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sigma

Constructing the future: recent developments in engineering insurance

sigma 50 YEARS

Foreword

This year we celebrate the 50th anniversary of *sigma*, the flagship publication of the Swiss Re Institute's research portfolio. Over the last half century, *sigma* has provided thought leadership spanning the ever-evolving risk landscape facing society, the macro and regulatory environments and their impact on insurance markets, and industry-specific topics such as underwriting cycles and distribution channels. As the industry's leading research publication, *sigma* continues to support Swiss Re's vision to make the world more resilient.

For the second edition of *sigma* in this anniversary year, the topic of interest is engineering insurance, a specialist area of the sector focussing on providing protection against engineering and construction risks. Although not mainstream, such specialty insurance lines involving difficult or unusual risks have often been covered by *sigma*. In fact, the focus of the second *sigma* ever published, back in 1968, was marine insurance, the 'mother of all insurance' classes. Marine insurance would later be featured again in *sigma* in the early 1970s, the 1980s, and most recently in 2013.

Other specialty lines that have been featured in *sigma* include aviation and credit & surety. Aviation insurance was covered by *sigma* twice in the 1970s, twice in the 1980s, once in the 1990s, and most recently in tandem with marine in 2013. Meanwhile, credit & surety has been featured just once, back in 1971. At that time, *sigma* published a comprehensive market overview of this specialty line, which also touched on the limits of insurability of credit risks and the impact of an economic downturn on loss experience.

While this year marks the first time that a *sigma* on engineering insurance has been written, Swiss Re released a study in 2006 titled "Construction as a driver of project engineering insurance". Over the past decade, much has happened (eg the fallout from the 2008 financial crisis, the development in emerging economies including in their insurance sectors, new technology etc), therefore it is useful to take stock of what the changing economic, technological and competitive environment means for engineering insurance.

Please visit the *sigma* 50 years section on the Swiss Re Institute website (institute.swissre.com/sigma50years) to find out more about the evolution of *sigma*, and the breadth and depth of our overall research offering.

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Executive summary

Engineering insurance accounts for around 3% of global commercial premiums, but plays a crucial role in facilitating investment.

Engineering insurance is a specialty line of business that provides protection against losses from unforeseen circumstances during the construction and operation of plant, buildings, and infrastructure. With annual premiums of around USD 21 billion, it represents only a small part (around 3%) of the overall commercial insurance market. However, without such cover many construction projects and the operation of vital machinery would prove prohibitively risky to undertake.

Premiums have been broadly flat in recent years.

Global engineering premiums have stagnated in recent years due to the limited growth in exposures and persistent weakness in insurance pricing. In advanced markets, construction spending as a percent of GDP remains considerably below its pre-2008 financial crisis peak, while some key emerging markets have recently experienced sharp recessions. Similar to other insurance lines, abundant insurance risk capital has also contributed to significant declines in premium rates.

Some engineering underwriting capacity is distributed across international hubs, such as London, Singapore and Dubai, typically via brokers.

Given the scale and complexity of some potential exposures, risk-absorbing capacity for large engineering covers is distributed across international wholesale insurance markets, typically via brokers. The London Market – comprised of Lloyd's of London and international specialist insurers based there – continues to play an important role, although alternative insurance hubs such as Singapore and Dubai have emerged. This decentralisation of capacity as well as consolidation among incumbent brokers has enabled intermediaries to reinforce their influence in wholesale insurance markets.

Engineering insurance remains a relatively profitable line, but there are signs that underwriting performance has deteriorated recently.

Engineering insurance has been relatively profitable compared with other specialty lines. However, underwriting performance has deteriorated recently, with loss ratios edging higher and claims rising in some construction sectors due to poor quality control. The increasingly complex, multi-stage, multi-party and sometimes multinational nature of 'mega' construction and infrastructure projects further complicates the task of evaluating risks. Given declining premium rates, the profit margins of some engineering insurers may already have been squeezed close to or below their long-run sustainable levels.

New technologies could foster efficiency and safety gains in construction, but this will happen slowly and brings with it new risks.

Technology is constantly evolving in engineering. Insurers must continually evaluate how technology could alter the risk landscape and influence their underwriting approach. Construction has typically been slow to innovate, but there are signs of rising digitalisation in the sector. Digital technologies could lead to significant improvements in efficiency including enhanced monitoring, mitigation and management of engineering-related risks. In turn, this could underpin further improvements in claims experience. However, such a digital transformation in construction is most likely to happen only gradually. New technologies also affect the nature of existing risks and bring new risks, such as cyber, which means that the severity of claims could increase even if the frequency of incidents falls.

In a digitally-connected world, engineering insurers may ultimately assume more of a risk avoidance/mitigation role.

Product and process innovation will help insurers respond to the evolving risk and competitive landscape, provided they do not overstep the boundaries of insurability. This includes deploying new technology to bolster efficiency and improve underwriting accuracy. In a digitally-connected world, insurance may come to play more of a risk avoidance/mitigation role, rather than solely indemnifying losses. This may ultimately require a more radical reconfiguration of engineering insurers' business models.

The cyclical macroeconomic upswing together with structural shifts such as urbanisation should translate into stronger demand for engineering insurance.

Beyond technological innovation, the outlook for engineering insurance is heavily influenced by prospective growth in the world economy and, in particular, the level and nature of construction activity. The strengthening and synchronised global recovery, together with structural adjustments such as urbanisation, replacement of ageing infrastructure and development of renewable energy sources, should promote construction spending and stimulate insurance demand. There is still however uncertainty about how far some of these factors will translate into a material pick-up in premium growth.

Introduction

What is engineering insurance?

Engineering insurance helps absorb unforeseen losses during the construction and operation of plant, buildings or infrastructure.

Engineering insurance originated in the 19th century to provide protection against property damage resulting from boiler explosion/implosion.[1] Over time, the scope of coverage has expanded considerably. Today, there are broadly three main streams:

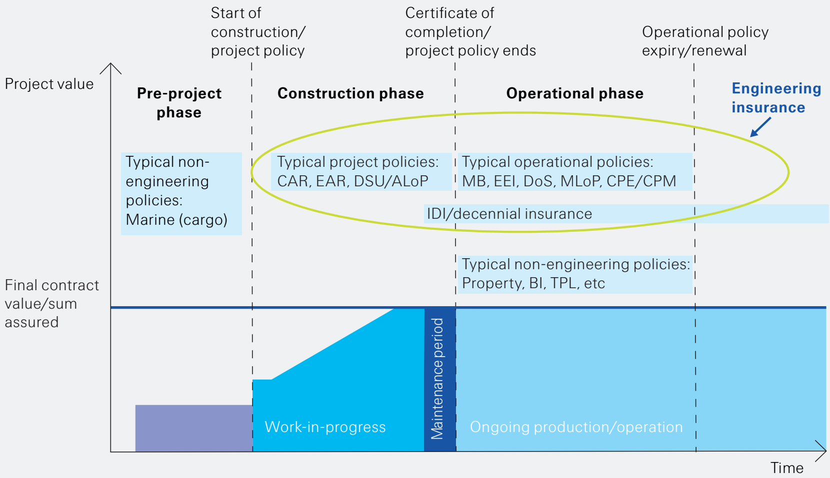
- *Project insurance:* protects against risks incurred during construction or installation of plant, buildings and infrastructure. Polices are usually taken out by the project owner or contractor – eg, Contractors' All Risks (CAR)/Erection All Risks (EAR).
- *Inherent (or latent) Defects Insurance (IDI):* covers physical damage to the property caused by defective design, materials or workmanship, which remain undiscovered upon completion of the project. In some countries such as France, building contractors are required to have IDI insurance before embarking on a construction project. IDI policies typically last for ten years, and hence are often referred to as decennial liability insurance. Unlike a professional indemnity policy, an IDI or decennial policy typically does not require any proof of liability: evidence of damage is in itself sufficient to trigger a claim.[2]
- *Operational insurance:* is renewable and protects against unforeseen losses arising once the equipment or structure is operational. Popular annual policies include protection against losses associated with Machine Breakdown (MB), Electronic Equipment (EE) failure and Contractors' Plant, Equipment and Machinery Insurance (CPE/CPM).

Engineering covers can provide protection against physical damage to machinery and infrastructure as well as financial losses.

Typical engineering covers offer protection against possible unforeseen and sudden physical loss or damage to property during the construction phase and once the building, plant or machinery is operational. Construction project insurance typically covers liability for third-party bodily injury. These types of policies usually cover "all-risks" associated with a particular project and may include financial losses associated with delay or business interruption.[3] Advance Loss of Profits (ALoP)/ Delay in Start-up (DSU) policy enhancements cover costs resulting from project interruptions, although any delay must be caused by a material damage covered under the project policy ie, a CAR/EAR policy. Operational policies usually refer to named perils that cause losses, including associated financial losses, but exclude third-party liability.

[1] For a more in-depth discussion of the history and development of engineering insurance, see Engineering insurance and reinsurance: an introduction, Swiss Re, 1997.
[2] See http://media.swissre.com/documents/Swiss_Re_inherent_defects_insurance.pdf
[3] Relatively small damages can have massive cash flow consequences. If a crucial part breaks on a drilling machine, for example, this could heavily disrupt building schedules.

Figure 1
Stylised timeline of engineering insurance



Note: Abbreviations refer to types of insurance policies. BI = Business Interruption, TPL = Third-party Liability, CAR = Contractors' All Risks, EAR = Erection All Risks, ALoP = Advance Loss or Profits, DSU = Delay in Start-up, MB=Machine Breakdown, MLoP = Machinery Loss of Profits and DoS = Deterioration of Stock, CPE/CPM = Contractors' Plant, Equipment and Machinery, IDI = Inherent Defects Insurance. The maintenance period refers to the period after practical completion of a contract during which a contractor is obligated to repair any defects in workmanship and materials.
Source: Swiss Re

Such covers often sit alongside other policies depending on the nature of the insured peril.

Prior to a particular project starting, other (non-engineering) insurance may be applicable – lost or damaged equipment or materials during transport/transit to the construction site might for example be covered under marine policies. Similarly once the project is completed, depending on the particular peril, policyholders might be insured under different policies (see Figure 1). For instance, damage due to external causes like fire or natural perils would typically not be covered by IDI but instead by regular property or business interruption insurance.

Role of engineering insurance in supporting growth

Insurance can play an important role in fostering capital investment.

Some risks may be too large or too complex for some firms or governments to absorb alone. By providing a mechanism for firms to share risks and mitigate fluctuations in their income and expenditures, insurance facilitates efficient investment in areas that might otherwise not be made. In this way, insurers can promote the allocation of financial resources to their most productive use, enable policyholders to recover quickly following an insured incident and promote private and public enterprise.[4] Insurers also work with developers and contractors to ensure that appropriate risk management and construction standards are in place, which can help reduce the risk of future failures.[5]

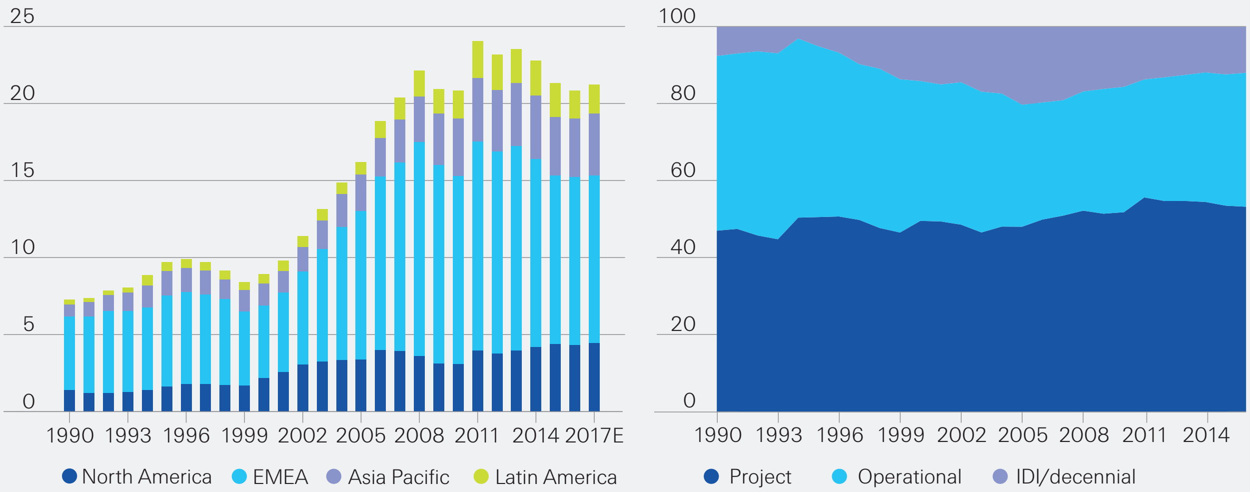
[4] For a general discussion of the role of insurance in societies, see *sigma* No 4/2017.
[5] Insurers usually employ independent engineering experts to consult on loss control and risk management, conduct audits, assess quality assurance documentation and advise on contingency planning to mitigate future losses.

Size and composition of the market

Engineering insurance premiums account for roughly 3% of global commercial insurance premiums.

Global engineering insurance premiums for 2017 were estimated at around USD 21 billion, and accounted for roughly 3% of total commercial insurance premiums (around USD 730 billion in 2017).[6] The EMEA region generated the largest share of global engineering premiums, mostly due to the popularity of operational covers such as machine breakdown as well as construction project insurance (Figure 2 – LHS). Among emerging economies, Brazil, Mexico and Colombia account for 70% of engineering premiums in Latin America while China currently contributes around a third of Asia Pacific (APAC) premiums.

Figure 2
Share of global engineering premiums, by region (USD billion) and major policy type (%)



Note: Left-hand chart is based on a sample of around 60 countries for which engineering premiums are separately reported plus estimates for countries where separate statistics are unavailable. The latter are constructed using the corresponding regional share of engineering premiums in non-life insurance. Right-hand chart is based only on a subset of the 60 countries where detailed engineering premiums by line of business are disclosed.
EMEA = Europe, the Middle East and Africa
Source: Various national sources, IMIA and Swiss Re Institute calculations

Around half of the global engineering insurance premiums are project-related.

Project-related policies account for approximately half of all engineering insurance, a share that has been broadly stable over time (see Figure 2 – RHS). According to market intelligence from IMIA, the vast majority of premiums are generated from small-to-medium-sized infrastructure projects.[7] Dedicated decennial liability policies are popular in only a few, mainly European countries, with France generating over 90% of IDI premiums.[8]

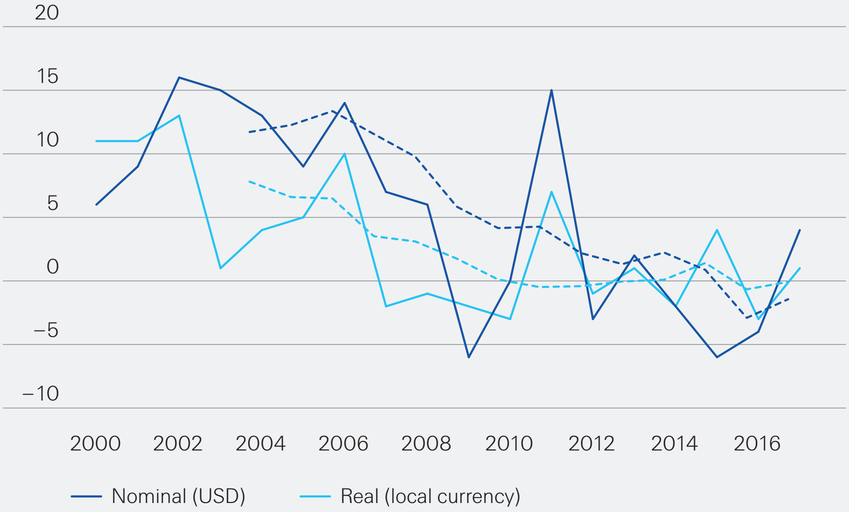
Global engineering premiums have stagnated in recent years.

After rising rapidly through most of the 2000s as construction activity in a number of developing countries soared, global engineering premiums have stagnated in recent years. The global market declined in 2015 and 2016 before bouncing back in 2017.

[6] Estimates for insurance premiums are based on a synthesis of data from Axco, local regulators/insurance associations and IMIA.
[7] Interview with Oscar Treceno to Insurance Day in November 2016. http://www.docosoft.com/docs/default-document-library/insuranceday02november2016docosoft.pdf
[8] Following the enactment of Law 1796 in 2016 (also known as the safe housing law), a nascent market in decennial liability insurance is developing in Colombia. A few Colombian insurers now offer ten-year policies that protect property damage to property owners affected by collapses, threats of ruin or other special coverage for the country's construction companies.

Part of the volatility was due to fluctuations of the US dollar, especially against emerging market currencies, and the conversion of insurers' revenues into a common currency. In local currency terms and after adjusting for inflation, global real premiums have been mostly flat since at least 2012 (see Figure 3 – top panel). The lack of growth largely reflects a slowdown in project insurance in both advanced and developing markets (see Figure 3 – bottom panel). Construction spending as a percentage of GDP in many advanced markets remains below its pre-2008 financial crisis peak, while some key emerging markets are only slowly emerging from recent recessions.

Figure 3
Global engineering premium growth (nominal and real) by market and major line (%)



Note: Dashed lines represent 5-year moving averages.

Real premium growth (local currency, %)	Major line	2011–2013	2014–2016
Advanced markets	Project	3.0	2.6
	Operational	3.6	1.8
Developing markets	Project	5.4	–4.6
	Operational	2.9	5.6

Note: The chart is based solely on the sample of around 60 countries for which engineering premiums are separately reported (accounting for around 90% of global premiums).
The figures in the table are based on a subset of the 60 countries where detailed engineering premiums by line of business are disclosed.
Source: Various national sources, IMIA and Swiss Re Institute calculations

Outline for the *sigma*

The rest of the *sigma* explores the institutional composition of engineering insurance markets, including the interaction between domestic and international wholesale insurance markets and the role of intermediaries. This is followed by a discussion of underwriting performance and the impact that new technologies could have on the construction risk landscape and underwriting practices. Finally, this *sigma* will provide an overview of the factors that are likely to shape the short-to-medium-term market outlook.

Structure of engineering insurance markets

Wholesale and retail markets

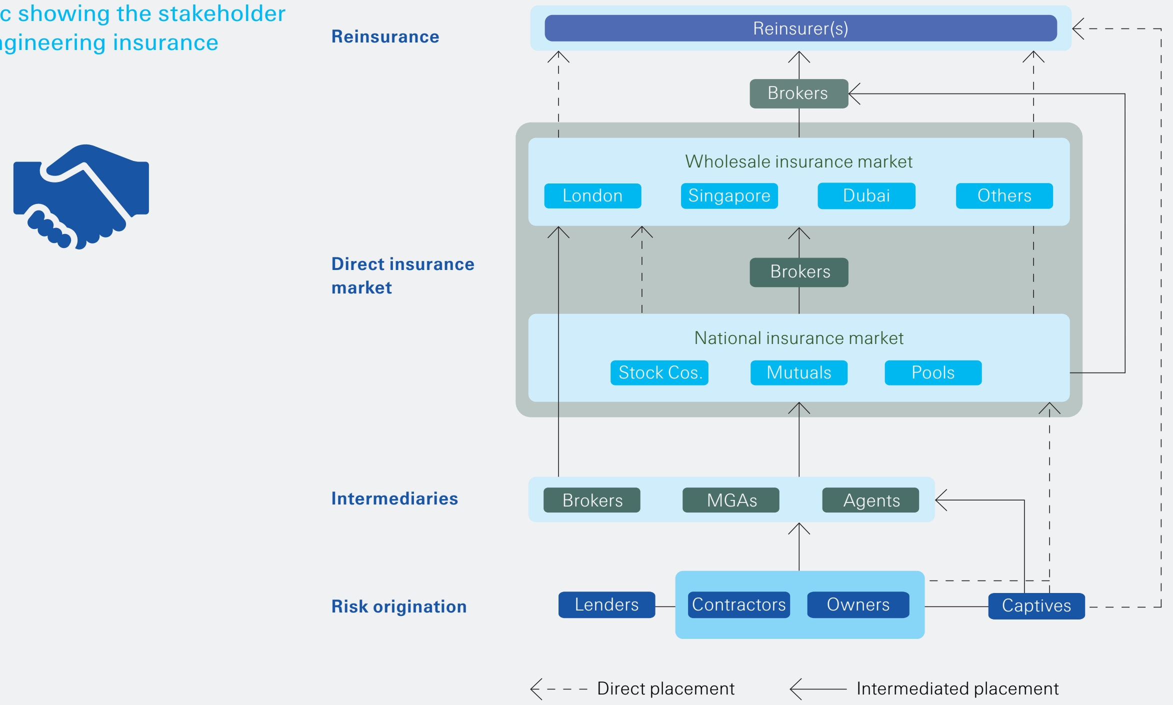
The engineering insurance market is complex and involves multiple parties.

The global engineering insurance market is typically structured with different layers straddling different actors, depending on who "owns" the risks and the nature and scope of the cover provided. Construction projects often involve multiple parties and extend over multiple stages of development that influence how project insurance is organised. In contrast, operational insurance is more akin to property insurance, where owners of the asset usually buy insurance. In both cases though, intermediaries play an important role in insurance placement (see Figure 4).

Risk diversification is achieved via a combination of national and wholesale insurance markets.

Diversification for large, complex engineering risks is achieved via a combination of national (eg, retail) insurance and wholesale co-re/insurance subscription markets. In a wholesale subscription market, the customer (usually acting through a broker) negotiates insurance terms with a re/insurer that agrees to cover a certain share of the risk and becomes the 'lead' co-re/insurer. If the leader is not interested in underwriting 100% of the risk, or if the broker and client want to spread the risk across insurers, the insurance programme may be syndicated with multiple re/insurers that then share the risk.

Figure 4
Schematic showing the stakeholder map in engineering insurance



Source: Swiss Re Institute

Factors shaping insurance demand

Insureds vary across contract types

Contracts govern the risk allocation between parties and as a result insurance purchasing.

Construction contracts allocate project responsibilities and determine whether one or several parties are responsible for purchasing insurance. Under controlled insurance programmes (CIPs), also known as "wrap-ups", one party arranges insurance on behalf of all (or most) parties or wraps up all parties working on a project. Depending on the contract, CIPs can be purchased by the owner (OCIP) or contractor (CCIP) or a combination of the two (ie, a partner controlled insurance programme (PCIP)). In a CIP, all key parties involved in construction are included as named insureds, which helps avoid coverage conflicts.[9]

Policies typically relate to specific construction projects.

Policies are usually arranged on a single contract basis, (ie, a separate policy for each individual construction project). Open cover – where a general description of contract works to be undertaken will be given and any construction contract falling within the description is automatically covered – is available. But such policies typically involve relatively low-to-medium insured limits and are issued selectively to trusted contractors who demonstrate a regular flow of homogenous risks.[10]

Contractors sometimes assume significant project responsibilities, including arranging insurance.

Sometimes large, sophisticated contractors may choose to assume more exposure and responsibilities themselves.[11] This is the case for Engineering, Procurement and Construction (EPC) contracts, where contractors take responsibility for project design and procuring materials and services.[12] Under such arrangements, the contractor arranges insurance (typically via CCIPs), and will include sub-contractors and owners as named insureds.[13] Contractors occasionally use captives and funded retentions (whereby they set aside provisions to finance potential losses) especially for casualty-related risks, although this practice is not widespread.[14]

Large contractors with operations in multiple countries may utilise global insurance programmes.

The international reach of construction firms can influence the insurance buying process. In 2016, the top 20 international contractors generated 46% of their revenues from projects in countries outside their home market.[15] Such projects are typically covered by local insurance policies, although they can also be complemented by global master policies that bridge differences in conditions and policy limits in different jurisdictions. As a result, country-level premiums may not necessarily reflect risks within that country alone, but also include risks assumed by large contractors abroad, which are partially underwritten in the contractor's home country.

9 At times it is not possible to include all interested parties as named insureds, as large projects may have hundreds of sub-contractors. In such cases, broad terms like "contractors" or "sub-contractors" often apply.

10 Open cover is rare in developing markets, as smaller and homogenous risks are usually self-insured by contractors. Exceptions include China and Saudi Arabia where open cover is sometimes issued for government projects.

11 M. Sobolewski, A. Kent, and J. Van den Berg, "2017 Engineering and Construction Trends", Strategyand.pwc.com, https://www.strategyand.pwc.com/trend/2017-engineering-and-construction-trends

12 Other variations of EPC contract are EPCC (Engineering, Procurement, Construction & Commissioning), EPCM (Engineering, Procurement, Construction & Management) and EPIC (Engineering, Procurement, Installation & Commissioning). An extension of the EPC contract is a lump sum turnkey contract, where contractors also guarantee operational readiness of projects.

13 Under OCIP, owners arrange the insurance and contractors/sub-contractors can exclude the insurance budget from their bids. In CCIP, contractors arrange the insurance and the cost of insurance is factored into the bids.

14 Based on data related to captives managed by Marsh, construction captives account for no more than 5% of the total number of captives; their share in terms of premiums is smaller still (less than 1%). See Captive Benchmarking Report, Marsh, 2016, https://www.marsh.com/content/dam/marsh/Documents/PDF/US-en/Captive%20Solutions%20Benchmarking-05-2016.pdf

15 "The Top 250", Enr.com, 21 August 2017. https://www.enr.com/ext/resources/Issues/National_Issues/2017/08-Aug/21-Aug/08212017_Top250_full.pdf

To mitigate credit risk, lenders often insist on adequate insurance cover.

Lenders often influence the scope of insurance purchased

The interests of financiers also play a role in insurance decisions. Lenders usually extend finance on a non-recourse basis (ie, if borrowers default, lenders can seize collateral yet cannot seek out borrowers for further compensation, even if the value of the collateral is insufficient). As a result, lenders often demand adequate insurance to protect their interests, especially because markets for the sale of project assets are typically illiquid.[16] Delays may cause extra expenses and lost revenue, which can be partially covered by ALoP/DSU insurance.

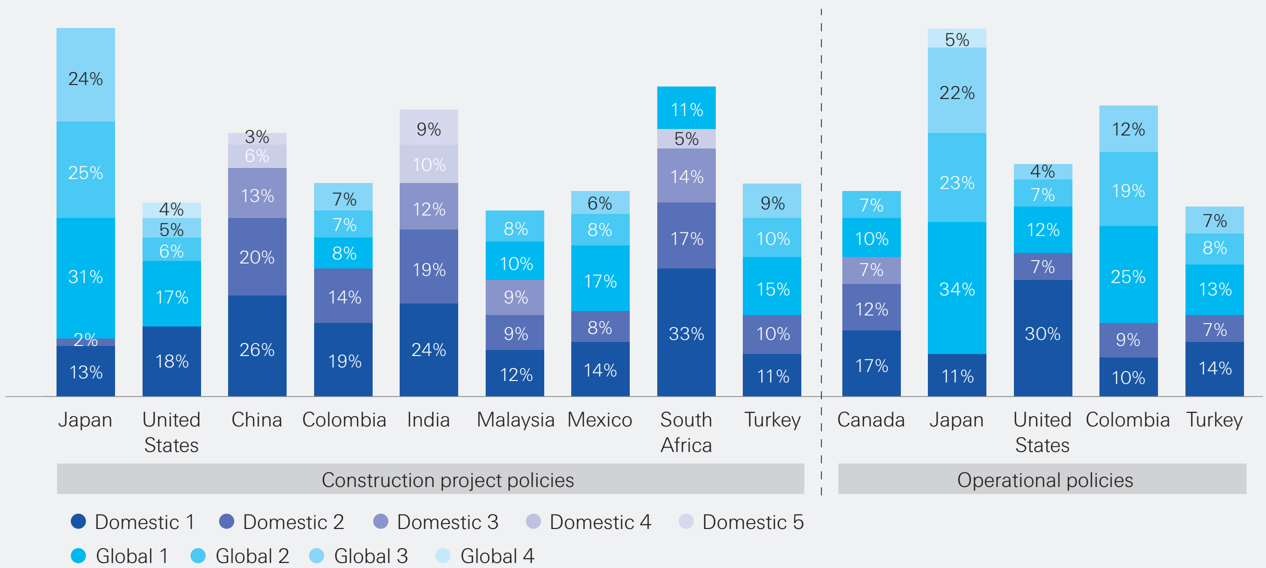
Sources of risk-absorbing capacity

International insurers' local entities often play a significant role in placing engineering risks.

Insurers with an international presence write the majority of premiums

International insurers with local footprints have a strong presence in engineering insurance. With operations in multiple countries and sizable balance sheets, these insurers have the ability to diversify risks geographically and better manage the losses. They often lead co-insurance arrangements, especially for projects involving international parties. The supply landscape is highly concentrated with the five largest insurers in each country usually commanding a significant proportion of domestic premiums (see Figure 5).

Figure 5
Share of top five engineering players in premiums (selected countries)



Note: United States' construction project insurance premiums are taken from Inland Marine line of business. The data relate to the most recent year for which data are available.
Source: AXCO, National Regulatory Authorities and Swiss Re Institute

[16] Lenders insist on including lenders' clauses in policies, as these clauses may reduce lenders' need for the insured's assistance/compliance in enforcing claims under the policy. However, insurers are often cautious of giving wider policy rights to lenders since they are not the named insured.

Specialist insurers are rare; a few exist for niche segments.

Leading insurers are usually active across multiple lines of business and also dominate in engineering. The major property risk insurers often write operational engineering covers. Stand-alone mono-line engineering insurers are rare as clients may find it unattractive to transfer only a portion of their portfolios to specialists.[17] However, specialised insurers do exist in niche areas – mainly as mutuals or captives – providing cover to members, which is either unavailable or very expensive in traditional insurance markets.[18]

National regulations related to domestic retentions influence how risk is transferred to wholesale insurance markets.

While engineering re/insurance is international in terms of market structure, institutional arrangements sometimes work to restrict cross-border business. To meet regulatory requirements in countries that limit participation of foreign insurers, a local insurer is often engaged to issue the policy. The so-called fronting insurer typically retains a small proportion of the risk, earns a fee and cedes the rest via reinsurance to wholesale insurance market participants.

London is still preferred for complex risks, but regional hubs have emerged

Regional wholesale insurance hubs have emerged in recent years to compete with the London Market.

Historically the London Market, which comprises Lloyd's of London and global wholesale insurers operating out of the City of London, has been an important centre for engineering and construction-related insurance, especially for high-value projects that are technically demanding to underwrite. Local hubs in developing regions have nonetheless matured and are now often well positioned to absorb some business themselves. In particular:

- Singapore has consolidated its position as the APAC re/insurance hub.[19] Cover for a growing number of projects is placed in Singapore, as more international projects are led by contractors based in Asia.[20]
- Dubai provides capacity for engineering risks in the Middle East and North Africa, mainly through the Dubai International Financial Centre, which includes leading re/insurers and intermediaries.
- Miami is a centre of placement for engineering risks in Latin America and the Caribbean.[21]

The London Market remains important for complex and high value construction projects...

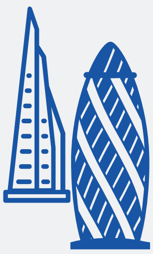
Complex risks are still placed in the London market for primary layers, although this is increasingly due to technical expertise on specific risks rather than the required risk-absorbing capacity. Oil & gas, power generation, heavy industries, mining, heavy civil engineering and underground risks often continue to find their way to the London market for underwriting expertise.

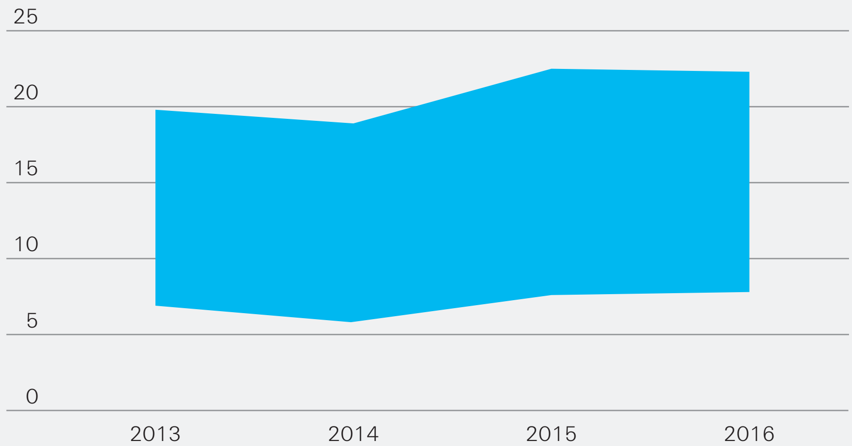
[17] A portfolio of insurance policies is often placed with an insurer for cross subsidisation among lines of business.
[18] Notable specialist insurers include: 1) SMABTP in France; a specialised mutual writing mainly decennial liability. 2) AR-CO and Protect; specialised insurers in Belgium, providing construction related professional indemnity covers.3) There are a handful of other specialist insurers such as Hartford Steam Boiler (HSB) that concentrate largely on operational engineering insurance.
[19] "Singapore insurance market report", axco.co.uk, December 2017, https://www.axco.co.uk/axcoimr/report_display_frame.asp?countryid=99&marketsectorid=1&topicid=19747&levelid=2
[20] Enr.com, 21 August 2017, op. cit.
[21] "Latin America, Using a Hub Strategy to Access Growth Opportunities", Aon.com, January 2016, http://www.aon.com/inpoint/bin/pdfs/white-papers/LatAmWhitepaper2016.pdf?utm_source=slipcase

...and has managed to maintain its market share over recent years.

Compared with earlier decades, the London market's importance in placing engineering risks has probably declined.[22] However, it has broadly maintained its share of global construction project premiums in recent years (see Figure 6), mostly by decentralising operations and pooling expertise in regional hubs. Lloyd's has grown its Singapore operation to 23 syndicates since 1999, 12 of which write construction and engineering business.[23] Lloyd's also participates in Chinese business via 100% retrocession through its subsidiary in China.[24]

Figure 6
London Market's share in global construction project premiums (range of estimates, %)





Note: The swathe in the chart represents the range of estimates for the London Market's share of construction project premiums based on different assumptions. The lower bound of the range uses estimated premiums written by syndicates that are part of the Construction Consortium at Lloyd's plus construction premiums reported by the IUA for the London company market. The upper bound includes premium estimates for all syndicates at Lloyd's as well as IUA's construction premiums. All estimates assume the same proportion of construction to total property business for Lloyd's syndicates as in the London company market.
Source: Lloyd's of London Syndicate Data, London Company Market (IUA) Statistics Report and Swiss Re Institute calculations.

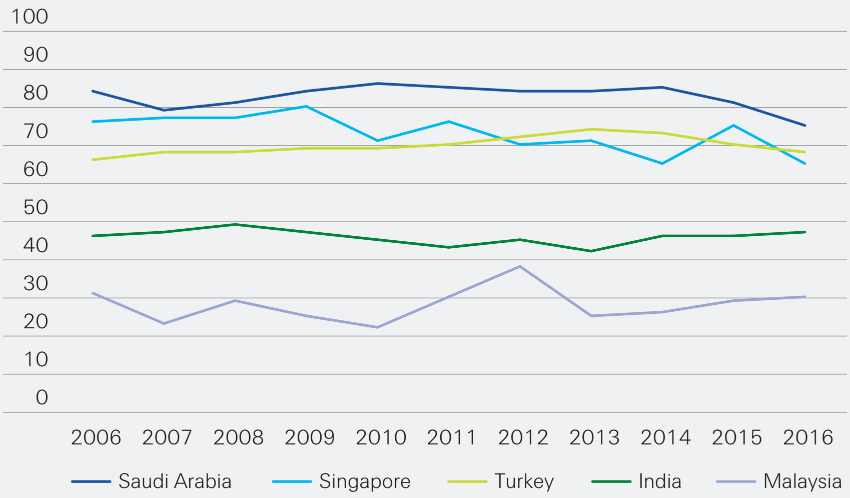
Reinsurance support is often significant, especially in developing markets

Engineering cession rates vary across countries.

In recent years engineering cession rates have declined a little in certain developing countries, although the share of premiums ceded varies widely across markets (see Figure 7). For example, insurers in Saudi Arabia and Singapore cede a major proportion of their engineering risks. This probably reflects the prevalence of large and complex engineering risks – the majority of insured risks in these countries relate to power, civil and transport infrastructure.

[22] The London Market reportedly wrote construction project premiums of approximately USD 700 million in mid 2000s, representing around a quarter of global construction project premiums estimated by IMIA in 2004 (See Insights, Swiss Re, September 2006).
[23] Four syndicates; Beazley, CNA Hardy, Talbot and Sompo Canopius formed a construction consortium in 2013. Two other syndicates, Noave and Travellers joined in 2016. See Lloyd's Asia, Extensive specialist underwriting, https://www.lloyds.com/~/media/files/lloyds/offices/singapore/1794c-lloyds-asia-matrix-web-revised.pdf?la=en
[24] Annual Report, Lloyd's of London, 2016.

Figure 7
Primary insurers' engineering cession rates in selected developing markets (%)



Note: Singapore figures include Singapore Insurance Fund (SIF) business only, and cession rates for Turkey are estimated for 2009 and 2010.
Source: National Regulatory Authorities and Swiss Re Institute

Proportional reinsurance arrangements are often preferred for engineering risks.

Proportional reinsurance is often preferred for engineering and construction covers. This reflects the nature of the portfolios, which usually combine non-renewable and annually renewable features with long tail exposures and large sums insured.[25] In contrast, non-proportional reinsurance is better suited for portfolios of standard operational policies. Large insurers with sizeable portfolios typically have sufficient scale to cede risks via standalone engineering treaties, although smaller insurers often collect engineering risks under property/multiline treaties.[26]

Role of intermediaries

Brokers remain dominant in distribution due to the size and complexity of risks

Brokers control distribution across markets and direct placement is limited.

Brokers organise insurance placements for most engineering and construction risks. In some emerging markets, such as Saudi Arabia and China, state-sponsored entities may arrange insurance directly with insurance carriers through tender processes. Nevertheless, these transactions would still typically involve domestic brokers, who are especially active in arranging insurance for local construction projects. International brokers play a key role for complex projects that require specialist expertise and/or those where foreign funding is involved.

The rise of new capacity and the highly customised nature of policies increasingly require broker support.

Over the past decade, international brokers have coordinated risk placement across an increasing number of local and international re/insurers. This is due to the decentralisation of insurance capital and transfer of expertise to emerging regional hubs. Accessing risk-absorbing capacity from around the world allows brokers to optimise available insurance solutions and secure the best available rates and terms for their clients.

[25] See Swiss Re 1997, op. cit.
[26] Combined property and engineering (PEN) treaties may have sub-limits and specific exclusions for engineering risks. Delay in start-up, metro rail line, nuclear power plants, offshore risks, transmission and distribution lines are either excluded or require special acceptance under such treaties.

The broker's role has expanded beyond placement to providing value added services.

International brokers also provide risk consulting, captive management and claims handling services to the construction industry, even helping insureds set up in-house brokers in some markets (eg, Germany, Italy). Requests for policy period and coverage extensions are common in engineering due to delays, and brokers play a key role in arranging these endorsements. Moreover, the involvement of brokers in complex and high value projects can facilitate reinsurance support.

Industry consolidation has reinforced brokers' influence

Consolidation has enabled brokers to strengthen their position and remain close to clients.

Significant consolidation has occurred in the insurance broker sector over the past few years. The big four brokers (Aon, JLT, Marsh and Willis) have invested heavily in acquiring knowledge and data to enhance their risk management services. Coupled with the decentralisation of insurance capacity, they have been able to strengthen their relationships with policyholders and influence where and at what price risks are placed.[27]

Brokers are developing new and alternative approaches to placing business.

Brokers continue to innovate to expand their franchise.[28] They are placing risks in new ways, eg, via underwriting facilities where brokers decide insurance placements based on pre-committed capacity from multiple insurers. Broker facilities are often most relevant for small and medium sized engineering risks, which may be more homogenous. They are less appropriate for large and complex engineering projects, which require specialised underwriting and large risk-absorbing capacity.

Traditional distribution channels dominate

Managing general agents (MGAs) play a somewhat limited role in placing engineering risks.

Engineering insurers have begun using managing general agents (MGAs) to deploy their underwriting capacity. An MGA is a specialised type of intermediary vested with underwriting authority from an insurer. This can be a highly efficient underwriting solution for niche-type business. The level of risks assumed through such arrangements are typically small and/or involve limited capacity. MGAs probably write less than 10% of global engineering premiums, mostly medium sized risks (sums insured < USD 100 million) in some advanced markets.

Innovations in distribution have not been widely adopted by commercial insurance markets.

New distribution technology has not impacted wholesale commercial insurance markets as much as in retail/personal lines. Previous attempts to introduce more direct wholesale distribution channels have not gained traction. Similarly, while online quotation and delegated authority platforms have developed, traditional manual placement processes continue to dominate. Some initiatives targeted at simplifying parts of the value chain are nonetheless moving forward. While not specific to engineering, Lloyd's of London, for example, have mandated that syndicates use electronic placements for writing no less than 30% of their risks by the end of 2018, with the aim to increase this proportion to 80% by the end of 2019.[29]

[27] In November 2017, the Financial Conduct Authority (FCA) in the United Kingdom launched a market study into the wholesale insurance broker sector. This initiative aims to understand how brokers compete, any potential conflicts of interest, and their broader impact on contestability of the wholesale insurance market. See "FCA launches Wholesale Insurance Brokers Market Study" fca.org.uk, 8 November 2017, https://www.fca.org.uk/news/press-releases/fca-launches-wholesale-insurance-brokers-market-study

[28] S. Sclafane, "Specialty MGAs Continue to be Popular Acquisition Targets", *insurancejournal.com*, 14 September 2017, https://www.insurancejournal.com/news/national/2017/09/14/464213.htm

[29] "Lloyd's issues electronic placement mandate", *Lloyds.com*, 20 March 2018, https://www.lloyds.com/news-and-risk-insight/press-releases/2018/03/lloyds-issues-electronic-placement-mandate and https://www.reuters.com/article/us-insurance-lloyd-s-of-london-trading/lloyds-of-london-aims-to-ditch-most-paper-trading-by-end-2019-idUSKBN1HU250

Underwriting performance & practices

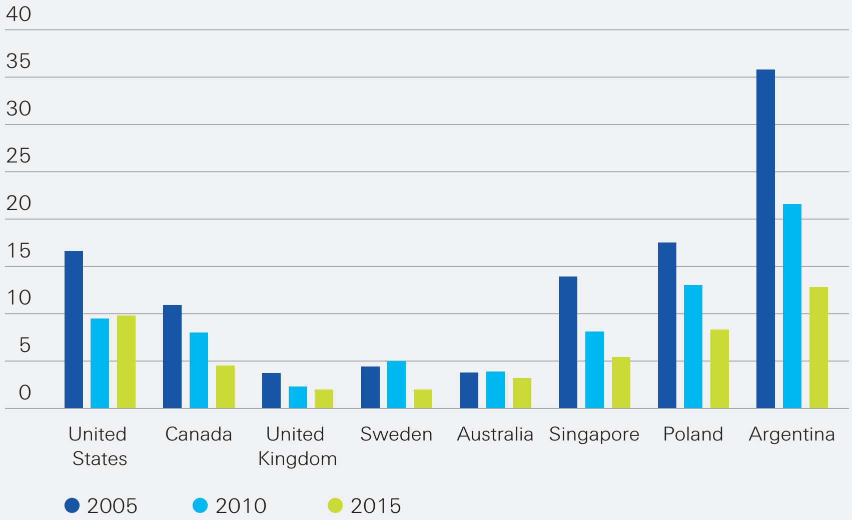
Recent market conditions

Enhanced safety and design underpin secular improvements in underwriting results

Improved safety measures…

Although construction typically tends to be one of the most hazardous industries,[30] accident and fatality rates have trended lower in many countries (see Figure 8). For example, in the UK accident rates have fallen by around 40% over the past decade.[31] This has contributed to improved claims experience in recent years compared with earlier decades.

Figure 8
Fatal occupational injuries per 100000 workers in selected countries' construction sectors, (2005, 2010 and 2015)



Note: US 2015 refers to 2014; Argentina 2010 refers to 2011
Source: International Labour Organisation

…as well as better design and work processes have led to lower claims.

The adoption of enhanced building standards and new construction techniques together with improved site security has also led to lower claims. Consistent with that, the share of large claims (by value) due to faulty design or operation has generally declined over the past thirty years. Similarly, claims linked to fires and explosions have become less prevalent, while the rising share of losses linked to natural hazards is consistent with the recent global trend of higher frequency and severity of natural catastrophe losses (see Table 1).[32] The increased cost predictability of projects (ie, delivery on budget) as well as enhancements in risk management practices may also have helped to limit potential for surprises in claims severity.

[30] Out of 4,379 worker fatalities in US private industry in calendar year 2015, 937 or 21.4% were in construction — that is, one in five worker deaths last year were in construction. Similarly, in the UK, 3% of workers sustained a work-related injury which contributed to 2.2 million days of that year, www.gov.uk/government/publications/the-health-and-safety-executive-annual-report-and-accounts-2016-to-2017

[31] The future for construction insurance: Working together: a cross-sector roundtable discussion, sponsored by Constructing Excellence and Lucas Fettes & Partners, December 2016.

[32] For a discussion of recent natural catastrophe losses see *sigma* No 1/2018.

Table 1
Share of large claims, by proximate cause (%)

	1990s	2000s	2010s
Faulty design, material & operation	54.1	44.4	39.4
o/w			
Faulty operation	*20.3*	*13.7*	*12.6*
Faulty material and workmanship	*16.2*	*22.6*	*19.2*
Faulty design	*17.5*	*8.2*	*7.6*
Fire/explosion	20.4	13.5	16.1
Natural hazards	5.7	14.3	22.3
Other	19.8	27.8	22.2
	100.0	100.0	100.0

Source: IMIA and Swiss Re Institute calculations

Recent technical results understate an underlying deterioration in profitability

Despite the generally benign claims environment, loss ratios have picked up recently.

The secular improvement in claims, in particular the absence of catastrophic loss events, partly explains why engineering insurance has typically been relatively profitable compared with other specialty lines. But loss ratios have picked up a little in the most recent years – globally loss ratios have increased by around 5ppt on average since 2011. The increase is evident across most regions, although it is particularly evident among insurers in Europe and Asia.

Weaknesses in quality control are reportedly on the rise in some construction sectors.

Poor workmanship remains a key challenge for project owners and contractors, and ultimately their insurers, with claims due to lower quality control reportedly rising in some construction sectors.[33] This can be partially attributed to the increased number of parties in the supply chain – ie, problems with sub-contractors, or sub-contractors of sub-contractors.

Ultimate loss experience takes time to fully develop.

Reported loss ratios likely understate the recent deterioration in underwriting profits. Ultimate loss experience takes time to become fully developed – claim settlements are often delayed and initial estimates of claims can be highly imprecise and subject to substantial revisions. For example, any deterioration in building quality resulting from difficulties encountered by construction companies during the recent financial crisis-led recession have probably not yet been fully revealed.[34]

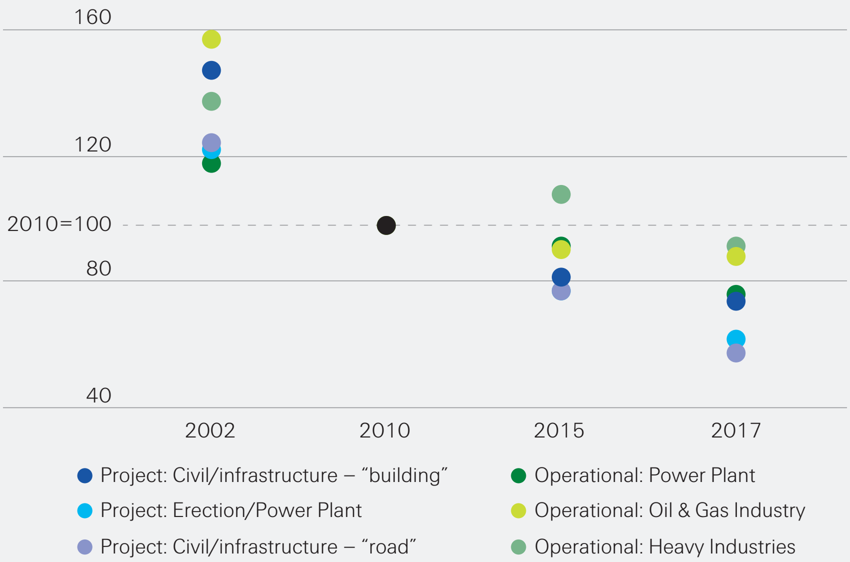
[33] For example, see https://www.jltspecialty.com/our-insights/thought-leadership/construction/water-damage-how-to-stem-the-flow-of-devastating-claims and http://www.aon.com.au/australia/insights/insurance-market-updates/2018/files/construction-market-update-brochure.pdf
[34] This is particularly important for inherent defect insurance. See for example, https://www.lemoniteur.fr/articles/a-la-recherche-d-un-nouvel-equilibre-35303345

Persistent premium rate declines imply a squeeze on insurers' margins

Abundant insurance capacity continues to put downward pressure on premium rates.

In common with other specialty insurance lines, the abundance of risk-absorbing capacity has maintained downward pressure on engineering insurance pricing. According to IMIA, premium rates in 2017 for all major engineering lines remained significantly below their 2010 levels; some declined by as much as 30 to 40% (see Figure 9). This is broadly comparable with the falling trend in global catastrophe reinsurance prices over the same period.[35] Unlike in some other insurance lines, developments over the past seven years represent a continuation of a secular decline in engineering premium rates.

Figure 9
Developments in premium rates for major engineering insurance lines (2010 = 100)



Note: Based on information published in https://www.imia.com/wp-content/uploads/2017/10/IMIA-Index-2017-v01.pdf
Source: IMIA

Terms and conditions have also continued to favour the re/insurance purchaser.

Alongside persistent price declines for engineering insurance, contractual terms and conditions have also weakened. An analysis of the various clauses and contract language suggest that reinsurance buyers have benefited from less stringent policy wordings, including improved positions on deductibles and exclusions (see "A text-based indicator of developments in policy terms and conditions").

Insurance buyers have resisted strong premium rate increases.

Commercial pressures in the construction sector, especially in advanced markets, have only added to downward pressures on insurance pricing. Construction firms have relatively thin – and volatile – profit margins, which are typically in the bottom quartile across industries.[36] In some countries, the construction industry suffered significant financial losses on low profitability contracts in the wake of the financial crisis.[37]

[35] http://www.gccapitalideas.com/2018/05/16/chart-global-property-catastrophe-rol-index-3/
[36] Reinventing construction: A route to higher productivity, McKinsey, February 2017.
[37] Construction Sentiment Survey 2017, Causeway/Barbour ABI, https://www.barbour-abi.com/wp-content/uploads/2017/05/Causeway-Construction-Sentiment-Survey-Report-Interactive.pdf

A text-based indicator of developments in policy terms and conditions

Policy wordings will change depending on competitive conditions.

Insurance contracts often contain standard policy wordings which outline the general terms and conditions of cover for a specific class of insurance. For example, Defects Exclusion(s) (DE) clauses, and London Engineering Group (LEG) wordings are routinely recognised and widely adopted in engineering insurance. However, the language, structure and content of clauses in individual contracts can be flexed and amended depending on the underlying competitive environment. In this way, changes in policy wordings often indicate the extent to which non-price terms and conditions have moved in favour of either the re/insurer or insured.

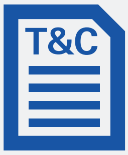
A count of included clauses with different risk characteristics can inform about the evolution of contract standards.

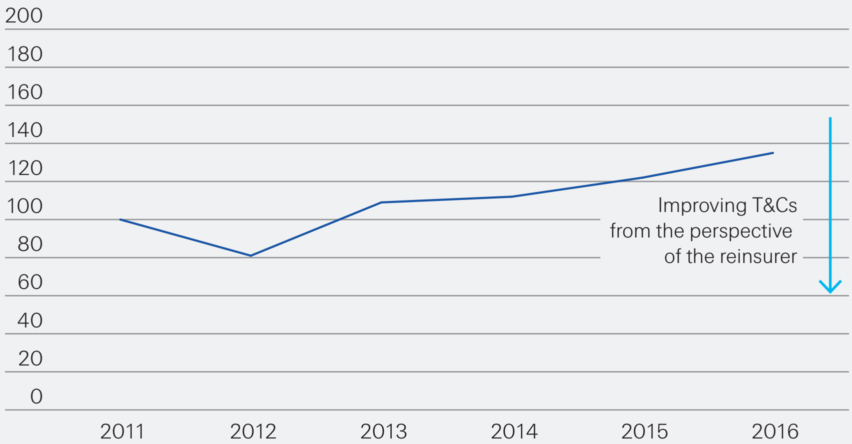
Analysing textual information on terms and conditions (T&Cs) contained in re/insurance contracts can provide a useful way to monitor evolving contract standards. Figure 10 shows a simple quantitative indicator based on a sample of engineering reinsurance treaties for North American risks over the years 2011 to 2016. The index is constructed from the number of times relatively high, medium and low-risk features – as categorised by reinsurance experts – appear in a particular set of contract clauses. For instance, if a contract is renewed on multi-year terms this would suggest, all else equal, an increase in risk for the reinsurer.

Based on an analysis of selected engineering reinsurance treaties, terms and conditions have recently moved in favour of policyholders.

Overall, the index suggests that in some segments of the market and regions at least, T&Cs have deteriorated from the perspective of reinsurers. Correspondingly, policyholders have secured more favourable T&Cs.

Figure 10
Text-based terms & conditions index for engineering reinsurance policies, (2011=100)





Note: The line shows the aggregate index of the overall standard of terms and conditions in a sample of over 1000 engineering reinsurance treaties for North American risks in which Swiss Re participated. The index is constructed from a count of around 30 key Swiss Re contract clauses where the latter are weighted by their risk characteristics, as judged by reinsurance experts.
Source: Swiss Re

Claims on recently written business seem likely to exceed expected losses.

The long-tail nature of construction risk has traditionally enabled insurers to continue to benefit in later years from the higher prices secured when projects were originally rated. Many of these deals have now been completed or are reaching a conclusion with the result that new long-term projects are being locked in for extended periods at lower premium rates, while total claims on existing business have yet to be realised. Taking into account further claims development on existing portfolios implies current underwriting returns for some insurers may be below actuarially fair costing levels (ie, expected losses when the policies were originally written).

Increasingly complex projects mean some insurers' returns may not adequately reflect their cost of capital.

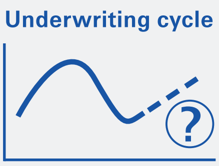
As well as setting prices to cover expected losses, insurers must ultimately reward their providers of capital for the uncertainty that claims turn out much larger than anticipated. Some engineering insurers' profit margins may already have been squeezed close to or below levels that are sustainable over the long term. For instance, a few specialist insurers of French construction business have recently had to strengthen claims reserves significantly and take profit write-downs as concerns have grown about their solvency position.[38] The increasingly complex, multi-stage, multi-party and sometimes multi-national nature of 'mega' construction and infrastructure projects can create risks that absorb additional capital for which insurers need to be adequately compensated.[39]

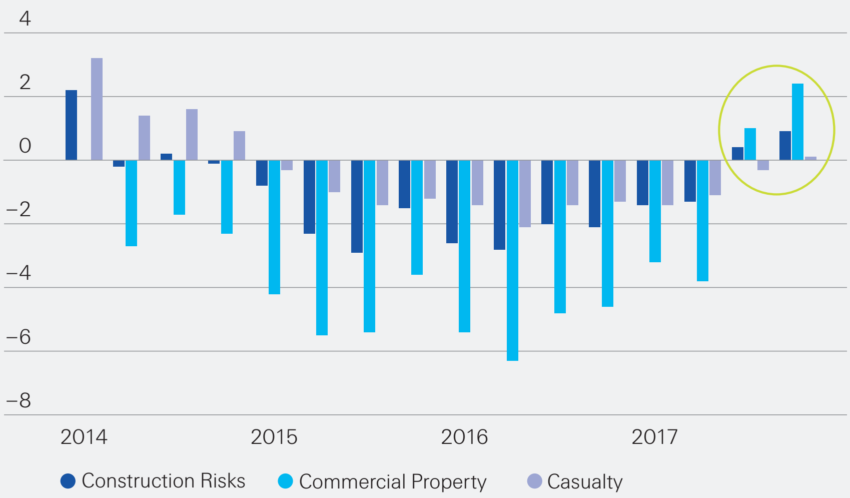
Improved pricing likely relies on a sustained upswing in the underwriting cycle

In some engineering lines, premium rates have started to increase, albeit modestly.

Developments in commercial premium rates are strongly correlated across lines of business and engineering rates have been affected by the broader soft market of the past few years. In the wake of the sharp rise in natural catastrophe property losses in 2017 H2, downward pressures on commercial insurance pricing have abated somewhat. In the United States, the cost of insurance on construction-related risks started to increase towards the end of 2017 (albeit very modestly – see Figure 11). Indications are that this continued into 2018 renewals, with some carriers reportedly managing to secure prices rises for some accounts and with less pressure to relax wordings and terms and conditions compared with earlier years.

Figure 11
Quarterly increase in US commercial insurance premium rates, by selected major lines of business (%)





Note: Casualty refers to a simple average of premium rate changes for casualty-related insurance lines.
Source: CIAB

[38] See for example: http://cblcorporation.co.nz/investors/financial-announcements/cbl-updates-the-market-on-fy17-results-expectations/
[39] The share of mega construction projects, defined as those valued at more than USD 1 billion in global construction spending, has quadrupled over the past decade to 20%. Although engineering is a very small part of the total commercial insurance market, engineering projects are often technically much more complex than commercial property.

A large, market-wide upswing in the pricing cycle seems unlikely, at least in the near term.

However, the resilience of risk-absorbing capital argues against a rapid and widespread rebound in the re/insurance pricing cycle, at least in the near term. Furthermore, in the past engineering premium rate cycles have tended to lag general property lines, reflecting the long-tail nature of some engineering covers. Finally, any capacity withdrawn from property markets following worries about exposures/losses could also be shifted to engineering lines to diversify the portfolio and gain access to new risk pools in emerging markets.

Maintaining underwriting discipline in the face of competitive challenges

Underwriting discipline will be needed to prevent further margin compression.

Against the background of deteriorating profitability, insurers must intensify their focus on underwriting discipline, especially while investment returns remain constrained. This might ultimately lead to withdrawing risk-absorbing capacity if the available terms and conditions are unfavourable. Equally, insurers must upgrade their underwriting methods to gain a better understanding of the risks, in particular, the changing vulnerabilities and sources of exposure as construction progresses from initiation to completion, in order to improve accuracy in underwriting. For example, some construction projects that initially involve coordination across many parties are more susceptible to damage or delay when they start rather than at the end.

Investment in formal risk modelling can support underwriting.

Customarily, engineering and construction underwriting have relied heavily on judgement and expertise, not least because individual projects are often unique and involve a diverse, dynamic set of risks. Increasingly, re/insurers and brokers have developed reliable rating models to systematise and standardise the underwriting process and improve their capabilities to steer engineering insurance portfolios. In 2013 Willis Re introduced its eNGINEER™ platform to provide formal actuarial analysis for construction projects for both per-risk and catastrophe exposures.[40] Likewise, Swiss Re's PUMA (Project Underwriting Management Application) is a tool that supports engineering underwriters in evaluating construction and erection risks.[41]

A stronger collaboration between insureds and insurers could help streamline insurance.

As well as enhanced risk assessment and underwriting tools, cost efficiencies will also be important to stay competitive. A stronger collaboration between insured and insurer might help streamline insurance, as multiple insurers sometimes end up underwriting the same risk, potentially leading to over-insurance.[42] Project owners and contractors might then no longer worry that information sharing could lead to higher premiums. At the same time, closer relationships between policyholders and their insurers might meet resistance from the broker community if this began to reduce their own margins.

More generally, product/process innovation can help widen the set of available insurance solutions.

Product/process innovation by insurers themselves can also help develop insurance applications and improve insurability of new projects.[43] Often project owners, or their contractors, want an integrated cover to protect against the full range of risks, both physical and financial. Provided insurers do not overstep the boundaries of insurability, insurance can play a bigger role going forward in risk financing (how much risk is retained by insureds) and risk intermediation (how much risk is transferred to parties best able to absorb it). Stronger cooperation between different lines of insurance and different functional areas within the business can widen and deepen the available insurance solutions, including multi-peril covers (see "Recent product innovations in engineering insurance"). A number of specialist insurers have sought to combine design and construct insurance with liability, contractors' all risks and professional indemnity, although so far few appear to incorporate any form of funding risk.

[40] Willis Re Analytics Review, Issue 4, October 2013.
[41] Swiss Re's engineering platform PUMA will be relaunched in October 2018 for CAR/EAR business. The upgrade will form the basis for a comprehensive engineering solution suite in the future.
[42] Constructing Excellence and Lucas Fettes & Partners, December 2016, op. cit.
[43] For a broader discussion of how product development and innovation around data and data analytics have expanded the scope of insurance solutions, see *sigma* No 5/2017.

Recent product innovations in engineering insurance

Holistic covers

Holistic covers combine protection across the entire life cycle of a project.

Traditionally, construction project and operational covers have been kept separate due to their distinct risk profiles and coverage requirements. The project phase is often more complex and volatile, due to the longer durations and multi-party involvement. However, there is growing interest in holistic engineering covers that provide comprehensive protection across the entire life cycle of a project. This may involve combining a number of heterogeneous covers eg, CAR/EAR, Credit & Surety, Marine, Liability, ALoP and DSU.[44]

Parametric triggers

Non-damage parametric products may be used to cover new risks.

With more investments being non-recourse financed, project owners often need to reduce earnings volatility to safeguard debt payment obligations to financiers, especially for projects where revenue generation is highly dependent on say weather conditions. Parametric insurance is available to close emerging protection gaps. Unlike traditional insurance, parametric instruments use a model to calculate the pay-out of the insurance policy. This enables speedier claims payment, since loss adjusters are not required to assess damage.[45] Examples of parametric products which aim to provide protection against revenue volatility include:

- Policies that pay out in case traffic volume on a toll road falls short of projections.
- Wind portfolio hedges that pay the client a fixed amount per megawatt-hour for power not generated due to low wind.
- Non-damage weather insurance to indemnify business interruption losses caused by a typhoon warning, even if the typhoon warning later turns out to be a false alarm.[46]

[44] For example, Swiss Re Corporate Solutions is attempting such an integration via its One Construction initiative. https://corporatesolutions.swissre.com/insights/knowledge/one_construction.html
[45] Parametric insurance does not necessarily indemnify the pure loss, but triggers a payment upon the occurrence of an event – eg, rain or snow.
[46] Swiss Re Corporate Solutions has developed a non-damage product called Insur8 that indemnifies local businesses against loss of earnings and costs stemming from a typhoon warning signal 8 or above. See https://corporatesolutions.swissre.com/insights/knowledge/insur8.html

Technology-led innovation in construction

Towards an age of automation

The diffusion of digital technology in construction could prompt significant change in engineering insurance.

Coping with technological change is nothing new for engineering insurers and their clients. Historically, the specialty line has often evolved in response to technological breakthroughs. The growing digitalisation of economies and its potential to impact virtually all industrial processes suggests the sector could be on the cusp of what some label the fourth industrial revolution, or "Industry 4.0". A 2016 survey by McKinsey reported that 70% of construction industry professionals expect to adopt digital technologies within the coming three years.[47]

Such technological innovations span the entire life project cycle from design to operation.

Table 2 provides some illustrative examples of recent technology-led innovations that span the entire engineering project life cycle from planning and design to building erection and operation. Broadly, the technologies can be classified into four main areas:

- *Design and planning software:* Digital tools are applied to assess the physical/topological characteristics of a building or materials under different environmental and topographical conditions. These include the use of virtual and augmented reality to simulate the properties and functionality of a structure.[48]

- *Construction management:* As well as aiding in architectural design, Building Information Modelling (BIM) provides a standardised way to share and exchange information about a building throughout its life cycle, including post-construction management of the facility. Such collaborative software tools can generate significant efficiency gains, especially for highly fragmented projects involving multiple stakeholders.

- *Data gathering and analytics:* Innovations in camera technology and unmanned aerial vehicles (UAV – ie, drones) facilitate regular, detailed surveillance of construction work-in-progress and site security. Internet-enabled sensors on buildings and equipment (including wearable devices) that automatically capture and send data to a central platform can also facilitate frequent and systematic monitoring of atmospheric conditions, concrete setting, structure load and displacement etc.

- *New production methods and materials:* The development of digital fabrication techniques – ie, computer-controlled manufacturing that either builds a product from the bottom up or cuts away at material to create a product from the top down[49] – is re-orientating the traditional construction process. Modular components can be pre-fabricated using automated and controlled factory environments and delivered and erected at the project site. At the same time, robots can be deployed at construction sites to design and engineer components or even whole structures using additive manufacturing techniques such as 3D printing.[50] New materials are also being developed, such as self-healing concrete, which repairs cracks without the need for maintenance, or kinetic technologies like Lybra, which enable flooring to harness the energy associated with vehicles or people moving on surfaces.[51]

[47] McKinsey Global Institute, February 2017, op. cit.
[48] Virtual Reality (VR) is a computer-simulated environment that allows you to interact in a realistic and/or physical way within the environment. An example of virtual reality in construction is interactive 3D modelling that allows the user to manipulate the model to test the effect of changes before making them in the real world. Augmented Reality (AR) is any technology that superimposes spatially contextual information over the user's view of the real world, providing additional data while still permitting interaction with the real environment. See https://connect.bim360.autodesk.com/virtual-reality-construction-technology-saves-money
[49] http://www.shieldcasework.com/pros-and-cons-of-digital-fabrication/
[50] Large 3D printers specifically designed for construction use a technique known as 'contour crafting', with cement as the 'ink'.
[51] See https://www.balfourbeatty.com/2050

Table 2
Illustrative examples of recent technological innovations in construction

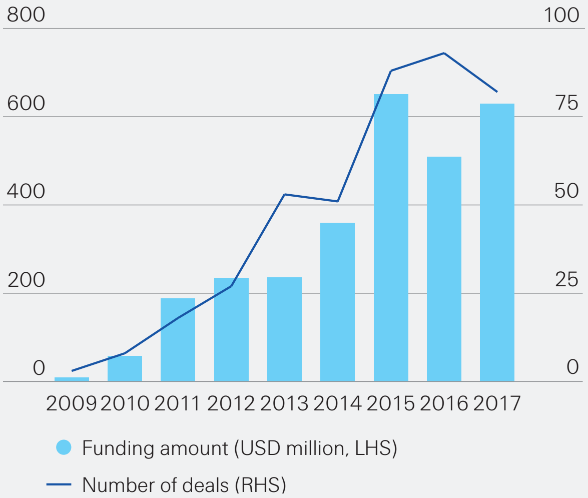
Company	Key technological concept	Brief description
Daqri	Augmented Reality (AR)	The combination of AR with a security helmet can be leveraged for communication of instructions and alerts. This helps reduce both accidents on site as well as workmanship errors. See https://daqri.com/
Skycatch	UAV/drones	Camera technology is used to monitor buildings and gauge topography and soil type throughout the construction lifecycle. Software can pair with a Skycatch UAV, or drones from other manufacturers. See https://www.skycatch.com/
Cazza	Additive manufacturing	In March 2017, Dubai construction firm Cazza said it plans to build the world's first 3D-printed skyscraper by 2020. For more details on the underyling technology, see https://3dprint.com/189228/cazza-3d-print-construction-robots/
Pillar	Sensors	Wireless sensor to monitor conditions on a construction site. Various functions from air monitoring to flood or fire alarm with the aim to increase safety and security. See http://pillar.tech/
PlanGrid	BIM	Cloud-based collaboration platform for multi-user design and integration. With strict versioning and modification tracking, it enables all actors to work on a single model, reducing conflicts in design. See https://www.plangrid.com/
NCCR Meshmould	Robotics/3D printing	Robotic fabrication system that "prints" two parallel reinforcement meshes serving as a formwork between which concrete can be poured. This eliminates the need for traditional formwork allowing for higher degrees of freedom and precision of construction. See http://www.dfab.ch/portfolio/mesh-mould-2/

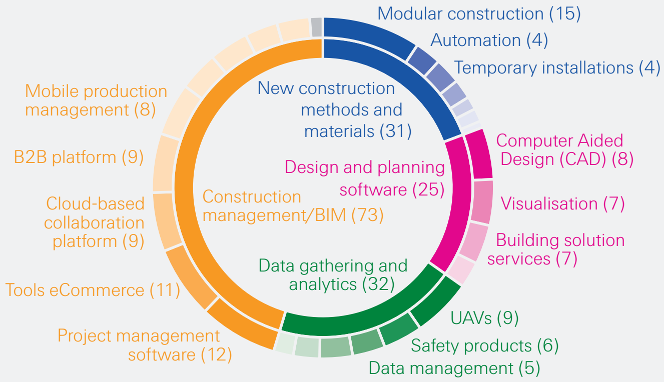
Source: Swiss Re Institute based on published articles and company websites

Investments in tech-led construction start-ups have increased significantly in recent years.

As in other industries, start-up companies are an important part of the emerging innovation narrative. Unencumbered by legacy systems and potentially less swayed by existing stakeholders with a vested interest in the status quo, tech-led construction start-ups (ie, constructech) have attracted significant capital over the past few years. According to CB Insights, more than 400 constructech firms have formed since 2009, raising USD 2.9 billion in funding; more than half of this activity has occurred in the past three years (see Figure 12).

Figure 12
Investment in constructech start-ups and their main areas of focus





Source: CB Insights and Swiss Re Institute calculations

Note: Segments of the concentric circle pie chart refer to share of the total number of start-up investments in that field. Figures in brackets refer to the corresponding number of deals.

Start-ups are particularly focussed on software-based innovations such as BIM.

Constructech start-ups are mainly focussed on small-scale digital opportunities in construction. Mobile and cloud-based technologies leveraging AI, analytics, robotics and AR/VR, as well as software-based products related to BIM/project management are particularly prominent. A number of incumbent construction firms are also embracing new technology, either through in-house R&D or by partnering with or sponsoring start-ups to road test larger innovations that may be integrated into their existing processes.

Construction could one day be fully-automated.

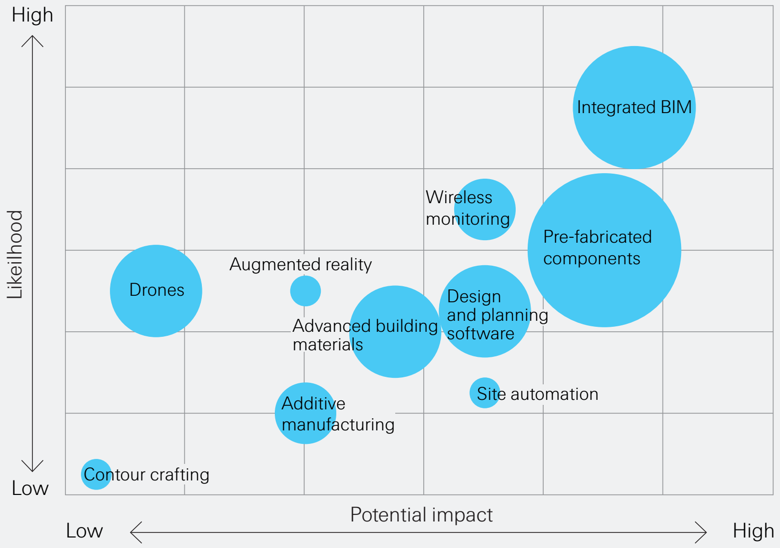
When the various technologies are combined, it could one day lead to unmanned construction and civil engineering sites, perhaps as soon as 2050.[52] Instead, robots will be using dynamic new materials to build structures with drones constantly monitoring the site to inspect the work and identify or solve problems as they arise. In May 2016, the world's first functioning 3D-printed office building was completed in Dubai, while Beijing-based HuaShang Tengda claimed in June 2016 to have completed the world's first 3D-printed house in just 45 days. These two examples reinforce the impression that new technologies have already begun to disrupt the construction sector.[53]

Such a radical disruption to the sector seems unlikely, at least for the foreseeable future.

In all likelihood, such a radical overhaul of construction and engineering remains a distant prospect, at least for most mainstream projects. The construction sector has typically been slow to innovate, which may explain why productivity continues to lag other sectors.[54] While some innovations in construction have recently been adopted, many have not progressed much beyond the proof-of-concept stage (see Figure 13). For example, although powder-based additives and resin 3D printing are widely deployed in the manufacturing industry, 3-D printed construction-ready materials have not been widely adopted. Digitalisation alone is unlikely to have a major impact on the construction sector. Progress is more likely to occur faster when value is added through additional functionality or integration of processes.

[52] Innovation 2050: A Digital Future for the Infrastructure Industry, Balfour Beatty, June 2017.
[53] https://www.reuters.com/article/us-emirates-printing-3d/dubai-says-opens-worlds-first-functioning-3d-printed-office-idUSKCN0YF1OB
[54] McKinsey Global Institute, February 2017, op. cit.

Figure 13
Impact matrix of new technologies



The size of the bubbles represents the technology readiness level (TRL) of the particular innovation. The TRL scale ranges from technologies that have not advanced beyond basic principles to those where applications have been widely tested and are fully operational. For details see:
https://www.nasa.gov/directorates/heo/scan/engineering/technology/txt_accordion1.html
Source: WEF and Swiss Re Institute calculations

The adoption of digital techniques is on the rise in construction and engineering.

Nevertheless, the adoption of digital techniques is on the rise in construction and engineering. BIM, though not yet mature, is already either in use or being tested by a majority of construction firms. Regulation too will help shape the digital transformation. A number of governments, including the UK, Singapore and Finland, now mandate the use of BIM for public infrastructure projects. Similarly, the Dubai government launched its Dubai 3D Printing Strategy in 2016, with the aim to ensure that 25% of buildings in Dubai are constructed using 3D printing technology by 2030. Insurers therefore need to stay abreast of emerging industry trends to understand how they alter the nature of underwritten risks. Likewise, they may need to revisit their own role in managing risks and adapt the services they provide.[55]

[55] Swiss Re recently held an expert hearing on automation in the construction industry. A write up of the event can be found here: http://institute.swissre.com/events/Automation_in_the_Construction_Industry.html

Evolving risk landscape

Risk shaping

Technological innovation affects the nature of risks that engineering insurers underwrite.

Choices made during the design phase with regard to principles and materials have a major impact on a building or structure throughout its life cycle. Engineers determine the manner in which the building or structure will be constructed and consider factors such as cost, energy efficiency, eco-friendliness, safety, ease of maintainability and feasibility of alterations and retrofitting. New materials and processes that influence the risk landscape, both positively and negatively, are constantly developed.

The development of BIM will foster efficiency gains and can help mitigate physical and financial risks.

BIM can contribute in a number of ways towards mitigating construction risks and reducing project liability, including safety, planning and execution risks.[56] These include:

- *Planning for and operating safer buildings.* A set of rules, based on compliance regulations and safety-related best practices, can be formulated and coded into BIM software.
- *Helping to limit the chance of negative project events.* BIM systems, integrated with construction management software, can streamline cost and time estimation of jobs and reduce or eliminate delays.
- *Making construction projects more environmentally friendly.*
- *Creating a digital 'memory' of the building.* BIM can record all aspects of history and operation, including problems which have occurred in the past and how they were resolved. When changes and alterations need to made later in the lifecycle, the BIM model can guide the designers and contractors, who may not have been involved in the initial design and construction.

Robotic applications will reduce human error and improve safety.

The use of robotics in construction also presents significant potential benefits in terms of safety, accuracy and speed. Using a robot, for example, would eliminate the need for humans to work in dusty, noisy and difficult to reach locations. Similarly, prefabrication, (ie taking work traditionally completed onsite into a more secure and weather-proof environment), can lead to higher quality workmanship and safer working conditions, as well as reduce the need for maintenance and lower the risk of human error. Using a drone to take measurements and carry out surveys also has the potential to reduce the risk of accidents and save considerable time, especially for unique buildings that are becoming taller and more complex.

Sensors and data analytics promote pre-emptive maintenance and lower the risk of mechanical breakdowns.

Real-time monitoring combined with data analytics can also isolate potential vulnerabilities and prompt increased predictive or pre-emptive maintenance, lowering the risk of mechanical breakdown and potentially reducing operational downtime.[57] In the energy industry, for instance, the Internet of Things (IoT) is being applied to the maintenance of wind turbines to improve their repair speed and reliability.[58]

[56] https://www.thebalance.com/how-can-bim-mitigate-construction-risks-845317
[57] With sensors that track vibrations and ultrasonic emissions from machines, predictive maintenance (PdM) technologies can predict when parts will malfunction or fail far more accurately than periodic maintenance. This enables companies to intervene at the right place and time to avoid catastrophe. According to the U.S. Department of Energy, PdM can reduce energy and maintenance costs by up to 30 percent, eliminate breakdowns 35 to 45 percent, and reduce downtime by up to 75 percent. See https://www1.eere.energy.gov/femp/pdfs/OM_5.pdf
[58] Digital disruption in insurance: Cutting through the noise, McKinsey

While sensors work well in residential properties, they are not as easy to use in commercial buildings or on construction sites.

The adoption of sensors in US residential properties significantly reduced the number of accidents, which could provide a benchmark for safety improvements in commercial settings should sensors be widely employed. Between 2009 and 2013, the death rate per 100 reported home fires was more than twice as high in homes that did not have any working smoke alarms (1.18 deaths per 100 fires), as it was in homes with working smoke alarms (0.53 per 100 fires). However, commercial buildings are considerably more varied than typical residences, and the associated risks and vulnerabilities are more complex. Similarly, sensors might not work as well on a construction site, where it might be difficult to differentiate between dust and smoke, or between a hot weld and a fire.

However, digitalisation also gives rise to new risks such as cyber.

At the same time, increased digitalisation brings with it new types of risk. Cyber security breaches, posed not only by viruses, malware and ransomware, which can disable and disrupt systems, but also by criminal cyber activity, are a risk. These breaches carry significant legal, financial, reputation and business interruption (BI) risks. Remotely accessible systems, like BIM, project management software and autonomous vehicles can create opportunities for cyber criminals to breach defences. Data from integrated robotics that assist in builds, drones that monitor worksites and IoT technologies could be vulnerable without their owners' realising it.[59]

Technical advances can also change the nature of traditional perils.

Technological innovations can also change the nature of traditional perils. Getting pre-fabricated building modules on site creates unique logistical challenges. Pre-fabricated units that include interior designs should not be exposed to weather, which makes transporting, delivering and storing them risky. New projects in new locations also bring about new exposures that are not comparable to the loss experience on other projects. For example, wind farms in Taiwan face more serious natural catastrophe threats (eg, typhoons) than similar projects in Europe.

The loss severity of accidents could rise even as their frequency falls.

The adoption of high-value electronic and computer equipment in construction and engineering could affect the potential scale of damage in the event of an accident. Likewise, the expansion in scope of insurance to include more financial-related/non-damage risks may mean that even though the frequency of losses may be permanently lower going forward, the severity of claims might remain significant. This is especially the case as global industries become increasingly interconnected, reflecting the higher potential for losses from the same incident to accumulate.[60] Technological advances such as BIM may help improve coordination, but alone are not sufficient to prevent catastrophic project failure.[61]

[59] https://www.nbins.com/blog/cyber-risk/new-cyber-risks-construction-industry/
[60] http://www.agcs.allianz.com/assets/PDFs/Reports/AllianzRiskBarometer2016.pdf
[61] For example, the tunnel excavation under the main high-speed rail route between Germany and Switzerland at Rastatt that collapsed in August 2017 was a BIM-managed project.

The rise of automation is likely to shift responsibility for losses from users to manufacturers of equipment.

Risk shifting

The current state of law often places significant liability on engineers and constructors for computer-related accidents; as professionals they must exercise expert judgement and not place blind in trust in machines.[62] That seems likely to change, if only gradually, as key tasks become more automated. The increasing use of computer software and robots shifts the associated risks from human error to pure mechanical or computer malfunction. This means that liability for any resulting losses could increasingly be shifted to the manufacturer/designer of the equipment rather than the user.[63]

The shift from personal to product liability may not be straightforward.

In principle, this move from personal to product liability should be straightforward, with insurers designing new policies to suit the changes in the underlying risks. In practice, the adjustment will be challenging. Specifically, the cause of an accident becomes more complicated to determine once it is no longer operator/user error. For example, in the case of a 3D-printed defective component or building, was the malfunction fundamentally linked to a hardware or software problem? Who is responsible for the properties of a bespoke printed component?

Legal disputes over culpability may arise if tasks are not fully automated.

Such complications could be particularly significant if tasks are not fully automated. In these cases, there may be disputes over whether the operator was following manufacturer guidelines (eg, overriding the robot). When autonomous machinery is involved in accidents, resolving the question of fault will pose novel and in some cases very complex legal and ethical questions over liability.

Robotic applications will lead to more usage-based insurance.

Risk slicing

In the absence of specific information about individual risk, insurers have traditionally had to underwrite risks by category and usually for a particular policy period. The use of IoT is changing that with its ability to monitor insured property or track policyholder behaviour. If data from sensors are embedded in key operational assets (eg, a cooler, conveyer belt, plant equipment etc), policies can be based on what industrial facilities are actually doing and the related risks – ie, usage based insurance. Put differently, insured risks can be broken down by configuration and duration. In this way, protection will be based more on when, how and in what context the machine or plant is being used rather than who produced, owns or typically uses it.

The use of robots should result in more accurate risk pricing, although the limited experience with them will make underwriting challenging.

To the extent that robotic devices permit users to control the level of machine autonomy, this will result in different risk profiles at different times. It could also lead to different liabilities: user liability in "hands on" mode and product liability in fully automated or "hands off" mode. In turn, this could result in different insurance premiums depending on the mode of operation, including when machines and plants are at rest. When calculating risk involves continuous monitoring and diagnostics, rather than scheduled preventative actions, the pricing of risk becomes far more precise. Given the limited experience of robotic applications in everyday use, accurate assessment of the underlying risks is nonetheless likely to remain a significant hurdle.

[62] http://www.hpac.com/liability-amp-litigation/computer-engineering-tool-or-time-bomb
[63] The question of determining liability for decisions made by robots or artificial intelligence is a live topic for debate among legal practitioners and policymakers, especially in relation to autonomous vehicles. See for example: https://betanews.com/2017/03/21/artificial-intelligence-robotics-liability/

Reconfiguring underwriting in a world of more connected risks

Digitalisation will change the business ecosystem in which insurers operate.

As well as changing the risk landscape, digital technology is reshaping the role of engineering insurers and the way they will likely operate in the future. In the past, an owner of a machine or a building contractor might have consulted an insurance carrier once a year (or at the start of a project) to discuss risk protection, perhaps using the services of a broker. Digitalisation could change this and, with it, lead to radical changes in the competitive environment and transform the insurance business model. Access to valuable data from sensors and predictive analytics capabilities will become increasingly pivotal for insurers to support their value proposition, creating the need for different business collaborations and partnerships (ie, new business ecosystems).

Insurers could play more of a risk avoidance/mitigation role rather than simply indemnify policyholders against loss.

In this new connected environment, which is still some way off, new types of insurance covers will eventually develop that are continuously updated with comprehensive real-time data on risk and tailored to manage the risk of specific industries and organisations.[64] Digital simulation models and a front-loaded design process will provide far more clarity and quantification of the potential risks, often at a much earlier stage than traditional underwriting techniques. Insurers will know, for instance, whether a business owner is following required safety and maintenance procedures. In this way, insurers of the future may come to play more of a risk avoidance/mitigation role rather than solely lending their balance sheets to indemnify a policyholder in the event of an accident.[65]

Insurers will need better ways to access and analyse structured and unstructured data.

New technologies will challenge re/insurers to develop novel approaches to understanding and evaluating risk. The proliferation of new data sources will require insurers to adjust their systems and processes to leverage the potential insights they offer. For both unstructured data – eg, video footage of construction sites – and structured data – eg, sensor information recording a machine's or building's performance – insurers must develop new ways to locate, organise, extract and analyse data. This may mean creating new types of databases to store and analyse information that currently doesn't fit the traditional mould.[66]

[64] http://insuranceblog.accenture.com/the-journey-to-new-iiot-insurance-models-for-insurers-and-industrial-sector-players

[65] The Hartford Steam Boiler Inspection and Insurance Company has introduced an Internet of Things based turnkey service to help insurers manage risk. This includes installing sensors at commercial locations insured by its client insurance companies to monitor conditions that pose potential risks. https://www.businesswire.com/news/home/20161004006443/en/HSB-Internet-Things-Insurers-Prevent-Losses

[66] https://www.adlibsoftware.com/blog/2017/November/how-data-analytics-is-changing-up-the-insurance-industry.aspx

Market outlook

The outlook for engineering insurance will be mainly shaped by growth in risk exposures.

Beyond the impact of new technology, the outlook for engineering insurance markets will be affected by the future development of premium rates and the prospective growth in risk exposures. With few signs of pricing shifting sustainably higher, business volume growth will instead depend heavily on prospective growth in the world economy.

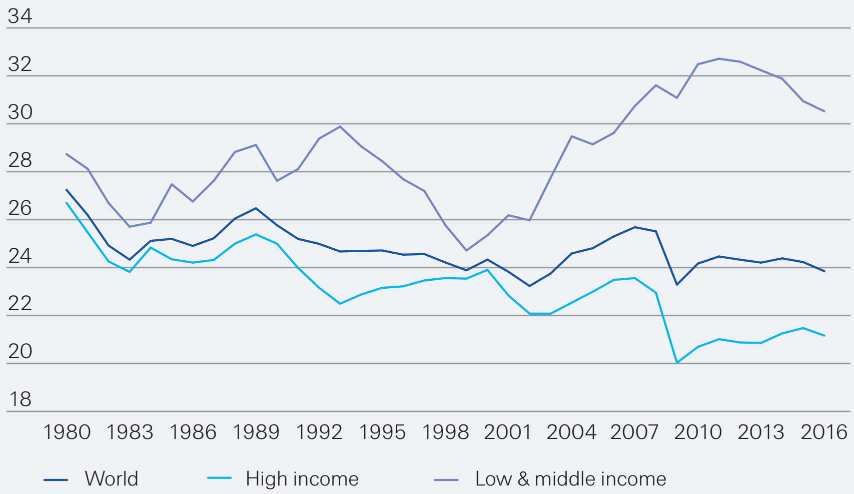
Increasing risk exposures will drive premium growth

Global economic upswing will stimulate investment

Fixed investment has been weak in recent years…

Investment in physical capital (buildings, infrastructure, machinery etc) has been relatively weak in recent years, most notably after the global financial crisis. This is most obvious in advanced economies, where total investment as a share of GDP remains well below levels in earlier decades. Even in emerging markets, investment has slowed noticeably since 2010 (see Figure 14).

Figure 14
Gross fixed capital formation (GFCF) by World Bank income category, % of GDP



Note: Gross fixed capital formation (GFCF) refers to the net increase in physical assets (acquisitions less disposals) over a specific time period, but does not account for depreciation.
Source: World Bank and Swiss Re Institute

…but is set to accelerate as the global economic recovery strengthens.

However, this situation is forecast to reverse somewhat over the coming years as the synchronised global economic recovery strengthens.[67] In the G20 group of countries, fixed capital formation rose by almost 6% in 2017 (well ahead of real GDP growth of 4%) and is set to continue its revival especially in emerging markets.[68] Within investment, real global construction output is projected to accelerate in the near term – around 4% per annum over the next few years according to some estimates – outpacing overall global economic activity.[69]

[67] The Euro area-wide aggregate manufacturing utilisation rate is almost back to its pre-financial crisis peak, despite a double dip decline both in 2008/2009 and during the Euro area debt crisis in 2012.
[68] OECD, 13 March 2018, "Interim economic Outlook: Getting stronger, but tensions are rising". Gross fixed capital formation in Brazil is forecast to bounce back in 2018 – 2020 after contracting for four years, while accelerating further in India to grow at the fastest in emerging economies. Morgan Stanley, "Global Economics Playbook: Global Capex Cycle: Gaining Strength and Breadth," February 7, 2018.
[69] https://www.construction-ic.com/Insight/global-construction-outlook-2022---highlights and http://www.lucintel.com/construction-industry-2018-2023.aspx

Structural factors also underpin future capital investment.

Slow moving structural developments also underpin rising protection needs

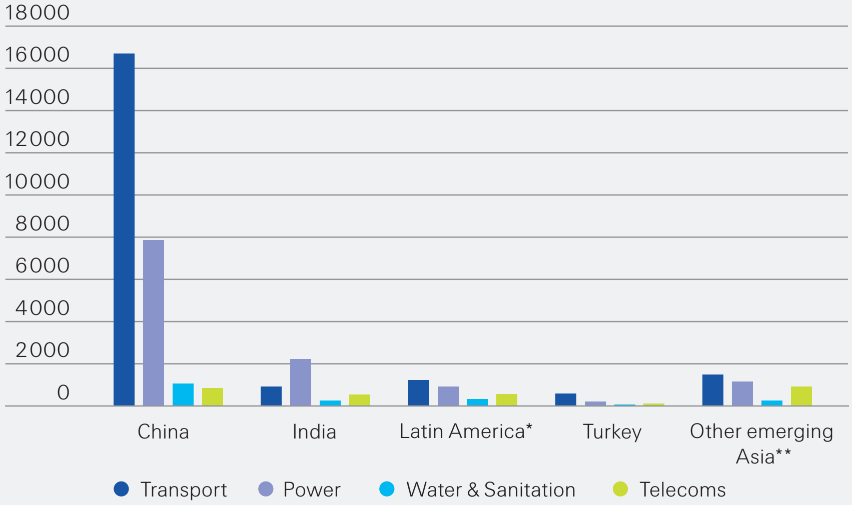
The cyclical recovery in investment is augmented by slow moving, but potentially high-impact structural factors, such as urbanisation, the rise in renewable energy, and replacement/upgrades of ageing or inadequate infrastructure.

Massive infrastructure investments are needed to deal with the influx of people into cities.

Urbanisation

The United Nations forecast that the global urban population will increase to 5 billion by 2030 means that by then, three-fifths of the world population will live in cities.[70] Emerging markets account for approximately 95 percent of that growth and ten new megacities of at least 10 million inhabitants will emerge.[71] Projections for global investment in transport (ie, rail, roads, airports and ports), utilities (power generation and water) and telecoms structures, based on current trends, are expected to accumulate to approximately USD 79 trillion (in 2015 constant dollars) between 2016 and 2040. Asia is projected to account for roughly 60% of these investments (see Figure 15).[72] Amongst emerging markets, Asia and Africa are expected to experience the most significant transformation.[73]

Figure 15
Forecast of infrastructure trends by sector in selected emerging markets, 2016–2040 (USD billion, 2015 prices and exchange rates)



Notes:
* Sub-sample includes: Argentina, Brazil, Paraguay, Peru, Uruguay and Mexico;
** Sub-sample includes: Bangladesh, Thailand, Philippines, Indonesia, Malaysia and Vietnam.
Source: Global Infrastructure Hub and Swiss Re Institute

[70] UN population projection
[71] The World's Cities in 2016 – Data Booklet (ST/ESA/ SER.A/392), United Nations, Department of Economic and Social Affairs, Population Division (2016), and https://www.huffingtonpost.com/wendell-cox/the-worlds-ten-largest-me_b_6684694.html
[72] Global Infrastructure Hub 2017, "Global Infrastructure Outlook – Infrastructure investment needs 50 countries, 7 sectors to 2014" and Swiss Re, *sigma* No 5/2013, "Urbanisation in emerging markets: boon and bane for insurers."
[73] The World's Cities in 2016 – Data Booklet (ST/ESA/ SER.A/392), United Nations, Department of Economic and Social Affairs, Population Division (2016).

Significant investment in renewable energy is needed to meet climate change targets.

Investments in renewable energy

Despite a decline in 2016, investments in renewable energy are expected to expand as the world continues to seek alternatives to fossil fuel power generation.[74] The International Energy Agency estimates that USD 3.5 trillion in energy-sector investments will be required on average each year between 2016 and 2050 to limit the global mean temperature rise to below 2°C with a probability of 66%.

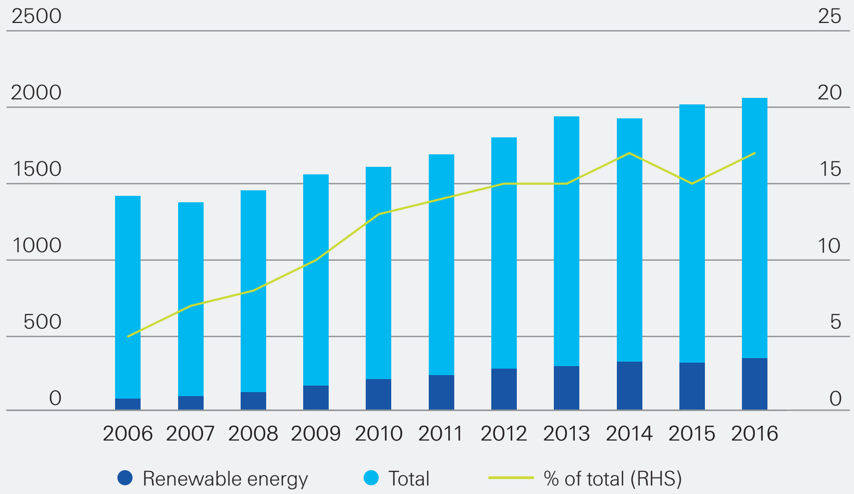
- In the US, total renewable energy production was roughly 12% of total energy production in 2016, a record high, and is forecast to increase to 17% by 2050.[75]
- In Germany, renewable energy already accounts for 29% of gross electricity generation, and associated investments have been an important source of demand for engineering covers (see "Renewable energy and engineering insurance"). Estimates suggest that until 2025, investments in renewables will add another EUR 370 billion, on top of the EUR 150 billion already invested, to achieve Germany's "Energiewende".[76]
- In China and other emerging markets, renewable energy production is also expanding rapidly. Under the 13th Five-Year Plan, the Chinese government plans to nearly double land-based wind capacity and triple solar PV by 2020.[77]

Renewable energy and engineering insurance

Renewable energy premiums in Germany have increased significantly.

Investments in renewable energy have been a key source of business growth for some engineering insurers. In Germany, related premiums have risen from 5% of total engineering premiums in 2006 to almost 17% in 2016 (see Figure 16). Annual growth has averaged over 20%, holding up even during the global financial crisis in 2008 and 2009.

Figure 16
Total and renewable energy premiums written in Germany, in EUR million, and as a % of total engineering premiums (RHS)



Source: German Insurance Association (GDV) and Swiss Re Institute

[74] Executive Summary/Chapter [1/4]] of Perspectives for the energy transition – investment needs for a low-carbon energy system OECD/IEA and IRENA 2017.
[75] Based on the reference case of the U.S. Energy Information Administration. U.S. Energy Information Administration, "Annual Energy Outlook 2017" and U.S. Energy Information Administration, "U.S. Energy Facts". https://www.eia.gov/energyexplained/index.cfm?page=us_energy_home
[76] https://www.welt.de/wirtschaft/article158668152/Energiewende-kostet-die-Buerger-520-000-000-000-Euro-erstmal.html
[77] Next Generation Wind and Solar Power – From cost to value, OECD/IEA, 2016.

Increased reliance on renewable energy may impact the broader engineering risk landscape.

The shift towards renewables has broader implications for engineering insurance. Increased volatility in power production resulting from intermittent energy sources (eg, fluctuating weather patterns that affect wind, hydro and solar power generation) increases peak-load strains on existing electricity infrastructure. This might increase wear and tear on machinery leading to increased chance of mechanical breakdowns. Innovations in large-scale battery storage technologies will go some way to mitigate that risk but also create additional complexities.[78] Fire hazards arising from inherently flammable material and the thermal properties of the battery can be serious. Likewise, batteries often contain toxic, caustic or corrosive components that can cause harm.[79]

Infrastructure upgrades

Infrastructure spending has fallen behind the pace needed to support future economic growth.

Another key underlying driver of exposure growth is the need to upgrade and close the global infrastructure gap. The gap represents the difference between what countries are forecast to spend on infrastructure, and what is actually needed to meet basic human needs, as well as satisfy the demands of a modern economy. Estimates vary although all suggest the infrastructure gap is large. For example:

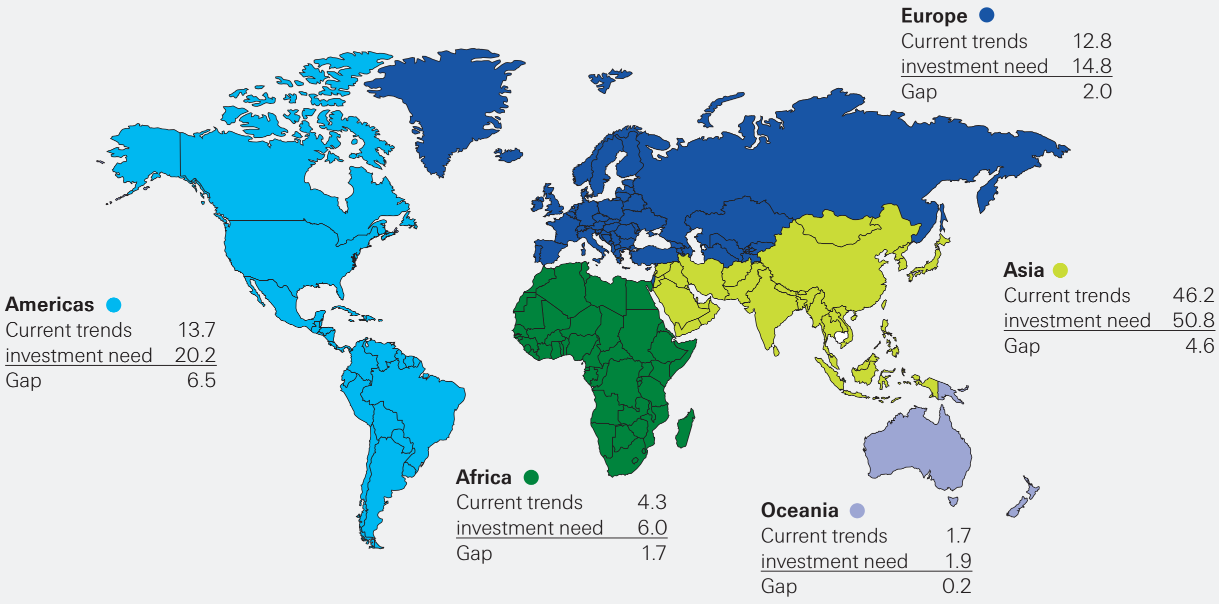
- The Global Infrastructure Hub, a G20 initiative, and Oxford Economics estimate that by 2040, the world could experience an investment shortfall equal to USD 15 trillion, or one-fifth of the forecasted global infrastructure investments.[80] To close this gap, infrastructure spending would have to rise by an extra 0.5 percent of global GDP annually, from 3% to 3.5%.
- Similarly, the McKinsey Global Institute projects that the shortfall in infrastructure spending amounts to around 0.3 percent of global GDP. In nominal USD terms, the cumulative gap is set to expand to USD 5.5 trillion globally between 2017 and 2035.[81]

Emerging markets account for the majority of the global infrastructure gap, although the US gap is the largest.

Emerging economies account for close to two-thirds of global infrastructure needs, with China alone accounting for 34%, followed by India with 8% (see Figure 17). China, however, is expected to almost fully meet its infrastructure needs. This contrasts with the situation in some advanced countries, such as the US, where the infrastructure gap is exceptionally large and growing, reflecting not only the depreciating capital stock, but also a continued projected underspend on investment.[82]

[78] For a broader discussion of the implications of new storage technologies for the different services on the electricity grid, see http://institute.swissre.com/research/library/Grid_Storage_Summary.html
[79] A recent incident in Belgium aptly illustrates the potential dangers. A large-scale battery – part of the first real live testing of power batteries being used to store wind power in Belgium – exploded into flames at a power station located near Brussels. https://www.wind-watch.org/news/2017/11/12/wind-power-backup-and-storage-batteries-explode-into-flames-and-send-a-toxic-cloud-over-the-city-of-brussels/
[80] At current trends, global investments of USD 79 trillion are projected by 2040, while USD 94 trillion would be needed, leaving a gap of USD 15 trillion. See Global Infrastructure Hub http://blogs.worldbank.org/ppps/forecasting-infrastructure-investment-needs-50-countries-7-sectors-through-2040
[81] McKinsey Global Institute, Bridging global Infrastructure gaps – Has the World made Progress, October 2017, an updated version of McKinsey Global Institute, Bridging global Infrastructure gaps, June 2016.
[82] The average age of all government-owned fixed assets reached 24 years in 2015, a new record for a data series going back to 1925. Swiss Re "Underwriting the US infrastructure gap", http://www.swissre.com/rethinking/financial_stability/underwriting_the_US_infrastructure_gap_new_publication.html

Figure 17
Total infrastructure spending gap per country 2016–2040, USD trillion



Source: Global Infrastructure Hub and Oxford Economics

Governments in advanced economies have announced plans to address the shortfall.

Governments in advanced economies have announced policies promising to boost public investment to address deteriorating infrastructure. The European Union has committed to invest in excess of EUR 315 billion under the EU Infrastructure Investment Plan, (also called the 'Juncker Plan').[83] Likewise, in the US, President Trump has promised to invest USD 1.5 trillion into rebuilding the nations "crumbling infrastructure".[84] This promise however, is as yet unfunded in the budget.

Emerging economies are promoting infrastructure development, supported by China's Belt & Road initiative.

In emerging economies, modern infrastructure needs to be built, often from scratch, to support long-term development. China, for example, plans to invest significantly to strengthen the country's integration with countries in Asia, the Middle East, Africa and Europe via land and maritime trade routes. The spending estimates in the Belt & Road Initiative range from USD 4 trillion to USD 8 trillion.[85] Much of the spending will be for constructing and upgrading infrastructure, both within as well as outside China. In markets like South East Asia, projects mainly involve the construction of transport and power infrastructure.

Baseline premium projections

Engineering premiums tend to grow at around three quarters of the pace of construction output.

Statistical analysis confirms a relatively strong positive correlation between engineering insurance and indicators of economic activity. Based on a panel of advanced and emerging countries, the long-run sensitivity (ie, elasticity) of total engineering premiums with respect to gross construction output ranges from 0.7 to 0.9, depending on the regression estimation technique used.[86] This suggests that, on average, engineering premiums tend to grow at least three quarters of the pace of gross construction output (see Table 3).

[83] https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/investment-plan-europe-juncker-plan_en
[84] https://www.ft.com/content/1ea12ffc-0f3e-11e8-8cb6-b9ccc4c4dbbb viewed 20 February 2018
[85] "Can China Afford Its Belt and Road?", Bloomberg.com, 17 May 2017. https://www.bloomberg.com/view/articles/2017-05-17/can-china-afford-its-belt-and-road
[86] Gross construction output refers to the total of all material and service inputs to construction plus the value added by the construction industry itself, all of which may count toward the sum assured.

Table 3
Actual and projected average annual growth for construction and engineering premiums (%) and corresponding long-run elasticities

	Construction		Long-run elasticities*		Premiums	
	2008–2017	2018–2027F	GDP	Construction	2008–2017	2018–2027F**
Global	3.5	7.3	1.1	0.7–0.9	–0.1	4.8–6.5
Advanced markets	0.1	4.2	1.0	0.7–0.9	–0.9	2.7–3.6
Developing markets	7.2	9.1	1.1	0.7–1.2	2.1	6.1–10.6

Note:
* The long-run elasticities are averages across countries based on a range of different panel regression estimators. Engineering premiums were regressed on nominal GDP and/or gross construction output for each country plus a survey-based indicator of global premium rates in construction. Different dynamic regression estimators were applied depending on the assumed degree of heterogeneity in parameters across countries and restrictions on what drives premiums in the long run. For example, premium rates were assumed to have only a short-run effect since they follow the broader commercial insurance underwriting cycle.
** Based on the range of long-run elasticities of premiums with respect to gross construction output.
Source: Various national sources, IMIA, Oxford Economics and Swiss Re Institute calculations

The co-movement is strongest for developing economies.

The empirical co-movement between premiums and construction activity appears to have been stronger in the past for developing markets compared with advanced markets. In part, this reflects the relatively larger share of project covers in developing countries especially on infrastructure. Demand for operational engineering insurance seems more likely to respond to developments in the wider economy, including industrial output, reflecting the intensity at which machines and plants are employed. Perhaps consistent with that, the elasticity of premiums with respect to nominal GDP are more broadly similar (and close to unity) for both advanced and developing economies.[87]

Strengthening construction activity should translate into engineering premium growth of around 5% per annum over the next decade.

A number of market commentators anticipate an extended period of strong growth in construction. According to Oxford Economics, global gross construction output is forecast to grow, on average, by over 7% per annum over the next ten years, up from 3.5% over the previous decade. Assuming that the long-run elasticity of premiums to construction spending is maintained in the future and that premium rates have a broadly neutral impact over the forecast horizon, this would mean that the global engineering market can be expected to expand by around 5 to 6% annually between 2018 and 2027. Most of that growth will likely come from activity in developing economies.

[87] The slightly larger elasticity estimates for developing markets is nevertheless confirmed by a simple comparison of long-run growth in premiums, nominal GDP and gross construction output.

Key sources of uncertainty

As forecasts involve uncertainty, it is important to consider the factors that could affect the outlook.

As with any forecast, uncertainty around these central projections remains. In order to assess that uncertainty, it is important to consider the factors that could affect the outlook for engineering premiums, particularly the downside risks.

Walking the talk

Many of the current plans for public infrastructure spending remain aspirations rather than guaranteed commitments.

Whether due to overpromising and under-delivering, technical difficulties or simply mismanagement, public infrastructure spending plans have often fallen short. Current public spending plans may also prove overly optimistic. In Germany, it is likely that the country will miss its own targets for renewable energy production by 2020.[88] Meanwhile, at the EU level, Juncker's plan for Europe does not entail significant sums of new money and may in fact cannibalise funding for other projects.[89] Similarly in the US, President Trump promised USD 200 billion to fund infrastructure, hoping the private sector would also contribute to reach the total financing package of USD 1.5 trillion.[90] However, concrete details have not yet been made available.

Availability and cost of finance

The global debt overhang represents a hurdle for future debt financing of infrastructure investments…

Following the global financial crisis, many countries continue to carry high levels of debt. Some government and corporate sector balance sheets remain stretched. Global credit extended to the non-financial corporate sector (CRE) as a percentage of GDP has continued to climb in recent years to reach its highest level on record at the end of 2016. The rise in debt is particularly noticeable in emerging markets where CRE (as a percentage of GDP) is over 50% above its pre-crisis peak.[91] Such high levels of public and corporate debt present a significant challenge for the future financing of new fixed investment.

…especially since interest rates are expected to rise.

This debt overhang constraint could become especially severe as the extraordinarily low interest rates over the past decade unwind. With global interest rates forecast to rise, borrowing costs for new projects as well as refinancing of existing debt will only increase.[92] This may undermine financiers' confidence that highly-indebted borrowers have the future capacity to repay any loans and thereby limit the availability of credit.[93]

Financing issues could be particularly important for the Belt & Road Initiative.

The IMF has recently highlighted that financing issues are a particular challenge for the Belt & Road Initiative.[94] The initiative may encourage unsustainable increases in borrowing in affected countries where public debt is already high. In addition, it relies heavily on debt financing from China, at a time when China itself is looking to deleverage and rebalance its economy away from investment towards consumption. Together with the limited capacity of the IMF or Asian Development Bank to support Belt & Road projects, this could ultimately lead to fewer projects and less investment than currently envisaged. So far, less than 10% of Belt & Road projects in countries outside of China have actually secured finance.[95]

[88] https://www.welt.de/wirtschaft/article158668152/Energiewende-kostet-die-Buerger-520-000-000-000-Euro-erstmal.html
[89] This might go some way to explain why only EUR 4 billion of infrastructure projects had been disbursed by the end of 2016, out of the original EUR 315 billion planned investment. https://www.ft.com/content/90712920-138b-11e7-b0c1-37e417ee6c76
[90] https://www.vox.com/policy-and-politics/2018/2/1/16959310/trumps-infrastructure-plan
[91] Based on BIS statistics: Table F1.1: Total credit to the non-financial sector (core debt)
[92] https://fred.stlouisfed.org/series/A091RC1Q027SBEA
[93] https://www.moodys.com/research/Moodys-US-corporates-5-year-investment-grade-maturities-exceed-1--PR_378820
[94] http://www.imf.org/en/News/Articles/2018/04/11/sp041218-belt-and-road-initiative-strategies-to-deliver-in-the-next-phase
[95] "China's Belt & Road initiative, and the impact on commercial insurance," October 2016, Swiss Re.

Long-term investors could help boost available finance, but private participants in infrastructure projects continue to face challenges.

Private institutional investors like insurance companies and pension funds, which hitherto have not been very active investors in this space, can help boost infrastructure investment. Innovative financing instruments may help alleviate funding constraints, especially if they could be designed with some equity-like features. Despite policy initiatives to help widen the investor base – including reduced requirements on capital that insurers must hold against qualifying infrastructure investments – institutional investor participation in infrastructure financing faces significant challenges. The lack of standardised reporting together with the inability to hedge political risks is holding back the development of tradable markets for infrastructure-related securities, which in turn makes it difficult for investors to benchmark and monitor returns.[96]

Political challenges

Construction projects face considerable political implementation risks.

Even when financing has been secured, construction projects face a myriad of implementation challenges including political obstacles and social opposition. Frequent changes in political leadership or policy changes can disrupt infrastructure projects that rely on long-term planning security. For example, the UK's decision to leave the EU could have a long-lasting impact on UK fixed investment. Cross-border projects may also face geo-political uncertainties during their life-cycle. China's Belt & Road Initiative is particularly vulnerable to political instability.[97] A number of target Belt & Road countries face heightened implementation risks raising doubts about project execution.[98]

Heightened protectionism has the potential to curb investment spending and in turn insurance demand.

Protectionism is on the rise globally. Newly imposed trade barriers, such as the recent tariffs on steel and aluminium imports into the US, have the potential to spark a full-scale trade war. A slowdown in global trade would undermine economic activity and ultimately reduce living standards. The construction and engineering insurance sectors would not be immune to such a development if investment spending plans were shelved.

96 Swiss Re, Infrastructure Investing. It Matters.
97 "One belt, one road": an economic roadmap, The Economist Intelligence Unit (EIU), 2016, https://www.eiu.com/public/topical_report.aspx?campaignid=OBORSept2016
98 "China's Belt & Road Initiative, and the impact on commercial insurance," October 2016, Swiss Re.

Conclusion

Engineering insurance plays a crucial role in supporting economic activity.

Engineering insurance plays a key role in supporting economic activity. Although aggregate engineering premiums are small relative to the size of the broader commercial insurance market, many large construction and infrastructure projects could not be undertaken without such policies. Likewise, the use of key plant and industrial machinery would be severely constrained if operators were unable to protect themselves against losses that arise from circumstances beyond their control, such as mechanical failure or boiler explosion.

Compared with other specialty lines, engineering remains relatively profitable, but there are signs that underwriting performance has deteriorated recently.

Compared with other specialty insurance lines, engineering has been relatively profitable. Underwriting performance has deteriorated recently, not least because the long-tail nature of some construction and engineering insurance lines means that ultimate loss experience on existing policies has yet to be fully developed. With engineering premium rates having declined for over a decade, alongside persistent weakness in other contract terms, some engineering insurers' profit margins may already have been squeezed close to or below levels that are sustainable over the long term. This is especially the case given the increasingly complex, multi-stage, multi-party and sometimes multi-national nature of 'mega' construction and infrastructure projects, which only add to underwriting risks.

New construction technology could foster further efficiency and safety gains, but this will happen only slowly and brings with it new risks.

Advances in technology could provide some relief if they bring continued improvements in safety and accident rates in construction and other industrial sectors. The digitalisation of manufacturing and construction offers much hope of significant improvements in efficiency, including enhanced monitoring, mitigation and management of engineering-related risks. But such a digital transformation is likely to happen only gradually. Moreover, new technology affects the nature of existing risks and brings with it new risks, such as cyber, which means that the severity of claims could increase even if the frequency of accidents decreases.

The outlook for engineering insurance is positive, although uncertainties remain.

The short-to-medium-term outlook for the engineering market is heavily tied to developments in global construction markets. After a period of relative stagnation in premiums, the expected acceleration of building investment in advanced and developing markets in the near term should underpin stronger insurance demand and revenues. This reflects the confluence of the ongoing cyclical upswing in the global economy and underlying structural shifts, such as urbanisation and rising demand for renewable energy. While the market outlook is positive, engineering insurers must remain alert as a number of macroeconomic uncertainties remain.

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