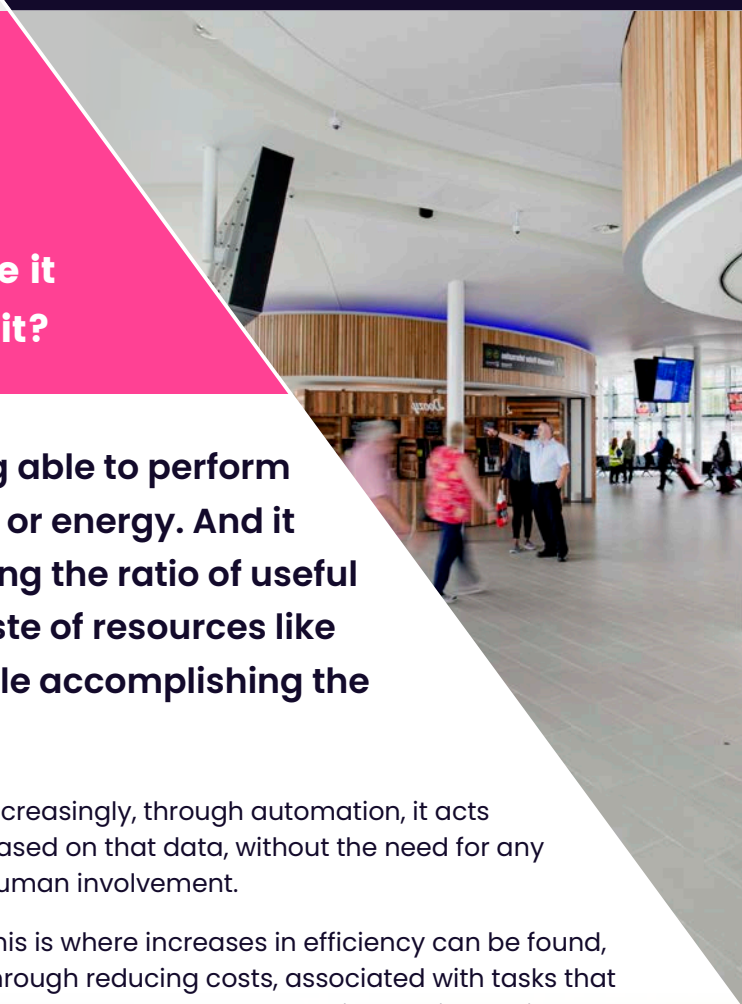
Efficiency, Industry 4.0 and Infrastructure Projects

Efficiency is the overriding commercial imperative for businesses. But how precisely do we define efficiency, how can we measure it accurately, and how can we increase it?



Basically, efficiency is the quality of being able to perform a task successfully, without wasting time or energy. And it is a measurable concept, determined using the ratio of useful output to total input. It minimises the waste of resources like physical materials, energy, and time, while accomplishing the desired outcome.

The increasing use of technology and the vast computing power at mankind's disposal means that it is now possible to use that power to increase performance gains and capture cost savings. This is known as Industry 4.0 - a massive development shaping industry today that connects machines, people, and physical assets into an integrated digital ecosystem that seamlessly generates, analyses and communicates data to improve efficiency.

Increasingly, through automation, it acts based on that data, without the need for any human involvement.

This is where increases in efficiency can be found, through reducing costs, associated with tasks that can be automated, and helping capital projects finish on time and on budget with less disruption, fewer surprises and increased predictability.

Singular Features of Engineering and Construction

This is especially important in industries like engineering andconstruction, which have unique specifications, as well as different locations, partners, customers and schedules.

PwC estimates that within 10 years, full-scale digitisation could lead to savings in the E&C industry of up to £1 trillion, or 21% in the Design, Engineering and Construction phases and £850 billion in the Operations phase of infrastructure projects.

The World Economic Forum says that E&C is the largest consumer of raw materials and other resources on the planet, using about 50% of global steel production and more than 3 billion tonnes of raw materials every year. Any improvement in productivity via the adoption of innovative processes would have a major impact.

The WEF says a 1% rise in productivity worldwide could save £850 billion a year.

But the E&C industry is notoriously conservative and has been hesitant about actively embracing the latest technological opportunities. The problems include the fragmentation of the industry, inadequate collaboration with both suppliers and contractors, the difficulties in recruiting a talented workforce, and insufficient knowledge transfer from project to project.

New Technology and Equipment

Some areas where new technology could be crucial in increasing efficiency include semi-autonomous construction equipment. Unmanned aerial vehicles, low-cost sensors, remote operations and autonomous control systems could enable significant increases in efficiency.

Autonomous equipment makes use of sophisticated digital tools and new technologies such as out-of-sight drones, leaving only monitoring roles for the human worker. Semi-automated equipment offers reduced construction costs, due to shorter delivery times and increased productivity; higher quality, thanks to higher accuracy, and fewer errors in workmanship and improved safety, by keeping workers out of danger zones, and so forth.

The continuing development of 3D printing is expected to have a huge impact on the construction industry. The technology promises productivity gains of up to 80% for some applications, together with vast reductions in waste. Construction time for some buildings could shrink from weeks to hours, and customised components could be provided much more cheaply.

Smart and life-cycle-optimising equipment is being pushed forward by technological advances, which are driving down the cost of sensors, data storage and computing services. In transportation, smart technology is allowing smarter transport and smarter parking. In housing, connected and smart devices are gaining popularity. And by interconnecting people, machines and data, smart-building equipment is contributing powerfully to the optimisation of the operations and maintenance (O&M) of buildings.

Collaboration through BIM

Building Information Modelling (BIM) is becoming considerably more important as a platform for central integrated design, modelling, planning and collaboration. BIM provides all stakeholders with a digital representation of a building's characteristics – not just in the design phase but across its life.

Most importantly BIM allows collaboration amongst all stakeholders – from early design through to O&M and even to the decommissioning phase – and offers the promise of large gains in efficiency.

All stakeholders can contribute information to and extract information from the central model. By providing a lifelong view of construction projects it offers companies huge benefits in the commissioning and operations phase.

Such a full life-cycle BIM eventually produces a continuous build-up of knowledge by enabling a seamless flow of information across different construction phases and stakeholders. By providing a neutral and unbiased viewpoint, BIM can also contribute greatly to creating a level playing field and offering more effective dispute resolution, if necessary.

One of the problems plaguing the E&C industry as a whole is a lack of adherence to general standards. Adherence to standards helps to ensure that products are safe, inter-operable and good for the environment.

Harmonisation of Standards

The harmonisation of technical specifications of products and services can make industries more efficient and can break down barriers to trade. The construction industry as a whole lacks effective global arrangements on standards. As a result, it has given up productivity gains that the modernisation of the industry might have brought. And it could, in the future, forfeit the potential that comes with new digital technologies: if it remains such a fragmented industry, unable to agree on internal standards, it is hardly likely to have much influence in determining cross-industry standards in the future.

The E&C sector, as a whole, should take concerted action. The industry needs to see standard interfaces between prefabricated modules and components, which would enhance system compatibility, provide economies of scale for suppliers and act as a powerful driver of productivity.

The industry also needs to see the standardisation of definitions of costs, classifications and measurements across the whole project life cycle, that will lead to greater comparability and compatibility among projects.

Standards in software systems, communication protocols and interfaces will help to facilitate the digitalisation of the industry. But companies will have to establish standards in computer code for robots and automated construction equipment, and in interfaces between different systems such as BIM and geographic location systems.

Increasingly Complicated and Increasingly Connected

Pressure is increasing on companies to join forces to create new products and services in a world that is becoming increasingly complicated but inter-connected. That increasingly applies to fragmented industries such as E&C, which has so many different facets and potential challenges.

But it is not so easy to put this into practice.

To promote partnerships or even informal sharing among individual companies on large-scale projects, which typified many infrastructure projects, a wide-scale approach is needed. Increased sharing of knowledge amongst peers can help close the gap between new technological development and its application.

New technologies arrive with increasing frequency, but the fundamental challenge to the E&C industry remains the same: the delivery of high-quality capital projects, safely, at a sensible cost, on time and on budget.

Defining Goals and Challenges

When deciding where and how fast to use Industry 4.0, companies need to define their goals and challenges, decide which digital strategies could meet those goals, then do a cost-benefit analysis. Through this process, it is possible to evaluate opportunities to establish a budget for implementing each digital strategy on a pilot project basis.

Companies can also track savings and measure a worthwhile return on the initial investment, through lower costs of delivery, additional revenue, or expanded efficiencies. Finally, a business can identify which strategies are the most effective and repeatable and scale up the initial investment to allow those benefits to multiply.

The Engineering and Construction sector is bound to remain a cornerstone of the world's economy and of almost all other industries, since they rely so heavily on buildings and infrastructure. Our homes, our workplaces and the means of travelling between them are all components of the built environment.

Change is Coming

While E&C has been slower than other industries to adopt new technology, it is beginning to undergo a transformation. Labour productivity is on the increase and should continue to increase once new digital technologies are more widely adopted.

The new era in construction will bring great benefits to society generally, by reducing construction costs and adverse social effects; for the environment, by improving the efficient use of scarce materials or by reducing the adverse environmental impact of buildings over time; and for the economy, by narrowing the global infrastructure gap and boosting economic development.

By adopting the Industry 4.0 approach of collecting and analysing data, companies can discover insights to improve their systems and develop new and innovative business models and relationships with suppliers. Although this transformation will not necessarily be easy, the technology is available to support companies through this transformation, making them more responsive to their markets, and ultimately more efficient, to everyone's benefit.

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