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IMPACT OF DIGITAL TRANSFORMATION ON THE CONSTRUCTION INDUSTRY

VPLYV DIGITÁLNEJ TRANSFORMÁCIE NA ODVETVIE STAVEBNÍCTVA

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Abstract

The construction industry serves almost all other industries, as all economic value creation occurs within or by means of buildings or other “constructed assets”. As an industry, moreover, it accounts for 6% of global GDP. It is also the largest global consumer of raw materials, and constructed objects account for 25-40% of the world’s total carbon emissions. New technologies in the digital space, for example, will not only improve productivity and reduce project delays, but can also enhance the quality of buildings and improve safety,

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working conditions and environmental. Tremendous opportunities are available through the application of new technologies, materials and tools.

The main aim of this article is to point out the internal challenges of the construction industry transformation framework.

Key words: innovative technologies, digitalization, strategy and business model innovation

Abstrakt

Stavebníctvo slúži takmer všetkým ostatným odvetviam, keďže všetka ekonomická hodnota sa vytvára v rámci alebo prostredníctvom budov alebo iných „vybudovaných aktív“. Ako priemysel navyše tvorí 6 % svetového HDP. Je tiež najväčším globálnym spotrebiteľom surovín a postavené objekty tvoria 25 – 40 % celkových svetových emisií uhlíka. Nové technológie v digitálnom priestore napríklad nielen zlepšia produktivitu a znížia oneskorenia projektov, ale môžu tiež zlepšiť kvalitu budov a zlepšiť bezpečnosť, pracovné podmienky a kompatibilitu so životným prostredím. Vďaka použitiu nových technológií, materiálov a nástrojov sú k dispozícii obrovské príležitosti. Hlavným cieľom tohto článku je poukázať na vnútorné výzvy rámca transformácie v stavebnom odvetví.

Kľúčové slová: inovatívne technológie, digitalizácia, stratégia a inovácia obchodného modelu

Introduction

One of the few industries that are yet to see many significant technological transformations is construction, the least digitized sector in Europe according to McKinsey's digitization index. The new era in construction will bring great benefits: for the wider society, 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 in general. All stakeholders along the value chain – individual companies, the industry (and associated experts in civil society and academia) and governments – should take action to move the construction industry forward. [1]

It then introduces a conceptual industry-transformation framework, listing several measures, grouped in eight topical areas that would profoundly change the industry system. The measures are classified into three groups: measures taken by private companies on their own; measures taken by companies in collaboration with their peers – or by the industry as a whole; and measures taken by the government, acting both as the regulator and as a major project owner. The eight topical areas are:

- Technology, materials and tools
- Processes and operations
- Strategy and business model innovation
- People, organization and culture
- Industry collaboration
- Joint industry marketing
- Regulation and policies
- Public procurement

The “Future of Construction Project” requires the commitment and encouragement of many active participants in this industry – people who believe in a modern E&C (Engineering and Construction) industry that will benefit all. [2]

Industry is Crucial to Society, Economy and Environment

- Societal relevance

Construction is one of the first businesses that humankind developed, and it continues to shape our daily life in unique ways. Virtually all other businesses rely on the construction industry to provide and maintain their accommodation, plants and infrastructure, and construction is a determinant of where and how almost everyone lives, works and plays. For nearly the entire population of the world, the built environment heavily influences quality of life.

So the building and the materials used in its construction and finishing have a major impact on the health and well-being of its occupants.

- Economic relevance

With total annual revenues of almost \$10 trillion and added value of \$3.6 trillion, the construction industry accounts for about 6% of global GDP. More specifically, it accounts for about 5% of total GDP in developed countries, while in developing countries it tends to account for more than 8% of GDP. The industry is expected to grow greatly in the coming years, to estimated revenues of \$15 trillion by 2025. More than 100 million people are already employed today in construction worldwide.

For countries to enjoy inclusive and sustainable growth, modern and efficient infrastructure is essential. According to a 2014 estimate by the International Monetary Fund, if advanced economies invested an extra 1% of GDP into infrastructure construction, they would achieve a 1.5% increase in GDP

- Environmental relevance

The construction industry is the single largest global consumer of resources and raw materials. It consumes about 50% of global steel production and, each year, 3 billion tons of raw materials are used to manufacture building products worldwide.

About 40% of solid waste in the United States derives from construction and demolition. Throughout the world, such waste involves a significant loss of valuable minerals, metals and organic materials – so there is great opportunity to create closed material loops in a circular economy. As for energy use, buildings are responsible for 25-40% of the global total, thereby contributing hugely to the release of carbon dioxide.

Value therefore lies in improving the quality of construction and the quality of materials used, in contributing to a healthier indoor environment, increasing its sustainability and reducing its cost. Any endeavor towards this goal will generate welcome benefits – whether for families investing in their first private home or governments embarking on a giant infrastructure project.

Construction Industry – Time for Transformation

For instance, 81% of the industry representatives believe that digitalization will improve the productivity of the construction sector. Mostly because none of the challenges the industry faces will work themselves out – projects aren't becoming smaller and easier to operate, the need for skilled labor, environmentally sensitive construction, and improved communication requires changes in traditional practices. Above that, the pressure for change is also coming from:

- ▶ evolving client expectations;
- ▶ new technological capabilities;
- ▶ a new generation of more tech-savvy craftsmen and professionals;
- ▶ the booming construction start-up environment; and supportive legal frameworks.

New opportunities are emerging as transformative developments reshape the E&C industry – from innovative technologies to revolutionary construction techniques. Productivity and efficiency will surge. It is up to industry to embrace these new opportunities more vigorously and change the way it has traditionally operated.

So, before you move on to implementing construction digital transformation, it's important to clear up two key questions. First, WHAT is still preventing the construction industry from speedy adoption of technologies? This may help you reveal what challenges your company has, in particular. Second, HOW the digital transformation can address challenges in each part of the value chain. This may help you discover new opportunities for future growth. The digital transformation itself is not an easy task. Digitalization of such a conservative industry as construction is a double burden – it faces many industry-specific challenges. [3]

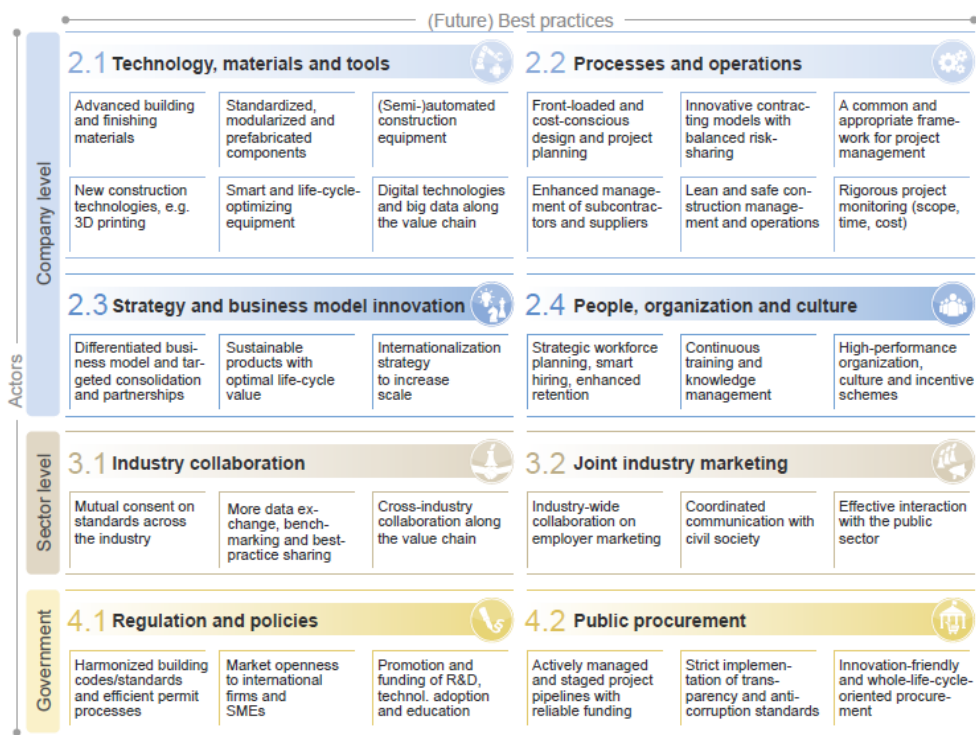


Fig. 1 - Industry Transformation Framework
Source: [4]

Given all the advantages and internal challenges, the construction industry should act in several areas. A comprehensive approach is outlined in the industry transformation framework show in Figure 1.

Technology, Materials and Tools

Materials constitute an extremely powerful lever for innovation. The European Commission estimates that 70% of product innovation across all industries is derived from new or improved materials. With approximately one-third of construction cost attributed to building materials, the scope for applying advanced building materials (ABMs) is considerable.

E&C companies should build up relevant competencies in-house and create a database of evidence on the applicability and benefits of ABMs, to be able to provide clients with a convincing quantitative case for using ABMs. Afterwards, contractors should institutionalize the knowledge transfer to local project teams, so the decision-makers at a project level have all the relevant up-to-date information and can thereby optimize their decisions on materials.

The solutions emerging from the building material industry are numerous and wide-ranging – from the incremental innovation of traditional materials and existing characteristics to the generation of new material combinations with additional multifunctional characteristics, to radically innovative materials with entirely new functionalities.

Standardized, Modularized or Prefabricated Components

Productivity in construction could receive a substantial boost from standardization, modularization and prefabrication. The standardization of components brings many benefits, including a reduction in construction costs, fewer interface and tolerance problems, greater certainty over outcomes, reduced maintenance costs for end-users, and more scope for recycling. Modularization adds to the advantages of standardization, by increasing the possibilities for customization and flexibility, and helping to realize the potential of prefabrication in a factory-like environment. Prefabrication would increase construction efficiency, enable better sequencing in the construction process and reduce weather-related holdups; by such means, it becomes possible to reduce a project's delivery times and construction costs relative to traditional construction methods, and to create safer working environments.

New Construction Technologies

The development of 3D printing is expected to have a disruptive impact on the construction industry. Technology enables the production of purpose-built shapes that cannot be produced by any other method; it promises productivity gains of up to 80% for some applications, together with an important reduction in waste. Construction time for some buildings could shrink from weeks to hours, and customized components could be provided at much lower cost.

At present, 3D printing is still mostly applicable to low-volume, high-value parts. It remains to be seen how quickly companies will overcome the main technological challenges, and whether they will be able to bring down costs and achieve economies of scale.

Smart and Life-Cycle-Optimizing Equipment

The concept of smart building is gaining in popularity. This is in part due to technological advances, which are driving down the cost of sensors, data storage and computing services. At the same time, potential customers are showing increased interest, attracted by the widening adoption of connected devices, and are demanding greater energy efficiency in buildings and improved safety and convenience. As for the owners or end-users of buildings, they stand to gain several benefits: reduced operating costs, through a likely 20-40% reduction in energy usage; greater comfort, thanks to improved lighting and temperature controls, for instance; and increased operational efficiency, partly by means of remote service.

Digital Technologies and Big Data Along the Value Chain

Digitalization – the development and deployment of digital technologies and processes – is central to the required transformation of the construction industry. Innovations of this kind enable new functionalities along the entire value chain, from the early design phase to the very end of an asset’s life cycle at the demolition phase.

These digital technologies also facilitate the adoption or enhanced application of many of the other innovations, such as prefabrication, automation and 3D printing, and should help to improve various processes in the industry, such as front-loaded design and planning or project management in general. For instance, advanced project planning tools use complex mathematical modelling to optimize the allocation of construction staff and individual roll-out functions for infrastructure projects.

When it comes to digital transformation, we know that acceleration generates profitability. However, business leaders in construction are still unsure of how to speed up their digital transformation efforts.

There are several practices that construction business leaders can undergo when accelerating their digital transformation journeys. These practices will ensure a more accelerated and streamlined pilot stage and deployment process. [5]

Technologies to support digital transformation have developed significantly over the last ten years and have been designed to meet specific construction needs. The construction industry is undergoing a substantial transformation shaped by innovations, challenges, and other factors that are forcing building companies to change the way they work and deliver their projects. [6]

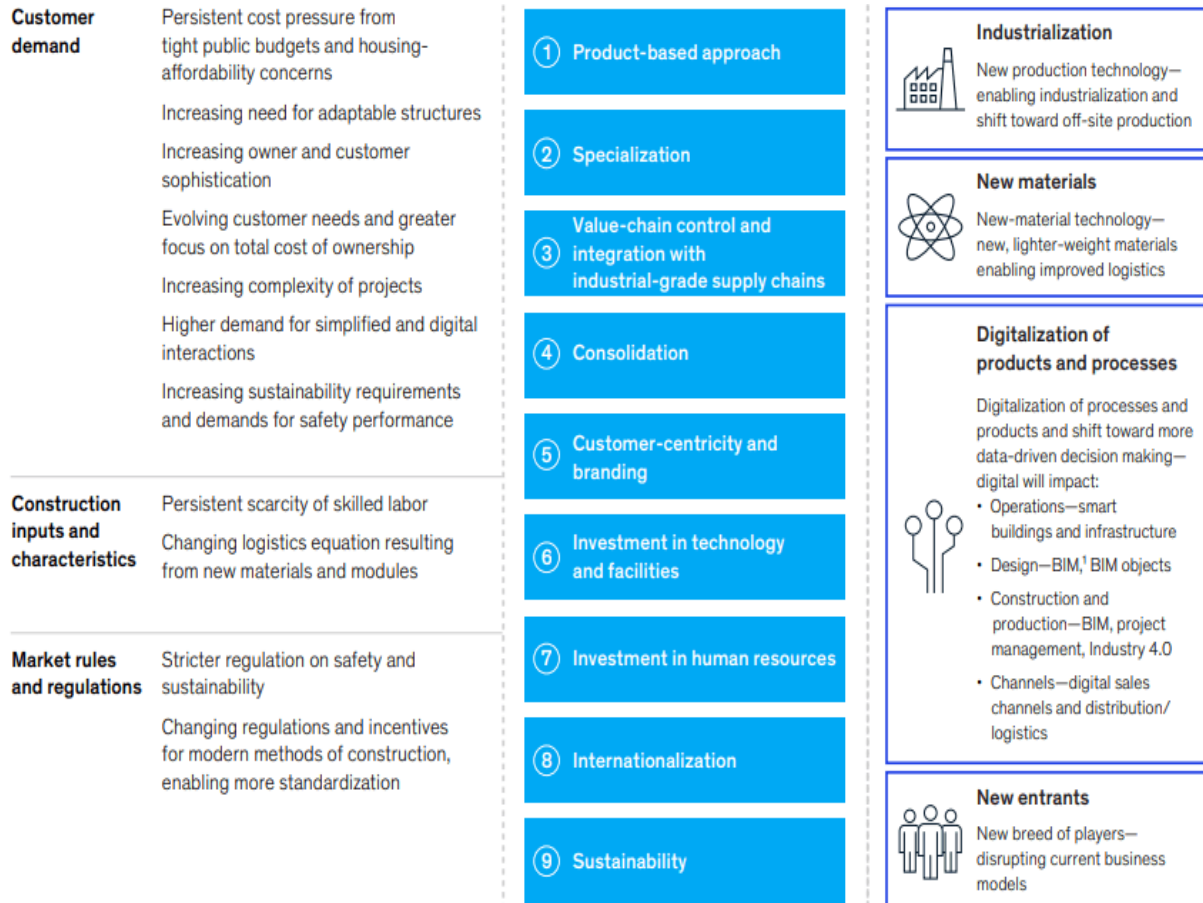


Fig. 2 - Changing in the Industry and Transform Ways of Working
Source: [3]

Benefits of Digital Transformation in Construction

The advent of digital technologies has brought about a swift transformation at construction sites. digital transformation can result in productivity gains of 14 to 15 percent and cost reductions of 4 to 6 percent. In this article, we offer a closer look at how E&C companies can realize benefits like these. The pace of change in our world is accelerating. In recent years, digital transformation has swept through nearly every industry, offering accelerated productivity, enhanced efficiency, and cost savings. However, amidst this digital revolution, the construction industry remains one of the least digitized sectors, despite its immense potential for transformation and the opportunities it presents for workers and clients alike.

For those who have embraced it, digitalization has opened new horizons. Civil engineers and construction experts now have access to real-time insights into project progress, thanks to data captured by sensors such as cameras and laser scanners. These technological advancements allow for a detailed comparison with the 3D model of the desired outcome, enabling better decision-making and more efficient project management.

1. *Elevating Customer Loyalty*: Digital technologies enable construction companies to offer personalized interactions and services, fostering stronger connections with clients. From customer relationship management systems to responsive chatbots, digital tools enhance customer satisfaction and loyalty.

2. *Streamlining Planning and Design:* Digital tools like BIM streamline the planning and design process, facilitating collaboration and visualization. Detailed 3D models enhance decision-making and productivity, leading to improved project outcomes.
3. *Enhancing Safety Protocols:* Drones and sensors allow construction companies to monitor job sites in real time, improving safety and efficiency. By leveraging digital insights, firms can proactively address safety risks and ensure compliance with regulations.
4. *Accelerating Decision-Making:* Real-time data and analytics empower stakeholders to make informed decisions quickly. Digital tools provide visibility into project performance, enabling efficient resource allocation and budget management.
5. *Fresh Income Avenues:* Embracing digital transformation enables construction enterprises to explore novel revenue streams via inventive products and services. Leveraging advanced digital technologies, firms can manufacture prefabricated modules off-site, optimizing costs in the process.
6. Moreover, this evolution supports *the development of smart buildings*, integrating state-of-the-art technology to enhance energy efficiency, occupant comfort, and operational effectiveness. Construction firms can also harness digital platforms to provide clients with virtual project visualization through comprehensive planning and design solutions.
7. *Driving Cost Reduction:* Technology and automation streamline processes, reducing inefficiencies and manual labor. Project management software and analytics optimize resource allocation, leading to cost savings and improved profitability.

Promoting Environmental Sustainability: Digital technologies support sustainable construction practices, from eco-friendly designs to optimized resource utilization. By embracing digital transformation, construction companies can reduce their environmental footprint and contribute to a greener future. [7]

Conclusion

Looking at the economic reality of the present, but especially the future, new conceptual and critical thinking is necessary. In this context, the adoption of the principle of pulsation and qualitative leaps as well as the principle of a new causal relationship architecture, interdisciplinary, and the attempt to see the whole causal relationship of direct organic coexistence, lead to the need for a different view of the economy and society and their mutual integrity. [8]

The construction industry has vast potential, however, for improving productivity and efficiency, thanks to digitalization, innovative technologies and new construction techniques. Consider the rapid emergence of augmented reality, drones, 3D scanning and printing, Building Information Modelling (BIM), autonomous equipment and advanced building materials – all of them have now reached market maturity. By adopting and exploiting these innovations, companies will boost productivity, streamline their project management and procedures, and enhance quality and safety.

Many of the issues and challenges are common across the construction industry, but overall, the industry remains very diverse and fragmented. Companies must choose the innovations and action areas that best suit their own ambitions and their clients' needs. We are on the verge of a substantial paradigm shift which is fueled by the appearance of innovative construction technology startups and their effort to build new tools and applications which will eventually transform the way companies design, schedule and operate projects. [9]

New opportunities are emerging as transformative developments reshape the E&C industry – from innovative technologies to revolutionary construction techniques. Productivity and efficiency will surge. It is up to industry to embrace these new opportunities more vigorously and change the way it has traditionally operated. Given all the advantages and internal challenges, the construction industry should act in several areas.

Initially, the transformation relies on the initiatives of individual companies – the adoption of new technologies and processes, business-model innovation, refinements to the corporate culture and organization, and so on. Individual action is not enough, however, in such a highly fragmented and horizontal industry: many of the challenges need to be tackled collectively – the industry has a responsibility. It needs to establish new forms of collaboration, or to improve existing forms. Finally, governments, too, have a large part to play in their dual role as regulators and clients. [10]

The digital revolution in construction entails more than merely adopting new technologies. Rather, it redefines our approach to safety, efficiency, and sustainability. The assimilation of digital technologies in construction has significantly impacted Health, Safety, and Environmental practices, thereby ensuring a safer and more sustainable future for the industry. [11]

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