TRUST RE

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THE NEED FOR INNOVATIVE CONSTRUCTION INSURANCE IN HIGH-GROWTH MARKETS – CHINA'S BELT & ROAD INITIATIVE AS AN EXAMPLE

REINSURER OF CHOICE

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Autumn 2017

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Preface by the Chief Executive Officer of Trust Re Group

Over the past two decades, the global construction industry has been characterised by below-average productivity growth, casting doubts on its ability to capture the potential associated with massive future construction needs. At the same time, the sector's insurers are currently faced with a challenging combination of eroding rates and growing exposures.

Having said this, there are fantastic opportunities for the industry such as the Belt & Road (B&R) initiative, one of the most visionary economic development projects of the recent past, which was launched in 2013. We believe that it offers a tremendous commercial potential for both contractors and their insurers, extending well beyond the sheer size of project values. In order to contribute in a meaningful way to the B&R vision, the construction industry must achieve a quantum leap in innovation. It is of equal importance that we as insurers reinvigorate our traditional role as enablers of innovation. China's proven ability to leapfrog entire stages of technological development augurs well in this respect. As such, B&R offers a great potential for both the construction sector and its insurers to make a virtue of the current challenges, ranging from low productivity growth to marginal underwriting profit.

For Trust Re, this potential is of particular relevance as we are a major construction reinsurance provider. In addition, our geographical scope of operations almost perfectly matches the territories falling under the B&R initiative, making us a 'natural' stakeholder.

We believe that in order to effectively promote the establishment and longevity of the 'New Silk Road' the (re)insurance industry needs to think outside the box and collaboratively build a global risk carrying facility with deep local and regional know-how. Of course, this is a very difficult concept to implement given the diversity of regulations, maturity of markets, security of companies and the vastness of the risk management task itself. Trust Re has been investigating the 'New Silk Road' ever since the vision was launched, exploring how the (re)insurance industry can bundle its global, regional and local capabilities to mitigate the many risks along the path towards B&R.

Against this exciting backdrop, Trust Re is pleased to bring forward this latest edition of our expertise series 'Perspectives'. It reflects our aspiration to develop into our clients' reinsurer of choice, a position we intend to establish based on our customer centricity and value added services. These include the proactive and regular sharing of views and expertise, benefiting both our clients and us.

Trust Re hopes that you will find this research paper both interesting and inspiring. We look forward to your feedback and would be delighted to engage in a strategic dialogue with you on how we can make a joint contribution to the successful re-establishment of the Silk Road.

Fadi AbuNahl

Group CEO & Director
Trust Re

1. Summary

Construction insurance traces back to the Industrial Revolution

Construction (or engineering) insurance entails various types of policies which protect construction works as well as the erection and operation of machinery. The origins of construction insurance trace back to the inspection of steam boilers during the Industrial Revolution in the first half of the 19th century.

Global construction activities set to grow faster than gross domestic product

According to Oxford Economics, the global construction market is set to reach a total annual size of US$ 17.5 trillion by 2030, growing by an average annual rate of 3.9%, well in excess of projected global gross domestic product (GDP) growth of about 3%. The cumulative volume of construction is expected to amount to US$ 212 trillion over the period to 2030, with US$ 78 trillion deriving from Emerging Asia. By 2030, the construction sector is estimated to account for 14.7% of global GDP, up from 12.4% in 2014. China, the US and India will contribute 57% of all global growth in the construction market by 2030, compared with the three countries' combined share of about one third of the world's population and economic output.

Global construction insurance: A fiercely competitive US$ 20-30 billion market

There are no reliable global statistics covering the engineering insurance sector. However, based on country-specific data, we estimate the global construction premium volume at 1.0-1.5% of the world's non-life insurance market, i.e. at between US$ 21-31 billion.

Global construction insurance is not exempt from the unabated softening trend across most non-life lines of business. Engineering rates, too, are under pressure due to excess underwriting capacity and a relatively benign catastrophic claims environment. At the same time, exposure levels increase in the wake of urbanisation, technological advances and engineering superlatives. Gross claims ratios are on an upward trajectory as premium income growth does not keep pace.

Massive scope and need for innovation

Construction (insurance) is a long-established and proven activity. However, one can argue that the industry's ability and willingness to embrace innovation have to improve dramatically in order to capture its future growth potential. Compared with other industries, the construction sector lags behind in its adoption of new materials, methods and (digital) technology. Such improvements are not only about boosting lagging productivity growth but are also aimed at enhancing safety at the building site.

The Belt & Road initiative as a Herculean opportunity and challenge

The B&R initiative, announced in 2013, is widely viewed as one of the most ambitious economic development ventures of the 21st century. The underlying vision is to revive the Ancient Silk Road. In its proposed shape, the initiative is estimated to affect about 60% of the world's population in a total of 65 countries.

Total B&R infrastructure investments projected at US$ 7.5 trillion up to 2030

Total B&R infrastructure investments could reach about US$ 7.5 trillion up to 2030, according to Swiss Re. Almost 70% of those funds are expected to be allocated to projects outside China. Various sectors will benefit, with transportation and power generation accounting for the majority share. Almost 40% of total investments are expected to go to Southeast Asia which would make the ASEAN region the biggest recipient of B&R funds. Since the inception of the initiative, Chinese companies, both state-owned and private, have invested more than US$ 60 billion in B&R countries, according to the China National Development and Reform Commission.

The B&R project presents investors and constructors with many risks. The sheer size, scale and complexity of the envisioned investment activities, compounded by the heterogeneous nature of the territories involved, will give rise to significant risk management challenges in a wide spectrum of areas, ranging from commercial and regulatory risks to much less predictable political, terrorism or environmental risks.

The construction insurance opportunity

Both public and private stakeholders investing along the B&R will need to consider insurance in lines such as engineering, property, credit & surety, marine, energy and casualty. In addition, there are opportunities for niche insurance products covering, for example, public non-payment, expropriation and political violence.

As far as engineering insurance is concerned, road construction projects usually require Contractors' All Risks (CAR) insurance especially if those projects are exposed to damage from flood and earthquake and if they include bridges and tunnels. In addition, port construction activities in particular are associated with major third-party liability exposures such as environmental impairment, covered by CAR policies. The construction phase in the energy sector is usually covered under Erection All Risks (EAR) policies, including niche cover against political risks, for example.

Some exposures along the B&R will test the traditional limits of insurability, calling for non-traditional product designs such as integrated risk transfer solutions. Those would include multi-line products which help capture diversification benefits within the insured's risk portfolio.

Swiss Re estimates that, up to 2030, the B&R initiative could generate additional accumulated commercial insurance premium income outside of China of about US$ 28 billion. This amount is projected to be almost evenly split between construction phase premiums and post-completion premiums.

2. The global construction (insurance) market

2.1 Product overview

Some historical reflections

"Construction or engineering insurance" usually stands for various types of policies which protect construction works as well as the erection and operation of machinery.

The origins of construction insurance trace back to the inspection of steam boilers. In the 19th century, during the industrial revolution and starting in the UK, the increasing frequency of explosions causing serious property damage and loss of life gave rise to efforts to prevent such incidents and to mitigate their financial impact. In 1858, the first engineering insurance company, the Steam Boiler Assurance Company, was founded as a mutual. It started with the insurance of boilers, leading the way for similar companies with constantly extending covers. Engine insurance (today's machinery breakdown insurance) emerged only a few years later. At the beginning of the 20th century, the first insurance policies covering loss of profits following machinery breakdown were issued. At the same time, erection insurance (covering the on-site erection and assembly of machines) was launched.

After the Second World War, spurred by post-war reconstruction and development, contractors' policies took off, providing insurance cover for buildings and civil works during the course of construction. With advancing technology, other engineering policies such as Computer All Risks, Low Voltage and Electronic Equipment All Risks were introduced.

More recently, engineering insurance products covering contractual liabilities and guarantees as well as certain political risks (expropriation, confiscation, etc.) were developed, the transfer of which is often mandated by project financiers.[1]

Main construction insurance products

Contractors' All Risks (CAR)

CAR insurance policies cover all types of building and civil engineering construction and offer protection against hazards that threaten works under construction. Risks often covered include fire, flood, wind, earthquakes, water damage, mould, construction faults and negligence.

Erection All Risks (EAR)

EAR policies cover the erection of individual machines or complete plants, ranging from complete power stations to air conditioning equipment. The policy wording is similar to CAR.

[1] Swiss Re (1997) and Munich Re (2017)

Advance Loss of Profits (ALOP)
This type of insurance is a business income protection cover aimed at covering the principal's loss of gross profit resulting from a delay in completion of the construction and/or erection works. ALOP is contingent upon CAR or EAR being in force. The delay must be caused by a loss covered under a CAR or EAR policy.

Civil Engineering Completed Risks (CECR)
CECR insurance provides coverage against losses or damages to civil engineering structures such as highways, roads, bridges, dams and tunnels after their completion. In general, only material damage to the structures and related repair costs are indemnifiable.

2.2 Market overview

The global construction market
Global construction activities have picked up significantly since the global financial crisis. A robust recovery of the global economy and a continuation of favourable credit conditions suggest that the expansion phase of the construction cycle is well-established and sustainable from a business cycle perspective.[2]

As Asian economies continue to industrialise and the US recovers from the sharp construction downturn following the global financial crisis, construction activities are expected to outgrow general global GDP for the foreseeable future. In addition, we are likely to see a continued shift towards faster-growing construction markets in Asia and other emerging economies where population and economic growth, in combination with rapid urbanisation, fuel construction activities both in consumer-oriented and industrial/commercial segments of the construction market.

In China, amidst the broader transition of the economy away from investment-led industrial growth, construction in the future will refocus on consumer-focused activities such as building schools, hospitals, retail facilities and business parks. Beyond that, China is still facing huge infrastructure challenges, with the latest five-year plan emphasising clean energy, water and sanitation. In addition, the Belt & Road initiative increasingly takes shape.[3] A second development that impacts construction markets globally is the sharp fall in crude-oil prices. Lower oil prices affect construction activity both positively and negatively. On the one hand, lower oil prices act as a tax cut for consumers, boosting spending and additional productive capacity. On the other hand, in oil exporting countries, construction projects related to oil drilling and refinement have been scaled back, exacerbating the effect from less generous public infrastructure and construction works as governments need to tighten their belts.

According to Global Construction Perspectives and Oxford Economics China, the US and India will account for 57% of all global growth in the construction and engineering market by 2030, compared with the three countries' combined share of about one third in the world's population and economic output.

The inclusion of the next five largest markets Indonesia, the UK, Mexico, Canada and Nigeria brings the

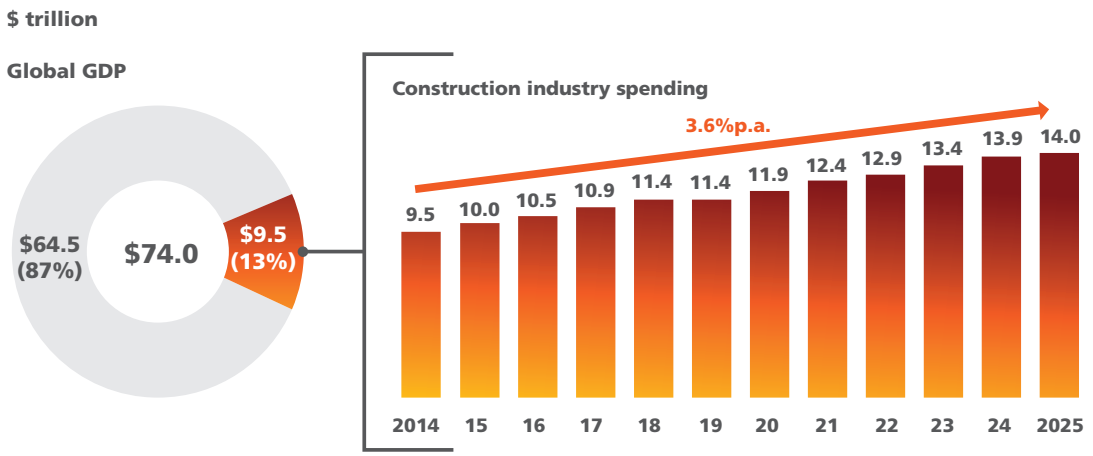
[2] Global Construction Perspectives and Oxford Economics (2015) [3] Ibid, section 4

major countries' contribution to global construction growth to a total of 70%.

The global construction market is set to grow by US$ 8 trillion until 2030, reaching a total annual size of US$ 17.5 trillion by then, growing by an average annual rate of 3.9%, well in excess of projected global GDP growth of about 3%. The cumulative volume of construction is expected to come in at US$ 212 trillion over the period to 2030, with US$ 77.8 trillion deriving from Emerging Asia. By 2030, the construction sector is estimated to account for 14.7% of global GDP, up from 12.4% in 2014.[4]

The McKinsey Global Institute (MGI) forecasts an annual growth in construction spending of 3.6% to a total volume of US$ 14 trillion by 2025 (see Exhibit 1). MGI cautions, however, that spending on construction is highly sensitive to the growth trajectory of GDP and, therefore, volatile. They point to the fact that in developed economies, growth in demand for construction output is often almost perfectly positively correlated with GDP growth. Similarly, given its large share of the global construction market, the economic performance of China will have a particularly significant impact on future construction volumes. Large swings in construction activity as a result of economic volatility are quite common.

Exhibit 1: Projected growth and GDP share of the global construction market (in %)



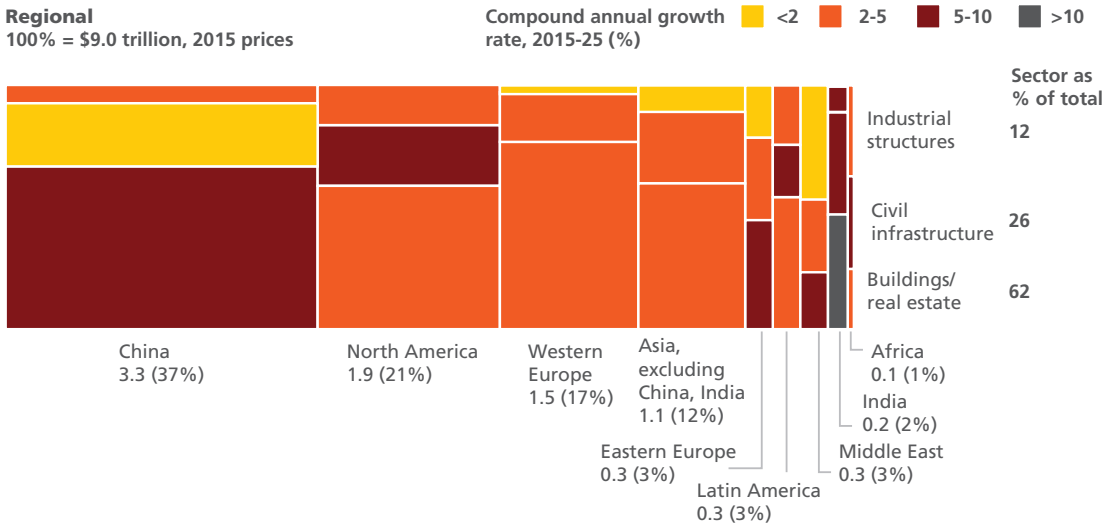
Source: MGI (2017)

At a volume of US$ 3.3 trillion (2015), China is the world's largest construction market, with a share of 37%. Asia as a whole accounts for 51% of global construction spending (see Exhibit 2).

Growth rates of construction spending largely depend on the geography and asset class. In major emerging economies such as China and India, and in regions including Latin America and the Middle East, spending on buildings and infrastructure tend to dominate. Projected growth rates of 5% to 10% p.a. in China, India and the Middle East primarily reflect expanding middle classes and the continuing rapid urbanisation.[5]

[4] Ibid [5] MGI (2017)

Exhibit 2: Composition of the construction market by region (2015) and growth projections

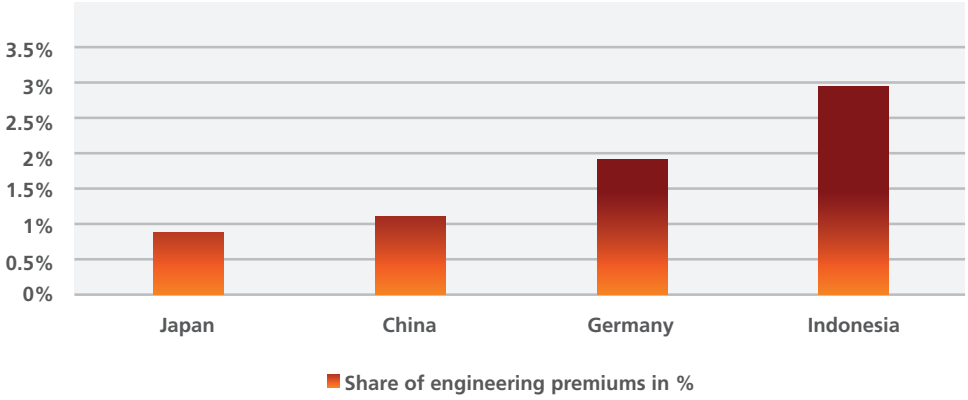


Source: MGI (2017)

The global construction insurance market

There are no reliable global statistics covering the construction/engineering line of business. Based on a bottom-up analysis of various individual country markets (see Exhibit 3), we estimate the global engineering premium volume at 1.0%-1.5% of the world's non-life premium volume of US$ 2.1 trillion in 2016,[6] i.e. at between US$ 21-31 billion.

Exhibit 3: Engineering premiums as a share of total non-life premiums (2015)



Source: Own calculations based on data from national supervisory authorities / trade associations

[6] Swiss Re (2017b)

Global trends in construction insurance

Heightened competition, the decentralisation of traditional market centres (including London), a continued excess in underwriting capacity (with even new players entering the market), and a relatively benign catastrophic claims environment have resulted in an unabated softening of premium rates - globally. At the same time exposure levels have increased in the wake of urbanisation, technological advances and engineering superlatives.

Even though global capacity for construction risks remains elevated, insurers still continue to generate satisfactory underwriting results, with the absence of catastrophic (casualty) loss events masking the inadequacy of current rates and their longer-term sustainability.[7]

Exhibit 4 summarises several other structural market trends which will be discussed in greater depth in section 3 of this study.

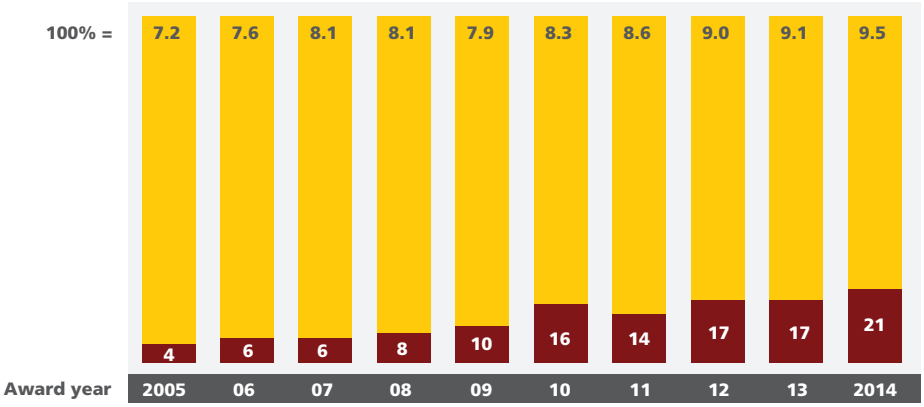
Exhibit 4: Structural trends shaping global construction insurance markets

Superlatives in projects (ever taller buildings, huge metro projects, huge diameter very deep tunnels, etc.)
The 4th Industrial Revolution (Big Data, Artificial Intelligence, Virtual Reality, Internet of Things, 3D Printing, etc.)
New transportation methods
Increasing cyber risk exposure (producing industry, energy, utilities, etc.)

Source: Adapted from Munich Re (2015)

Exhibit 5 shows the increasing share of complex megaprojects in global construction. It has increased more than fivefold within just ten years – a trend which adds to insurers' exposure to costly schedule overruns, for example.

Exhibit 5: Megaprojects (total value > US$ 1 billion) as a share of global construction spending, in % and US$ trillion



Source: MGI (2017)

[7] JLT (2016), Willis Towers Watson (2017)

Strengths and weaknesses of global construction insurance markets[8]

The following factors support a positive outlook for the global construction insurance market:

- A massive unmet demand in emerging countries for infrastructure and housing development, driven by population growth and continued urbanisation.
- The stimulating impact of new environmental and building standards in mature markets.
- A supply side characterised by well-established major construction firms with good technical know-how, a technically skilled workforce, vast pools of historical data, constantly improving aggregate monitoring and risk analysis capabilities and ample risk engineering resources.

However, the outlook is somewhat clouded by:

- Smaller companies with fragile financial structures and a high exposure to market fluctuations.
- Longer payment delays compared to other sectors of the economy.
- The deferral of infrastructure investments in some emerging countries.
- The exposure of national and household borrowing capacity to a scenario of rising interest rates.
- Excess capacity, combined with severe competition in the construction insurance market.
- New construction insurance players with limited know-how compromising minimum technical standards of underwriting.

2.3 Key drivers of demand in construction insurance

Construction insurance is basically an exchange of a contingent claim for a fixed payment to protect the interests of the parties involved in a construction project. Its core function is to transfer certain risks from clients, contractors, subcontractors and other parties involved in the construction project to insurers which provide contingent funding in times of difficulty. [9]

The typical construction contract has four major characteristics which drive construction insurance demand. Firstly, there is generally an express or implied undertaking that the contractor will complete the works and the project as a whole. Secondly, due to the grand scale and complexity of many major building and civil engineering projects, financial institutions, banks and governments are usually involved in raising the funds needed for the execution of the project. These parties require guarantees. Thirdly, a construction project is a unique artefact and creation with its own individual (risk) characteristics. Fourthly, any construction project presents its stakeholders with a complex and multi-faceted risk landscape. Therefore, it is essential to be prepared for adverse occurrences and to forestall their undesirable effects through appropriate risk management which includes mitigation through insurance.[10]

[8] Euler Hermes (2017), Aon Risk Solutions (2016), JLT (2016a) and Trust Re assessment

[9] Liu et al (2005) [10] Bunni (2015)

In light of the above, construction insurance is purchased for the following reasons:

Coping with rapid technological advances

The breathtaking pace of technological progress makes many construction projects high-risk prototypes which require bespoke insurance cover. [11]

Stakeholder management

Insurance can credibly underpin a company's commitment to work safety and environmental protection, for example, in particular if associated with additional services such as loss prevention measures and safety planning. Also, risk transfer is a signal to shareholders that the company is pursuing a responsible risk management policy and will not 'expropriate' creditors by undertaking high-risk activities. [12]

Financial considerations

From a transaction cost point of view, insurance is likely to be a low-cost alternative to more cumbersome and expensive contingent contracting among the stakeholders of the construction project. Firms also have an incentive to insure risks in the presence of a convex (progressive) tax scheme, which implies that risk hedging reduces the expected tax burden. As hedging risk reduces the likelihood of financial distress, it will improve a company's access to the credit market. In addition, insurance helps firms secure their access to cheap sources of funding for their future investments, by pre-financing the reconstruction costs and/or reducing the severity of liquidity shocks. [13]

Legal obligations

Most construction contracts require proof of (mandatory) insurance, in particular if the beneficiary is the public sector. This phenomenon is also spreading to developing and emerging markets. In Vietnam, for example, since 2016, contractors are obliged to purchase insurance for complex projects and their construction workers. Any construction work that may affect community safety or the environment and work that is subject to special technical requirements must be insured.[14]

The 'macro' framework

In addition to these 'micro' level determinants of construction insurance purchasing there are 'macro' drivers which shape and affect global construction insurance markets. Such drivers include:

- Changes to governments.
- Changes of public attitudes towards the power and energy industry (for instance towards coal as a result of global efforts to combat global warming or towards nuclear power following the Fukushima disaster in 2011). Such changes can affect, for example, renovation business through new environmental regulations.

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[11] Ibid, section 3 [12] Liu et al (2005), Gollier (2007) [13] Gollier (2007) [14] Baker & McKenzie (2015)

- Changes to the business cycle (economic growth, recession or depression) and interest rate environment (this is particularly relevant to housing construction).

- Major new infrastructure programmes such as the B&R initiative which drive capital-intensive civil engineering.

- The public sector as a major purchaser of construction (this implies that construction companies are heavily constrained by public demand and, at times onerous, public procurement processes. Government contracting is notorious for very strict definitions of what should be built and how, with straightforward implications for construction insurance demand. Government spending on construction also tends to be cyclical, adding to the boom-bust cycles of the industry).[15]

3. The scope for innovation

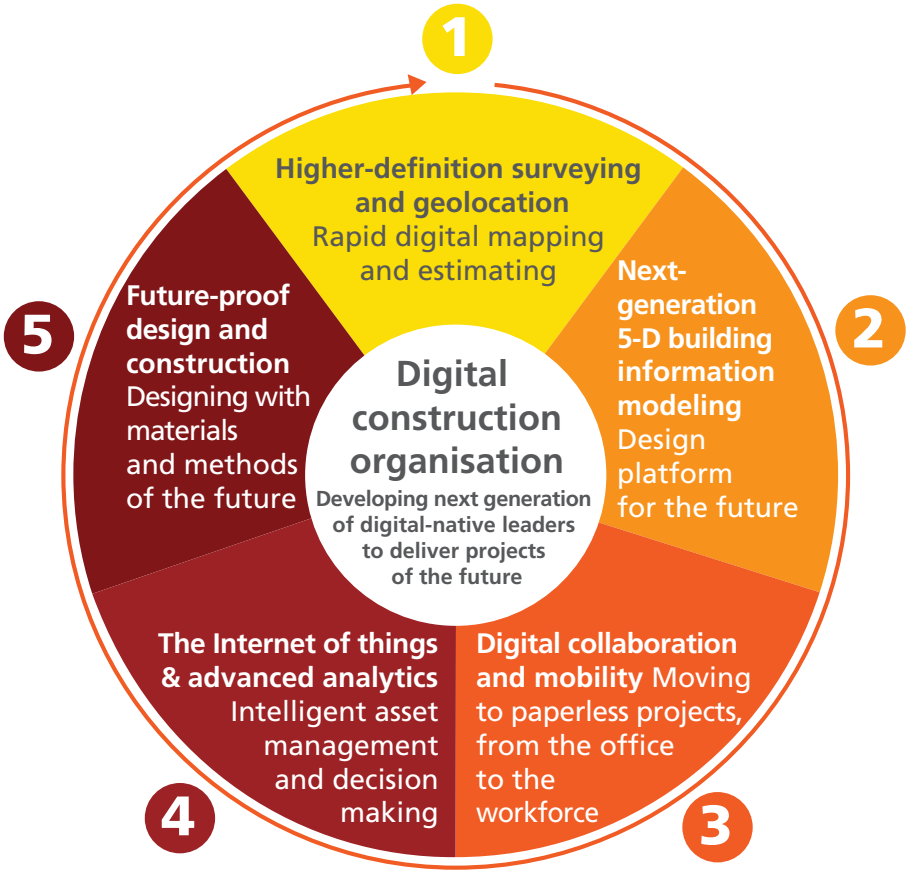
In the previous section, we have characterised construction and construction insurance as long-established and proven activities, with significant potential for further growth over the next few decades. However, one could argue that the industry's ability and willingness to embrace innovation have to improve dramatically to capture this potential. Indeed, compared with other industries, the construction sector lags behind in its adoption of new materials, methods, and (digital) technology. [16] Such improvements are not only about boosting productivity but are also aimed at enhancing safety at the building site.[17]

In principle, innovative changes to the risk landscape are major opportunities for insurers and reinsurers. However, some innovations may test the limits of insurability and should be embraced with caution. Let us recall the prerequisites to offering commercially viable insurance. Firstly, randomness: the location and time of an insured event must be unpredictable and the occurrence itself must be independent of the will of the insured. In this context, insurers need to understand that the existence of insurance may change the behaviour of insureds and, therefore, affect the probability of the occurrence of an insurable event as a result of moral hazard. Secondly, the frequency and severity of claimable events must be quantifiable within reasonable confidence limits. Thirdly, the premium rate must be economically viable and needs to cover the insurer's expected cost of acquiring and administering the business as well as claims costs. In addition, the price must allow for an appropriate return on the capital deployed to the risk, a return which meets shareholders' requirements.[18]

[15] MGI (2017) [16] MGI (2017) and McKinsey (2016b) [17] CEA/CSTB (2010)
[18] See Berliner (1982) who introduced the notion of limits to insurability

Exhibit 6 summarises the major opportunities for innovation in the construction sector, as discussed above.

Exhibit 6: Innovation in construction – Key trends



Source: McKinsey (2016a)

3.1 Harnessing digital technologies

MGI (2017) identifies four main digital trends capable of boosting construction productivity: First, next-generation 5D Building Information Modelling (BIM). Virtual-design tools allow to create a digital representation of the physical and spatial dimensions of a project, accelerating and improving decision-making. In the not too distant future, 5D BIM can be integrated with augmented- and virtual-reality technology, enabling seamless interaction between offices and the work site.[19]

[19] Construction SmartMarket Report (2011)

The second trend is digital collaboration and mobility. Construction companies are moving away from paper-heavy processes, replacing them with digital workflows in the form of simple, intuitive and user-friendly apps. A major advantage of digital collaboration is an improved transparency of processes, enabling real time collaboration and large-scale data mining.

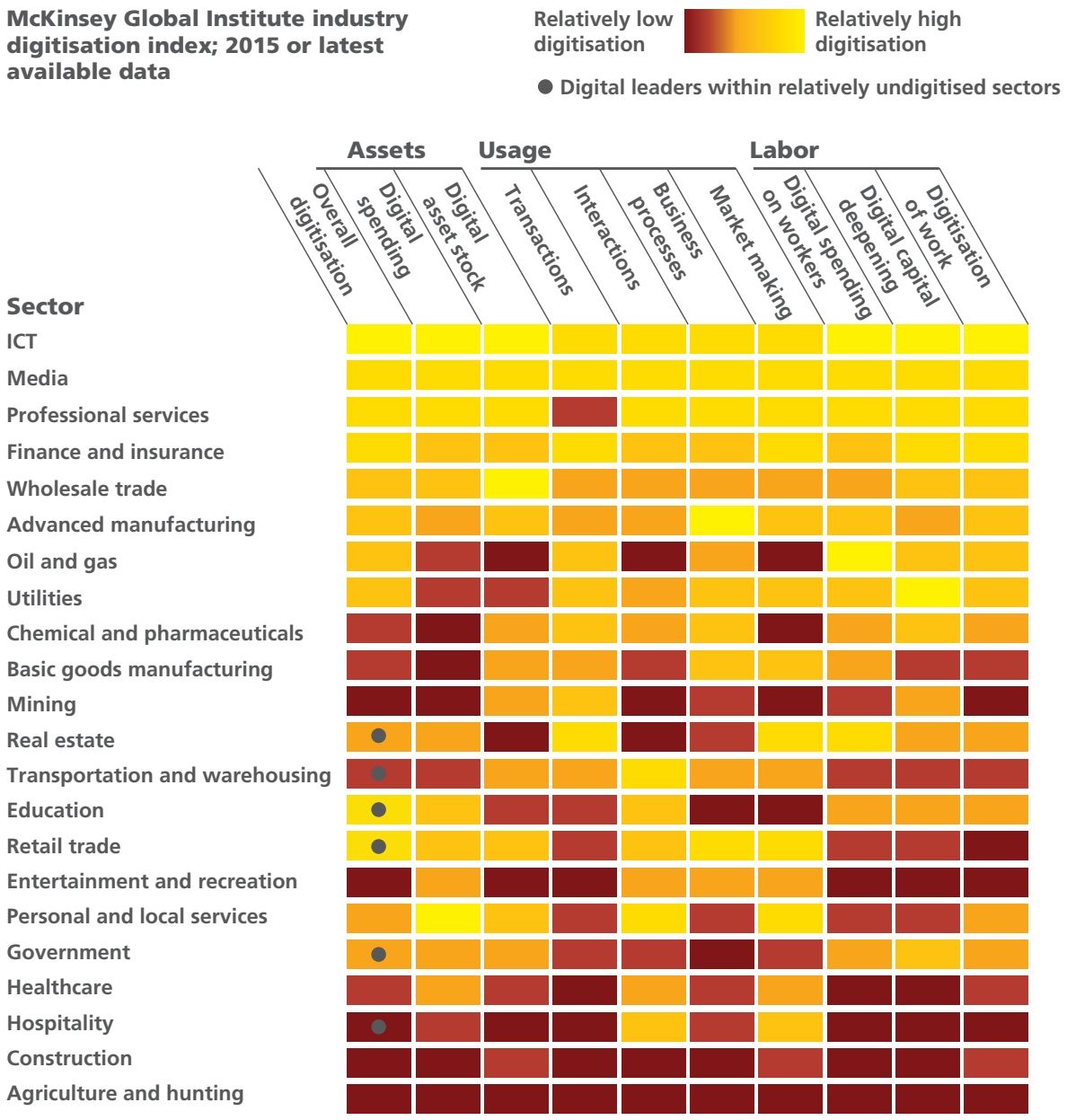
Thirdly, near-perfect surveying and geolocation. Traditional electronic distance measurement for surveying is expensive and labour-intensive. Nowadays, photogrammetry and satellite positioning systems producing high-resolution images are being introduced. Light detection and ranging (LiDAR) laser scanners make use of optical lasers to detect thousands of points per second, based on which they provide a high-quality 3D output. These technologies greatly improve the accuracy and quality of surveys even in the most difficult terrain at massively reduced cost.

The fourth digital trend relevant to construction productivity is the Internet of Things (IoT) in combination with advanced analytics. Through IoT, sensors and communication technology can be used to track asset utilisation and performance of construction equipment by capturing real-time data from crews, equipment, and stores. Construction companies can also deploy pattern- and trend-based advanced analytics for generating insights into the productivity of projects and the quality of day-to-day decision making. [20]

Exhibit 7 illustrates the low level of the construction industry's current digital preparedness and the enormous scope and need for catching up with other sectors of the economy.

[20] MGI (2017)

Exhibit 7: Digitisation levels by sector



Source: McKinsey (2016a)

3.2 Capturing opportunities from advances in materials technology

The materials used in construction are obviously a key driver of sector innovation. There is an overarching trend towards lighter-weight, more flexible materials which facilitate both logistics and execution on-site. The growing imperative of green construction is adding to this momentum.[21] One specific example of innovation in materials is concrete and steel construction such as lighter, more flexible, and more versatile forms of concrete (e.g. self-consolidating concrete) which can save significantly on time and deliver large productivity gains. Steel is another material undergoing change, e.g. through the development of modular structural steel systems. In the longer term, we may see more radical adaptations, particularly to concrete. Examples include carbon nanotubes as a strong, very lightweight alternative to reinforcement which would boost on-site productivity.

In addition, alternative materials are under development. Ethylene tetrafluoroethylene (ETFE), which is 99% lighter, stronger, eco-friendlier, better at light transmission, and more flexible than glass, is an example. This material was first employed on a large scale at the "Water Cube" swimming venue at the 2008 Beijing Olympics, resulting in significantly lower energy consumption. New polymers and plastics are also impacting more ordinary applications such as the use of recycled plastics to form modular road sections that would replace traditional asphalt construction.

Digression 1: An overview of new construction materials[22]

- **MR6 bitumen replacement products** (roads are stronger and longer lasting than with standard asphalt mixes [waste plastic blend])
- **Nano-level lubricant tuning** (improved surface coatings)
- **Metamaterial** (can switch from hard to soft; easy to manipulate to increase the stiffness of its surface by order of magnitude - the difference between rubber and steel - without damaging or altering the material itself)
- **3D printed aerospace-grade carbon fiber composites** (opening the door to greater control and optimisation of the material which is both lighter and stronger than steel)
- **High-capacity lithium nitride (Li3N) hydrogen storage systems under nano-confinement** (resulting in fundamental changes to the uptake and release of hydrogen, leading to dramatically faster performance and reversibility)
- **Fiber Reinforced Polymers and aramid ropes** (suitable materials for reinforcing and pre-stressing concrete; economic feasibility continues to present challenges)

[21] See Society for Excellence in Habitat Development—Environmental Protection & Employment Generation http://www.preventionweb.net/organizations/8158/view and UN-Habitat (2012)

[22] Compiled by the Trust Re experts involved in this paper, based on Royal Academy of Engineering (2013) as well as http://www.materialsforengineering.co.uk/engineering-materials-news/, https://www.sciencedaily.com/news/matter_energy/materials_science/, https://www.worldbuild365.com/news/iet0guhii/building-architecture/new-building-materials-for-the-future-of-construction, https://greenbuildingelements.com/2014/05/26/6-building-materials-future/ and https://www.raconteur.net/business/top-ten-construction-innovations

3.3 Boosting productivity through advances in automation technology

Advances in automation technology offer a substantial potential to accelerate execution on-site. According to estimates, more than two thirds of construction tasks are susceptible to automation.[23] Three areas are most noteworthy: First, additive construction (3D printing). Although this technology is still in its infancy, it is now possible to print submodules or even complete concrete structures. For example, in early 2015, Shanghai-based WinSun Construction unveiled a six-story apartment building built entirely with a 3D printer. [24]

Second, autonomous navigation technology for construction machinery enabled by LiDAR. The benefits of this technology include higher utilisation ratios and reduction in operator costs. The full potential will be captured when a project's entire fleet is equipped with this technology.

Third, robotics and drone technology. Robotics has the potential to replicate its game-changing impact on manufacturing in construction. Highly repeatable elements of construction such as bricklaying have already been reshaped by robotics. In addition, construction companies in India have used drones to string transmission lines spanning towers. [25]

Digression 2: Examples of (design) innovations which strengthen earthquake resilience[26]

A building can be floated above its foundation on **lead-rubber bearings**, which contain a solid lead core wrapped in alternating layers of rubber and steel. Steel plates attach the bearings to the building and its foundation and then, when an earthquake hits, allow the foundation to move without moving the structure above it.

Japanese engineers have taken base isolation to a new level. Their system actually **levitates a building on a cushion of air.** Sensors on the building detect the telltale seismic activity of an earthquake. The network of sensors communicates with an air compressor, which, within a half second of being alerted, forces air between the building and its foundation.

The cushion of air lifts the structure up to 1.18 inches (3 centimetres) off the ground, isolating it from the forces that could tear it apart. When the earthquake subsides, the compressor turns off, and the building settles back down to its foundation.

Engineers generally place **dampers** at each level of a building, with one end attached to a column and

[23] MGI (2017) using US Bureau of Labor Statistics
[24] https://3dprint.com/38144/3d-printed-apartment-building/
[25] Hodson (2013), "Spider drones weave high-rise structures out of cables," New Scientist, November 6, 2013.
[26] Compiled by the Trust Re construction underwriting team based on Japan Institute of Architects and Japan Seismic Safety Organization (2015). For examples of other architectural innovations see http://www.ist-palcom.org/publications/files/AEC-Spatial.pdf, http://www.archdaily.com/449785/four-architectural-innovations-make-time-s-top-25-inventions-for-2013, https://www.raconteur.net/business/top-ten-construction-innovations, http://theweek.com/articles/442971/7-innovative-ideas-architectural-design and http://www.architecture.org/architecture-chicago/topics-news/topic/innovation-in-architecture/

the other end attached to a beam. Each damper consists of a piston head that moves inside a cylinder filled with silicone oil. When an earthquake strikes, the horizontal motion of the building causes the piston in each damper to push against the oil, transforming the quake's mechanical energy into heat.

Another solution, especially for skyscrapers, involves suspending an enormous mass near the top of the structure. Steel cables support the mass, while viscous fluid dampers lie between the mass and the building it is trying to protect. When seismic activity causes the building to sway, the pendulum moves in the opposite direction, dissipating the energy. Engineers refer to such systems as **tuned mass dampers** because each pendulum is tuned precisely to a structure's natural vibrational frequency. If ground motion causes a building to oscillate at its resonance frequency, the building will vibrate with a large amount of energy and will likely experience damage. The role of a tuned mass damper is to counteract resonance and to minimise the dynamic response of the structure.

Steel frames that make up the structure can be elastic and allowed to rock on top of the foundation. In addition to the steel frames, Japanese researchers introduced **vertical cables** that anchor the top of each frame to the foundation and limit the rocking motion. The cables do have a self-centering ability, which means they can pull the entire structure upright when the shaking stops. The final components are the replaceable steel fuses placed between two frames or at the bases of columns. The metal teeth of the fuses absorb seismic energy as the building rocks. If they "blow" during an earthquake, they can be replaced relatively quickly and cost-effectively to restore the building to its original, ribbon-cutting form.

A better solution for structures in earthquake zones calls for a **rocking-core wall combined with base isolation**. A rocking core-wall rocks at the ground level to prevent the concrete in the wall from being permanently deformed. To accomplish this, engineers reinforce the lower two levels of the building with steel and incorporate post-tensioning along the entire height. In post-tensioning systems, steel tendons are threaded through the core wall. The tendons act like rubber bands, which can be tightly stretched by hydraulic jacks to increase the tensile strength of the core-wall.

Shape memory alloys, which can endure heavy strains and still return to its original shape. Many engineers are experimenting with these so-called smart materials as replacements for traditional steel-and-concrete construction. One promising alloy is nickel titanium, or nitinol, which offers 10% to 30% more elasticity than steel. In one 2012 study, researchers at the University of Nevada, Reno, compared the seismic performance of bridge columns made of steel and concrete with columns made of nitinol and concrete. The shape memory alloy outperformed the traditional materials on all levels and experienced far less damage.

Manufacturers produce fiber-reinforced plastic wraps, or **FRP** by mixing carbon fibers with binding polymers, such as epoxy, polyester, vinyl ester or nylon, to create a lightweight, but incredibly strong, composite material. In retrofitting applications, engineers simply wrap the material around

concrete support columns of bridges or buildings and then pump pressurised epoxy into the gap between the column and the material. Based on the design requirements, engineers may repeat this process six or eight times, creating a mummy-wrapped beam with significantly higher strength and ductility. Amazingly, even earthquake-damaged columns can be repaired with carbon-fiber wraps. In one study, researchers found that weakened highway bridge columns cocooned with the composite material were 24% to 38% stronger than unwrapped columns.

Digression 3: Quantum leaps in transportation construction

Beyond high-speed rail (an established and proven technology for which engineering underwriters are well equipped) the Hyperloop technology offers exciting opportunities. Underwriting challenges presented by this largely unproven technology include the design of covers for near vacuum tube, extensive bridgework and tunnelling as well as expensive magnetic components. These challenges are daunting as the following sections suggest.

For the Hyperloop as promoted by Tesla Motors CEO Elon Musk to work, it would need a way to pump out roughly 2 million cubic meters of air from its tubes and make sure that the air stays out of a 373 mile-long pipe with walls less than an inch thick. In comparison, the world's largest vacuum chamber only pumps out about 1.5% as much air and requires enormous amounts of structural reinforcement.

The proposed Hyperloop would be built in the heat of a California desert out of steel, which can greatly expand and change its shape as the temperature changes. Dr Phil Mason, a former Cornell University chemist, calculated that between the coldest and hottest days in this location, the Hyperloop would expand by about the length of three football fields, which would utterly wreck the tube. [27]

Hyperloop would also be vulnerable to terrorism. Merely shooting a few holes in the thin tubing surrounding the Hyperloop's vacuum would create air pockets which would trigger the same kind of cascading failure caused by a crash. To make matters worse, the 373 mile length of the Hyperloop and the fact that it would run down the middle of the freeway would make it effectively impossible to defend from terrorists. Dr Mason compared the terrorism risks of the Hyperloop to air travel by saying "any crazy with an anti-material rifle could shoot holes in the tube which would probably be fatal to almost the whole system." In comparison, Mason noted that "one plane crash does not destroy the entire infrastructure and kill everyone else flying the same route."[28]

Other concerns relate to the cost of Hyperloop. Michael Anderson, a professor of agricultural and resource economics at the University of California Berkeley, predicted that construction costs of the system would reach US$ 100 billion — almost 20 times more than Musk's cost estimates. The extra cost would make the economics of the Hyperloop totally nonviable. [29]

[27] http://dailycaller.com/2016/07/26/scientist-lays-out-5-huge-problems-with-elon-musks-hyperloop-video/

[28] Ibid [29] http://its.berkeley.edu/node/9641.

4. The potential for innovative thinking in construction insurance for the Belt & Road initiative

4.1 Overview of the Belt & Road initiative

B&R is one of the most ambitious economic development ventures of the 21st century. Announced in 2013 by Chinese President Xi Jinping, it seeks to revive the Ancient Silk Road, a network of major trading routes that linked the Han Dynasty to other Asian regions, Europe and Africa. In its proposed shape, B&R would affect about 4.5 billion people in 65 countries, about 60% of the world's population and 30% of global GDP. China is set to benefit both politically through stronger alliances and economically on the back of higher connectivity in cross-border trade and finance as a result of much improved land and sea links (see Exhibit 8). In addition, the initiative will enhance energy and food security for China and promote the development of its still underdeveloped and land locked Eastern and Western provinces which have limited trade connections with neighbouring countries. [30]

From an insurance point of view, too, the initiative's holistic character is a fascinating endeavour: On the one hand, it comprises the land-based Silk Road Economic Belt ("the Belt") with transportation routes, pipelines and other infrastructure linking China with Central and Western Asia, the Middle East and Europe. The sea-based Maritime Silk Road ("the Road") will consist of shipping routes and port facilities across the South China Sea and the Indian Ocean, connecting Southeast and South Asia, East Africa and Europe (see Exhibit 9). Outside China alone, B&R investments are estimated to generate an additional US$ 28 billion in commercial insurance premiums up to 2030, equally split between engineering and marine insurance during the construction phase and property insurance thereafter. [31]

Exhibit 8: The overarching B&R policy agenda

Source: EY (2015)

[30] HSBC (2015) [31] Swiss Re (2017a)

Exhibit 9: The geographical scope of B&R

Source: The Economist (2016b)

4.2 Infrastructure investments across Belt & Road countries

Total B&R infrastructure investments up to 2030 are projected to reach close to US$ 7.5 trillion, with almost 70% of funds expected to be invested outside China (see Table 1). Investments will be directed at various sectors, with transportation and power generation accounting for the lion's share of 55%.

Table 1: Estimated B&R-related investments by 2030

		Aggregate project value (US$ billion)		
	Types of project	**China**	**Overseas**	**Total**
Infrastructure	Transportation	649	1557	2206
	Telecommunication	203	546	749
	Water and sanitation	241	212	453
	Power and resources	662	1211	1873
	Other infrastructure	259	704	963
Agriculture	Agriculture, forestry, animal husbandry and fisheries	31	96	127
Cultural exchange, tourism	Cultural exchange, tourism	69	174	243
Others	Capacity cooperation	39	111	150
	Industrial parks	101	288	389
	Commercial building	85	204	289
Total		**2339**	**5103**	**7442**

Source: Swiss Re (2017a)

As the project sponsor, China will spearhead many projects across the B&R countries, either through funding or as part of construction consortiums. According to the China National Development and Reform Commission, since inception of the programme, total investments from state-owned and private Chinese companies in B&R countries amounted to more than US$ 60 billion, with an initial focus on Central and Southeast Asia.[32] For funding purposes, the Chinese government has launched a US$ 40 billion 'Silk Road Fund', backed by the China Investment Corporation, China Development Bank, the Import-Export Bank of China and the State Administration of Foreign Exchange. In addition, the Asian Infrastructure Investment Bank (AIIB)[33] is expected to play a major role in financing construction as well.[34] Overall, B&R is estimated to trigger up to US$ 1 trillion of outbound state financing from China in the next ten years. [35]

Overall, at an estimated US$ 1.9 trillion or 38% of total investments, Southeast Asia is likely to be the biggest recipient (see Table 2). The region is a main conduit for the 21st Century Maritime Silk Road. It will benefit from improved port facilities and rail links into industrial hinterlands. As a result, there could be an accelerated relocation of manufacturing activities from increasingly costly production sites in China to Cambodia, Myanmar, Laos and Vietnam in particular (so-called "CMLV-countries").[36] Transport-related projects (especially ports) are expected to draw close to 30% of total funds.

[32] China Daily (2017)

[33] Led by China, the AIIB has 57 founding members. The initially authorized capital is US$ 100 billion of capital stock. The AIIB is committed to working with multilateral development banks in order to address infrastructure needs in Asia, including energy, power, transportation, telecommunications, rural infrastructure, agriculture development, water supply, sanitation, environmental protection, urban development and logistics. See Fung (2016).

[34] EIU (2015) [35] PWC (2016) [36] Fung (2016)

Table 2: Estimated B&R-related investments outside China per region and sector [37]

		Aggregate project value (US$ billion)							
		Africa	CEE	Mongolia & Russia	Middle East	Southeast Asia	South Asia	Central Asia	Total
Infrastructure	Transportation	123	158	232	137	565	268	75	1557
	Telecommunication	19	70	45	55	203	97	57	546
	Water and sanitation	12	41	8	36	80	19	17	212
	Power and resources	79	106	136	131	493	146	121	1211
	Other infrastructure	46	75	84	72	267	106	54	704
Agriculture	Agriculture, forestry, animal husbandry and fisheries	6	10	11	10	36	14	7	96
Cultural exchange, tourism	Cultural exchange, tourism	11	19	21	18	66	26	13	174
Other	Capacity cooperation	7	12	13	11	42	17	8	111
	Industrial parks	19	31	34	29	110	43	22	288
	Commercial building	13	22	24	21	78	31	16	204
Total		**335**	**542**	**610**	**519**	**1940**	**767**	**390**	**5103**

Source: Swiss Re (2017a)

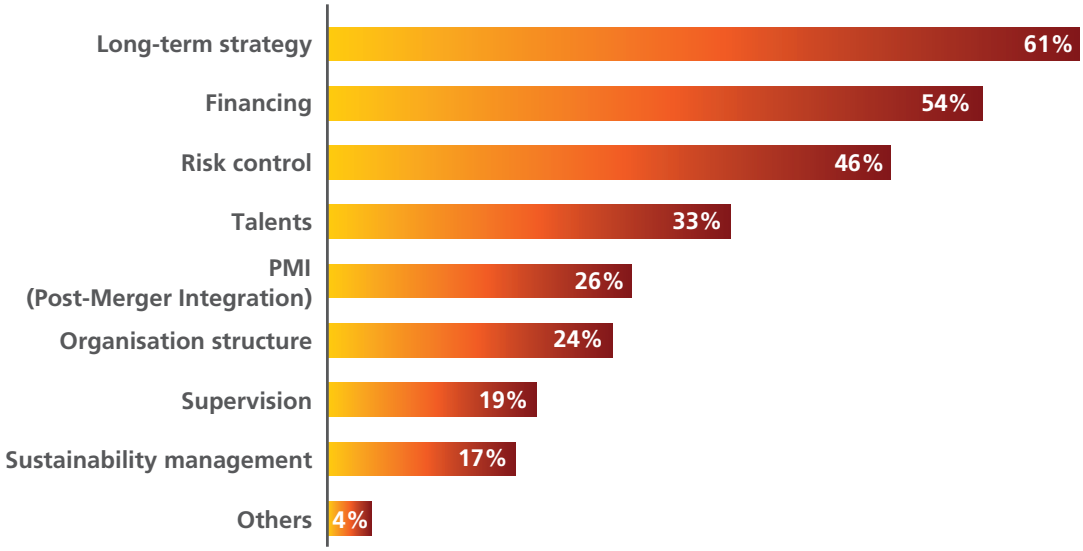
[37] Additional country-specific information is available from EIU (2016)

4.3 Risk management and transfer challenges

The B&R project presents investors and constructors with many risks. The sheer size, scale and complexity of the envisioned investment activities, compounded by the heterogeneous nature of the territories involved, will give rise to significant risk management challenges in a wide spectrum of areas, ranging from commercial and regulatory risks to much less predictable political, terrorism or environmental risks. [38]

According to a survey of Chinese state-owned enterprises (SOEs), the top three challenges for companies engaged in B&R activities are: (1) develop a long-term strategy for overseas investment and expansion, (2) obtain funding support and (3) control risks in host countries (see Exhibit 10). [39]

Exhibit 10: Major challenges perceived by internationally operating Chinese SOEs



Source: Deloitte (2016)

Credit, surety and political risks [40]

B&R countries vary greatly as far as political governance systems are concerned. As a result, political risk features prominently on any corporate B&R agenda.

[38] XL Catlin (2016) [39] Deloitte (2016)
[40] Examples include: The Sino-Thai Railway has been affected by the instability in Thailand, the construction of the Myitsone Hydropower Project in Myanmar was suspended due to NGO opposition, and the new Sri Lankan government suspended the Colombo Port City project approved by the former government (see EY (2015))

Infrastructure projects are poised to face a broad variety of political obstacles during their life cycle, e.g. social opposition during the planning and construction phase; expropriation risks during the operating phase and regulatory, tax and judicial risks through the entire life cycle. [41]

Inconsistent government decisions and wide spread poverty in a number of B&R countries often lead to political instability, rioting and even terrorism. Insurgent groups often oppose infrastructure projects violently as they are considered as strengthening the authority of the central government. The forcible relocation of people as part of major infrastructure projects can spark unrest, too. These risks can derail projects, jeopardise the safety of foreign and local employees and result in severe financial losses. [42]

Therefore, more often than not, local government authorities decide to question the execution of projects or withdraw from them altogether.

In addition to domestic political risks, geopolitical tensions need to be considered as well. Territorial disputes and a certain wariness of China's growing assertiveness and clout could be an obstacle to closer cross-border cooperation.

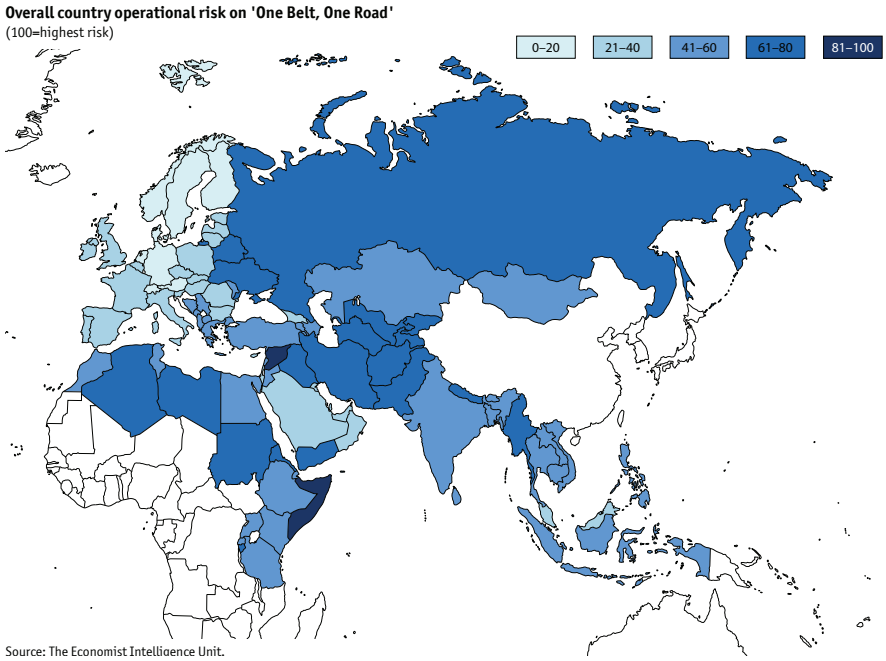
And last but not least, frequent and fundamental changes in political leadership can also disrupt infrastructure projects that rely on long-term planning security. [43]

Political uncertainties and governance deficits exacerbate other operational risks such as those arising from inadequate or failed internal processes, a lack of knowledge of local economic and regulatory environments as well as business interruption in countries with poor infrastructure and low risk management capabilities (see Exhibit 11).

In addition to addressing political risks, banks and lenders will be required to make an extra effort in providing sizeable credit facilities and guarantees to contractors and subcontractors - along the supply chains of the projects - to support working capital requirements and secure the performance of their contractual obligations to the relevant parties. In particular, the structured use of surety bonds and contract guarantees will ensure that project owners are protected against the risks of mis-performance and/or default by contractors and subcontractors, making sure that works are executed according to the contractual terms and conditions and being compensated for any delay or failure to deliver as scheduled at the time of signing of contracts.

[41] Swiss Re (2016) [42] XL Catlin (2016) [43] Swiss Re (2017a)

Exhibit 11: An overview of country risk along the B&R



Source: EIU (2016)

Table 3 presents more in-depth information about specific political risks in a number of major B&R countries.

Table 3: Country-specific risks along the B&R

	Azerbaijan	Egypt	India	Indonesia	Myanmar	Saudi Arabia	Sri Lanka	Turkey
Strikes, Riots & Civil Commotion	4	5	5	3	4	4	4	5
Terrorism	3	6	5	5	4	4	4	6
War & Civil War	4	4	4	3	4	4	3	4
Country Economic Risk	6	6	5	5	6	3	6	5
Currency Inconvertibility & Transfer Risk	6	7	5	5	8	3	6	4
Sovereign Credit Risk	6	7	5	5	8	3	7	5
Expropriation	5	7	4	5	7	3	6	5
Contractual Agreement Repudiation	5	7	6	6	7	7	6	6
Legal & Regulatory Risk	6	6	6	6	8	4	5	5

1= Low Risk
10= High Risk

= Under Review (Monitoring for increased risk)

=Under Review (Monitoring for decreased risk)

Source: JLT (2016b)

Economic risks

Most B&R countries are emerging or developing economies with above-average economic growth and significant future potential. However, they also exhibit a high degree of vulnerability to external shocks such as weakening demand in mature markets, protectionist tendencies as well as currency and commodity price volatility and the subsequent impact of any of these factors on public spending. Some countries' currencies have come under pressure in the wake of a tightening monetary policy stance of the US Federal Reserve. In addition, the ratio of (dollar-denominated) non-performing loans has increased in some countries. High inflation rates and weakening currencies have prompted a number of central banks across the B&R to tighten monetary policy, pro-cyclically adding to slowing economic growth. [44]

The B&R project could both stabilise and promote economic growth across its geographical scope, provided that local governments successfully manage risks such as over-investment in projects and fiscal strain. [45]

In addition, the insurance industry could make a major contribution to reducing macro-economic vulnerability through the provision of coverage for local households, firms and governments. The low level of current insurance penetration in most B&R countries suggests a significant potential.

Regulatory risk [46]

A lack of awareness of (frequently opaque) legal and regulatory frameworks can cause costly project delays. Frequently the issue is less the wording of such requirements but the way in which they are implemented, as well as their medium- to long-term predictability. More often than not, government effectiveness leaves much to be desired due to corruption, vested interests and poor accountability of public officials, for example. Other legal and regulatory risks include the fairness of the judicial process, the enforceability of contracts and the protection of private property rights.

Environmental regulations are particularly relevant given the major role played by energy projects in the overall B&R initiative. Although many B&R countries have legislation in place to address environmental concerns, laws are frequently not properly and predictably enforced. As a result, operators need to be prepared for international scrutiny and the potential legal and reputational costs associated with it.

Also, local labour regulations and customs may entail risks of delay and cost overrun. Chinese state-owned enterprises operating abroad try to mitigate this risk by deploying Chinese speaking management and workforce, sparking resentment amongst local populations. [47]

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[44] IMF (2017) [45] GDI (2016) and Swiss Re (2016) [46] EIU (2015), JLT (2016), Fung (2016) and The Economist (2016a)
[47] Lain (2016)

4.4 The (construction) insurance opportunity

In light of a complex, rapidly evolving and multi-faceted risk landscape, both public and private stakeholders operating along the B&R will need to consider insurance in lines such as engineering, property, credit & surety, marine, energy and casualty. In addition, there are opportunities for niche insurance products covering non-payment, expropriation, political violence and currency inconvertibility or transfer restrictions.

The macro perspective [48]

Insurance opportunities associated with the B&R initiative go way beyond specific construction projects. Longer-term, once the necessary infrastructure is in place, the B&R project will pave the way for China transferring part of its labour intensive industries to other countries in the process of rebalancing its economy. As a result, new (property and casualty) insurance opportunities will arise as the focus of Chinese foreign direct investments shifts from natural resources to manufacturing.

Insurance markets along the B&R are also set to benefit from specific measures for developing domestic capital markets. B&R investments could add a lot to the breadth, depth and liquidity, especially of the smaller markets. For instance, bond issues of development banks might enhance local credit markets, attract global investors and expand the development of long-term capital markets in the region. The likelihood of this scenario would certainly benefit from the availability of insurance solutions which effectively mitigate commercial and political risks for private investors. In addition, the stable income provided by bonds can also be an attractive investment for insurers keen to match their liabilities in the region.

Furthermore, insurance can also greatly facilitate commercial bank finance, for example in the energy and communication sectors where projects tend to generate revenues. In other sectors with lower returns and higher barriers to viability, public-private partnerships are more suitable. In these areas as well, insurance can add much value, in particular as public sector entities increasingly understand the rationale behind pre-event risk mitigation through insurance.

More specifically, insurers could join forces with development banks, promoting their core mission of mitigating political and commercial risk in infrastructure projects and thereby attracting more private capital. There are many examples of successful collaborations in the field of natural catastrophe protection such as various World Bank projects supported by commercial (re)insurers.

And last but not least, an important qualitative B&R aspect presents opportunities to the insurance industry. The project will have to live up to the criteria defined by the Agenda 2030 for Sustainable Development and the Paris COP 21 Agreement on combating climate change, both being subscribed

[48] Based on GDI (2017)

to by all B&R countries. Future infrastructure investments will require new technological solutions for decarbonising the economies. Insurers can offer an attractive and proven suite of products to help ensure that the B&R initiative meets the requirements of a modern 21st century growth plan.

Insurance covering the construction phase of projects

Road construction projects, for example, usually require Contractors' All Risks (CAR) engineering insurance, in particular if those projects are prone to damage from natural disasters such as flood and earthquake and if they include bridges and tunnels.

Port construction activities, in addition to being vulnerable to natural catastrophes, are also associated with major third-party liability exposures stemming from the use of heavy lifting machinery. Environmental impairment to sensitive ecosystems is another relevant risk factor. Again, CAR policies offer a risk transfer response to such exposures.

As shown before, energy projects such as oil pipelines, refineries and power plants will account for an important part of the total B&R investments. The construction phase in the energy sector is usually covered under Erection All Risks (EAR) policies, including cover against political risks, terrorism, theft of materials and, of course, natural perils.

Insurance covering the operational phase of projects

Operating roads in low lying areas, for example, presents major flood and water risk exposures. In addition, port authorities and terminal operators need to manage risks across a wide spectrum from damage to vessels to losses because of environmental pollution.

Infrastructure in the operational phase is generally covered against physical damage by property insurance. Regular exclusions include contingent business interruption, cyber risk and terrorism. Innovative forms of coverage provide package solutions for port and airport operators encompassing property, engineering and liability insurance in one contract.

The promise of innovative forms of risk transfer

Alternative forms of risk transfer usually come into play when risk exposures test the traditional limits of insurability. One example are multi-risk products. These are highly customised structures that combine various risk exposures into a single insurance contract. On that basis, risk transfer is usually cheaper as correlation effects reduce volatility. In addition, the efficiency of bundled risk transfer transactions is superior to an isolated line-by-line approach. [49]

[49] Banks (2008) and Culp (2006) offer a comprehensive discussion of multi-line products

Instead of pursuing a modular approach to insurance buying, large infrastructure companies should consider integrated risk transfer solutions. This is particularly true for Chinese firms investing overseas, many of which only have basic and rudimentary construction insurance cover and do not have the experience to negotiate and administer a whole portfolio of separate insurance policies.

The scope for innovative surety insurance

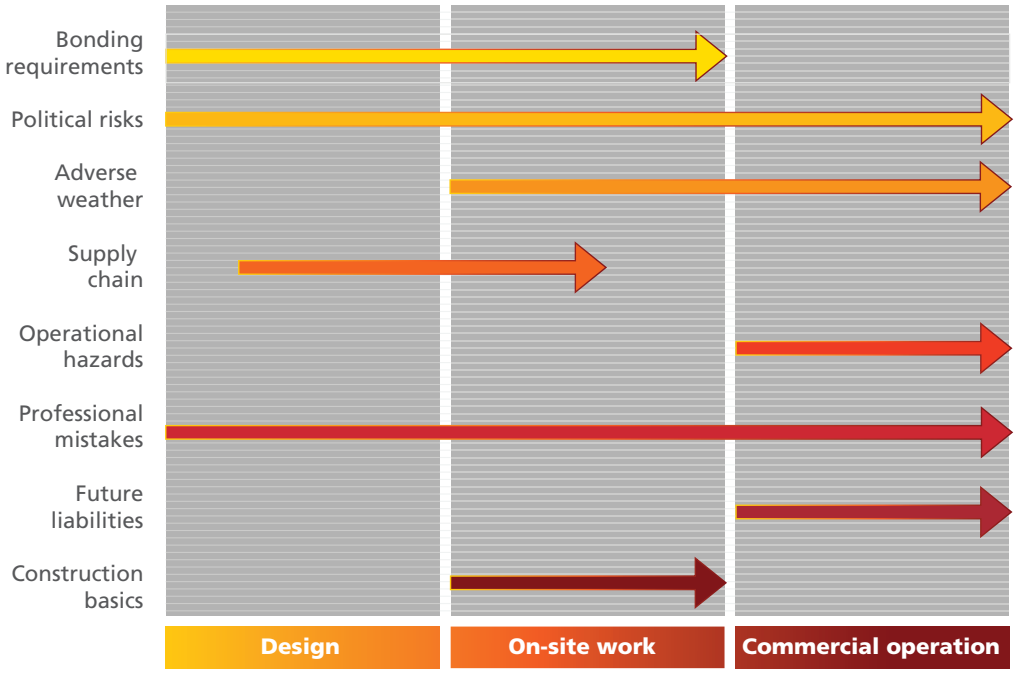
A specific area of promise is the innovative use of surety insurance. Reverse bonding schemes, for example, might further enhance the synergies between project owners and surety bond providers. In these schemes, surety companies actively participate with project owners in the selection process of the appropriate contractors, via advising about their financial strength and technical expertise. In fact, whenever a contractor is deemed to be "unfit" for a surety provider, either because of lacking credit worthiness or a poor technical track record, it is a serious warning signal for project owners willing to award the contract. Generally, surety companies are involved only at the stage of signing of the contract rather than in the selection process and this sometimes can cause some issues at the issuance of the guarantees. Reverse bonding schemes would instead ensure the selection of higher standing contractors and consequently smoother execution of projects.

In this exceptionally vast initiative of the B&R, it will be crucial to work also on comprehensive frameworks where the various financial institutions can share risks, in order to mitigate excess of exposure and cope with capital absorption limitations. Indeed, via Credit Insurance and Political Risks covers, the terms on the lending activities can be relaxed and more affordable to obligors but, even on non-cash facilities, such as performance guarantees and contract bonds, banks and insurance companies should work to establish closer cooperation. More specifically, in bank-surety syndication schemes, banks and insurers enter into risk participation agreements in the unfunded business such as performance bonds, advance payment bonds and so on, on a *pari passu* basis. These structures represent the conjunction link between the insurance industry and the banking sector and, while ensuring a broader alignment of interests, will leave room (in other terms capacity) to banks and insurance companies for granting support to contractors on classes and products which are their core business: lending on the banking side and traditional insurance covers such as CAR, EAR etc. on the other side.

These innovative schemes will need to fully adhere and comply with different laws and jurisdictions, across the countries involved and, as such, will be impacted by the different regulatory frameworks. It might be ambitious, but given the magnitude of the B&R initiative, it will be key to harmonize all the actors on the stage. While not being an easy task, governments will play a decisive role in this coordination effort.

Exhibit 12 illustrates the potential shape of a holistic construction insurance product tailored to the specific requirements of the B&R risk landscape.[50]

Exhibit 12: An integrated multi-line construction insurance solution for B&R projects



Source: Swiss Re Corporate Solutions, Swiss Re Economic Research & Consulting.

The premium potential

The B&R initiative is estimated to translate into additional accumulated commercial insurance premium income outside of China of US$ 28 billion by 2030. This amount is almost evenly split between construction phase premiums and post-completion premiums.[51] Engineering insurance is expected to benefit most, with additional premiums of more than US$ 10 billion, on the back of massive construction of transport and power infrastructure. Southeast Asia is anticipated to generate the biggest share (38%) of the additional engineering premium outside China (see Table 4).

[50] Based on Swiss Re (2016) [51] Swiss Re (2017a)

Table 4: Estimated commercial construction-phase premiums generated by B&R-related investments outside China up to 2030, US$ billion

Commercial insurance lines	Total Overseas	Southeast Asia	Mongolia & Russia	South Asia	Central Asia	Middle East	CEE	Africa
Construction-phase								
Engineering	10.2	3.9	1.2	1.5	0.8	1.0	1.1	0.7
Transportation	3.1	1.1	0.5	0.5	0.2	0.3	0.3	0.2
Energy	2.4	1.0	0.3	0.3	0.2	0.3	0.2	0.2
Others	4.7	1.8	0.5	0.7	0.4	0.5	0.6	0.3
Marine (general cargo)	2.9	1.1	0.3	0.4	0.2	0.3	0.3	0.2
Marine	0.5	0.2	0.1	0.1	0.0	0.1	0.1	0.0
Liability/PA	0.4	0.2	0.0	0.1	0.0	0.0	0.0	0.0
Subtotal	**14.0**	**5.3**	**1.7**	**2.1**	**1.1**	**1.4**	**1.5**	**0.9**

Source: Swiss Re (2017a)

Demand for ongoing property cover is set to take off once projects are up and running. 56% of the expected additional premium post-completion will derive from power plants and other energy-related projects in the operational phase. At 41%, Southeast Asia's share is projected to be even higher than in the engineering space (see Table 5).

Table 5: Estimated commercial operational-phase premiums generated by B&R-related investments outside China up to 2030, US$ billion

Commercial insurance lines	Total Overseas	Southeast Asia	Mongolia & Russia	South Asia	Central Asia	Middle East	CEE	Africa
Operational-phase								
Property	13.5	5.3	1.3	1.7	1.0	1.3	2.0	0.8
Transportation	0.9	0.3	0.1	0.1	0.0	0.1	0.1	0.1
Energy	7.5	3.1	0.7	0.8	0.6	0.7	1.0	0.5
Others	5.1	1.9	0.5	0.7	0.4	0.5	0.9	0.3
Total	**13.5**	**5.3**	**1.3**	**1.7**	**1.0**	**1.3**	**2.0**	**0.8**

Source: Swiss Re (2017a)

5. Conclusions

The B&R initiative is a massive endeavour which is bound to stretch the capabilities of contractors and their insurers alike. The scale and nature of the envisioned projects require innovative approaches, not only to managing operational, economic, regulatory and political risks but also to adopting new materials and technologies in order to improve the construction industry's underwhelming productivity record.

Any increase in productivity means that higher value can be provided to customers with the same or fewer resources. This translates into a beneficial mix of higher-quality output (also at shorter and more reliable schedules) at lower cost, higher profitability for contractors and higher wages for workers. Even though any one or two of these effects could also be achieved without productivity growth, the realisation of all three benefits requires requires improved productivity.

We believe that the B&R initiative is a great opportunity to catalyse the global construction industry's embracing of the various forms of innovation discussed in this report. The complexity of the challenges ahead requires fresh and unorthodox approaches. And China's impressive leapfrogging record in areas such as e-commerce and renewable energies augurs well for quantum leaps in construction innovation, too.

The insurance industry is called upon to facilitate the construction industry's inevitable transition from outlived legacy systems to productivity-boosting, innovative ways of addressing the sheer scale of global construction needs and their increasing complexity, as exemplified by B&R.

As a major construction reinsurer with a significant footprint in the B&R countries and a reputation of dynamism, Trust Re is willing and able to contribute to meeting the expected additional demand for tailored and innovative construction insurance solutions. For example, we do have the internal capabilities to deliver on the surety product innovations outlined in this report. These solutions are designed to smoothen the execution of the large-scale and complex construction projects envisaged by the B&R initiative.

Enabling innovation and progress has always been a core mission of insurance. Henry Ford was quoted as saying "Without insurance, there would be no skyscrapers". Let us aim high and our offspring may read something similar with respect to the rebuilding of the Silk Road in the 21st century.

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