5th annual report

CRUX INSIGHT

BATTLING THE HEADWINDS

A regional analysis of claims and dispute causation

HKIA

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FOREWORD

HKA's integrated research programme analyses and reports on the causes of claims and disputes on major capital and infrastructure projects worldwide. Uniquely, CRUX is based on first-hand investigations by industry-leading consultants working on projects globally.

Our Fifth Annual CRUX Insight Report is a distillation of their findings on more than 1,600 multi-year projects in 100 countries, up until the end of July 2022.

The combined capital expenditure on these projects was more than US$2.13 trillion.[1] Our analysis quantifies the toll of additional costs and time claimed for their completion. The cumulative value of the sums in dispute exceeded $80 billion. Together, the extensions of time sought would stretch beyond 840 years.

These are huge impacts in time and money to the global economy, our industry and project stakeholders. At project level, these claims and disputes amounted, on average, to 35.1% of the capital expenditure committed by the conclusion of our current report. Where contractors claimed extensions of time, project schedules were typically prolonged by 68.6% – or 16.5 months.

We also analysed the causes of claims and disputes by region. Our regional commentaries identify the common and distinctive forces at work in Africa, the Americas, Asia, Europe, the Middle East, and Oceania. HKA consultants in each region share actionable insight and advice to tackle the root problems, based on their expertise and real-life experience.

Projects in progress and planning now, and in the foreseeable future, are facing even stronger global headwinds since the outbreak of war in Europe. We review these economic pressures and other risks, and explore possible strategies to build in resilience and withstand these pressures in the section, Battling the Headwinds (see page 9).

The purpose of CRUX is to provide the world's most authoritative analysis of the multiple reasons for distress on capital projects – and to use this clearer understanding to help project promoters, and the construction and engineering industry, achieve better project outcomes.

We mine this unmatched and growing databank to help clients gauge risks in various markets and regions, benchmark performance, and identify areas for improvement. We share the lessons from our research programme with the wider industry, through:

- The CRUX Insight interactive dashboard
- Regional webinars and presentations
- Other joint events with professional bodies

We hope that you find The Fifth Annual CRUX Insight Report informative and encourage you to join with us in applying the insights from our research programme to improve the planning and delivery of capital projects and infrastructure.

Renny Borhan
Partner, Chief Executive Officer

Industry view

Lessons to be learnt

The world economy, industry and households alike, are facing an extremely difficult period. As described in this report, strong headwinds are not only heightening uncertainty for capital projects, they also highlight the complexity of the global energy system.

While there are important regional differences, CRUX Insight reveals the recurrent trends in claims and disputes on major projects across industries.

At enterprise, programme and project level, lessons can and should be learnt from the CRUX analysis. Shell is partnering with HKA, using the CRUX framework to maximise insights from our own project data.

Mike Alves
Head of Contract Management & Claims
Shell Global Solutions

1 Throughout the report, values are quantified in US dollars, unless otherwise stated

OVERVIEW

Last year's CRUX Insight report predicted "a long COVID legacy of uncertainty and heightened risk from supply chain delays, cost inflation and skills shortages". In 2022 that economic and logistical overhang has been exacerbated by the war in Ukraine, accelerating inflation, further supply shocks, and a slowdown in the global economic recovery.

Risks and uncertainties whipped up by these global headwinds (which are examined separately, later in the report) threaten performance on major capital and infrastructure projects in all regions, to a varying degree.

The Fifth Annual CRUX Insight analysis quantifies the impact of claims and disputes investigated by HKA consultants over a five-year period up to the end of July 2022.[2]

Change in scope – the top-ranking cause of claims and disputes in most regions – seems inevitable on large construction projects and requires constant management. CRUX Insight confirms the ongoing failures of owners and contractors to navigate this challenging process. Closely related, the high prevalence of design conflicts can be attributed, at least partly, to the complexity of these major projects. However, contract interpretation issues – the other most recurrent trigger – should be eminently more avoidable.

The effects of the pandemic continue to manifest on projects worldwide. Delays in granting approvals, accessing sites, issuing design information, and delivery of materials have all ratcheted up in the CRUX Insight ranking of causes. Restrictions on access to workfaces were notably more prevalent in two regions: Africa, where the construction industry contracted sharply in 2021, and Asia, which has been comparatively slow in emerging from COVID-19's long tail. Project owners have been taking an increasingly hard line on relief and redefining contractual terms on force majeure and changes in law.

Despite the global headwinds, many of the world's major construction markets remain buoyant and boast strong project pipelines. However, this workload will only intensify gaps already evident in project teams' skills and experience, labour shortages, strained supply chains, and general cost and tender inflation.

2 See CRUX methodology, page 59

A high-risk, low margin contracting model that loads maximum risk on contractors amplifies these inherent dangers. Amid high uncertainty, the value of collaboration increases. It allows the parties to identify critical risks, apportion them more equitably, and lay the groundwork for more effective delivery.

The causes underlying claims and disputes on projects around the world are common but also influenced by regional and cultural factors. In our regional analysis, HKA consultants draw on their experience in the field, examine the challenges in their regions, and outline proactive responses.

Africa

Hit harder than most by the pandemic, the continent's recovering construction industry faces strong inflationary headwinds as well as a persistent pattern of causation underlying claims and disputes. Programmes in Africa are also susceptible to longer overruns than most other regions (extending to almost 83% of planned schedules, on average).

- Already endemic before COVID-19, restrictions on site access remained the leading cause of claims and disputes. This problem can be alleviated through better integration of the parties' operational practices and approvals for site-based working.

- Cashflow and payment problems persist because approvals procedures are overly bureaucratic and contract management teams are stretched.

- Project leaders need to promote transparency – from procurement through to claims management – by strengthening governance processes and contract administration in line with wider political moves to combat corruption. Often these processes are in place but not fully understood and complied with.

Americas

With project timelines and budgets already stretched, particularly in North America, acute skills shortages and rising labour and input costs increase the risk of overheating. Claimed costs already amount to more than a third (33.8%) of average project CAPEX in the region.

- Many of the dominant causes of claims and disputes – notably, change in scope, unforeseen physical conditions, and deficiencies in design or workmanship – arise from short-sighted attempts to save time and money up front.

- As rising costs squeeze margins further, more contractors are finding relief – from sympathetic arbitrators or, in some cases, owners choosing to settle otherwise unsupported claims.

- Projects in North America's congested pipeline will need to be carefully phased to avoid large hikes in construction inflation as the US embarks on an unprecedented investment programme.

Asia

The lingering effects of COVID-19 on labour and logistics have disrupted many contracts in Asia, which has a high concentration of megaprojects. Claimed time extensions would add almost two thirds (65%) to the typical schedule, while sums in dispute amount to 27.8% of CAPEX, on average – a heavy toll, though below the global average.

- Two of the main causes of claims and disputes – restrictions on access to sites and workfaces and late approvals – were largely attributable to the pandemic. Shocks continue to reverberate through supply chains from China.
- A contracting culture averse to conflict and claims is changing. The administration required by certain contract forms is flushing claims out earlier in projects. In time we expect a shift to more technical disputes.
- Action is urgently needed to minimise project risks through more rigorous pre-contract management, price adjustment clauses, and hedging on materials prices.

Europe

War in the region, energy insecurity and rapidly accelerating inflation are all adding to the already heavy cost of claims and disputes. At 38.3% of average CAPEX, the sums in dispute were higher than in other regions. Although rising interest rates may slow construction activity, investment in the world's second-biggest renewables market and adoption of digital technologies should accelerate.

- Many problems – including those revolving around design, contract interpretation, management of subcontractors and contract administration – can be avoided by doubling down on proven best contract management practices.
- Deficiencies in workmanship and lack of skills and experience loom even larger than in other regions. The industry must broaden its appeal to young talent, up the pace of modernisation, and embed new technologies to boost productivity.
- Greater clarity on the application of force majeure clauses is necessary, but loading responsibility for future pandemics on contractors would be a retrograde step for risk management.

Middle East

Projects overall faced longer overruns than any other region. The extra time claimed by contractors would, on average, add more than 80% to schedules. Also significant are the cost implications of disputes – claimed costs typically amount to 35.8% of CAPEX. Problems around design and structural anomalies in the construction and engineering industry underly the most dominant causes of claims and disputes.

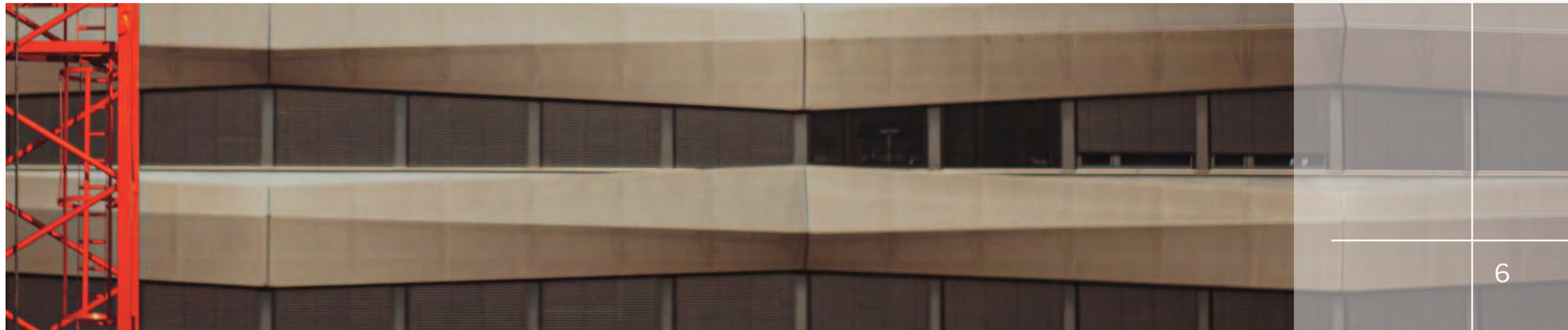
- Analysed over time, projects are distressed by the same top factors – change in scope and design information that is either late or incomplete. No other region shows such consistency.
- Late approvals and cashflow payments are common in the region, and spring from weaknesses in contract administration. While payment procedures tend to be strictly applied on contracts, other contractual deadlines are routinely missed.
- With markets overheating and a strong project pipeline in Gulf states, a re-balancing of risk allocation is long overdue. A more collaborative approach, including earlier involvement of contractors, would pre-empt many of the design and other conflicts arising on projects.

Oceania

Major projects are being delivered amid an unprecedented construction boom, acute skills shortages and supply chain disruption. Contentious costs typically totalled more than a quarter of a project's CAPEX (26.2%, on average), while contractors sought extensions of time equivalent to 63.8% of the planned schedule. The shift in workload in both Australia and New Zealand to more complex infrastructure projects is straining the industry's capabilities as well as capacity.

- Extreme weather events have restricted contractors' access to worksites, while spurious claims – another notably prevalent problem in the region – are often a mask for poor productivity and labour problems.
- The root cause of many conflicts – including disputes involving design and management of subcontractors and interfaces – lies upstream in the planning, development and procurement of projects.
- A more strategic approach is required: at project level, to setting objectives and engaging with the market; and at national level, to phasing the pipeline of state projects and accelerating deployment of modern construction techniques and technologies to promote productivity and sustainability.

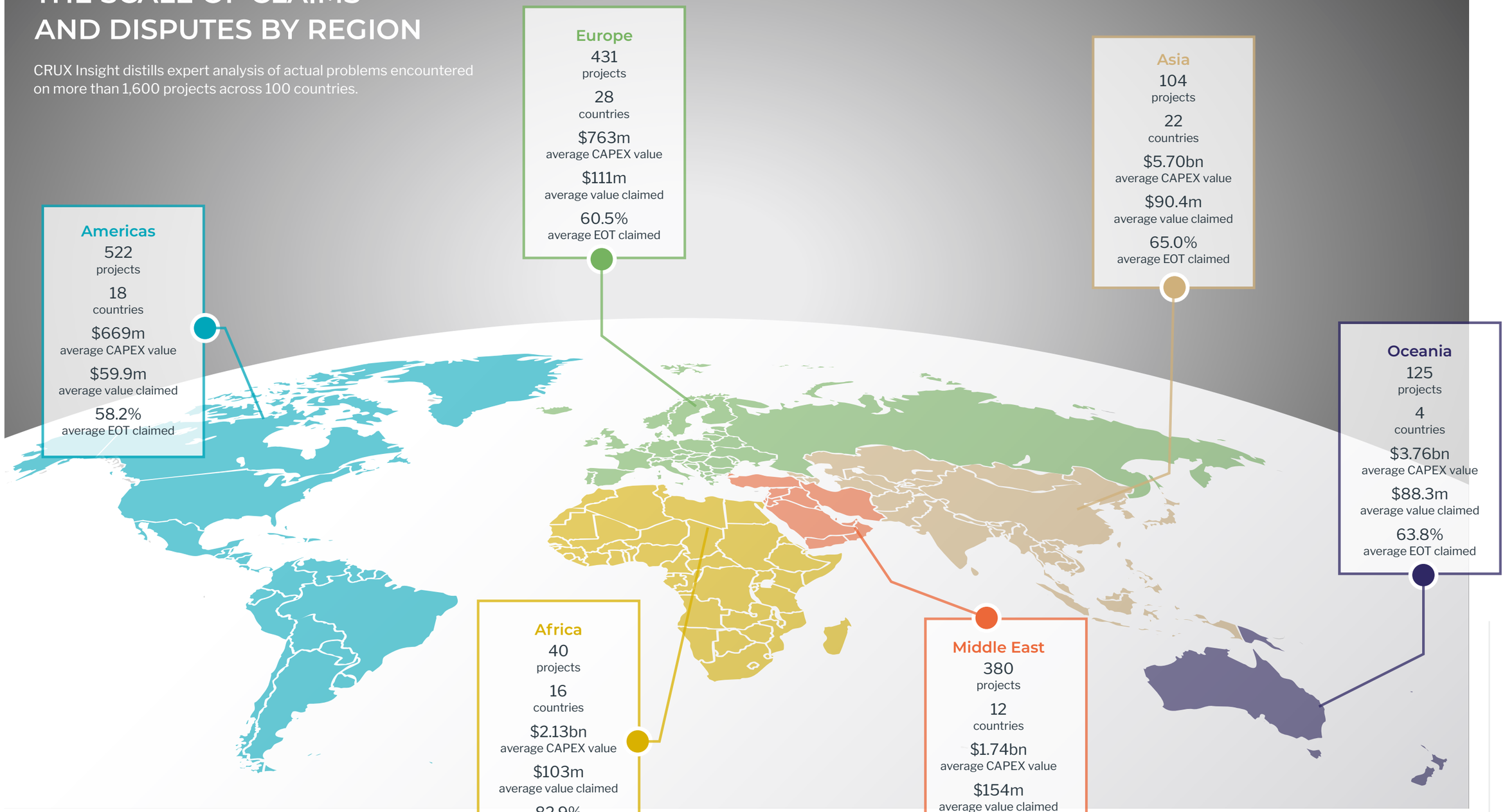
Toby Hunt
Partner, CRUX Sponsor



A WORLD VIEW

THE SCALE OF CLAIMS AND DISPUTES BY REGION

CRUX Insight distills expert analysis of actual problems encountered on more than 1,600 projects across 100 countries.



Americas
522
projects
18
countries
$669m
average CAPEX value
$59.9m
average value claimed
58.2%
average EOT claimed

Europe
431
projects
28
countries
$763m
average CAPEX value
$111m
average value claimed
60.5%
average EOT claimed

Asia
104
projects
22
countries
$5.70bn
average CAPEX value
$90.4m
average value claimed
65.0%
average EOT claimed

Oceania
125
projects
4
countries
$3.76bn
average CAPEX value
$88.3m
average value claimed
63.8%
average EOT claimed

Africa
40
projects
16
countries
$2.13bn
average CAPEX value
$103m
average value claimed
82.9%
average EOT claimed

Middle East
380
projects
12
countries
$1.74bn
average CAPEX value
$154m
average value claimed
83.1%
average EOT claimed

BATTLING THE HEADWINDS

When steering a project to succeed, the right course needs to factor in multiple risks related to complexity, prevailing market conditions and headwinds. As these gather force, navigating the uncertainties becomes an increasingly treacherous task.

Capital projects and the infrastructure sector are already experiencing impacts in time and money. Start dates are being pushed back as owners, contractors and their backers struggle to strike mutually acceptable terms. Where works are in progress, timescales and budgets are overrun as delays and costs pile up.

Here, we consider the headwinds buffeting the industry, and what lessons can be drawn from the CRUX data and HKA colleagues' first-hand experience as project partners seek strategies to weather them and build resilience.

The war's fallout is amplifying the background uncertainties and risks associated with general election cycles and energy insecurity, surging inflation, labour disputes and social unrest.

POLITICAL

Geopolitical turbulence is unleashing disruptive economic and social forces, across regions if not worldwide.

War in Ukraine is the most far-reaching. Beyond the loss and destruction of infrastructure, communities and lives, the conflict is impacting food, energy prices and supplies, and hence, projected global growth (see Economic and Social factors overleaf). Russia is a major supplier of oil, gas, steel, timber and other raw materials. Capital projects are being impacted by supply shortages as well as rocketing energy costs due to trade disruptions and sanctions.

In the political sphere, the war's fallout is amplifying the background uncertainties and risks associated with general election cycles and energy insecurity in Europe, surging inflation, labour disputes and social unrest.

The levers of government policy are in new hands in Germany, the UK and Australia. France faces a stalemate between presidency and parliament, with the prospect of a similar impasse following US mid-term elections, and polarisation too in Latin America's largest economy, Brazil. Meanwhile, in Europe, inflation is fuelling wage demands, threatening a rash of strikes in the UK, France, Netherlands and Italy, disrupting transport and other services.

Like China and India, states in the Middle East, Africa and other parts of Asia have maintained a pragmatic stance on the geopolitical standoff over Russia, but it cannot insulate them fully from the reverberations. Taiwan's status is another geopolitical flashpoint between China and the West and regional powers. Having fomented the toppling of Sri Lanka's government, price hikes for food and fuel are ratcheting up social tensions in other parts of Asia, Africa and the Middle East.

Coming in the long tail of the pandemic, this turbulence compounds the challenges facing policymakers seeking to balance conflicting priorities to support the vulnerable, combat inflation, contain financial risks and steer economic recovery.

Major capital projects and the infrastructure sector already have to navigate the perennial uncertainty arising from political factors – not least in relation to planning and funding.

Short election cycles (and the revolving door of premiers in major democracies) clash with long-term funding commitments essential for public sector projects. Accountability over the whole life of long project lifecycles may be lost amid this 'changing of the guard'. Changes in regulatory frameworks and policies impact designs, costs and delivery arrangements. Urgent and short-term challenges risk changing the promised funding priorities of incumbent administrations. Public agencies spend unused budgets for fear of losing allocations in the next funding cycle.

Decision-making is overly centralised in some countries. Where senior officials in central government – rather than at municipal level – continue to determine local projects and funding, community benefits may be reduced. Differing priorities among government departments can also detract from outcomes; for example, the treasury may focus on lowest cost, whereas transport or other agencies responsible for delivery seek to maximise transport outcomes. Programmes are often disrupted and prolonged, meanwhile, by the heavy burden of evidence required, which slows decision-making.

The already high political pressure to streamline the delivery and cost of public sector projects can only intensify in the face of these headwinds and faltering economic growth.

Major capital projects and the infrastructure sector already have to navigate the perennial uncertainty arising from political factors – not least in relation to planning and funding.

Managing political uncertainty

Political and industry leaders cannot dismiss acute bottlenecks in skills and the supply chain as a global force majeure, notwithstanding the effects of COVID-19, a blockage in the Suez Canal and war in Ukraine. The warning signs and pressures were evident in regional markets long before the pandemic and the subsequent rebound.

Navigating the increasing turbulence requires a change of mindset in both public and private sectors at industry, enterprise and project level. This should involve the creation of long-term pipelines of work focused on the delivery of outcomes and value, a re-balancing of risk allocation, more collaborative approaches to capital projects, a wider perspective of talent acquisition and development, and interventionist industrial strategies that resolve fundamental flaws that construction and engineering markets themselves cannot fix.

Government can be the catalyst in the technological space. Just as its federal funds bankrolled breakthrough technologies behind the iPhone, the US government helped accelerate the commercialisation of electric vehicles by investing in Tesla. From China to Europe, taxpayers' money is laying the groundwork for advances in nanotechnology, biotech and quantum computing in the global tech race to create and shape new markets. The vulnerability of extended supply chains and medical shortages amid the pandemic focused policymakers' attention on overlooked yet fundamental industries and the national business case for reshoring key manufacturing activities.

In construction, public procurement, funding pre-conditions and national standards are just some of the levers governments can use to force the pace of modernisation.

The industry is aware of the relationship between poor information management and waste, defects, sustainability challenges, and poor health and safety outcomes. By mandating use of building information modelling (BIM), the UK, United Arab Emirates and other governments are improving information management and driving the adoption of technology that has the potential to boost productivity, while addressing some of these other issues.

Clients and contractors are recognising the benefits of modular, off-site construction for quality, speed, productivity and sustainability. With state bodies' support, prefabrication can become the norm for social housing, schools, hospitals and other civic infrastructure. In the Australian state of New South Wales, the government aims to develop a sustainable market in modern methods of construction (MMC).[3] It is sponsoring the design and production of the 'kit of parts' to be used for new schools across the state. Such investment stands to reap economic returns, while addressing other challenges facing the industry.

Dubai aims to boost productivity, while restructuring its economy and labour markets, by becoming the world's 3D printing hub. Municipal regulations require minimum printed content for new buildings, rising to at least 25% by 2025.[4]

As well as promoting sustainable construction, state agencies can champion collaborative approaches to capital project procurement and delivery. In another Australian example, Sydney Water engaged with the market to devise a long-term partnership balancing value for money with continuity of returns to contractors. This approach, now rippling out into the wider water industry, was also essential to secure a supplier base amid a construction boom.

Focus on infrastructure

Investing in infrastructure as a stimulus for economies emerging from the pandemic – or facing a global economic downturn – boosts the construction industry. But it can compound some of these political challenges, cause markets to overheat, and provide sub-optimal economic returns.

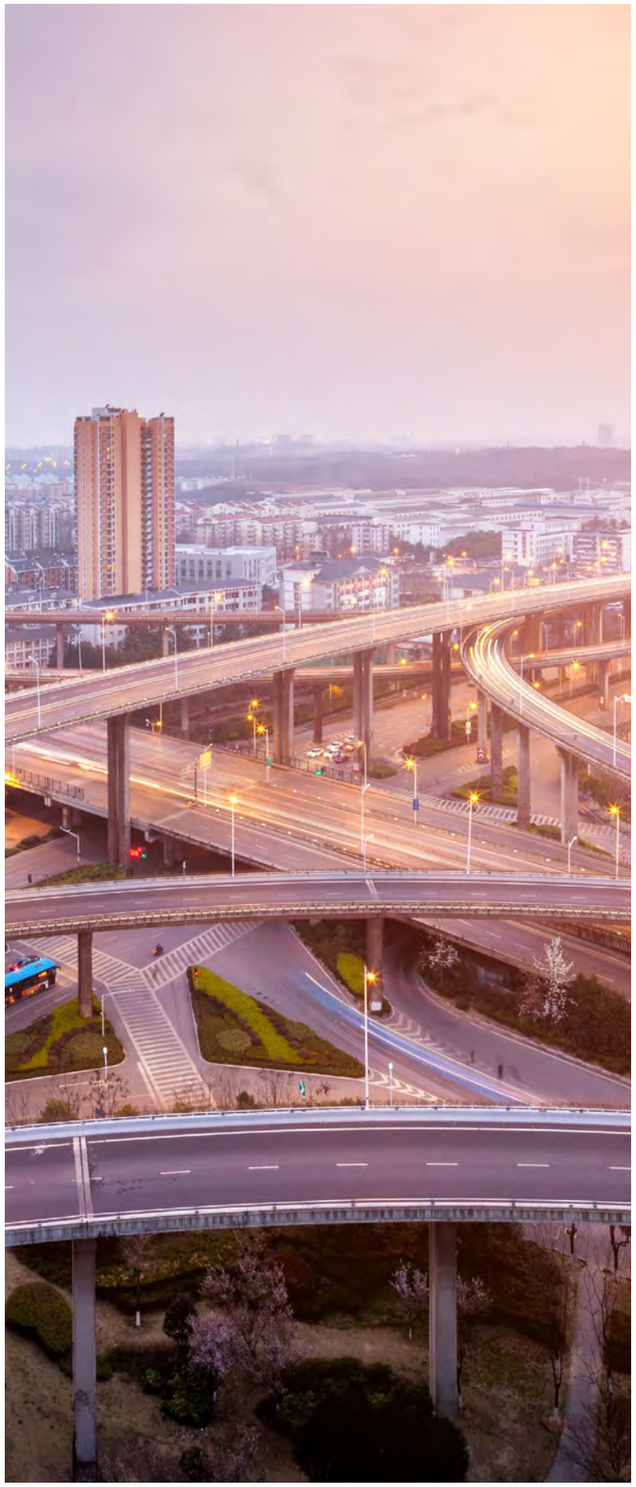
3 https://www.schoolinfrastructure.nsw.gov.au/what-we-do/we-build-schools/modern-construction-methods.html
4 https://3dprinting.com/construction/a-closer-look-at-construction-printing-in-dubai

Projects on the shelf deemed 'shovel-ready' may not represent the best value for money or the highest national or regional priority. Following the devastating Christchurch earthquake in 2011, New Zealand's recovery plans succeeded in funnelling investment efficiently into the city's regeneration. In other countries, where the construction and engineering market lacks capacity or capability, funds designed to boost economic recovery from the pandemic are not being spent so wisely.

Short-termism in politics, as in equity markets, is the enemy of strategic planning. In the public sector, certain countries are addressing this by de-politicising their capital projects pipeline. Development masterplans with broad party-political and public support give industry the confidence to make long-term investment decisions. They also help avoid 'pork barrel' distortions in expenditure to favour local or special interests.

National infrastructure strategy requires parliamentary approval in Denmark, for example. Australia, Canada, South Africa and the UK have infrastructure advisory bodies designed to be independent of government.

Pipeline visibility can help focus the attention of government and industry on joint strategies to gear up market capacity and strengthen weak links in the supply chain. Changes may be required in national and regional policies for education and training, funding criteria and land use planning, immigration control and bi-lateral trade agreements. For their part, contractors and the supply chain can commit to apprenticeships, local recruitment, and sharing knowledge and innovation. As well as building capacity, megaprojects also provide an opportunity to generate wider economic and societal benefits, by regenerating deprived areas and tackling



social exclusion and unemployment through training (see Social) – as well as spurring innovation and developing exportable expertise.

The case for change

Construction and engineering capability is not only critical to a nation's infrastructure. The industry also accounts for a significant share of economic activity and wealth, not to mention associated carbon emissions, natural resource depletion and land use. Low productivity, resistance to innovation, and dysfunctional performance resulting in significant financial loss are vexed problems that merit high political priority, and action.

The industry itself recognises the need for change. Many positive steps are being taken. The UK government's Construction Playbook for public works,[5] The Institution of Civil Engineers' industry-leading Project 13,[6] and Infrastructure Australia's Delivering Outcomes[7] all point to a movement away from the broken transactional model for delivering infrastructure programmes to a more efficient enterprise approach and resilient future. In the traditionally adversarial mining market in Australia, companies are taking a more collaborative line (as do the water utilities, also prompted by a market supply predicament). Similar interest is growing in Saudi Arabia and other regions.

But progress so far has been grindingly slow; more needs to be done. These credible strategies need to be converted into practical action. Economic pressures and other headwinds should propel political and industry leaders to heed the emerging consensus on long-overdue strategies for systemic change and lead their implementation.

5 https://www.gov.uk/government/publications/the-construction-playbook
6 https://www.project13.info
7 https://www.infrastructureaustralia.gov.au/publications/delivering-outcomes

ECONOMIC

Considering these geopolitical and other forces, economic growth forecasts have been downgraded for most regions. The UK, Euro Zone, US and China are set for steep reductions in economic output (see table).

Impacts on economic growth

GDP % growth by economy	2021	2022	2023
US	5.7	2.3	1.0
Latin America & The Caribbean	6.9	3.0	2.0
China	8.1	3.3	4.6
Euro Area	5.4	2.6	1.2
Middle East & Central Asia	5.8	4.8	3.5
Emerging & Developing Asia	7.3	4.6	5.0
Sub-Saharan Africa	4.6	3.8	4.0
UK	7.4	3.2	0.5

Source: International Monetary Fund – World Economic Outlook update July 2022

Inflation is supplanting geopolitical stability as the greatest economic concern in most regions, pressurising central banks from the Americas to Asia to increase interest rates. The end of an era of cheap funding and rising construction costs – fuelled by soaring energy and materials prices – may curtail investment in capital projects, even in more economically robust regions. Tender costs have increased in Asia and risk overheating Gulf states amid strong economic growth and construction activity.

Supply chain disruption and shortages of critical materials were already stoking commodity price inflation as business activity picked up after the peak of the pandemic. Notably, iron ore and copper command a premium in North America and Europe, while the costs of steel, nickel, aluminium and semiconductors have also risen.

The continuing shortage of shipping containers pushed up transportation costs before the war-inflicted spike in oil and energy prices hit logistics and production costs even harder.

Tighter budgets result in increased pressure on cost and quality control, putting additional strain on already stretched supply chains and squeezed margins. As suppliers pass on rising costs, the risk of insolvencies rises, especially in Europe and the Americas where contractors' profits have been hit hardest.

Whilst uncertainty has not choked off funding, investors are more selective and averse to backing projects now facing heightened risk.

Economic war with Russia, and trade tensions between China and the West, are raising these risks, not only in terms of funding, cost inflation and supply chain disruption. Cybersecurity is another growing concern (see Technology). Construction companies and major projects have joined the long list of potential targets for criminal gangs and/or state-sponsored cyber attackers – along with utilities and energy, defence, healthcare and high-tech R&D.

Managing uncertainty in the supply chain

As geopolitical forces change the context in which projects are sponsored and delivered, risk-sharing must be reconsidered and re-balanced. Every contract is an allocation of risk, whether or not the parties desire or fully realise it.

Both owners and the supply chain need to recognise that there are recurrent drivers of disputes and claims that impact the delivery of capital projects worldwide before construction starts, during construction and after construction is complete. Both sides have a role to play in addressing these issues, at the relevant project stage, as shown overleaf.

Cause of claim or dispute*	Before Construction	During Construction	After Construction
Contract interpretation issues	X		
Contract management and/or administration failure	X		
Design information was issued late	X		
Access to site/workface was restricted and/or late		X	
Physical conditions were unforeseen		X	
Workmanship deficiencies		X	X
Operational performance			X
Installation failure			X

*Top three factors at each stage excluding change in scope

On the client side, capabilities and strategies need to be more intelligent and mature to secure better performance and outcomes downstream. An intelligent client seeks to understand the capacity and capability of the supply chain before determining its procurement and delivery model and bringing a project to market.

Risks should be shared and allocated to the parties best placed to manage them. Adopting from the outset the view that contractors and the supply chain need to make a profit discourages a claim culture and should reduce the time and money lost to disputes, and overall project cost. Having a 'playbook' and following it, ensuring a common information framework (for work breakdown structures and benchmarking), employing a 'should cost' model, and requiring each party to own their data are all ingredients that can only increase the likelihood of successful project outcomes.

This implies systemic change, and there are positive signs of movement by project owners, though tentative and often reluctant, towards greater collaboration and more balanced risk allocation.

Contractors, in turn, need to respond creatively and encourage this shift by resisting unreasonable risk transfer. They can work with end clients to better understand project visibility, investment requirements and desired outcomes. Amid the unprecedented pressures they face, the onus on tracking productivity closely must increase.

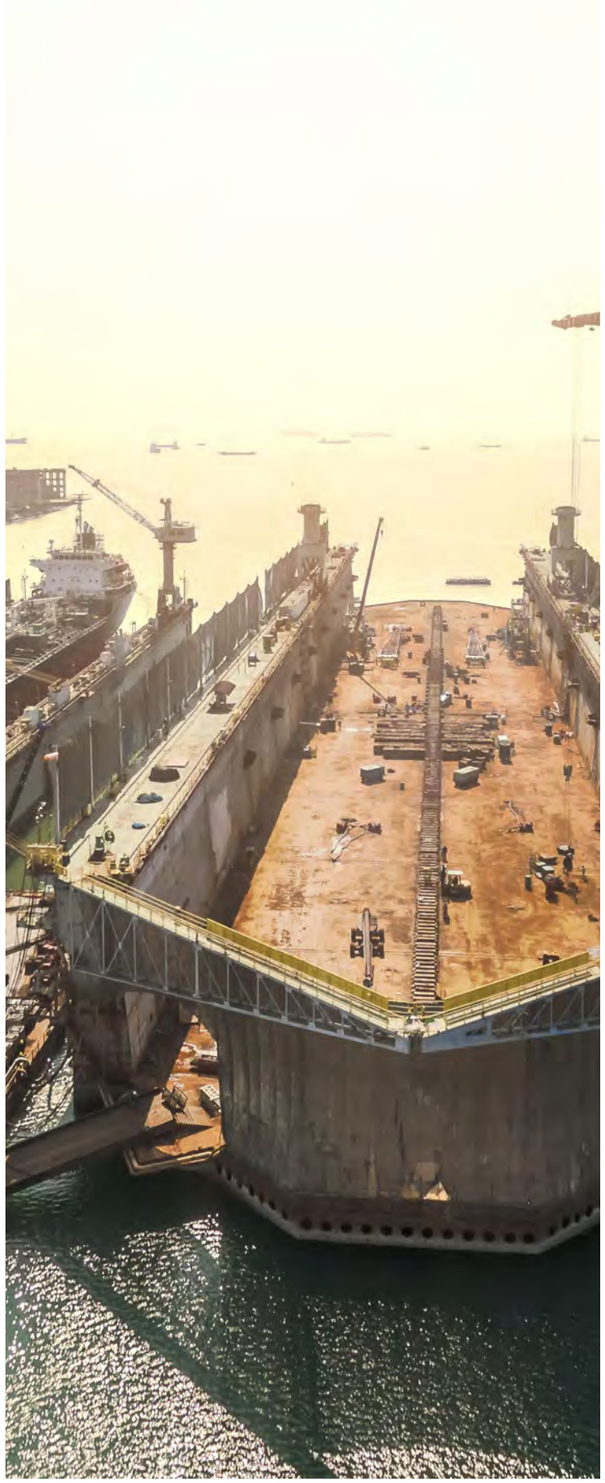
Focus on shipbuilding

The supply chain is festooned with risks – from sharp rises in costs (affecting materials, equipment and labour) and in shipping fees, to shortages in both labour and materials, which in turn lead to increases in delivery timetables. There is limited scope for mitigation.

Fluctuations in oil and gas prices are feeding cost inflation across the board, but they are a particular concern for energy-intensive industries, like shipbuilding.

The impacts on existing contracts are being widely felt. Some shipyards in the Far East, for example, will be unable to successfully deliver vessels to the timeline and fixed prices often agreed pre-pandemic. This risks unbearably heavy losses for the shipyards, often leading to complex arbitrations.

To complement hedging and cost escalation clauses, a longer-term perspective is needed. This can be achieved by fostering strategic relationships between owners and contractors.



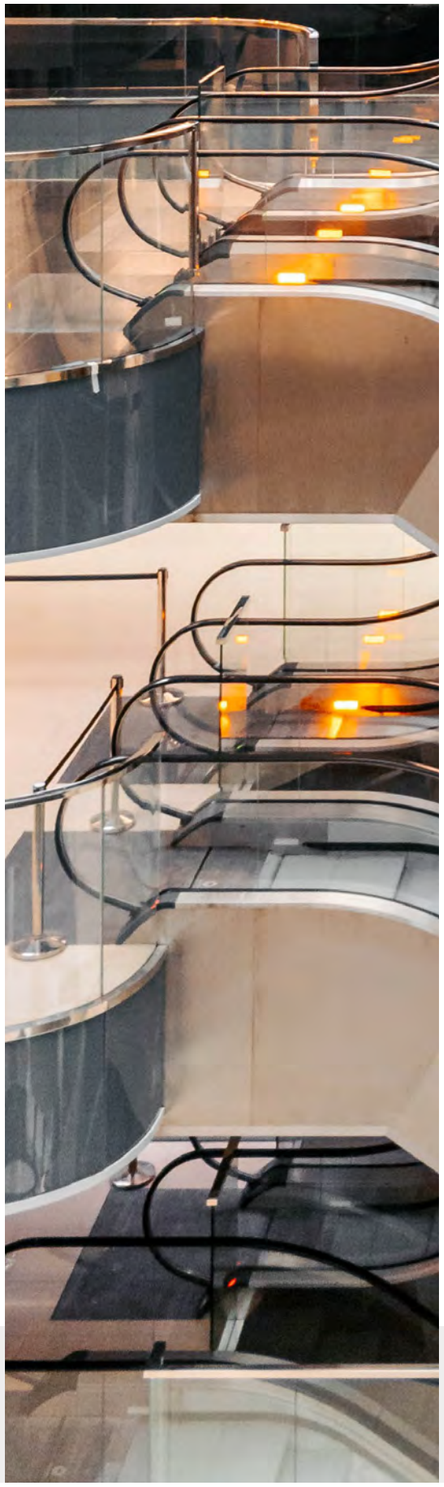
Other shipyards are two years behind schedule on the construction of projects such as drill ships and FPSO (floating production, storage and offloading) platforms bound for African oil and gas fields. While many delays were caused by COVID-related shutdowns, acute shortages and increased labour costs are compounding these projects' distress.

Losses arising from delays can sink a project, while also threatening the viability of shipyards, if not clients. Changes in international maritime regulations that overtake delayed projects risk rendering a vessel's design non-compliant before it is ready to be launched, leaving it potentially with no value except scrap.

Even where a degree of price certainty is achievable on some elements – such as Chinese steel for a ship's hull – the cost of equipment such as engines, turbines and pumps from European or American manufacturers could be subject to significant change, making take these price inflation risks prohibitive for shipbuilders.

To complement hedging and cost escalation clauses, a longer-term perspective is needed. This can be achieved by fostering strategic relationships between owners and contractors. For FPSO assets on a 25-year charter, for example, the up-front capital cost of construction is a relatively small proportion of the overall costs, as revenue streams and operating expenditure occur over the asset's lifespan. Short-term survival of contractors is in the interest of owners, so a partnership approach can be to the mutual advantage of parties delivering a project.

Ongoing business relationships might take a new form of the strategic alliancing seen in the development of North Sea oil and gas fields in the 1970s, full-blown joint ventures, or contractors taking minority equity stakes in major capital projects.



Wider changes to come?

Despite the resurgence of cost inflation and other supply chain disruptions, we have so far observed only limited use of hedging, which should now be standard practice across all capital and infrastructure projects.

Contractors more widely are recognising the need for cost escalation clauses to limit their risk exposure. However, a new generation of lawyers is having to learn how to draft and manage these terms, which have not been included in most contracts for decades.

Exercising more caution, contractors have also begun to fight shy of fixed-price, lump-sum contracts. Where they accede to insistent clients, prudent bidders must price in significant contingencies. Forcing owners to negotiate may be a sea change, but both sides need to take a long-term view. In the present climate, onerous conditions will lead to bankruptcy. A more cautious tendering strategy can help secure survival, even if on reduced volumes, especially when demand remains buoyant in many markets.

Attitudes towards owners are hardening as the supply chain becomes more averse to risk. As some suppliers fold, survivors' resilience is underpinned by the relatively high barrier to new entrants. Consolidation in the market will reduce competition, and increase contractors' leverage, adding further upward pressures to costs and, potentially, friction. Technological capabilities also bolster the supply chain's bargaining position. Larger, privately owned contractors and suppliers, who are not subject to the short-term expectations of shareholders, may be at an advantage too.

In distressed projects, the same longer-term, big-picture perspective would help opposing parties plot a way to more mutually acceptable outcomes. Commissioning an independent appraisal of claims and disputes promptly when they arise can defuse conflict before the programme is blown off course. Where the standoff seems intractable, both sides can limit their risks and losses by setting aside their differences and committing to complete the project first, and then settle the outstanding matters afterward.

SOCIAL

Managing the uncertainty of COVID & skills shortages

The threat to life, livelihoods and business activity from COVID-19 may have eased. However, with the relaxation of track and trace monitoring in most countries comes greater risk of further spikes in infection levels, and increased hospital admissions in certain countries. China's zero-tolerance policy could again disrupt supplies of critical goods, while the danger remains that more virulent strains may emerge to debilitate national economies further.

Steep increases in the costs of fuel and food are stirring public protest across Africa and beyond. Civil turmoil is a risk to the global as well as national economies, including less affluent countries in the Middle East and Asia that are unable to cushion the impact on citizens.[8] Even in advanced countries, the lockdown-related protests seen amid the pandemic may morph into a backlash against falling living standards and rising inequality.[9]

Skills shortages are endemic across the capital projects and infrastructure sector in many markets, and most severe in Europe, North America, the Middle East and Australia. Recruitment of both domestic and foreign workers has become more difficult in the US and Canada. The COVID-enforced departure of many migrants compounds the Gulf Cooperation Council states' continued reliance on skilled and manual workers from abroad.

The skills pipeline is broken, leaking talent to more attractive industries that offer higher remuneration, a better work/life balance, greater prestige or less arduous working conditions. Skills development varies widely at national, industry and corporate level.

In some regions, lack of clarity over the pipeline of projects curbs the necessary commitment to develop new talent. Even where there is intent to invest in the next generation, current shortages and a lack of succession planning will continue to impact capacity, especially given the long lead time for developing professional and technical capabilities.

Focus on COVID

The pandemic's ramifications for major projects varied widely between countries and regions. With exceptions, most developed economies bounced back rapidly, even where the construction industry shut down for periods. Nevertheless, claims and disputes over project delays, if not cost overruns, almost invariably have a COVID dimension, demonstrating the industry's heavy reliance on global supply chains.

Asian states were more effective in containing the spread and associated disruption of the coronavirus. However, China's policy of zero tolerance has heavily impacted contracts and its ramifications continue to reverberate through global supply chains. The Shanghai shutdowns in early summer 2022 are a case in point. Entire workforces who travelled back to towns and villages for Chinese New Year didn't return as quarantine restrictions were introduced. Even equipment had to be quarantined for two weeks.

Asian economies are also, with some exceptions, managing to limit inflation in food and fuel costs. The costs of materials, equipment and labour are rising, but so far projects are being impacted more by logistical disruptions in the supply chain.

Across all jurisdictions, how force majeure and change in law clauses in contracts are interpreted and redefined will be an ongoing focus of attention and contention in coming months (see Legal).

Focus on skills

Shortages in project-critical skills are a common challenge facing all regions – especially, countries with more developed economies.

8 https://www.middleeasteye.net/news/cost-living-crisis-middle-east-likely-further-repression
9 https://blogs.imf.org/2022/05/20/social-unrest-is-rising-adding-to-risks-for-global-economy

The underlying causes are complex, longstanding and mainly revolve around ageing workforces and difficulties in attracting, developing and retaining young talent. Measures to plug the gaps are required across a broad front (see Political, Technological, Environmental) and most will only prove effective over the longer term. The level of skills and experience available to project teams will remain a high-ranking factor in claims and disputes for the foreseeable future.

As with many of the industry's ills, the solution needs to be systemic if it is to attract younger generations. Construction has a fundamental image problem – evoking mud-caked boots, a dirty environment (think polluting oil and gas, as well as noise and dust), and macho culture.

Outreach work in schools shows young minds that engineering is constructive and inspiring, and essential to meet society's needs for housing, infrastructure, transport and clean energy too. Construction companies collaborating in campaigns to inspire young people's interest in the STEM subjects (science, technology, engineering and mathematics) also help to feed a pipeline of future talent.

Present leakages must also be stemmed. Too many graduates in engineering and other industry disciplines (which include growing proportions of women) are attracted to other industries, from high technology to finance. Re-positioning construction and engineering as key components of the solution to the world's net zero challenge, rather than part of the problem, can raise its profile and appeal. Not only the industry's image needs a makeover if it is to be perceived to offer fulfilling careers. Pay and perks, training and development, mentoring, unconscious bias, succession planning, and corporate culture all have to be addressed.

An obvious priority is investing more in apprenticeships across the board – both blue- and white-collar – from trades and administration roles to data analysis and cybersecurity through to other technical specialists. Degree-level apprenticeships are a further opportunity to talent-spot employees for re-training and career advancement. A more strategic approach to apprenticeship training is possible on long-running megaprojects where state agencies, contractors and the supply chain co-invest in capacity building and local communities' untapped talent pools of unemployed and socially excluded (see Political).

In construction, one half of humanity's resource is severely under-represented at all levels in most countries. Some societies are more gender equal, but our industry tends to be among the most unbalanced.

At least some major contractors are following the example of international engineering consultancies and employers in other sectors by setting diversity targets for gender (in professional roles) as well as ethnicity. This goes beyond image and reputation; a growing body of international research shows a positive correlation between gender balance and profitability,[10] innovation and risk management[11] in businesses generally. This applies particularly at management level, where women are becoming more visible.

However, only 3-8% of construction's blue-collar workforce in most countries is female. In countries such as the US, women are more willing to put themselves in a war zone by joining the armed forces than step onto a building site.

In Chile – ranked 70th out of 156 countries on the World Economic Forum's gender equality index[12] – the Spanish infrastructure and renewable energy conglomerate Acciona made a point of constructing an extension to a hospital near Valparaiso with a wholly female workforce.[13] Historically, greater construction feats have been achieved by women workers in various countries, mostly in wartime. Ensuring construction sites and work practices are gender-neutral would help combat labour shortages and an ageing workforce.

10 https://www.mckinsey.com/business-functions/organization/our-insights/delivering-through-diversity

11 https://www2.deloitte.com/content/dam/insights/us/articles/4209_Diversity-and-inclusion-revolution/DI_Diversity-and-inclusion-revolution.pdf

12 World Economic Forum – Global Gender Gap Report 2021

13 https://experience.acciona.com/social/building-built-entirely-women/?_adin=11551547647

Measures to make the industry more welcoming to women – and conducive to work/life balance – also appeal to men. Examples include parental leave, flexible hours, remote working (for white-collar staff), and a four-day week (which some contractors have already successfully trialled in the UK).

Other developments can reduce the number of bodies needed on site. Innovations and technologies already available and scalable include factory-based modular construction, digital modelling, drones and robotics. These ways of working also involve roles suitable to a wider cross-section of skilled recruits, including women.

Focus on Asia

Developed countries in Asia face similar shortages but some different circumstances.

Both professionals and operatives have been leaving the region for better pay and conditions. This is at least partly because local employers are reluctant to meet higher wage expectations. Subcontractors are forced to recruit inexperienced labour and provide training; in the case of security and other site services providers this included retirees from other industries.

Another impact at project level is the loss of continuity and first-hand knowledge. As well as contributing to claims and disputes, this hinders investigation of the facts.

Many aspiring construction professionals choose to study at universities in North America and the UK, and go on to work there, at least in the early stages of their careers. Colleges report a drop in the number of entrants to construction-relevant courses in the last couple of years.

Asian contractors can learn from the region's consultancies and their counterparts in other regions by building relationships with universities and directly targeting undergraduates. Early, hands-on experience in project delivery also makes for a more rounded skillset should they go on to consultancy.

Part of the skills and experience gap may also arise from new ways of working. The shift to remote working during the pandemic has reinforced the silo effect, curtailing cross-disciplinary contact and communications. (This is also proving detrimental to mental health, which remains more of a taboo topic in Asia than some other regions.) Less experienced professionals who are predominantly office- or home-based are also missing out on insights into the practical realities of construction and engineering that can only be gleaned on site.

Tighter limits on expatriate workers are having the intended effect of encouraging local contractors and consultants to invest more in developing their own people. More lax restrictions on senior roles are conducive to introducing knowledge from other regions.

The region's fast-developing economies are leveraging this approach. Vietnam and Cambodia have large pools of young skilled and unskilled people. Working on projects awarded to Chinese, Japanese and other foreign contractors, they benefit from practical experience and upskilling, which means that local companies are increasingly well-placed to compete for projects in their own right.

TECHNOLOGY

As more advanced technologies and materials are incorporated into projects, the capabilities of built assets from buildings to transport systems, power plants to factories, are increasing. So too is the complexity of the construction and engineering process.

A particular challenge, often underestimated, is the integration of new and legacy systems. Significant expense and time are needed up front to ensure seamless operation. Development timescales often prove insufficient.

Similarly, the systems and technologies used by teams delivering projects also present challenges and opportunities. Effective training of the workforce is required to maximise this potential.

From digital modelling, digital twins and BIM to data analytics and AI applications, and drone surveys to LIDAR remote measurement by laser – technologies can help project teams manage complexity and work smarter. While much of the supporting software is developed in the US, the Middle East has digitised its public infrastructure records more comprehensively. Seizing the opportunity of its rapid development, the region has successfully adopted BIM on a wide scale. In Europe, digitalisation in the construction and engineering industry is increasing, while the EU develops policies and initiatives to accelerate adoption.

As firms embark on digitalisation programmes, the first priority should be to identify solutions that improve workflows and processes, while keeping more systemic transformation in view.

Projects, companies and countries that fail to exploit the advances being made across an array of new and converging technologies risk foregoing opportunities to boost productivity and sustainability. However, adopting Internet of Things (IoT) technologies for monitoring activity, for example, not only increases a company's digital footprint, but also the potential attack surface for hackers. New and emerging technologies – such as containerisation within digitalisation, machine learning, and smart contracts – introduce different types of cyber risk.

Unfortunately, cybercriminals are showing greater sophistication in their methods and targeting. In the past, financial institutions, consumer brands and healthcare services offered more lucrative returns in cash and personal data. The construction and engineering industry is now seen as an easier target, given cyber defences are not as mature. Companies have fallen prey to ransomware, compromised business email, data breaches, and supply chain attacks – a significant risk on larger, complex projects with multiple parties and interfaces.

Cybercrime is rising up the corporate agenda, yet both the risk and impact of cybercrime are under-estimated, due to poor detection and limited reporting.

Managing technological risk

Focus on digitalisation

As construction businesses seek to cut costs amid a global economic downturn or national recession, the value added by digital transformation will be closely scrutinised. That evaluation should take full account of the costs of poor information management.

The toll is obvious on live projects. An estimated 13% of a construction team's working hours are spent searching for project information.[14] When it comes to claims and disputes, missing records can compromise loss recovery or a defence. By project closeout, typically 30% of the initial data created during the design and construction phases is lost.[15]

14 https://a.storyblok.com/f/64835/x/137c281eda/harnessing_the_data_advantage_in_construction.pdf

15 https://www.emerson.com/documents/automation/operational-readiness-bringing-gap-between-construction-operations-for-new-capital-assets-en-68086.pdf

If internal staff cannot find essential evidence, what chance for third-party legal representatives?

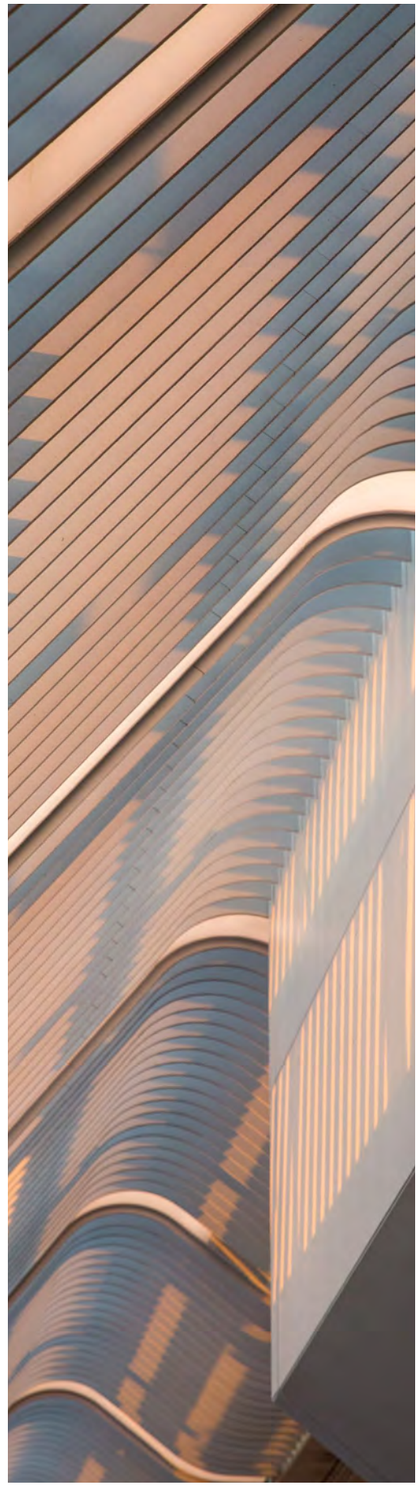
Therefore, a Common Data Environment (CDE) is essential for the collation of all pertinent project data. The ultimate purpose of a CDE is to manage and mitigate project risk; it helps store, share, and manage project data effectively; and it is this data that becomes the essential evidence in future disputes. Implemented well, CDEs boost productivity and collaboration, as all users spend less time searching and coordinating project information. All project records are stored in a single platform and can be retrieved easily as the documents are usually uploaded with the required metadata that makes them searchable for an outside third party. A 2021 construction and infrastructure sector study found that every £1 invested in information management generated £5.10 - £6.00 in direct productivity gains.[16] To manage information effectively, CDEs should also be used in conjunction with a BIM system.

If organisations are to mitigate the risks of poorly managed data and reap the full benefits of digital transformation, they need to adopt BIM from the outset of design. But they must also foster a culture that welcomes change and embraces technology. Return on investment in a competent BIM team will be maximised if all the project team members understand the modelling process and how it helps manage information.

16 https://assets.kpmg/content/dam/kpmg/uk/pdf/2021/06/cdbb-econ-value-of-im-kpmg-atkins-main-report-new.pdf

Safety documentation

In the UK, the Building Safety Act 2022 introduced new obligations concerning the collation of safety documents – the so called 'golden thread' of information. They will apply to those commissioning work or involved in the design or construction phase, and to the 'accountable person'. The rule is designed to ensure all important documents on the safety of a building and its residents are in one place. These will need to be captured digitally and maintained for the lifecycle of the building.



While some governments mandate the use of BIM, standardisation of how data is generated and classified, secured and exchanged is lacking. Public sector bodies in the UK, for example are merely advised that they 'should' adopt the UK BIM Framework and follow guidance with respect to ISO 19650. They are advised to 'comply or explain', but the penalties for ignoring this guidance are not evident.

Private owners should consider the business case for making digital modelling mandatory on their projects, and consider drafting contractual penalties to ensure project teams follow guidance on best practice.

Digital transformation in the industry varies widely in breadth and depth – from bespoke Electronic Discovery Reference Model (EDRM) platforms that search, review and present information, to technologies underpinning Design for Manufacturing and Assembly (DFMA). Here, the potential benefits in time and cost are significant, but the usual pitfalls apply. For instance, special attention is required to facilitate the movement of pre-formed bathroom pods to and on site. We have also seen incorrect designs, including where an on-site change was not communicated to the off-site manufacturer, leaving the design unfit for purpose without significant modification.

Projects, companies and countries that fail to exploit the advances being made across an array of new and converging technologies risk foregoing opportunities to boost productivity and sustainability.

Focus on cybersecurity

Governments have begun introducing regulatory frameworks to improve cyber resilience and, for their part, business leaders are recognising the operational risks posed by potential breaches in cybersecurity.

Although cybersecurity spend is increasing year-on-year, it is increasingly difficult for in-house cyber teams to navigate the fast-changing threat landscape.

To help organisations better manage these risks, regulators need to specify sector-specific job descriptions, if not require designated professionals in those roles. A common threat and risk framework would raise threat intelligence, promote knowledge sharing, and lead to greater vigilance and detection.

US legislation stimulating infrastructure and green technology investment now mandates cybersecurity standards that were previously voluntary. Projects receiving federal funds must have a mature cybersecurity programme in place for their entire lifecycle.

Although cybersecurity spend is increasing year-on-year, it is increasingly difficult for in-house cyber teams to navigate the fast-changing threat landscape. As in other fields, more high-quality, regulator-certified apprenticeship schemes would help meet the projected 13% annual growth in demand for cybersecurity professionals.

Organisations need to be clear about the various risks they face – when using cloud services, emerging technologies or in-house systems – and build a robust business case for investment. A thorough risk assessment should identify the areas that yield maximum risk reduction and provide a remediation plan to equip the business to anticipate, detect and respond to incidents.

Industry view

Unlocking digital demand

Despite the historic challenge of dispute management across the global construction sector (currently valued at $10 trillion), this remains a profitable environment for many. But who are the real beneficiaries of such an intrinsically contentious process? Can the evolution of disruptive technology – including data-driven, BIM-enabled workflows and potentially, digital twins – be a key part of a sustainable global solution?

In the context of achieving better project outcomes and 'battling the headwinds', there exists a clear and defining role for disruptive technology, a concept that some of us have explored since the 1990s. An information management framework – working seamlessly with an eco-system of CDEs (common data environments) – can and will go some way to mitigate the most critical and fragile elements of any construction project, the sector's wider supply chain, and material logistics.

At a global level, CRUX Insight distils dispute causation down to three key areas: change in the scope of works, design conflicts, and contract interpretation issues. The wider challenge of global teams operating in a high-risk, low-margin environment, can only lend itself to greater deployment of technology – thus facilitating an environment that will mandate and unlock the demand for digital skills.

Bola Abisogun OBE FRICS

Founder & Chairman, DiverseCity Surveyors

Digital Director, BIM Academy and Chairman, (IAB) London South Bank University

LEGAL

As anticipated in last year's CRUX Insight report, our consultants in the field are dealing with more force majeure and 'change in law' events, and their consequences.

Notably in the US, Asia and the Middle East, contractors have sought to recover additional costs, sometimes also invoking price escalation or 'cost adjustment' clauses. As more owners successfully push back against claims that events triggered by the pandemic were 'unforeseen', contracting parties are exploring other legal options to address the uncertainties causes by international trade sanctions and supply chain disruption.

Disputes have increased in number and impact as a result of these tensions. The costs of financing mounts as projects are delayed. Certainty about delivery timetables and confirmed costs are also common casualties when these clauses are invoked in response to exceptional events such as coronavirus clampdowns or severe storm disruption.

There are positive signs that mediation and alternative dispute resolution avenues are becoming more popular in various jurisdictions. In a tighter financial environment, cost-effective options have greater appeal than litigation and arbitration.

Recent legislation heralds significant changes in several countries. Regulation of fire safety has been beefed up in the UK, and developers, designers, contractors and construction product manufacturers face increased liability for defects. Prompt payment rules will be applied more widely in Canada. Employers in the Middle East must adjust to labour mobility following full or partial dismantling of the restrictive Kafala framework by Gulf Cooperation Council countries.

Managing legal uncertainty

In an era of heightened uncertainty – not least around material costs and supply chain logistics – risk allocation assumes even greater importance on each project. The form of contract and amendments must be subject to rigorous review by legal and cost estimating teams. Contractors should be acutely aware of the need to include price adjustments and/or cost indices to reflect actual increases in market rates for materials, their transportation – due to the spike in shipping fees, as well as higher fuel costs – and labour.

Current volatility in the global economy may be a sufficient catalyst for employers in jurisdictions where Engineer, Procure and Construct (EPC) contracting is the norm to embrace a more collaborative approach to construction project delivery. This could deliver significant benefits in risk management, particularly for supply chain disruption and price escalation.

The refined terms on change of law and force majeure increasingly favoured by employers also deserve special scrutiny. Contracting parties must ensure that they strike a fair balance, given the probability of fresh outbreaks of coronaviruses and extreme weather events.

It is important to consider the post-COVID landscape when drafting relevant contract provisions, both in terms of lessons learned (what did and didn't work) and whether a further outbreak would fall within the contractual definition of a force majeure clause. Typically, this will only cover unforeseeable events and, on this basis, future COVID events may be excluded.

Some questions which need to be considered include: Whether future pandemics should be explicitly included within the scope of force majeure? Can changes in law give rise to a contractual force majeure event? Whether government guidance, regulations, and circulars, which have a material impact, also qualify?

Should new COVID events be included or treated entirely separately from the force majeure regime? Also, a separate clause could allow entitlement to a claim not just for time, but also compensation in certain circumstances.

Ultimately, it is in the interests of the project and all involved to achieve the most appropriate allocation of risks so they can be managed by the parties best placed to do so. As has always been the case, proper risk allocation helps avoid claims and disputes. Contracts should also identify the contractual mechanisms that can be used jointly by the employer and contractor to resolve conflicts and avoid disputes.

Before agreements are struck, rigorous contract challenge sessions are more important than ever for contractors to test scenarios that may emerge during delivery. The results can provide a strong rationale for changes to terms or a robust basis for establishing appropriate risk contingencies. Furthermore, stress-testing the contract before it goes live gives both parties the opportunity to understand how key provisions may work in practice and either amend terms or put in place working practices to support compliance with the contract and optimise delivery of the project.

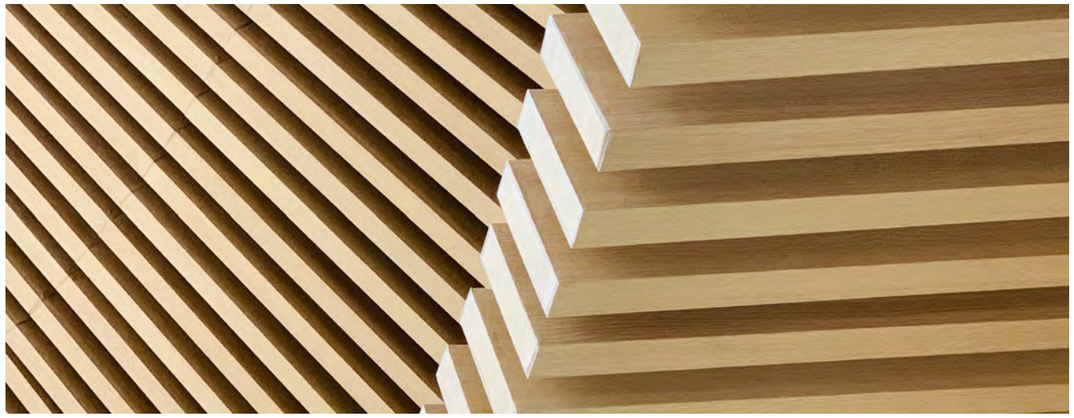
The contracting parties may want to mitigate the risk of projects being impacted by supply chain disruption, as experienced during the pandemic, by carrying out thorough due diligence on the supply chain pre-contract.

Focus on the built environment

The UK's Building Safety Act has brought about a significant change in the country's regulation of fire safety and building standards. Enacted in June 2022, the reforms are a response to the Grenfell disaster in London and may spur further measures. Incidents in other European countries, Australia, the Middle East and China have also prompted changes in relation to the design and construction of tall buildings generally. Knowledge and experience are being shared.

Seventy-two residents lost their lives when the cladding of the 24-floor Grenfell Tower burned out of control in 2017. The public inquiry that followed has revealed a series of failings by the municipal client, contractors, designers, cladding suppliers, building safety inspectors, and others. A crucial revelation was how fragmented teams operated in silos as the design of the over-cladding system evolved. The resultant diffusion of responsibility saw no-one take ownership of the design, its safety and fitness for purpose. This is a systemic problem, witnessed in the investigation of tower blocks in the UK and elsewhere, where flawed specifications as well as faulty workmanship have been recurrent issues in construction disputes.

The Act created new regulators for building safety and construction products. It also prescribed that essential design and fire safety information – a 'golden thread' explaining how the building was designed, constructed and should be operated – is accurately recorded and safeguarded through the lifecycle of a building.

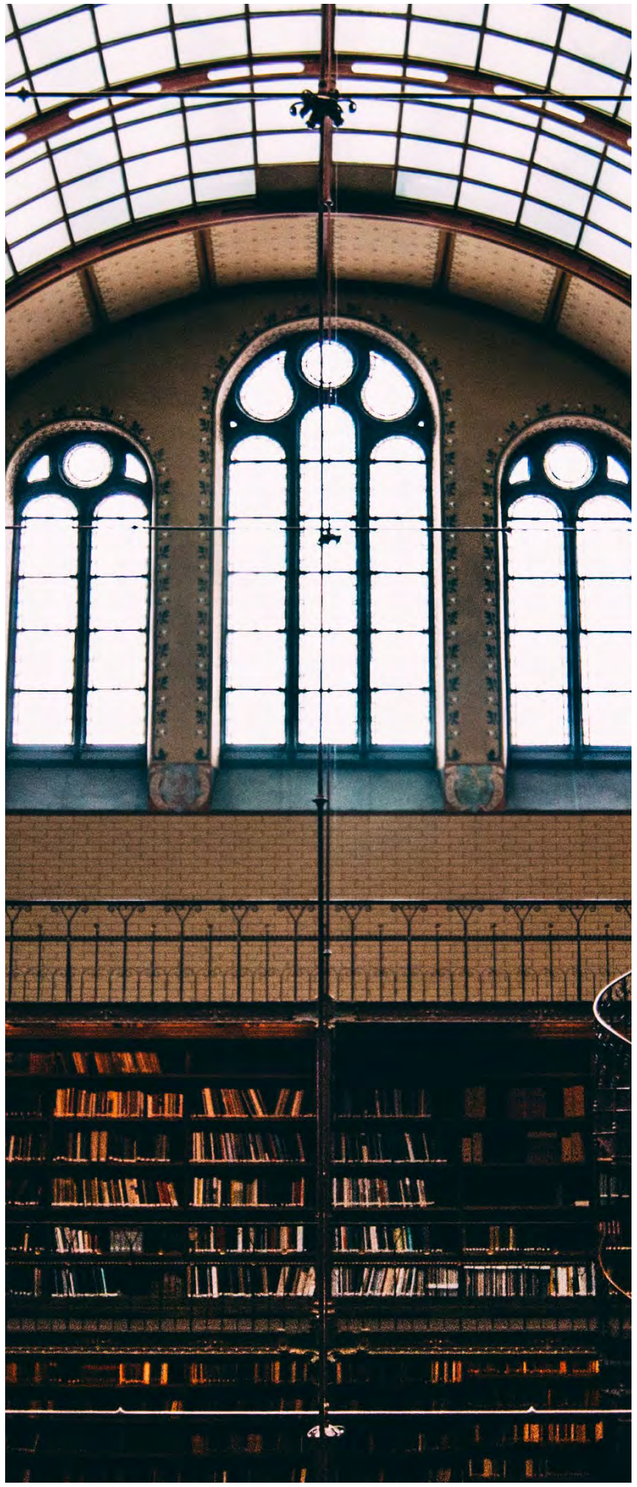


Disquiet remains over how cladding and other building products are certified and marketed in different regions, and how certification is applied and interpreted across jurisdictions. It also remains to be seen how the industry updates and enforces standards, shares best practice, and changes behaviours when procuring designs.

As the CRUX Insight analysis shows, a significant proportion of claims and disputes have a design-centric cause, which appears to be a growing trend across project types and regions. Risk and resource allocation are at the root. The allocation of design risk by contractors with design responsibilities is an increasingly problematic area, giving rise to disputes. They often pass on their overall design management responsibility to the design sub-consultant or subcontractor, who may be targeted for buildability or design risk decisions taken by contractors at the tendering stage, prior to their involvement in the project.

To drive up design quality, it will be necessary to reverse the significant cuts in fees of recent years. Designs need to be developed as early as possible and frozen, so that all parties are clear about what they must deliver, with risks allocated appropriately and owned. Employers must resist the temptation of clever contract terms that purport to pre-empt this design process. Through their early involvement, contractors can help minimise the project risk. Designers too need to upskill, improving their understanding of construction challenges and tailoring designs to support buildability.

With the findings of the Grenfell inquiry still awaited at the time of this report, and hundreds of cladding and fire safety disputes in litigation, there will undoubtably be further policy and legislative changes for designers, contractors and building owners in the coming years.



ENVIRONMENTAL

Climate change is generating headwinds – literally – in the form of extreme storms and other weather events, but also economic and regulatory pressures. Owners and stakeholders, including the public, increasingly expect that projects will be designed and delivered with both future resilience and sustainability built in.

One consequence of heat waves, floods and other impacts of the climate crisis will be increased, or diverted, investment in the repair and resilience of infrastructure and the built environment. The new energy crisis is another driver. As gas supply is weaponised by Russia, Europe is compelled to accelerate its transition to renewables, (while also building LNG terminals and upgrading oil plants). However, the lead times are considerable.

In the US, newly passed infrastructure and energy bills have secured unprecedented investment, unlikely to be reversed by a new administration. Roads, bridges, rail, wind turbines, solar panels and battery, hydrogen and carbon capture will share $1.2 trillion of funding along with other technologies from broadband to cybersecurity.[17]

The scale of the commitment to curb climate change may embolden other governments to make good on pledged action and investment, reviving hopes of limiting global warming to the 1.5-2°C target range by 2050. Most have targets to phase out fossil fuels and/or achieve net zero carbon emissions.

Switching to renewables is also compelling on grounds of cost. From Europe to China, the Middle East to Australia, investment in wind and solar power is growing rapidly. Progress in South America has been slowed by the pandemic, and in Africa by limited access to capital. Other potential solutions being explored include carbon capture, utilisation and storage (notably in Canada), hydropower (Brazil and Africa), mini-grids (Africa) and community battery banks (Australia).

Decarbonisation of power, electrification of cars and other vehicles, and production of alternative fuels will generate construction and engineering activity into the medium term. The upgrades required to transmission and distribution infrastructure alone are significant. Adaptation for climate change will also drive up civil engineering activity – including coastal and inland flood defences, addressing sewerage and run-off, transport networks with enhanced resilience, and retrofitting of buildings to improve energy efficiency and decarbonise cooling and heating.

The development of other greener energy sources, including hydrogen, needs to accelerate at scale to complement renewables and nuclear power. Minimising the risk associated with this investment is essential to win over funders and insurers, as well as users.

While policymakers may advocate or mandate sustainable methods and materials, contractors must contend with cost inflation and supply chain disruption. Across Europe, the supply certainty of steel is trumping the lower-carbon credentials of timber, which has also risen sharply in price given post-lockdown demand and lost imports from Russia and Ukraine.

In the longer term, depletion of natural resources will increase costs, necessitate innovation in materials, and drive recycling and re-use. Alongside sustainable designs and methods that save on waste and carbon, many other changes will be needed to integrate construction and engineering in the circular economy.

Managing environmental uncertainty

Focus on sustainability

Re-use is becoming increasingly important both for materials and structures. Refurbishment and re-purposing of buildings, where the steel and/or concrete shell is retained for re-development or change of use, is a more

17 President Biden's Bipartisan Infrastructure Law | The White House

common as well as sustainable approach even in those markets where demolition and all-new construction was the default.

Sustainability validation and accreditation metrics – such as Leadership in Energy and Environmental Design (LEED) or British Research Establishment Environmental Assessment Method (BREEAM) – place heavy emphasis on the re-use of buildings and equipment as part of their holistic assessments.

Architects and engineers trained over the last two decades may have the new skillset required, but a mindset change is required of clients. Sustainable solutions for re-purposing buildings tend to require more iterative design work. Budgets need to take account of this up-front resource as well as whole-life costs.

Capital projects in all industries are being designed with greater efficiency and sustainability in mind. Industrial processes recycle waste heat for productive uses. Earthworks for new road and rail construction schemes seek to re-use excavated material and minimise haulage movements to and from site.

Over more than 20 years, other jurisdictions have followed the European Union by legislating to curb the environmental impact of construction and engineering, though not on a consistent basis. More regulatory and policy changes will need to flow from national commitments made at Glasgow's COP26 climate summit in November 2021 if pledges to cut carbon are to be achieved.

Just as legislation forced manufacturers to phase out chlorofluorocarbon refrigerants, combustion engines will no longer power new light vehicles – from 2025 in Norway, 2030 in the UK, and 2035 in the EU, North America and dozens of other countries. State and private investment in electric vehicle charging infrastructure is lagging. An even greater challenge awaits with hydrogen – the clean fuel needed for heavier vehicles, construction plant and potentially cars too, longer term. A localised distribution and storage network will be required in or close to urban areas, again driven if not funded by governments.

New contractual frameworks can also be an enabler for the transition to low-carbon construction. In August 2022 the New Engineering Contract (NEC) released new contract clauses designed to help the construction industry achieve net zero emissions and deliver sustainability in built assets. They allow clients to specify 'climate change requirements', including use of renewable energy on site and designs that reduce carbon emissions. Failures to comply are treated as breaches or defects. A disclosure clause allows environmental performance data to be gathered, disclosed and publicised.

Professional bodies representing architects and lawyers have also proposed embodied carbon criteria and commercial agreements to align contracts with net-zero targets.[18] It remains to be seen if other widely used standard forms will embrace the greening of construction and engineering projects – and how widely they are adopted by private as well as public clients. Many international and British Standards now include sustainability requirements for projects, whilst some financiers have made capital loans contingent on borrowers' commitments to build sustainable measures into project delivery.

Focus on ESG

Depending on how governments and individual project promoters react, the economic headwinds arising from cost inflation and the energy crisis may slow the pace of change or speed the transition, especially to renewables. But there are also specific risks to be weighed with respect to climate change and corporate Environmental, Social and Governance (ESG) performance.

Companies failing to live up to their commitments to sustainability (as well as workers' rights and ethics more generally) not only risk reputational damage, and even legal action by environmental campaigners and NGOs. Investors too have begun holding directors to account and linking remuneration to ESG criteria. Meanwhile, a new generation of employees are disinclined to work for organisations that do not demonstrate corporate responsibility.

18 https://www.scl.org.uk/sites/default/files/2022-03/Procuring%20Net%20Zero%20Construction%20Report%20for%20SCL%2018%20March%202022.pdf

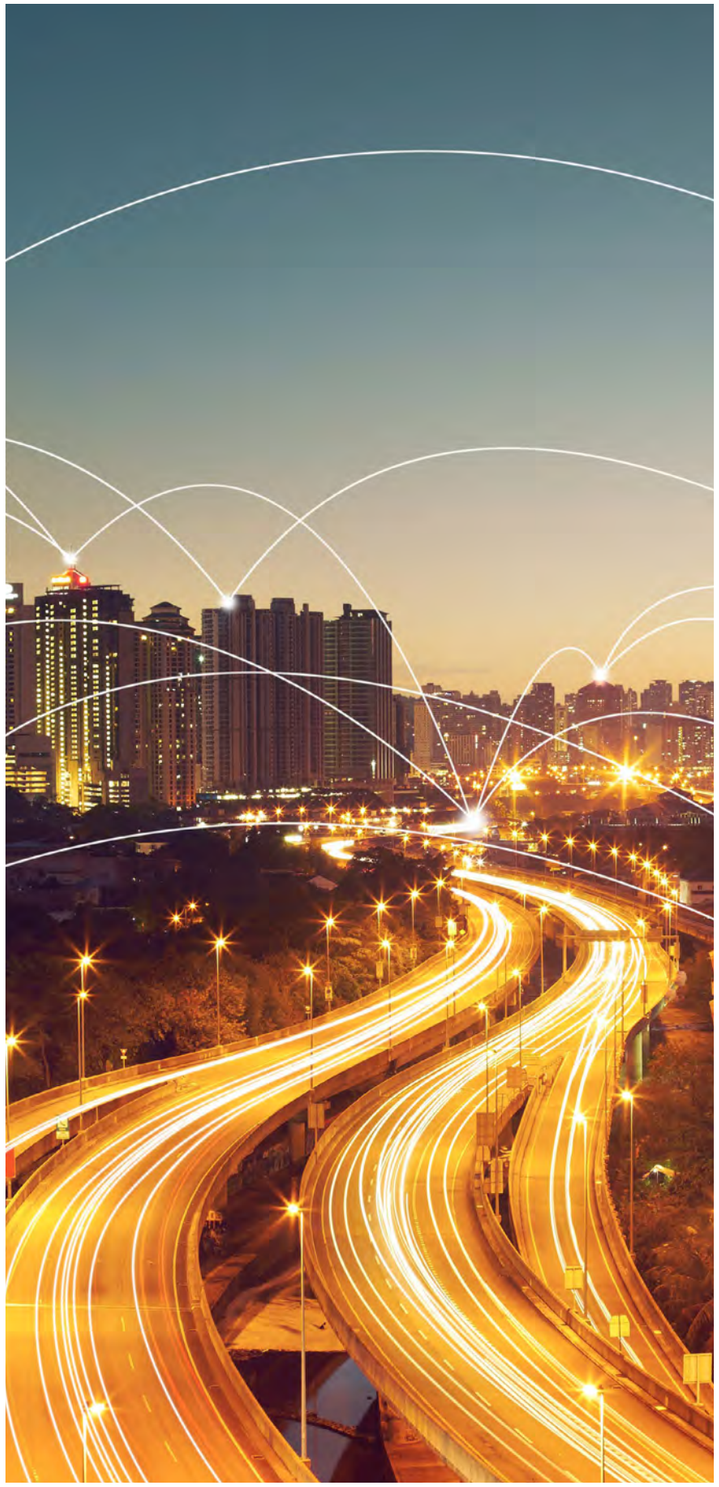
Commercial damages are another risk. When bridges, dams and other infrastructure fail to withstand extreme weather events, contractors, insurers, regulators and owners may end up in court. Design standards based on one-in-100-year events are being overtaken by climate change. The time lag in turning new laws and design codes into practical guidance creates further difficulty as contractors and the supply chain strive to implement the necessary changes, ensure compliance, and educate clients about the additional costs.

Building information modelling (BIM), digital twins, and other technologies from drones to off-site prefabrication enable various efficiencies. While green concretes using reclaimed wastes, and asphalts with additives such as graphene, are being perfected, development of low-carbon steel and other alternative materials needs to advance apace. From design and procurement through construction to demolition (or dismantling of built assets for re-use), the industry's net zero challenge is daunting.

Companies failing to live up to their ESG commitments face multiple risks – to their brand, investor funding and recruitment, as well as legal action.

CRUX FINDINGS - GLOBAL

Top causes of claim or dispute	Rank
Change in scope	1
Contract interpretation issues	2
Design information was issued late	3
Contract management and/or administration failure	4
Design was incorrect	5
Design was incomplete	6
Poor management of subcontractor/supplier and/or their interfaces	7
Access to site/workface was restricted and/or late	8
Physical conditions were unforeseen	9
Workmanship deficiencies	10
Approvals were late	11
Level of skill and/or experience	12
Cash flow and payment issues	13
Claims were spurious	13
Operational performance	15
Materials and/or products were delivered late	16
Tender errors and/or inaccurate estimates	17
Installation failure	18
Shortage of skilled and non-skilled workers	19
Targets and/or expectations were unrealistic	20
Weather conditions were exceptionally adverse	21
Inadequate responses to information requests	22
Poor interface management with a third party	23
Personality and/or cultural differences	24
Bias and/or failure to cooperate	25
Reporting was incomplete and/or incorrect	26
Late appointment of subcontractor/supplier	27
Socio-political/regulation	28
COVID-19	29
Fraud	30



1602
projects

100
countries

$1.56bn
average CAPEX

$98.7m
average cost claimed

68.6%
average EOT claimed

AFRICA

Africa's construction industry was hit hard by COVID-19, and vaccination rates remain low by global standards. Yet economic activity rallied faster than expected in the second half of 2021. The International Monetary Fund has since raised its growth forecasts for 2022 and 2023 to 3.8% and 4.0%, respectively.[19]

With war in Europe, the outlook has clouded again. Surging fuel and food prices have contributed to civil unrest, not least in South Africa, and pushed inflation higher than any other region except South America. Construction materials' costs have outstripped general inflation, rising in 2022 by up to 10%, but 20% in Egypt, and up to 30% in Nigeria.[20]

Yet, despite the dampened expectations in most markets – and serious risks around political instability, public safety, and insurgencies – there remain massive opportunities for development in such a populous and resource-rich region.

South Africa allocated more than $45 billion to infrastructure in 2022, and its National Infrastructure Plan 2050 pipeline includes projects in energy, water, transport and telecommunications. Across the continent, there are more than 570 construction projects together worth $450 billion,[21] including major power and infrastructure projects underway in Nigeria, Ethiopia, Kenya, Congo and Senegal.

China has a significant economic presence in Africa. Over the last few years, Chinese contractors have grown their share of the continent's $50 million-plus contracts to more than 30%, supplanting Western firms who previously dominated the construction and engineering market.[22]

The Africa dataset for CRUX Insight 2022 covered 40 projects in 16 countries. Power and utilities projects dominated (onshore renewable, fossil power plants and combined-cycle gas turbines), while commercial buildings were the next most important category. With a total CAPEX value of more than $76 billion, the sums in dispute were also significant, averaging more than $103 million per project. Programmes in Africa tend to be impacted more heavily than other regions; only those in the Middle East face greater delays, which are marginally longer. Contractors claimed extensions of time that would add almost 83% to planned schedules on average – a pattern consistent with previous CRUX Insight reports.

Top causes of claim or dispute	Rank
Access to site/workface was restricted and/or late	1
Change in scope	2
Cash flow and payment issues	3
Design was incomplete	4
Contract interpretation issues	5
Contract management and/or administration failure	6
Claims were spurious	6
Poor management of subcontractor/supplier and/or their interfaces	8
Level of skill and/or experience	8
Approvals were late	10

19 https://www.imf.org/en/News/Articles/2022/04/28/pr22133-sub-saharan-africa-a-new-shock-and-little-room-to-maneuver

20 www.mordorintelligence.com/industry-reports/africa-construction-market

21 www.mordorintelligence.com/industry-reports/africa-construction-market

22 China is delivering over 30% of Africa's big construction projects. Here's why. (theafricareport.com)

CAUSES AND EFFECTS

Such was the scale of disruption caused by the pandemic, it is no surprise that restricted access to site and workfaces is the top causes of claims and disputes in the latest Africa analysis. However, the CRUX Insight dataset also shows that these restrictions had been endemic on projects already underway as early as 2017, long before the emergence of COVID-19.

Late designs were the number-two cause of claims and disputes at that stage but dropped down the ranking over time. Major projects are multi-year in nature and all delays have cascading effects. Change in scope and incomplete designs – both prominent in the latest CRUX Insight analysis – are related to each other, and they also trigger other claims on projects.

We see clients go to tender when designs are less than 70% complete. Contractors identify gaps in design information and then target these programme risks as opportunities to claim for variations and the inevitable access delays at the workface and interface conflicts that ensue.

As CRUX Insight confirms, it is all too common for owners in other regions to launch their projects prematurely. In the African market, this tends to be compounded by serious shortcomings in pre-feasibility studies and tender evaluations of technical components, scheduling and costs. Lack of transparency in the procurement process exacerbates these problems.

Necessary skills are in short supply not only for such technical analysis, but also across contract management and administrative roles. Bureaucratic procedures and approval processes, especially where state funds are involved, contribute to payment delays and cashflow issues – another notably prominent cause of claims and disputes on the continent. As contract management teams are spread thinly, they struggle to keep abreast of early warning notices and variation order requirements. It does not help when document management and control systems are inadequate, or staff are not trained in their use.

Skills shortages and these project control and governance shortcomings help reinforce a project environment that is not conducive to the still only gradual maturing of the region's claims culture. Site teams often lack experience and understanding of the type of contract being used. Spurious claims continue to run at a higher level than the rest of the world, nurtured in many cases by inadequate governance processes.

40
projects

16
countries

$2.13bn
average CAPEX

$103m
average cost claimed

82.9%
average EOT claimed

The pandemic incentivised opportunistic claims even where restricted site access was not a factor. On a highway project, for example, the extra time and costs claimed by the main contractor were shown to be down to delays in the delivery of materials at inflated prices.

LOOKING AHEAD

The impacts of the coronavirus will continue, and the possibility remains of further flare-ups that could affect the mobilisation of workers. In any case, as this appears to be an endemic issue, it is unlikely that site and workface access restrictions will fall down the causation ranking for claims and disputes during 2023.

However, comparing projects approaching completion over the CRUX Insight timeframe, there is evidence that the impacts of late design information may be diminishing, at least in this later phase of projects.

Anecdotal observations suggest that management of the design process is improving. More fundamental changes are required of owners, however, if they are to pre-empt the multiple problems caused when it falls to contractors to mature their designs. Owners stack the odds against themselves, and contractors take advantage. Failures to follow through their design responsibilities in a timely manner increase the likelihood of a clashing interpretation of scope.

By increasing design maturity before issuing tenders, and making more realistic choices when allocating contractual risk, owners can limit scope changes downstream and reduce the potential for misinterpretation. Engaging contractors early in the design so that the project requirements are more precisely understood should be encouraged to reduce the prevalence of 'low-ball' pricing.

Stronger document management and document control systems accessible to all parties will ensure there is 'one version of the truth' regarding all project performance covering costs, deliverables, and schedule. Developing and agreeing upon an integrated schedule is essential so that all parties are accountable for their responsibilities and the timing of interim and final milestones.

Improving contract administration processes and the checks and balances that apply will promote transparency across the supply chain. It is the project promoter's responsibility to assure this transparency of engagement at every level, from their team's leadership through tier one and downwards.

There are some encouraging signals of a culture change in governance – in the civic sphere – but embedding this in public procurement and contracts will be a lengthy process prey to political uncertainty, not least in South Africa. Over the last three years, the government's anti-corruption strategy has shown tangible signs of progress. Depending on how they are implemented, the recommendations of the Zondo Commission – which investigated 'state capture' by, inter alia, the Guptas during the presidency of Jacob Zuma – will have far-reaching effects on state bodies and private companies operating in South Africa.

Amid the pandemic, the continent's third-largest economy – and its most industrialised and technologically advanced – suffered a sharp contraction that left one in three unemployed. More than a quarter million construction jobs were lost by late 2020. Despite this, the rebound following the worst of COVID-19 means that the industry is expected to grow by more than 9% in 2022.

Significant investment will be required to develop the continent's workforce as well as its infrastructure. This is more pressing given an exodus of skilled and experienced professionals, which will not be reversed without sustained improvement in public security, political stability and economic prospects.

A lot depends on early planning to mitigate risk in the infrastructure pipeline. Navigating the risks on lump-sum contracts will continue to be difficult for contractors. Greater private sector involvement, in project management as well as funding, and wider adoption of engineering, procurement and construction (EPC) contracts – particularly on multi-contractor megaprojects – would also reduce the risks borne by public agencies.

International investment is already flowing into the energy sector. Although vested interests still favour fossil fuels, the prospects for the continent's renewables are bright. South Africa has removed its cap on production by independent energy providers. A power-hungry region still hampered by highly disruptive 'load shedding', the region has promising solar, wind and hydro sources, as well as abundant natural resources, including rare earth metals crucial to the global energy transition. Africa's demand and construction industry will continue to grow with population growth and economic recovery.

Industry view

Positive avoidance strategies

Construction and infrastructure disputes have had a considerable impact on capital project costs and timescales in Africa, with extensions of time adding over 80% to planned schedules.

Businesses and professionals can, however, adopt positive strategies to avoid the costs, time and stress associated with dealing with fully fledged disputes in court or arbitration. Making sure the contract is right for the project, and ensuring all parties are clear as to their rights and obligations under the contract, is an immensely effective way to prevent disputes. Also, embracing a culture of mutual co-operation, allocating risks clearly and fairly between contracting parties, and open and honest communications between contracting parties before and during project delivery, are among the best means of protection against disputes.

CRUX Insight reveals how restricted access to work sites, coupled with late designs (the top two regional causes highlighted) have caused disagreements, which can and should be resolved early and collaboratively to pre-empt deeper conflicts. Investment in training on conflict avoidance and management measures, and developing skills in document management, project controls, contract management and administration could significantly reduce financial and other costs associated with contractual disputes.

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Head of ADR Research and Development
RICS

AMERICAS

Construction in the US and Canada weathered the pandemic and is set to grow strongly as a sector, despite the prevailing global uncertainties and challenges. Resurgent inflation – though lower than the European average – may now be the greatest threat to project outcomes, compounding difficulties in the supply chain and labour market.

Regional inflation in 2021 was at its highest in South America (at 10.6%),[23] where the recovery is inconsistent. Nevertheless, the larger economies of Argentina, Chile, and Colombia bounced back strongly, though Brazil is lumbered with additional risks from higher interest rates and highly polarised politics.

On the ground, project timelines across the Americas are being stretched by supply chain disruption due to the Ukraine war, if not directly, then through increased costs for fuel, metals and other commodities.[24] COVID-related lockdowns in China are also causing disruption through its global supply chains.[25] As well as delays or sourcing alternative supplies, contractors face squeezed margins as they struggle to recover all their additional costs. Input costs rose by 42.5% in the year to March 2022 in the US.[26]

Although the prices of some materials, such as iron and steel, have peaked, demand and disruption will keep them high. The Bipartisan Infrastructure Law, now fully enacted, earmarks $550 billion of new investment for transportation, broadband and utilities – providing the largest US infrastructure investment in nearly a century. This would represent 20% growth for the infrastructure sector,[27] a 'once-in-a-generation' opportunity but also a stretch for the industry. Confidence is tempered by concerns that larger programmes may have to give way to smaller projects at less risk of delay and cost overruns.

More than 520 projects in 18 countries across the Americas were analysed for CRUX Insight 2022. Buildings – residential and public sector – were the largest categories, followed by transport infrastructure. The projects' combined CAPEX value was $325 billion. Potential cost overruns were high, given that sums in dispute amounted to a third (33.8%) of average project CAPEX to date, while time extensions sought by contractors would add 58.2% to the planned schedule of a typical programme.

Top causes of claim or dispute	Rank
Change in scope	1
Physical conditions were unforeseen	2
Design was incorrect	2
Workmanship deficiencies	4
Design was incomplete	5
Poor management of subcontractor/ supplier and/or their interfaces	6
Design information was issued late	7
Contract management and/or administration failure	8
Contract interpretation issues	9
Access to site/workface was restricted and/or late	10

23 Inflation Is Raging Everywhere, But It's Worst in Latin America (bloomberglinea.com)
24 Ukraine Conflict Further Disrupts Under-Pressure Global Supply Chains - Gary Wollenhaupt | Procurement & supply chain news and insights | Procurious
25 China Lockdowns Create Supply-Chain Chaos From Apple to Tesla - Bloomberg
26 Impact on Materials Costs | CBRE
27 Construction industry outlook – Hylant

CAUSES AND EFFECTS

The most dominant causes of claims and disputes are not only intertwined, they also tend to share common roots.

Project owners seek to minimise their outlay on up-front design, allowing construction work to proceed, which almost invariably leads to changes in scope. Main contractors on design-build contracts can succumb to similar cost-saving temptations with a view to improving thin margins. In some areas, designs may be rejected by third parties, such as state agencies that vet structures in areas of seismic activity.

Design-build contracts are more widely used[28] and we have observed how progressive design-build – with early review points to assess and cost designs as they progress before construction – are being deployed on US airport and water projects, for example.

Other pressures, however, still give rise to claims and disputes over changing scope, incorrect or incomplete design, and unforeseen ground conditions, whatever the form of contract. On public projects, federal funds are conditional on being spent by a fixed deadline. Work may proceed before full due diligence on buried utility services, or all necessary rights of way or licences are in place.

In Canada as well as the US, we see the effects of allowing insufficient time for thorough ground investigations on both private and public projects. For example, contractors may be given a mere two weeks to verify the results of employers' bore tests before they must assume liability. Meanwhile, risk avoidance clauses embedded in contracts commonly make contractors and consultants liable for unforeseen conditions.

Overly tight schedules often push design teams into issuing drawings before the design is frozen or mature enough for Issued-For-Construction (IFC) drawings, or even before they can fully incorporate changes. Even where the contractors are in control of the process on EPC contracts, owners request changes late in the design phase. There is also a growing appetite for pursuing design consultants and professional indemnity insurers for alleged design errors and omissions.

Changing designs without the necessary schedule relief – especially when personnel are less experienced and labour is in short supply – risks creating a vicious circle of overtime working, lower productivity and workmanship

28 Study Shows Popularity of Design-Build Contracts Grows | 2021-09-29 | Engineering News-Record (enr.com)

522
projects

18
countries

$669m
average CAPEX

$59.9m
average cost claimed

58.2%
average EOT claimed

deficiencies. For the third CRUX Insight report running, sub-standard quality of work ranks more highly as a trigger for claims and disputes in the Americas than in the rest of the world.

None of these problems are new or unfamiliar, yet project owners and contractors alike continue to gamble, whether on saving money or recouping costs. More mature project planning, design and project control processes would yield benefits by setting contingencies aside up front, that can be released as necessary to cater for the occurrence of risks that will otherwise cause projects to overrun their schedules and budgets, and give rise to onerous claims.

With margins tight and costs rising, the industry faces a real and rising danger of insolvencies, that would further erode the industry's capacity to meet potential demand. In this current climate of heightened uncertainty, owners should be aware that arbitrators may make allowances for contractors when they have failed to do so. A series of US arbitration rulings have come down more heavily on the contractor's side than expected.

At the same time, we have seen owners settle large claims that were not supported by robust evidence. The contractors who persist in under-bidding and then fight for a profit – sometimes in the court of public opinion through media relations – also damage the industry's standing and project outcomes.

Another market distortion increasingly evident in the US is the tendency of general contractors to drag their supply chain into litigation in a cynical attempt to recover lost profits. Despite having performed as contracted, subcontractors and suppliers end up paying significantly higher premiums to insurers who pay for their counsel and defence.

LOOKING AHEAD

Complex projects delivered in a fast-track environment will continue to be entangled in these persistent causes of claims and disputes without a fundamental change of approach.

Conventional wisdom and assumptions need to be examined afresh with open eyes. Challenge sessions – facilitated by experts – enable project teams to identify holes and gaps in their contracts and role-play scenarios for mitigating risks.

Even, or especially, in turbulent times, project owners can achieve much greater certainty if they get the business case right in the first place. Pushing ahead for an early start before designs are mature ultimately works against the interests of the employer and the entire supply chain.

If all parties, including subcontractors, engaged in open discussion and collaborated before contracts were executed, they could identify risks, agree appropriate contractual provisions, and contingency plans and costs, if needed. Wider use of Integrated Project Delivery (IPD) and alliance contracting models can also boost the industry's lacklustre productivity as it faces up to an unprecedented workload.

Recurrent change-in-scope and design risks can also be better managed under progressive design-build contracts with pre-construction price and design checkpoints. We also see a trend of contractors converting lump-sum to cost-reimbursable contracts, which tilt the risk imbalance back toward the owner – and the onus to exercise tighter control over costs. But unless their team has experience managing or monitoring costs effectively, the outturn may still end up higher than planned.

Future projects in North America may need to be carefully phased to avoid falling foul of inflation and labour market conditions. Wages will remain high given wide unionisation and, in the US, newly mandated labour agreements on larger federal projects. The country's infrastructure plans could see 3.2 million new jobs in the supply chain for non-residential construction.[29]

Recent and impending COVID-induced retirements should only increase the emphasis on succession planning and the transfer of knowledge between generations of employees. Subsidised training programmes need to be ramped up. A modernising, more productive construction industry also cries out for more 'green collar' and tech-savvy skillsets.

Conservative when it comes to technological change, construction in the Americas needs to embed digitalisation, including digital twinning. In Canada, more than 95% of project data is never analysed, while other sectors – from pharmaceuticals to manufacturing – are showing how advanced data analytics can boost efficiency and performance.

As a minimum, parties should make quick gains by streamlining the archaic paper processes commonly used for change order management, project correspondence, and design approvals. To reap the full potential of design and project management tools, the entire planning and delivery team need to keep up to date with the latest technology, as these systems continuously evolve.

Access to digital platforms also needs to be shared, ensuring a common data environment. Parties locked out after a claim could lose crucial evidence for their case. It is essential too that the contract clearly allocates responsibility for creating, updating and managing the project's integrated digital model.

Net zero poses yet another steep learning curve for the industry. The current generation of engineers and construction professionals should be able to steer projects towards sustainability. Performance can be gauged against the Leadership in Energy and Environmental Design (LEED) benchmark, but its holistic assessments will have to be applied more widely, especially on industrial projects.

Industry view

An anchor in turbulent times

In our rapidly changing world, infrastructure projects can address critical social issues, building resiliency to climate change and accommodating increasing urban populations. In complex, high-stakes projects, significant sums of money combined with daunting technical requirements and public scrutiny create a situation ripe for dispute. Typically very long timeframes mean that rising labour and materials costs, and the political environment, often shift design parameters mid-stream. The global pandemic and geopolitical conflict in Europe have added cost, talent and logistical pressures to the era-defining endeavour of delivering Net Zero.

In this turbulent context, the annual CRUX Insight Report provides a vital anchor to which professionals, practitioners and investors in the built environment can hold fast. The report provides a solid basis for decision-making and avoiding unnecessary obstacles. It sheds a fascinating light on the specificities and commonalities of project challenges globally, based on in-depth understanding of real projects at scale, offering valuable comparative insights for everyone in the sector.

RICS professionals have long known that the basis of sound problem-solving are respected and consistent standards of measurement. An unwavering ethical foundation in practice instils the trust that, in the event of dispute, is the bedrock of healthy, confident markets and societies. CRUX Insight makes an important contribution to understanding this dynamic.

Ann E. Grey FRICS
Principal
Gray Real Estate Advisors & RICS President-Elect

29 Solving US construction's worker shortage | McKinsey

ASIA

Despite being in the first wave of the coronavirus, and in many cases managing outbreaks more effectively than other countries, Asia has been hampered by the lingering impacts of the pandemic on labour and logistics. Supply chain shocks due to China's zero-COVID policy are an ongoing concern.

Economic growth forecasts have been downgraded amid the financial tightening globally, following the Ukraine war. Asia is still feeling the effects of the distant conflict, though to a lesser extent than Europe. Inflation is hitting construction harder than consumers, with input costs exceeding 10% in India and Pakistan, and tender prices reported to be heating up in Malaysia and Singapore.

Construction activity continued to grow through 2021 in China, Taiwan and Japan, and South Korea is rebounding to pre-pandemic levels of output. This will see North-East Asia account for 39% of global construction output in 2022.[30] Led by China, the sub-region is home to many of the world's largest industrial and infrastructure construction projects, while South-East Asia, including fast-developing Vietnam, also has a healthy share.

This concentration of megaprojects in Asia is reflected in CRUX Insight. The total value of the 104 projects analysed was $501 billion – the second largest in this year's global survey. Offshore oil and gas formed the largest project category, followed by transportation infrastructure and buildings in the hospitality sector. Spread across 22 countries, these projects experienced cost claims exceeding $90 million, on average – equivalent to 27.8% of project CAPEX at that point. Contractors sought extensions of time equivalent to 65% of their planned contract schedules.

Top causes of claim or dispute	Rank
Change in scope	1
Access to site/workface was restricted and/or late	2
Poor management of subcontractor/ supplier and/or their interfaces	3
Contract management and/or administration failure	3
Design information was issued late	5
Approvals were late	6
Level of skill and/or experience	7
Contract interpretation issues	8
Design was incomplete	9
Cash flow and payment issues	10

CAUSES AND EFFECTS

Contractors on projects in Asia were held up by site and workface access restrictions more than their counterparts in the rest of the world (Africa excepted). The CRUX Insight ranking of the causes underlying claims and disputes also shows that late approvals were more common across the region.

Despite anecdotal evidence that COVID management was handled well in the region, both findings reflect how the construction industry emerged more slowly from pandemic controls compared to Europe and North America, for instance. Even where site closures were avoided and infection rates well controlled – as in Hong Kong, until its outbreak in March 2022 – the reduced movement of workers, materials and equipment hampered progress. Remote working also slowed the issuing of approvals and design information.

Failures in administering contracts will have contributed to these and several other high-ranking factors. The loss of continuity, as staff were rotated – including ex-patriates who sat out the epidemic in their home countries – led to lapses in contract management and administration.

The claims culture on construction projects is changing. The traditional perception across Asia has long been that issuing contract notices would sew disharmony and invite confrontation. The uptake over the last five years of more administration-heavy contract forms, such as NEC and FIDIC, has spurred improvements in record-keeping and investment in management resources and training to ensure that contracts run smoothly. The parties are increasingly willing to issue notices, and they need to do so in a timely fashion to protect their contractual rights.

Asia is no different from most other regions in respect of design conflicts. Design teams are put under intense pressure and owners go to market with immature designs. Owners also offload maximum risk onto contractors, who are just as – if not more – willing to shoulder it, compared with their counterparts in other regions, as they wish to remain ultra-competitive.

Notably, in oil and gas, contractors not only assume the risks associated with delivering all elements of projects under EPC contracts. Often, they also have to work with an incomplete Front End Engineering Design (FEED), because the owner has invested insufficient time and money in studies. As projects proceed, owners realise that the design will not meet their full requirements. Technological changes occur too over the life of a programme which may take 3-5 years. Unforeseen ground conditions (the final factor in the top ten causes of claims and disputes) are also more likely when false economies are made in site investigation.

Additional expense arising from the pandemic continues to cause contention. While these costs have fallen more heavily on owners, firms in every tier of the industry are trying to recover their own losses. Although contracts provide for force majeure and changes in law, many contractors have found it difficult to prove they were prevented from performing their obligations. Some of these clauses also restrict full cost recovery.

As owners are taking a hard line, contractors are forced to seek remedies outside the contract. In certain jurisdictions, common law doctrines of frustration or material adverse change or hardship can provide grounds to claim relief.

104
projects

22
countries

$5.70bn
average CAPEX

$90.4m
average cost claimed

65.0%
average EOT claimed

30 Northeast Asia to account for 39% of global construction output in 2022, finds GlobalData - GlobalData

The pandemic has also exacerbated a general skills shortage, and the long-term challenges posed by an ageing construction workforce. Employers are struggling to recover or replace workers laid off during the hiatus. Markets such as Singapore and Hong Kong suffer additionally from deficits in migrant labour, worsened by tighter immigration controls.

In the absence of national, industry-wide initiatives to promote careers in construction, contractors are poaching competitors' personnel, driving up pay rates. More attractive salary packages and benefits are needed to counter the skills shortages, along with commitment to enhancing employee morale and building loyalty.

The loss of continuity, as staff were rotated – including ex-patriates who sat out the epidemic in their home countries – led to lapses in contract management and administration.

LOOKING AHEAD

The construction and engineering industry can boost both its appeal to a new generation and its productivity through digitalisation; (though technology alone cannot solve skills shortages). This aside, BIM is not yet approaching its potential across Asia. BIM is generally perceived as an advanced version of Computer-Aided Design (CAD). Companies fail to see the full value proposition and hesitate to invest in systems and upskilling staff.[31]

Contractors, consultants, owners and the entire supply chain need to take a more strategic view of the technology and information management standards to enhance project delivery productivity across the board. Major projects are an opportunity to provide incentives. Increasing payments for completing designs would encourage investment in the technology down the supply chain. This is necessary given that the weakest link – in terms of user competency – limits BIM's power to facilitate project performance.

We foresee a further shift in the claims culture as contractual requirements erode historical qualms that issuing notifications signals aggression. Claims are being flushed out earlier in projects as better record-keeping makes it easier to demonstrate procedural failures. As contract administration matures, the focus will move on from these 'low-hanging fruit' to more technical matters. As a result, factors such as the quality of design and contract interpretation are likely to rise up the causation ranking in Asia. These and other technical issues are often at the heart of disputes about change in scope, cementing its position at the apex of causation for the foreseeable future.

Unbalanced risk allocation is a more vexed problem. Many contractors, not least Chinese companies, commit to contracts and only then seek to negotiate terms. Project owners need to realise that it is in their own best interests to allocate risk to the party best able to manage them. Pushing inappropriate risks down to contractors and through the supply chain inevitably generates claims.

However, there is a notable push at various national levels for a more collaborative approach to contracting. In Singapore, the Building and Construction Authority has started to drum up support for longer-term sustainable project outcomes through partnering and more equitable risk sharing. Government contracts would lead the way, with the possibility that private contracts follow in time. However, not all jurisdictions are mindful of the need for greater collaboration or have had any traction with this concept.

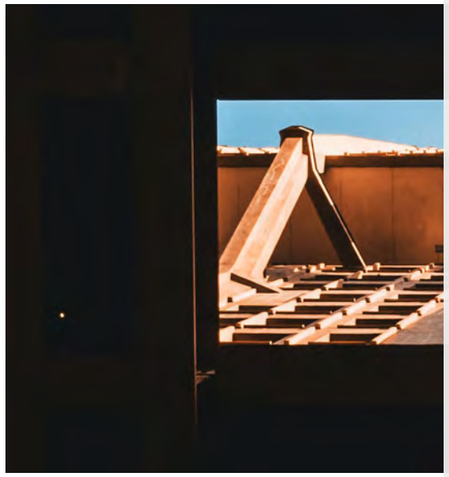
The challenge remains to manage project risks in a more consistent manner elsewhere across the region. Companies would be well advised to invest in more rigorous pre-contract management processes. Given the heightened uncertainties surrounding input and labour costs, price adjustment clauses in contracts and appropriate price indices are essential. Remarkably, we have seen little or no hedging on supply chain costs

Despite the global headwinds, the outlook for Asia's construction and engineering industry is positive. Even amid the financial tightening worldwide, the climate crisis is stiffening national commitments to the low-carbon energy transition, which should sustain investment in renewables. China's pledge is for carbon emissions to peak by 2030, en route to its 2060 net zero target, whereas countries such as Japan and South Korea are aligned with the 2050 deadlines of the US and European Union.[32]

Malaysia has set an example with its rapid expansion of solar energy, while Taiwan is heavily invested in offshore wind; though further expansion may be limited by geopolitical tensions in the South China Sea, which will be an ongoing concern for the region and the world.

31 Asia must change its approach to construction to fully harness digital benefits | New Civil Engineer

32 Asia - ICMS 2022 (turnerandtownsend.com)



Industry view

Accelerating digital investment

The construction sector in Asia continues to feel the ripple effects of the pandemic. As highlighted by CRUX Insight, supply chains in the PRC continue to be affected by workplace and travel restrictions, alongside growing costs and tender prices stemming from inflation connected to the macro-economic environment. Skills shortages in construction have deepened as a result of the long tail of the pandemic, coupled with reduced numbers of new entrant labour and low unemployment levels.

Yet construction activity in the region has been buoyed by growing construction activity associated with large industrial and infrastructure projects. Coupled with this, growing adoption of improved contract forms such as the NEC and FIDIC in recent years reflects a changing culture around construction project management and timely resolution of issues.

Accelerating the digital transformation of the sector is essential to deliver higher levels of safety, quality and certainty across the construction supply chain. Sector investment in a more technologically savvy workforce and in pursuit of technological advancement, alongside greater cross-sector collaboration, can help ensure projects are delivered more reliably, safely and responsibly. The use of common data platforms – alongside standardised and interconnected policies, procedures and practices – will also support more collaborative, and ultimately, more productive, project outcomes.

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Chief Executive
Gammon Construction Limited

EUROPE

European countries have long been major importers of Russian and Ukrainian steel, iron and timber. The war in Europe's backyard has not only severed these supply chains, but the resulting energy shocks are also reverberating through every industry and sector of society and economies.

Higher fuel and energy prices have driven up operating costs, and the prices of materials from bricks and asphalt to steel. In the UK, the cost of new construction work has increased by more than 27% year-on-year.[33]

Inflation is now seen as the greatest threat to the stability of the industry, supplanting even the geopolitical headwinds. While some costs may have begun to level off, labour and material shortages, volatile energy prices, and rising interest rates will continue to pose serious risks.

Company profits will be dented as annual growth in EU construction slows to 1.2-1.5% over the next two years. The UK's economy will contract, putting some transport and energy projects at political risk. However, Europe's new energy insecurity only increases EU commitment, and the private investment business case, for the low-carbon transition. Development of solar and wind power capacity and other clean technologies will accelerate in what is already the world's second-largest renewables market after China. The continent's acute housing shortage will also drive construction demand.

CRUX Insight 2022 examined 431 projects across 28 countries. Residential and commercial buildings provided the two top categories, followed by buildings for the education sector, transportation infrastructure, and power and utilities projects. Their combined value was just under $242 billion. Compared with most other regions, projects were smaller in scale, but the toll in claimed costs was higher – at 38.3% of the average project CAPEX. The extensions of time claimed were more in line with other territories – equivalent to 60.5% of planned programme durations, below the global average (68.6%).

Top causes of claim or dispute	Rank
Design was incorrect	1
Change in scope	2
Contract interpretation issues	3
Poor management of subcontractor/ supplier and/or their interfaces	4
Workmanship deficiencies	4
Contract management and/or administration failure	6
Design was incomplete	7
Design information was issued late	8
Level of skill and/or experience	9
Physical conditions were unforeseen	10

CAUSES AND EFFECTS

Design failures are now firmly entrenched among the main drivers of claims and disputes on European projects, but the latest CRUX Insight analysis also confirms that deficiencies in workmanship and skills or experience are prominent problems in the region. High-ranking in last year's report, these two closely related factors loom larger in Europe than in the rest of the world.

The finding reinforces what we see first-hand on projects, and the personnel challenges admitted by their stakeholders. Many reasons are involved, from an ageing workforce to the loss of existing workers and new talent being drawn to more attractive industries. COVID-19 seems to have made matters worse by encouraging earlier retirement, as in some other industries.

Apart from gaps in skills and experience, the region's workmanship problems are related to wider issues too, such as funding constraints and tighter margins through the supply chain. With more lump-sum contracts, contractors trim staff to save costs. Economising on managerial resources may mean fewer supervisors and pressure on quality control.

Suspicion that these shortcomings are worsening is borne out when the European data is analysed over time. It is on projects in progress post-2020 that deficient workmanship rises up the causation ranking from the bottom of the top ten.

The phase in the project's lifecycle also affects where skills gaps are most likely to bite. For example, an analysis of power projects in Europe shows insufficient skill or experience was a top-two cause of claims and disputes during pre-construction, falling to tenth thereafter. Levels of skill and experience are critical in the design phase of most projects, especially when schedules and budgets are being shaved. During construction, project teams are better able to cope with fewer people who are highly experienced.

In Europe, as worldwide, immature design and change in scope form the primary axis around which many claims and disputes revolve. Pressure to get projects to market and squeeze schedules has been increasing over recent years. Sometimes this pressure is political. Almost always it is counterproductive. There is an inverse correlation between the time (and money) saved in the design phase and at a project's outturn – i.e., overruns become more likely and bigger as changes are made later in a project.

Acceleration elsewhere also tends to result in loss of control. Assumptions that the procurement phase can be shortened often collide with fixed limits for fabricating equipment, while driving construction by opening up multiple workfaces leads to clashes involving different trades or safety restrictions.

The prevalence of contract interpretation in claims and disputes across Europe and the world is also perturbing, and largely avoidable. Ensuring clarity on responsibilities and liabilities is the principal aim of contractual agreements. If properly and clearly drafted – including documents, drawing lists and specifications – the contract should not be an issue. The fact that conflicting interpretations continue to happen and so often can mostly be explained by lack of effort, time or money, if not competence, during contract preparation and project on-boarding of team members. In practice,

431
projects

28
countries

$763m
average CAPEX

$111m
average cost claimed

60.5%
average EOT claimed

33 Monthly Statistics of Building Materials and Components - Commentary, June 2022 (publishing.service.gov.uk)

insufficient time is again probably the most likely reason, perhaps compounded by insufficient training and education, or language skills.

On the other hand, we have also observed that parties are managing contracts more on the basis of entitlement. While taking greater care that contracts are as unambiguous as they can be in defending their interests, commercial management has become looser. On target-cost contracts for infrastructure, for example, the focus is on managing money rather than on value analysis and assessing progress against the planned programme.

While not a valid excuse for contract misinterpretation, erroneous assumptions made when working with a contractor for the first time, or breaking into a new sector such as renewables, may also leave parties at cross-purposes.

Novelty too may be contributing to lapses when managing subcontractors, suppliers and their interfaces. Main contractors find new, cheaper subcontractors without due diligence to prove their reliability, or they move into new markets and need more time to become familiar with ways of working in different supply chains.

As project complexity increases with multiple interfaces, pared-down management teams spread skills and competency too thinly across contracts. Poor management of subcontractors, suppliers or interfaces is another recurring cause of claims and disputes. The challenge increases with project complexity, but project owners may share responsibility too, depending on the type of contract. If planning and procurement are poor, work packages will not be assembled to reflect the key interfaces on the project, so coordination becomes extremely difficult.

LOOKING AHEAD

COVID-19 features in most recent claims and disputes, and will continue to be a factor in contracts completing over the next year. Force majeure clauses have been cited and debated intensively. Inevitably, terms are being refined in light of the recognised future pandemic risk. More clarity around their application is to be welcomed, but attempts to make contractors solely liable for the consequences of a recurrence would be a retrograde step for risk management.

Inflationary mechanisms have – in a low-inflation market – been required to a lesser degree in contracts for 20-plus years. Many contractors seeking redress must rely on employers' goodwill rather than entitlement. Along with hedging, the current volatility in prices warrants protecting the survival of the supply chain, not necessarily just its profitability.

Skills shortages will intensify in the short term. It is an industry-wide challenge, exacerbated in the UK by Brexit. CRUX Insight's evidence of shortages in the power industry, which remained buoyant through the pandemic and retained more of its skilled people, is an indicator of how a high-growth segment of the industry is going to struggle to serve the expansion required in energy capacity and electrification.

Construction must broaden its appeal, and at every level – from hearts and minds in schools, through apprenticeships, in-house development and more competitive recruitment (and better retention) of graduate talent, both men and women. The longer-term outlook will be more positive when the true social, environmental and economic value of careers in a re-purposed construction and engineering industry is apparent to the young.

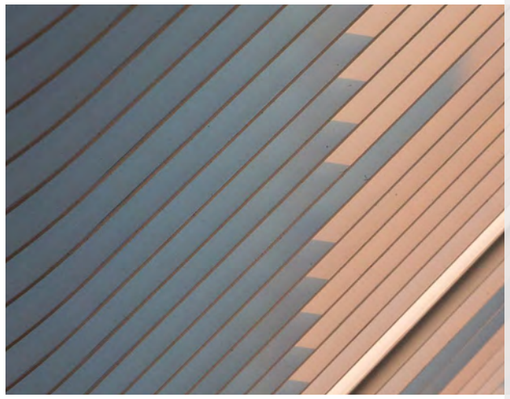
Although a global threat, the climate crisis is a tailwind for an industry that must deliver vital solutions – from clean energy updates to more resilient infrastructure and sustainable development. Governments, private financiers and contract clauses like the NEC's X29 option – and other commercial measures designed to promote carbon reduction – can drive innovation and investment in the transition to net zero.

Technology is already supporting that transformation, while enhancing productivity, safety and sustainability. Examples include virtual reality in training and walkthroughs, or Internet of Things sensors in connected hardhats (monitoring location, motion and temperature) and hexagon geosystems (monitoring structural weaknesses). Various applications of artificial intelligence are expected to help improve cost prediction, safety and sustainability.

BIM is being more widely used, although a lack of skilled professionals is slowing progress. Often now on large projects, design workflows are international as remote teams can collaborate seamlessly, saving costs. Having exploited 3D modelling for decades, the oil and gas industry is developing the use of digital twins, allowing the plant to 'talk back' to the model, and make operations more efficient. Digital twinning of major buildings and infrastructure is sure to follow.

In the meantime, there are fundamental but recurrent errors already described that the industry can put right. Most can be avoided through best practices that should be followed anyway. In a time of high uncertainty, it is self-evident that owners and contractors must double down on proven approaches to planning, procuring and managing successful project outcomes.

Collaboration is all the more valuable when facing multiple risks – it can help contracting parties identify, understand and price them. Contractors need to be more honest with themselves and owners alike when drawing up procurement strategies and related tenders, and push back risks to organisations that should own them. Earlier and more open communications between the parties will help avoid disputes. But, when progress falters or potential disputes emerge, this dialogue should also lead to earlier and less costly resolution of the problems and conflicts that are exacting a heavy toll on European projects.



Industry view

Proven solutions to deploy

The UK infrastructure sector is facing significant headwinds, with inflation having a heavy impact on the cost of operations and maintenance activities, as well asset renewal and enhancement programmes.

CRUX Insight illustrates how shortcomings in design and delivery interface management of increasingly complex infrastructure programmes cause additional costs and delay, which in turn, drive claims and disputes.

Helpfully, the report also points to approaches that mitigate against such risks and many of the techniques cited are established features in Network Rail's pursuit of safe, efficient and dispute free rail investment. Our emphasis on collaborative working continues and a significant proportion of our portfolio employs the principles of The Construction Playbook, draws on enterprise delivery models like Project 13 and the use of NEC4.

Our collective challenge is how to achieve net zero, build greater asset resilience, invest in technology and transform digital & delivery capability, in a way that demonstrably adds (social) value and avoids the inefficient and corrosive effects of claims and disputes.

This year's CRUX report provides analysis and insight on this challenge and offers up credible and proven solutions that we know can make a difference. Stakeholders, clients and key suppliers would do well to consider the extent to which these aspects inform the planning and delivery of their investment.

Stephen Blakey FRICS, FCInstCES, FICW
Commercial Projects Director
Rail Investment Centre of Excellence, Network Rail

MIDDLE EAST

Trade sanctions and drastic cuts in Russian oil and gas exports have boosted the sovereign funds of oil-producing countries in the Middle East, and will continue fuelling economic growth and construction output, at least until a global downturn dampens investment.

Shelter in the region from other global headwinds is more limited. Rising commodity prices have driven up inflation in the region's less affluent countries, setting back progress in reducing poverty as in other regions, from Asia to Europe.

In Gulf Cooperation Council (GCC) states, tender costs have increased due to materials and skills shortages and supply chain disruption. Several markets are overheating, notably Saudi Arabia and, to a lesser degree, Qatar, Dubai and Abu Dhabi. The skills shortage, on top of the challenges associated with importing labour into the market, now represents a fundamental project delivery risk across many of the GCC states.

Construction and engineering output – from real estate and infrastructure to oil and gas – remains buoyant, with a full pipeline of megaprojects, underway and planned, in Saudi Arabia, Qatar and the United Arab Emirates.

The CRUX Insight 2022 analysis covers 380 diverse projects in 12 countries. The top three categories – together accounting for more than 100 projects – were commercial buildings, onshore oil and gas, and transportation infrastructure. With a total CAPEX value of $578 billion, projects in the Middle East faced high overruns in cost and, especially, time. The average sum in dispute was more than a third of project expenditure (35.8%) at the point we completed investigations. Extensions of time claimed by contractors would add more than 83% to programme durations – compared with a global 68.6% average.

Top causes of claim or dispute	Rank
Change in scope	1
Design information was issued late	2
Contract interpretation issues	3
Design was incomplete	4
Contract management and/or administration failure	5
Approvals were late	6
Access to site/workface was restricted and/or late	7
Cash flow and payment issues	8
Poor management of subcontractor/ supplier and/or their interfaces	9
Design was incorrect	10

CAUSES AND EFFECTS

Many of the dominant causes of claims and disputes in the region are design-centric and stem from lower levels of maturity in the construction and engineering industry. The high-risk, low-margin contracting model rules in most parts of the Middle East. Risk allocation is skewed by heavily amended standard forms of contract with onerous terms on payments and liability. Often poorly drafted, they tend to include additional bespoke clauses that may have been designed to address problems that arose on previous projects, but conflict with other provisions of the current contract. Claims and disputes over contract interpretation ensue. Foreign contractors' reliance on translated versions of Arabic contracts is another complicating factor.

While contractors' willingness to take on inordinate risks rises at times of economic distress and falling investment, competition for prestige projects also results in over-ambitious bids.

The prime causes of claims and disputes in the region are not only inextricably linked, they are also unchanging. When the 380 projects are analysed by time period – pre-2017, 2017-19 and post-2020 – the same factors top the rankings: change in scope, and design information that was either issued late or incomplete. No other region shows such consistency – a compelling finding in itself that raises further questions.

However, the chief cause is one seen in all regions. Projects are tendered and launched when designs are still immature. Change is inevitable in major construction projects and unless managed, inexorably leads to a wave of claims mounting into disputes.

But there are compounding factors in the Middle East. Some project owners may be inclined to revise their plans without appreciating the full consequences. Ambiguities in the way contracts are drafted can mean that the parties do not necessarily understand where design responsibility lies.

In the case of design-and-build and EPC contracts, especially, there is a tendency to conflate design development and design changes. On construct-only contracts, design work done under the obligation of employers may be poorly coordinated. As well as errors and omissions in design, we see design development during the shop drawings phase when it falls to the contractor to deal with. More often than not, the contractor takes on 'responsibility' for completing the design during the execution phase of the project. This adds further complexity as to where responsibility for the design actually lies.

Cashflow problems and late approvals are more prevalent, partly because some private employers are strict on payment requirements and the revision of invoices to reflect continual changes, but lax when it comes to approvals. Contractual deadlines may not be correctly interpreted, or consultants delay decisions pending an employer's approval.

These two factors also become entwined with, and are exacerbated, by changes in scope. The mechanisms in contracts for managing change are not generally understood, and because these processes are not followed properly, claims for increased costs and extensions of time lead to disputes. It does not help that contractors often draft their claims poorly, so that any negotiations quickly escalate into formal disputes.

Skills deficits are not new in the Middle East, which still relies heavily on foreign workers – 70% of the working population in GCC states, and as much as 95% in the private

380
projects

12
countries

$1.74bn
average CAPEX

$154m
average cost claimed

83.1%
average EOT claimed

sector in Qatar and UAE.[34] Historically, the Kafala sponsorship system restricted mobility and productivity. As this unwinds, COVID-19 has added to shortages. Private companies struggling to recruit skilled employees are having to increase wages and/or invest in automation.

For two decades now projects have struggled to find suitably qualified engineers. From a localization perspective, the long-running Saudization policy to fill more posts with nationals has made more headway in construction than other industries.[35] But the increasing remuneration packages of staff is adding further to cost inflation, while the Vision 2030 investment programme is driving the high pace of construction activity and sucking up resources.

LOOKING AHEAD

The NEOM project to build a net-zero carbon city from scratch epitomises that visionary ambition and the Saudi commitment to diversify the economy while exploiting modern technologies.[36] Its Vision 2030 and the UAE's 2040 Master Plan should drive investment in digital information management and training on capital projects and infrastructure.

Developers, contractors and consultants are encouraged to invest in technology and digitalisation on megaprojects and other complex works. This is essential for efficient delivery, prompt decision-making, fluid communications, and comprehensive record-keeping. Cost management of labour and materials also benefits, and outcomes on future projects become more predictable.

Other countries can follow Saudi Arabia in mandating the use of BIM on significant projects. The accompanying investment in training is crucial to ensure not only that key staff develop specialist skills but also so project teams are fully conversant with the technology. We have already seen claims arising from misuse or misinterpretation of digital models and data.

Another no less decisive departure from outmoded attitudes and ways of working is needed to reduce the heavy toll of lost time and money on projects in the region. Contracting parties will have to redress their optimism bias and recognise the importance of rigorous risk assessment, while owners must resist the desire to press the project start button once funding is approved.

If more time was taken at the beginning of projects, many of the most persistent problems chronicled by CRUX could be pre-empted. Among other benefits, this would allow for better drafting of contracts and more planning – from how the works are to be sequenced, to the sourcing and logistics of materials and equipment.

Extra effort to get the right team on board ahead of contract award would help ensure staff are suitably qualified and have risk management expertise, (although, admittedly, this remains challenging amid skills shortages). Ensuring continuity between the pre-contract and project delivery teams would at least stem the loss of experience and understanding that is common on projects.

There is now scope for employers in the Middle East to move away from their ingrained insistence on transferring as much risk as possible to contractors. Owners should commit willingly to a more collaborative approach, before their hands are forced by contractors' reluctance to bid, escalating tender prices and market under-capacity. While it remains to be seen whether or not the region is truly ready to embrace collaborative contracting, it is apparent that there is not yet a clear appreciation of what collaborative contracting truly entails.

While it may seem anathema to owners used to determining terms, in other regions early contractor involvement and other standard forms of contract encouraging closer coordination have been seen to help avoid many of the design conflicts endemic across the Middle East.

Designs need to be frozen and analysed for errors and gaps before construction starts. Bringing contractors and suppliers together in the early phases of the project to identify risks allows these to be allocated and mitigated more effectively. This is a cultural shift, however, that will involve accepting the need for behavioural change, as much as adopting different forms of contract.

Resistance to price escalation provisions is also storing up trouble. Squeezed contractors find other reasons to claim. Delay claims are being used as the basis for entitlement to recoup the increased costs they have to absorb.

Buoyed by the oil and gas market, the growth in construction and engineering activity will be sustained at least in the wealthy Gulf states by strong public and private investment. Socio-economic development plans will include a heavy emphasis on energy diversification, notably the Energy Strategy 2050 of the UAE, which was the first Gulf country to commit to the 2050 net zero emissions target. The lessons being learnt in concentrated solar power and other early renewables projects should be captured and shared among the construction and engineering community across the region.

34 Changing the Tide for the Gulf's Migrant Workers | Wilson Center
35 Engineering sector making strides to achieve Saudization targets (zawya.com)
36 About (neom.com)

Industry view

Progress must continue

Construction and engineering activity is buoyant, and the prospects for sustained development are hugely positive, as the engine economies of the Gulf diversify.

While a global slowdown is a worry, the impact of cost inflation and skills shortages is more immediate and pressing, especially in the region's construction hotspots.

The latest CRUX Insight findings reinforce those concerns. The high cost of disputes and long overruns are a concern, and particularly the high prevalence of design-related disputes.

There is rapid change as our industry adapts to deliver technically advanced projects – from solar to world class buildings and infrastructure – and adopts digital and other technologies, at times more rapidly than other territories. Yet the region suffers from a disproportionately high number of claims and disputes.

Recently we have seen vast improvements in terms of project planning, procurement and contracting. This needs to continue – to reverse the claims trend and increase project performance.

With so many significant projects in hand and in the pipeline, project promoters, contractors and the supply chain can learn not only from the experience of other states and stakeholders in the region, but also from other parts of the world where alternative methods have been tried and tested.

Christopher Seymour

Head of Strategy and Investment for Middle East, Africa & South Asia, Mott MacDonald

Chair of Royal Institution of Chartered Surveyors MENA

OCEANIA

The two dominant economies of the vast Oceania region spanning Australasia and the Pacific Islands both recorded strong economic growth in 2021. They also have healthy pipelines to sustain construction and engineering growth in the short to medium term. While Australia has experienced boom conditions over recent years, the long-term trend in New Zealand saw output more than double since 2010, as measured by contribution to GDP.

Already struggling with labour shortages and inflation, Australia and New Zealand are remote from war in Europe, but not immune from the effects of price rises in oil, gas and base metals. Trade sanctions also impact supply chain bottlenecks, not least for timber – Australia was a heavy importer of wood products from Russia, with smaller flows from Ukraine.

Trade tensions with China and the capacity of the local construction market are, perhaps, greater concerns. With unemployment rates near record lows in both countries, recruitment is difficult and there are tendering hotspots in several cities and states.

While rising interest rates may dampen some activity, Australia also benefits from global inflation as a commodity exporter. With the new federal Labor administration (ALP) pledging further significant investment in Australia's transport infrastructure, as well as the residential sector and mining, construction's boom is set to continue.

A total of 125 projects in four countries within Oceania were analysed for CRUX Insight 2022. The three largest categories were transportation infrastructure, mining and metals, and liquefied natural gas (LNG). Total CAPEX value was more than $410 billion, third-highest in the analysis. Costs claimed on these major projects averaged $88.3 million, which represented 26.2% of CAPEX. The time extensions sought on projects in the region were equivalent to 63.8% of programmed durations, a few points below the global average.

Top causes of claim or dispute	Rank
Change in scope	1
Contract interpretation issues	2
Access to site/workface was restricted and/or late	3
Contract management and/or administration failure	4
Design was incorrect	5
Design information was issued late	5
Claims were spurious	7
Design was incomplete	8
Poor management of subcontractor/ supplier and/or their interfaces	9
Physical conditions were unforeseen	10

CAUSES AND EFFECTS

The pattern of causation underlying claims and disputes in Oceania largely mirrors that in the rest of the world, apart from spikes in impediments to site access and conflicts over spurious claims.

Climate change is increasing the frequency and intensity of extreme weather events, notably more regular flooding in Australia and New Zealand, and extensive Australian wildfires. While many of the claims may be blamed on the elements, the high number of transport and infrastructure projects underway in Australia is another major factor. Access becomes critical on rail projects, in particular, where track and other works have to take place in strictly controlled windows for operational and safety reasons.

Site and workface restrictions also have a cascade effect. A delay in progress by the head contractor or a subcontractor can hold up the following trade or works package. Knock-on effects can extend through the supply chain and wider project environment, where a project is impacted by delays outside its control on other schemes.

However, in most cases, the root causes lie upstream in planning, development and procurement, which have unintended consequences on interfaces between the different elements of the project and how they are managed, or mismanaged.

Spurious claims – often designed to conceal contractors' low productivity – also spring from various hidden causes: poor design management, a flawed understanding of their own works, and increasingly, labour problems. Lump-sum contracts are setting a very high bar for contractors' claims for delay or quantum, whatever the grounds. However, contractors are all too aware that they will lose out to competitors if they submit a non-conforming bid offering a different approach to cost build-up.

Despite the uncertainties whipped up by the global headwinds and local market overheating, contractors continue to show a voracious appetite for risk. Though the pressure on margins in Oceania may have eased slightly compared with some other regions, firms that are one big claim away from failure feel pressured to win the next project and submit spurious claims to fund it. Amid under-bidding in a highly competitive market, it is not unknown for winning tenders to omit large elements of works. Contractors also commit to impracticable timeframes. Claims for costs and extended time become their only recourse for recovery and survival.

Some other high-ranking factors – such as contract interpretation and failures in contract management or administration – also reflect the changing nature of construction and engineering workload. Up to 2015, resource extraction was Australia's most buoyant market. Mining has since given way to a construction boom led by transport projects, mostly in brownfield environments that have to navigate below-ground utilities, adjacent foundations of buildings, and other access complications.

In the case of contract interpretation, the type and scale of projects are also influencing the mix of claims and disputes. Government contracts, even when based on standard forms, are customised to suit the client. The value of projects is also markedly different from what the market was used to. Rather than contracts worth hundreds of millions, contractors are taking on works valued in billions of dollars, with a commensurate step change in complexity, placing greater strain on skills and contract management processes.

125
projects

4
countries

$3.76bn
average CAPEX

$88.3m
average cost claimed

63.8%
average EOT claimed

Again, as with access, rail and other transport projects are also raising the stakes in interface management as possessions of the network must be meticulously planned long in advance.

LOOKING AHEAD

While transport and rail projects will still be to the fore in Australia, the balance in this market segment is changing to a more even mix between greenfield and brownfield locations. Nevertheless, access issues can be expected to prevail, and physical and systems interface management will be a major risk. Both clients and contractors need to make greater efforts to improve planning and coordination through close engagement with all other parties and stakeholders. The onus will be on project promoters to plan up front and manage both physical interfaces and the integration of systems effectively. The scope of works and designs must be developed effectively too so that teams are ready to access their window and avoid delays.

Gaps in skills and experience may underlie other causes of claims and disputes, from management of contracts and subcontractors to design and contract interpretation. Workmanship deficiencies – perhaps surprisingly absent from the top-ten ranking – can be expected to become a greater problem as skills shortages worsen.

In Australia, the industry faces a shortfall of 105,000 full-time equivalent workers by mid-2034, according to Infrastructure Australia's assessment of market capacity. A broadly proportional trend is also playing out in New Zealand, where it is estimated the construction sector will be 120,000 workers short by 2025.[37] Megaprojects have attracted skilled tradespeople with higher pay and longer-term job security, leaving smaller projects high and dry. In the current labour market, a big portion of the workforce is under-trained or inexperienced. Higher investment and more concerted training programmes are essential if skills are not to be spread too thinly through the region.

Amid a construction boom, contractors may be more selective in some markets, but they are showing little aversion to risk. The mentality remains 'win first, solve problems later'.

If contractors cannot help themselves, it falls to project owners.

Owners need to show a more rigorous understanding of their project's objectives, and then consider how to engage with the market, the information to provide, and the type of relationships that would best serve their desired outcomes. In a construction and engineering market operating at or beyond capacity, that may mean slowing the pipeline of major government-funded infrastructure projects. In Australia, expenditure is set to reach AU$52 billion in 2023, and AU$300 billion over the next 10 years.[38] Similarly, in its 2022 budget, the New Zealand government committed to spend NZ$61.9 billion on infrastructure over a five-year period.

Additional rigour is required too when reviewing tenders, with greater emphasis on bid quality rather than cost alone. When project controls are not connected to scope it becomes difficult to assess tenders on their merit. There are clear benefits in following a published project playbook but there is resistance in Australia to this approach.

Good behaviours are fundamental and need to be cultivated. It is necessary for parties to understand their supply chain, and market capacity and capabilities. Owners would also be well advised to monitor performance and the challenges contractors are facing, and continue to support them and the supply chain in finding solutions.

COVID has accelerated digitalisation – from cloud services and wearable technology to drones, advanced analytics and green solutions. Yet there is no national BIM mandate in either Australia or New Zealand and few standards for technology adoption. Queensland has given BIM the state's seal of approval, and New South Wales is kick-starting modern offsite methods of construction by sponsoring prefabricated designs and production. To raise the productivity of a fragmented industry facing acute skills shortages, a holistic construction tech strategy is required.

There are parallels with the climate crisis. Governments are committed to environmental responsibility and a raft of related investments and measures. The federal Labor administration's Powering Australia Plan, for example, will invest US$15 billion to accelerate high-voltage infrastructure with further support for the manufacture and deployment of low-emission solutions and renewable energy – while still expanding coal mining.[39] Some 85 solar banks and 400 community batteries are planned, at a cost of US$225 million, but no new power stations. Environmental targets are set for recycled content, but not for zero carbon or zero waste on major projects.

Policymakers and construction industry leaders may not lack commitment to transformative development, but a strategy is needed that sets out priorities and a sustainable plan for delivery. In the short term, market stresses may be more disruptive of capital projects than climate change and other global and regional headwinds.

37 First Infrastructure Market Capacity report reveals surge in demand for skills, labour, plant and materials | Infrastructure Australia

38 Opportunities and Challenges – Top 10 Trends and Developments for the Australian Construction Market : Clyde & Co (clydeco.com)

39 61a9693a3f3c53001f975017-PoweringAustralia.pdf (keystone-alp.s3-ap-southeast-2.amazonaws.com)

Industry view

Improve through engagement

Much like the rest of the world, Oceania has been grappling with a series of transformations in the movement of people and goods, against the backdrop of the COVID pandemic and worsening climate crisis. Extreme weather events are increasing, from wildfires to flooding, across Australia, New Zealand and other parts of Oceania.

Infrastructure projects must contend with growing complexity as they address changing trends in urban logistics. Thriving cities must cater for increasing urban populations. In this increasingly urbanised world, transport infrastructure is a key factor on the path to realising our low-carbon, sustainable future. Yet the necessary projects to upgrade and future-proof our transport systems must grapple with outdated practices which prioritise cost over project quality.

CRUX Insight shows the extraordinary tolls in project time extensions and costs claimed. Project coordination and planning can be improved through closer engagement with all parties and stakeholders. To realise long-term strategic change, behaviour change must be harnessed now, so that the potential benefits are locked in for the future.

Joanne Carmichael

Principal, Cities, Planning and Design and Global Planning Skill Lead

ARUP

HOW TO USE CRUX

CRUX is our integrated research programme that captures data on the proven causes of claims and disputes. The purpose of this CRUX Insight report is share insights from this data – and from our consultants working in the field – to help improve project outcomes.

Our aim is that as many industry stakeholders as possible, not just our clients, derive value from this unique and growing bank of data. Previous CRUX Insight reports have been referenced in panel discussions, webinars, speaking engagements, interviews, and articles published around the world, as well as by a UK parliamentary inquiry into management of major state projects.[40]

CRUX is a source of valuable intelligence on the causes underlying claims and disputes that can inform planning and policy at national, industry, enterprise and project level.

Industry and professional bodies and universities are encouraged to disseminate CRUX's lessons widely, and they can be used by Governments to inform legislation, policy, and practice. At the project and enterprise level, various companies can gain from further analysis, including employers, contractors, insurance providers, designers, suppliers, financiers and lawyers.

This report's high-level findings are underpinned by what we believe is the most comprehensive, fact-based analysis of claims and disputes on engineering and construction projects worldwide. Industry stakeholders can delve deeper into the CRUX dataset with the help of the CRUX Interactive Dashboard.

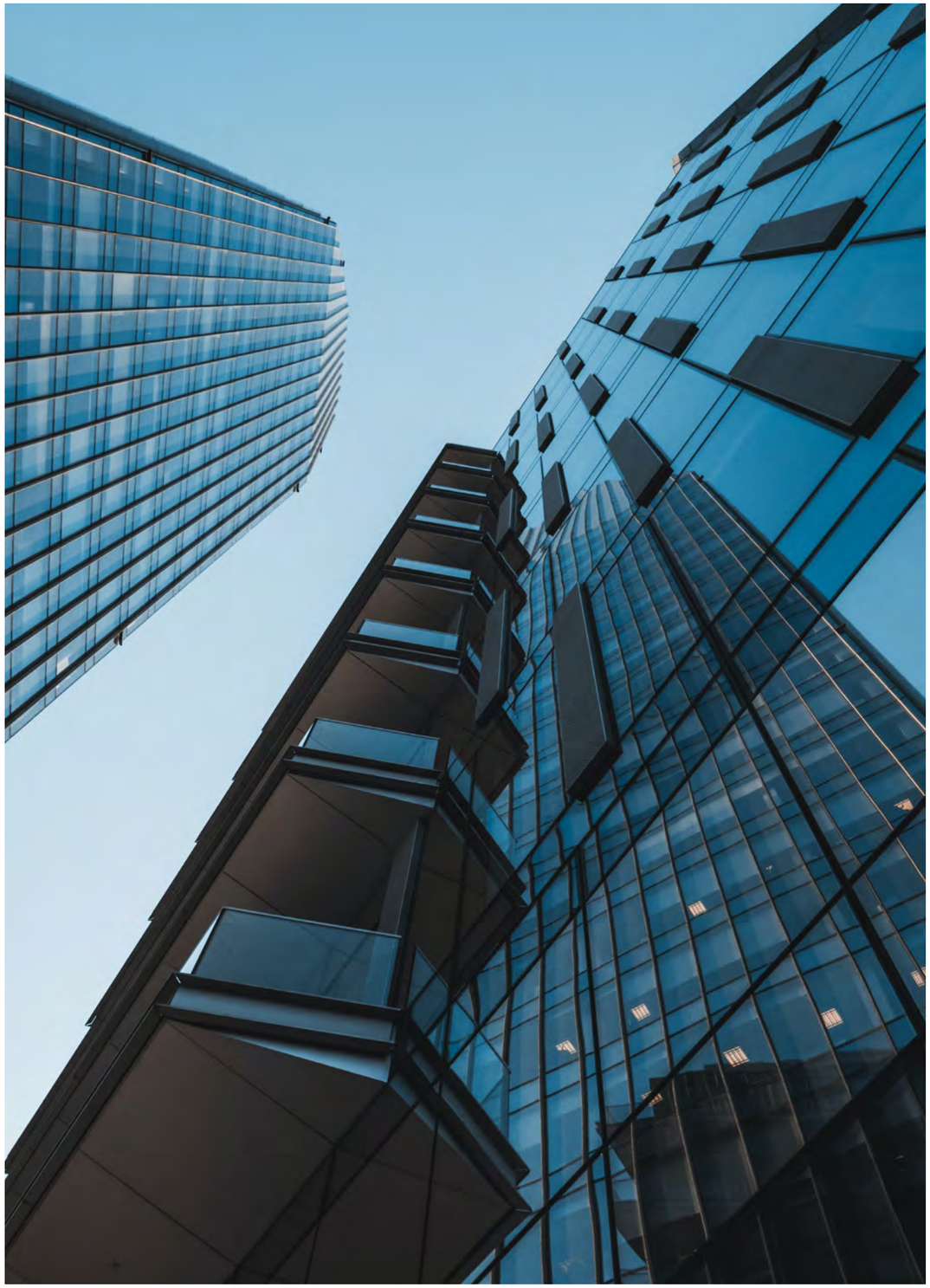
New insights also emerge from tailored analysis by HKA data analysts, helping clients shape strategy and set priorities for planning, procurement, and project controls and governance.

CRUX can answer a multitude of questions, such as: the most prevalent causes of claims and disputes by industry; the proportion of projects affected by a specific cause in particular jurisdictions; or the extension of time typically claimed on different types of renewable or fossil energy projects by region or globally; among many others.

The intelligence can be used to:

- Benchmark current performance.
- Analyse and mitigate project risks more accurately.
- Gauge risk in new target markets.
- Re-calibrate risk at corporate level, by region or sector.
- Improve commercial decision-making
- Compare procurement options.
- Evaluate dispute resolution methods.

HKA is committed to our ongoing integrated research programme, and to sharing the fruits of our analysis with clients and the wider industry, in all regions.



40 House of Commons Public Administration and Constitutional Affairs Committee review of government management of major projects

CRUX METHODOLOGY

The Fifth Annual CRUX Insight report presents the high-level findings from our analysis of the causes of claims and disputes on over 1,600 projects in 100 countries worldwide.

What are the main causes of claims and disputes?

As stated in previous CRUX reports, we are committed to continual refinement of our defined causation factors for claims and disputes to reduce subjectivity and improve reliability. The CRUX team compared the causation taxonomy against 57 peer-reviewed academic publications, industry reports and other available sources worldwide. This yielded a list of 1,750 causes of construction and engineering claims and disputes.

Through detailed analysis and mapping for trends and variations in terminology, we were able to rationalise these causes into 50 coherent, individual causes of claim or dispute. The list was then reviewed by a HKA Expert Review Panel to test these often-theoretical factors against practical experience of live projects. This exercise produced a refined list, which the panel ranked according to frequency rather than gravity to give the top 30 most common causes of claim and dispute.

The list was then shared more widely with HKA experts from all disciplines and regions to ensure that the causation factors used in our questionnaire would be comprehensive and representative of the disputes and projects handled across the business. This led to further refinements, for example, the addition of three causes to cover claims and disputes relating specifically to COVID-19, before final agreement on the list of top causes in the questionnaire.

Criteria for a CRUX project

The CRUX report looks at construction and engineering projects which have had a claim and/or a dispute and that HKA has provided services for.

Process of producing the report

Once our team has been involved with a project for long enough, they use their experience and knowledge of the project to complete a digital questionnaire to provide us with data and insight for CRUX. Ahead of each annual Insight report, we analyse the updated dataset – globally and by region, sector and various other parameters. Having shared our findings with colleagues in each of HKA's six operating regions, we interview panels of our experts to test our findings and gain insights from their experience. The combined commentary and analysis are peer-reviewed by senior leaders before publication.

If you would like to know more about the methodology behind our reports, please contact CRUX@hka.com.

The CRUX dataset is based on the findings of HKA investigations of claims and disputes. Regional expert panels challenge our analysis and share their insights, which are also grounded in real-world experience.

CRUX INTERACTIVE DASHBOARD

CRUX, HKA's integrated research programme, is building a unique bank of knowledge on the causes of claims and disputes on major capital projects across the globe. This is a potentially valuable resource for decision-makers – from owners and financiers, insurers and legal advisors, to contractors and suppliers – and all parties to construction and engineering contracts.

The CRUX Interactive Dashboard allows you to explore this dataset on more than 1,600 projects. You can review the top causes of claims and disputes in your region and sub-region, and sector or sub-sector. Or compare the patterns of causation across regions and sectors. The 2022 dashboard now also allows you to select a data range for your analysis by specifying start and end dates for construction.

We urge you to engage with the CRUX research programme's findings so that the planning, procurement, project governance and controls for your project can be informed by this empirical data and our analysis.

The CRUX team will be delving deeper into the dataset and sharing new insights through various media. Please feel free to contact a member of the CRUX team should you be interested in collaborating with us.

Scan the QR code or visit

www.hka.com/crux-interactive-dashboard

WHO WE ARE

HKA is a leading global consultancy in risk mitigation, dispute resolution, expert witness, and litigation support services.

We provide a comprehensive set of specialist offerings, including Expert, Claims and Advisory services for the capital projects and infrastructure sector. HKA provides forensic accounting and commercial damages services for all types of contracts, including commercial and investment treaty disputes. Our other area of specialist expertise is in US Federal Government contracts. HKA consultants support contractors and suppliers operating in this complex business and regulatory environment.

HKA brings a proud record of excellent service and high achievement to bear on today's challenges. As trusted independent consultants, experts and advisers, we help clients manage disputes, risk and uncertainty on complex contracts and challenging projects.

Clients have access to leaders and problem-solvers who decode complexity through collaborative working and innovative thinking, making the best possible outcomes a reality for our clients, every time.

Achieving successful and fair outcomes is our passion, so we have the confidence always to provide impartial advice as well as expert insight. We are proud to make the difference that benefits clients and their projects, our industry and society at large.

HKA works with law firms, contractors, owners, operators, and other professional service providers across the breadth of the risk mitigation and dispute resolution market. Our global portfolio includes some of the world's largest and most prestigious commissions across a wide range of industries including industrial & manufacturing, power & utilities, resources and energy transition, transportation infrastructure, buildings, technology, financial services and government contracts.

HKA combines unmatched experience with a multi-disciplinary skillset that sets us apart in capital projects consultancy. We decode their growing complexity to achieve the best outcomes possible by resolving disputes, managing claims, and providing strategic advice.

Our people have vast first-hand experience spanning all major industries and the world's most complex megaprojects, as well as an international track record of achieving successful outcomes.

We have over 1,000 experts, consultants and advisors across 40+ offices in 18 countries – with the skills and experience that are essential to get to the heart of even the most complex issues.

CRUX INTERVIEWEES

Below are our CRUX experts, drawn from all HKA disciplines and offices, who were interviewed as part of the research process. They have contributed their expert insights and regional perspectives based on direct experience working on some of the world's largest and most complex engineering and construction projects.

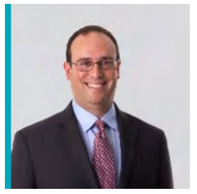
Justin Axten
Consultant

Gerry Brannigan
Partner

Bob Breeze
Partner

Hamish Clark
Partner

Maged Abdelsayed
Partner



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Dan Squillace
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CRUX INSIGHT