The race to the future for the construction sector

Chapter 12

THE RACE TO THE FUTURE FOR THE CONSTRUCTION SECTOR

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An international perspective

Annual global construction of work put in place in 2020 is estimated to be worth around US$9 trillion, exclusive of land, local taxes, and construction professional services. Estimates of annual output rely upon national statistics; amounts may be distorted by output from the informal sector[1]/black economy which is unreported in many countries. Lack of consistent available data on construction output is a major challenge, particularly for developing countries. Annual global construction output for the sector represents around 10% of global gross national product, demonstrating the vital importance of the construction sector to the economy in every country. There has been year-on-year growth in construction output since 2010, but just like the financial crisis in 2008-2009 that disrupted the markets, Covid-19 is impacting and influencing change in the markets.

Structure of the construction sector

The terms construction industry and sector are often used interchangeably; that is wrong, the sector comprises a much wider grouping than the industry.[2]

The construction sector is fragmented and complex, with four principal groups:

1. Knowledge intensive professional service (KIPS) providers, the architectural, civil, structural, mechanical, electrical, and plumbing engineering, cost, project and programme management consultants.
2. Construction contractors and specialty trade contractors.
3. Materials, plant, equipment, and component manufacturers and suppliers, including merchants.
4. Ancillary service providers, such as IT developers, financiers, insurers, transport, security, logistics, accountants, legal advisers, and regulators, all of whom may work across several sectors.

They are all dependent upon the market for construction works but have different net profit margins, see Figure ; the return on capital employed, and perceptions of risk are also an influence. Net profit margins of 1%-4% for construction enterprises are not conducive to building resilient companies. There are drivers and issues that influence the market, this chapter focuses upon the construction market, which ultimately impacts all the players.

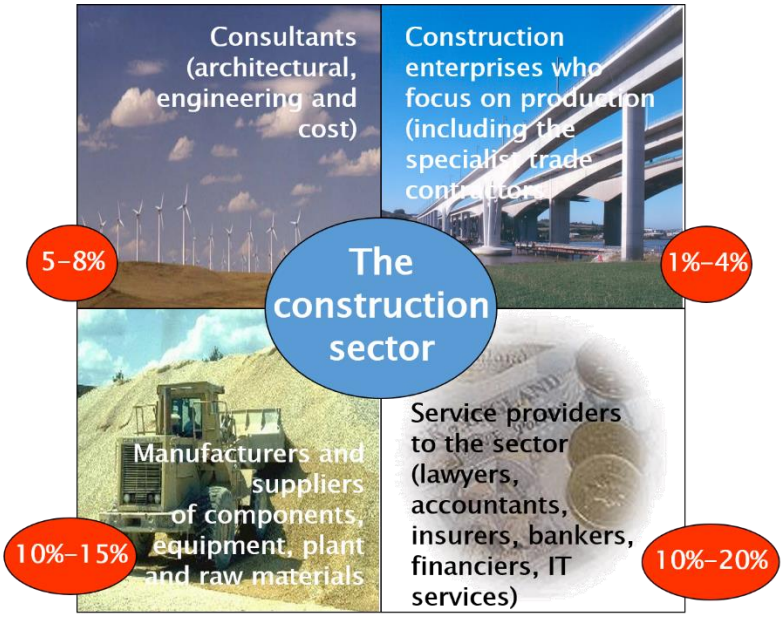


Figure 12.1 The four principal groups in the sector and their net profit margins

Construction projects are location-specific, economies of scale are not easily achieved, with the need for local labour and local materials to keep down costs. Planning and regulatory codes and standards are local, designed to meet local conditions and requirements. Some standards for materials, workmanship and design are international, such as ISO standards.

The perfect storm

International construction is being transformed by the influence of the fourth industrial revolution, with Covid-19 changing the way the industry works. There are changes to market making and project creation, project procurement, architectural and engineering design, new governance requirements and more regulations, and more off-site site production.

Four drivers are coming together to create the perfect storm. Firstly, the fourth industrial revolution with digitalisation and new technology transforming and disrupting all industry sectors (see section 0). Secondly, the growing importance of combatting climate change and achieving zero carbon. Thirdly, the tension between internationalisation and localisation, influenced by geopolitical factors. Fourthly, pandemics with Covid-19 causing economic and social disruption and re-alignment of production. Construction sector enterprises must respond because they are such an important part of helping countries return to economic growth and prosperity. The need for enterprises to rebuild their balance sheets and investment programmes and to re-think their business models.

The old world of international construction was about enterprises using models that worked in their home country, believing that they must be superior and will work overseas. The separation of architectural and engineering design from site production is such an example. The new world is about flexibility, integration, adaptation, modernisation, localisation, governance, transparency, and conformance to new standards. Western enterprises no longer believe that home country technology or systems are superior. They source globally and act locally.

The design, build and throwaway society is no longer appropriate, with the move towards a circular economy. A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims to eliminate waste through the superior design of materials, products, systems, and business models.

Change is fast moving and not respectful of geographic boundaries.

> *Charles Darwin wrote, "It is not the strongest of the species that survives, nor the most intelligent that survives. It is the most adaptable to change." [3]*
> *That statement is still true in 2021.*

The nature of the construction business requires local production when working in any country, with few exceptions. Site production involves the technical, financial, and management capacity, the production process, and the assembly of an integrated supply chain. Financial capacity is the glue that bonds the process together. Scale is an important part of international success, micro, small and medium sized enterprises find it difficult to go overseas. Chinese enterprises are an example of how scale has provided the ability to exploit overseas opportunities.

The 'new kids on the block' have arrived, many of whom were the Asian tigers in the 1990s. Turkish materials and component producers, and construction firms have exploited the new opportunities by using their low-cost advantage in developing countries. The 'new kids' have been quick to adopt new technologies and to build new business models that better reflect the international nature of the construction sector. Their flexibility and innovativeness have given them opportunities to compete against more established companies. However, the increasing complexity of construction and the need to adopt collaborative funding opportunities (especially for infrastructure) has led to the large players being able to create competitive advantage through project creation.

The aim to be global but act local is still prevalent in many large companies in the sector. The way they achieve this differs across countries/regions and business types. For example, construction professional service firms, whose 'currency' is their skill base, competencies, and intellectual capital, use different growth strategies to contractors, primarily because they are more risk averse. However, the sector is witnessing international growth being a popular policy. Mergers and acquisitions have played a major role with acquisition of companies established in a particular country/region with a proven track record.

Being global but acting on a local basis relies upon trading freedoms and operating on a level playing field; a field that is skewed by increasing protectionism. Localisation policies are not a new phenomenon and are prevalent in some countries, including Argentina, Brazil, China, India, Indonesia, Russia, Saudi Arabia and the USA (Derringer et al., 2018). Figure 12-2 shows the number of interventions by the countries ranking highest (for numbers of interventions). Interventions are trade related policies that are import restrictive and export related.

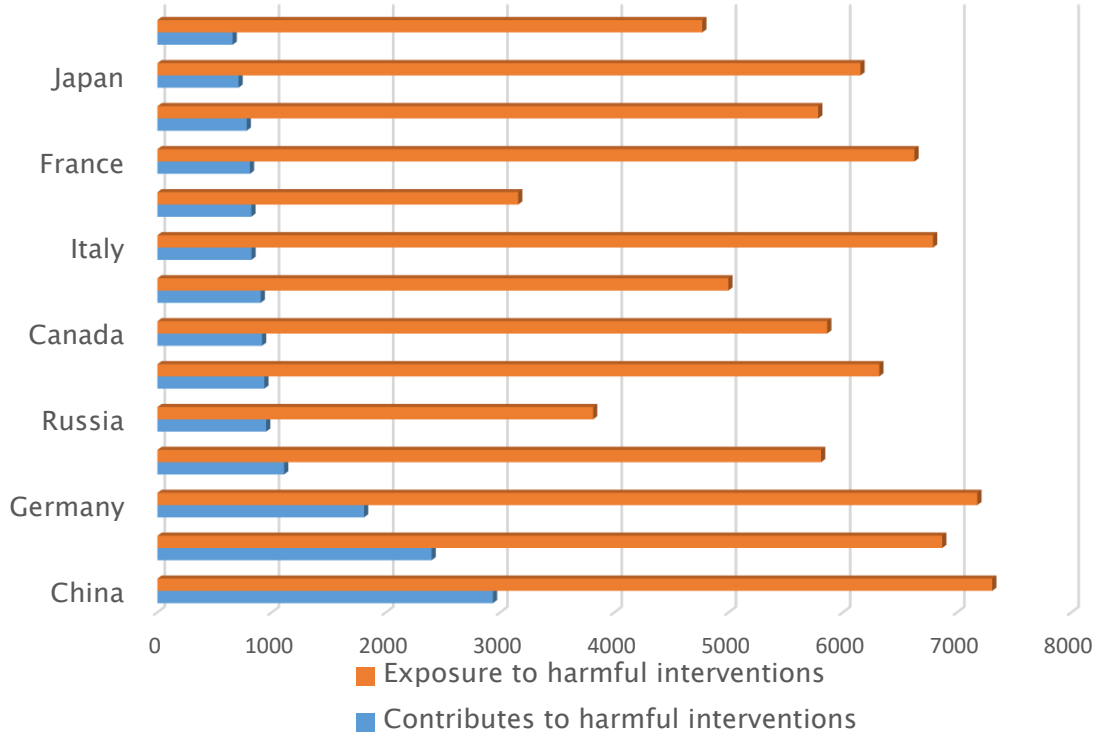


Figure 12.2 Exposure/contribution to harmful interventions

The interventions were across all sectors. Some interventions are liberalising. For example, China benefited from 2001 of these in the latest Global Trade Alert (2021) figures.

> *"[Localisation] policies are imposed by governments that require firms to use domestically manufactured goods or domestically supplied services in order to operate in an economy" (OECD, 2016, p. 4).*

Localisation

Whilst the aim may be to improve/protect local business, in an economy with inefficient firms, a high degree of required local content thwarts competition. Increasing localisation/protectionism is changing the face of global competitiveness. China is engaging in 'import substitution' through a 'buy Chinese' policy. Licensing agreements discriminate against foreign companies and Chinese companies benefit from cheap capital through a state-directed financial system (Springford, 2020). India has announced its intention to seek self-reliance. It is prohibiting global tenders for government procurements worth up to $26.5m to help local businesses sell to government (2021). The intention is to build local brands and make them world class. It's not about looking inwards or being isolationist; it's about a confident India that contributes to the globe.

Localisation is one of the tensions between internationalisation and protectionism. Globalisation has changed the landscape of international construction with more international design teams, the emergence of Chinese construction companies as a global force, greater migration of labour, and many "new kids on the block" from a variety of countries seeking to win construction projects. Scale and influence have been important with big is best, big

meant greater competence. However, higher revenue has not always been converted to bigger profits.

Fourth industrial revolution and construction

The fourth industrial revolution (FIR), unlike its predecessors, has not merely built upon the innovations and progress of the third industrial revolution. Instead, it presents a distinct change because of its speed, scope and impact on systems. The FIR comprises a fusion of technologies from different disciplines with their edges getting increasingly blurred, blending the physical, the digital and the biological worlds. The FIR is disruptive by bringing rapid change, which is exponential, rather than linear as in previous revolutions. Production and management systems and governance need to adjust to reflect the changes the FIR brings.

The four industrial revolutions followed a shallow curve at their inception, gathering pace, but nothing like the speed of the 3rd and 4th industrial revolutions – see Figure 12-3.

The technologies shown at the start of the 4th industrial revolution are in no particular order, each of them has been increasing exponentially but at different rates. The take-up of these technologies has varied from sector to sector. The common factor is the information overload that accompanies this rate of innovation.

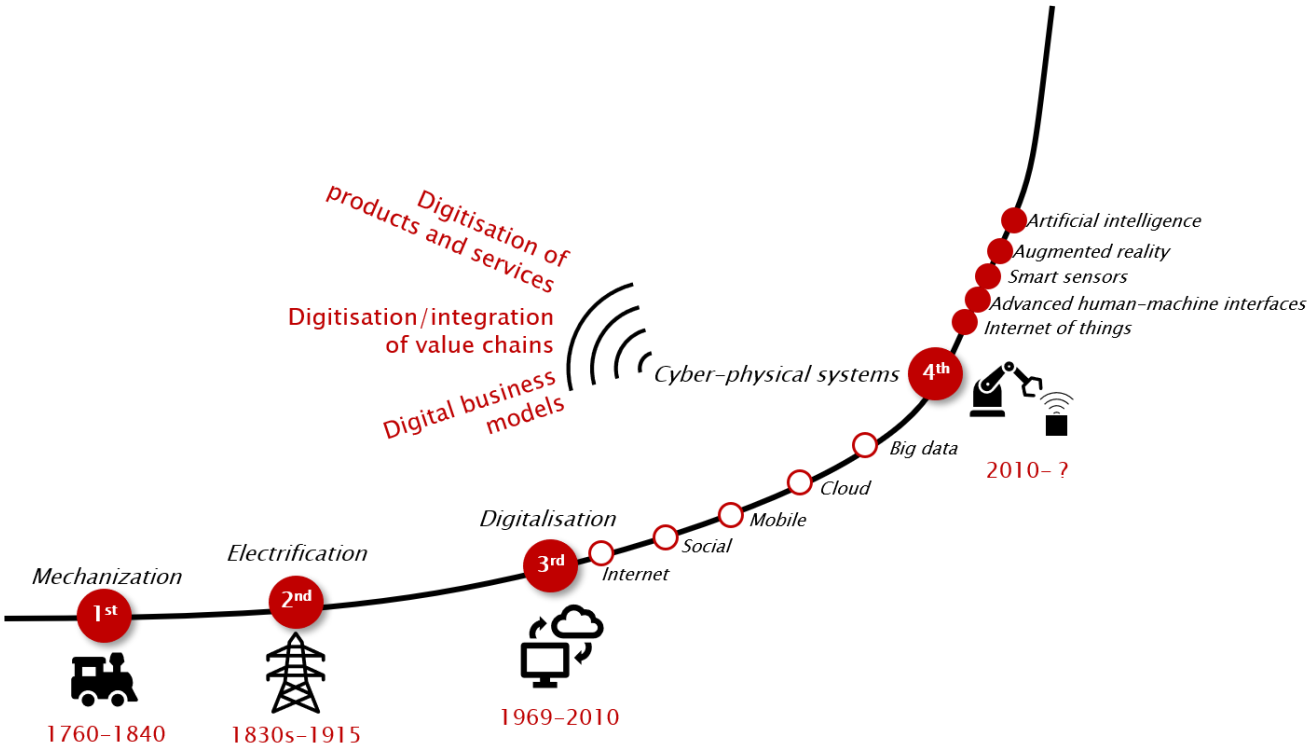


Figure 12.3 Moving towards the fourth industrial revolution

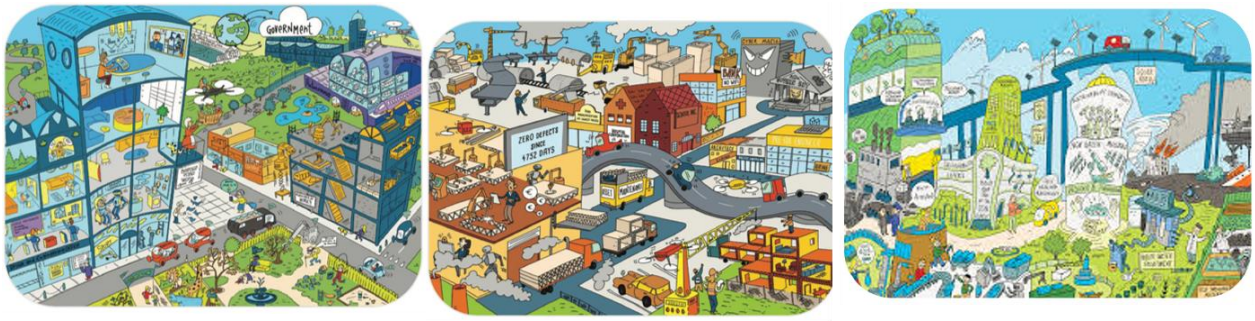
Digitalisation is a core part of FIR, but it has experienced a slower pick-up in the construction sector, compared with other sectors, although BIM, off-site fabrication, sensors, and automated equipment are evidence of change. Construction still relies heavily on manual labour and technology that has not dramatically improved over the last few decades. Digital innovations in the industry could see costs cut and productivity increased but its

fragmentation is a considerable barrier. There is a 'long tail' of small and medium sized enterprises (SMEs) in most countries' construction sectors which have low profit margins and limited cash flow.

As technologies become cheaper this can change. Smartphones have led the way towards greater accessibility of information and communication technologies (ICTs), with wireless technologies no longer leaving a construction site a disconnected island.

Facing the future

The six World Economic Forum working groups, part of the Shaping the Future of Construction project, developed three infrastructure and urban development (IUD) scenarios: Factories run the world, the green reboot and Building in a virtual world - see Figure 12-4.



Factories run the world

In an era where people are immersed in virtual reality in all aspects of life, intelligent systems and robots run the construction industry

The green reboot

A corporate-dominated society uses prefabrication and modularization to create cost-efficient structures

Building in a virtual world

A world, with increasing conflicts over scarce resources and climate change, rebuilds using environmentally-friendly construction methods and sustainable materials

Figure 12-4 The World Economic Forum's future scenarios

The World Economic Forum (WEF) is calling for action for a more circular economy with a shift from 'grey' to 'green'. Increasing life cycle thinking in the construction sector is a major step towards this goal. The WEF states that growth should not be the sole aim of the global economy but, instead, a greater distribution of wealth. These changes will be enabled by greater innovations in terms of energy, food, safety, and shelter. The threat of climate change requires innovation in self-healing systems as well as being smart and robust. Affordability is key if innovations are to get a widespread take-up. Human-centred approaches are also important with the increase of cyber-physical systems in the 4th industrial revolution.

"Art, culture, music, a sense of place and a feeling of belonging will increasingly be seen as critical to the physical and mental happiness and well-being of the global population, thus fostering a culture of enjoyment and a personal creative responsibility for socially stable and vibrant communities" World Economic Forum

Change - the drivers, issues, disruptors, enablers, and actions

An approach to make sense of the future is to use drivers, issues, disruptors, enablers, and actions required.

Drivers

Figure 12-5 shows the drivers of global construction as a system of cogs, a dynamic process that faces constant and rapid change. The eight drivers selected have a major impact on global construction. They are not self-sustaining but are interdependent and interconnected. All are impacted by the growing complexity, risk and speed of change within the sector.

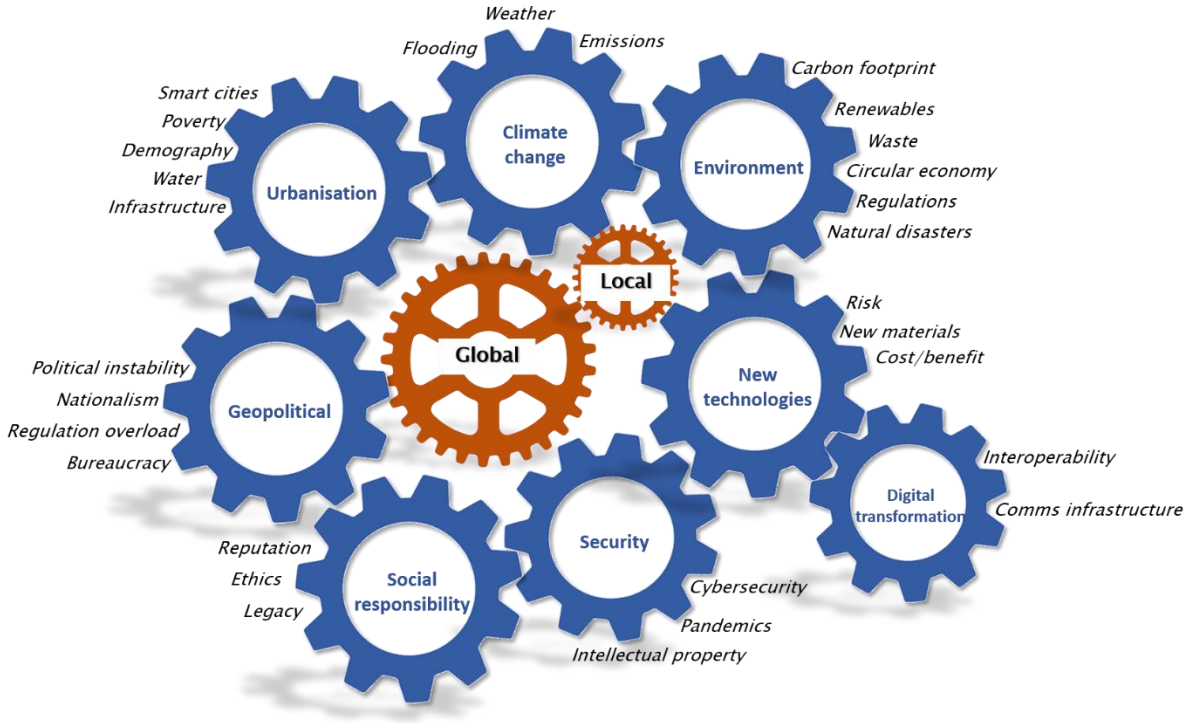


Figure 12-5 Drivers and issues impacting global construction

The drivers lead to issues around the eight cogs that must be confronted by governments, policy makers, and companies.

The environment is an example of interconnectivity; the issues that arise are closely connected with both tackling climate change and embracing new technologies. The new technologies can help to find solutions for climate change, but they involve social responsibility with actions to be taken by individuals to reduce their carbon footprint.

Drivers are difficult to control, whilst the issues must be addressed. They manifest themselves on both a global and local scale and are influenced by the growing complexity, speed of change, and attitudes that exist today.

Complexity

Projects have become more complex with new technologies, increased demands of clients, and requirements for sustainability. Complexity affects the business environment as well as

the workforce. It puts pressure on the ability to manage change in both processes and technologies.

Speed of change

The speed of change is apparent in technologies, the competitiveness landscape, and the regulatory system (both local and national). Firms in the construction sector are having to be nimbler and more flexible to meet the pressures of the rapid change. The choice is to be a leader or a follower. Lessons can be learned from the approach used for innovation discussed later.

Globalisation

Globalisation has brought about stronger connections. Pandemics are more prevalent as social and business mobility increases. Some regulations have moved beyond domestic borders to become supranational. Business risks are different from just a decade ago. For example, cybersecurity is a more prevalent issue. Compliance risks have changed with the increase in regulations.

Issues

Issues may be local, national, or firm-specific, their level of impact can change over time. The urbanisation driver is an example. Figure 12-6 shows some of the issues derived from urbanisation.

By 2050, 6.5 billion people will live in urban centres – two-thirds of the projected world population. This movement of the population has huge impact on cities' resources as well as their environment. There is a growing need for *smart cities* that make better use of smart technologies. This requires three things: 1) the development of a technology base for connected networks and devices, 2) smart applications and the ability for data analysis, and 3) applications and usage, which means educating users and behavioural changes. The pressure on water increases with rapid urbanisation. Both a safe and accessible *water* supply and the management of wastewater including sewerage helps to maintain the sustainability of a city and the health of its inhabitants.

Figure 12-6 Urbanisation drivers and issues

Demographics are changing with increasing single-person households and, in many countries, an ageing population. Demography will impact the types of construction needed and the ability to future-proof buildings. *Energy* requirements in a city can be huge and diverse. Whatever the size of either the city or the energy requirements, there are 3 essential obligations that need to be met: a reliable and secure supply; long-term affordability; and the reduction of greenhouse gas emissions associated with energy supply. Constructing new buildings or refurbishing/retrofitting existing ones is an opportunity to achieve better energy management reducing usage, costs and emissions.

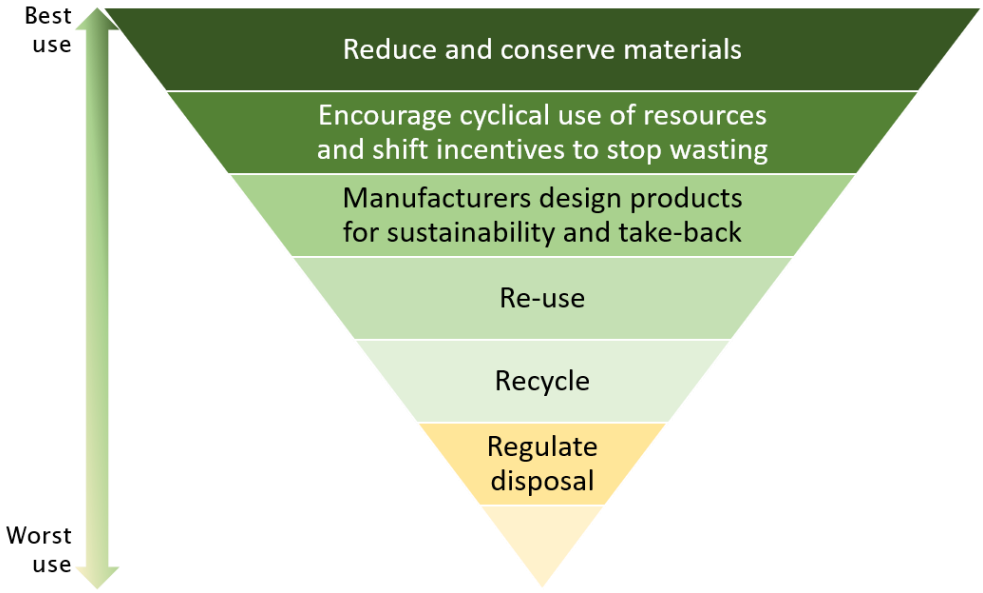


Figure 12-7 The zero-waste hierarchy

Reduction and management of *waste* has many benefits. Reduction, recycling, and re-use (the 3 Rs), which are part of the zero-waste hierarchy see Figure 12-7. Zero waste policies are becoming increasingly popular and have a significant impact on the construction sector, especially as it is responsible for a large percentage of the world's waste.

The volume of construction waste generated worldwide every year will nearly double to 2.2 billion tons by 2025 (Transparency Market Research, 2018).

The need for sustainable *transport* systems within cities increases as the population grows. This provides an opportunity for construction companies for both the infrastructure and the associated facilities. Where a city lacks a good transport system, which may cause severe congestion, construction work can be affected, adding time and money to a project.

The availability and quality of *infrastructure*, whether it is for transport, communication or utilities is an issue for construction. Whilst the lack, or inefficiency, of any infrastructure will be a challenge, it can present an opportunity for construction firms.

Where infrastructure development/growth has not kept pace with rapid urbanisation, *poverty*/inequalities can/are likely to exist. International agencies focusing on the eradication of poverty are often the source of funding for the development world – an opportunity for construction.

Air, ground, water and noise *pollution* are all impacted and created by construction. Environmental legislation (local, national and international) needs to be understood and complied with. Pollution is an important issue in terms of site operations and building system management.

Disruptors, enablers, and actions

Disruptors can negatively impact or exacerbate issues; they must be minimised/managed to avoid significant effects on projects and on the business. Disruptors can be anything from severe weather to a workforce strike, to civil unrest. *Enablers* are the ways in which the disruptors can be prevented/ameliorated. These need to be enhanced and the disruptors reduced through formulated company-specific *actions*.

Disruptors can be a on a local, national, or global scale. Global-scale disruptors are pandemics, such as the recent Covid-19 pandemic, and the global financial crisis. Events on this sort of scale are difficult to combat. Finding enablers that would reduce the disruption is difficult. However, on a more local scale, the disruption caused by bad weather can be foreseen (unless it is a catastrophic event) and steps taken by say, providing site protection or planning construction at a different time of the year. Workforce disputes may be avoided by better communication and/or employee empowerment.

There are market disruptors, such as the influence of Chinese companies in the international construction market. China's domestic construction market is the largest single market in the world, yet there are few foreign firms who have entered the market.

The concept of drivers, issues and disruptors is important with the huge changes the fourth industrial revolution is bringing.

The emergence of China as a major influence in construction

Large Chinese enterprises have followed a strategy for international growth over the past 20 years based upon the competitive advantage of low price, access to project finance, leveraging of China's geopolitical influence overseas, and market making/project creation abilities. Price is always a critical factor in any project. Building upon the low-cost Chinese supply chain to go overseas with materials, plant, equipment, and human resources proved a good base for winning overseas work. A mobile and flexible Chinese workforce was prepared to work overseas in difficult conditions, but that is changing as the living standards improve wages rise in China.

Chinese companies have the advantage of a largely protected domestic market in China. Foreign construction companies are prohibited by law from participating in all public tenders in the construction sector, whilst so-called foreign companies registered as "wholly-foreign

owned enterprises" are only allowed to take part in tenders that are financed by non-Chinese authorities, i.e. foreign investors and multilateral institutions.

Geopolitical influence is leading to conflict between internationalisation and localisation in many overseas markets, with demands for capacity building for local industries with employment opportunities, social responsibility, stringent local contract requirements, and local standards.

Chinese enterprises need to create a new operational and business model going forward, built upon the success of the past, and recognising the challenges of the future. The propensity to use Chinese inputs for project delivery on international projects will change as digitalisation, technology, and integrating the design with off-site and on-site production plays a bigger role. It makes economic sense to source locally instead of artificially sourcing inputs from overseas; that principle works in developed countries, but not in developing countries where the quality standards can be poor and there is limited skills availability.

Chinese enterprises have used project finance at attractive loan rates to engage in project creation/market making. China has a large overseas development aid programme in developing countries, with development assistance provided in the form of infrastructure projects given as gifts, grants, interest free and concessional loans, disaster relief, and other forms of technical assistance. Work undertaken on the projects is generally undertaken by Chinese enterprises. For example, the Belt and Road Initiative (BRI) has created opportunities overseas, alongside projects funded by the multilateral banks, such as the World Bank/IFC, and the regional development banks.

The BRI (also known as the Silk Road) has opened new opportunities for Chinese investment overseas. The BRI links China with south-east Asia, south Asia, Central Asia and Europe by land as well as a sea route connecting China's coastal regions - see Figure 12-8.

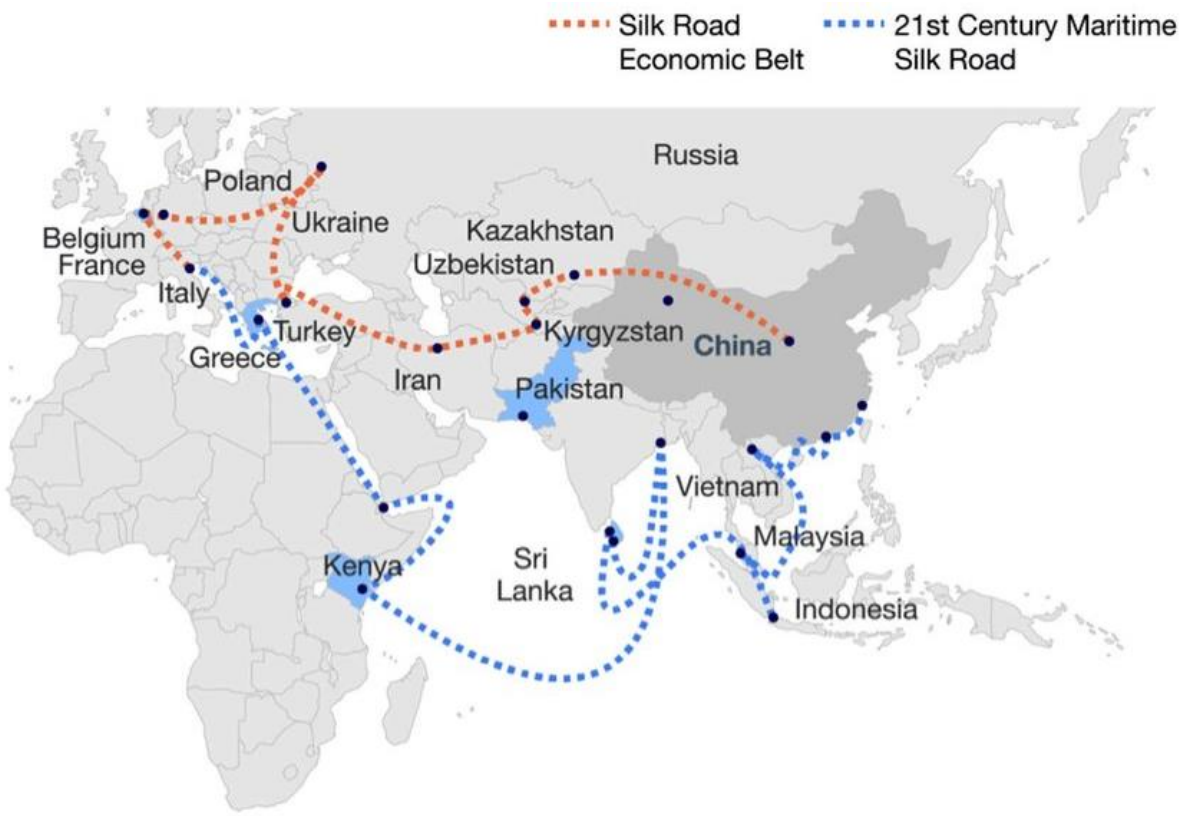


Figure 12-8 The map of the Belt and Road Initiative

Source: McKinsey Company. https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/one-belt-and-one-road-connecting-china-and the-world

Competitors in the international market, often with a longer history of working overseas, have watched, and learned from China's international strategy. They are seeking new ways to compete based upon operational excellence by investing in market making. This means creating projects through PPP and other ways of creating opportunities. Competitors are demanding a level playing field[4], where enterprises do not gain an unfair advantage by receiving aid or subsidies from their home country.

Chinese construction companies are growing organically in developing and other countries; they are also growing through acquisition, as was the case in Australia and the USA. Competition in the global market from Chinese construction companies changed the strategy adopted by many western construction enterprises. China Communications Construction Company (CCCC) acquired the Australian firm John Holland in 2015, but failed to acquire the Canadian construction company, Aecon, in 2017, following intervention by the Canadian government. The number of Chinese construction companies has increased with the top five in ENR's[5] 2020 Top 250 Global Contractors (based on construction revenue generated domestically and overseas) being Chinese.

An inhibitor to international growth is the lack of acceptance of Chinese standards and codes of practice as being to the highest international standards for materials, plant, and equipment in the international market. Whilst China is a member of the International Standards Organisation (ISO), standards are very important in gaining acceptance of Chinese

manufactured goods to be incorporated in overseas projects. Standards can be at the national level, local level, industry level, and enterprise level. Having Chinese-manufactured steel used in a project in the USA means the material must meet the highest international standard and conform to the local standards.

Another inhibitor is the development of Knowledge Intensive Professional Services (KIPS) for independent design and consultancy. China's fourteenth five-year plan (2021-2025) emphasises the development of professional services as a priority, which means more Chinese KIPS firms will enter the international market. An enabling factor is that many large Chinese Design Institutes are owned by large State-Owned construction enterprises, which provides the opportunity to deliver integrated design and construct projects.

How companies respond to the future

Leader, fast follower, pack member, late mover, laggard

Firms in the construction sector are having to be nimbler and more flexible to meet the pressures of the rapid change shown in the cogs. The choice is to be a leader, fast follower, pack member, late mover, laggard, Figure 12-9 shows the innovation hierarchy, with the different types of enterprise behaviour. The concept is relevant to international construction enterprises from the perspective of how projects are procured and delivered. KIPS providers can leverage a technology, such as 5D digital design with BIM through the integration of design with site production and into use. Construction enterprises can leverage advantage through the integration of an off-site production manufacturing technology through to site installation, such as in the development of de-salination equipment, or photovoltaic panels through the design, manufacture and installation process. Construction equipment manufacturers exploit technology to produce intelligent and more efficient site equipment that embody artificial intelligence.

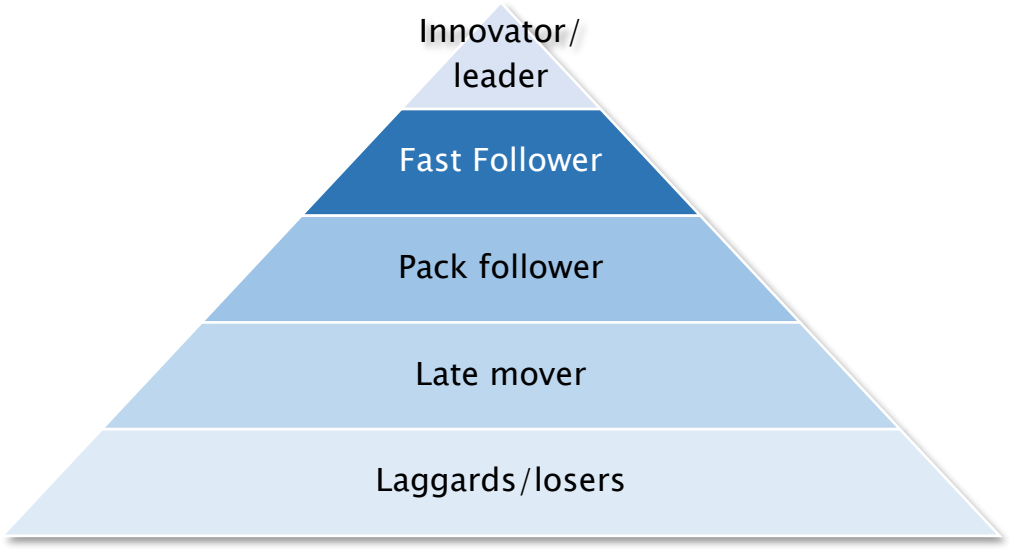


Figure 12-9 The innovation hierarchy model

The innovator is the leader pioneering the approach, the trailblazer, and being first to market hoping to achieve the largest market share and best profit potential. The fast followers replicate and duplicate. Once success is clear, the pack followers enter the market. The pack follower and late mover can be left behind, by relying on proven tried and tested approaches; many traditional KIPS firms fit this mould believing professional services are different. The laggards struggle to catch up, which means being left behind.

The construction sector has reached a tipping point in 2021. The business model based upon price competition is hard to sustain. The traditional triangle of cost, time and quality has changed, it is now supplemented by the importance of health and safety, sustainability, zero carbon emissions, green issues, ethical and social responsibility, diversity, and exploiting digital transformation. Most importantly, project creation has become an important part of winning work. China, and Japan's knowledge of high-speed rail infrastructure has involved the bringing together of the train manufacturers with the infrastructure design and delivery teams to produce an integrated approach.

Globalization has brought about stronger connections. Pandemics are more likely as social and business mobility increases. Some regulations have moved beyond domestic borders to become supranational. Business risks are different from just a decade ago. For example, cybersecurity is a more common issue. Compliance risks have changed with the increase in regulations and the dangers of blacklisting. The innovators, sometimes from outside the construction sector are seeing the opportunities, such as the way Google is applying artificial intelligence to systems.

Stand out, break out, watch out, and stall out

Another way of looking at the way companies seek to grow in the international market is the approach often used by digital organisations. They look at countries adopting digitalisation as being stand out, break out, watch out, and stall out – see Figure 12-10, this can be adapted to suit enterprises in construction:

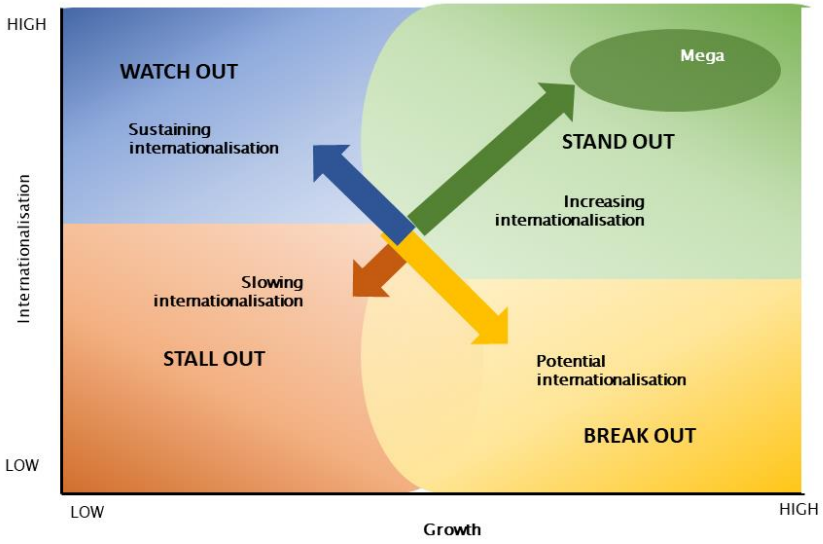


Figure 12-10 Internationalisation and enterprises

Stand out

Stand out enterprises show high levels of adaptation, and flexibility, especially in innovation and digital development. They continue to remain on an upward trajectory, they fit sustaining internationalisation in figure 12-10 Stand Out enterprises in other industry sectors, for example, Uber Technologies Inc. (taxis and ridesharing), Tesla Inc. (automotive), and Ryanair DAC (air transport) are all examples of international enterprises who developed a new business delivery model, they were innovators and, in some cases, fast followers. In construction, many enterprises have looked at moving up the value chain to higher margin activities, and many have become more specialised and focused.

Traditional construction has low barriers to entry, it can be highly mechanized, and carries high risk. Building projects fit this category, where local enterprises know the local market and can compete on price because they understand the local conditions and local suppliers. High risk is endemic, companies must ensure how they leverage their competitive advantage. Competition is fierce and low price dominates. By engaging in large infrastructure projects, the barriers to entry into the market are restricted because of the need for specialist competencies and a strong balance sheet to sustain high risks. Many of the large state-owned Chinese enterprises are Standing Out, such as China Communications Construction Company (CCCC), China State Construction Engineering Company (CSCEC), and China Railways Construction Corporation Ltd (CRCC), all their businesses are at the leading edge. They are devising new delivery models with focus on their competitive advantages.

Break out

Break Out enterprises have the potential to develop strong growth through innovative ideas, or by diversification either laterally or horizontally through the supply chain. They are moving upward and are poised to become Stand Out companies in the future. They fit the

increasing internationalisation in Figure 12-10. Break out companies are emerging in the knowledge intensive professional services (KIPS) enterprises, where many mergers and acquisitions resulted in KIPS design and engineering enterprises becoming very large with 50,000 plus staff on payroll. They believe that larger KIPS enterprises can engage on mega projects more easily, they have economies of scale, and invest in technology to create competitive advantage. They have also diversified into the defence, automotive, and aviation sectors by providing high value design and engineering services.

In construction, Turkish construction enterprises are winning more overseas work whilst diversifying into investment and manufacturing.

Watch out

Watch Out enterprises face significant opportunities, they fit the potential internationalisation category. A new way of looking at a company is needed, other than profitability and revenue growth. Some overcome limitations with clever innovations and stopgap measures, while others seem to be stuck. Scale is part of the process. The sector is a mix of micro, small, medium, and large enterprises. Micro and small enterprises have high rates of failure, hence the desire for growth as a survival principle. Watch out companies face many challenges. Some spectacular company failures occurred recently, caused by a mixture of bad luck, poor management decisions, poor focus, and a weak balance sheet. Arabtec in the UAE was a construction business that went into liquidation in late 2020. They grew very fast from 2010 in the Middle East construction market and won many high-risk projects in a market renown for volatility and intense competition. They suffered losses and went into administration. Carillion plc in the UK, the largest UK construction contractor by revenue, diversified into providing industrial services to hospitals, they won too many public-private partnership projects, and worked on large loss-making projects in the Gulf region. Leadership was poor, financial controls weak, and they went into liquidation with liabilities of US$8 billion.

Stall out

Stall Out enterprises have achieved a high level of evolution but are losing momentum and risk falling behind unless they can adapt quickly to the new world of construction, they have slowing internationalisation. Many western construction enterprises fall into this category. Enterprises from the UK, New Zealand, South Africa, Brazil, and Malaysia are examples of having large construction enterprises who have scaled back their international activities from the international construction market because of increasing competition, they are focusing on domestic and more regional work, which is regarded as having lower risk and uncertainty. Stall out companies include some of the traditional construction enterprises from Brazil, Germany, Italy, and the UK, who continued to believe that competing using the traditional model of price competition would secure growth. It failed because of local competition, and enterprises from break out countries, such as Turkey, and Vietnam creating new competition. Stall out can occur for several reasons, such as the Lava Jato[6] scandal in Brazil. In 2016, Odebrecht, the Brazilian-based engineering and construction group signed what has been described as the world's largest leniency deal with the US and Swiss authorities, it confessed to corruption and paid US$3.5billion in fines. Dozens of companies acknowledged paying bribes to politicians and officials in exchange for contracts with the state oil company.

Odebrecht executives confessed to paying bribes in exchange for contracts in Brazil, and other parts of the world, including Argentina, Colombia, Ecuador, Peru and Venezuela. The company President was sentenced to 19 years' imprisonment. The government has introduced Draconian legislation to ensure Brazil is not embroiled in corruption scandals in the future. Where once Brazilian companies boasted about profits, now they may be as likely to emphasise how they stick to compliance rules.

Infrastructure and urban development industry scenarios

Tomorrow will not be like today; the current business models are not fit for meeting the challenges of global megatrends with climate change, resource depletion, and rapid urbanisation.

The changes will bring disruption to the sector which needs to be addressed by players across the construction value chain. Improving the skill base will be important as well as increasing the levels of collaboration and integration. Advanced technologies are key but only if they can operate within a system that allows their take-up, growth and success.

Conclusions

There will be winners and losers in the race to the future. The old business model used by the construction sector for governance, regulation, procurement, design, and site production, evolved over the past decades; it is robust and stable. Change is now faster moving than ever before, disruption is a fact of life. The new world is about flexibility, integration, adaptation, modernisation, resilience, localisation, governance, transparency, and conformance to new standards. Digital transformation is an enabler, driving the 4th industrial revolution. The construction sector will change, it is resilient, and the companies within the sector will change. Projects will be built faster, safer, and to a higher quality. Localisation will increase with more demands for local content and jobs. Geopolitics will play a bigger role as the pandemic has shown. Government to government agreements will create work, but will be tied and closed to outside competition.

Modern methods of construction will evolve, and productivity will improve. New players will disrupt those companies who believe that tomorrow will be like today.

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[1] (OECD definition - OECD, 2008): The informal sector typically operates at a low level of organisation, with little or no division between labour and capital as factors of production and on a small scale. Labour relations, where they exist, are based mostly on casual employment, kinship or personal and social relations rather than contractual arrangements with formal guarantees. Taxation, registration, insurances, and employment rights are issues. The construction sector uses a high number of enterprises in the informal sector in developing countries.

2 Although they may seem the same, the terms industry and sector have slightly different meanings. Industry refers to a much more specific group of companies or businesses, while the term sector describes a large segment of the economy.

3 Charles Darwin wrote on the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life, published in 1859.

4 A level playing field is a trade-policy term for a set of common rules and standards that prevent businesses in one country gaining a competitive advantage over those operating in other countries. It is about fair and open competition goods in services and capital. Donald Tusk, President of the European Council, underlined the fact that "our aim is to focus on achieving a balanced relation, which ensures fair competition and equal market access." The rebalancing of the economic relationship remains a top objective and priority for the European Union.

5 Engineering News Record (ENR) is a US weekly news publication that annually publishes the top international firms in construction.

6. Operation Car Wash (Portuguese: Operação Lava Jato) is an ongoing criminal investigation by the Federal Police of Brazil, Curitiba Branch.