

Understanding how driving forces will impact the construction industry in Europe by 2030

A foresighting exercise by ENCORD and its partners



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Thank you

A big thank you to all the sponsors of the ENCORD foresighting conference, without your support this report would not have been possible.



Introduction

Our world is facing unprecedented change, at a remarkable speed. Mega trends such as climate change and new, mostly digitally driven, technologies are penetrating every aspect of our lives. Transforming economies and behaviours, which in turn are placing a strain on the social cohesion of our communities. The list of challenges that arise from these changes are substantial and many affect the built environment.

For business leaders, ascertaining the impact of future trends on their business has always been a difficult task. Today, despite having more, readily available and better processed information, it seems harder than ever to be able to predict the future. This is due to ever increasing contingencies, caused by the creation of more options - mostly due to technology.

Yet a better understanding of these options and their interplay is crucial if your organisation is to be ready to realise opportunities and manage risk. In response to these challenges, ENCORD decided to expand its Working group portfolio to include Foresighting. Its aim was to assist our members to get a better understanding of how future change might impact the construction industry, the built environment and their organisations.

Twelve months later, we are proud to launch our first report that explores which driving forces will impact both the built environment and the construction industry and its business in Europe between 2020 and 2030. Compiled from the output of four workshops, with over 250 professionals from across the construction sector, it gives a unique industry perspective on the forces that are driving change, their relevance, certainty and potential impact.

We recognise that every organisation is unique. For this reason we do not make any strategic recommendations. Instead we present the results of our research and provide an overview of how these driving forces could impact key elements of your business, such as the value chain, costs, HR and innovation. Thus enabling you to apply this knowledge to your own business planning process and strategy development. This work should be seen as a progress report, which will be continuously honed and reviewed - ideally by many of us - in order to better reconcile the diverse approaches and issues, which are inherent within the construction sector.

Finally, I would like to thank the Foresight Working Group, particularly our lead Stephanie Whittaker from BAM UK; Laetitia Flourent and Nicolas Bouby, both from Bouygues Construction; Olivier Lepinoy from Autodesk and Franz Klager from STRABAG, for the work they have carried out. I would also like to extend my gratitude to all the people who have shared their perspectives and ideas with us during the workshops and to the ENCORD member companies for their support.



Norbert Pralle
Chairman, ENCORD
Head of Development and Innovation,
STRABAG SE

Executive summary

Our world is facing unprecedented change, from social and economic issues, to climate change and new technologies, the list of challenges is substantial. For business leaders ascertaining which of these driving forces will impact your operations and when, is often a difficult task. Yet an understanding of the future is crucial if your organisation is to be ready to realise opportunities and manage risk.



ENCORD created a Foresighting Workgroup to offer a joint forum to help companies address these issues. This was launched in March 2019 in Amsterdam.



The Foresighting Workgroup met to agree the focus of our work. We decided to explore which driving forces will impact the construction industry in Europe between 2020 and 2030 and the likely impacts on your business.

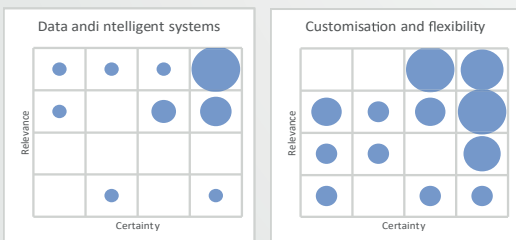
To answer our question we carried out four interactive workshops in Amsterdam, Woking, Manchester and London. Over 250 participants from across the European construction industry took part in two exercises which sought to ascertain the relevance and certainty of each driver and their impact on the construction business.



Following the workshops, the Foresighting Workgroup met to analyse the outputs. This included determining which drivers were viewed as the most relevant and certain, what to do with those where there was a divergence of opinion and how to interpret each groups' views on the impacts of the drivers of change on construction businesses.



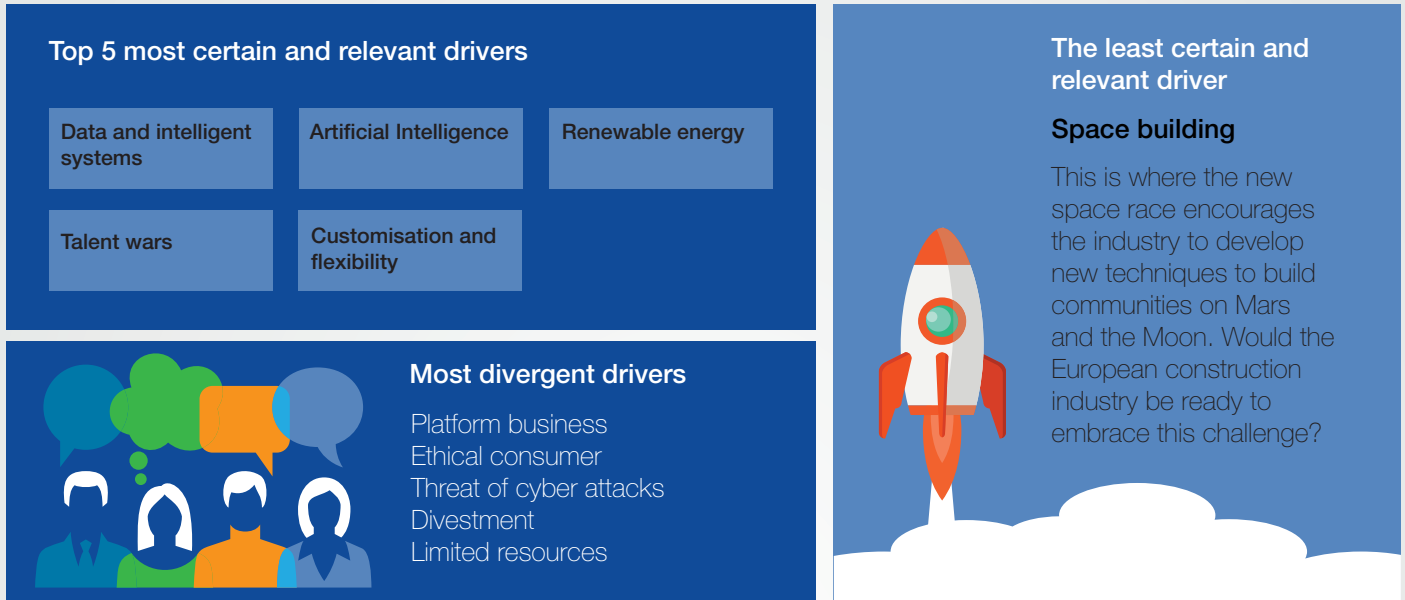
The first workshop was held in Amsterdam as part of ENCORD's 30th anniversary celebrations. Attended by over 100 members the event aimed to give participants a flavour of what foresighting is and how they could apply it in their business.



Heat maps helped us to determine patterns in the groups' responses.

Understanding the relevance and certainty of driving forces cards

Our research found that there is strong agreement in the certainty and relevance of some drivers and widespread opinions for others. This may be due to factors such as industry trends, individual biases, or a lack of knowledge about a topic. However, despite these limitations, we can draw some conclusions from these results, which are shown in the graphic below. We would encourage companies to consider all of these “divergent drivers” when evaluating which might impact their business between now and 2030. This is because it is often those topics that we are most unsure about, which have the potential to have the biggest impact on our operations; as we don't see them coming or prepare for them properly.



Understanding the impact of the driving forces cards

Each of the workgroups evaluated a driving force card of their choice and considered the impact on the business of companies like yours, within the construction industry. All of the drivers explored by the groups could impact key parts of your business including areas such as costs/profits, operations, HR, service offering and value creation across the project lifecycle. Companies must consider their own ability to respond to these changes so they can be ready to realise any opportunities and manage risks. Below are four drivers with a series of considerations to help you with this task. These were the drivers that were chosen by the most workshop groups as part of their evaluation.

Considerations for Talent Wars

- How would you compete to attract and retain the workers you need in a very competitive market?
- How would rising salary costs affect project pricing?
- Can your supply chain afford to employ these workers and what does it mean if they cannot?
- Are we a sector of choice for workers – how can we make certain we are?
- Are employers making the most of the workers they have?
- Do we need to adopt modern methods of construction faster e.g. offsite, automation, to counteract the impact of a falling number of skilled trades people?

Considerations for Automation and Autonomy

- How can the acceptance of robotics be improved?
- What new job roles will emerge as a result of this trend?
- What changes are required during design and planning?
- How can we facilitate a rapid adoption of these techniques?
- Will autonomous robot systems still need humans in the future? Which activities will be replaced first?
- Can you remain competitive without these methods?
- Can self-learning algorithmic systems make operational business more productive?
- What cybersecurity risks must be considered due to increasing data flows and data dependency?

Considerations for Circular Economy

- How would you adapt to requirements for buildings with long life cycles?
- How can your business prioritise reused materials and building components?
- Is your supply chain able to reuse components for buildings and re-sell them after use?
- Are you ready to be paid based on your building's performance over time, rather than its initial cost?
- Can you develop long term partnerships to provide a building lifecycle service to your clients and improve an asset's environmental performance?

Considerations for Platform business models

- How can we design a better value chain?
- Can I improve our existing cost structure?
- How can you accelerate growth via distribution channels?
- Why are you experiencing bottlenecks in certain areas?
- Is your organisational structure helping you to grow?
- What can your company do to develop new services?
- How could your company better orchestrate its ecosystem, to interact with other members of its network?
- If you wanted to build a platform to offer new services, how would you go about this?

Why carry out foresighting?

We live in a fast-changing, uncertain environment. How can we make the right decisions today to be better prepared for changes that may not be felt within our businesses for a few years?

**“Prediction is very difficult, especially if it's about the future.”
Niels Bohr, 1922 Nobel Prize winner for Physics**



What is foresighting?

Foresighting is a discipline that studies possible futures in order to give business leaders the insights they need to make decisions. Foresight is based on the idea that future is never a foregone conclusion and that change is always possible.

Foresight content can empower our organisations to act in two ways:

- To prepare for probable outcomes or possible futures
- To promote and lead the way for a preferable future and determine the best option for us

We cannot predict the future, but we can look ahead to a vast array of possible futures and identify which contingencies we have to prepare for.

Where does foresighting come from?

Typically foresighting has not been a business related discipline. However, after World War One, US President Hoover set up a Research Committee on Social Trends to identify areas where there would be a need for future action. This work was expanded by American researchers such as Kahn, Gordon and Helmer who created the first formal tools to project into the future for military purposes. Before, European thinkers from the 1950's onwards, promoted a more pluralist view of foresight and developed tools for use by organisations.

Why do you need foresight?

Over the last 15 years business models have changed rapidly in other industries. Today, we have a better understanding of what drove those changes, but 15 years ago, no one could have guessed what would happen. The European construction sector is now on the brink of possibly

disruptive change. Although the way we actually build on site may continue for a while; eventually all businesses will be impacted in some way.

For a long time construction has seemed to be less susceptible to change - mainly owing to its decentralised nature and regional relatedness - now quite diverse driving forces are pushing for change. These include new market entrants (potentially from other continents); the need to put an end to the high environmental toll of construction activities and new technologies that are better able to cope with the contingencies of construction.

We have a lot of challenges to address in the coming years and we should not react only when things become unbearable. Executives and policy makers often justify their decisions by saying they had no choice but to act out of necessity, but it need not be this way. Foresighting allows us to look ahead in order to be ready when the day comes. As European construction businesses, we need to answer the challenges of our time so we are not left by the wayside.

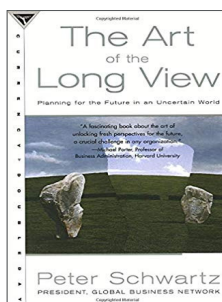
With our network, knowledge and tools, we are in the good position to turn negative trends around and lead the way towards a bright future for the European construction industry.

What did we do?

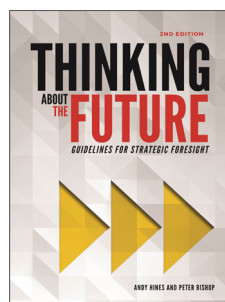
To help us determine what may happen in the future, foresight specialists such as Peter Schwartz have created several tools and processes including: futures watch, weak signals, drivers of change, impact, scenarios, mega trends and disruptions. However, there is no single methodology for foresighting and in response we built our own process to carry out our work, which is detailed in this report.

Want to find out more about foresighting?

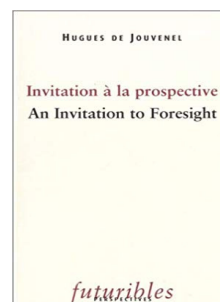
These are some of the most respected texts on the subject of foresighting:



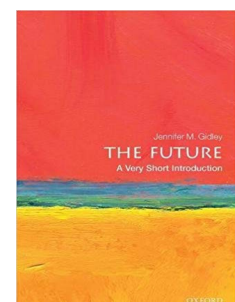
Peter Schwartz
The Art of the Long View: Planning for the Future in an uncertain World



Andy Hines and Peter Bishop
Thinking about the Future: guidelines for Strategic Foresight



Hugues de Jouvenel
An Invitation to Foresight



Jennifer M. Gidley
The Future. A very short introduction.

The workshops and conference

A brief history of the Foresighting Workgroup

In 2018, the ENCORD Council decided to establish a Foresighting Workgroup to help members better understand how disruptive changes might impact their businesses. The workgroup launched in Amsterdam in March 2019 with a kick-off workshop attended by ENCORD members, which explored what the focus of the group should be and what makes it unique.

ENCORD celebrated its 30th birthday in June 2019 with a conference dedicated to Foresighting. Attended by over 100 members the event aimed to give participants a flavour of what foresighting is and how they could apply it in their business. To set the scene we had three speakers from companies who are involved in disrupting the construction industry. Petran van Heel, who is the Sector Banker Construction at ABN AMRO and talked about investing into the circular economy. Darren Bechtel, who is the CEO of Bricks & Mortar, a venture capital firm who invests in construction start-ups and Trevor Schick, who leads the materials division for Kattera. To view their presentations visit www.encord.org.

In the afternoon participants took part in a workshop which examined how driving forces might impact the construction industry and the outputs from this session formed the basis of our report. Workshop participants came from across the European construction industry and included C-Level individuals, leaders in innovation and other specialists from areas such as digital construction, business development and sustainability.

Since Amsterdam, we have carried out a further three workshops including one at Digital Construction Week in London and have engaged with over 250 individuals from across the construction industry. The results of these activities have been analysed by our foresighting team and are detailed in the following chapters of this report.

What makes us different?

Our team is made up of construction professionals, who understand the AEC industry and project delivery. Our aim is to be humble, listen and interact with individuals from across construction, to help us understand how disruptive change might impact the industry. We want to inspire others to embrace change in a positive way and realise the opportunities it can bring.

We have adopted an open source approach, using four interactive workshops and have engaged with over 250 participants from across the construction industry. This approach has enabled us to undertake a comparison of how peers view the drivers of change and what their impact might be. It has also allowed us to give participants the opportunity to learn more about foresighting as a discipline and to help them change the way they think about the future.

Although we have finished this phase of our work. We would like to encourage everyone to consider how the driving forces could impact your business going forward. The tools we used for our workshops can be downloaded from our website www.encord.org









Determining the relevance and certainty of the driving forces cards



An introduction to the driving force cards

To identify which drivers of change we would include in our study, we began with the most current set of the Arup drivers of change cards. These contained 230 separate drivers covering areas such as convergence, energy, water, climate change, oceans, demographics, food, waste, poverty and urbanisation. The foresighting group then evaluated each of the cards in terms of their relevance and ability to impact the construction industry between now and 2030; resulting in a final list of 22 drivers. A card was created for each of the drivers, which gave a definition of what it was and a brief description of what its impact might be.

Methodology

A number of structured and moderated workshops were held to ascertain the relevance and certainty of the various driving forces. These workshops took place at the ENCORD Foresight Conference in Amsterdam, at the Digital Construction Week in London and twice at BAM. In total, over 250 construction industry experts participated in these workshops. They came from companies across Europe and undertook roles throughout the project life cycle. This diverse group of participants enabled us to obtain a broad and meaningful overall picture.

During the four workshops, the participants were divided into small diverse groups of about seven to ten people. Each of

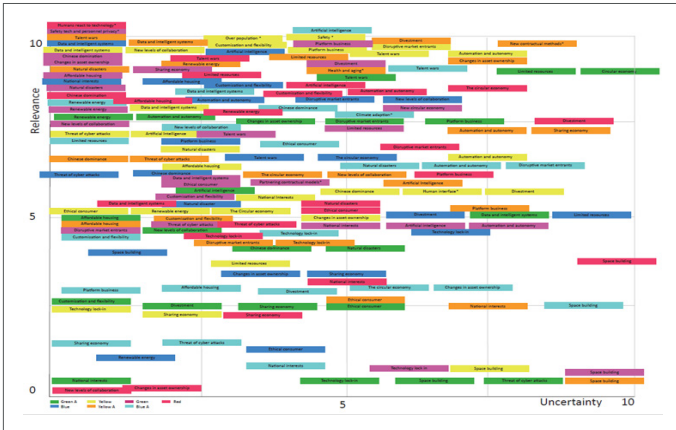
these groups received the 22 driving force cards to discuss and evaluate together. In the course of the discussion, the facilitators asked the participants to look at the driving forces from the perspectives of the various roles and stakeholders in the construction industry. The groups were also encouraged to actively discuss the driving force in all its aspects and avoid the obvious.

In addition to the 22 driving forces cards each group was also handed three blank cards to add a new, not yet considered driving force. This ensured that we did not neglect any major trends.

Following the discussion, agreement was reached on how big an impact each driving force would have on the construction industry and how likely this effect will be felt within the next ten years. This assessment was captured by placing the individual driving force cards on a relevance-certainty matrix.

Each of the driving forces was discussed, evaluated and placed on the matrix by 27 groups, resulting in 27 separate group assessments.

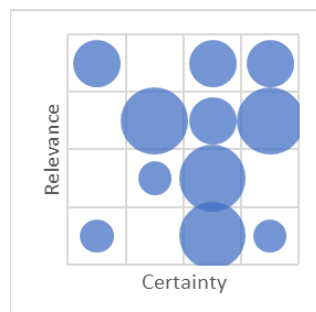
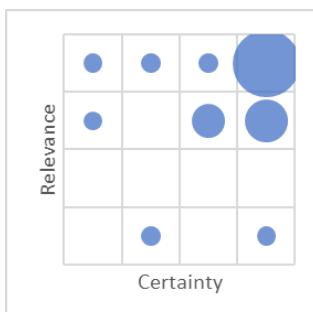
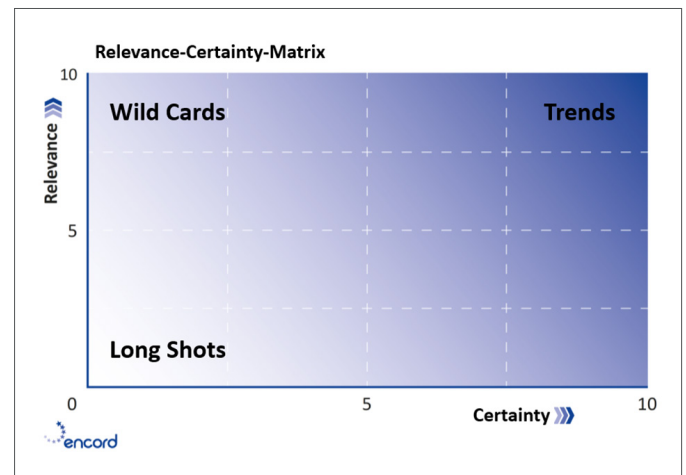
The results



In total 593 assessments were made in the workshops, resulting in roughly 27 ratings for each driving force card. To enable us to analyse all of these ratings, we took the results for each driving forces card and placed it on a single matrix. This allowed us to see the consensus and divergence in opinions, which are represented by the bubbles on the diagram.

It is interesting to consider why we have consensus in some areas and a lack of agreement in others. Widespread consensus could be due to the topic being more widely understood and therefore its relevance and certainty was easier to ascertain. Similar divergence could be caused by a lack of knowledge about a driver and its likely implications for the industry. We would recommend that companies take the time to develop a better insight into those drivers to ensure they do not miss any issues that could impact their business in the future.

Companies may also wish to explore those Driving Forces with a low certainty, but high relevance, which we have called “wild cards”. Although these were thought by workshop participants to be very unlikely to impact the industry in the years to come, should they materialise they could have a potentially disruptive impact. Also worth considering are the driving forces for which the relevance and certainty are very low. These so called “long shots” may take some time to materialise but could have a huge transformative effect on businesses over the longer term.





Limited resources

Lack of resources in the foreseeable future forces the industry to look at new ways to design and construct buildings and infrastructure.

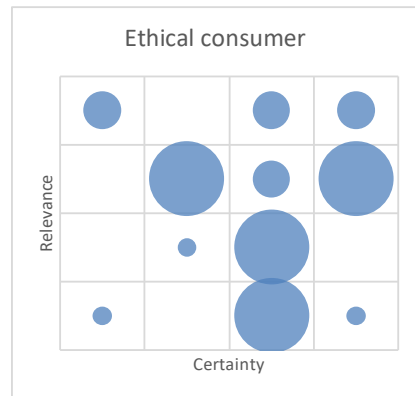
Resources scarcity leads manufacturers to develop new products that use less water, materials and energy. In some cases, products such as concrete that use high levels of water can no longer be used in water scarce environments.



Ethical consumer

Increased consumer awareness about the impact products such as plastics have on the environment changes people's perceptions about how assets should be built.

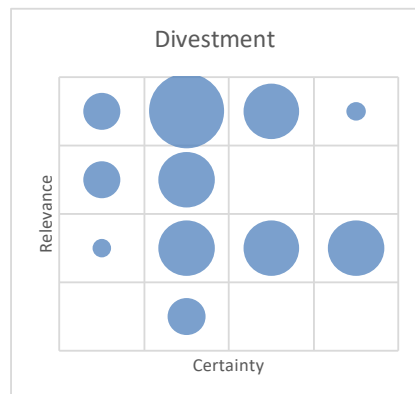
In 2018 the BBC documentary series Blue Planet II featured an episode that showed the impact plastics were having on wildlife. Research showed that as a result of this one program 88% of viewers reported changing their behaviours. As a direct result of this, retailers are now looking at ways to remove single use plastic from their stores.



Divestment

Investors remove their support for businesses which damage the environment and have high carbon emissions.

A contractor's involvement with carbon polluting projects causes investors to sell shares in the company, pushing their share price down and making it hard to access new capital.



Conclusion

The diagrams on the previous pages represent a visual depiction of how each card was placed on the matrix by the workshop participants. As discussed they represent each group's opinion, which may be influenced by factors such as individual biases or a lack of knowledge about a topic. However, despite these limitations, we can draw some conclusions from these results.

Top 5 most relevant and certain

There were some drivers that the majority agreed were both highly certain and highly relevant:

- Data and intelligent systems
- Artificial intelligence
- Renewable energy
- Talent wars
- Customisation and flexibility

Many of these topics will come as no surprise to most companies and should be a focus for business strategy and planning activities.

Divergent drivers

There was also a group of drivers, where there were divergent opinions as to their certainty and relevance. Some examples of these include:

- Platform business
- Ethical consumer
- Threat of cyber attacks
- Divestment
- Limited resource

Our research showed that there were some drivers that were seen as very relevant, but the timing of their impact was uncertain. Similarly, there were some drivers that were viewed as very certain but their relevance to the construction industry could not be ascertained. This might be due to a lack of understanding of the drivers, which prevented people properly assessing their impact and certainty or it might highlight how the different companies participating in the workshop believed it would impact their business, dependent on their role or activities.

We would recommend that companies consider all of these "divergent drivers" when evaluating which might impact their business between now and 2030. This is because it is often

those topics that we are most unsure about, which have the

potential to have the biggest impact on our operations; as we don't see them coming or prepare for them properly.

Long shots

Space building was viewed by all participants as a long shot i.e. a driver that might be ignored because we cannot imagine such a scenario today but might have the potential in the future to impact the industry. Space building refers to a drive to build in space caused by a new space race, which encourages the industry to develop new techniques to build communities on Mars and the Moon. The question is, would the European construction industry be ready or interested in meeting this challenge. Drivers like this should be considered as part of a long-term strategy.

Considerations

- How can you avoid these biases in the future?
- Do the drivers impact all of your business in the same way?
- Do the impacts vary dependent on the lifecycle stage?
- Could some of the drivers combine to lead to different outcomes for your business?
- What assistance does your business need to identify long shot trends?



Driving forces card
Environmental

The Circular Economy

The circular economy leads to changes in the way we build and value assets.



Driving forces card
Environmental

Limited resources

Lack of resources in the foreseeable future forces the industry to look at new ways to design and construct buildings and infrastructure.

Resources scarcity leads manufacturers to develop new products that use less water, materials and energy. In some cases, products such as concrete that use high levels of water can no longer be used in water scarce environments.



Driving forces card
Environmental

Renewable energy

A move towards cleaner, renewable forms of energy provides challenges and opportunities for construction.



Driving forces card
Economic



Divestment

Investors remove their support for businesses which damage the environment and have high carbon emissions.

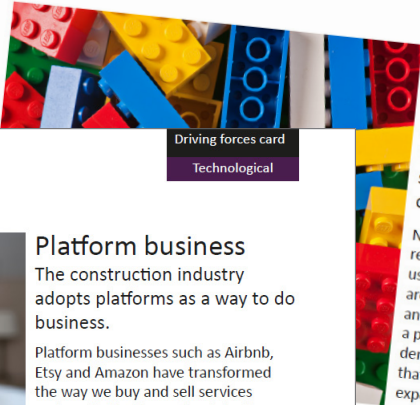


Driving forces card
Social

Customisation and flexibility

A greater focus on end user requirements requires solutions that offer increased customisation and flexibility.

New technologies such as virtual reality are making it easier for the end user to visualise assets before they are built, better understand assets and engage at the design phase of a project. As a result end users are demanding more custom solutions that ensure their assets will deliver as expected from day one.



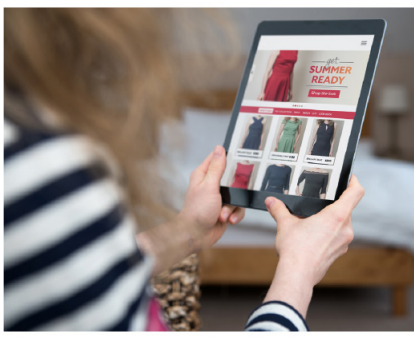
Driving forces card
Technological



Platform business

The construction industry adopts platforms as a way to do business.

Platform businesses such as Airbnb, Etsy and Amazon have transformed the way we buy and sell services and products. New entrants to the construction sector such as Katerra are demonstrating how a platform approach could work in construction, but could this work for more traditional contractors and if so, how?

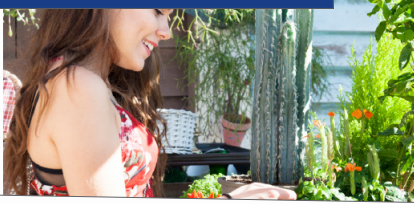


Driving forces card
Social

Ethical consumer

Increased consumer awareness about the impact products such as plastics have on the environment changes people's perceptions about how assets should be built.

In 2018 the BBC documentary series Blue Planet II featured an episode that showed the impact plastics were having on wildlife. Research showed that as a result of this one program 88% of viewers reported changing their behaviours. As a direct result of this, retailers are now looking at ways to



more reliant on data and digital we will need to attract workers with a new skill set. Currently these individuals are attracted to tech and other industries, making it difficult for us to attract and retain staff. In a worse case scenario, if we cannot get the right staff we won't be able to carry out projects.

Driving forces card
Technological

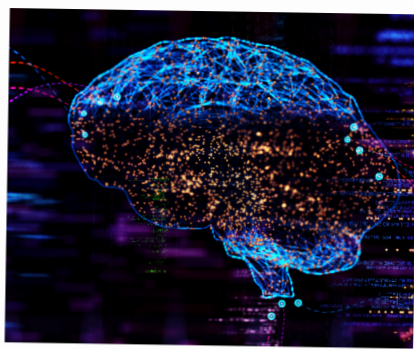


Driving forces card
Technological

Data and Intelligent systems

A growing reliance on data and technologies to deliver services

The widespread use of data and technologies for the design, construction and operation of buildings and infrastructure is increasing our reliance on these to deliver projects. This makes our businesses vulnerable to factors as the loss of WiFi/ 5G technology failure technology or loss of data which could seriously impact our ability to operate and deliver to and budget.



Artificial Intelligence

Artificial intelligence changes the way we design, build and operate assets.

AI can be used at the concept stage to create a series of design options based on client requirements and data from previous or similar schemes. This generative design process helps the design team to narrow down options and speeds up the concept phase.

Understanding the impacts of the driving forces



Methodology

To enable us to understand the potential impact of the driving forces on the construction business, we asked each group to choose at least one driving force impact card. They then had to identify an element of their business or a client's business and consider how the driving forces card they chose would impact it. To assist with their discussions each group was given a driving forces impact card to complete, which asked them to list the likely impacts and explore the risks and opportunities related to this. Participants were also asked to establish a timeline as to when their driving force would impact construction.



Results

We have picked four of the driving forces to analyse for this report. These were the top four driving forces that were chosen by the workshop groups for further analysis as they completed the driving forces impact card.

Talent Wars

What are talent wars?

The increased use of digital and data driven solutions within the construction industry is causing a gap between the skills the construction industry needs to operate on a daily basis and the skills and expertise the workforce is able to offer (today and into the future). Workers such as coders, game developers, UI and UX specialists etc. are also in high demand from other sectors. As a result, they can ask for higher wages, are easily poached by others and have greater freedom to choose the sectors and jobs they think are most attractive to them.

However, it is not just new types of workers that we need to attract. The industry is facing a skills shortage and is finding it hard to recruit workers to carry out traditional trades too. Could these issues be resolved by techniques such as offsite construction and automation and autonomous working? And will they be adopted fast enough before the trades skills shortage becomes critical?

Why is attracting the right talent so important to the construction industry?

Currently, an inability to attract the right workers will prevent companies from being able to carry out projects in the manner in which they do today. However, looking forward, a failure to attract new types of talent such as tech and data workers, will prevent businesses from realising new opportunities and make them vulnerable to new market entrants, who can offer services the industry cannot.

For contractors being unable to attract new types of workers would mean that they cannot make the transition from asset builders (working to low margins) to companies that build and offer additional value through asset data services; a new offering for clients with higher margins and revenue streams that will grow in importance as more companies embrace data, intelligent systems and AI.

What did the workshop participants think would be the impact of this driver?

- Skills shortages
- Overheated market
- An aging workforce
- Hard to retain staff
- Need to outsource skills leading to higher costs
- Work culture challenges
- Lack of innovation
- Reduction in quality during the design/planning and estimation phases
- Unable to win work

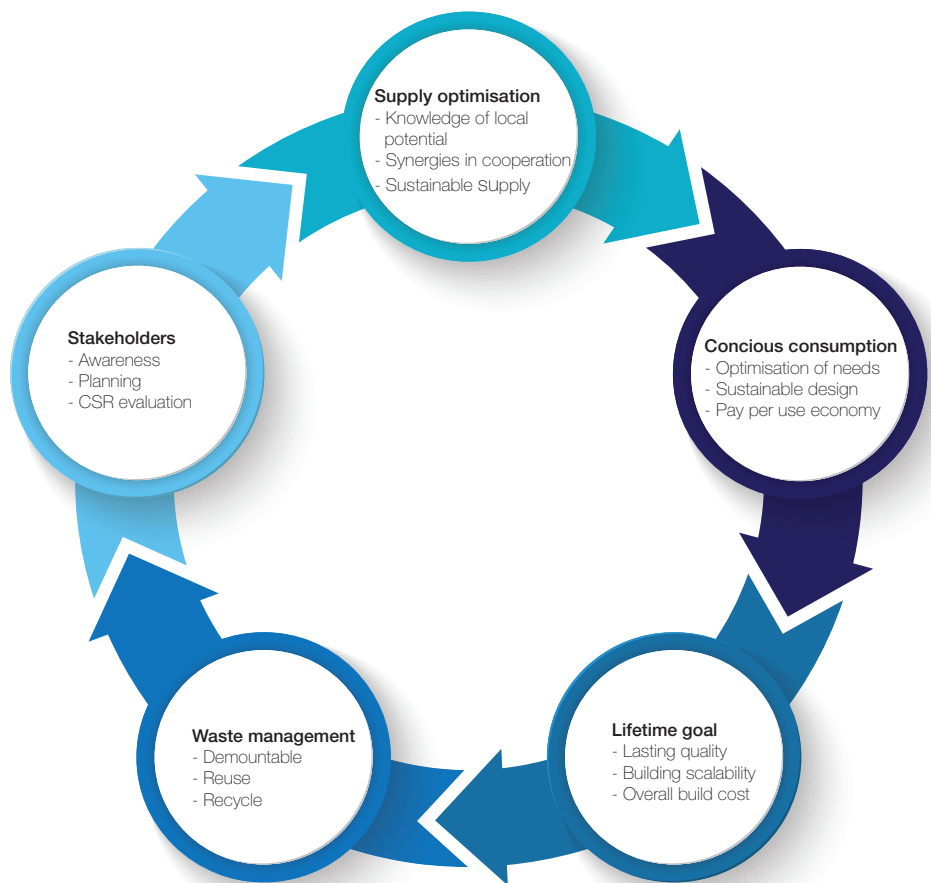
How did they think we might address these challenges?

- Educational engagement – links with universities and early recruitment via apprenticeships
- Upskilling - training existing staff/mentoring/peer to peer networking/enhancing roles/transparent career routes
- Greater diversity
- Flexible working
- Rapid culture change (industry/organisational)
- New routes into the industry
- Increased automation
- Increased use of data
- Outsourcing and off-shoring
- JV for talent (Shared services model)



Considerations

- How would you compete to attract and retain the workers you need in a very competitive market?
- How would rising salary costs affect project pricing? Could you pass these costs on to customers or would you have to absorb these in other ways?
- Can your supply chain afford to employ these workers and what does it mean if they cannot? Would major contractors have to employ them and allow others to use them for a fee?
- Are we a sector of choice for workers – how can we make certain we are?
- Are employers making the most of the workers they have? Could you upskill some of your workforce and how would you do this?
- Do we need to adopt modern methods of construction faster e.g. offsite, automation, to counteract the impact of a falling number of skilled trades people? What would need to happen to facilitate a more rapid adoption of these techniques?



Circular economy

What is the circular economy?

The construction industry has traditionally followed a take, make, dispose process. However, in order to preserve our ability to build in the future, there is a need to change the way resources are used.

Circular economy is a new way to design, build and operate within the planet's resources. The diagram above illustrates how the circular economy can impact the building industry.

In a circular model, buildings are made for a longer lifetime. Thus, designers should design components, systems and ultimately whole buildings in order to improve their service life. The maintenance, upgrading and refurbishment of buildings should also be prepared during the initial design. Material supply should use mainly recaptured materials and system components, while new materials should be mainly bio-based and fully recyclable. Circular business models centre on delivering performance, thus product providers like mechanical plants, lighting and fit out, can become service providers. Once used, building products can then be sold back to the supplier and re-used to meet other needs.

Why is circular economy so important for the construction industry?

The circular economy has to be looked at as a transversal leverage to build, renovate and manage sustainable buildings. It will facilitate better operational performance and utilisation of spaces; assets which maintain a higher value over the long term and material supply security.

It also presents existing businesses with opportunities and risks. Transforming established markets across the entire building lifecycle/value chain and forcing the entire project team to develop long term, more beneficial relationships. Circular economy will also radically change the demolition business, in order to maximize material asset value.

What did workshop participants think would be the impact of this driver?

- Encouraging re-use
- Prolonged building service life
- Real estate market re-shaped
- A local recycled building materials market
- A global recycled building materials market
- Recycled infrastructure
- Cheaper project costs
- Improved customer reputation
- Increased non-financial reporting pressures

How did they think we might address these challenges?

- Performance based contracts
- Closed loop
- Industrial symbiosis
- Push towards new business models
- Develop skills



Considerations

- How would you adapt to requirements for buildings with long lifecycles?
- How can your business prioritise reused materials and building components?
- Is your supply chain able to reuse and retain components for buildings and re-sell them after use?
- Are you ready to be paid based on your building's performance over time, rather than its initial cost?
- Can you develop long term partnerships to provide a building lifecycle service to your clients and improve an asset's environmental performance?

Automation and Autonomy

What is automation and autonomy?

The rapid adoption of autonomous and automated technologies such as robots, impacts how we deliver projects and the resources we need i.e. human, energy etc. The introduction of an autonomous workforce might not only have great impacts on efficiency during the construction process but would also improve health and safety on site. There are fears that the use of robots could have an adverse effect on the existing workforce who may lose their jobs as a result. However, it should be mentioned that many robot systems are still controlled by humans e.g. drones and new jobs are being created as a result e.g. drone pilot. Some activities, which require intuition and the ability to think on your feet, cannot currently be fully automated. This is where new human-machine cooperation solutions could emerge that combine human skills and new supporting technology e.g. smart glasses, exoskeletons.

In manufacturing (e.g. the automotive industry) automation is already in use to make processes more efficient and cost effective. In a static environment, robots carry out the same activity 24/7 to produce an identical product in large quantities. Automation offers incredible potential for the construction industry as it faces the demands of rapidly changing environments.

Currently construction is unable to realise the possibilities of automated production and construction sequences must be adapted to address this. A rethinking of the planning process will also be necessary in order for us to be able to use robotics profitably.

What did workshop participants think would be the impact of this driver?

1. Autonomous machines on-site
The most obvious impact is on the manufacturing processes themselves: on-site work is done by robots, drones and other automated and autonomous machines. With the sensor technology already available, existing machines of all kinds can be “tuned” to almost any intelligent automaton, i.e. robot. Autonomous rollers, trucks, semi-autonomous pavers, excavators and crawlers already demonstrate this today, especially in earthworks and road construction. For building construction and civil engineering, the first applications are emerging for the construction site, especially in logistics and the assembly of components.
2. Prefabrication and modular construction
There will be a push to prefabricate components offsite as much as possible in a protected and predictable environment and to minimise the necessary on-site work. Modular construction will support this trend and at the same time drive it forward.
3. Employee impacts and improved health & safety
A big impact will be on health and safety as physically demanding and hazardous jobs will be undertaken by robots; reducing the risk of accidents or health problems. As a result, work can also be carried out with fewer necessary safeguarding measures.
4. Integration of robots in design process/real time control
In order to optimise adoption, the use of robots must be considered in the design process, which will result in increased upfront project design. Processes must be created so that machines and robots can be controlled directly. This will require a much closer interface between design and execution, with new roles that focus on “design for manufacturing”. Permanent real-time control of processes and feedback will increase productivity.
5. Changed value propositions for customers
An improved construction process driven by automation and autonomy, leads to the advent of new value propositions for the customer. Adherence to time and budget and the absence of defects could indeed become standard and more reliable process planning can reduce risks and necessary contingents. This could lead to more competitive offers for the customer, or in higher margins for companies. It would also result in the drastic reduction of waste and carbon footprints.



Considerations

- How can the acceptance of new robotics systems in the construction industry be improved among employees?
- What new job roles will emerge to allow us to realise the potential of this trend?
- What adaptations in the design and work preparation process will be required to allow automation and autonomy in construction?
- What would need to happen to facilitate a more rapid adoption of these techniques?
- Will autonomous robot systems still need humans in the future? Which activities will be replaced first?
- Can you remain competitive without modern construction methods?
- Can self-learning algorithmic systems make operational businesses more productive?
- Cybersecurity – what risks must be considered due to increasing data flows and data dependency?

Platform business

What is a platform business?

A platform business is a business model that creates value by facilitating exchanges between two or more interdependent groups, usually consumers and producers. In order to make these exchanges happen, platforms harness and create large, scalable networks of users and resources that can be accessed on demand. Platforms create communities and markets with network effects that allow users to interact and transact.

This platform business model is considered by all technology and business experts as the most valuable type of business model. Companies building platform businesses scale more rapidly, grow revenues faster, generate higher profit margins and use assets more efficiently than companies using any other type of business model. In many respects, these new types of players, the “network orchestrators”, operate in ways that run counter to what we’re used to thinking of as the best practices of other business model.

A business model describes the rationale of how an organization creates, delivers and captures value. For a company of any size it shows ways to unlock long-term value while, over the short term, delivering valuable products and services. A business model isn’t just about how a company generates revenue. In short, a business model is a holistic framework to understand, define and design a business in the marketplace.

A business model can be described through nine basic building blocks that show the logic of how a company operates its business. The nine blocks (Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, Cost Structure) cover the four main areas of a business: customers, offer, infrastructure, and financial viability.

Platform business and the AECO industry

Nearly all Architecture, Engineering and Construction (AECO) organisations can be classified into one of four business models.

- **Asset builders:** these companies make, market, distribute, sell, and lease physical things.
- **Service providers:** these companies hire and develop workers who provide services to customers for which they charge.
- **Technology creators:** these companies develop and sell intellectual property such as software and analytics

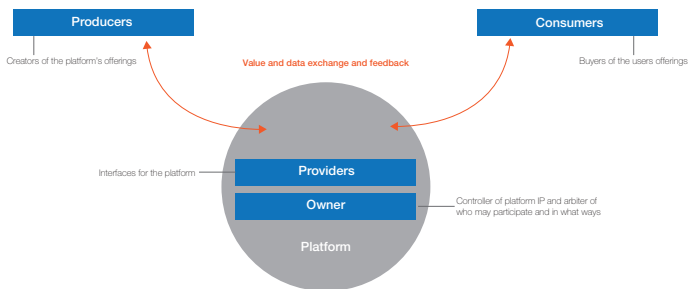
- **Network orchestrators:** these companies create a platform that participants use to interact or transact with many other members of the network. They may sell products, build relationships, share advice, give reviews, collaborate, and more.

The vast majority of Architecture, Engineering and Maintenance firms provide services to their clients, while Construction firms build physical assets. With difficulties to stay head of the competition, to grow and to maintain their margins, most of the large AECO firms look at Platform Business Models with envy. Yet, the transformation of a Business Model is a long journey and not all AECO firms are agile enough and have enough investment capabilities to pivot toward new business models.

Pure digital players like Airbnb, Amazon, eBay, Facebook, Google, Netflix, PayPal, Spotify, Uber, YouTube are already orchestrators of large networks. The growth, the profit and the scaling advantages of these network orchestrators result in unprecedented market valuations. Their businesses increase not by buying more assets, but by acquiring more users, which is a near-zero cost. Inspired by these phenomenal successes, innovators have started bringing platforms into an increasing amount of industries. This is happening already, in industries such as Telco, Food & Beverage, Transportation, ECommerce, Music, Banking, Insurance... It is possible that some of these players might, in the future, enter the AECO industry and disrupt it. It is already the case with companies such as Katerra.

Other types of companies, firms like Autodesk, IBM, Microsoft, Oracle, Salesforce, SAP are developing and making available digital technologies. The type of platforms they are offering are IT environments in which softwares are executed and information is managed. Within these environments, AECO players develop and build their own platforms for BIM, Project Management, CRM, HR, Procurement, etc.

In this context, we gradually see changes in the mindsets, the behaviours and the beliefs of the traditional incumbent players. In yesterday’s world, their business was run like a pipeline: what mattered was to control resources, to optimize them internally, and the focus was on the value delivered to the client. In tomorrow’s world, the business will be managed like a platform. What will matter will be how you orchestrate resources within a network, what will be important will be external interactions. The focus will be on the value delivered to the ecosystem as illustrated on the following page from Pipelines, Platforms, and the New Rules of Strategy, HBR, 2016.



What is currently happening

How Platform Business will change the AECO industry is hard to tell. We can see that AECO industry is at a tipping point. To avoid commoditisation, the largest global players are creating their own technology platforms, they understand that data is the most valuable asset they have. They are developing new service offerings, and conceiving new business models to deliver and capture value. They try to move up the ladder, from asset builders and service providers to technology creators & network orchestrators.

It is still difficult to predict what is going to happen. Business models scale differently, and network orchestrators grow revenues faster, generate higher profit margins and use assets more efficiently than companies using the other three business models. In many ways, network orchestrators operate in ways that run counter to what we're used to thinking of as the best practices of other business models. What we know is that it is a journey and that most of the current changes are invisible to the eye. The most essential ones affect the way the AECO industry is structured, not in the way building are built. First it was Digitisation, then it was Digital Transformation. Now comes a time of awareness: "data is an asset". At this point, some incumbent companies have launched their own platform initiative and are trying to create new ecosystems around them. In this new environment, roles and boundaries are changing or becoming blurry.

Views of participants

Workshop participants thought there is a possibility that the whole Architecture, Engineering, Construction and Operations (AECO) industry might turn towards Platform Business Models. They see the potential benefits across the lifecycle of projects: fewer resources, less waste, greater predictability, better quality, greater traceability, great productivity, better collaboration, better management of the built assets, etc. At a higher level, they think it implies new contracting mechanisms, a change in skill sets, new processes and standards, and new types of partnerships and alliances. They also asked themselves: who will be the providers of the platforms, who will the producers of the offerings (data/services), who will the consumers of the services, who will be the owners of these platforms.



Considerations

- How can I design a better value chain?
- Can I improve the existing cost structure?
- What is the distribution channel that can accelerate growth?
- Why is my company experiencing bottlenecks in certain areas?
- Is the organizational structure helping the company to grow as it should?
- What can my company do in order to offer and sell new services?
- How could my company better orchestrate my ecosystem, interact or transact with other members of its network?
- If I build a platform to offer new services, who will be the provider of the platform, who will be the producers of the offerings, who will the consumers of the services?

A plea for business model innovation within the construction industry to enable us to move forward



The construction industry and the businesses within it are facing radical changes, which come at an unprecedented speed. Many driving forces are at work - often in tandem with each other. The most powerful ones are technological progress, accelerated demand for (better) housing, working places and infrastructure services, as well as the dawning realization that we cannot continue to use virgin raw materials inefficiently for construction at this current rate. Furthermore, we must seriously start to decarbonize our industry. It is safe to say that players in construction will have to find answers, if they are to thrive in this business in the next decade.

Although we live in an era of seemingly unlimited information, which is available at our fingertips at the speed of light, foretelling the future is not possible. However, for the first time in human history, we are able to better understand the likely consequences of our actions.

Foresighting is an approach, which can – when done carefully and comprehensively – help to better assess the potential consequences of trends and driving forces for one's own business activities. This report attempts to demonstrate that and wishes to encourage decision makers to carry out similar exercises. Each business will have to develop its own strategies to adjust.

Taking our research forward

To help you with this process, the ENCORD Foresighting Work Group will continue to explore some of the driving forces in our study. The next steps for our research will be to tackle the topic of new business models including construction as a platform business. At our kick-off workshop in March 2019, participants chose business models and platform business as the number one area we should focus on. This interest in business models was also reflected in the workshops, where platform business was one of the topics most frequently chosen by participants when asked to consider the impact of a driver on their business. We are starting this exploration with a short outline of why as an industry we need to look at new business models and how digital data and a different culture could be a catalyst for change. This will allow us to cope better as the built environment becomes a complex ecosystem, driven by the increased integration of processes, materials and functions.

The transformation imperative: massive decarbonisation and reduction of virgin raw materials consumption
The construction industry is not without its challenges. Stakeholders seem to be stuck, and for decades we have been nurturing fragmented structures in the entire value chain. This has led to a silo mentality, which in turn, fostered adversarial pricing models and lack of collaboration. As a result, we have low productivity, low margins and significant

risks that are often difficult to assess. Risk has also been responsible for the low investment in R&D and innovation within the sector, as poor outputs, gave it a bad image and made it unattractive.

Society is increasingly concerned that the sector is not able to meet the imminent challenges. Technology is now available at low(er) cost, disruption is lurking everywhere and stakeholders have a better grasp of approaches such as circular economy. It has become obvious that technology alone will not provide the needed solutions. A new mindset is imperative, boosted by new business models.

The promises of Digital Transformation have now reached the Architecture, Engineering, Construction & Operations (AECO) industry. Up until circa 2015, Digital Transformation equated to Building Information Modeling (BIM) with its focus on the design phase and the digitisation of back office operations. This narrow view had to change, as what Digital Transformation really means is having all the relevant information readily available digitally. To replace our present hands on approach, digital data will have to be at the core of our business and all phases of project delivery will become data-centric, using digital data that can be widely processed.

However, to be truly successful this approach needs to focus beyond the operational level (optimisation of existing workflows, cost saving, higher productivity...), and embrace the strategic agenda as well – which may also lead to the transformation of business portfolios through innovation.

For AECO firms, creating alternative business models is key to survival. Until now, most companies who launch strategic initiatives - and attempt to move them mainstream - tweak at their existing business model until the initiative becomes somewhat financially viable at a desired scale. This tweaking will likely no longer suffice. Companies must now consider a more fundamental overhaul of their business models to create the necessary conditions for change.

We will all have to embrace the availability of vast amounts of digitised data and the opportunities that arise from it. We will need to foster the robotic applications that are just starting to become more adept in coping with the ever changing, uneven terrains and the typical contingencies of construction sites. We will also have to push for a circular economy - hitherto a promise based on the life-cycle approach - to reduce the carbon-footprint and the use and waste of virgin raw materials.

Digital Data - and the Culture to go with it are key

The AECO industry continuously generates massive amounts of complex, interrelated data for every project. Data is stored and archived in filed paper documents, 3D-models, RFIs, as schedules, costs, safety records, and more. However, as most of it is in silos and non-digital, it cannot be processed

to provide (quick) insights and alerts. As a result, we need to digitise just about everything - documents, news, music, photos, video, maps, personal updates, social networks, requests for information and responses to those requests, data from all myriads of sensors and robotic performances, and more. This will allow us to process data in mostly automated workflows to give us meaningful insights and enable us to handle the increasing complexity of the paramount challenges ahead.

Corporations are now starting to realise that digital, workflow-ready data is the lifeblood for their future operations. Comprehensive and integrated digitised data is key to the technological part of the transformation. Culture is also a pivotal success factor and companies must address deep rooted behaviours and underlying attitudes, if they are to make the transition to become a data driven business.

Considerations

Many technological conditions for a step change are available - but the ecosystem is not culturally ready:

- What needs to change from a cultural standpoint?
- What does the AECO industry need to do to make a step change? What about the Clients? What about the Finance Sector?
- Is your company ready for major transformative change and how are you preparing for this?

Who is ENCORD?

The European Network of Construction Companies for Research and Development (ENCORD) is a forum for all industry stakeholders whose main business lies in the construction sector.

Founded in 1989 ENCORD has become a major network for innovation in the construction sector. All members are leading companies and suppliers with a business focus in Europe, who are represented by decision-makers and executives working on research, development and innovation (RDI). Members are involved in many key sector projects and initiatives, such as the European Construction Technology Platform (ECTP). ENCORD is also a member of the "European Council for Construction Research, Development and Innovation (ECCREDI)".

The uniting devotion to RDI for the increased competitiveness and growth of all members is reflected by the mission statement of ENCORD:

"Our mission is to promote industry-led research, development and innovation in the construction sector."

What does ENCORD do?

- Sharing knowledge - ENCORD facilitates the exchange of experience and best practice
- Providing information - ENCORD delivers inputs for future strategic decision making
- Setting priorities - ENCORD influences the R&D agendas of corporates and authorities

Besides the ENCORD Council there are currently five Working Groups formed around some of the most relevant issues. ENCORD organises these Working Groups to exchange information on state-of-the-art construction research and to set the agenda for future activities. The Working Groups meet on regular basis and comprise ENCORD members as well as guests from ECCREDI, universities, and clients.

Who are the members of ENCORD?

The member companies are found regularly in the Top 50 European and Global Contractor lists and all together employ over 1.15 million people and have combined annual revenue of over 205 billion Euro.

The ENCORD board

Chairman, Norbert Pralle (Strabag)
 Menno de Jonge, Vice-President and Treasurer (Royal BAM Group)
 Franz Klager, General Secretary (Strabag)
 Juan Elizaga, Vice-President (Ferrovia)
 Thierry Juif, Vice-President (Bouygues)
 Ilari Aho, Vice-President (Uponor)





European Network of Construction Companies
for Research and Development