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Enhancing Sustainability Measures Through Policy Incentives for a Better Circular Economy of Construction Waste

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Abstract:

Purpose: *Since there is a shortage of land in Malta due to the island's small size, effective land management is essential, especially in connection to waste practices given that the building industry is expanding and producing tons of waste every day. Several Waste Management plans have been established and made mandatory in the country in order to help the nation meet more of the goals outlined by the European Commission. In order to help the sector meet its goals, the European Commission (EC) has established the Waste Framework Directive for all of its Member States, which mandates that by 2020, each Member State must have at least 70% of non-hazardous construction and demolition waste (C&D) for the recovery of the said waste stream and as classified under Chapter 17 of the European Waste Catalogue. Despite the fact that less waste is being disposed of in designated landfills and more C&D waste is being used as backfill in abandoned quarries, urgent waste management is still necessary. Solutions to aid the growing construction sector in becoming greener and moving toward a more circular economy are required.*
Design/Methodology/Approach: *To have a systematic grasp of the phenomenon under inquiry, qualitative data was gathered. Researchers conducted semi-structured interviews to elicit important informants' perspectives on the subject matter, from an institutional standpoint.*
Findings: *Findings demonstrated that local architects are using innovative methods such as the substitution of glass for cement and sand, in concrete mixes, despite eliciting concerns about cleanliness and color. Further studies revealed how architects are leading in reconstituted stone techniques, and that reconstituted stone is now enhancing sustainability practices through better circular economy of construction waste, following the acquisition of a patent for its production.*
Practical applications/originality: *The study supports the contention that in order to implement incentives for recycling construction processes, authorities must push for the preservation of existing structures as a resource for permit processing; reduced permit fees provided that the existing structures are included and integrated into the proposed development; and the imposition of an environmental tax in addition to the current price of the naturally extracted material in an effort to deter developers and contractors.*

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1. Introduction

Malta, a relatively small island, exhibits a very high population density, given its limited geographical area of about 316 square kilometers. The availability of land is constrained, necessitating the implementation of effective land management strategies. Hence, it is crucial for the government and relevant authorities to implement measures that minimize trash generation and efficiently manage the treatment of various waste types.

This approach will successfully mitigate the adverse effects on the local ecosystem and the environment at large. The quantity of construction and demolition (C&D) trash generated on a yearly basis constitutes around 80% of the overall garbage deposited in landfills, as documented. The waste stream under consideration is widely recognized as being both substantial in weight and volume.

The objective of this study is to analyse existing regulations pertaining to waste management in the construction sector and identify potential strategies that can enhance the industry's efficiency by implementing a regulatory framework. The overarching aim is to analyse potential tactics for improving the management of waste produced by excavation, construction, and demolition operations. This will involve examining the existing challenges within the industry and exploring both immediate and long-term solutions.

2. Literature Review

Malta is currently confronted with a growing issue pertaining to the diminishing availability of land designated for garbage disposal. Consequently, it is imperative to prioritize the implementation of waste management strategies and the reduction of waste generation at its origin. The waste produced in Malta is typically disposed of at either the Maghtab landfill or utilized for backfilling purposes in abandoned quarries.

Construction and Demolition waste (C&D) encompasses a wide range of materials, such as concrete, gypsum, metal, glass, asbestos, globigerina limestone offcuts, and various others. The construction and demolition (C&D) waste stream primarily originates from activities such as building demolition, site excavation, repairs of deteriorated structures, modifications to existing buildings, construction of new

structures, road construction and maintenance, and urban area upkeep (Government of Malta, 2010).

According to available data from 2003, over 80% of the aggregate Construction and Demolition (C&D) debris produced was disposed of at the Maghtab landfill site. Starting in 2003, the practice of redirecting clean inert trash from landfills to previously abandoned or privately owned quarries for the purpose of backfilling was implemented. Data on the quantity of construction and demolition (C&D) waste measured in metric tonnes diverted from the Maghtab landfill site for the period from 2003 to 2013 (WasteServ Ltd., 2015) has been collated through time.

Since Malta's admittance to the European Union (EU) in 2004, the European Commission (EC) has established targets for member states with the aim of mitigating the quantity of trash that enters its end-of-life cycle. The Government of Malta endeavours to mitigate waste generation and achieve specified targets through the utilization of various reports and corresponding action plans.

The European Commission (EC) has also conducted an investigation of the construction industry in Malta and has formulated precise objectives for waste management. This is due to the significant potential for recycling and recovering the garbage that is currently being produced.

Construction and demolition waste refers to waste that falls under the waste codes listed in Chapter 17 of the Annex to Commission Decision 2000/532/EC (commonly known as the List of Wastes). This definition excludes hazardous waste and naturally occurring material as specified in Category 17 05 04. According to the European Commission (2018).

WasteServ Limited is in charge of the waste management in the island, and any users that would like to make use of the landfill are charged, which varies according to the nature of the waste and on the weight being disposed. The weight is calculated by weighing the vehicle on entry and weighing again the vehicle before exiting the landfill and the difference between the two weights is equal to the amount of waste being disposed of.

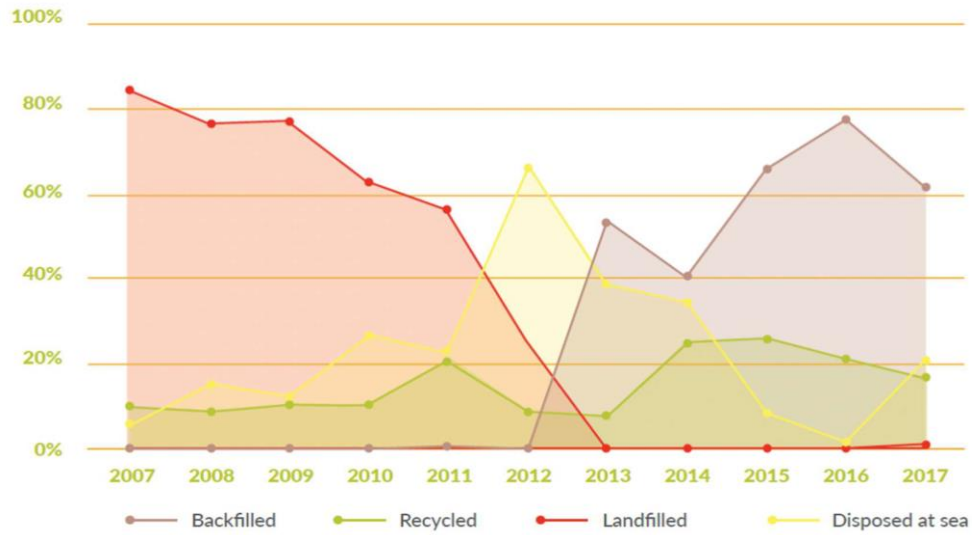
In order to limit the number of users that enter any landfill, WasteServ only allows licensed and certified contractors to access the landfills and at a rate of €3.79 per tonne. In 2012, the total amount of 1,085,571 tonnes of C&D waste was recorded which consisted in 758 tonnes of hazardous waste whilst 1,084,813 of non-hazardous waste (Eurostat Office, 2015).

The European Waste Catalogue (EWC) defines in detail all types of waste, and the C&D waste can be derived and categorized as excavation works (topsoil, softstone, hardstone and more); road works (asphalt, concrete, stone blocks, gravel and more);

waste from the building industry (mixed mineral waste, iron, wood, glass, aluminium, textiles, gypsum, ceramics, plastics and more).

According to the EU reports, the C&D stream is one of the highest rate from all the Member States, and there exist a high potential for recycling and re-use of this waste. The components and material generated there from has a high resource value, also taking into consideration the derived aggregate from C&D waste from the roads and other infrastructural works (European Commission Board, 2015).

Figure 1. *Construction and Demolition Waste Strategy for Malta 2020-2025*



Source: *Own study.*

3. Guidelines and Standards

In order to ensure quality, technical standards or codes of practice are produced to outline the minimal requirements. These standards serve as a means of notification and reference. While the nation frequently draws inspiration from the standards adopted in the United Kingdom, it is imperative for the country to develop its own customized standards, supported by robust legal frameworks (Government of Malta, 2010). These standards are intended specifically for Malta, resulting in some variation in standards across the Member States of the European Union.

Nevertheless, it is imperative that the fundamental principles underlying these standards and benchmarks remain consistent throughout all nations. The observed disparity can be attributed to variations in architectural design and construction materials utilized in different countries. The Malta Standards Authority is responsible for the official introduction of these standards in Malta (Government of Malta, 2010).

These technical standards are being developed and implemented in respect to the management of waste which potentially put the public health and the workers at risk, landfilling and end-of-life cycle, management of waste within the public sector as a result of the efforts imposed by the green leaders (Government of Malta, 2010).

4. Waste Framework Directive (2000/60/EC)

The consideration of groundwater and compliance with paragraph 3.4 of the Landfill Directive are important factors when determining the locations and materials to be disposed of. The preservation of groundwater holds significant importance, particularly within our nation, due to its restricted availability and finite quantity.

5. Construction and Demolition Waste Strategy for Malta 2021–2030

The Environmental Resources Authority (ERA), as the primary governing body overseeing the management of resources in Malta, has produced a customized report specifically tailored to the country's context. This report is derived from the one published by the EC, focusing on the concerns over the significant amount of construction and demolition (C&D) waste created in the Maltese Islands, as well as the considerable potential for reusing and recycling such material.

Furthermore, it has been observed that the management of waste generated by construction and demolition activities has primarily involved diverting it to backfilling sites (ERA Editors, 2021). The aim locally is to support and facilitate the country's transition towards a more circular economy, thereby enhancing environmental protection and ultimately safeguarding human health (Bao Z, 2020).

Moreover, this economic system would result in an augmentation in both the quality and amount of construction and demolition (C&D) waste. Frameworks have been designed to facilitate citizens in fostering a cultural and behavioral transformation in their mindset (ERA Editors, 2021). The European Union has established a new directive that outlines a specific objective for Malta, which is to achieve a 70% recovery rate from construction and demolition (C&D) waste.

This information was disclosed by the National Audit Office in February 2021. In this manner, waste is not perceived as an underutilised substance to be discarded, but rather as a valuable resource with potential for various applications.

Based on the documentation and suggestions pertaining to the recycling and disposal of construction and demolition (C&D) waste, a notable disparity is observed in the annual quantities. The observed discrepancy arose as a consequence of the prohibition on depositing inert trash at Maghtab landfill, leading to the utilization of abandoned quarries for the purpose of backfilling and disposing of this inert waste.

Moreover, according to the European Commission (2008) there was a decline observed between the years 2004 and 2005, which might be attributed to the rise in the inert waste tax imposed by governmental establishments.

6. Methodology

A series of semi-structured interviews were conducted, involving a sample of individuals who possess significant experience in strategic positions within the construction industry. The study involved interviewing participants who were local architects actively engaged in the profession and with extensive industrial experience.

These individuals met a set of pre-defined criteria in demonstrating a high level of knowledge in on-site operations and had significant experience in policy development. Purposive sampling was use which is a commonly employed method in qualitative research for the purpose of identifying and selecting examples that possess a high degree of information richness in relation to the topic under investigation. Interviewees selected also included seasoned officers from the national regulatory body tasked with the formulation of waste management strategies and the preservation of environmental integrity.

The officer was directly involved in the formulation of the preceding Waste Management Plans for the Maltese Islands; thus, the study could benefit from the input of stakeholders directly accountable for creation and implementation of a waste strategy in Malta. The interviews were methodically documented and later transcribed, following data saturation attained. The process of qualitative data analysis was performed manually (Yuan and Shen, 2011).

7. Research Results and Discussion

All participants exhibited knowledge regarding the various studies being conducted with the objective of mitigating C&D waste. They recognised that in order to transition towards a circular economy, it is necessary to provide incentives that can foster greater interest in recycling and to establish a regulatory body or authority under governmental view to categorise the diverse contractors functioning within the construction sector.

The findings indicate that one approach to address the issue is to raise the prices of extracted natural resources to discourage and diminish reliance on these materials. This is particularly relevant in the context of construction projects, where tenders are predominantly evaluated based on cost considerations.

This would incentivise contractors to explore alternative materials within the construction sector that possess comparable quality to naturally mined resources, while minimizing adverse environmental consequences. The initial phases of the

project should prioritise the consideration of deconstruction as the preferable alternative to the demolition of structures.

Moreover, it would be more logical to pursue the integration of the current structures rather than resorting to demolition or deconstruction methods to minimize the development of waste. Participants agreed that in order for such measures to be implemented successfully, a political commitment and intervention is required.

The findings indicate that the preservation of preexisting structures has the potential to yield architecturally compelling designs that combine contemporary elements with the distinctive features of historical buildings. An alternative approach that may be employed involves retrofitting the preexisting structure to fulfill the intended requirements.

By opting to retain structures, the potential for more efficient material management is facilitated, as the focus is mostly on making adjustments rather than complete demolition. Consequently, this approach leads to a reduction in waste materials generated during the construction process. The inadequate execution of construction and demolition (C&D) waste management necessitates a thorough analysis to ascertain potential improvements for forthcoming outcomes.

The implementation of suggestions outlined in this study should prioritize the safeguarding of the environment and human health, while simultaneously minimizing the overall environmental footprint. The issue of pollution being emitted into the atmosphere, land, and water is of paramount importance.

According to the National Authority responsible for waste management, the control and management of construction and demolition (C&D) waste involves considering land reclamation as a potential solution to address the problem. Furthermore, it recognizes the significance of many research endeavors, including investigations into the socio-economic and technical environmental consequences linked to the sector and its waste streams (Zhang *et al.,* 2010).

Since 2013, Malta has achieved its targets with respect to the directives as set out by the European Commission. The observed achievement of the targets established by the European Commission can be primarily attributable to the practice of backfilling C & D material that has been carried out in recent years.

Sixty percent of the waste generated is being diverted to old disused quarries for backfilling, however, only 30% of the C&D waste is being recycled. The investigation into reconstituted stone has the potential to facilitate the substitution of naturally harvested materials with an equivalent stone. The Authority also perceives this as a promising opportunity to enhance recycling efforts and minimize the quantity of garbage utilized for backfilling purposes.

The National Authority perceives this occasion as a means to instigate a cultural transformation and foster a transition towards a circular economy within the nation and its society. Furthermore, this phenomenon has the potential to induce a shift in societal behavior, wherein the waste produced is perceived as distinct and prompts an increased inclination towards recycling practices.

Development fees due to Planning Authority during submission of development applications proposing retrofitting or the existing structures as being included as part of the development, should be incentivised through a percentage reduction of the permit fee that are to be omitted or given as a guarantee. This can be released after the works have been done and once this can be confirmed, the guarantee or part of the permit fee can be re-given to the applicant/architect.

However, it is important to emphasize that in addition to the aforementioned alternatives, another viable approach involves dismantling the current frameworks. The initial step in the deconstruction process involves the extraction of hazardous elements from any given structure.

Additionally, it is necessary to conduct a thorough evaluation and categorization of the materials in order to effectively distinguish and segregate the various types of materials. It can be concluded that to reap success from the above option working successfully, separation at source is crucial and of utmost importance. Hence, this shows that although different options on how to instigate a circular economy and conservation can be implemented, all actions need to be taken so as to get the best outcome.

Moreover, incentives can be implemented to attract more stakeholders. This would attract new investors and new stakeholders within the industry. Such incentives are to instigate new stakeholders to embark on the concept of the circular economy. This is a concept that to be implemented every level of the construction industry needs to play its part. Therefore, incentives are to be considered, at all levels and therefore these incentives are to be spread across the industry.

Another potential measure that could be implemented is the augmentation of environmental fees. In addition to waste disposal, environmental fees may also be levied on demolition activities. Furthermore, these incentives can be utilized to encourage the implementation of additional programs that seek to convert additional structures (Hao *et al.*, 2020).

Therefore, the imposition of penalties for the demolition of buildings can generate funds that can be allocated towards incentivizing projects aimed at conservation and the preservation of existing structures, as well as their integration into projected developments. Furthermore, it was observed that certain participants expressed a greater inclination towards reducing reliance on naturally sourced materials and instead utilizing recycled materials (Chen *et al.*, 2021).

This shift in preference may be attributed to the anticipated increase in price for naturally extracted materials, while the cost of recycled materials is expected to be maintained at a minimum through a subsidized program. It is anticipated that this will facilitate a rise in the utilization of recycled materials, as the majority of tenders in the construction business, as Contractor 1 has explicitly said, are categorised based on cost.

Architect 2 stated that the natural stone is getting scarcer and therefore a solution is needed and pointed out that the first step in the process is separation of all the materials that are being either demolished or deconstructed. Architect 2 also stated that presently there is nothing concrete ongoing to control, manage or enforce except the method of transportation.

Various presentations, discussions, and initiatives have been brought to attention. However, there has been limited implementation. The lack of a cohesive and efficient approach among experts and technical staff in the construction industry towards adopting a greener and more circular economy has been highlighted by architects. According to the participants, Architect 2 has also expressed a preference for land reclamation as a potential solution.

The architect further emphasized that any potential decision about land reclamation should only be made following a comprehensive scientific investigation and thorough examination of all pertinent research. Architect 2 provided an example from Holland, demonstrating that the cost of natural aggregate is greater than that of recycled aggregate. One potential approach to address the rising cost of recycled materials is to implement either subsidies or tax increases on natural materials.

The Architect also mentioned an example pertaining to the inclusion of glass material into concrete mixes as a potential option for reducing the quantities of cement and sand. This example was based on a study conducted several years ago. However, concerns over cleanliness and even coloration have emerged. However, the research demonstrated that the glass has the potential to be ground into a fine powder that can serve as a substitute for sand, not exclusively in concrete applications.

A recent investigation was conducted to investigate the creation of reconstituted stone. The formation of this stone occurred through the amalgamation of rock, stone, concrete, and marble slurry. The components were combined and placed into a specialized mold designed specifically for the research investigation. Subsequently, the stone was employed in the construction of a diminutive chamber situated inside the confines of the University grounds.

The Architect has determined that a portion of this project is currently undergoing the process of commercialization. Architect 2 concurs with the consensus among

participants that the introduction and implementation of such measures in the building industry necessitate political action to facilitate the cultural shift towards a circular economy.

8. Conclusions, Proposals and Recommendations

Based on the aforementioned data and the possibilities articulated by the participants, it may be inferred that there are multiple viable recommendations for implementation. One potential approach to enhance interest in recycling and hence raise recycling rates is the implementation of incentives for the recycling process. Moreover, these incentives are expected to facilitate the cost aspect of the process, thereby supporting contractors who are diligently striving to adopt more environmentally sustainable practices and transition towards a circular economy.

Furthermore, in an effort to incentivise greater utilisation of recycled materials, individuals who employ such materials for their projects are eligible to earn a subsidy upon verification of the materials' usage. This might be directed towards developers who employ contractors that are striving to engage with the concept of circular economy. This approach offers potential benefits for several stakeholders within the building industry, including contractors, developers, and recycling processing companies.

Consequently, it may be of interest for these entities to actively engage in a transformative shift towards a circular economy, as they stand to gain from the incentives and subsidies available at all levels of the construction hierarchy. This may also enhance interest, since, as indicated by the participants, tenders and contracts are given based on cost, thus emphasising the role of price motivation. Another alternative that could potentially be of interest is the implementation of a system that enables guarantees to be provided for permission payments.

This approach enables developers to decrease waste generation by preserving the existing structures to the greatest extent possible. By using this approach, the current streetscape would remain intelligible as the contrast between the existing and intended construction would become more apparent. This would facilitate the process of development while also preserving and safeguarding the existing structures (Liu and wang, 2020).

Applications that are seeking authorisation for projected construction can potentially get a subsidised permit fee, provided that the existing structures are included and integrated into the proposed development. Nevertheless, it is worth noting that the fees that have been subsidised have the potential to be reimbursed to the applicant subsequent to the successful completion of the project, contingent upon the certification that the intended development has been executed in accordance with the initial proposal.

An alternative approach entails the implementation of an environmental tax in addition to the prevailing cost of the natively sourced substance. Consequently, the cost per unit of the extracted material would see an escalation.

The inclusion of this charge may be intended to discourage developers and contractors from engaging in the extraction of materials.

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