, thus lacking complete data on CDW (Deloitte, 2014).

Participants in the Bulgarian construction sector are aware of some of the main problems and shortcomings in the field of CDW management, but at the same time do not have appropriate tools to deal with these problems and:

- They rarely use recycled materials in their projects due to the high price of these materials, which in turn shows that there is a lack of competitiveness in this market and retailers offering recycled CDW are few in number.
- They do not find information about the quality and benefits of recycled CDW.
- They believe that the legislation in its current form leads to problems with the interpretation of terminology, as well as the roles and responsibilities of the various participants in the governance process.

So far small steps have been taken to introduce innovative waste management solutions in Bulgaria, such as public registers with the EEA (Executive Environment Agency), including Register of persons holding documents for performing waste activities. Another example is Bulgaria’s participation in the international project S.W.A.N. (a digital Solid Waste reuse platform for Balkan) in partnership with other Balkan countries – Greece, Albania and Cyprus. The project aims to develop a digital solution that will play the role of a facilitator in the development of sustainable business models in the Balkan region, providing detailed mapping of sources of solid waste and potential receivers, as well as an assessment of the economic feasibility of all symbiotic schemes in the region.

Conclusion

Observations made during this research show that the EU countries that meet and even exceed the set targets and goals for CDW stream, implying the executions of circular economy principles, already rely on complex digital solution, covering different aspects of the CDW management process. Bulgaria itself has taken first steps towards digitization of some areas of the process and is further making progress in its efforts to reduce the total amount of waste generated by construction and repair works, especially in the case of public procurement projects, but studies show that more ambitious and decisive steps are needed to tackle this problem in the long run. The so-called bottom-up approach would be the most appropriate one, namely allowing private initiatives to attempt to solve

the problem, which in turn would lead to a chain reaction and increase pressure on the government to change the legislative framework, as well as to establish relevant and working regulatory and control mechanisms.

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