

# DEVELOPMENT OF WASTE MANAGEMENT PLANNING FOR THE CONSTRUCTION SECTOR CONSIDERING CYCLE ECONOMY

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Waste is an area regulated by a large number of legislations at both international and European Union level. Building waste was recognized as a special waste stream in the 1990s and identified as a priority waste stream. This recognition for this waste stream was necessary because of the large proportion of this waste in proportion to the total amount of waste, but also the huge potential for reuse and recycling contained. The term used in Cyprus Legislation is Excavation, Construction and Demolition Waste, which includes waste from the construction and civil engineering works, and of natural and technological disasters. The aforementioned waste is also produced by the demolition of existing buildings as well as from renovation and maintenance work. They contain various ingredients - hazardous or not, and problems arise when their management doesn't take into account the protection of the environment and public health. This paper deals with the management of Construction and Demolition Waste considering the Cycle economy, with a special focus on Cyprus, as well as the analysis of the existing strategy and policy on the national level. On this basis, solutions are proposed, and recommendations are noted where needed as to revising, updating and strengthening the existing policy.

*Keywords:* SWOT analysis, Construction waste management, Strategy, Sustainable development, European Union.

## 1 INTRODUCTION

The construction industry plays a dominant role today, both nationally and globally, due to population growth in urban and other areas. The projects that are being constructed have a huge technical, economic, cultural, and environmental interest, which is constantly increasing (Bossink and Brouwers 1996, Hongping 2017). But as a result of the above, it has also been perceived as a major contributor to environment degradation (Menegaki and Damigos 2018). Its negative impact includes among others, land depletion, energy consumption, gas and dust emission, noise pollution, consumption of non – renewable nature resources and waste generation (Weisheng and Hongping 2011, Wu *et al.* 2014).

As stated above, as a result of construction and technical works, huge amounts of waste are produced each year, with studies showing that about 10% of the volume of materials needed to build a technical project will end up as waste (Tam and Tam 2006). In Europe and globally, construction and demolition waste (CDW) accounts for about 25 – 40 % of total waste (Yuan and

Shen 2010, Rodriguez-Roblez *et al.* 2014, Jin *et al.* 2019). In addition, it is estimated that about 35% of the quantities of CDW produced are directed to landfills (Menegaki and Damigos 2018).

CDW refers to a mixture of materials generated from excavation, construction, and demolition activities, as well as from renovation and building maintenance work (Liatas 2011, Poulikakos *et al.* 2016). Moreover, CDW includes materials that may be generated by natural disasters (Menegaki and Damigos 2018). CDW consist of different sources such as asphalt, concrete, wood, ferrous and non-ferrous metals, gypsum, and glass (Osmani 2012). The Waste Framework Directive (WFD) 2008/98/EC explicitly defines the term waste as any substance or object which the holder discards or intends or is required to discard. CDW is further specified in the Directive in reference to the European List of Waste (Chapter 17) (Saez *et al.* 2011). The definition results from the nature of the waste - type of material. However, construction waste management practices and outcomes are different between countries members of the EU and globally.

Furthermore, Sustainable Development is designated to be the development that meets the basic needs of the community and satisfies their expectations for a better life without compromising the ability of future generations, as stated by the World Commission on Environment and Development. With the increasing recognition of sustainable development and the cycle economy as a new value, waste from the construction sector has received attention around the world.

During past years a notable amount of construction debris has been listed as a result of large-scale construction works in Cyprus. Although construction waste management practices and outcomes are different between countries, members of EU and globally (Akhtar and Sarmah 2018), compared to many advanced European Countries like United Kingdom, Sweden, Germany and Spain, limited studies have been completed regarding the investigation of CDW management problems in Cyprus.

This work, by applying a Strength, Weakness, Opportunity, and Threat (SWOT) analysis among others, targets in understanding the present situation of Construction and Demolition Waste Management (CDWM) in Cyprus. Data supporting the analysis were extracted from multiple sources, including state reports, construction and demolition waste management guidelines and laws, literature review, expert group meetings, and questionnaires analysis. The present offers an opportunity through which major stakeholders involved can understand the strengths, weaknesses (internal conditions) and opportunities and threats (external conditions) of CDWM in Cyprus. The strategies presented based on the SWOT analysis could be useful for the Cyprus authorities and stakeholders to develop and promote their future CDWM plan at the strategic level. Recommendations also, to upgrade the existing plan, in order to achieve less waste generation and more waste recovery in the construction industry are provided for the Republic of Cyprus and they can also be transferred to other countries.

## **2 RESEARCH METHODOLOGY**

As stated above, the tool used for understanding and evaluating the present situation of CDWM in Cyprus is a SWOT analysis (Nicolaou and Evangelinos 2010). It's clearly demonstrated that SWOT analysis approach is one of the best tools for examining problems from a strategic point of view (Nicolaou and Evangelinos 2010, Hongping 2013, Furcas and Balletto 2014); thus it is proposed and adopted in this study.

The research methodology flow used, consist of four parts. In the first part, the current situation of CDWM in Cyprus is introduced and briefly analyzed. Information and data were collected through a detailed examination of government reports, and specific studies, websites,

regulations and by consulting the government's departmental staff. Next, the research questions are developed in order to diagnose the strength, weaknesses, opportunities, and strengths of CDWM in Cyprus. Third, the SWOT analysis is implemented according to the research questions. The answers are abstracted based and through analyzing and evaluating data given by the stakeholders, which includes various government departments' officers, CDWM organizations technical advisors and executive directors, and CDW treatment facilities technical directors. Finally, considering the results of the analysis, measures to improve the current state are suggested.

## **2.1 Current Situation in Cyprus**

The nomothetic basis for the CDWM in Cyprus is defined by the Waste Law of 2011(N.185(I) 2011), which transposes the EU WFD into the local legislation. All provisions in the WFD related to CDW are valid for Cyprus and compose the legal basis of CDWM. Other regulations and instructions governing environmental permits and urban planning regulations are also relevant to the specific stream. According to the law, actors in the construction industry are obliged to organize CDW management systems. CDW produced in the constructions is transported to CDW treatment facilities where it is sorted and processed into final recycled materials. Anything that is not reclaimed as usable material can be used as a landfill and/or backfilling (Deloitte 2015). Based on Eurostat, in 2006, 2008, 2010 and 2012, 298,000,431,000, 1068 and 965,000 CDW produced in Cyprus respectively. In addition, in 2012, almost 59% of the specific waste stream was recovered and 38 % send to landfills (Akhtar and Sarmah 2018). It is emphasized that the above quantities do not include excavation waste and the waste produced in the occupied part of Cyprus.

## **2.2 Defining the Research Questions**

The objective of this step was to provide information on the following questions:

- Q1 The strengths of Cyprus when implementing CDWM: Identify the major internal strengths of the Cyprus CDWM plan, e.g., find the benefits of implementing the specific waste management plan – strategy.
- Q2 The weaknesses when Cyprus performs CDWM: The questionees were asked to express their options on matters referring to what could be improved, what is not performed properly, define some obstacles and what is needed to be changed.
- Q3 The opportunities that Cyprus can exploit to develop CDWM: examining the opportunities that may arise externally when adopting the Cyprus CDWM plan. However, this question requires more information, e.g., financial and product challenges.
- Q4 Threats that Cyprus might face when developing CDWM: The threads that might arise when adopting waste management practices are analyzed. Specifically, the information involves future regulations or additional financial funds.

## **3 RESULTS**

The outcomes of the SWOT analysis lists in Table 1, the top strengths, weaknesses, opportunities and strengths of CDWM.

Table 1. Outcomes of SWOT analysis on CDWM in Cyprus.

Internal conditions	External conditions
<p><b>Strengths</b>                      Full harmonization of Cypriot legislation with the corresponding European: comprehensive legislative framework. Existence of an extensive chapter for the management of CDW in Cyprus strategic waste management plan.                      Strong perception of the government about promoting CWM practices.                      Existence of CDW treatment facilities. Innovation development.                      Organization of CDW management systems (obliged by the legislation) by the actors in the construction sector.                      Creation of new working positions.</p>	<p><b>Opportunities</b>                      Extensive support from government and industry associations.                      Participation of the Public and private sector in research programs.                      Enhancing entrepreneurship and creation of new jobs.                      Geographic location.</p>
<p><b>Weaknesses</b>                      Lack of standards and specifications for recycled materials.                      Low percentage of on – site waste sorting.                      Poor construction waste reduction.                      Non – participation of all active contractors in waste management systems.                      State failure to implement green contracts.                      Conflict of laws.                      Reduced number of construction and demolition waste treatment facilities and low territorial network.                      Mentality in the construction sector.</p>	<p><b>Threats</b>                      Immature market for construction waste recycling.                      Insufficient funds for supporting CDWM research.                      Low charge for landfilling.                      The reconstruction of the occupied area of Cyprus and especially of Famagusta in case of reunification.</p>

#### 4 RECOMMENDATIONS

The recommendations proposed for the review and strengthening of the existing policy of the CDWM in Cyprus are shown below. Their purpose, based on the study findings, is to improve and strengthen the existing policy and to trigger the development and modernization of the CDWM in Cyprus, in order for the preparation of the construction industry to a zero-waste production industry, a close loop system, according to cycle economy philosophy. The specific recommendations are listed below:

- CDWM is a complex system, which involves many actors and governmental departments. Based on this, the coordination can be obtained by establishing a mechanism to determine the responsibility of the people involved.
- Creation of a network of CDWM consultants and raising awareness through training, seminars and promotion activities. After training, the consultants will be able to answer questions and solve specific problems relating to CDWM to the actors involved in the construction sector. Contractors training and education could also be mandatory for bidding on projects. The potential results of this recommendation are to supply information and propose solutions for those companies – individuals, in order to raise the environmental standards and promote cycle economy philosophy and benefits in the construction industry.
- Implementing a program for the use of recycled material. To have a successful program, the government could create standards and technical specifications for the produced products resulting from the CDWM. Furthermore, adoption of regulations requiring the

mandatory use of recycled products in public and private construction projects and on-site waste sorting, as well as mandatory participation of all active contractors in waste management systems for bidding on projects. In that the case, the difficulty that exists today for the availability of recycled materials will be gradually reduced.

- Cost benefit analysis in terms of profit and loss for the contractor in addition to a minimum required % of allowable waste can be used for the reduction of construction waste.
- To improve the implementation of green contracts, the authorities should assess the current situation and set ambitious goals, which will be achieved and then revised every three years.
- There are Laws that are conflicting on waste management. For example, the Law on Waste and the Law on Mines and Quarries conflict regarding the reuse of excavated materials. An expert committee shall be formed and appointed by the authorities that will be responsible for identifying and clarifying these issues.
- Establishing a CDW research center with the collaboration of local universities. Given that there are various CDW problems to be studied and solved, the establishment of a research center is suggested focusing mainly on CDW recycling and management. Assessment of the current situation on the treatment facilities using feasibilities studies and if needed proceed firstly with upgrading of existing facilities and then planning and construction of new facilities. This should be part of a strategic plan for waste management.
- Establishing a CDWM framework that will include preventive maintenance for systems so as to minimize the need for repair and therefore extent their lifespan. To obtain an effective preventive maintenance strategy that considers various available options, optimization techniques can be implemented (Tantele *et al.* 2006, Tantele and Onoufriou 2009).

## 5 CONCLUSIONS

Construction and demolition waste is a major component of the solid waste stream. As a result, CDWM has been a worldwide issue, which attracts increasing attention. Through the accomplishment of a SWOT analysis, the internal and external conditions of CDWM, as well as the present status quo in Cyprus, were presented. Through the research methodology, and by answering the four research questions, the major findings can be summarized as follows:

CDWM in Cyprus faces challenges, weaknesses, and threads, as previously summarized. However, a compendious legislative framework for the specific waste stream is in place. Regardless of its weaknesses and threads, the strategic plan for the CDWM in Cyprus presents strengths and opportunities that, if used properly, will be a first step toward the course of its reorganization.

The recommendations proposed could be the starting point for a more functional and modernized policy regarding the CDWM in Cyprus, with a view of protecting the environment and natural resources, within the terms governing the Sustainable Development. By improving and shielding the current status quo and strategy, the foundations will be laid for the transformation of the construction industry into a zero-waste production industry.

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