POSITIVE ENERGY

Digitalisation is one of the key technology trends of this century. The intelligent use of data derived from operations has transformed major industries, driving efficiency improvements and increased profitability in sectors as diverse as retail, transport, supply chain logistics and energy. This data resource has also enabled the emergence of completely new companies and business models, for example, Uber and Revolut in transport and finance respectively.

The importance of digitalisation in manufacturing has been highlighted by the World Economic Forum, which established the Global Lighthouse Network to recognise companies that are incorporating 4th Industrial Revolution technologies – such as artificial intelligence (AI) and the Internet of Things (IoT) – into daily manufacturing and supply chain operations.[1] These 'lighthouses', or factories that have implemented these technologies, are the most advanced factories across the globe. It is significant to note that, of the 100 manufacturing plants identified as lighthouses in the latest whitepaper (World Economic Forum, 2023), not one is a cement producer. This speaks to the current state of digitalisation in the cement industry, a fragmented landscape lacking consensus on best practices or minimum standards for adopting the latest digital technology. Even plants within the same group may operate in completely different ways.

A considerable amount of literature has already been produced on the benefits of digitalisation to the cement industry. It is a necessary enabling technology for further advanced technologies such as predictive maintenance or AI for process control and automation. It can also contribute significantly to the industry's decarbonisation ambitions, with digitalisation accounting for an estimated 10% of emissions reduction in the roadmap produced in the 2021 article Decarbonising Cement Production.[2] This article will not re-tread those arguments, rather, it will discuss how the cement industry can 'get digitalisation right' by learning from the UK energy industry.

The cement industry shares a number of commonalities with the energy sector. Both industries are dominated by engineering companies that operate expensive critical infrastructure that is expected to deliver reliable continuous operation with significant costs associated with any unscheduled interruption. Over the last five years, the UK regulator for gas and electricity markets, OFGEM, has been driving a digital transformation of the energy sector. The objective behind this strategy is stated as a sector-wide goal to build a resilient digital energy system that accelerates and enables the decarbonisation of the power grid.

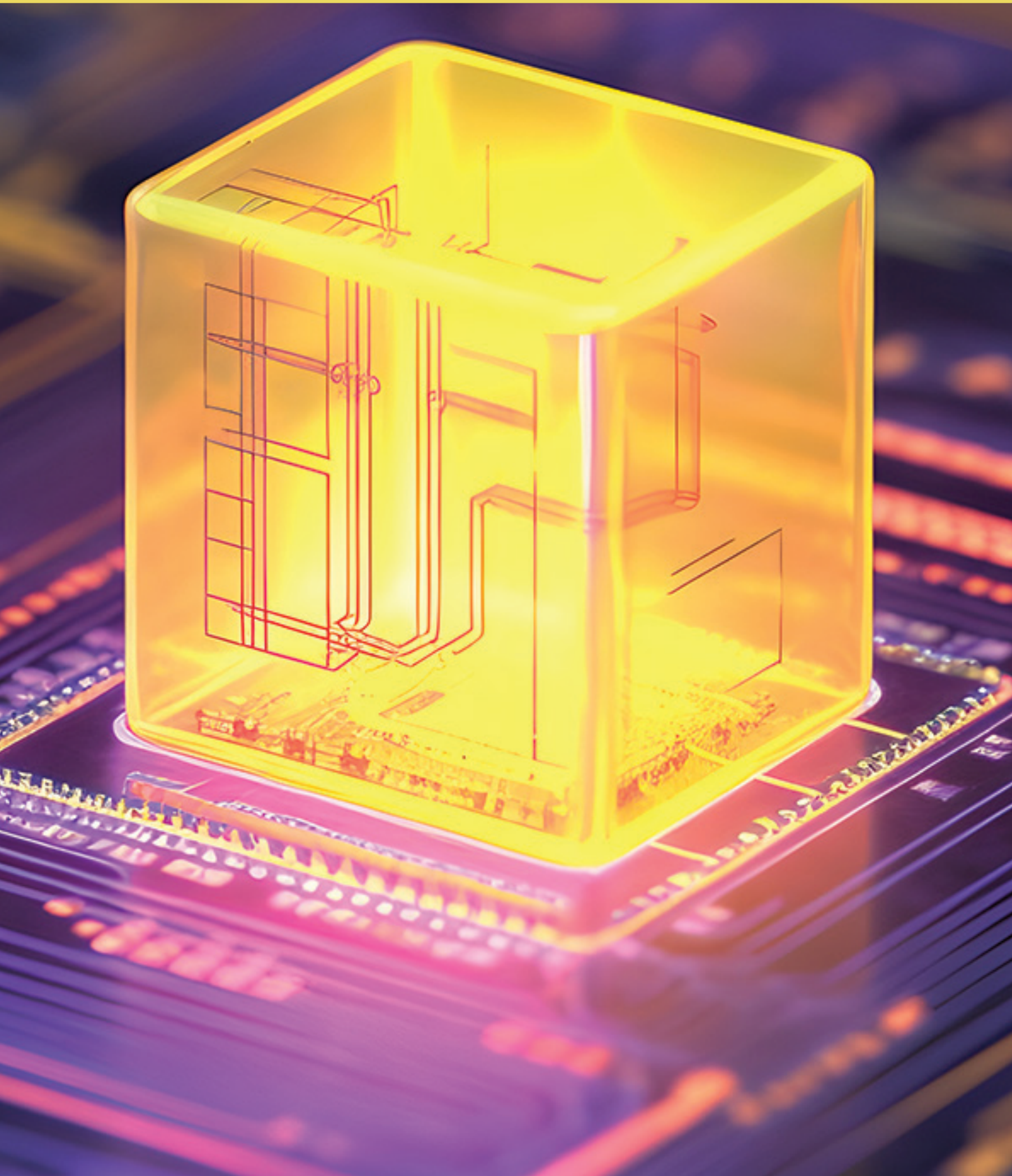
Equally, the goal of digitalisation in the cement industry should be to deliver a digital transformation of the industrial process that accelerates and amplifies decarbonisation efforts, rather than business operations. There are key learnings that can be taken from the work done by OFGEM and applied to the cement sector.

Among the many recommendations made by OFGEM, Carbon Re has identified three key initiatives that are particularly relevant and potentially transformational for the cement industry:

- Requiring companies to publish a digitalisation strategy.
- Adopting data standards such as FAIR data principles and the Common Information Model.
- Improving data quality across the industry through the use of metadata.

This article will explore these recommendations and how they may be implemented or driven through

Dr Aidan O'Sullivan, Carbon Re, considers the challenge of digitalisation in the cement industry and highlights the lessons to be learned from the energy sector.



strong leadership from organisations such as the World Cement Association (WCA), Global Cement and Concrete Association (GCCA), and Cembureau.

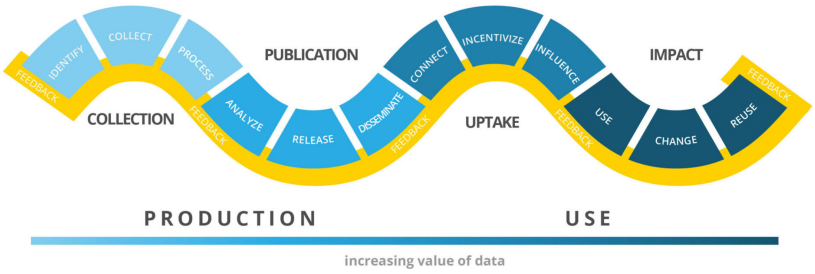
Publishing a digitalisation strategy

Digitalisation is the transformation of a business or industry by using digital technologies to improve its processes.[3] As part of a strategy to accelerate the digitalisation of the energy sector, the Department for Business, Energy, and Industrial Strategy (BEIS) launched the Energy Data Taskforce to develop guidelines to improve data availability and transparency in the energy sector. This has led to the publication of a groundbreaking report which proposes a strategy and list of recommendations.[4]

Chief among the recommendations is the requirement for energy companies (particularly network operators) to publish a digitalisation strategy. This document outlines the steps they would take to modernise their data collection and infrastructure for sharing data. This requirement has been implemented with some initial success, with energy companies submitting strategies that allow for comparisons and benchmarking of where different companies are along the digitalisation journey. They have also allowed for the sharing of best practices and creating open dialogue, rather than each company solving the same problem in different ways. This is particularly useful in an industry that historically lacks experience in digital technology, and has unique challenges as an operator of critical infrastructure that commercial tech companies such as Amazon or Google have not had to handle.

Currently, a number of major cement producers and associations have published decarbonisation strategies outlining their roadmap for reducing carbon emissions.

This has been fundamental in highlighting the industry's commitment to a strategic and coordinated effort to reduce emissions in a sector that is responsible for 7% of global carbon emissions. A similar approach to digitalisation would be transformational.



The data value chain provides an overview of the process of data creation, use and possible reuse. It can be used at an industry level as a teaching tool to show the steps from data creation to use and impact or on a group or company level as a management tool to monitor and evaluate the data production process.[5] Image: CC BY 4.0 International license.

Digital readiness index

The ideal mechanism to drive the publication of digitalisation strategies would be for major cement associations to require their members to publish one. The introduction of the Best Available Techniques standard has increased the adoption of industry best practices for hardware technology.[6] A similar recognition programme for digital technology would achieve similar effects.

This benchmarking could take the form of a 'Digital Readiness Index' which may rank companies based on the accessibility of their data. As an example:

- Level 1: Data is stored on a DCS system. Only contains limited historical data, and is mostly inaccessible.
- Level 2: Data is stored on a local historian. Although extensive historical records are available, it is inaccessible through remote connection.
- Level 3: Data is stored on a cloud historian. Significant historical data is available, and is easily accessible through remote connection.

Adopting data standards

A successful digitalisation strategy must be applicable beyond an individual plant, and capable of unifying & bringing coherence to data across a fleet of cement plants within a group. Data standards are key to enabling interoperability, which is achieved by defining common ontologies for data exchange so that data is consistent from one plant to another.

FAIR principles

In an open letter to energy network operators, OFGEM identified the critical need to adopt data standards on the basis that "Digitalisation is optimised through the standardisation and interoperability of data".[7]

This can be expounded further to incorporate the FAIR data principles, as outlined below. From the point of view of potential users, metadata and data must be:

- Findable – Data must be easy to find for both humans and computers.
- Accessible – Data must be accessible and secured through authentication & authorisation.
- Interoperable – Data must be capable of being matched and reused across different use cases.
- Reusable – Data must be richly described so they may be replicated and or combined in different settings.

These principles were designed for scientific and Open Source

data, however they can be applied to companies developing a common digitalisation strategy across an entire group. The end goal of data being FAIR across all plants can benefit centralised users at head office, as an example.

Common Information Model

One major data standard implemented across the UK energy system is the Common Information Model (CIM). This is an ontology that maps data in a principled and consistent manner, showing the properties of data and relations between variables. The CIM is used for exchanging data models of electricity networks, data, and other information across transmission operators in Europe.[8]

The complexity of the manufacturing process and the uniqueness of each individual cement plant makes this challenging.

A considerable amount of investment will be required to develop standards and ontologies that translate these disparate sources into structured and coherent information. However, in adhering to a CIM, cement plants under the same group can be empowered to share learnings and operational data more easily with one another. Every producer must adopt a CIM ideally under the guidance of best practices and guidelines set out and agreed by the WCA, GCCA, Cembureau, or other standards bodies.

Improve data quality

Data quality is a key consideration for digitalisation, and an area where OFGEM has challenged energy companies to improve. Their Energy Data Taskforce has found that metadata, or data about data, adds significant value to the meaning and reusability of the data. An accurate description facilitates use cases beyond the original intent of the recorded values, and abides by all four FAIR principles.

Dublin Core principles

A key recommendation by the Energy Data Taskforce is to improve data quality by adopting the Dublin Core metadata principles to define metadata. This set of 15 elements adds richness to datasets by capturing meta information, most notably important changes that may have occurred over the lifetime of the data being recorded.

For example, metadata that describes the sensor recording the data could include maintenance history, which can be useful for identifying faulty readings when a sensor has been replaced.

Conclusion

This article has outlined some critical learnings for the cement industry from the experience of the UK energy sector in driving digitalisation in an engineering dominated industry that operates critical infrastructure with significant reliability constraints. The main recommendations are for cement companies to: publish their digitalisation strategy, adopt data standards such as FAIR data principles and CIM, and improve data quality through metadata.

This movement will require a very clear vision and leadership from an Industry Data Taskforce headed by a major cement industry association. Similar to the Taskforce headed by OFGEM for the energy sector, the industry will benefit from having a work group that can guide and support cement companies on their digitalisation journey.

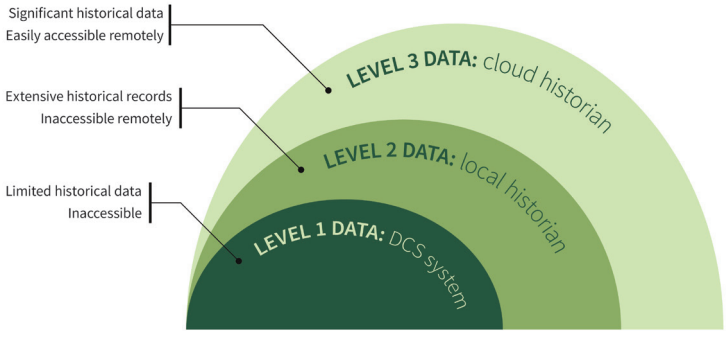
They can take an active role in encouraging good data practices, which will result in a more cohesive and unified industry, and reduced carbon emissions. ■

References

1. 'Global Lighthouse Network' – https://initiatives.weforum.org/global-lighthouse-network/home
2. FENNELL, P., et al., 'Decarbonising Cement Production', Joule, 2021.
3. 'The Common Information Model (CIM) regulatory approach and the Long Term Development Statement' - https://www.ofgem.gov.uk/sites/default/files/2022-01/The%20Common%20Information%20Model%20%28CIM%29%20regulatory%20approach%20and%20the%20Long%20Term%20Development%20Statement.pdf
4. 'Energy data taskforce' – https://www.gov.uk/government/groups/energy-data-taskforce
5. 'The data value chain: Moving from production to impact' – https://opendatawatch.com/reference/the-data-value-chain-executive-summary/
6. 'Production of cement, lime and magnesium oxide' – https://eippcb.jrc.ec.europa.eu/reference/production-cement-lime-and-magnesium-oxide
7. Ibid at 3.
8. Ibid.

About the author

Dr Aidan O'Sullivan is the Chief Technology Officer and Co-founder of Carbon Re.



A Digital Readiness Index can be used to evaluate the accessibility of different companies' data standards identified by major cement associations. (Image supplied by Carbon Re).