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Short Communication

Sustainability in Civil Engineering (Infrastructure)

Onkarr Singh[1] and Dr Brian Johnston[2]*

[1]*Onkarkitekt Limited. Wolverhampton, U.K. Wolverhampton University Alumni*

[2]*iBiotech Ltd, B1-B2 Guy Motors Industrial Estate, Park Lane, West Midlands, Wolverhampton, WV10 9QF, UK*

Corresponding author: Dr Brian Johnston, iBiotech Ltd, B1-B2 Guy Motors Industrial Estate, Park Lane, West Midlands, Wolverhampton, WV10 9QF, UK.

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This article is based on the main author's experience in the Architectural, Engineering and Construction (AEC) industry and education in Information Communication Technology (ICT), Computer Aided Design (CAD), Building Information Management (BIM) and Geospatial Information Systems (GIS) within AEC and the Built Environment (BE). The main author is also a digital construction engineer and specialist.'

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Introduction

Clean air, clean water, nutritional food, heating, and shelter from the harsh weather are vital for humanity [1], and in one way or another these necessities are provided through infrastructure, via pipelines, pylons, railways, motorways, tunnels, highways, bridges, and power plants. These interconnected networks are designed with the intention to connect land, sea, and air and to stand the test of time. It is the lifeblood of civilization, allowing resources to be transported via a global network, and are critical to our survival. Falkirk Wheel, Burj Khalifa, 3 Gorges Dam, and the Panama Canal (to name a few) are examples of great feats of engineering. To exist, engineers had to overcome many challenges, however some of these projects could inflict long-term damage on the environment only found years after completion. There are also many failures, and engineering disasters such as the Grenfell Tower (London) incident in 2017. Many of these issues were not foreseen at the time of construction, but they result in new methodologies and innovations, making future construction sites and building projects safer for the workforce, inhabitants, and users. This is where sustainable civil engineering needs to be considered and be factored into the full life cycle and end-of-life of a project, before building and after handover, and this can be achieved via the Building Information Management (BIM) Information Delivery Cycle.

The pressing issues in civil engineering for the United Kingdom (U.K.) vary from Natural Disasters such as flooding, [2] housing shortages [3], poverty [4], malnutrition [5], as well as deforestation, waste [6,7] and emissions. The 3 topics covered in this article are related specifically to Waste, Flooding and Housing. It is estimated that by 2050, the global population will rise to 9.7 billion [8] and that will result in the number of electronic devices and plastic products produced to also be multiplied, along with the demand for housing and food, plus the supply chains, the manufacturing and energy consumption involved.

The Issues

As we leave the 4rd Industrial Revolution and transition into the 5th, Technologically it is a marvelous time to be an engineer because of all the tools and software solutions, as well as the technological advancements, lessons learnt and data sets available to us. One issue is retrofitting technology into an outdated infrastructure which was designed specifically for the past Victorian and Edwardian era. It would be wiser to create new state of the art, fit for purpose infrastructure, rather than to retrofit to the old. We live on a planet with finite resources, and we should be planning for a future that depends more on hydroelectric, solar, and wind infrastructure than the current reliance on fossil fuels. We also fall short in working as close with nature as we can in cold and wet climates such as the U.K., where we have an abundance of land and soil and could build below ground rather than above. We have an abundance of light to tap into solar energy (as energy prices rise dramatically) and if we use Agricultural practises using passive solar principles and kinetic architecture, we can improve it further with buildings that adapt to the environmental conditions and where temperatures stay balanced annually. Globally there is an abundance of land in desert areas and sand in which could repurposed over 50 years via dessert greening [9]. Earth sheltering methods could be considered as normal practice for areas above the flood plain, and if done properly can reduce the dependency on electricity to light and heat dwelling spaces. Many towns in England will be affected by rising sea levels and flash floods and a new infrastructure plan for flood defenses and prevention needs to be considered.

Plastic & E-waste

It is believed that planned obsolescence is the root cause of contaminating the planet with unnecessary plastic and e-waste, due to under engineered products. Research suggests that recycling has not been successful [10] and rubbish is still largely exported [11,12] causing environmental problems, with plastic washing up on shores, creating garbage patches that float on the oceans, in waste heaps and land fill sites giving off harmful emissions, polluting the land and water supply. If we continue to create waste at the current rate and buy into planned obsolescence, it will pollute more water sources, oceans [13] and ecosystems, having a negative effect on our food supply [14-16]. With all that being said, more is being done to reduce waste leaving the United Kingdom and there have been positive steps with new legislation regarding waste export [17] and the Right to repair [18] to reduce e-waste, however the main concern should be no more virgin plastics entering the system until older plastics are repurposed.

Mitigation Measures

We believe in order to mitigate problems and to achieve green sustainable civil engineering projects, future infrastructure should be synergetic with nature and be optimized by principles of; earth sheltering, biomimicry, gentle architecture and passivhaus principles, which will revolutionize the landscapes and achieve a carbon neutral status. There is also scope for using man-made biounits that act as trees [19], absorbing harmful environmental gases and capturing carbon plus a scope for plastic eating microbes for breaking down waste [20-23]. There are initiatives to replant trees in deforestation areas and to repurpose and up-cycle waste [24, 25] and recycling centres and waste management should implement these standards. With the further assistance of Building information modelling (BIM) technologies [26], Geospatial information systems (GIS), the internet of things (IOT), quantum computing power and artificial intelligence, we can make better informed decisions using cloud solutions to bridge the gap of different metrics (including waste locations, categories of waste, microbe sites, deforested sites, sea levels, flood plains) allowing generative design variations and calculations to optimize site layouts and dictate where the best suited sites will be on the map (prioritizing based on the severity level of pollution). It will also calculate how much of that waste can be used within the purpose-built mega structures or be sent to be processed elsewhere within the wider waste resolution network. The parts and assemblies will be modular and parametrically designed, allowing parts of different systems to be interchangeable, repurposed, and recyclable once they come to the end of their life when they are no longer maintainable, allowing a circular economy and regenerative process.

Conclusion

This article highlighted the main engineering challenges that are faced globally with food, plastic and e-waste and how access to a plethora of data sets will enable mankind to achieve excellence and resolve design issues. Once we transition from the "throwaway culture" to the culture of "doing more with less", we can overcome the current limitations and remove bottlenecks in the global system to reach our goal of protecting life and ecosystems. Communication, Coordination, Cooperation and Collaboration will play a core part and be an enabler for Interoperability to tackle the current levels of pollution. In a digital age, it is an exciting time to be a Civil and Design Engineer, and it should serve as an incentive to find the root causes of the biggest offenders and to use the available tools in order to bridge science, technology, engineering, and data, to balance the global waste trade, reduce exports, and creating jobs locally.

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Conflict of Interest

No conflict of interest.

References

1. McLeod S (2007) Maslow's Hierarchy of Needs. [online] Simply Psychology.
2. Barques (2022) Flood prevention: is the UK prepared for the worst? [online] GeoSmart Information.

3. Shelter (2022) Social housing deficit. [online] Shelter England.

4. McRae I, Glover E, West water H (2022) UK poverty: the facts, effects and solutions in a cost-of-living crisis. [online] The Big Issue.

5. BDA (n.d.) Malnutrition. [online] www.bda.uk.com.

6. Trashed How the UK is Still Dumping Plastic Waste on the Rest of the World.

7. Parker L (2018) A Whopping 91 Percent of Plastic Isn't Recycled | National Geographic Society.

8. United Nations (2017) World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100.

9. (nd) Kubuqi a successful example of desert greening. [online] www.chinadaily.com.cn.

10. The Guardian (2022) England fails to reach household waste recycling target.

11. letsrecycle.com. (n.d.) UK plastic waste exports 'fell by 13%' in 2021.

12. Laville S (2021) UK under growing pressure to ban all exports of plastic waste. [online] the Guardian.

13. Parker D (2013) Garbage Patches | OR&R's Marine Debris Program. [online] Noaa.gov.

14. News S (2022) Microplastics found in 75% of fish we eat. [online] SCUBA News.

15. Campanale C, Galafassi S, Savino I, Massarelli C, Ancona V, et al. (2022) Microplastics pollution in the terrestrial environments: Poorly known diffuse sources and implications for plants. Science of The Total Environment, 805, p.150431.

16. Bosch F (2022) Around 80% of cow and pig meat, blood and milk contain plastic. [online] Plastic Soup Foundation.

17. Carpani J (2020) Britain to stop exporting its plastic waste to developing countries under new environment legislation. The Telegraph. [online] 30 Jan.

18. Circle IT (n.d.) Planned Obsolescence and the Right to Repair.

19. JAD (2019) (n.d.) Biotech trees. [online] Nursery Management.

20. Johnston B, Adamus G, Ekere AI, Kowalczuk M, Tchuenbou-Magaia F, et al. (2022) Bioconversion of Plastic Waste Based on Mass Full Carbon Backbone Polymeric Materials to Value-Added Polyhydroxyalkanoates (PHAs) Bioengineering, 9: 432.

21. Frost R (2022) Meet the plastic-munching lake bacteria fighting pollution. [online] euronews.

22. Kart J (nd) Protein Evolution Engineers Supercharged Organisms to Break Down Plastic Waste. [online] Forbes.

23. MIndseteco (2021) Plastic-Eating Mushrooms: The Full Discovery and Details [2022 Update]. [online] Mindset Eco.

24. Corbley A (2021) Nigerian Homes Built from Thousands of Plastic Bottles –12x Stronger Than Brick And Earthquake Strong. [online] Good News Network.

25. www.abc.net.au. (2021) Your beer bottles and old clothes could become home furnishings in 'recycling revolution'.

26. Dr Stephen Hamil (2013) The benefits of using a structured approach to data. [online] NBS.