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The Future of Major Programme Delivery
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The Future of Major Programme Delivery

In this report, currencies are given as US dollars unless stated otherwise.

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Foreword: Davendra Dabasia, Chief Executive Officer, Consult, Mace

For more than 20 years, I have been involved in the delivery of some of the most iconic programmes and projects in the world. A standout moment for me was playing my part in the exceptional team that delivered venues for the London 2012 Olympic and Paralympic Games. Not only did the Games attract millions of visitors worldwide and generate significant value and pride for the UK, the construction of the venues, infrastructure and the entire Park was considered to be an exemplar for how to deliver complex, large-scale capital developments effectively. The programme also taught us a lot at Mace, helping to guide the evolution of our global consultancy business. The experience was invaluable and helped shape what we stand for. This influences the work we do and how we deliver for clients across the world.

The London 2012 Olympic and Paralympic Games was one of the first times that a 'delivery partner' model – a truly collaborative delivery approach – had been used in a meaningful way. It enabled the entire programme to be delivered early and below budget, with venues and infrastructure assets completed a year before the Games began and with an underspend of £600m ($800m). It also attracted ongoing investment, generating a legacy of socioeconomic value that lives on to this day.

However, more than 15 years later, instead of applying and building on that model's proven performance, and following the general consensus that collaborative models lead to better outcomes, our industry continues to face significant challenges managing and delivering on promises.

Analysis shows that more than 90% of mega-projects (those valued over $1billion) experience cost and schedule overruns. The root causes remain the same: unclear governance structures and funding agreements; overly optimistic estimates; poorly defined scope; disjointed execution; and conflicts often exacerbated by poorly defined programme objectives and failure to integrate project organisations, supply chains, operating systems and technologies.

Nevertheless, we are at a turning point – a time of record investment, with more than 11,000 live mega-programmes and projects and 250 giga-programmes and projects (those valued at more than $10 billion) around the world. This is an estimated 280% increase compared to 15 years ago and represents more than $15 trillion of expenditure, with significant consequences for countries, climate and people.

Our insights, from a dataset of more than 5,000 mega and giga-programmes and projects around the globe, and interviews with 30 industry leaders, provide an indication of the state of major programme and project delivery today. We are exploring common challenges, lessons learned and, most importantly, practical steps that leaders can take to promote effective delivery of current and planned projects.

A core part of the solution is a concerted industry shift towards truly collaborative delivery approaches, whether that's alliancing, progressive design and build or the delivery partner model. Irrespective of the specific approach, what's important is the formation of a truly integrated delivery team, consisting of clients, consultants, contractors and supply chain organisations, that is empowered to take best-for-programme decisions across the entire lifecycle and focused on achieving long-term beneficial outcomes.

Time and again, I've seen the power of collaboration in practice. What's more, there are studies suggesting that more collaborative approaches significantly improve delivery outcomes. Evidence has shown a 4%-13%[i,ii] reduction in costs compared to less collaborative contracting models and a 50% reduction in the risk of the project being delivered late[iii,iv].

A collaborative mentality only works if the wider ecosystem allows for it. What that means in practice is genuine alignment on meeting shared goals, with everyone pulling in the same direction to achieve them on behalf of the client. Shared success should mean shared reward too. An ecosystem that operates fairly will boost engagement, morale and commitment.

It is within this context where I believe we're leading the charge at Mace. Blending our unique focus on programme and project management with the global insights of our delivery consultants and the practical knowledge of our construction experts, our collaborative approach is unique in that we understand how to deliver. We act as a trusted partner across the entire programme lifecycle, not simply providing strategies for delivery, but executing them. At the programme level, this means we actively shape and optimise the approach. At the enterprise level, we help to develop a one-team culture, focused on unifying all parties against common goals.

I hope this report serves as a practical, honest, and ambitious roadmap to change the way we deliver large-scale programmes for the better.

— Davendra Dabasia, Chief Executive Officer, Consult, Mace

Foreword: Andy Beard, Managing Director for Europe, Consult, Mace

When I describe what constitutes a major programme, I like to take things back to basics. Major programmes exist to deliver outcomes and benefits.

It doesn't matter whether its renewable energy or railway stations, hospitals or homes, schools or stadiums, defence estates or datacentres, everything we build should always begin with benefits in mind.

While simple as an overarching concept, to unlock real benefit requires deeper thought and thorough planning. The more efficiently and effectively we deliver the programme to achieve the outcome – while not diluting any of the expected benefits – the greater the impact we will have on society and the stronger the enduring legacy of the investments we make.

The value of outcomes is a consistent theme in this paper, and the importance of playing to this strength as an industry has never been greater. Major programmes around the globe are under increasing scrutiny in the wake of high-profile examples of overspend and delay, with the media regularly placing the likes of The UK's Crossrail and Germany's Brandenburg Airport in the headlines.

Why are major programmes so often faltering and, therefore, struggling to realise the intended benefits? You might point to heightened political fragmentation and bureaucracy, economic headwinds, and the impact of 'shock' events like the Covid-19 pandemic and military conflicts. These things undeniably have an impact, but our analysis indicates that underperformance has persisted across at least the past 15 years. What's more, our interviews with industry leaders point to a collective recognition that there are plenty of challenges within the control of the programme team.

This industry-wide reflection presents an opportunity. In the UK alone, there have been just under 500 mega-projects announced since 2010 – a substantial number. All the while, the scale and complexity of such programmes continues to increase. The prize for 'getting it right' is considerable – better defined outcomes, better delivery and better long-term benefits. In turn, the reputation of our industry gets elevated, boosting confidence, further investment and innovation. It's a virtuous circle.

Of course, it's important not to underplay the barriers to reaching this state. When I draw on my own experiences, there are undoubtedly more things that can get in the way of achieving outcomes today compared to when I started my career. In my opinion, this is largely a by-product of increased complexity, both within the programme environment and across external factors, creating more blockers to 'getting stuff done' to deliver the outcome.

Recognising the breadth of the challenge, we've created this paper to serve as a comprehensive framework for better programme delivery. From practical improvements that programme leaders can make at the earliest of stages (such as nailing down a clearly defined scope) to a concerted call to governments for clear, funded and long-term programme pipelines, our recommendations reflect the need for genuine collaboration between all 'players'.

My ask to anyone reading this document is to strive for true collaboration, regardless of the size or scope of your project or programme. Many of the principles we outline in this paper are scalable and, if framed in the context of achieving long-term meaningful benefits, provide the basic ingredients for a better future for major programme delivery.

— Andy Beard, Managing Director for Europe, Consult, Mace

Executive summary

Major programmes have entered an era of unprecedented investment, unmatched scale and unique complexity. Today, there are over 11,000 mega and 250 giga-projects and programmes in delivery across the world. Just this group of programmes – categorised as having a value of more than $1 billion and $10 billion respectively – represent more than $15 trillion in capital expenditure. However, despite this momentum, the industry continues to grapple with persistent challenges to delivery, with associated cost overruns, schedule delays, and under-realised benefits remaining the norm rather than the exception. Failure to get on top of these challenges puts at risk more than $1.5 trillion of economic growth by 2030.

This report, grounded in an analysis of more than 5,000 mega and giga-programmes and projects, and enhanced by insights from over 30 industry leaders, offers a frank assessment of the barriers to effective delivery. It identifies the systemic issues that continue to undermine performance, ranging from optimism bias and fragmented governance to talent shortages and misaligned incentives. These challenges are not confined to any one geography or sector; they are global, structural, and deeply embedded in the way projects are conceived, procured, monitored and managed.

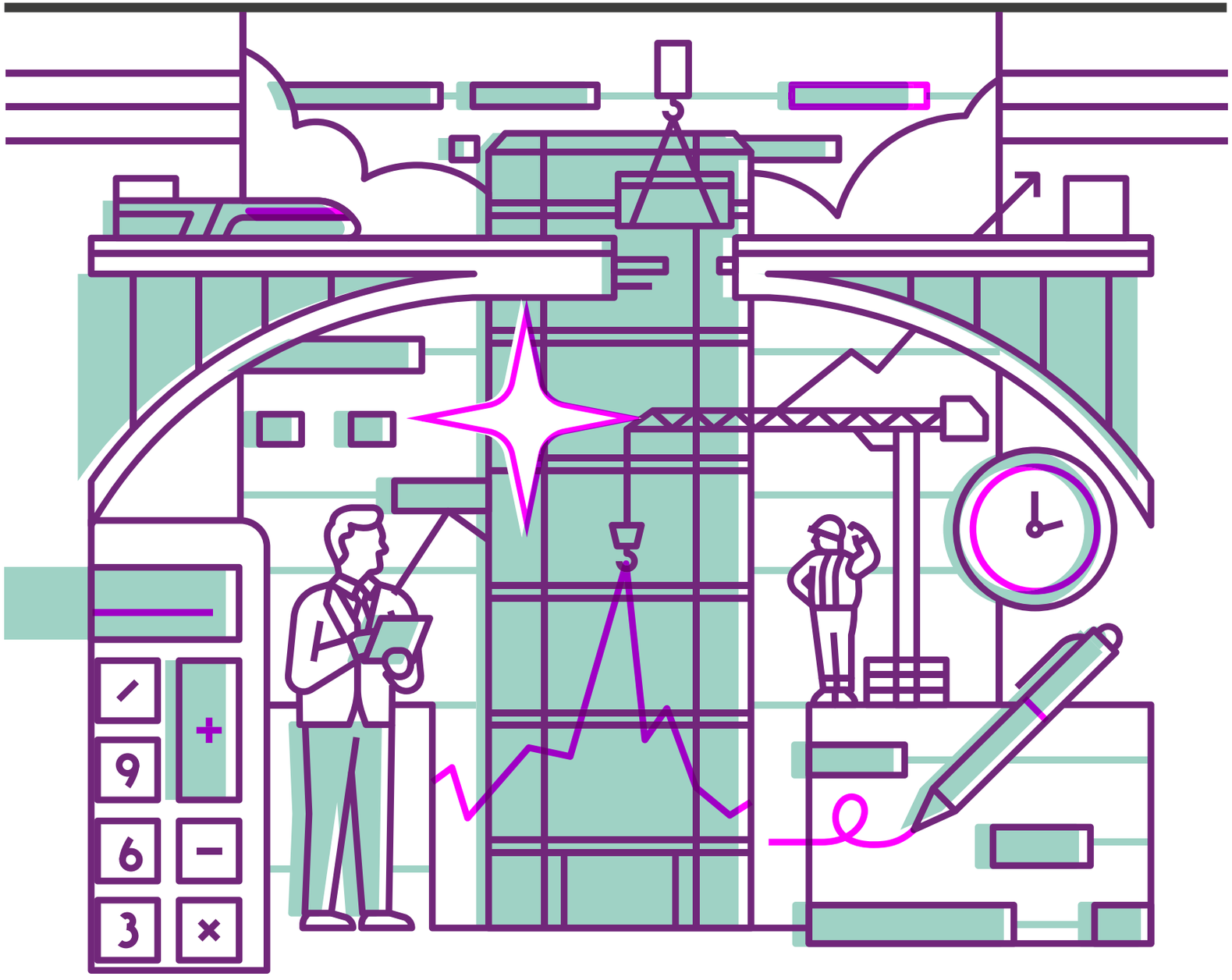
Even so, there is a promising opportunity for change. This report calls for a fundamental shift towards collaborative delivery models, pointing to ten core pillars as a guiding framework for anyone in the industry. These are approaches that prioritise robust governance, integration, common goals, shared accountability, and long-term value over transactional relationships and short-term gains. Drawing on successful case studies such as the London 2012 Olympic and Paralympic venues, the Hudson Tunnel Project in the US and the Reconstruction Programme in Peru, the report illustrates how collaborative frameworks can significantly improve intended outcomes.

Along with collaboration, the industry must evolve through innovation, with the transformative potential of digitalisation and AI in reshaping delivery at the vanguard. From predictive analytics and digital twins to intelligent procurement and real-time risk monitoring, technology is not as a panacea, but rather a powerful enabler of better planning, more informed decision-making and improved productivity.

This report serves as both a diagnosis and a roadmap, challenging industry leaders and wider influencers to reflect on the barriers they face (and perhaps enable), as well as offering twelve recommendations for actionable solutions. From clearly defining baseline scopes with realistic cost envelopes, to purposeful procurement that seeks suppliers who ‘fit’ the culture, to ensuring a legacy of global industry knowledge share: the opportunities for improvement are there to be taken. If clients, consultants, contractors and supply chain act selflessly, aligning behind a unified understanding of the intended outcomes, we can unlock the long-term value tomorrow’s large-scale programmes can bring.

> **“Since I established Mace’s major programmes offering in 2013, the urban environment has changed beyond recognition; shaped by innovative processes, intelligent people and iconic projects. Mace has played a prominent role in driving the major programme boom, bringing lessons from around the globe, and across both our consultancy and construction teams, to help foster the collaboration that is so crucial to delivering modern, fit-for-purpose and resilient buildings and infrastructure.”**
>
> —Jason Millett, Group Chief Executive Officer, Mace

Setting the scene



Setting the scene

Across the world, programmes and projects are becoming larger, more complex and more expensive. We are no longer in an era of mega-programmes (typically valued at more than $1 billion) but an era of giga-programmes and projects.

'Giga' applies to programme investments that exceed $10 billion, usually spanning a decade or more, and with significant potential to transform entire nations. If they are not well delivered, they can substantially erode value by diminishing productivity, service capacity and resources needed to meet current and future demands.

The findings and recommendations we present in this report have relevance for both programmes and projects of scale at a time of record investments in public infrastructure and advanced manufacturing and technology facilities around the world.

Our research shows that the number of live mega-projects and programmes has ballooned by 280% over the past 15 years to more than 11,000, with over 250 programmes of giga-scale currently in development or delivery. Altogether, they reflect $15 trillion in capital investment. Meanwhile, through our literature review, we found research that points to particularly strong construction activity in India, the US and China. India's growth potential, in particular, is considerable. In 2024 its total construction market was valued at $1.04 trillion, with final 2025 figures expected to be $1.21 trillion. By 2030, the growth trajectory will see the nation's construction industry reach a value of $2.13trillion[v]. Behind these three standout nations, the UK, Kingdom of Saudi Arabia (Saudi Arabia) and the United Arab Emirates (UAE) are also seeing healthy construction pipelines.

We also note growth driven by significant urbanisation in North America and Latin America[vi]. When looking specifically at investment trends in mega and giga-projects, the USA, India and Saudi Arabia top the list[vii].

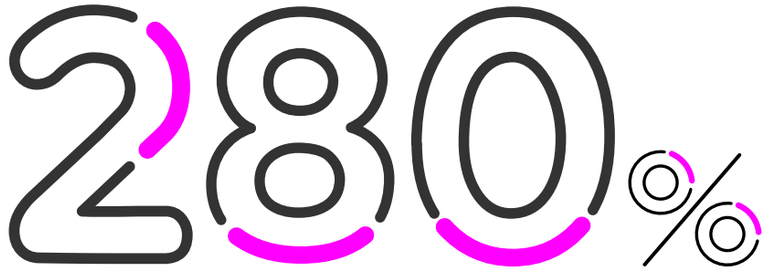
However, despite the significant rise in construction activity, and particularly in very large and complex projects, the ability to deliver on time, on budget and with the promised economic and societal benefits continues to suffer and, in some instances, has gone in the opposite direction. While this is being countered to some degree through best practice collaborative delivery models, there are more barriers to success than ever before. Let us be clear, the issue goes far beyond delivery (in a literal sense), with politics, economics, regulation and climate change among the influencing factors that can only be solved with a true, multi-agency collaborative effort.

These programmes present an opportunity to significantly improve the capability and capacity of global and local supply chains, while enhancing the skills and competency of the workforce to achieve improved productivity, quality and safety.

New analysis for this report indicates that across our sample of over 5,000 global mega-projects, 11% of them are at risk of significant delay or cancellation.

From a cost perspective, a previous research paper and subsequent book – *'How big things get done'* – by Professor Bent Flyvbjerg, showed that nine out of ten mega-projects experience cost overruns. Programme and project overruns are common across the board, and overruns of more than 50% are not unusual for mega and giga-projects.

Since 2010, our research shows that the number of live mega-programmes and projects has ballooned by...



These instances are not merely historical hangovers. Such challenges continue to escalate, with urbanisation, technological advances, and the need to bolster resilience to climate threats driving greater demand and urgency for large-scale capital developments. This holds true in both mature and emerging economies, in public infrastructure and private industries. As programmes grow larger, more complex and expensive, socioeconomic stakes take on greater weight, with significant potential to generate value or diminish it in real terms.

Applying lessons from past mega-projects, we know that bias for action and over-optimism often influence misguided decisions. Nobody sinks billions into capital investments without expecting to generate a positive return for the investor or society, but the ability to achieve intended outcomes depends on causality. This requires well-defined, multidisciplinary management levers, proven to drive effective execution and results by design.

Those who think this is solely an issue for a small handful of countries would be wrong. Yes, some countries have better delivery rates than others, but even in the highest performing nations, a sizeable proportion of large projects and programmes are delivered late and over budget. A recent research project by Middlesex University Dubai[viii], looking across 95 organisations in the Middle East and North Africa, found that 82% of respondents expect their construction projects to face disputes within the next three years. The main drivers are delays (90%), alongside claims for disruptions, such as limited availability of materials and equipment, supply chain and service coordination issues, such as utilities (86%), changes in scope (86%) and additional, unforeseen costs (86%).

In addition to delivery challenges, many countries and sectors suffer from a shortage of suitable talent and can find it difficult to build highly capable teams that can oversee the delivery of major programmes and projects.

Balanced against the value created by major programmes that come to fruition is the consequence of not doing them. For example, the reason the $16 billion Hudson Tunnel Project is considered America's most urgent infrastructure priority is because it will resolve chronic service disruptions at the busiest point of the US Northeast Corridor, home to $2.6 trillion of the nation's annual economic output. At the heart of the world's largest regional economy, the costs of this single point of infrastructure failure far exceed the project price – amounting to $16 billion in productivity losses, $22 billion lost in property value, and $7 billion in tax revenue losses every year.

Acknowledging the stakes, the New York and New Jersey Gateway Development Commission chose a collaborative partnership model to make the most of the project (with a Mace-Parsons-Arcadis joint venture serving as delivery partner). The project is already supporting 20,200 jobs and $4.5 billion in economic output, and throughout the

construction period, it's expected to create 95,000 jobs and $19.6 billion in economic activity.

To give another sense of scale, the average Fortune Global 500 company (the 500 largest corporations worldwide by revenue) employs 140,000 people. Across New York's Metropolitan Transport Authority's 2020-2024 capital investment programme[ix] there were 170,800 roles directly or indirectly supported or created.

In light of the stakes, the aim of this report is to consider why mega and giga-programmes and projects encounter delivery problems, despite years of case studies documenting critical success factors for effective delivery. Why have we not seen marked improvements, and why, in some instances, does it seem that delivery has regressed? In an era of accelerating digital modelling, automation and augmented intelligence, we also look at the potential opportunities with AI and digitalisation on major programme delivery and how it can help us to overcome common challenges, risks and management pitfalls.

Our research provides insights, drawn from analysis of a global data set of more than 5,000 mega and giga-projects, a review of global academic research, and in-depth interviews with more than 30 of the world's foremost programme leaders.

While there is no singular 'silver bullet' solution to the delivery conundrum, the insights within this paper seek to provide guidance for those involved in complex programme and project delivery. To do so, the paper offers a considered and consolidated framework to inform their understanding of issues they are likely to encounter, their root causes, and recommendations to progress effective delivery that realises the full promise and value potential inherent in these large-scale programmes.

Global delivery in numbers

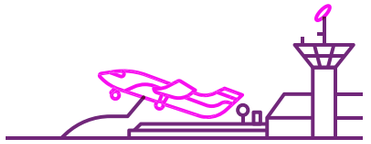
Global delivery in numbers

Before we dive into why mega and giga-projects face challenges, the solutions and what the future of major project delivery looks like, it is helpful to orient ourselves with an assessment of the delivery landscape of today and recent years around the world.

To do so, we have undertaken a new analysis of a global dataset of more than 5,000 mega-projects (capital value of $1 billion or more) and giga-projects (capital value of $10 billion or more). To build the database we sourced information from GlobalData, used AI tools and conducted our own academic desk research from a selection of geographies that are reflective of the global position. We captured both mature and evolving delivery track records, and those which we believe have active capital pipelines.

The locations we included were Saudi Arabia, UAE, Philippines, Hong Kong, India, Australia, UK, Ireland, US, Canada, Peru and Colombia, with reliable data going back to 2010.

This data set allowed us to better understand important delivery trends, the types of mega and giga-projects, delivery and cost overruns, and projects at risk of delivery challenges. In the interests of transparency, a technical appendix is included at the end of this report with important information and caveats about the approach and data set used.



The projects within the data are grouped into six types:

1. **Commercial and leisure**
   Including buildings and facilities that support retail, hospitality, entertainment, and transport-related functions. This incorporates hotels, restaurants, cinemas, stadiums, offices, retail stores, and shopping centres.

2. **Energy and utilities**
   Comprising infrastructure used to produce, transmit and manage energy and water services.

3. **Industrial**
   Referring to buildings and facilities dedicated to manufacturing, processing, extraction, and waste management. It includes manufacturing plants for automotive, electronics, food, textiles, and pharmaceuticals, as well as specialist facilities like semiconductor and battery plants. It also includes data centres.

4. **Infrastructure**
   Focussing on transport, communication, and essential services. This includes railway, road, airport, and marine infrastructure, fibre-optic lines and underwater cables.

5. **Institutional**
   Encompassing buildings and facilities that serve public, civic, religious, defence and social functions. This includes educational buildings (e.g. schools and universities), healthcare facilities, and a broad range of civic and government infrastructure such as libraries, fire stations, courthouses and prisons.

6. **Residential**
   Including all types of housing for individuals and families including entire districts and new towns.

The top lines

Unsurprisingly, the USA is ahead of other countries in terms of the number of mega and giga-programmes and projects with 1,663 announced (active and complete) since 2010, followed by India (729), Saudi Arabia (577) and the UK (484).

For giga-projects specifically, the USA again leads the pack with 88, followed by India (43) and Saudi Arabia (43).

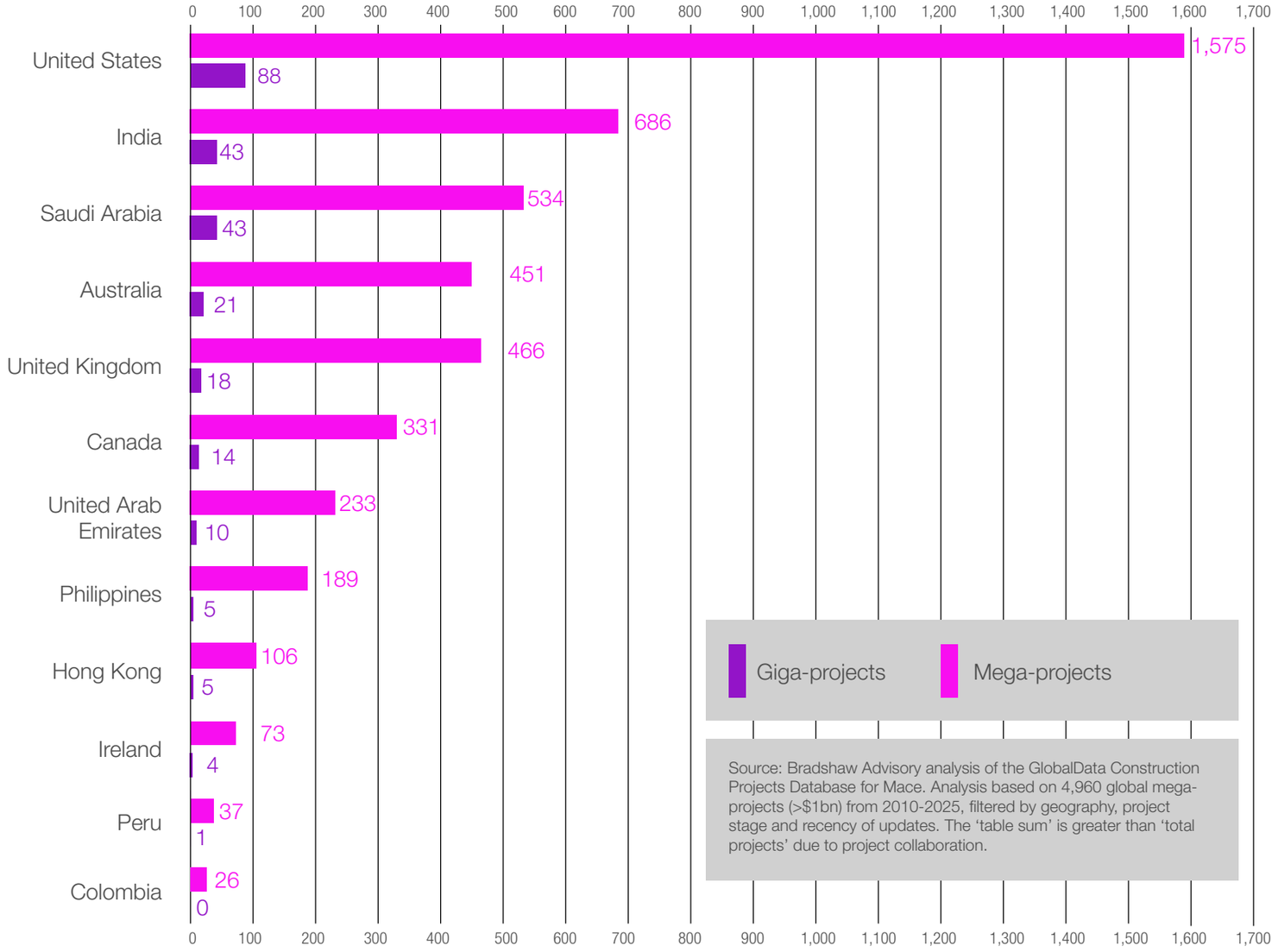
Of the mega-projects in the data set, the most common sectors are...

1. **Energy and utilities** (1,389 projects)
2. **Residential buildings** (1,012 projects)
3. **Infrastructure** (858 projects)

These allocations likely reflect a number of different global trends, including the rise of the fourth industrial revolution and its energy-intensive infrastructure such as datacentres, as well as efforts to meet net zero targets, improve energy independence and service a growing global population, which is set to hit around 10.3 billion people by the mid-2080s[x].

Increasing rates of urbanisation (the UN predicts 70% of the global population will live in towns and cities by 2050, compared to 58% today), driven by access to educational, economic and social opportunities, are likely to be behind much of the growth. More generally, increasing populations in some countries have created a greater demand for modern living, which calls for supporting infrastructure as well as new homes.

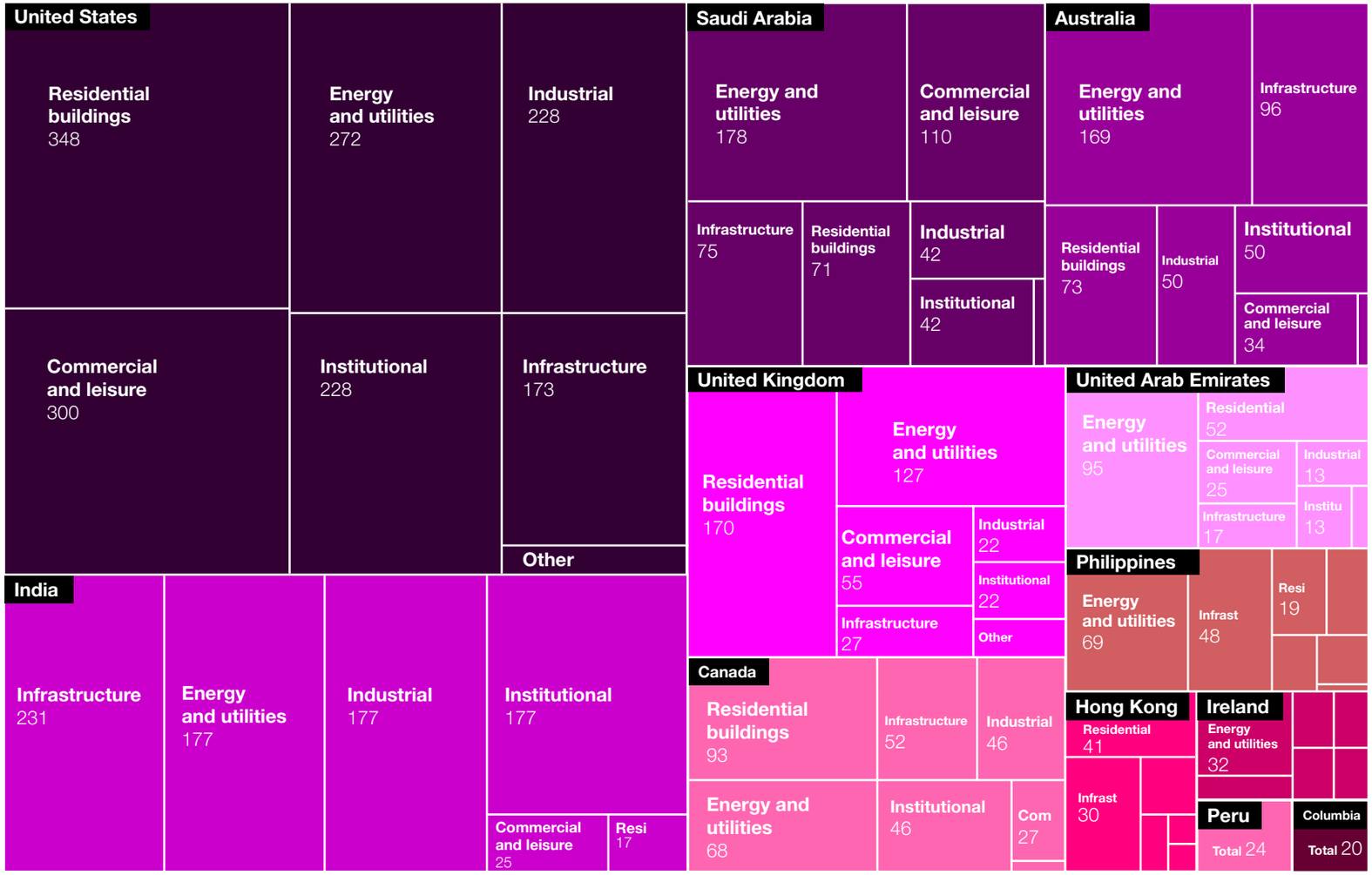
Mega-projects and giga-projects worldwide



Source: Bradshaw Advisory analysis of the GlobalData Construction Projects Database for Mace. Analysis based on 4,960 global mega-projects (>$1bn) from 2010-2025, filtered by geography, project stage and recency of updates. The 'table sum' is greater than 'total projects' due to project collaboration.

The distribution of mega-projects worldwide

$1bn+ projects announced since 2010, active or complete, select countries



Source: Bradshaw Advisory analysis of the GlobalData Construction Projects Database for Mace. Analysis based on 4,318 global megaprojects (>$1bn) from 2010-2025, filtered by geography, project stage and recency of updates.

The active mega-project pipeline

The number of active mega and giga-programmes and projects around the world has increased nearly fourfold since 2010.

Within our specific geographic range, Saudi Arabia has seen one of the highest rates of increase in the world, with 64 mega-projects in 2010 and 476 in 2025 (643% increase). This is driven by the country's ongoing transformation under Vision 2030, which includes the likes of NEOM, The Red Sea Project, Diriyah, Qiddiya, King Salman International Airport and New Murabba.

The USA, UK and India also show high rates of increase. 15 years ago, the USA had 275 active mega-projects of over $1bn in value and today (2025) that figure is 1,334, which represents a 385% increase. Over the same period the UK has seen a 200% increase and India 153%.

Kingdom of Saudia Arabia
Active mega-projects
↑643%

United States of America
Active mega-projects
↑385%

United Kingdom
Active mega-projects
↑200%

India
Active mega-projects
↑153%

It is not surprising that we have seen such a significant increase in infrastructure spending and large-scale projects, given wide recognition that such investments are a key driver of economic growth in both the short term and long term.

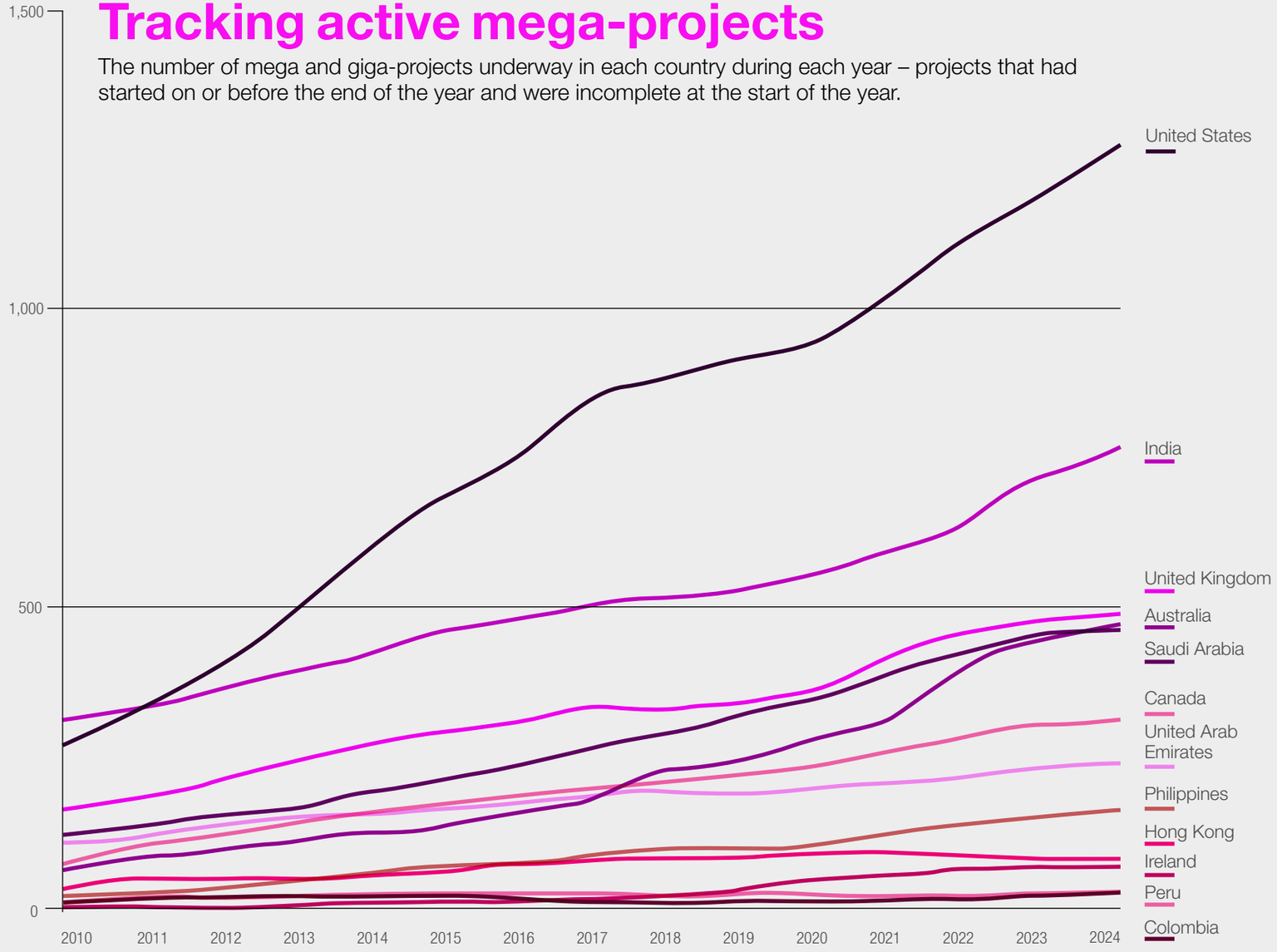
'Fiscal multipliers' for infrastructure tend to be substantial. A meta-analysis by the G20's Global Infrastructure Hub[xi] found that public investment has an average multiplier of about 0.8 within one year – meaning $1 of spending raises GDP by about $0.80 in the first year – and around $1.5 within 2–5 years. Macroeconomic conditions and project type also influence multiplier effects. For example, the American Public Transit Association notes that investments in transit infrastructure yield higher returns because they stimulate transit-oriented residential and commercial development, thus returning four to five times every dollar invested[xii].

While the focus of this report is mega and giga-programmes and projects, it is useful and interesting to reflect on this data in the context of recent global construction trends. Reported trends in headline construction workloads from the RICS Q1 2025 Global Construction Monitor[xiii] show that the top three performing countries across the period were UAE, Saudi Arabia and India. The strong growth in construction activity, particularly in the Middle East, is echoed by a high score in the corresponding Construction Sentiment Index. Combined, the datasets point to confidence in, and commitment to, construction activity across the region and follow on from a similarly positive outlook in Q4 2024. In the US, while overall sentiment remains strong, the pace of growth has slowed, according to the RICS data for Q1 2025. The data for Europe shows a mixed picture, with Spain indicating particularly strong headline results and Ireland also tracking well. The UK, meanwhile, showed a flat headline picture in Q1 2025.

While the RICS data is a point-in-time snapshot, the reasons behind the variance in the headline figures serve to highlight our earlier point that the challenges to effective programme delivery are multifaceted and reach far beyond factors in control of the delivery team.

Tracking active mega-projects

The number of mega and giga-projects underway in each country during each year – projects that had started on or before the end of the year and were incomplete at the start of the year.



Source: Bradshaw Advisory analysis of the GlobalData Projects Database for Mace. Analysis based on 5,330 global mega-projects (>$1bn), filtered by geography, project stage and recency of updates. Mega-projects includes giga-projects

Programme lengths

The longer the project goes on, the more chance that it will encounter a significant external event with the potential to knock it off course (a health pandemic, significant price shocks, a war or political upheaval).

Across our database, Ireland has the shortest average duration (from announcement to completion) of mega-project at approximately 5.8 years (although the absolute number of projects is much smaller). In contrast, Peru has the longest average at over 13 years, followed closely by the United Kingdom at nearly 12.5 years and India at around 11.6 years. From our interviews, these long delivery times are often related to high levels of bureaucracy, challenges in gaining project consents and stop-start funding as part of budgeting cycles. Scale and complexity shouldn't be overlooked, though.

That said, Saudi Arabia and the US average similar durations of just under nine years, even with programmes that are often at the largest scale globally. Other locations like the UAE, Hong Kong and Canada fall in the 10–11 year range.

Average delivery times vary significantly by the type of programme or project, as well as the country. This is down to a range of factors, including existing ground conditions and site constraints, the number of technical interfaces with other programmes and stakeholders, regulatory requirements, and the uniqueness of the build, among other factors.

Infrastructure, in particular, shows a dramatic spread in speed of delivery within a country (although Australia is remarkably consistent, perhaps due to the widespread use of collaborative delivery approaches like alliancing[xiv]), with the UK performing particularly poorly. Not only is the mean project duration much higher than the 75th percentile project of every other country, the 75th percentile for the UK is 50% higher than the next closest geography (Hong Kong).

Why is this the case in the UK – a country that successfully exports its delivery capabilities around the world, having built a reputation for best practice? Based on our interviews, and in line with a 2024 report by the National Infrastructure Commission (NIC) (now subsumed by the National Infrastructure and Service Transformation Authority) there are wider underlying factors at play. In its paper, titled 'Cost drivers of major infrastructure projects in the UK', the NIC took a broader look at barriers to delivery. A lack of clear strategic direction, at the government level, to inform pipeline and build supply chain confidence underpinned much of the narrative. Bureaucratic consenting processes, where the average time taken to secure approval doubled between 2009 and 2019, is another underlying issue. Along with the obvious impact on timelines, this comes at a cost.

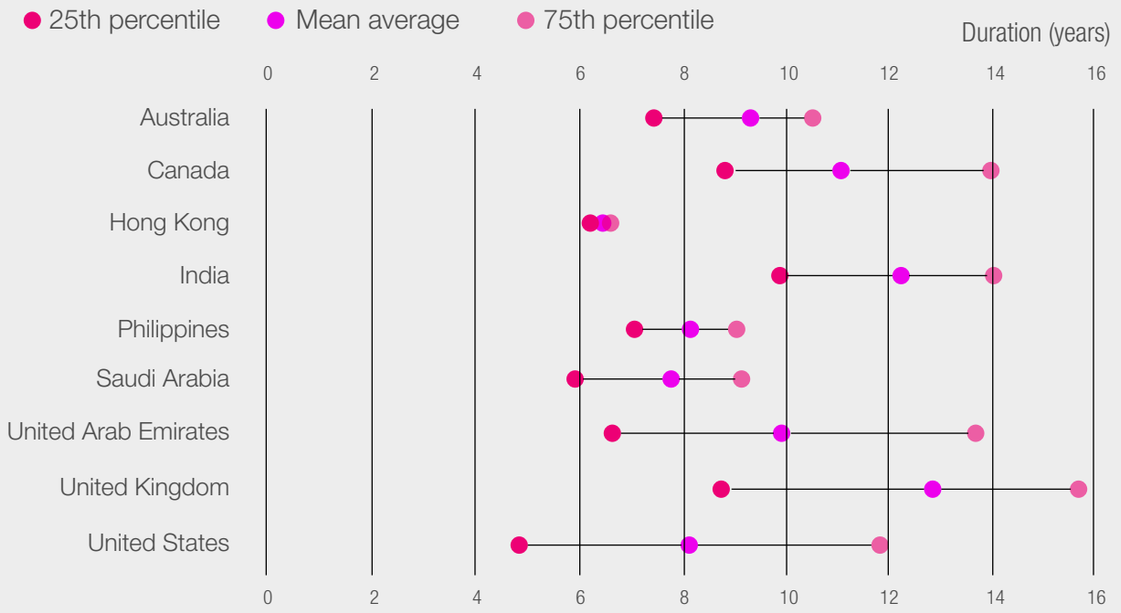
The paper does flag challenges with clients and sponsors, and points to constraints within the supply chain, but there is an overriding sense that a lack of central strategic direction is the biggest barrier to more effective delivery in the UK.

> **Democracy is expensive and takes time, and it's not got any easier. If anything, it's become more difficult.**
>
> —Sir John Armitt, Former Chair of the National Infrastructure Commission

"Within the UK, we see a parochial approach to planning and consenting which creates substantial inefficiency. For example, we are often required to do additional (nugatory) work to demonstrate compliance with a specific requirement of the planning process, when our thinking and understanding of what is required is already more advanced. We can therefore find ourselves producing a report which simply unlocks the next more detailed report; this wasted effort and inefficiency adds little value, increases costs and delays programmes. That's a fundamental process and system failure."

—Phil Brown, Managing Director, Major Nuclear Capital Programmes, Babcock International Group

Energy and utility mega-project duration



Completed projects by country | Project value $1bn–$10bn | Duration measured from announcement to completion.

We have produced these graphs to give a sense of the complex picture around the world. Programme and project durations point to much more than delivery inefficiency, with scale and scope playing their part, as well as existing legislation and regulation. As such, this data is not a criticism of delivery capability, rather a reflection of the opportunity to drive efficiencies through continued improvement and innovation.

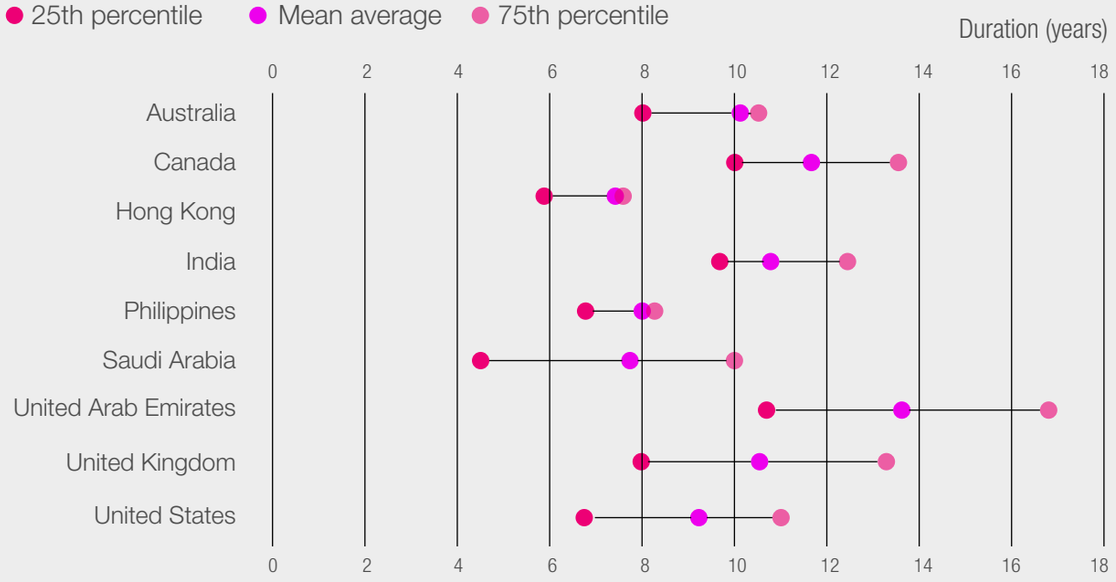
For energy and utility mega-projects, Hong Kong, the Philippines, the USA and Saudi Arabia seem to be much more effective in progressing from announcement to completion. We see longer timelines in India, which may, in part, reflect complexities associated with ageing energy infrastructure that needs upgrading and challenges around integrating renewable energy sources into a network weighted towards fossil fuel energy production. The opportunity and ambition within the country to deliver much needed maintenance and enhancements is mirrored by the sheer number of active programmes over $1bn in value.

The UK shows the longest timelines but, as noted above, evidence points to legislation, regulation and consents as common causes of delay. This is true for energy generation and utilities programmes. Like India, connecting large energy generation programmes to the grid can often add more time to a schedule, even if all other elements are in place.

For residential mega-projects, there is a significant spread in delivery performance with some of the quickest mega-projects delivered in just over four years and the slowest taking 17. Hong Kong is again a strong performer, with not only low average completion times, but also a tight spread within the data suggesting a consistency of approach and management.

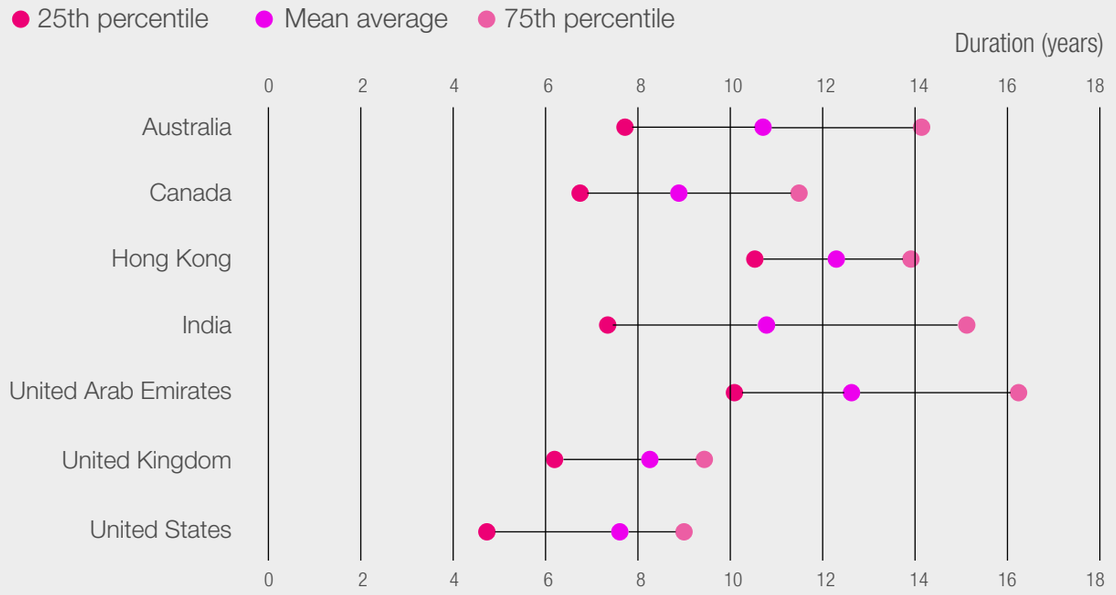
The UAE, famed for its iconic and sizeable skyscrapers, shows longer than typical durations in the residential sector. It is likely that the sheer scale and complexity of many of these programmes is skewing the data and increasing the overall average timeline. Achieving ambitions of this nature, invariably require more time to plan and deliver and certainly do not reflect shortcomings in capability.

Residential building mega-project duration



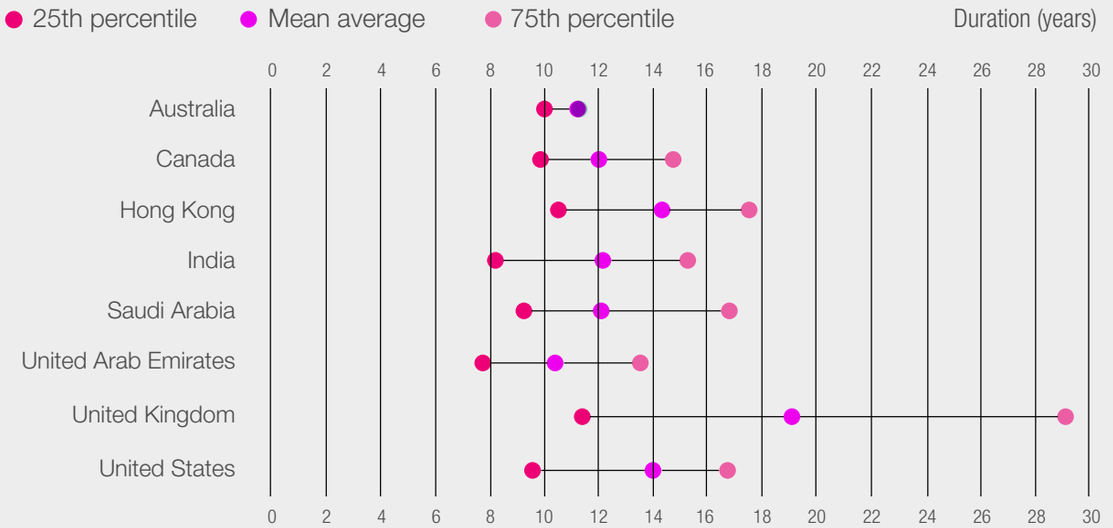
Completed projects by country | Project value $1bn–$10bn | Duration measured from announcement to completion.

Commercial and leisure mega-project duration



Completed projects by country | Project value $1bn–$10bn | Duration measured from announcement to completion.

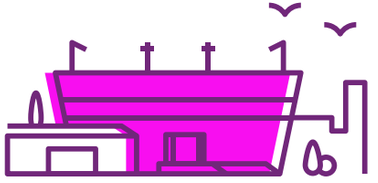
Infrastructure mega-project duration



Completed projects by country | Project value $1bn–$10bn | Duration measured from announcement to completion.

Interestingly, when we look towards commercial and leisure project delivery performance, the general trends in performance we have seen so far reverse, with the UAE and Hong Kong being generally slower in delivery and the US and UK leading the world. As with residential projects, this difference could be due to the size of projects delivered in the UAE, for example, Expo 2020 Dubai – a programme that covered six million square metres and had a peak workforce of 30,000. When countries like UAE are delivering programmes of this scale, timelines are invariably longer. It is also worth remembering that Expo 2020 Dubai, like so many projects and programmes was heavily impacted by the global Covid-19 pandemic, with opening and operation delayed for a year as a result of health and safety measures.

When it comes to infrastructure, the spread in the UK's programme duration data is noticeable. This largely reflects systemic issues that sit outside the control of those responsible for delivering infrastructure, but create a challenging operating environment. An excessively bureaucratic planning process is chief among the barriers to quicker delivery, while shifts in political backing for some of the nation's biggest programmes in recent years has created funding uncertainty and caused delay.



On-hold/inactive

Percentage of projects announced since 2010 that have become inactive or put on-hold.

Source: Bradshaw Advisory analysis of the GlobalData Construction Projects Database for Mace. Analysis based on 637 global mega-projects (>$1bn) declared on-hold or inactive from 2010-2025, filtered by geography, project stage and recency of updates.

Projects on pause

A proportion of global mega and giga-programmes and projects ultimately stall, with many placed 'on hold' or becoming inactive at various stages of development due to poorly defined scope and inadequate budgets being ringfenced at the outset to get them through the approvals process. Our analysis shows that a stop-start approach does create a significant impact. Where countries and sectors experience particularly high rates of delay, it causes uncertainty in project pipelines, which can have a knock-on impact on investor confidence, as well as hinder the supply chain's ability to invest in skills and innovation.

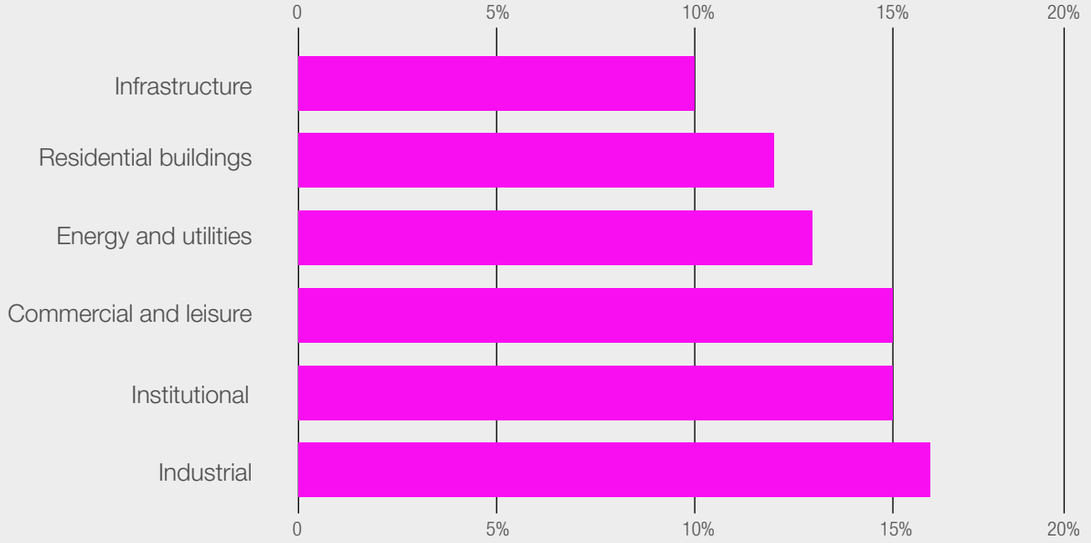
Peru and Colombia have the highest proportions of stalled projects since 2010, with over 30% and 25% respectively declared on hold or inactive. These elevated rates typically reflect underlying issues such as historic political volatility, financial pressures or limited institutional capacity to sustain complex, capital-intensive projects.

Both countries are taking action to overcome this issue, however. One way is through government to government (G2G) agreements – collaborative arrangements that draw on international expertise to support and enhance in-country capability. Mace has been at the centre of the G2G evolution in Peru, as our case study on page 23 outlines.

There are noticeable variations by sector according to the data. Industrial, institutional and commercial developments are more likely to become inactive. Infrastructure programmes, while exposed to political and planning risk, appear more likely to see a continued commitment to completion, but are much slower in delivery.

On-hold/inactive

Total of projects announced since 2010 that have become inactive or put on-hold by sector.



Source: Bradshaw Advisory analysis of the GlobalData Construction Projects Database for Mace. Analysis based on 637 global mega-projects (>$1bn), declared on-hold or inactive after announcement from 2010-2025, filtered by geography, project stage and recency of updates.

Getting a sense of what lies ahead

While many studies have looked retrospectively at finished projects to assess delays and cost overruns, we wanted to consider the risk of notable delay to mega and giga-programmes and projects that are yet to complete.

To do so, we used a bespoke AI research tool that looked at publicly available information relating to our database of more than 5,000 programmes and projects, and used a set of key word indicators to understand the sentiment involved around their delivery. As with any modelling, the findings present an interpretation of the situation. Further information on the methodology can be found in the Appendix.

Our analysis of a sample of 5,330 mega and giga-programmes and projects across 12 locations indicates that...

11%

are at risk of significant delay.

Our research also shows variation in the risk levels across different geographies and sectors.

But, before we look at some of the findings, we should reiterate the importance of clear and accurate baselines when setting expectations. While change is an inevitability (as we discuss later), the reality is that baselines often frame success criteria for major programme delivery, certainly in the eyes of politicians and the public. Early certainty of outcomes informs benchmarking, which allows for realistic baselines that coordinate scope, time, cost, quality and safety. And so, while 11% of programmes being at risk of significant delay is a more complex issue than just getting the baseline right, fundamentally, this is the 'number' upon which all future milestones will be assessed. A failure to align the simplest of baselines on major programmes, often because there isn't an informed partner coordinating these workstreams, calls into question whether schedule is truly delayed or actually unrealistic.

Even so, our data provides some useful reflection points. While efforts are being made to strengthen the pipeline and boost industry confidence, nations that are still maturing their infrastructure delivery capabilities, such as Peru and Colombia, continue to face higher chance of delay to programmes and projects, with over 20% at risk. As the in-country supply chains boost their capabilities on programmes that are in full flow, including those under G2G agreement, success stories like Peru's Lima 2019 Games, Reconstruction Programme and Bicentennial Schools Programme are certainly playing their part in aiding a growing sense of confidence. In the context of the Reconstruction Programme, the Peruvian Government estimated that non-G2G programmes of comparative investment would take considerably longer to complete. Specifically, the Government determined that education facilities would take three years longer and healthcare facilities four years longer without the support of the UK Delivery Team.

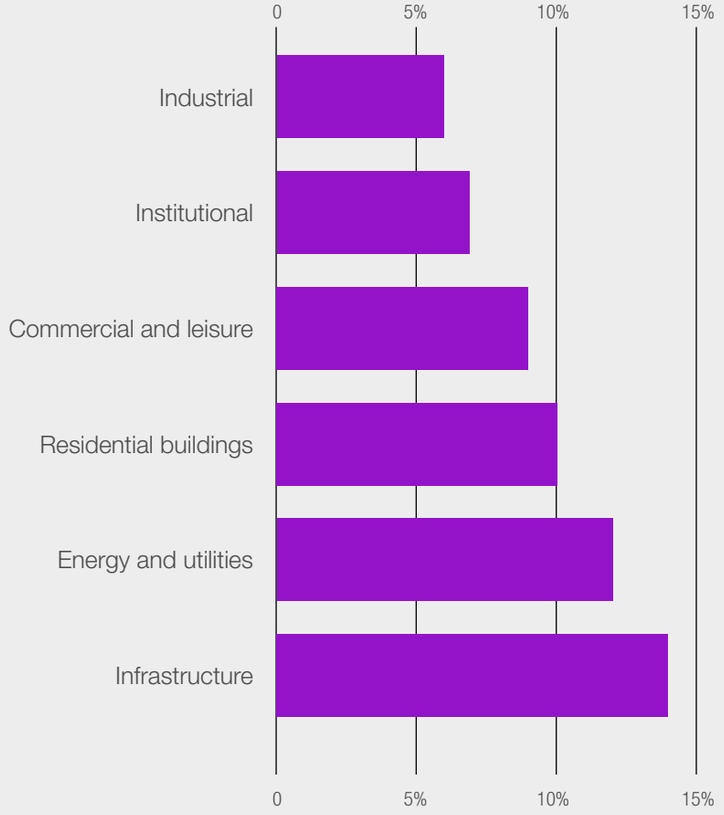
In contrast, locations such as Ireland, Hong Kong and the United States, which are more mature in their programme delivery journey, showed notably lower rates, with fewer than 10% of projects flagged by the algorithm. The reasons for this are likely to be varied.

In Ireland, a smaller and seemingly more achievable pipeline, along with a mature approach to collaborative delivery models, could be underpinning this confidence.

In Hong Kong, careful coordination of the pipeline by the Government, combined with a small geographic area, will aid certainty. The US, on the other hand, has a huge pipeline and vast expanse, yet performs well despite added complexity from varied and sometimes conflicting state local and federal regulations. This largely reflects efforts led by the private sector and the US Armed Services to deliver large capital projects using progressive design-build and other collaborative approaches.

Risk of significant delay

Percentage of projects flagged as having evidence of a significant risk vs. no evidence of significant risk.



Source: Bradshaw Advisory analysis of the GlobalData Projects Database for Mace. Analysis based on 5,330 global mega-projects (>$1bn), filtered by geography, project stage and recency of updates. Mega-projects includes giga-projects.

When we look at sectors across the globe, infrastructure programmes and projects are the most exposed to risk, with nearly 15% showing evidence of delivery delay. This was followed by energy and utilities and then major residential programmes. In contrast, industrial and institutional projects were the least likely to be flagged, both with risk levels below 7%.

These findings suggest that geography and sector both play an important role in shaping delivery risk, with large-scale infrastructure and energy investments particularly vulnerable in certain emerging markets.

What's important to remember with all of these graphs and associated commentary is that nothing is black and white. Longer programme duration is not necessarily an indication of poor delivery performance. It can reflect underlying political structures. It can reflect sheer scale or complexity. It can reflect a blend of some or all of these. The reality is, whatever the country or sector, nobody gets absolutely everything right. Part of the response to this should be looking at major programmes as learning opportunities, where industry practitioners commit to taking the lessons (good and bad) to their next commission. In essence, this is about creating an industry culture where everyone sees it as their responsibility to improve delivery performance.

In turn, this culture can encourage a commitment to coordinated solutions, driven by capable partners that are able to help navigate the pitfalls of this complicated ecosystem alongside client organisations. It starts at the beginning. Many of the biggest challenges stem from misaligned baseline scopes and, to address them, requires a schedule that is integrated across workstreams and, importantly, realistic. Establishing a well-thought-out and accurate scope gives teams the best chance of delivering on time and, in many ways, this matters most. If a programme is running on time, then cost, quality and safety are likely to follow. It is why we so commonly hear of success stories on major games programmes – the time constraints sharpen focus.

Having looked at the number, types and spread of mega and giga-programmes and projects, as well as how performance varies via geography and sector, the report now goes on to look at delivery models being used around the world, as well as some of the barriers to effective delivery and what we consider to be the solutions.

Transferring knowledge

The Lima 2019 Pan American and Parapan American Games marked a significant milestone for Peru, showcasing the nation's capability to host a major international sporting event.

The Games hosted over 8,500 athletes from 41 countries, enhancing Lima's global reputation (especially within the Americas) and served as a catalyst for investment in the city. It also acted as a 'blueprint' for further major programme delivery. Central to this achievement was the involvement of the UK Delivery Team (UKDT), a consortium led by Mace in collaboration with Arup and 4global.

The team brought significant experience from the London 2012 Olympic Games around collaborative working, incentivisation, supply-chain management, PMO and risk management. UKDT had responsibility for the overarching delivery strategy for the core permanent venue infrastructure, establishing and implementing an integrated programme management office function, and supporting the delivery of key venues. UKDT's efforts were instrumental in the successful completion of five world-class venue clusters and a new Athletes' Village, spanning 44 hectares and providing 1,100 apartments.

Beyond economic benefits, the Games left a lasting social legacy for the local community, supply chain partners and the government. The venues developed are accessible and resilient, ensuring their long-term utility for the community. The Athletes' Village has transitioned into housing for local residents, contributing to the social fabric of the Villa El Salvador district.

The UKDT introduced modern procurement and contracting practices – such as the use of collaborative NEC contracts, streamlined digital platforms and sensible risk management – which allowed the project to reduce the time required to contract and mobilise. They also aligned the team to the key project outcome: delivering the games venues on time. The approach shifted how Peru plans, builds, and manages its public infrastructure.

From that success came a comprehensive, nationwide programme to re-build and bolster the resilience of critical infrastructure in Peru, numbering 140 projects mitigating devastation wrought by the El Niño floods since 2017. The Peruvian government entered into an agreement with the UK to dispatch a team consisting of Mace, Arup and Gleeds to provide technical expertise and programme management to deliver the reconstruction effort.

The team applied its earlier experience and relationships from the Pan American Games to deliver climate-resilient infrastructure for millions of Peruvians, while also transferring knowledge, implementing digital tools and providing skills development to local stakeholders to leave a legacy of value and opportunity.

Over the course of the partnership, the team has supported the planning, procurement, and delivery of 74 new and retrofitted schools, 18 healthcare facilities, and extensive flood protection infrastructure across 17 river basins and seven cities.

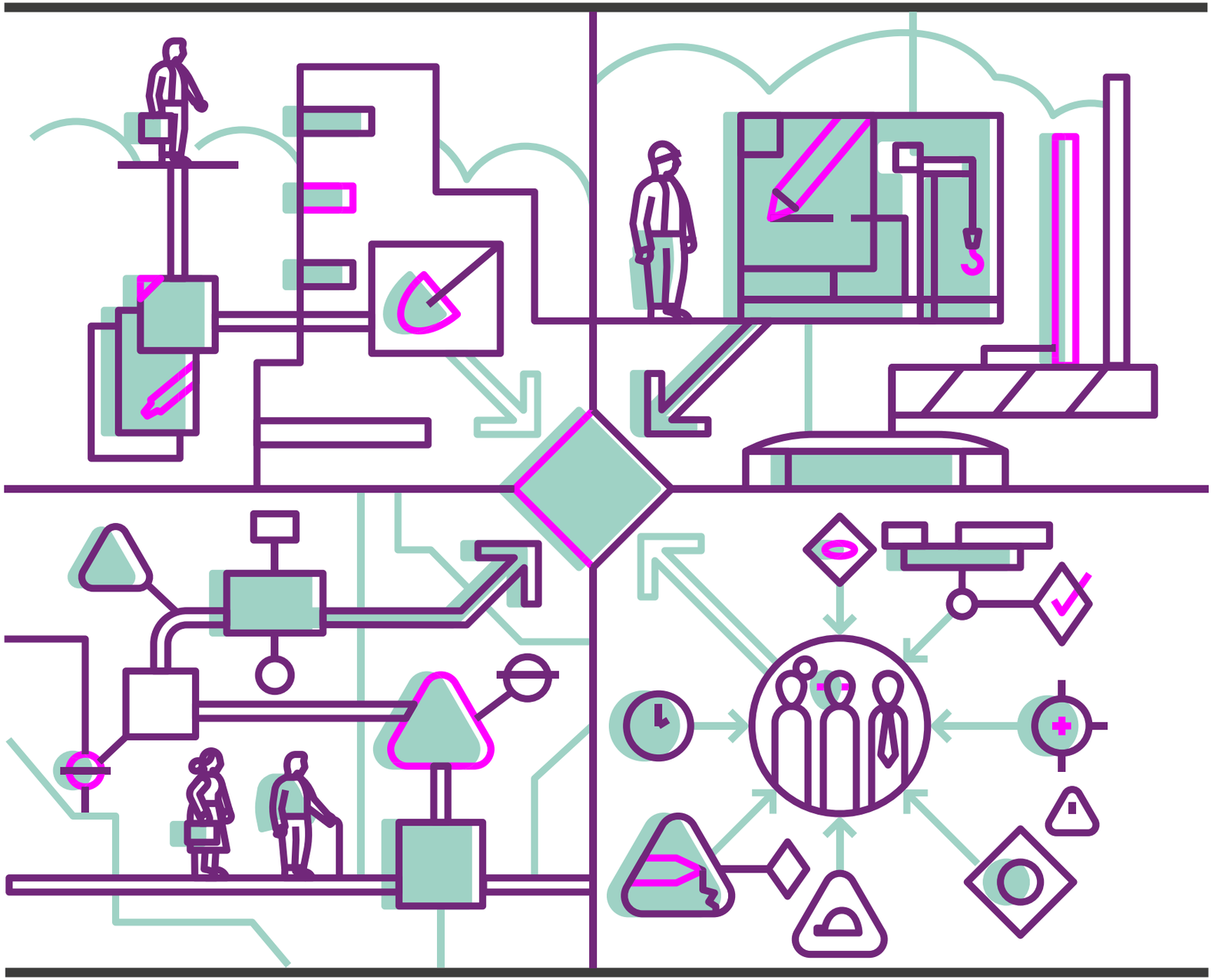
In many cases, delivery timelines were reduced compared to similar projects undertaken in Peru, with schools completed up to three years faster and healthcare facilities delivered four years ahead of timeframes normally required. More than 16,000 individuals across 100 organisations have received formal or informal training as part of the programme, including an executive leadership course on NEC contracts designed to equip Peru's infrastructure leaders with the tools and capabilities to successfully deliver future programmes. This has helped to develop native talent, promoting domestic ownership and partnership to sustain and build on the infrastructure improvements.

Mega-project delivery in Peru

> *We put together a team from different origins and different backgrounds to create the 'Lima Team'. The systems of working they brought allowed people to see how the 'new' way of contracting [NEC3 contracts] is a much more efficient way of doing things.*
>
> — Carlos Neuhaus, President of Lima 2019 Games

> *I'm hugely proud of what has been achieved for and with the people of Peru. The faster delivery of better, and more sustainable infrastructure for education healthcare, and flood defences is improving lives and creating opportunity.*
>
> — Gavin Cook, UK Ambassador to Peru

The value of clear governance and collaboration



The value of clear governance and collaboration

Around the world, there are several different approaches to programme and project delivery. The chosen method often reflects a blend of regional and cultural preferences, specific sector needs, the scale of the commission, how complex or unusual it is, the past experience of those involved, the capability and capacity of the client and the nature of the risk.

To manage programmes and projects with tighter scopes requires clear governance structures to be established, with teams empowered within defined guidelines. Design and build might be selected as the most appropriate delivery mechanism, while, in the world of oil and gas, an Engineering, Procurement, and Construction (EPC) approach is common. Depending on the geography, water infrastructure programmes are seeing 'progressive design-build' emerge as a preferred, collaborative alternative to conventional contracting mechanisms like 'design-bid-build'.

Looking at a specific water sector example in a UK context, the repeated use of an alliancing approach by Anglian Water has enabled consistent out performance of the targets set in the business plan, according to a case study developed by the Institution of Civil Engineers[xv]. It is a model valued elsewhere in the country, with Melissa Dudley, Deputy Director for the Ministry of Justice's New Prison Capacity Programme, highlighting the value she sees in the model. When asked about the core principles that underpin a successful alliance, she said "it's everyone having skin in the game for each other's success", before adding that this typically sees all team members "driving towards the same outcome, leaving their organisational badges at the door and upskilling each other collectively to try and pull together to deliver a common outcome."

Other collaborative models include Construction Manager at Risk, Integrated Design-Build, and Integrated Programme Delivery.

While there are options, the delivery partner model has emerged as one of the most effective approaches for programmes and projects in the mega and giga tiers due to its provision of end-to-end management across all elements and phases of the lifecycle. Taking a very literal view of the word 'partner', it allows for a single culture, with aligned governance, goals, agreed outcomes and mechanisms to create a fairer arrangement for every party involved. All of this combines to ensure client visions are fully supported.

Regardless of the specific model chosen, where the scale of programme or project falls into the mega and giga category, meaning scope can be less clear and complexity higher, a delivery approach centered on true collaboration proves to be the best way forward.

This increase in complexity and scale is also driving more collaborative approaches when it comes to financing. With public purses in many countries around the world squeezed, innovative public-private partnerships (PPP or P3s) and intergovernmental investment agreements are becoming increasingly important to bring large-scale projects to fruition. Design build finance and operate (DBFO) contracts, are set to become increasingly commonplace.

Certainly, it was clear from interviews conducted for this report that collaboration and building trusted partnerships must be central to the delivery of major programmes and projects. This is also backed up through academic research into the impact of more collaborative delivery models on programme and cost.

> **We are looking at framework contracts, we are looking at other collaborative forms, so that good contractors can work with us for longer and build lasting relationships.**
>
> —John Kwong,
> Vice President for Development,
> The Hong Kong University
> of Science and Technology

Really powerful delivery partners are those who truly, truly own the mission with you, almost more than you.

—Toufic Machnouk, Managing Director, GBRX

"Appointing a programme delivery partner is a key part of the response to the resourcing challenge, because then we have much easier access to the kind of capabilities we need."

—Programme Director, Energy and Utilities Sectors, UK

"Projects are team games, so collaboration is critical. Spend the time building relationships."

—Senior Director, Water Sector, UK

"To have confidence in a programme, I need to see the budget, the bill of quantities, and the schedule. Without continuous visibility into these, it's difficult to find the delivery partner credible."

—Atif Ansar, Executive Chairman and Co-Founder, Foresight Works

"The delivery partner becomes an extension of the client, but importantly they know the market well, they know how to package work, they are responsible for procurement, then they have to integrate and deliver it."

—Andy Haynes, Commercial Director, Delivery Authority for the Restoration and Renewal of Parliament

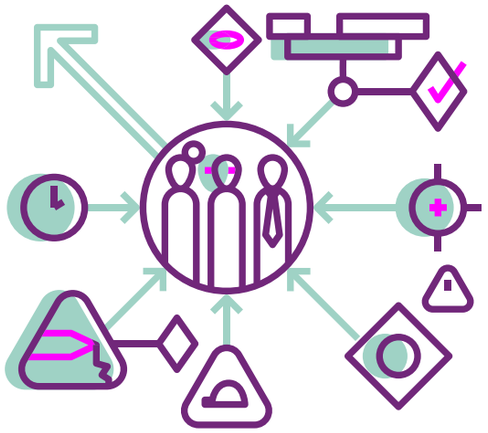
"When you do a mega-project, you have to look at contractors and consultants as your partners. Genuinely as your partners, so the contract needs to be in the favour of both."

—Ahmed Al Khatib, Chief Development and Delivery Officer, Expo 2020 and Expo City Dubai

Over the last 10 years there have been academic studies comparing more collaborative delivery approaches to traditional and transactional ones, and their conclusions concur that collaborative contracting models significantly improve cost and schedule performance on major programmes and projects.

In terms of budgets, collaborative approaches were found to reduce costs by between 4%-13%[xvi,xvii] compared with large-scale programmes delivered via other contracting models. In terms of on-time delivery, a study in Australia found that a collaborative approach more than doubled the chances of timely programme delivery (from 36% to 78%)[xviii,xix].

While collaborative delivery models are not a cure-all for programme and project risks, when applied properly and managed well, with full buy-in, the results can be impressive, with projects coming in on or under budget, finishing on time or ahead of schedule, and achieving long-term benefits. Our case studies for London 2012 and Lima 2019 stand as just two examples of different collaborative models that have achieved such success.



Barriers to a brighter future

4

Barriers to a brighter future

The reasons that mega and giga-projects spiral out of control, in terms of costs and delivery timelines, are multi-faceted and one issue can cause broader ripple effects. Our interviews with more than 30 industry professionals across the globe highlight a number of common risks in programmes and projects that lead to things 'going wrong'.

The findings below reflect the most frequent and consistent issues cited in our research.

"There is pressure to show progress. This is most acute in projects of interests to politicians who have short-term agendas. Many start before designs are complete and before people are actually sure what the end product is. The money is often released in a way that incentivises this behaviour too."

– Senior Executive, Rail Sector, North America

Starting too quickly

The majority of experts we interviewed noted the desire to get 'spades in the ground' as soon as possible as a way to demonstrate timely delivery. More worryingly, there can be pressure to accelerate commencement so that key decision-makers have 'ribbons to cut', in the words of one interviewee. This is particularly true in countries where politicians seek public credit for infrastructure programmes that are important to their constituents. It is a mentality that can influence decision making before construction works are even close to starting. Even the Thames Tideway Tunnel in London, England – completed in 2025 after ten years of construction and regarded as an infrastructure delivery success story in many ways – was subject to scrutiny for how its early options appraisal was carried out. Critics argued that decisions were made too quickly and driven, in part, by government inertia that favoured larger, more visible solutions[xx].

Supporting the notion of taking your time to get it right is analysis by the UK's Construction Leadership Council[xxi] of 20,000 projects that found those with the best planning at the outset had 20% lower costs and were delivered up to 15% faster.

Not spending enough time thinking at the early stages of a programme, in order to get to a 'solution' quickly, is a false economy and, worse, can create a broader series of problems based on a flawed baseline, whereby decisions taken ultimately may hamper efficiency, the opportunity to innovate, and the ability to acknowledge and respond to challenges throughout the entire lifecycle. Along with risks to delivery, this puts perceptions of the programme's performance under unreasonable pressure.

Taking the time early on to establish a clear baseline is invaluable. Aligning scope with time, cost, quality and safety sets realistic goals and avoids surprises. A realistic baseline enables better evaluation of performance and helps to mitigate perceived overruns or overspends. It also enables better realisation and promotion of benefits. Along with London 2012, Marina Bay Sands in Singapore got the baseline right. In both instances, clear governance was essential to achieving this. It ensured the scope was well defined. In turn, this meant that the teams had a clear understanding of the outcomes they had to deliver and the risks they needed to manage. Both were delivered on time and within budget and continue to deliver value to local communities and visitors alike.

"Plans are best-case scenarios. They ignore what usually happens."

– Nobel Prize winning psychologist, Daniel Kahneman

"What we tend to do on large projects is go in with an overly optimistic position on costs which are often founded more in hopes than on true facts."

– Managing Director, Rail Sector, UK

Too much optimism

Optimism about the future has driven people to take risks for millennia and that has undoubtedly enabled ongoing advancement through the ages. However, for all the positives of a 'can-do' attitude, the tendency toward optimism has been shown to have a particularly negative impact on the delivery of infrastructure programmes and projects. This is especially visible on those at the mega and giga-scale.

In 1979 the pioneering psychologist, Amos Tversky, identified the 'planning fallacy' as a systematic cognitive bias that gives humans the tendency to underestimate the time, costs, and risks of future actions while overestimating the benefits.

In combination with that bias, Tversky's academic collaborator, Daniel Kahneman, identified the 'inside view'. This is the propensity of people to focus on their current project while ignoring similar past projects with real outturn data and results. Together these contribute to 'optimism bias'.

To combat this issue, the UK Government developed guidance (contained within the HM Treasury Green Book) to provide fact-based rigor for project baselines and estimates. The approach includes adjusting estimated costs upward for a programme, using reference class forecasting (that is, benchmarking the project against similar projects that have been completed) in an effort to ground programmes and projects in real-world performance data.

"I've often seen over reliance on what a cost consultant tells a project, and this has created tense situations and arguments. The market will tell you much more accurately what it costs to build and cost consultants are only able to do this when the design and scope are developed enough."

—Executive Director, Major Programmes, Middle East

Misusing cost consultants

There was consensus across interviews that the work and estimates of cost consultants is often compromised by inaccurate or incomplete data – especially when early-stage estimates are produced before designs are complete, or proper validation has been conducted.

In their most simplistic form, cost consultants are brought in to give programme and project owners a cost for the delivery of their ideas. This is done through estimating quantities and costs and multiplying the two together, including some risk and contingency budgets.

While these estimates can be useful in setting an initial range based on known parameters, they should not be misunderstood to account for all uncertainties and information gaps associated with a programme or project. Only once detailed designs and constructability reviews are completed, with input from contractors, can realistic estimates be determined. But even at that stage, the cost estimates should be understood as informed but inexact assessments, preferably provided as ranges to account for uncertainties and contingencies made necessary by changing market dynamics that affect the course of programme and project delivery (e.g. inflation, trade tariffs and resourcing risks).

"At its heart, cost consultancy is the art of knowing change will happen and baking that in at the outset with a correct risk and contingency mindset."

—Ceri Evans, Director for Cost and Commercial Management, Global, Consult, Mace

Many mega and giga-programmes and projects are funded via public money, which means they are planned under political and media scrutiny, and this can lead to pressure for precise, up-front assessments of expected costs and delivery times, that can, in practice, be unrealistic and potentially counterproductive to success.

To progress projects from an initial concept there is normally a requirement for a sign off process, which usually involves clearing a hurdle rate or cost-benefit analysis, or achieving a cost-benefit ratio above a certain number. These are highly sensitive calculations, where changing a small variable or assumption can produce quite dramatic improvements in the benefits of the scheme.

Hong Kong has moved to a system of 'reference class forecasting' – whereby a large project database is used to provide estimated costs from similar projects that have been completed. This top-level approach to estimation – rather than the bottom-up measured quantities approach – has been shown to provide more accurate estimates of cost and time.

One case study of the Australian State Road Authority, conducted by the Project Management Institute[xxii], showed that an approach that included reference class forecasting halved the estimation margin of error in final costs.

Transactional relationships

Many large-scale programmes are divided into phases of work with different partners, with varied contract types and sometimes different leaders from within the client organisation. While, of course, you need the right people with the right experience at the right time for successful delivery, it is important to mitigate for breaks in continuity that can affect performance measures and incentives; such disconnects are common root causes of delivery failures. In addition to changes (personnel or otherwise) within delivery organisations, many large projects must contend with changes in the market landscape that can affect project performance and outcomes, such as shifting political priorities or workforce and supply chain developments affecting the ability to achieve budget and schedule targets.

At different stages of the journey, programmes commonly involve multiple participants with different perspectives, from project managers, to consultants, to engineers, designers and contractors. If these parties co-exist independently with little or no continuity between them, and each takes the view that 'I will just look after my phase and someone else can fix it later', these gaps can create larger ripple effects resulting in more significant shortfalls later in the project lifecycle.

"In my experience, the projects that worked were the ones where the client knew what they wanted and were clear about it. The ones that didn't work were the ones where the client didn't really know what they wanted or the direction of the project changed without anyone dealing with it."

—Andy Haynes, Commercial Director, Delivery Authority for the Restoration and Renewal of Parliament

A lack of clarity

Our research and interviews show that several mega and giga-programmes and projects are set up for failure because they lack common understanding, causality and clarity about the outcomes they are meant to deliver. The most important part of any project is having a clear and shared understanding of the problem you are trying to solve and how the work being performed will help achieve that solution.

Despite this, many projects are not set up in this way. Even when outcomes are clearly articulated and understood, they are bound to be met with challenges and conflicts that only well-defined governance, cohesive management and practical experience can overcome. These essential provisions enable collaborative problem solving, negotiation of trade-offs, and agile execution to keep complex programmes on-track.

Scarcity of experience

The increasing number and size of construction projects places substantial demand on the workforce required to deliver them. From the front-line workers and technical specialists to managerial ranks, the volume of talent possessing substantive experience required to deliver large-scale programmes is small and limited, and intense competition places a high premium on experience. From our interviews, this concern is especially acute at the most senior levels, with a belief that only a handful of programme and project directors possess significant and relevant experience at the mega and giga scale.

The limited supply of experienced professionals with the right capabilities (and availability) to steward an increasing number of mega-projects makes it especially challenging for public sector entities that cannot match pay scales offered by the private sector. Some Middle Eastern countries also face discontinuity challenges when expatriates work for abbreviated periods due to personal tax reasons. This not only interrupts management continuity; it makes it difficult to consistently develop native capabilities.

A mega or giga-project is, in its own right, larger than many companies. Several interviewees highlighted that the skills required from a project leader today are quite different from those required 20 years ago. There can also be resistance to change and a lack of willingness to embrace a 'learning mindset' that challenges convention and encourages new ways of working. Even the most technically competent individuals may find it challenging to understand and adapt to the different ways of working and varied cultural customs as they move around the globe. This is why effective employee engagement and team building are especially important to successful delivery. No longer can project leaders argue such skills are not part of the job. People skills are central to every project management role.

These challenges can mean a lack of capability and capacity at all leadership levels in the client and partner team, which then cause substantial delivery problems.

It's a challenge the UK has recognised more broadly in its 2025 Industrial Strategy, seeking to tackle workforce deficiencies through a global talent drive. Underpinned by a £54 million fund, the initiative will attempt to attract "top tier managerial and engineering talent" to the UK's 'growth-driving sectors'[xxxi].

"Trust is the bedrock of any good business. Without it, it is very difficult to deliver or succeed"

—Warren Kencroft, Vice President, Technical Integration, GO Expansion

Trust issues

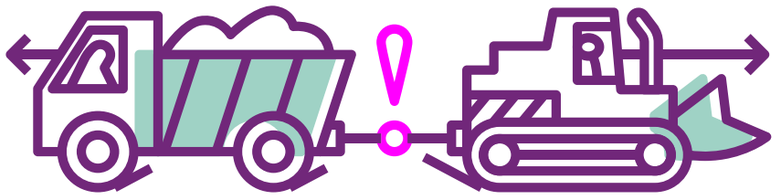
For relationships at all tiers of a programme or project to work effectively, they need to be high trust. Trust takes time to build, but leads to empowerment, recognition, information sharing and transparency – all key ingredients in enabling effective delivery. Trust and relationships are much easier to lose than gain, especially when programmes and projects encounter significant periods of stress and challenge. If people do not trust each other then they cannot work and perform effectively.

A lack of trust can, in part, be down to the transactional relationships mentioned above. Poor governance (either in its absence or overcomplication) and limited access to transparent data also create barriers to trust.

Pulling in different directions

Through a lack of clear objectives, having the wrong people, and poorly designed contracts and organisational structure, different parties involved in project delivery can often pull in different directions in response to their different incentives. As you would expect, this causes significant risks to project delivery.

Additionally, many mega and giga-pogrammes and projects span multiple jurisdictions – with sometimes conflicting regulatory requirements – and there are often deliberate work package breakdowns across different physical sections and distinct phases. These are commonly supported by different supply chains and interact with varied stakeholders, which can present significant challenges when it comes to managing interdependencies and bridging varied interests and interfaces across a programme as a whole. These multifaceted interfaces and the motivations must be fully understood to pre-empt disconnects and conflicts that otherwise impede progress.



Ten pillars of successful collaborative delivery

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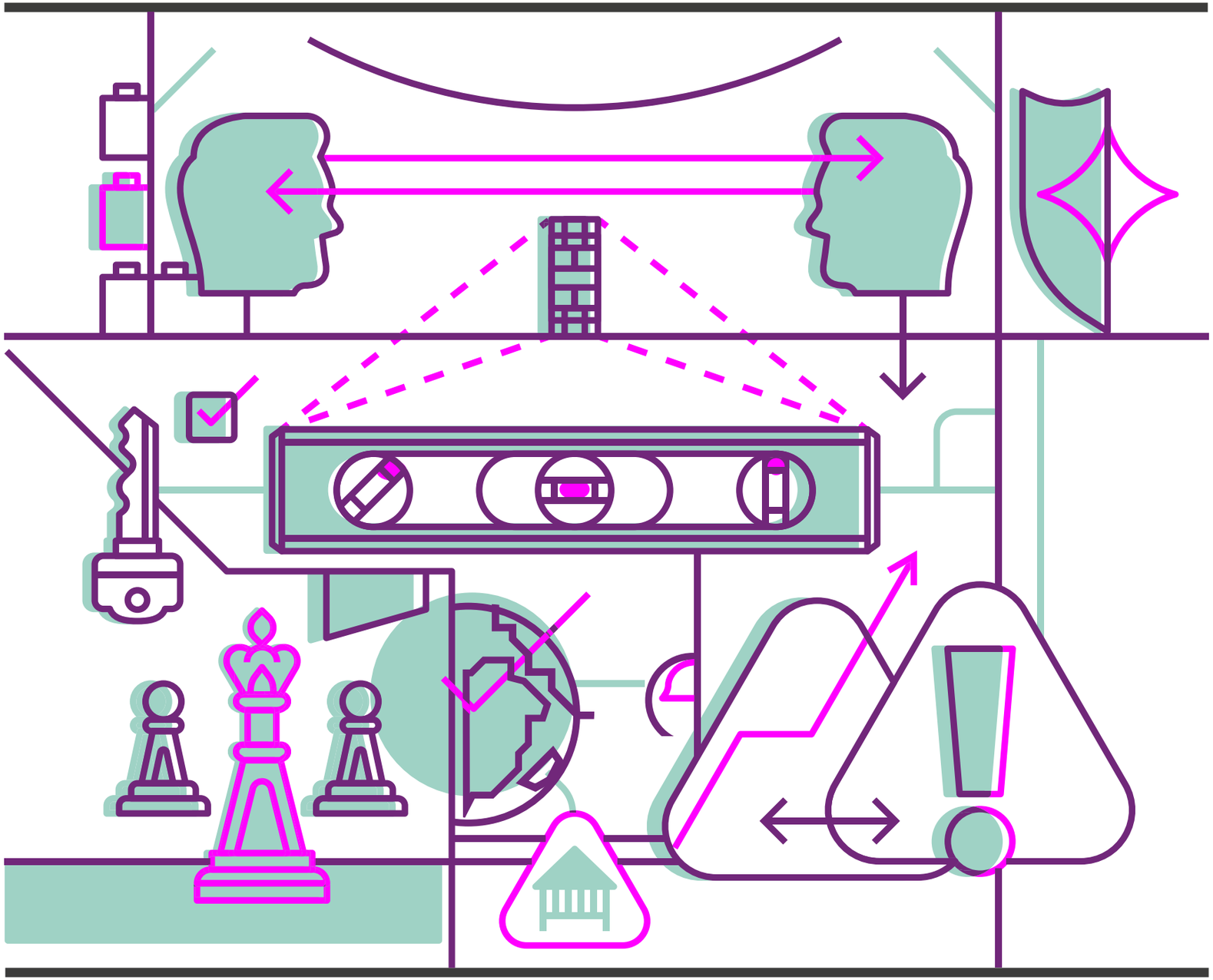

Ten pillars of successful collaborative delivery

Around the world, increasingly complex mega and giga-programmes and projects are struggling against global demand for talent, commonly going overbudget, being delivered late, and under-delivering on benefits.

At Mace, we believe a big part of the solution to these challenges is the routine creation of more collaborative management built on trusted relationships sustained throughout programme lifecycles, whereby clients, consultant partners and the wider supply chain are aligned through common goals and a shared vision. Much of what we include here has been informed by our experience successfully implementing collaborative approaches, including the delivery partner model. The recommendations outlined here apply across all types of collaborative delivery approach. Whether implemented in totality or not, each one stands alone as a valuable component of effective programme and project delivery.

For us, a comprehensive collaborative delivery approach considers ten key ‘pillars’:

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Collaborative delivery unlocks maximum value when there is true alignment at every level. In practice, this means clients, consultants and contractors – from senior leadership to day-one apprentices – unifying behind shared visions, objectives and culture to work together towards the same desired outcomes. Knowing that success is shared, as is failure, sets expectations, guides decisions, sharpens focus and, ultimately, raises performance.

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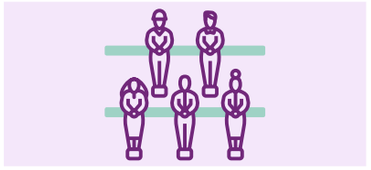
—Davendra Dabasia, Chief Executive Officer, Consult, Mace

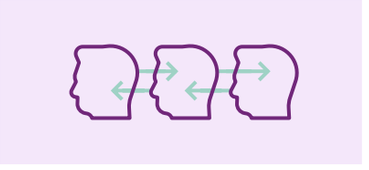
1 **Outcomes focused**



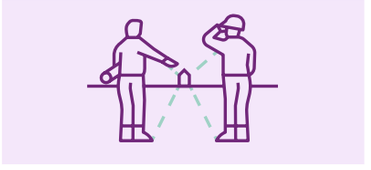
2 **An integrated ‘one team’ approach**

3 **Shared risk and reward framework aligned to outcomes**

4 **Highly collaborative in every sense**



5 **Knowledge transfer and capability building**



6 **Long-term relationships**

7 **Look beyond leadership for key decisions**

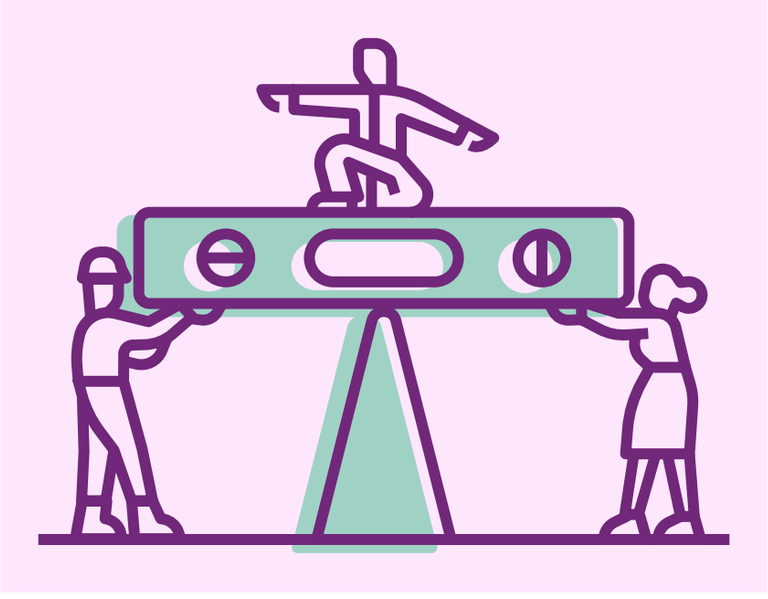
8 **High capability consultant team with a breadth of involvement**

9 **Trust and transparency**

10 **Integrated technology and processes**

One

Outcomes focused



Before embarking on any programme or project, the whole team needs to be crystal clear on the key outcome or outcomes being sought.

Outcomes that go beyond the physical asset, placing emphasis on positive change, legacy and community benefit, should underpin every single programme and project. It is a mentality that creates alignment, and serves as a yardstick for decision making, helping teams to identify the priorities and whether the proposed solution is 'best for programme'.

For example, if the key outcome is to improve the connectivity of a city to its neighbouring towns (because this will enhance access to jobs and opportunities for thousands of people) decisions may lead to a preference for light rail, tram and bus networks over an expensive and linear heavy rail line. An output-centric approach, on the other hand, might lead decision makers to lean towards the more eye-catching, headline-grabbing heavy rail option.

A lack of clarity on intended outcomes makes it much harder to align and incentivise all parties, including all layers of the supply chain, to pull in the same direction.

> **If you're not completely clear and aligned on outcomes and objectives then that can cause you a lot of problems. Projects spend a relatively small amount of time and expenditure before they get into the construction phase, but that pre-construction time is often the most critical. Once you've committed to a contractor and start building, that's when the big spend comes.**
>
> — Peter Hurst, Executive Director for Singapore and Hong Kong, Consult, Mace

Starting with outcomes

Many large projects around the world start their journeys and even begin delivery without clarity of the key outcome, or outcomes, that the scheme is looking to achieve. When projects have multiple outcomes, they also often fail to prioritise them, which then prevents trade-offs and compromises from being made effectively.

Amazon – the fourth largest company in the world by market capitalisation – addresses this by focussing hard on outcomes upfront. It 'works backwards' from the traditional project endpoint of writing a press release (PR) and 'frequently asked questions' (FAQ) document to try and get the customer to use and buy the product.

It entails a large amount of upfront work, but it saves time and drives value creation in the long run.

Instead of starting with technical specifications or roadmaps, Amazon begins with a narrative: a mock press release describing the finished product as if it were launching tomorrow. This is paired with a FAQ document anticipating potential questions from customers, stakeholders, and internal teams. The goal? To validate whether the product should exist before building anything and how best to address the need case.

The documents have to be written in clear, non-technical language and focus on customer benefits, problems solved, and how the product will improve lives. It is typically one page long, with the first paragraph structured like a real press announcement. The FAQ can span several pages, covering anticipated objections, customer concerns, technical implementation ideas, and go-to-market strategy.

This method aligns tightly with Amazon's leadership principles; particularly 'Customer Obsession' and 'Think Big.' By forcing teams to articulate the value proposition from the outset, Amazon avoids investing in products that lack clarity or purpose. The PR/FAQ process is also intentionally rigorous. Often those presenting the idea have to undergo the process repeatedly, refining their answers, thinking and outcomes to get approval.

Documents are reviewed in silent meetings, where stakeholders read and reflect before discussion. This deep thinking replaces the usual PowerPoint-heavy presentations found in many corporate environments.

A notable example from this process is the development of the Amazon Kindle. Before a single device was built, a PR/FAQ document outlined how the Kindle would deliver books instantly, have long battery life, and transform the reading experience. This allowed Amazon to focus product development around key customer-centric outcomes, not just features.

How Amazon works backwards

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Done correctly, the working backwards process is a huge amount of work, but it saves you even more time later. The process is not designed to be easy, it's designed to save huge amounts of time on the back end by ensuring we're building the right thing.

So many companies build the software [or product] and get it all working, then they throw it over the wall to the marketing department and say here's what we've built, write me a press release for it. That process to me is backwards.

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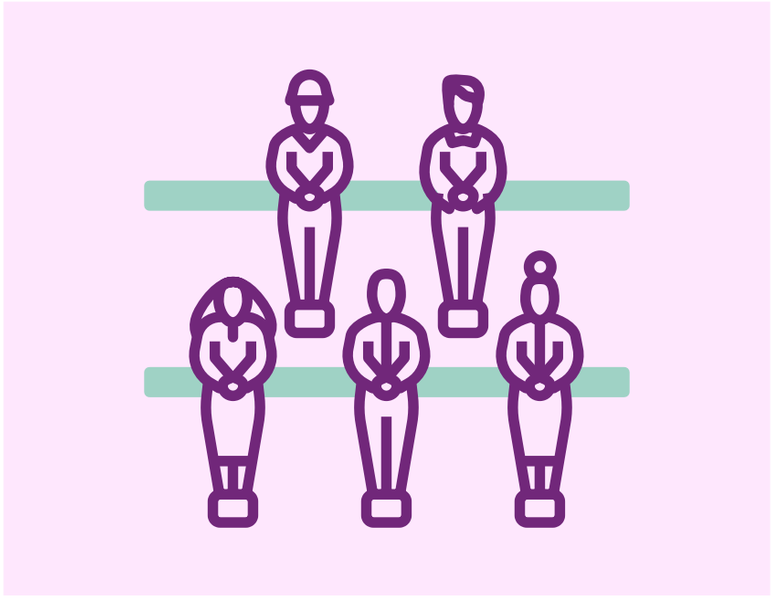
— Jeff Bezos,
The Founder of Amazon

Two

An integrated ‘one team’ approach



In a truly collaborative delivery team, when you walk into the project office it is not clear who is working for a consultant, the client (or as some prefer to say ‘asset owner’), a contractor, or supply chain organisation.

Everyone is part of one, unified team working together to deliver on the key programme or project outcomes and brings a breadth of expertise from project initiation through to delivery and operation.

As the illustrative story goes, on a tour of NASA’s Kennedy Space Center, President John F Kennedy saw a janitor carrying a broom. The President walked over to him, introduced himself, and asked the janitor what he was doing. The janitor replied: “I’m helping put a man on the moon, Mr President.”

Good governance and organisational design, defined early and agreed by the client, consultants and contractors, is essential to setup the project and team on solid footing for collaborative delivery. Taking a systematic approach to fitting together all parts of a delivery team, assigning clear roles and responsibilities and aligning all parties to the shared vision lays the foundation for optimising effectiveness from the outset. Beyond this, it aids the creation of a work environment that people want to be part of and give their best in pursuit of the programme outcomes.

66

Every type of supply chain you can imagine was involved in Expo 2020 Dubai – probably the entire country in some way. Whether consultants, contractors, those supplying materials, supplying plants, supplying food, supplying drinks – everybody was involved.

We had to spend a huge amount of energy and effort building the right culture, building the right behaviours. Those were absolutely critical for delivery. You also have to work with your contractors as partners and make them feel good about working on the project.

We tried as much as possible to engage with the supply chain and contractors as early as possible when we were doing the master plan so they understood what Expo was, its importance and the scale of the opportunity.

—Ahmed Al Khatib, Chief Development and Delivery Officer, Expo 2020 and Expo City Dubai

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Building a highly-capable integrated team

In May 2020, amid the escalating global COVID-19 pandemic, the UK government created the Vaccine Taskforce (VTF) to expedite the development, manufacture, and deployment of effective vaccines – a 'mega-project' in any definition.

Tasked with a project of unprecedented urgency and complexity, the UK government appointed Dame Kate Bingham, a biotech venture capitalist with no formal civil service or public sector background, but experienced in building teams and launching new products, to lead the effort.

Core to delivering any nationally significant project is building a high-performing and highly capable team aligned to delivering your key outcome and objectives. That's exactly where Dame Kate began. Her primary focus was assembling a high-performing team with the skills, agility, and mindset necessary to navigate the scientific and logistical challenges ahead.

In contrast to the approach of many mega-projects, the VTF didn't focus on the number of people in the team it was building or on how many were 'internal' hires (i.e. from within the civil service) or from outside. The key priority was finding the right people for the right roles and establishing a team of true world-class experts that could be trusted and empowered to deliver.

Dame Kate recruited leaders from across industry and academia, including Ian McCubbin, formerly of GSK, to oversee manufacturing; Divya Chadha Manek from the National Institute for Health Protection to lead clinical trials; and Ruth Todd from the Ministry of Defence to manage operations. Each was given autonomy over their area, fostering accountability and rapid decision-making. The result was a dynamic, interdisciplinary team with a laser focus on the key outcome (securing early access to vaccines for the UK) and a strong sense of ownership.

The diversity of the taskforce was key to its success. By drawing on professionals from different sectors, with a range of technical skills and experiences, the VTF team could tackle complex problems from different perspectives with credibility and creativity. This richness of perspective, combined with trust and empowerment, enabled the Taskforce to move at speed without compromising rigor.

Under Bingham's leadership, the VTF helped the UK to secure multiple vaccines before most of the rest of the world and to begin its mass immunisation ahead of any other country, with Margaret Keenan receiving the vaccine on the 8 December 2020 – only six months after the Taskforce was created. The Taskforce played a central role in securing over 350 million doses across various platforms, mitigating the risk of scientific failure.

The UK's COVID-19 Vaccine Taskforce

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By March 2020 a small internal COVID-19 vaccine team was coming together... but the tiny band of officials [civil servants] had little expertise in the pharmaceutical industry or knowledge of recent advances in vaccine development. On their own, they were unlikely to slay the COVID-19 Leviathan. They would need skills that lay beyond the confines of Whitehall.

The team [we built] was highly effective, I think precisely because of empowerment and [a] very clear mandate, and also because of the team's diversity—not only gender, age, and ethnicity, but also diversity of thinking.

— Dame Kate Bingham,
Chair of the UK's COVID-19
Vaccine Taskforce

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Three

Shared risk and reward framework aligned to outcomes

As we have highlighted, all organisations involved in delivery, development or operations – from top to bottom – need to be aligned to key performance objectives to achieve the outcomes envisioned.

This can be aided through collaborative contracting and incentivised performance measures, which promote a sharing of risk but also reward, helping to overcome traditional challenges of conflict and associated delay.

The implementation of shared objectives, key performance indicators (KPIs) and commitments – fosters a sense of *'you're in it together'* if backed up by meaningful rewards when successfully met. This can be especially powerful further across the supply chain, proving to suppliers that they're an important extension of the project team by enabling rewards for exceptional performance. Incentivisation is key to managing underperformance in a balanced way. This can be achieved by clearly outlining reduced earning potential as a consequence of failure. Both components can help to strengthen future procurement processes, encouraging participation and getting more firms to put their best foot forward.

The delivery of the London 2012 Olympic and Paralympic venues provides a useful reference of such an incentive framework to fairly allocate risk and reward.

> **Show me the incentive and I will show you the behavior.**
>
> —Charlie Munger
> Co-Founder of Berkshire Hathaway

Sharing risk and reward to deliver on outcomes

Although now more than 13 years old, the 2012 London Olympic and Paralympic Games continue to yield generational value to London and the UK today.

It remains the gold standard of mega-project delivery, exemplifying how large-scale capital programmes can and should be delivered, not only because it was completed nearly a year ahead of schedule and 10% below budget, but also because of its execution.

The Olympic Delivery Authority (ODA) engaged a joint venture of Mace, CH2M Hill and Laing O'Rourke, known as 'CLM', as the programme delivery partner responsible for managing £8.9 billion in publicly funded capital projects.

Given the programme's profile and scrutiny, the ODA needed to align CLM's interests to ensure on-time, on-budget delivery. The solution was an innovative contract structure that put a significant portion of CLM's profit at risk, tied to performance measures required to deliver the plans and obligations promised.

The ODA used an NEC3 contract with CLM that was essentially cost-reimbursable with strong risk/reward and incentive-based elements. This meant that in practice, CLM shared delivery risk and received incentive payments only after achieving the milestones, KPIs and cost benchmarks agreed. It tied CLM's income directly to outcomes – such that if key targets were missed, fees related to those objectives were reduced accordingly.

The approach was designed to drive continuous improvement and delivery at pace, including key risk/reward mechanisms to promote alignment and collaboration across the project supply chain. Instead of a one-time payout at project completion, incentives were sequenced in incremental intervals within project stages. By aligning payments in intermittent phases from preliminary tasks through design, construction and operation, the contract helped to incentivise continual progress and collaborative problem solving to avoid misses or last-minute scrambles to meet requirements. Such mechanisms include the following:

Pain/gain cost sharing: a pain/gain provision aligned cost outcomes with CLM's reward. If the programme came in under the target budget, CLM would share in the savings as a bonus (capped at £50m); if costs overran, a portion of their profit was at risk. This gave CLM a strong incentive to drive cost efficiencies on behalf of the ODA to deliver the key outcome of bringing in the venues on budget.

Milestone & KPI-linked fees: CLM's fee was tied to key performance indicators (KPIs) for time and cost. Incentive payments were released only when defined project milestones were achieved on schedule and within budget.

Scheduled bonuses: the ODA built in rewards for exceeding critical deadlines. Delivering work ahead of schedule earned bonus payments, reinforcing the importance of the fixed Games timeline. Conversely, any delay would cause CLM to lose a portion of their profit.

This commercial approach effectively aligned the delivery partner and ODA's incentives to meet the key outcomes and objectives of the programme. CLM had a financial stake (as well as the reputational risk) in delivering on time and under budget, fostering an integrated 'one-team' mentality with the ODA and contractors.

Ultimately, the London 2012 construction programme was delivered ahead of schedule and within the £9.3bn budget.

London 2012 Olympic and Paralympic Games

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The Olympics was first and foremost a huge exercise in programme and project delivery. Delivery is often a challenge for the government... but the Olympics were delivered on time and to specification. This was because of the combination of time invested upfront in getting the scope right and tight control on scope changes. A substantial proportion of the ODA budget was spent on programme management, using a highly incentivised delivery partner, CLM. The NEC3 contracts used for the venues incentivised contractors to act collaboratively. Delivery was left to those best placed to do it.

— Sir John Armitt, Former Chairman of the Olympic Delivery Authority

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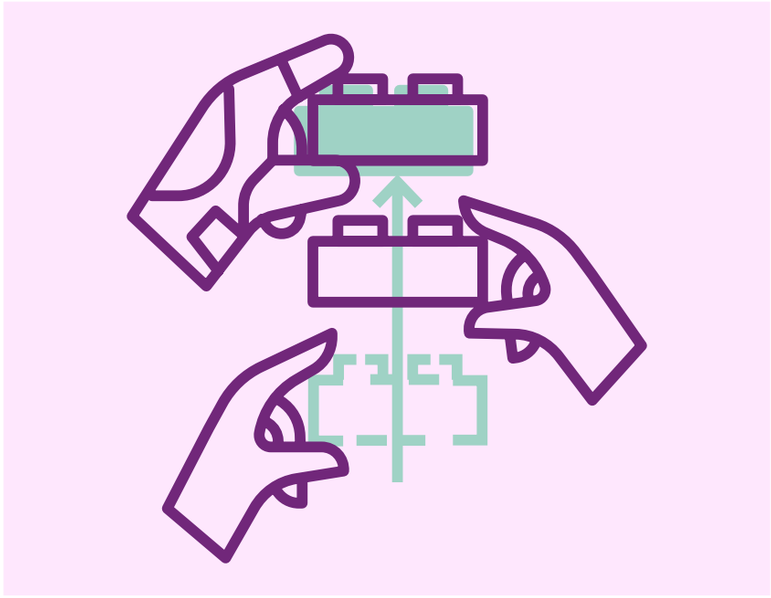
Four

Highly collaborative in every sense



The essence of any successful project, organisation or business is about assembling and uniting a capable team to serve the best interests of the project by working together as one cohesive unit.

A highly collaborative organisation needs clear and transparent communication, defined roles and responsibilities, shared tools and systems, alignment to outcomes and objectives, trust and mutual respect.

Collaborative consultant partners bring these behaviours but also advise owners on organisational design and development, underpinned by maturity assessments to help them build and develop the right tools, capabilities, structure and team culture for successful execution.

This level of collaboration needs to carry through to physical delivery as well and it is important that clients and consultants appropriately support contractors to ensure this.

To enable clients to achieve this, a collaborative approach that also affords active control of construction works is needed. This can be enabled through a Construction Management Office (CMO) – developed and assured by a consultant partner with an appreciation for delivery – which disseminates information across all parties, provides insight and makes recommendations to the construction functions to enable real time best-for-programme decisions.

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Collaboration doesn't mean always being 'nice' to each other, but working to align the interests and objectives of different individuals and organisations through frank negotiation and candid communication. Honest conversations can come with tension, but having the right values and behaviours in place helps teams to navigate this. The outcome is clarity, with everyone knowing the role they have to play and the benefit it will bring.

— Caroline Lassen,
Director for Programme and Project Management, Global, Consult, Mace

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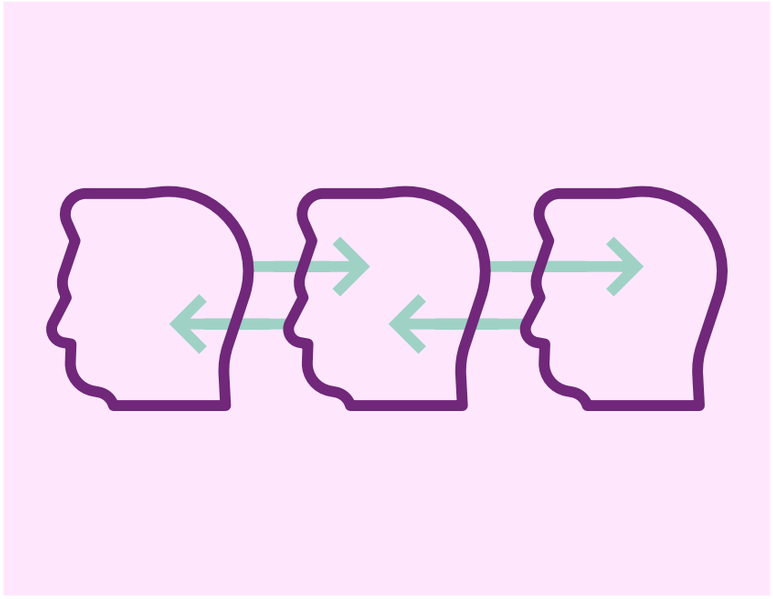
Five

Knowledge transfer and capability building



Many client organisations have limited experience delivering mega or giga-programmes and projects, while some form new entities as ‘Special Purpose’ organisations to plan, deliver and sometimes operate a new infrastructure programme.

Since large programmes and projects often last for a decade or more, they are likely to experience turnover on the delivery team. As managers come and go, the knowledge transfer, capability development and succession planning play a particularly important role in sustaining progress.

A key feature of the delivery partner approach involves formalised knowledge transfer and development, allowing client organisations to benefit from best-practice learning, institutional knowledge and practical experience throughout the life of the programme. The long-term nature of the partnership also allows for the upskilling and development of other team members and supply chain partners, who gain greater skills and opportunities to move into more significant roles over time.

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There are very few people within the public sector who have experience of delivering on mega-projects. Projects of this scale require a different skill set and many clients haven’t got enough capability.

—Director,
Highways Infrastructure, UK

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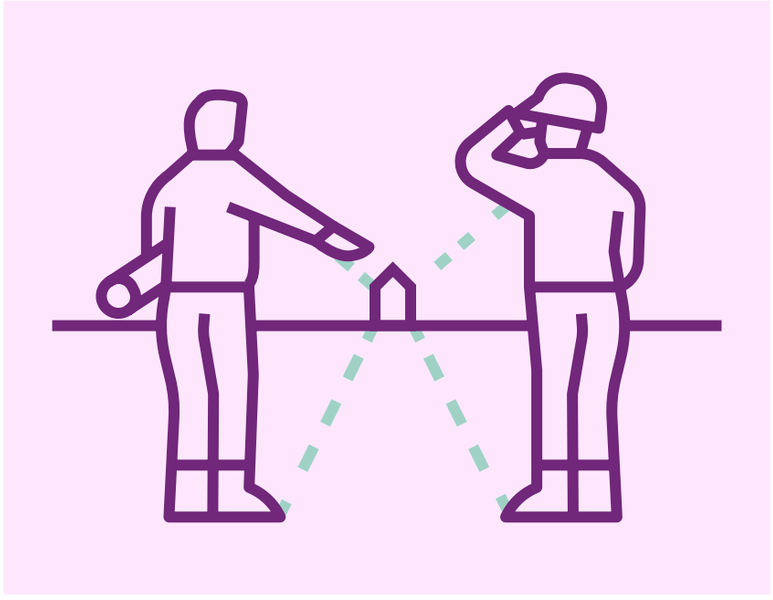
Six

Long-term relationships



Psychologically, people act quite differently to those they know they will be working with over years compared to those they are seeing merely for a few days or weeks.

Similarly, if businesses invest in greater continuity and stability of relationships, people will invest into and act to support long-term outcomes rather than focusing only on immediate circumstances[xxiii,xxiv].

For example, when an organisation brings in different design, engineering and consultant teams at different project phases to contribute to project plans, time and cost estimates, it sets the stage for disjointed management and conflicts between the various parties involved. Long-term relationships, inclusive of project partners, provide a common frame of reference and greater continuity. Fostering long-term relationships helps to eliminate ambiguity and information silos, enabling parties to work together from the ‘same page’ to deliver the programme. In contrast, a disjointed approach promotes fragmented execution, making it impossible for parties to understand or act in the best long-term interests of the project.

A noteworthy pitfall of disjointed management and a lack of long-term relationships is failure to appropriately consider buildability. The gap between planning and construction phases is a recipe for failure when one team is incentivised to create a series of outputs that seem right early in the programme, and others, with no connection to early considerations, are expected to execute them while compensating for changing realities down the line.

Seven

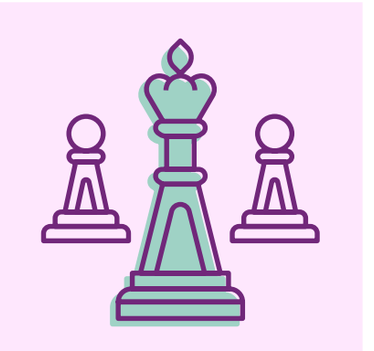
Look beyond leadership for key decisions

All major parties involved in the project – the client, delivery partner, contractors and subcontractors – need to be involved in major decisions together.

The shared risk-reward framework means that all main parties involved have the ability to influence project performance and outcomes. Including them in decisions promotes collaboration and a shared sense of ownership for successful delivery. It allows greater opportunity for innovation and improved delivery by reducing the potential for misunderstandings, conflicts and claims.

Eight

High capability consultant team with a breadth of involvement



A collaborative approach does not prescribe a fixed number of staff for the duration of a project. Rather, it is meant to thoughtfully deploy the right resources and people with the capabilities and experience needed to perform work precisely as required.

For maximum effectiveness, the consultant partner manages execution across the breadth of roles and functions required for optimal performance. This provides the visibility needed to aptly manage interface challenges while also maintaining 'skin in the game' that helps maintain focus on critical delivery requirements.

Where clients show a willingness to embrace fully integrated execution, it is likely they'll have a better chance of positioning themselves as an *'employer of choice'*, boosting their status among industry professionals and, therefore, taking steps to combat workforce and skills challenges.

Nine

Trust and transparency

Trust is the most essential ingredient in enabling teams to work collaboratively toward a shared goal. If parties do not trust each other, a significant amount of energy is wasted dealing with 'friction', diverting precious time and resources away from delivering on project requirements and outcomes.

Misunderstandings, misinformation and not having the full picture can all create distrust, which is why it is so important to provide maximum transparency with project information and communication – shared openly across platforms and systems that are accessible to all participants. This is an important function of a PMO – to provide transparent tracking, communication and guidance to build trusting relationships and aligned performance. People will only do what's best for the programme when trust and transparency are in place.

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Things always come back to trust. To build trust you need transparency so people don't spend too much energy second guessing.

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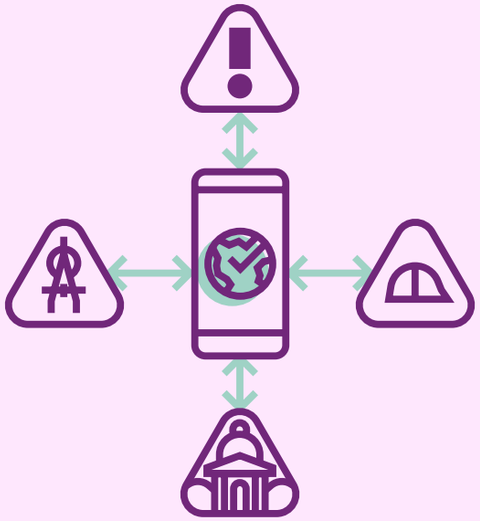
—Senior Executive, Life Sciences and Pharmaceuticals, Global

Ten

Integrated technology and processes



Not having a common version of ‘the truth’ and a consistent way of working can cause significant issues when moving through phases of a project and especially when moving into commissioning and operation.

It also impedes collaboration and transparency – that’s why Mace's delivery partner approach draws on the POPIT model (People, Organisation, Process, Information, and Technology) to enable consistency from start to finish.

Building integrated technologies relies on integrated processes (from site level all the way up to portfolio level), clear information, structured configuration and collaboration across all partners and the supply chain. These are core ingredients to successful delivery.

66

Nowadays, project data is openly available and everyone wants a dashboard. So many are being created that people don’t really understand what they’re looking at, or what the key issues and messages are. We need to streamline this approach so it’s easy to focus on the critical issues that need to be addressed.

— Executive Director,
Major Programmes, Middle East

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Bringing it all together

Metrolinx, the Canadian government agency responsible for managing and improving Greater Toronto's transport system, has embarked on one of the biggest transit infrastructure programmes in Canadian and world history: GO Expansion.

Metrolinx, the public transportation agency for the Greater Toronto and Hamilton Area mega region in Ontario, Canada, has embarked on the largest transit infrastructure programme in the nation's history, expanding the GO surface rail system and extending subway lines to increase connectivity and service in North America's fastest growing metropolitan area, with current population estimates topping 10 million.

Due to the scale, complexity and transformational nature of the programmes and numerous projects entailed, leaders recognised that a collaborative approach with an experienced delivery partner would aid successful delivery, integration and operation of new and existing system components.

Metrolinx selected a joint venture of Mace, Comtech and SYSTRA (MCS) to act as delivery partner for the GO Expansion, working as an integrated team at enterprise, programme, and project levels to manage complex workstreams involving varied contract types and multiple delivery methods.

At the enterprise level, the partnership's role is twofold: providing construction oversight tying together various active projects, while also building local delivery capabilities for future programmes. From the outset, Metrolinx and MCS jointly established programme governance, an integrated team, and delivery plans designed to pre-empt problems and maximise value.

At its core, the $61 billion, 10-year GO Expansion programme is about turning what has primarily been a system providing commuter services into an all-day, high-frequency transit network with trains running every 15 minutes. The improvements will transform the region's entire mass transit network, making it a highly efficient system that, once fully operational, will have the capacity to serve more than 200 million passenger trips per year.

The highly complex programme is progressing as planned, including more than 375 miles of electrified track, 78 miles of new track, 40 new stations, signaling systems, supporting infrastructure, and maintenance facilities.

Building on trust established in the GO programme, Metrolinx and MCS subsequently launched a second delivery partnership to oversee projects extending the Scarborough and Yonge North subway lines, comprising $11 billion in capital investments. The Scarborough project marks Canada's first use of the progressive design-build model with an adjacent design-build-finance contract to construct a new 4.8-mile, two-way tunnel. The project also includes four new stations, traction power, signalling, and ventilation systems. Lessons from that approach will support the Yonge North extension, which includes a 5-mile, twin bore tunnel and five new stations.

As with GO, Metrolinx and MCS formed an integrated team to manage the Subways programme. It includes the progressive-design builder, operator, tunnel representatives, and municipalities to foster collaboration for effective delivery. Given the complexity of the organisation, combined with the number of new approaches, capabilities development is a core part of the programme to help Metrolinx effectively implement the progressive design-build model, while maintaining the schedule and target-cost negotiated-price provision.

Throughout delivery of these programmes, the partnership leverages industry-best practices, collaborative management, continuous improvement, and local supply-chain and workforce capability, enabling industry-leading performance, delivery assurance, and outcomes benefiting the greater community.

Metrolinx's GO Expansion in Toronto

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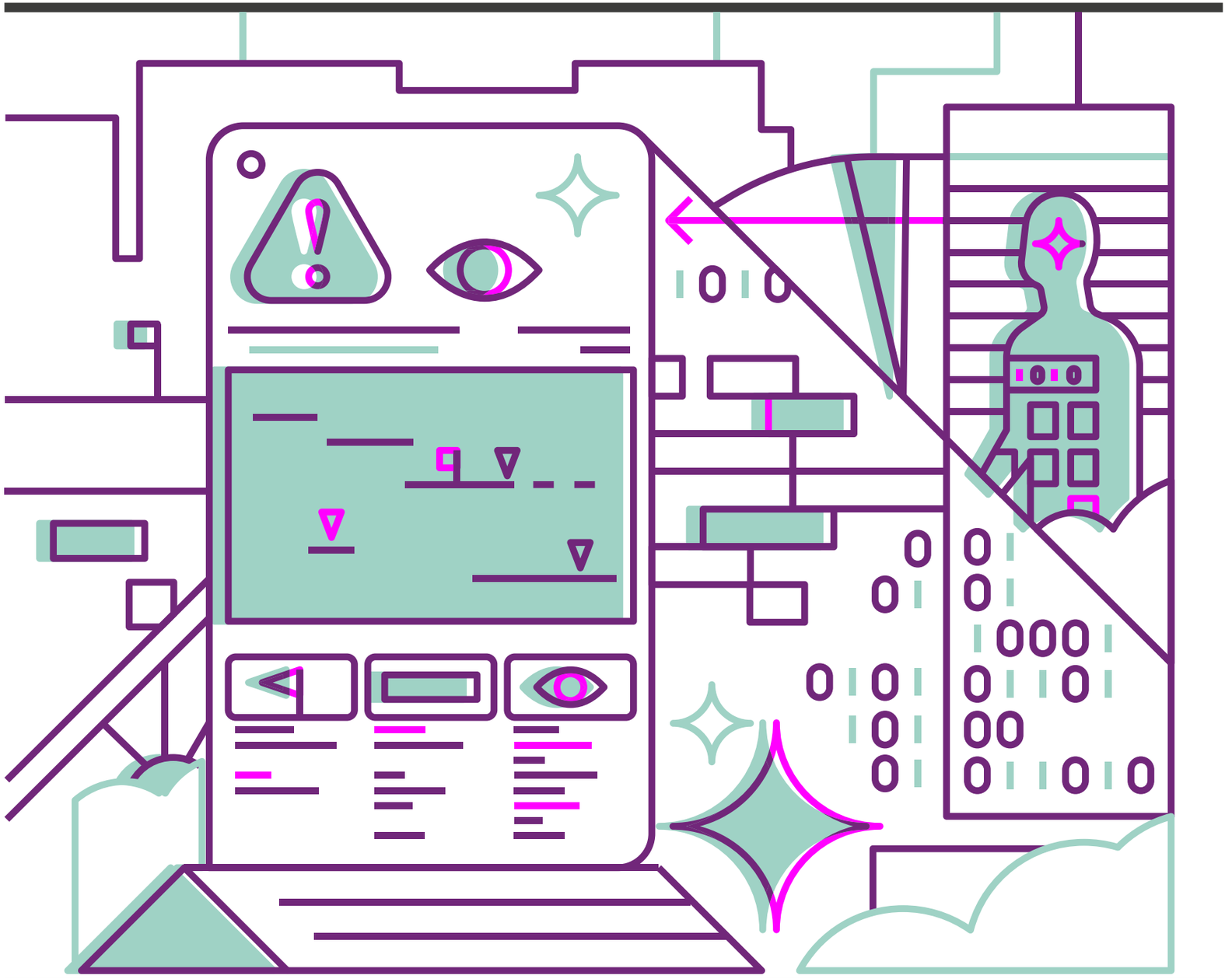
The essence of delivering a successful large project is having clarity on what you want to deliver and why, the right team that trusts each other, a fully resourced schedule, consistent processes, systems and a common data environment. You need to have one version of the truth and the right information to make decisions.

— Warren Kencroft, Vice President, Technical Integration, GO Expansion

99

The role of digitalisation, data and AI in delivery



The role of digitalisation, data and AI in delivery

Given this report looks at the future of major programme and project delivery, it would be remiss of us not to dedicate time to looking at the trending topic of digitalisation, data and AI.

Since ChatGPT was launched in December 2022 there has been a clamour of excitement to integrate AI into different industries and for different purposes.

The broad application of AI and innovative data tools on mega and giga-projects has the potential to help break the ongoing cycle of over-budget and late projects with disappointing benefits realisation.

Understanding the huge consequences of inefficiencies in mega-project delivery, our estimates suggest the global economy is at risk of missing out on more than $1.5 trillion of growth by 2030,[xxv]– value that could be recovered for the greater benefit of society. A conservative 1:1 benefit–cost ratio has been applied to estimate lost economic benefits globally.

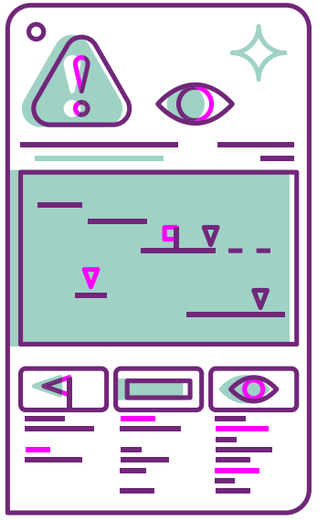
Major programmes and projects succeed when there is clarity of direction, trust, the right incentives, accountability, and timely decision-making. AI can be seen as an enabler of these principles. A tool that provides better information and options, helping boards and project leaders to make more informed choices aligned with the desired outcomes.

For instance, an AI-driven dashboard might highlight that a key milestone is likely to slip or that a risk indicator is trending upwards, prompting the project board to intervene earlier than they would have normally done rather than let issues fester. But it is still, of course, up to a high-performing integrated team to act on those signals.

Used pragmatically, AI can help to overcome the issue of optimism bias through AI-enabled reference class forecasting, tackling wishful thinking.

At the planning stage, advanced analytics can mine historical project data to produce more realistic forecasts and flag hidden risks from patterns and trends that humans fail to spot (getting AI to provide the ‘outside view’ in the words of Daniel Kahneman).

Designers can also leverage AI simulations to test scenarios and options[xxvi]. A digital twin of proposed infrastructure, such as a bridge or railway, serves as a parallel reality portal that lets decision-makers experience and explore different options and outcomes tied to project variables, revealing potential clashes or operational considerations before committing significant resources that are hard to undo.



Our interview with Ahmed Al Khatib, Chief Development and Delivery Officer, Expo 2020 and Expo City Dubai, in particular, showed AI in action for ‘clash detection’ and the time and money it saves in the long run:

“We built a digital city in a BIM model which put all the designs in one place. We detected so many clashes using AI – I’m talking hundreds of thousands. Imagine if we discovered those during construction – significant cost, disruption and redesign.”

By properly stress-testing plans upfront with more extensive, AI-powered predictive analytics running ‘what if’ scenarios, mega and giga-programmes can gain valuable insights, enabling them to pre-empt issues and risks that otherwise might not emerge until after construction is under way.

One perennial challenge in mega and giga-project delivery is the fragmentation of procurement and supply chains – silos between contractors, suppliers and clients lead to miscommunication, delays and waste.

While a collaborative delivery model can help with these challenges, it can be complemented by AI and other digital tools. For example, intelligent procurement platforms could be used to forecast material demand and automate orders, while providing real-time logistics tracking so that components arrive exactly when needed.

Likewise, AI systems can be used to integrate scheduling with live data on weather, team availability and site conditions, optimising work plans to keep the project on track. The result is not just efficiency but also transparency. Stakeholders get a live, data-rich picture of progress rather than intermittent reports. By streamlining these processes, AI could help to cut costs and time overruns while improving collaboration across the project ecosystem.

However, the application of AI tools in construction comes with some challenges.

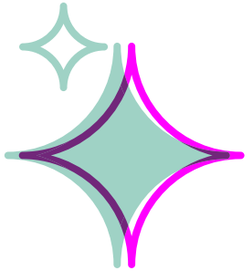
Over the last 20 years, construction productivity levels have remained stagnant, in part because construction remains one of the least digitised industries, traditionally spending less than 1% of revenues on technology and R&D.

Yet there is growing recognition in both governments and industry that we cannot go on delivering projects how we have done to date.

AI offers practical benefits to address long-standing industry problems – from poor cost estimating to low productivity, to inefficient delivery and logistics. Indeed, some countries (particularly in the Middle East, as well as Hong Kong) seem to be ahead of others in using it already for mega and giga-project delivery.

AI won't replace project managers or engineers, it can augment their capabilities and reduce systematic human biases, while taking over tedious tasks and processing large amounts of data. These applications enable project professionals to make more informed, thoroughly considered decisions.

The productivity benefits that can be achieved through digitalisation and the application of data and AI have an important part to play in closing the infrastructure gap. But there needs to be widespread uptake for the value to be realised, and this requires a shift in mindset. Too often, it seems that AI is seen as a threat to jobs, but this isn't the case. Professional acumen remains a valuable currency and blending this with AI tools should be seen as a step towards more effective delivery.



> **AI and big data are possibly the most important parts of the projects nowadays. If you're not using them, you're missing perhaps one of the most critical elements in project delivery.**
>
> —Global Senior Executive, Life Sciences and Pharmaceuticals Sector

An AI early-warning system for mega-projects

Forecasts estimate that construction expenditure in Hong Kong will rise to HKD 300bn ($39billion) annually in the coming years; a 30% increase on 2021.

The region is in an unusual position globally, with projects typically coming in 15% underbudget (compared to global trends which show that nine out of ten mega-projects experience cost overruns). Only 10% of projects in Hong Kong overrun their budgets, with overspend averaging 8%; very effective by international standards.

To help manage the increased forecast spend and to improve project delivery, the Development Bureau of the Government of Hong Kong SAR (DEVB) has transformed the city's HKD 600 billion ($77 billion) public works sector through comprehensive digitalisation, spanning the entire lifecycle of design, construction, and asset maintenance.

Hong Kong has a unique governance structure in which a single policy bureau oversees all public works across various works departments. This centralised approach is a distinctive feature not commonly found elsewhere in the world. Leading industry-wide change, DEVB implemented an integrated ecosystem of digital platforms, including a Digital Project Delivery System (DPDS), a Digital Works Supervision System (DWSS), and a Project Surveillance System (PSS). These systems centralise data from over 200 active public works projects (including more than 300 works contracts and 700 consultancies) into the self-developed Integrated Capital Works Platform (iCWP), and enable AI and predictive capabilities, revolutionising portfolio and project management.

The PSS was developed by DEVB in 2018 as part of Hong Kong's Construction 2.0 agenda and aims to improve project governance, predict risks, and facilitate early interventions. It is a web-based tool that continuously monitors ongoing programmes and projects by analysing cashflow data. Projects submit actual and forecasted cashflows, which are assessed against patterns derived from a historical project database. Each project is categorised using a traffic light system: 'green' for normal progress, 'amber' for potential issues requiring departmental review, and 'red' for critical concerns necessitating top-level attention.

The system was further enhanced with AI-enabled early warning function in 2022. The AI model was trained on data from 849 completed projects valued at HKD 460 billion ($59 billion). A custom-developed algorithm, described as a 'rolling discretizer,' proved most effective in identifying characteristics of high-risk projects. The AI achieved up to 70% accuracy in detecting projects with potential cost overruns and schedule delays.

A key insight from the deployment was that the AI required only about 10% of a project's data to generate meaningful predictions. This efficiency suggests the system can be applied early in a project's lifecycle. The PSS could become an intelligent benchmarking technology with the capacity to improve over time.

Hong Kong's Project Surveillance System

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By referencing data on project cash flow, we can forecast whether the project is tracking to be under or over budget, and whether it may suffer delays. Assisted by AI, we're able to make these predictions earlier on in the project lifecycle, giving us a better opportunity to put solutions in place and reduce risk.

— Joseph Lo, Head of Project Strategy and Governance Office, Development Bureau of the Government of Hong Kong SAR

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Actionable solutions

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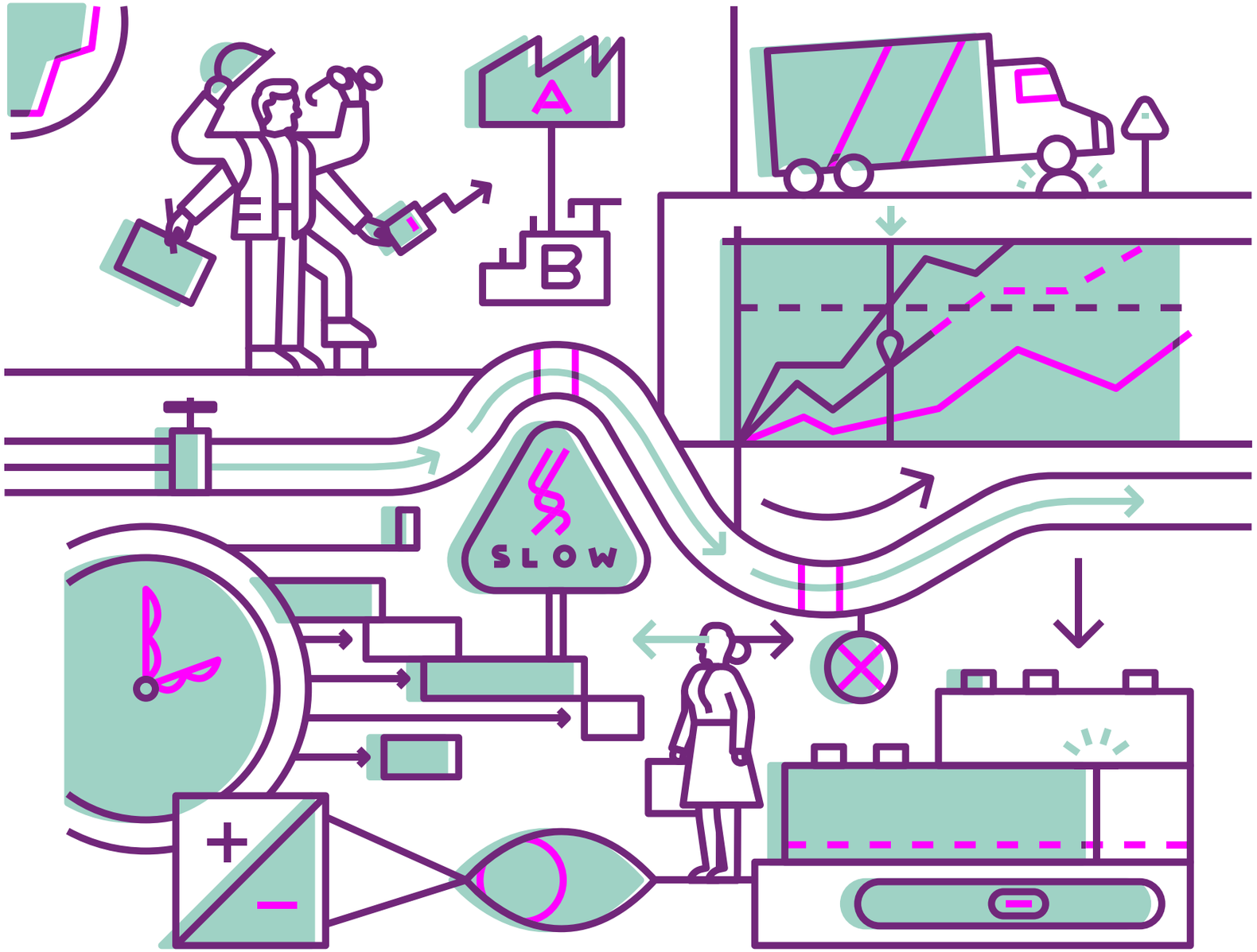

Actionable solutions

Now we have a good understanding of the state of mega and giga-programme and project delivery, the common challenges, and the collaborative delivery concepts that offer a compelling framework for implementing solutions, we have a set of 12 actionable steps that can be implemented today by those delivering large-scale programmes and projects.

1 **Start with the purpose**

2 **Be a well-governed client of choice**

3 **Slow down to go quicker**

4 **Establish clear and stable pipelines**

5 **Enable purposeful procurement**

6 **Value time**

7 **Do the basics brilliantly**

8 **Ensure cost realism**

9 **Draw on global experience**

10 **Change scope with care**

11 **Hold a 'pre-mortem'**

12 **Think off-site**

1. Start with the purpose

Nearly every one of our interviewees touched on the importance of understanding why a programme or project is being undertaken, the key issue or issues it seeks to address, and the key outcomes that are needed from the intervention.

Success on a mega or giga-programme or project stems from having clarity on the 'why' and the desired outcomes. It is also important to have a sense of how the outcomes are prioritised between those which are 'essential' and those which are 'nice to have'. This work allows projects to effectively find the right solution and then to make informed choices around scope, cost and time and how they relate back to the purpose of the project.

What's more, establishing a purpose early on helps to build valuable relationships beyond the programme environment, as outlined by Mohamed Saad, President, Diriyah Company:

"When a project has a clear purpose and the surrounding community is properly engaged on it, you can create a sense of pride. People feel like they are part of something bigger and, when combined with tangible benefits that will improve their quality of life, you generate valuable local support for your plans."

2. Be a well-governed client of choice

Our interviews clearly highlighted that for projects to succeed they need to have a client or sponsor organisation as high-performing as the delivery organisation.

The best clients understand their strengths and decide on what sort of client they want to be – whether that is a 'thin' client with a relatively small team, or a 'thick client' with significant internal capacity. Depending on the situation there can be good reasons for both approaches, but our interviews found that clients often do not clearly ask themselves the question and hence do not then make an active choice in organisational design. The decision of what sort of client organisation to be clearly then drives the type of delivery model they want to use for their programme or project.

Our analysis shows that the average mega programme or project is in delivery for around a decade. Clearly then, the

team that initiates the project is unlikely to be the same team that completes it. So, from the start, the best clients have succession planning, continuity and the development of the next generation of leaders at their heart.

They also have a good understanding of their strengths and weaknesses, opportunities and threats, and then partner with external organisations based on that assessment. This understanding can be established by undertaking a 'maturity assessment', like the P3M3 diagnostic tool, which helps them chart a course towards 'maturity'.

Most importantly, our research found that the best clients pay particular attention and expend significant effort in ensuring that they select their partners carefully. And that the subsequent combined team has the right collaborative culture, clarity of purpose and the right incentive structures in place to drive performance and the best outcomes.

3. Slow down to go quicker

Nearly all of our interviewees cited how the desire for speed can lead to hasty, misguided decisions in the earliest stages of the programme, resulting in more time and money spent in the long run. A particular issue raised was not doing enough substantive work on design, management protocols, logistics, constructability and deliverability before actually starting work on site and fully engaging contractors. This is especially acute in projects where political pressures prioritise a visible show of tangible progress over intangible preparatory work that plays a bigger role setting the stage for success.

To some it may sound counterintuitive, but mega and giga-programmes need to slow down and resist the rush to start on site until serious work is done to understand why you are doing the project – that is specifically how it will resolve the need – precisely what must be delivered, and how to then deliver it.

4. Establish clear and stable pipelines

With global net profit margins within the construction industry ranging between 2-5%[xxvii], the sector is particularly vulnerable to the stopping, starting and scope shifts of programmes and projects. These low levels of profitability and, in some countries, a fragmented industry means that, in general, construction firms invest significantly less in research and development, and training their staff, and so are less able to 'ride out' downturns in demand which lead to lay-offs and redundancies.

To address this, governments and organisations alike need to create mechanisms that try to smooth out the typical peaks and troughs of demand seen in construction. This can include creating longer-term capital investment strategies, multi-year funding settlements, the use of arms-length government bodies for decision making around funding and seeking to develop broad political and public support for projects before they begin.

Publicly funded pipelines also need to be open, transparent and realistic. In several countries that were studied, significant pipelines were published with a sizeable quantity failing to ever materialise, causing the construction industry to lose faith in the data.

5. Enable purposeful procurement

"One of the things that can lead to a suboptimal outcome is when we procure everything in exactly the same way, which some large organisations advocate. Clearly there have to be guiderails, but my preference is to look at the specific need and then work out who the best supplier is from a technical and relationship perspective. Make sure you have a baseline cost and schedule you're working to, then do the deal that motivates them for their style of working."

—Ruth Todd, Operations and Supply Chain Director, Rolls-Royce SMR

Procurement can make or break programme and project delivery, such is its centrality to getting the right people, partners and suppliers on board and working as part of the team.

The complexity, effectiveness and approach to procurement varies greatly around the world, with a common challenge being that organisations and commercial teams can lose sight of the purpose of a procurement exercise and end up focussing too heavily on process.

For example, while there has been a move in the right direction with greater uptake of NEC contracts, in Latin America, many procurements are still awarded solely on price, putting limited emphasis on questions relating to technical capabilities and experience. In the UK, the process can often be so complex and complicated that it takes over a year to complete and is frequently challenged through the courts.

However, the essence of an effective procurement is simple: does the bidding organisation have the right people, culture, experience and skills to deliver this programme or project effectively?

To answer that question, the procuring organisation must look beyond the process and paperwork and prioritise meaningful face-to-face engagement. Whether this is through a behavioural assessment, a presentation and discussion with an interview panel, or an ongoing period of dialogue and discussions before and during the tender itself, spending time together is critical. A consistent commitment to getting to know the people being brought into the team is crucial to high performance.

So, wherever in the world the programme is, 'buying' organisations should introduce an appropriate amount of in-person time with their bidders and remember why they are running the procurement: to find the best long-term partner to effectively deliver on the programme's purpose.

6. Value time

Time is as important as money when it comes to delivering mega and giga-projects, especially, as so often is the case, if the outcome is likely to deliver significant economic and societal benefits.

There was a view that the industry – especially in Western countries – has become conditioned to decisions and processes taking a long time and with no benefit to the project or outcomes. One example might be having part of a design signed off at multiple levels and within different departments and organisations that lack the expertise to properly input or provide valuable feedback.

Part of the reason for this is a proliferation of bureaucracy and the ever-larger size of teams, which is generated by a view that 'throwing more people' at the project will lead to improved delivery and outcomes. Our research found that the opposite is often true.

The longer a project goes on, the more likely it is to encounter significant external shocks – whether they be geopolitical conflicts, inflationary impacts, climate crises, or health pandemics — and the more likely they are to be affected by policy shifts that can result in funding losses or costly scope changes.

All those involved in mega and giga-projects need to adopt a 'value of time' mindset where the time allocated to processes and decisions is treated as seriously as how much the project may cost to deliver. Time needs to be spent well.

7. Doing the basics brilliantly

This recommendation is, of course, not a new idea. But our interviews show that on many projects the basics required to optimise project delivery are still not being done properly.

Projects need to have a clear scope definition. They need to have realistic, integrated delivery schedules that track inter-dependencies across contracts, supply chain providers and work packages. Projects need the right people in the right roles at the right time. There needs to be clarity of 'why' the project is being delivered, with clear understanding of causal factors that can make or break the outcomes promised.

Excellent internal and external communications play a crucial role in keeping stakeholders informed and managing expectations. To banish information silos and ambiguity requires consistent transparency with highly visible engagement. Risks need to be identified, tracked and managed openly and actively. Common data environments and performance indicators need to be established and shared constantly, alongside measures for continuous improvement and formalised knowledge sharing mechanisms on the project and with other relevant programmes and projects.

These things may sound basic, but they are not being implemented across mega-projects as consistently as they should be. As such, the likelihood of successful delivery is persistently low.

8. Ensure cost realism

Many mega and giga-projects start from a point of failure. This is because the information they are using around costs is wrong, often due to optimism bias, incentives to downplay costs, incomplete designs and misinterpretation of data. All of this means that programmes and projects are founded on flawed and unrealistic thinking and inaccurate baselines.

A key approach to counter this (in combination with the input of cost consultants) is the use of reference class forecasting which has been made even easier and more practical with the rise of AI.

Reference class forecasting for a specific programme or project involves three steps:

1. Identify a 'reference class' of similar completed projects.
2. Establish a probability distribution for the selected reference class for the parameter that is being forecast (e.g. time or cost).
3. Compare the specific project with the reference class distribution, in order to establish the most likely outcome for that specific project.

This 'top down' rather than 'bottom up' approach to estimating costs has been shown by various academic studies[xxviii] to be more accurate and, if used in conjunction with traditional methods and cost consultant modelling, capable of halving cost and schedule overruns.

9. Draw on global experience

Given the size, complexity and number of people involved in a mega or giga-project, leading one is a specialised job which requires a broad range of skills, just like those leading large corporations.

No longer can the mega or giga-programme and project director role be seen as a 'generalist' turning their hand to something different. It is a specialised role with relatively few people from the general construction and built environment industry having the skills to do so.

The best programme directors focus on building a high-performing team with a collaborative, constructive and high achieving culture that wants to learn from others and drive best practice. Above everything else they inspire people to follow them, not because they have to, but because they want to.

In the same way that larger companies have an executive committee or senior management team, the best project directors will recognise their strengths and weaknesses and surround themselves with those who can make the project run as effectively as possible.

Given that, globally, a very small number of people are leading programmes and projects of significant scale (around 0.00017% of the earth's population, in fact) it can be a lonely role, similar to being a CEO or organisation leader. To combat this, we suggest two things: developing a global network of high-performing project leaders to provide each other with challenge, insight and support; and the introduction of 'Project NEDs' (non-executive directors) who are seasoned programme and project professionals who can provide guidance, outside perspective and act as a sounding board to project leaders.

10. Change scope with care

So many mega and giga-programmes and projects are radically different – and radically more expensive – than their original conception. This is driven by a number of factors: 1) unclear outcomes or clarity of the real issue the project is seeking to address 2) a lack of value placed on time which allows projects to meander off and away from their core purpose and 3) continual scope creep that adds time and cost to the programme.

One of the main ways to combat scope creep is to use a delivery model that includes a fair pain/gain share for the delivery team and gives them a seat at the decision-making table. If all the parties share the upside of delivering on or under target cost then they will need a good rationale and evidence for any proposed change in scope.

Programmes need to develop a minimum viable product (MVP) that delivers on their key outcomes. This idea which has successfully been used in the tech world to test assumptions, gain early feedback, learn and iterate, and is starting to gain more and more traction in the construction industry globally.

Having an MVP doesn't mean cutting corners or compromising quality. It means developing a baseline focused on meeting the critical deliverables, objectives and outcomes fundamental to the programme's success (like health and safety). The MVP can then be used as a benchmark against which to make active and informed choices to add to or change with clear rationale, costs and time implications understood.

11. Hold a 'pre-mortem'

With more than 11,000 mega-projects and 250 giga-programmes and projects currently in delivery – not to mention those that have completed in the last decade – there is a significant amount of experience and evidence to tap into.

We are very used to holding a 'post-mortem' (or lessons learned) session at the end of key project phases. But what is much less common from our interviews is bringing this forward to the start of the project instead of the end.

Project leaders with a learning mindset go out of their way to understand in detail what went well and what went wrong on other large-scale projects in their home country and globally, and subsequently how this could translate to their own project. This 'pre-mortem' approach will clearly bring significant benefits to delivery and the mindset it represents sets the right tone and culture for the organisation.

12. Think off-site

Depending on where you are in the world, you may call it Modern Methods of Construction (MMC), Construction to Production (C2P), Design for Manufacture and Assembly (DfMA), Modular Integrated Construction (MIC), or something else entirely. Whatever you call it, the premise is the same; a shift from traditional, labour-intensive site work toward digitally enabled, industrialised construction processes that provide greater predictability, productivity, quality, and speed.

For complex, multi-year programmes under increasing pressure to deliver faster, with lower emissions and with fewer skilled workers on-site, MMC provides a compelling solution. Components – from modular building frames to entire MEP systems – are designed and built in controlled factory settings, then assembled on-site with minimal disruption. The benefits of such an approach are many. It can improve health and safety, enable more consistent quality of output, reduce waste, and dramatically shorten time on site.

The most successful of these approaches prioritises repeatability, interoperability, and scalability across products and sites which result in a continual learning process, economies of scale and a stable pipeline for the production factory.

Academic research has shown modular and prefabricated systems can triple productivity levels[xix] while significantly increasing safety and quality. In Hong Kong, where their 'MiC' programmes have been the subject of a good amount of academic research, they have been able to access cutting edge partners in Mainland China to provide high-levels of modularisation. This approach led to 50% time reductions, 6-10% cost reductions and 100-400% increases in on-site labour productivity compared to traditional methods[xxx].

Mega and giga-programmes and projects need to think 'offsite-first' and look to create a design that optimises for standardisation and factory delivery.

Appendices

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Methodology and disclaimer

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Methodology and disclaimer

Bradshaw Advisory – on behalf of Mace – undertook analysis of more than 5,000 global “mega-projects” (capital value of $1 billion or more) and “gigaprojects” ($10 billion or more) to assess how major programmes are delivered across different markets. The analysis undertaken draws on tailored datasets provided by GlobalData, further enhanced by AI-supported analytics and targeted academic desk research.

GlobalData applied a series of filters to its global construction project database of more than 277,000 projects to generate a focused dataset of 5,330 capital projects. These filters included geographies with active capital pipelines and regional diversity: Kingdom of Saudi Arabia, UAE, Philippines, Hong Kong, India, Australia, UK, Ireland, USA, Canada, Peru and Colombia. Projects were then only included if their capital value exceeded $1 billion and if they were at one of the following stages: Announced, Study, Planning, Pre-Design, Design, Pre-Tender, Tender, EPC Award, Execution, or Construction Complete. This is our Primary Dataset.

In addition to the Primary Dataset, the research team used a second, complementary dataset from GlobalData focusing on inactive and on-hold “mega-projects” across the same set of countries (Complementary Dataset). Together, these two datasets (our Foundational Dataset) provided a robust empirical foundation for understanding and analysing how large-scale capital programmes are conceived, funded and delivered, offering insights into both high-performing projects and those facing significant barriers to progress.

For comparisons where consistency across time and geography was essential, such as cross-country volume analysis, we limited the data to projects initiated since 2010, reflecting the period when GlobalData began systematic tracking. Both data sets were used individually and when combined. Earlier projects were excluded from these comparisons to ensure robustness. However, for other parts of the analysis where large sample sizes were preferable and time comparability was less critical, the broader dataset was used .

Techniques applied

Descriptive statistics were then applied to the Foundational Data set to enabling us to examine distributions of project volume, value and type across geographies, sectors and time periods. This supported a broad suite of analyses, including assessments of megaproject growth over time, comparisons of pipeline scale and benchmarking of delivery performance across countries.

Duration analysis was conducted using structured timeline fields such as Announcement and Construction End Dates to calculate project lifecycles. These metrics were then benchmarked across geographies and sectors to assess systemic differences in delivery timelines. A supplementary dataset containing stalled and inactive projects was used to support comparative analysis of pipeline activity across countries and sectors, while a natural language processing (NLP) model was deployed to identify schemes showing signs of severe disruption based on unstructured project update fields.

Where appropriate, secondary sources were used to supplement the data and validate key outputs, helping to contextualise results within broader industry trends.

Natural Language Processing (NLP)

To identify infrastructure projects at risk of severe delay, a Python-based NLP methodology was developed to systematically assess risk across a global portfolio. Using a custom-built phrase bank of disruption indicators and a pre-trained sentence transformer model based on BERT, the approach analysed project updates to detect signs of severe disruption.

A highly conservative phrase bank was defined, deliberately excluding routine delays or early-stage uncertainty, which occur across a large portion of projects, in order to reduce false positives. The model compared sentences in each project update to the phrase bank using semantic similarity scoring. A cosine similarity threshold of 0.75 was applied, enabling the model to identify sentences that are semantically aligned – but not necessarily identical – to high-risk patterns such as “project cancelled” or “put on hold.”

Projects were classified as either at risk of severe delay or not at risk, with each flagged project also providing the specific sentence that triggered the classification. In this analysis, severe delay is defined as cessation of progress with no active recovery timeline. In practice, this typically corresponds to projects that have been inactive or halted for two years or more.

While the methodology is designed to minimise false positives through a conservative phrase bank and a high similarity threshold, it may still underreport risk in cases where language is ambiguous or where project updates are infrequent or missing. NLP-based methods can also struggle to interpret context or tone, which may limit their ability to detect implicit or cautiously worded signals of disruption.

Moreover, the underlying data is dependent on the accuracy of GlobalData’s reporting. These factors mean that while the NLP risk flags offer valuable insight into systemic delivery risk, they should be interpreted as directional indicators rather than definitive classifications.

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Industry leaders from across the globe

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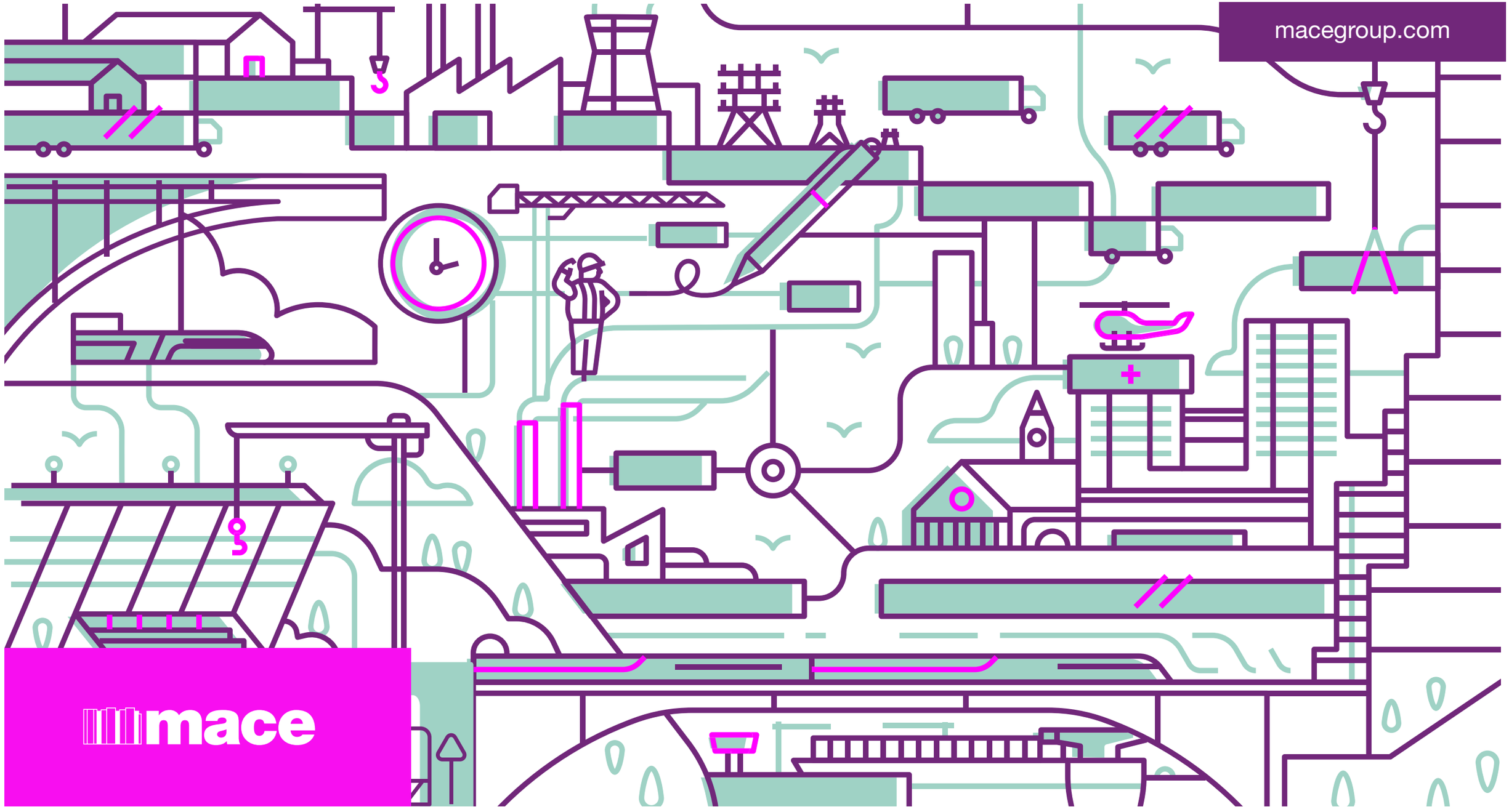
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