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Summary

Unsustainable use of materials in the construction industry is a big problem in society today. The cost of resources required to source raw minerals, produce and transport products around the globe is heavy. And in many cases products have a far shorter time in use than necessary and end up causing waste problems. This report seeks to highlight issues with current practice in society and will deliver suggested solutions as to how improvements can be made in this area. The main solution presented is based on electronic products such as lighting, wiring and other components and suggests a novel approach to reduce waste using automated categorisation and cataloguing. This is in order to reuse and extend the lifecycle of products thus reducing the demand for resources in production as well as minimizing waste.

These solutions containing innovative ICT and how it can play a role in tackling sustainability issues are discussed and evaluated.

1 Introduction

Sustainability, environmental impact and climate change have become prominent global issues in recent years. Awareness of these and other connected issues has grown and there is great concern over society-wide patterns of resource consumption, CO2 emissions, global warming, toxic waste pollution and a variety of other problems. A helpful visualisation of these issues and the alarming impact society is having is the ‘hockey stick’ graphs as presented by Elina (Eriksson, KTH 2022). These provide a clear visualisation of the impact modern society has and is having on the world and the urgent need for change and to take measures toward sustainable practices.

In response to these urgent issues, several studies have been undertaken and reports written. The Brundtland report, written in 1987(Development, W. 2022) helpfully defines the concept of sustainable development as “...development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”, whilst general it provides a helpful foundation to build upon. A more specific and applied set of goals have since been defined known as the 17 goals or ‘SDGs’ (UN 2022). These 17 goals are directed to significant and defined areas such as sustainable cities and communities and clean water and sanitation.

This report including problems and solutions discussed have been formed on the basis of these definitions and goals. Specifically, problems with production and waste as a result of unsustainable electronic consumption patterns in the construction industry, which can be directly linked to goals: 6- clean water, 9-Industry, innovation and infrastructure, 11-Sustainable cities and communities, 12-Responsible consumption and production, as well as, indirectly to others. As such, solutions which can bring a sustainable change towards these goals are highly valuable.

2 Aim

This report aims to discuss and raise awareness of issues connected with the current patterns of consumption of electronic components in the construction industry. Subsequently, solutions will be presented that aim to make significant and sustainable improvements in this area. Key goals of the report concerning these solutions are that they would: make a significant sustainable improvement; be practical, realistic and implementable; be as simple as possible; be user friendly and as such interesting for potential customers.

Solutions will subsequently be analysed and evaluated using recognised sustainability frameworks. Closing thoughts including a critique of the report itself will be presented to the reader, as well as, suggestions for further research and other points to ponder.

3 Description & Analysis

3.1 Direct Impact

Current patterns of material consumption within the construction and building industry are not sustainable and result in various problematic and direct impacts. Firstly, mineral resources including the metals needed to produce various electrical components are finite resources (NAP 2022) and there are concerns over the fact the resources needed to support modern society cannot last. One initiative seeking to highlight and raise awareness around this consumption, as well as, the CO2 emissions which can be linked with mineral extraction, production and transport of goods is the Earth overshoot day campaign (Earth Overshoot Day, 2022). Change is urgently needed and action must be taken to reduce patterns of consumption.

Another major issue is the waste produced as a result of consumption and the ways in which this waste is handled. Electronic waste related to electronic components used in construction could fall into 2 categories: basic installation components such as wire, bulbs, simple structured lights and fixings, as well as, more complex components containing microchips, regulatory computers and other combinations of small parts. While issues remain, basic parts, especially wire, can be recycled effectively (Wire Recycling,2022) and it's a profitable process, giving inherent motivation. But that which can be considered complex falls into the category of e-waste over which major concerns have been raised (The guardian 2014). Franky, this consequence alone should be enough to motivate major change, the inhumane living conditions and reinforcement of a dysfunctional socio-economic system caused by western consumption are embarrassing. Furthermore, the pollution it causes to land and water means that it is directly in conflict with multiple UN FDG goals and must be urgently addressed.

3.2 Indirect Impact and system perspective

On top of the direct impacts of the issue, a multitude of indirect problems can be linked to electronic consumption, the following gives a brief overview of some of the more significant of these:

As previously mentioned in relation to E-waste handling (The guardian 2014) there are major social issues linked with the consumption of electrical goods. In order to move towards a fair and sustainable world for all to live in, in connection with UN goals (UN, 2022) 1, 4, 8, 10, these social issues require a huge amount of attention. Helping children to attend school, ensuring safe working conditions, preventing structures that lead to poverty and reducing inequality are among the key tasks. Reducing waste and its flow of it from wealthier to poorer countries and communities is urgently needed.

From a system perspective, a large problem with modern society's patterns of consumption is that many products have extremely short lifecycles despite being produced and capable of much longer usage. A significant method to lowering both resource consumption and waste production is to extend product lifespans (EAB 2022). If users can be more conscientious in how they purchase and use products, if producers can design with longevity, quality and repairability in mind and if systems such as the solutions proposed in this report (and many others) can be realised then a huge difference can be made. This requires a willingness from society to change its values as well as for investment to be made by governments and major organisations to look at the problem from a system overview perspective and make creative strategic solutions to tackle the problems described.

One final indirect problem which cannot be ignored is co2 emissions in connection with producing and transporting construction products. The construction industry is responsible for a significant part of global annual emissions (Architecture 2030, 2022) and as such all efforts to minimize these emissions must be seen as valid. Even if electrical components only make up a fraction of these total figures, when multiplied globally it adds up to huge amounts of noxious emissions and should be improved as much as possible. Since the problem is the sum of many parts, the solution to global emissions is also to tackle the issue by breaking it down into small contributing factors and solve each of these as effectively as possible, including issues raised here.

System effects of the proposed solution can be evaluated using Hilty's model designed for analysing the sustainability of ICT solutions (Hilty, KTH 2022). Key positives are the reduction of negative impacts through enabling users to prolong the lifecycle of products and minimize waste. As such the system is optimized through substitution- using existing used products which mitigates the need to produce new ones and at the same time reduces waste. The intended result would also include structural impacts in altered patterns of production and consumption. The particular solution has no real rebound issues nor induction or dependence since it is largely an optimization of current practices. One critique could be that it is too trivial/particular and the problem be solved more creatively/aggressively. This, I would happily concede and agree that further research and work in the area is urgently required and a multitude of solutions needed.

4 ICT solution

4.1 Solutions

The two solutions proposed are connected and the second can be seen as a method to improve the main idea proposed in this report.

The main solution (part 1) is to facilitate a circular use of electronic components in construction. This is to be achieved through effective deconstruction, categorization/cataloguing and storing of used components. The key focus here in order for this to be a viable solution is the ease of use for customers who would purchase such materials as well as keeping costs to a minimum. Similar to an urban mining solution presented by Tove (Malmqvist, KTH 2022), effective processing, transport and storage of materials is essential in order to maintain value to customers.

In this particular solution focusing on electronic components, there are accurate ways to categorize products since electrical equipment as standard has various metrics and standards such as power(watts), brightness(lumen), sizes, area of use (heat, light, installation, wiring, switchboard, regulation….). This means that products can be effectively organised and labelled in a database and items easily searched and found. The same is true for how items can be physically stored.

In time, it is hoped that design and production could be influenced by solutions like this and that products be built to last. Several products may also be repaired where necessary or updated if, for example, modern energy-efficient parts such as led bulbs can be fitted in place of outdated technologies whilst the light casing and wiring may be intact and viable for reuse. This type of thinking already exists in various applications such as designer lighting and maintaining the architecture of cultural importance in historic buildings. As such one key aim here is to make such practices more mainstream in terms of product quality, availability of spare parts, ability to repair and update products. At the same time moving away from short term ‘use and throw’ mentality and seeing cost merely as a price tag and instead as several things related to a product(emissions, labour, resource sourcing etc). Another factor that could make a big impact in facilitating this type of solution would be if products were highly standardized. Standardization could vastly improve the ability to repair and reuse products, as well as, likely lead to better quality and longevity in products due to more refined design, especially if multiple brands were to develop products according to unified compatible standards.

Finer details which would need consideration in connection with this solution include: How to price products in order to be market competitive and valuable to customers, effective transport and storage depot’s in close proximity to cities, how to recycle products which are not reusable, how long to store items and many others. Lastly, there may even be viable alternatives of ownership in connection with a circular economy, solutions such as leasing or buy-back schemes may be implementable to help in this area of minimizing consumption and waste.

The second solution and addition to part 1, involves the handling and processing of products within such a solution. Namely, Artificial Intelligence(AI) might be used in the processing phase to streamline processing and reduce costs. The aim being, that AI could be used in a way that with basic imaging, products could be automatically

categorised, photographed ready for sale and even autonomously transported to the relevant storage location with minimal need for human intervention. The application of AI technology has rapidly grown in recent years from something seen as highly advanced and hi-tech to a relatively mainstream and widely used means of effectivization (InData Labs Blog 2021), making a solution such as this a realistic possibility. In areas such as this where cost and effectiveness are essential if the value is to be maintained it can be a key ingredient to the success of an idea where, without it, the same solution may be too time-consuming, costly and impractical to implement. It's worth noting that some human input and processing will always be required in this type of solution but if this can be minimized too, for instance, simply reviewing information about a product rather than having to handle and input large amounts of data then such a system can be extremely effective.

4.2 Solution analysis

The two-part solution detailed in section 4.1 has many strengths and at the same time, various issues/ challenges can be easily identified.

Having done a brief analysis using Hilty's model for evaluating ICT solutions in section 3.2 virtually only positive effects can come as a result of such a solution. If it fails then there is little to no sustainability-related cost and correspondingly, were it successful then both resources, waste and harmful emissions are minimized. It could also help avoid negative social issues abroad such as the issue connected with E-waste(section 3.1) and may even contribute to meaningful and healthy employment wherever implemented. The solution could play a role in shifting the way consumption is viewed and the options available to consumers (both private and organizational). It would also be a relatively easy solution to start, and at the same time, has huge options to scale up and affect whole industries, legislation and large organizations.

It is not without issues and various aspects of the solution can be critiqued. Whilst the database, categorization and simplicity of the basic idea are easy to implement, improvements such as using AI are far more complex. This may require lots of investment and resources to set up. There are also a number of potential issues which could arise, including (and not exhaustively):

- The condition of used products would need to be reviewed. This is very much a sliding scale judgement and difficult to perform autonomously
- handling in a cost-effective way may prove difficult and it may remain cheaper for the end-user to purchase new products. If so the solution becomes in many ways invalid and unlikely to be used.
- At the current time, there is a huge variety of products available. Choosing which products to stock would be difficult and need addressing. Limiting products would be critical otherwise storage becomes problematic and in the meantime standardization and industry changes in thinking are likely to take time leaving several question marks.
- The ability to repair and update is important and at the same time somewhat idealistic. A critical realist may say this is directly against business competitiveness and unlikely to take hold
- Several products may end up being demounted, transported processed, stored a long time to go unsold and end up being scrapped/recycled. This would be a

costly process for no gain aim must be taken account for in the whole system's effectiveness. If too many items follow such a path the solution is unviable.
- Several products are dramatically updated and it may be difficult for older products to remain relevant.

Some of these issues can be mitigated through good decision making in designing the system as well as in choosing which products are and aren't stocked. Nonetheless, there are huge challenges to making such a solution effective.

5 Reflection

This report has raised some major issues with patterns of the consumption of electrical products in the construction and building industry. Major issues have been identified and motivated including a number of direct and indirect impacts caused by current 'unsustainable' practices. Asides from the motivation given within this report, the issue was chosen based on recent experiences learning about ICT during my studies on the KTH IT engineering MSc program including the current course- sustainable development. Another key factor was my previous experience in working for 3 years as an electrician in Stockholm. During this employment, where large projects were carried out for various clients, I noted how much material was wasted, including often fully functioning and at times almost new components. This also plays a large role in why I, as both an engineer, as well as someone with pre-existing industry insight believe that the proposed solution has the possibility to be implemented successfully and that a market for such used items does exist especially for items of high value.

In my recent experiences including the sustainable development course, I have noted that ICT can be effectively applied to help make a difference within sustainability issues and it is an extremely important area where all that can be done, should be done. Furthermore, while it is noted that this solution may only make a small contribution to the issue, this and many other similar solutions can sum up to make a huge difference.

In relation to the issues raised in this report, it is hoped that further research will be performed in how to implement this type of solution and many other similar initiatives within the area of circular economy and lengthening product-lifecycles. It is also hoped that this type of research will lead to the adoption of more sustainable practices in society and to a shift in thinking and mindset in connection with the consumption of this and all other types of goods.

The aim of this report was to raise awareness of the issues described, as well as present some creative solutions which the author believes have the potential to make a difference. My hope is that it leaves the reader with a sense of the importance that changes must be made in our society with regards to consumption, that many creative solutions are needed to achieve a sustainable society and that technology can be applied effectively to help tackle the problems of our time. I hope it inspires thought, creativity and a hunger to work towards a healthy world for everyone now and for the future, locally and globally.

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