SAFETY IN NUMBERS

Resilience and Certainty Through Data

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Safety In Numbers:

Resilience and Certainty through Data

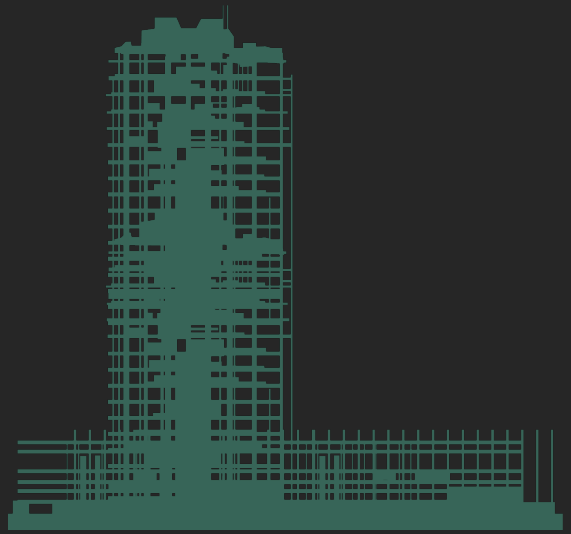
How harnessing the power of data has helped Laing O'Rourke achieve closer alignment with clients, create a safe working environment, and consistently deliver quality engineering solutions that are on time, on budget, and sustainable across the project lifecycle

1. Introduction
2. How has the industry evolved (Construction 3.0) ?
3. How does data help address the challenges ?
4. Where are we headed (Construction 4.0) ?
5. How has COVID-19 impacted that future vision?

What does it take to deliver a programme of work?

Before work begins

Information
Plant
Material
Labour
Logistics
Dependencies
Safety
Sustainability



Programme of Work

What are you left with?

Physical Asset
Information Asset

What does it take to productively deliver a programme of work?

The fourth industrial revolution is underway, and construction is again on the precipice of change.

1765	1870	1969	Today
First revolution	Second revolution	Third revolution	Fourth revolution
Mechanization	*Mass production*	*Automation*	*Industry 4.0*

"It is clear that in many respects, construction has not even made the transition to 'Industry 3.0' status which is predicated on large scale use of electronics to automate production…"
Farmer Review of the UK Construction Labour Model (2016)

Wind power is an industry that is harnessing the power of data

An onshore wind farm with a long-term power purchase agreement has a limited ability to absorb risks. Therefore, they use vast data sets in a highly structured way to increase certainty.

Cost	Programme	Energy Yield	Interest Rates
Revenue	O&M	Availability	Regulation
Warranties	Services	Force Majeure	End-of-life

Broad risk categories that are relevant to a developer and long-term owner of the asset

- ***Resilience*** *is the ability of a system to maintain and adapt its operational performance in the face of failures and other adverse conditions*
- ***Certainty*** *is having confidence at the start of a project that it will be completed within the agreed constraints*

Hinkley Point C sets new delivery standard on the journey to the UK's low carbon future

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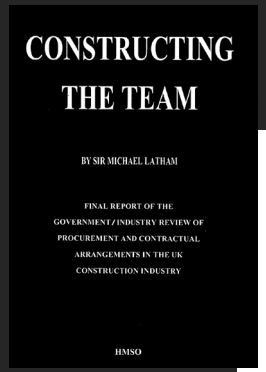
Construction has long had a poor image.
A series of reports have identified persistent problems over the past 30 years

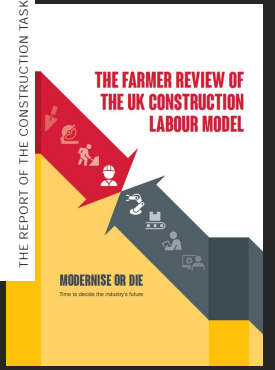
- Persistent fragmentation
- Inadequate collaboration
- Difficulty in adopting & adapting to new technologies
- Insufficient knowledge transfer between projects
- Difficulty in recruiting talented, future-ready workforce

1994



1998

2016



Modern Methods of Construction (MMC) have improved safety and delivery

Safety has improved dramatically

- Fatality rate has fallen from ~9 per 100,000 workers to ~1 per 100,000 over past 30 years[1]

Design for Manufacture and Assembly (DfMA) is enabling faster, high quality delivery

- Off-site manufacturing and assembly integrated in the design and delivery program
- Global value of offsite construction market forecast to grow at ~6% p.a.[2]

Environmental performance is now a focus

- UK has committed to net zero carbon by 2050 and the built environment accounts for 40% of UK's CO_2 [3]
- Some progress has been made, e.g. average household energy use fell 21% in the past decade [4]
- However, there is much still to be done to improve sustainability of construction & building performance

Digital technologies have improved the coordination of design & delivery

- Digital twin of our assets generated during construction to support the asset optimisation
- BIM has improved efficiency, cost estimation & coordination and enabled use of modular construction

Note: [1] https://www.hse.gov.uk/statistics/industry/construction.pdf; [2] Frost and Sullivan "Global Modular and Prefabricated Buildings Market, Forecast to 2025";
[3] https://www.ukgbc.org/climate-change [4] Energy Consumption in the UK, Table I3

Laing O'Rourke is an industry pioneer in offsite manufacturing and integration:

We have three key metrics for demonstrating that we are employing MMC

70:60:30

QUALITY
70% of components are manufactured off site

PRODUCTIVITY
60% reduction in required staff and workforce on site

CERTAINTY
30% improvement in schedule

Our DfMA approach is improving productivity and delivering projects faster

- 33% faster programme[1]

- 30% faster programme
- Up to 80% less onsite labour for DfMA elements

- 25% faster programme
- 60 fewer people onsite

- 6 months' time saving
- 25% less labour per bridge

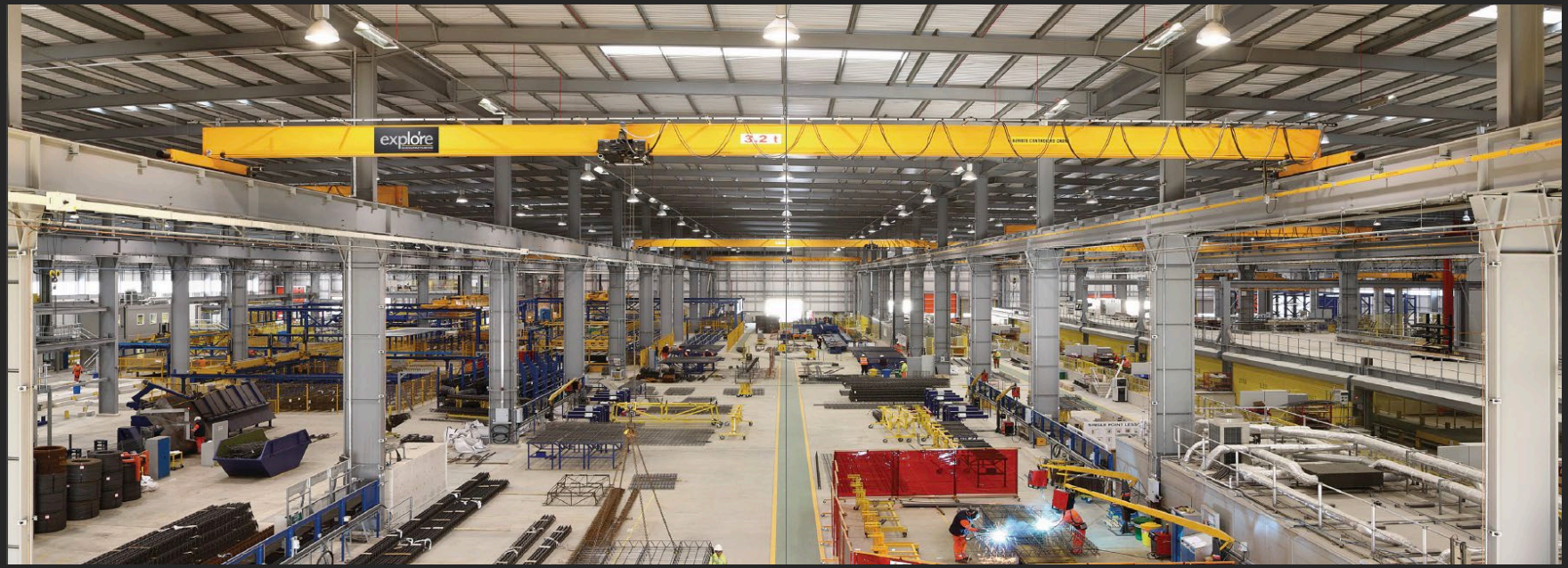
- 4 times faster than traditional approach
- 50 fewer people onsite

- 40% faster programme
- 40% less labour per bridge

Note: [1] Refers to time to deliver frame (from ground to level 40)

We have unique self-delivery capability for offsite manufactured products

Our UK manufacturing facilities are central to our Design for Manufacture and Assembly approach. At Explore Industrial Park (pictured below) and CHt Manufacturing in Oldbury, we create products using modern assembly processes, using lean automation and quality assurance systems.



Note: At Explore Industrial Park, we create precast concrete products (e.g. for building frames and facades). At CHt Manufacturing, we create mechanical, electrical and plumbing components and modules.

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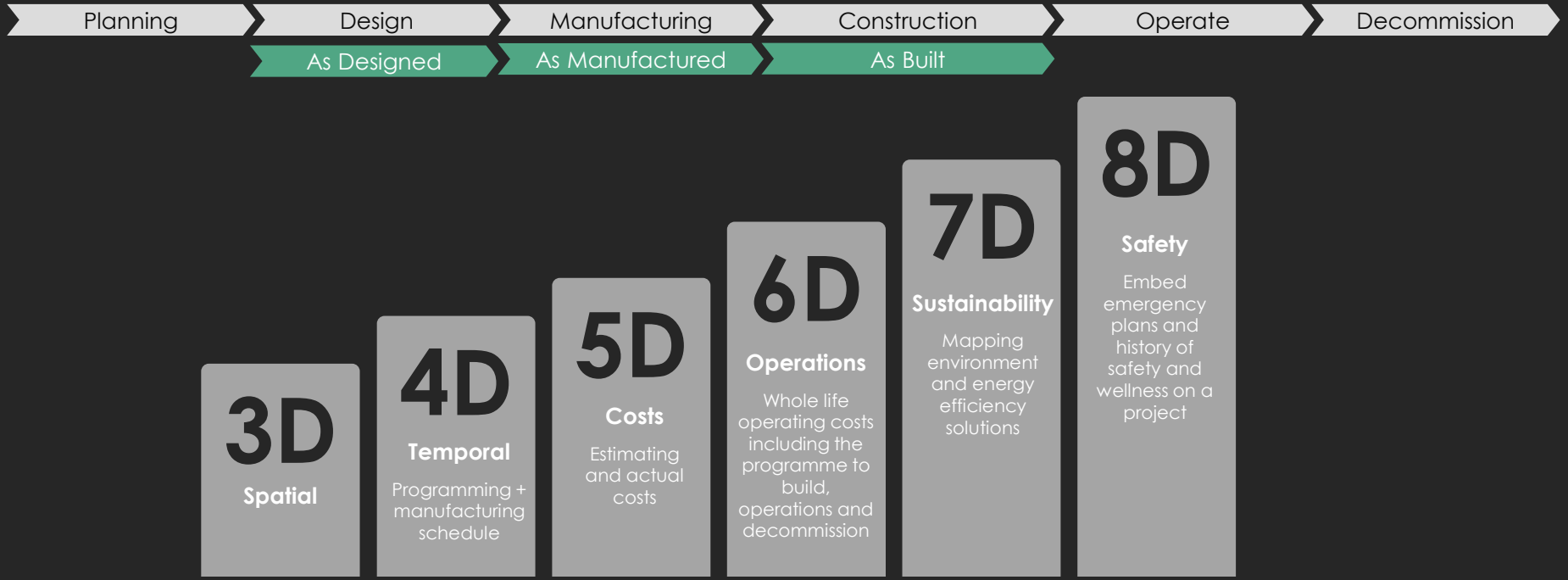
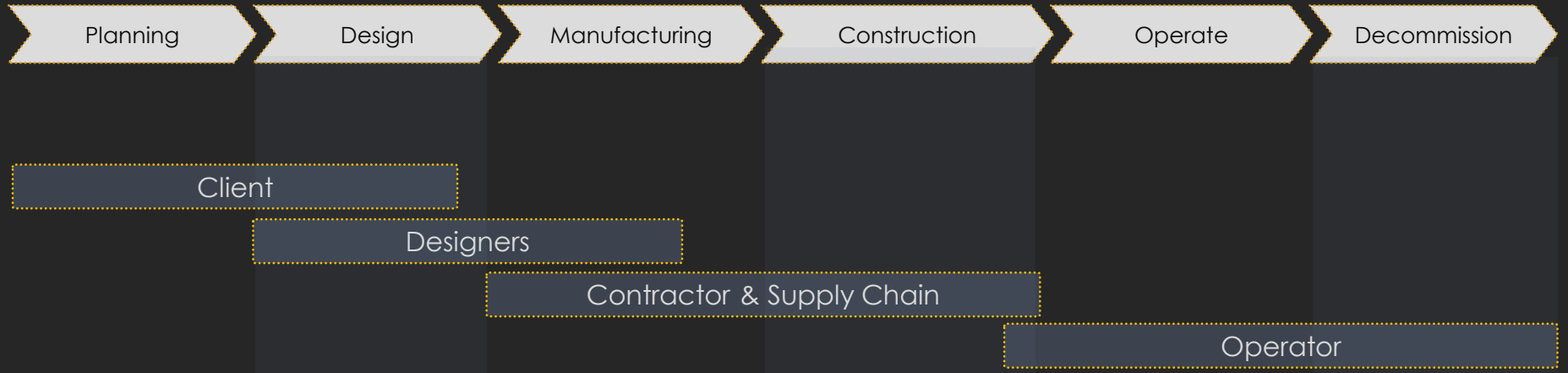
What information is available during construction and how is it coordinated?

Building Information Modelling (BIM) is a process for creating and managing information on a construction project across the project lifecycle, and the Golden Thread links those elements together through the phases.



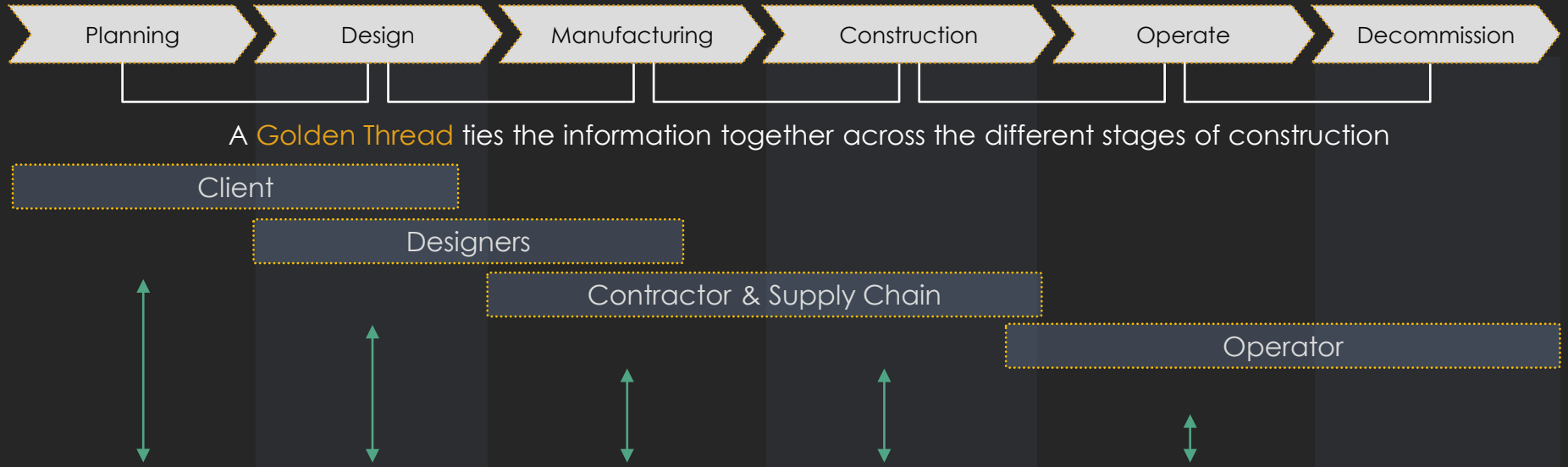
Several enablers are required to bring this information together

There are no standards to allow interoperability, no one environment information to follow and no alignment through the product cycle to deliver value to the end users.



Several enablers are required to bring this information together

The golden thread is a critical challenge across the full supply chain as there are no standards to allow interoperability, and no one common data environment to allow this to succeed.



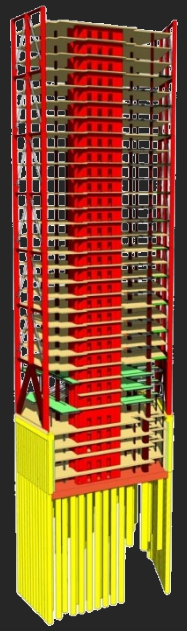
A common data environment (CDE) with global standards to drive interoperability, privacy & security can compensate for some of the barriers that exist across the value chain.

By using a coordinated data model, we are reducing embedded CO_2 in buildings

Example: a generic 30 story residential tower. The colour code represents carbon intensity

Planning | Design | Manufacturing | Construction | Operate | Decommission

As Designed



As Designed
Carbon Budget
14.5 kt CO_2e

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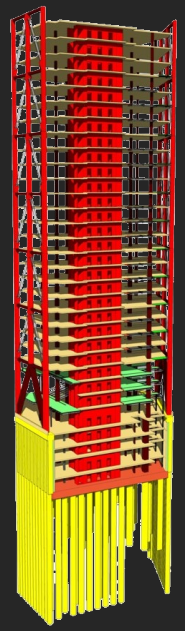
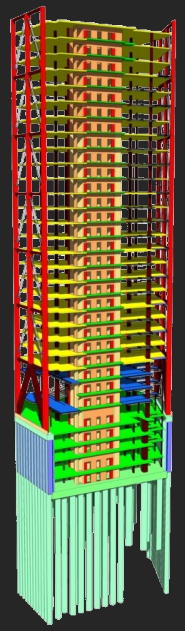
As Optimised



As Designed
Carbon Budget
14.5 kt CO_2e

35%
Reduction

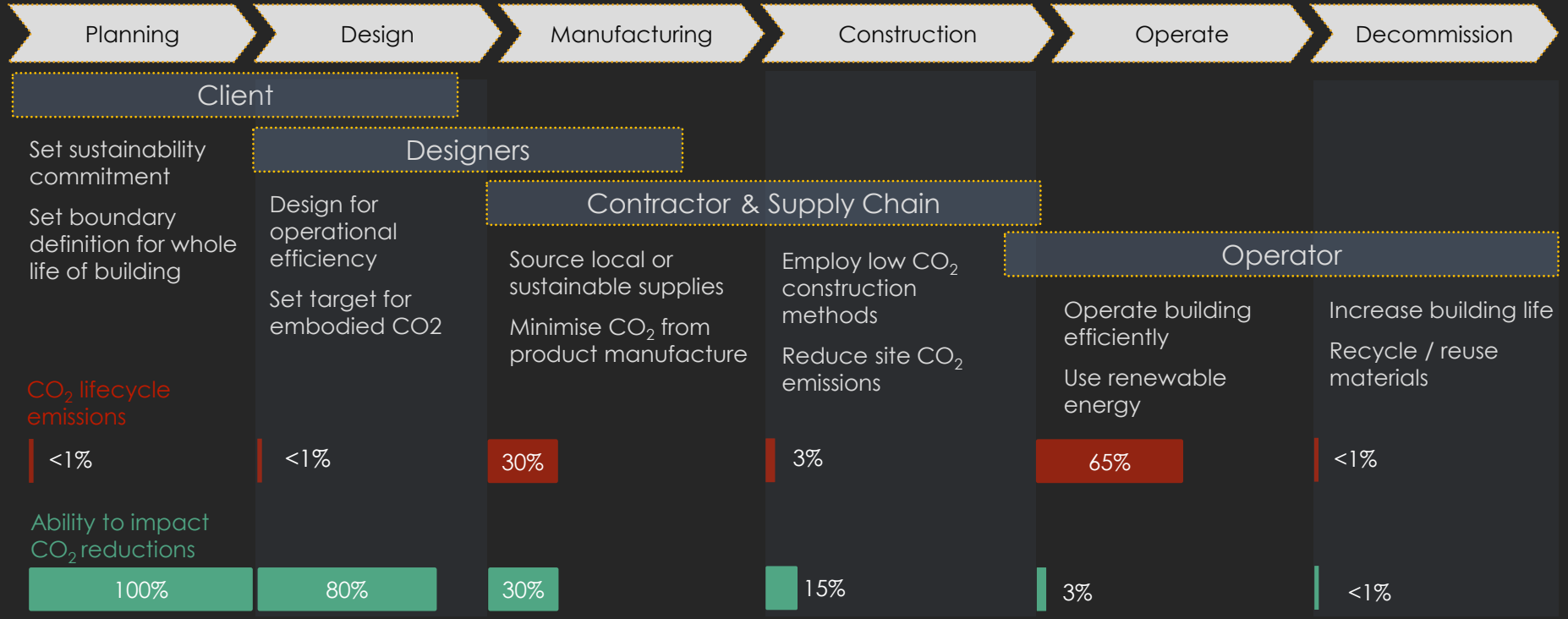


As Optimised
Carbon Budget
10.0 kt CO_2e

Achieved simply by changing materials and designing for off-site manufacturing

Fragmentation leads to sub-optimal outcomes

Example: client and designer have almost complete control of a building's lifetime sustainability performance. If builder is not engaged early, they cannot improve the design (and hence embedded and operational CO_2)



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Ultimately what does the client really want from the construction industry?

Lower cost
For the same scope of work

Confidence in Outcome
Greater certainty in programme, cost, quality and safety through the full project lifecycle

Flexibility in design
Retain flexibility in design during full engagement

Impact of change
Understand the full implications & risks of change

Transparency
To be a part of the process, have a clear view of progress, and understand risks and opportunities

Sustainability
Understanding the full environmental, economic and social impacts of their design decisions

Digitally enabled
Leverage information generated during design and construction to support whole life asset maintenance

Coordinated
Understanding how the asset fits with their existing portfolio

Options
Understand the trade-offs in design between key metrics such as sustainability, cost, schedule and certainty.

Ready access to high quality data is critical to improving customer satisfaction

Agile

Embed new operating structures in delivery teams → supports agility & increased productivity

Lean

Define, measure, understand & control construction process to improve the customer experience

Integrated

Integrate delivery, design, engineering & supply activities → coherent & coordinated workflow

Sustainable

Reduce the industry's environmental impact and build a better future

Transform construction into a customer aligned…

Digitally Enabled

Leverage the vast pools of data to drive operational efficiency and new business models across the industry

….and data driven industry

Being digitally enabled requires a mature data environment

It is as much about culture as it is about technology

1 What we are doing?

Using digital technologies and advanced analytics to unlock new sources of value such as higher productivity, faster delivery, enhanced transparency for ourselves and our clients

2 How are we doing it?

Coordinating activities globally across 3 core elements

- Developing new products and services
- Longer term research with dedicated analytics skills
- Creating a stable and secure operational environment to serve those applications

3 What are the enablers?

- **Invest in people, processes and a platform** to support new digital initiatives
- Product focus
- Partnering where possible

Digital tools & offsite manufacturing are key to the Hinkley Point C nuclear project

"… Experience, offsite manufacturing and digital tools are all making construction run more efficiently …"
Stuart Crooks, MD Hinkley Point C, EDF Energy

"… Hinkley Point C is already demonstrating the value of replication in new nuclear construction. Sizewell C will reap the benefits, being a copy, leading to significantly lower construction costs and risk …"
Humphrey Cadoux-Hudson, CEO of Sizewell C, EDF Energy

Process Digitisation

- Revolutionising how we go to work
- Digital model is the 'baseline' and is used for all phases
- Reducing manual inputs
- 100% of rebar is modelled
- Multiple variables recorded for each item
- Informs delivery in a highly detailed data environment

Replication

- By digitising processes, we can deliver substantial cost & time savings when replicating an elements or an entire project
- A major milestone in construction of the second reactor at Hinkley Point C was achieved 30% quicker than on the identical first reactor[1]
- We expect that Sizewell C can be delivered 20% cheaper using the data captured during Hinkley Point C construction

Note: Hinkley Point C being delivered by BYLOR – a JV between Laing O'Rourke and Bouygues Travaux Publics.
[1] The major milestone is the the lifting of the first part of the massive steel containment liner. This was achieved in September 2020


TIMELINE
MONITOR TRACKER
SAFETY HAZARDS
SENTIMENT ANALYSIS REPORTS
TRANSPORT & TRACKING
LOGISTICS

Standard contractual terms are inhibiting progress towards Construction 4.0

We have proposed potential changes that could facilitate progress by improving data sharing, early engagement and change management

Data, Digital and Innovation

Greater openness will promote continuous improvement, including for safety, productivity and sustainability

Data

- Limit confidentiality obligations to genuinely confidential data
- e.g. sharing 'building in use' data is crucial to improving building energy efficiency

Intellectual Property

- IP should be owned by the company that creates it, as it has invested over the long term and is most likely to be able to leverage the learnings
- Royalty-free licensing should be given to the client

Offsite Manufacturing

Re-baseline contracts so that they support, rather than detract from, a manufacturing-led approach

Delivery Model

- Early contractor engagement enables product-led design
- Collaborative procurement models are critical to unlock potential of offsite manufacturing and innovation

Payment Profile

- Current payment terms follow old practices which assume no value is created until works are incorporated onsite
- When significant product is created offsite, payments should reflect the cost of securing manufacturing slot

Change Management

- Late changes often cause inefficiency and acrimony
- Manufacturing-led approach demands more discipline in digital engineering → 'construction' more akin to 'assembly'
- A freeze on changes after design completion would help deliver real certainty of cost, programme and quality

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We have dealt with the COVID-19 crisis in three phases

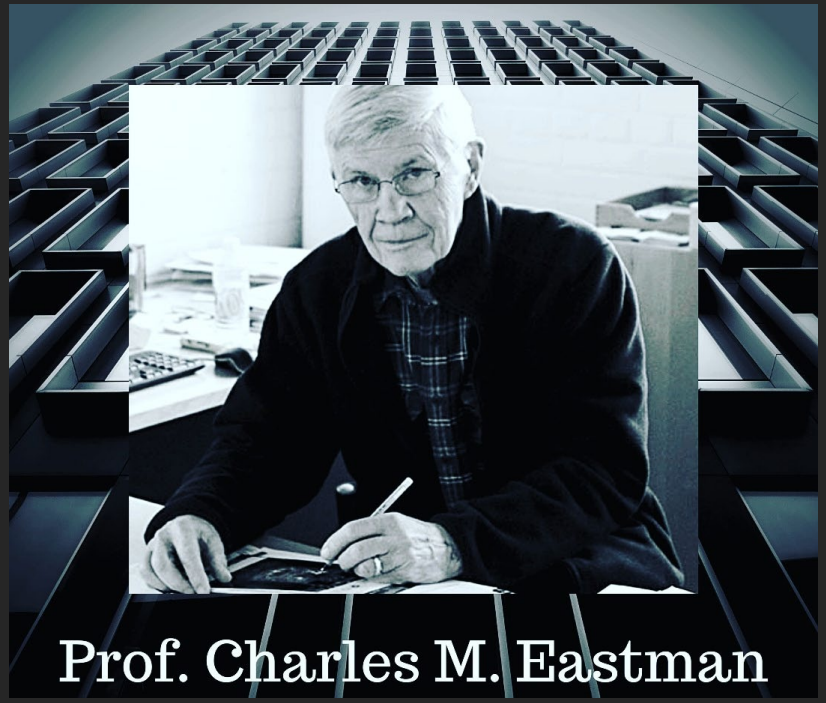
The crisis has reinforced the need for Industry 4.0

Start of Crisis	Bouncing Back	New Normal
Resilient	Responsive	Remote

"If you want to go fast go alone, if you want to go far go together"

1	Building a data driven culture is in the best interest of our clients and key stakeholders across the construction industry. It will translate into greater value and lower risks.
2	To build a data driven culture requires us to think not just about data platforms, but also about the people, the process and the products required to best support the industry.
3	All industries are coming across the new wave of Industry 4.0 and we are in a race. Time to market will have a significant benefit.
4	The world of opportunity around data is broader than any companies ability to address it. You need to partner and collaborate to achieve the scale and pace required to win.
5	While there are barriers to building a customer aligned industry, the steps to move forward are simple.

Thank You



May 5, 1940 – November 9, 2020

Known by some as the “father of BIM”, Charles Eastman claims that drawings for construction are inefficient due to the redundancies of having one object projected multiple times on different scales.