



The Problem with Construction

and the Digital Opportunity

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DIGITAL TECHNOLOGY AND DATA ARE TRANSFORMING OUR WORLD.

As a consumer, you have probably experienced big changes to the way you shop, bank and consume media. You expect instant access to information, fast online-processes and consistent service.

Lots of industries have been revolutionised, entirely new companies have risen with new business models, and old companies that couldn't change fast enough have disappeared.

In contrast, the basics of the construction industry have been slow to change. The way that most construction sites are run hasn't fundamentally changed in decades. Paper rules and processes are manual. The way that buildings and infrastructure are designed has changed, from paper-based drawing to computer aided design.

However, the underlying work that designers, engineers and clients do is largely the same, and in many projects does not take real advantage of the new digital world. Research by the McKinsey Global Institute on construction reported that the construction industry had made little productivity improvements in the last 60 years.

Over the same time period, other industries such as manufacturing, retail and even farming have all seen large improvements.

The conclusion was that construction productivity can be greatly improved, and that 'infusing' digital technologies into construction processes would cause a 14-15% improvement to construction industry productivity.

That level of savings is in line with our experience and translates into large, real world savings on projects that do use technology effectively both in design and on-site.



**THE CONSTRUCTION
INDUSTRY HAD MADE
LITTLE PRODUCTIVITY
IMPROVEMENTS IN
THE LAST 60 YEARS**

IT IS NOT JUST PRODUCTIVITY (AND THEREFORE PROJECT COST) THAT CLIENTS CARE ABOUT.

THE TRADITIONAL APPROACH TO DESIGN AND
CONSTRUCTION FAILS CLIENTS IN OTHER WAYS.

Projects are typically late and over budget.

For large projects, the typical average is 20% late and 80% over original budget.

The traditional approach is error prone.

There are design clashes and problems to be resolved on site (adding delays and inefficiency) and often lots of snags to be resolved. An off-site manufacturing approach can deliver big improvements in quality if the design and manufacturing are well aligned.

The real needs of the users of the building often aren't brought into the design process.

Yet modern 3D design and virtual reality allows the users of the buildings to really experience what it will be like during the design process, so that a building can be designed to really fit its use.

Disruption to neighbours or existing operations during construction can be high.

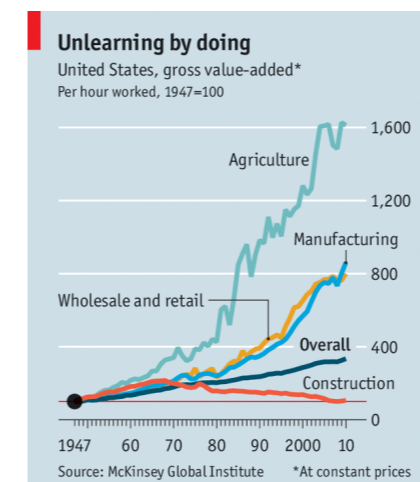
Digital design approaches allow construction plans to be visualised over time (4D), so that options to reduce disruption can be found, and problems headed off well before they hit.

The long-term running costs of a piece of infrastructure are often a multiple of the cost to build it.

Yet real design for maintenance (which could make the building cheaper and easier to run) is rarely done, and the data generated in design is usually not handed over to the people who will maintain things after construction.

So, there is a very large opportunity for digital construction that gives clients much more efficient, on-time, on-budget, lower disruption and higher quality building works, that are also cheaper to maintain. Given all that, you would expect the industry to be changing to digital at a rapid pace. Yet the pace of change in construction has been slow.

Why is that? Perhaps it is that the traditional industry is very profitable, and so construction companies are reluctant to change?



The McKinsey research showed that construction was the second least digitised industry, just above agriculture, but way behind media, IT and retail.

Well, no. When you look globally, and in major countries you see that the major construction companies work on tiny margins, despite the large risks they take on.

For example, in 2017 the UK's 10 biggest contractors made a combined margin of less than half a percent on turnover of £31bn.

Part of the reason that the industry has been slow to change is that the traditional approach splits the procurement of the services you need into multiple phases and services (master planning, architecture, engineering of various kinds, project management, construction supervision, main contractor and layers of sub-contractors) generally all bought separately.

There is little opportunity for a group of companies contracted like that to come up with a joined-up, slick and efficient digital process. There is nobody looking end-to-end and making sure that the whole, complex process is orchestrated well. The traditional approach also provides no incentives, or even perverse incentives, for the companies involved to adopt digital processes.

For example, in many markets the design services have been typically paid for as a % of project cost. That incentivises people to make the project cost higher, which is surely not in the clients' interest!

Similarly, paying companies for hourly paid staff means that they have every incentive to be inefficient, using more hours, rather than trying to drive down the amount of effort to deliver a project.

The Digital Opportunity

Digital technology can be a real help in a complex design and construction project.

Using the technology well allows clients to be better informed, to make better decisions, to take time and cost out of the process, to design better, and to join-up all the disparate companies and tasks to reduce delay, errors, risks and costs and potential claims.

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You can use an eraser on the drafting table or a sledge-hammer on the construction site

- Frank Lloyd Wright

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Frank Lloyd Wright, the famous architect said in the 1930's that: "You can use an eraser on the drafting table or a sledge-hammer on the construction site". This still applies in a digital world, but even more so.

Rather than finding problems on the construction site, with a digital approach, everything about the design and the project can be simulated step-by-step and problems solved more cheaply using the digital equivalent of an eraser as it is only information that needs to be changed.

This saves a lot of time and cost during the actual construction.

Building digital technology into the design can also make buildings, roads and other infrastructure "smart" which should provide benefits long after construction finishes.

Digital construction technology includes:

- Digital surveying, geolocation and drones
- 5D Building Information Modelling
- Digital Collaboration and Mobility
- The Internet of Things and Smart Cities/ Transport/ Buildings

These are all described in more detail further on. But first it is important to understand the benefits.



Digital construction lowers risks, costs and disruption and improves long-term asset values

All this technology exists today, and it works. The companies sponsoring this publication use the technology and find that it helps their construction projects, if used well.

The “if used well” bit is important. The technology on its own won’t necessarily make projects better unless the way-of-working for a project takes advantage of the new technology to deliver a better result. This requires the project team to be set-up for a modern approach.

THE OPPORTUNITIES THAT DIGITAL TECHNOLOGY BRINGS TO CONSTRUCTION ARE SUBSTANTIAL FOR ASSET OWNERS AND DEVELOPERS, AS WELL AS CONSTRUCTION COMPANIES.

Lower risk, time and cost

A major construction project requires lots of decisions to be made by many different experts.

Getting those decisions right using data and keeping everything in the project joined-up has a major impact on risk and cost by reducing errors, decisions that must be changed in construction and clashes in the design elements.

Using a 5D Building Information Modelling process with good data, such as digital surveying, geolocation, cost data, and a collaborative approach (enabled by collaborative digital technology) gives the project the best chance of success.

A digital by default way of working

Leading architects and engineers have already moved to a “digital by default way of working” where model-based design, integrated data and cross-discipline working is either the only way they will work, or one they strongly recommend to clients.

Our experience is that a digital approach can reduce the design cost of a project and more often a better design is produced using digital technology, that saves time, cost and reduces risk in the construction phase. Fewer clashes, problems, mistakes and changes help the construction to be on-time.

A better-quality design, developed using a 5D Way of Working approach, makes a more easily buildable design (perhaps with more factory-built modular components). Simulating the building in virtual reality allows users and operators to affect the design, to make it a great building that meets their needs exactly.

Simulating the construction process enables construction planning to be easier, and design for manufacture and assembly to reduce the time, cost and risk of construction. When looked in at the total cost of a project, less than 10% of it is in design. We typically see savings of 10%-15% of construction cost being achievable from where the project would otherwise have ended up.

So spending a bit more on a better design that reduced costs and problems can have a big payback, we see as much as a x10 return on investment from a digital by default way of working in design, particularly if some design effort is spent on making the building cheaper to run and maintain.





Blackpool Police Headquarters in the UK provides office space and a 42-cell custody suite to hold suspects.

Simulation for a better headquarters

The project started in 2015, opened just 3 years later and won the Best Public Service Building Award 2019 (awarded by North West Building Excellence Awards).

The police aspirations were for a flexible building that was affordable and efficient in use. The constructed building would use modern technology to provide an agile working environment, tailored to individual users and teams. The ability for visitors, members of the public reporting crimes,

police staff and prisoners to all be dealt with securely with minimal staff was important.

McBains (a multi-disciplinary, digital by default firm) provided the architecture and engineering. In the design process the real-life users of the building simulated doing their jobs in virtual reality.

The journey to the custody suites for example, and enabling privacy for visitors reporting crimes, whilst allowing a single Desk Sergeant to monitor security and intervene easily if trouble broke out.



Improved asset value

- Smart technology enables better control and more information for decision making.
- Smart motorways reduce congestion and can get more traffic through the same road space by using the hard shoulder.
- Smart buildings can use energy more effectively for heating and cooling, saving money as well as the environment.
- Smart technology can be used to reduce maintenance by predicting when systems are starting to fail and fixing them proactively.

A fundamental reason for embracing smart technology is that it increases asset values for owners. An asset that is of lower cost to run, lower risk or simply better understood, will have a greater value than an equivalent asset where performance, running costs or risk are worse or not measurable at all.

Just think about two identical assets, one that comes with a wealth of data on usage, costs and the design, and the other that comes with no documentation at all. Which would you pay more for?

Reduced disruption

When construction work is changing an existing asset or site, then disruption to the existing operations can cause real problems; traffic queues during roadworks, late trains during rail works, lost production during factory site construction, or lost sales for businesses.

Using a digital construction approach, the construction process can be simulated in 4D, testing the designs and project plans with the whole team and seeing the problems before they occur.

This enables a better project, with problems solved before they occur and disruption managed or mitigated as much as possible.



Reduced Disruption: Stopping Clashes in Time

4D simulation brings a model of a construction project together with the plan and the requirements for machinery access and space to ensure that the design is buildable and the plan is realistic. It can be particularly valuable when disruption to an existing business is part of the challenge.

For example, Pell Frischmann worked with London City Airport on 12, nose in/push back parking stands at the airport. Four existing, non-compliant stands had to be upgraded and eight new parking stands built on a new structure over water.

The original plan had a high risk that the original capacity of the airport would be reduced during construction, and that delays to a new baggage handling facility would knock-on to a delay in getting the additional capacity to go live.

The solution involved de-linking the baggage and aircraft space projects, and resequencing construction, with a rapid interim phase to add space and guarantee that capacity was protected throughout.

The approach accelerated the delivery of the extra capacity to be six months earlier than it would otherwise have been and reduced the risk of disruption.



Our Recommendation

To get the benefits of digital construction, make sure that the companies you hire understand the technology, know how to use it, and are good at collaborating with others in the supply-chain to use data and technology well. It is also important to think about the procurement process, the commercial incentives, and how you buy all the things you need for a successful project.

The companies that have sponsored this publication are all highly experienced in using digital technology. Get one of them to share their experiences with you, and to help you work out what is best for your project.

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