

**CICA Working Group Construction 4.0**  
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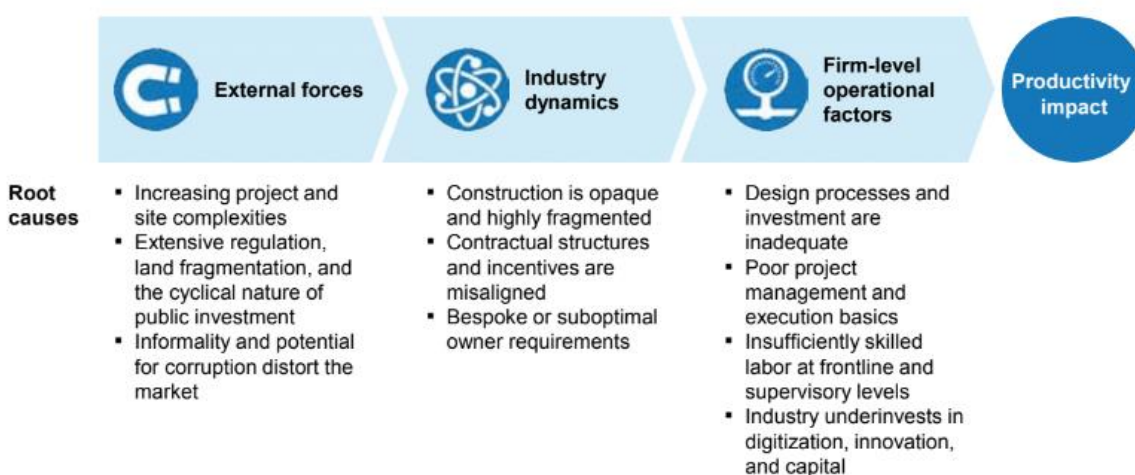
**I. State of the art**

**General tendency: low productivity in the construction sector**

Globally, the construction sector’s annual productivity growth has only increased by 1% over the past 20 years, compared with 2.8% for the total world economy and 3.6% for manufacturing. If construction productivity would catch up with the whole economy, the industry’s value added is expected to rise by \$1.6 trillion a year, meeting about half of the world’s annual infrastructure needs or boost global GDP by 2% (cf. McKinsey Global Institute 2017).

**Root causes for low construction productivity**

We tested ten root causes for low construction productivity



SOURCE: McKinsey Global Institute analysis

Following conclusions of various seminars and roundtables, it appears that public clients do not actively promote the development of innovations targeting the use of new and digital technologies in construction processes. This is a shared tendency within Europe. However, construction companies themselves as well as Small and Medium Enterprises (SMEs) in construction also tend to be reluctant to introduce the use of new and digital technologies in their businesses. They consider the changes to be too expensive to implement and assume that this would result in client’s unwillingness to pay associated costs (cf. EY 2018).

According to those tendencies, it appears for digital change to be occurring slowly within the construction business. However, it is suggested that it would be a mistake to underestimate the digital change and its pace, especially when regarding the previous developments, e.g. in telecommunications. It can be assumed that transformation in the construction sector will be significant and there will be a need for retraining that big companies as well as SMEs will have to anticipate (cf. CECE Congress 2018).



### **In brief: main barriers to digitalization in construction**

- No consensus across the industry and the public clients on exactly which technologies will become most widely used, or by which date and in which technology to invest;
- Public sector owners stick to traditional, proven technical solutions. They do not devote a sufficient part of their budget to projects with an “open innovation” approach;
- Technology use is more tactical vs. strategic: In order to justify investing in new digital tools or technologies, spending is frequently focused on technologies that address a specific problem identified onsite and opportunities for wider usage are not explored. Its use is limited to solving problems rather than preventing them;
- No scaling-up: Technologies of the fourth industrial revolution such as robotics, 3D printing or artificial intelligence are generally limited to small pilots, as investment in larger scale innovations is considered too risky;
- For the time being, the use of new technology may mainly concern infrastructure projects with long timescales, big budgets and powerful government clients, thus limiting and stigmatizing SMEs (cf. CICB 2018).

## **II. Possible Scenarios**

The reluctance of companies and public authorities to endorse new and digital technologies on the one hand and the emergence of new players from the (digital) economy on the other hand is challenging the capacity of construction companies to stay relevant and to keep their productivity and their competitive advantage high. In order to counter this tendency, construction companies have to reaffirm their added value which consists in contractors’ assembling function onsite coordinating between the client, the engineer and other suppliers.

CICA notably points out to two possible scenarios which could likely occur putting at risk construction companies’ activities. The first one focuses on China’s digital developments while the second scenario deals with the strong market presence of digital players such as Google, Apple, Facebook or Amazon or also other strong local and regional stakeholders able to take the lead in some construction projects.

- i) Chinese construction companies do not appear to use more innovative digital technologies than other construction companies. However, public clients are much more open to the use of new and digital technologies as it is allegedly part of a political objective fixed by the Chinese Communist Party (CCP). Recent CICA missions have led to the conclusion, that China is ahead of several years compared to other European or North and South American countries in the redefinition of procedures between the owner, the engineer and the contractor in order to optimize the design, the construction, the uses and the subsequent maintenance of the works with the help of new and digital technologies. Although the material and the bricks used are the same in China and abroad, the capacity to assemble them freely, thus enabling more opportunities for experiments and innovations, is much more developed in China.  
The emergence of Chinese know-how on the optimization of construction processes through the use of new and digital technologies could be exported abroad, creating a competitive advantage for Chinese practices.
- ii) New platforms such as Google, Apple, Facebook, Amazon or Airbnb as well as other strong regional players could enter the construction market in order to meet their own needs. They could substitute themselves to construction companies in the relationship construction companies have with the client, on the basis of the data they possess on their clients and their final users. As the laws and regulations concerning the digital industry are issued on a national level up to now, one cannot exclude the possibility of having different scenarios in each country depending on the countries’ capacity to foresee, adapt or force upon their national regulatory framework.



### III. Construction 5.0: Shaping the concept of Construction 4.0 around the Sustainable Development Goals (SDGs)

The possible scenarios show that the development of new and digital technologies and the slow adaptation of both, clients and construction companies, may lead to a substitution of the latter by other players. Construction companies will have to redefine their added value and emphasize their assembling function onsite regarding the development of new and digital technologies or new construction models such as modular construction challenging the existing supply chain management. Construction companies will have to decide how they want to engage in this transformation process. To this end, CICA suggests to go beyond the mere implications of Construction 4.0.

Basically, Construction 4.0 could be described as using the Internet of Things (IoT) for the integration of information among different platforms and adopting Robotization (drones, robots) as well as Artificial Intelligence (AI) including Big Data and Augmented Reality with the expectation of enhancing the ability to monitor construction projects and to improve the performance of the construction industry towards delivering sustainable and smart buildings. Construction 4.0 thus goes beyond Building Information Modelling (BIM).

However, considering approaches of digital governance being discussed at this years' G20 and B20 Japan or at the European Commission's level, the industry developments towards 4.0 are likely to be widened. The European Commission's [Reflection Paper: Towards a sustainable Europe 2030](#) describes digital transformation as a catalyst to meet the SDGs and the B20 Japan has introduced the concept of Society 5.0 in its [B20 Tokyo Summit Joint Recommendations "Society 5.0 for SDGs"](#). Society 5.0 aims at resolving various social challenges by incorporating the innovations of the fourth industrial revolution (i.e. IoT, big data, artificial intelligence (AI), robots, and the sharing economy) into every industry and social life.

Based on Society 5.0, CICA suggests to introduce the concept of **Construction 5.0** aligning the technological and digital innovations for the construction sector with the societal dimension meaning the United Nations 17 Sustainable Development Goals and the Paris Agreement. Defining the industry's own SDG goals is deemed crucial for the construction sector to stay relevant in front of other concurrent players.

Indeed, the construction industry per se does not arouse much interest. That is the main reason why the industry struggles to attract young people. To become more attractive, the construction sector should highlight activities that are of broader interest, namely i) new technologies and ii) sustainable development. To this end, the construction sector must be able to explain the performance indicators of the infrastructure or the buildings in terms of efficiency and sustainability to its final users and it has to demonstrate to government institutions how the industry's performance contributes to the SDGs.

Although SDGs are well-known at world level, they have to be embodied at national level and outlined by national governments. The construction industry can contribute to the definition of national SDGs by promoting its own SDGs for its construction activities in the construction and use phase (e.g. enhanced recycling, reduction of greenhouse gas emissions, more efficient energy consumption, contribution to circular economy etc.).



## Development of Society, Industry and Construction 1.0 to 5.0

	<b>Society</b>	<b>Industry</b>	<b>Construction</b>
<b>1.0</b>	Hunting Society	Bartering	Stone and mud
<b>2.0 (a)</b>	Agrarian Society	Mechanization, steam power, weaving loom (late 18th century: beginning of the industry culture).	Brick and mortar
<b>2.0 (b)</b>	Pre-Industrial Society	Mass production, assembly line, electrical energy (beginning of 20th century, marked the start of the second industrial revolution: optimize worker, workplace techniques and optimal allocation of resources).	Brick and mortar
<b>3.0</b>	Industrial Society	Automation, computers and electronics (last few decades of the 20th century: resulted in reduced effort, increased speed, greater accuracy and complete replacement of the human agent in some cases).	Click and mortar (BIM)
<b>4.0</b>	Information Society	Cyber Physical Systems, Internet of Things (IoT), networks (started with the boom in the Internet and telecommunication industry in the 1990's: Digitization and increased integration of vertical and horizontal value chains; Digitization of product and service offerings; Innovative digital business models).	BIM, Robotization (drones, robots etc.) and Artificial Intelligence including Big Data and Augmented Reality
<b>5.0</b>	Imagination Society	Digitalization across all levels of society creating a super-smart society resolving various social challenges by incorporating the innovations of the fourth industrial revolution (i.e. IoT, Big Data, Artificial Intelligence (AI), robots, and the sharing economy) into every industry and social life.	Societal dimension of digitalization including commitment to Sustainable Development Goals (SDGs) by aligning Key Performance Indicators (KPI) to the UN 2030 Agenda for Sustainable Development

#### IV. Recommendations

The following CICA Recommendations are meant to explain how to endorse the concept of Construction 4.0 and 5.0. These recommendations are addressed to i) Regional and national construction federations, ii) International organizations (Multilateral Development Banks, the OECD or the UN) and governmental institutions as well as iii) Construction companies and Small and Medium Enterprises. However, these recommendations can only be carried out efficiently if supported by regulators and the corresponding legal framework.

- **Promote data use, intellectual property protection and transparency in the construction sector**
  - Promote Segmented Open Data which allows the share of information and acknowledges the role of data for development by simultaneously protecting a company's intellectual property
  - Ensure Data protection by promoting the use of Blockchain in the supply chain as well as in financial processes and by also promoting the interoperability of different legal frameworks by applying European Union or equivalent General Data Protection Regulation (GDPR)
  
- **Define and take over customized SDGs for the construction sector**
  - Define how the construction industry can contribute to the 17 United Nations Sustainable Development Goals (SDGs) and the Nationally Determined Contributions (NDC) on climate required by the Paris Agreement by, e.g. elaborating investment strategies allowing to meet the carbon budget (2°-1,5°C)
  
- **Define the measure and the contractualization of Key Performance Indicators (KPI) that allow to ensure progress in fulfilling the UN 2030 Agenda for Sustainable Development**
  - Focus on both, the use as well as the production phases of the works, taking into account all the externalities of a projects: conditions of ageing, maintenance, its ecological footprint, its environmental and social impact etc.
  
- **Invest in Innovation and the use of New Technologies (Research & Development)**
  - Enable Open Innovation: Strategic partnerships with SMEs and start-ups (accelerators, incubators)
  - Enable Industry Connectivity: creation of platforms and networks (knowledge spillover)
  
- **Invest in Recruitment, Training and Retraining**
  - Create a culture of digital literacy and digital upskilling (e.g. through apprenticeships programmes)
  - Initiate a strong culture of change (transformational lead, test and lean)
  - Adapt and anticipate future and regularly evolving work environments and job profiles
  
- **Convince owners and regulators to regularly adapt the legal framework to the use of innovation and its evolving requirements**
  - Include an innovation clause in public contracts/tenders
  - Increase public investment in R&D and the use of new and digital technologies

## V. Conclusions

Adopting new and digital technologies of the fourth industrial revolution is deemed essential for construction companies, especially in order to catch up in productivity and to stay competitive. This challenge is also valid for public authorities that have to accompany the changes and give financial and regulatory incentives especially for SMEs that face more difficulties to invest and implement new and digital technologies when compared to bigger companies.

However, adapt new and digital technologies of the fourth industrial revolution alone will not be enough to redefine the added value of the construction sector and differentiate it from new players that are, for now, far ahead in the developments of new technologies. The key issue lies in endorsing the concept of Construction 5.0 aligning the use of new technologies and the performance of each company with the SDGs. This will allow construction companies to gain legitimacy on governmental level but also towards their clients and towards the final users of the infrastructure through concrete environmental and societal contributions which are specific to the construction sector's activities.

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**Further literature available on the CICA (Drop)Box Construction 4.0:**

<https://www.dropbox.com/home/Box%20Construction%204.0>



[www.cica.net](http://www.cica.net)

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