

BUILDING FUTURE CITIES

Can the construction industry keep up with rapid urban development?

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A NEW ERA DAWNS

Rapid urbanisation dictates that cities must evolve with time. What does this mean for the industry?

One of the most significant long-term trends around the world is the movement of the human population into 'urban centres' or cities. Not only are our cities getting bigger, but they are also becoming busier, more complex and must serve a more demanding population.

The challenge facing urban authorities today is to provide the infrastructure to support their expanding populations, and create happier, healthier cities that foster harmonious and safe communities.

The Middle East, particularly the Gulf, is gripped by rapid urban expansion. Focused economic growth and investment in projects has created some of the fastest-growing cities in the world, including Dubai, Abu Dhabi, Riyadh, Doha and Jeddah.

Rapid growth comes with its fair share of challenges for urban planners, architects and engineers. Every city faces its own unique set of issues. But it also creates exciting new opportunities for the government, businesses and society to converge and change the way that cities are developed.

At the same time, new technologies are enabling new ways of thinking. From building information modelling (BIM) to energy storage solutions and renewable sources for powering our future cities, technology has empowered experts to dream bigger.

Our future cities are set to be better planned, better operated and happier places to live. But what do these developments mean for the construction industry? Is the industry keeping pace with the demand for rapid development? How can construction adopt best practices when it comes to technology and design to execute competent 'smart' cities? What do future urban populations want and expect from their built environments?

Building Future Cities is the sixth report from the MEED/Mashreq Construction Partnership. The report looks at the factors shaping the region's cities of the future: social, economic, environmental and technological. It features insights from experts on trends shaping our future cities, potential transformations enabled by new and emerging technologies, and considers whether the construction industry is ready for change.

As the experts from Arup remark in one of our insight pieces (page 23), successful cities are not built overnight. Cities must be developed in a way that allows lessons learned from earlier phases to be used to improve later phases.



EXECUTIVE SUMMARY

- A 'future city' can be defined as one that balances urban infrastructure development, use of technologies and sustainability with a human-centric, community approach
- Rapid urbanisation is advancing the need to develop smart cities that are backed by quality data, best design practices and the latest technology
- The Middle East, especially the Gulf, is well-versed in urban development, but must learn from shortcomings such as the lack of first and last-mile connectivity, data-backed designs and complementary legislation
- Technologies such as 3D printing, internet of things, autonomous vehicles and artificial intelligence are transforming construction and design practices. Governments and key stakeholders must successfully integrate these technologies to deliver a smarter future
- Urban planners can foster healthy communities where people want to live, work and play by ensuring future cities are people-centric. This can be achieved by involving citizens throughout the planning process, and with public and private sector collaboration
- Regional cities are shifting towards clean energy sources as long-term solutions for future cities. The UAE and Saudi Arabia have the most ambitious renewable energy plans
- Revising existing standards, guidelines and legislation is essential if the region's cities are to achieve their urban development goals

CONTENTS



06-08

SHAPING FUTURE CITIES

Gulf cities are the perfect testbed for urbanisation elsewhere in the world

13-14

CITY GUIDE

Regional cities face their own set of challenges as they strive to expand

20-22

POWERING CITIES

Clean energy sources are the viable solution to sustaining future urban hubs

09-10

BEST PRACTICES

Data-backed design ensures best practices are followed in urban planning

15-16

EVOLVING TRANSPORT

Solutions should address the problems of today and solve the challenges of tomorrow

23-25

DELIVERING PROMISES

The private and public sector must work together to deliver the UAE's future city plans

11-12

BUILDING COMMUNITIES

Masdar City's success stems from its people-centric approach to masterplanning

17-19

TECHNOLOGY

The digital age has made it easier for construction to 'dream bigger'—or has it?

26

LOOKING AHEAD

Are planners, designers and construction companies game for the challenge?

BEYOND A CONCRETE JUNGLE

Future Gulf cities need crucial connections, data-backed design and a strong sense of environmental responsibility

Global cities have growth in their future, whether they are ready for it or not. The UN predicts that 68 per cent of the world's population will be urban by 2050, up from today's 55 per cent. Combined with natural population increases, this forecast homes another 2.5 billion people in cities in a little over 30 years.

This is the kind of urbanisation the Gulf's baby boomers have already experienced. In 1950, just 54.5 per cent of the UAE population and 21.3 per cent of Saudi residents lived in urban areas. Now that figure has shot up to 86.5 per cent in the UAE and 83.8 per cent in Saudi Arabia. Both countries are forecast to broach the 90 per cent mark by 2050.

What has happened in the Gulf may point the way ahead for key centres in Africa and Asia, where many of the 2.5 billion new city dwellers are likely to live.

As planners, architects and engineers in the Gulf design and build ways to comfortably accommodate more people, the future development of the region's cities could prove to be a test bed for urbanisation elsewhere.

Unhindered by the hundreds of years of organic development that underpin some global population hubs,

Gulf cities have grown upwards and outwards in their own way. They have eschewed the centre-out pattern of the old world, opting for what architects have coined 'polycentric development'; creating cities that start off with more than one clear centre, or develop multiple centres over time.

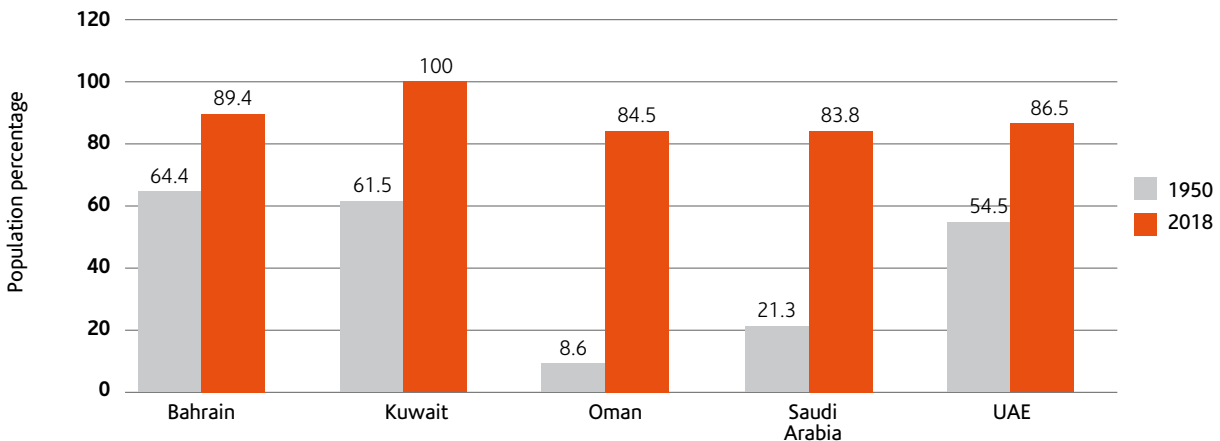
"Newer places are where things seem to have taken off in a polycentric direction from the start," says Daniel Safarik, an architect and journal editor at the Council on Tall Buildings & Urban Habitat (CTBUH).

Dubai's linear organisation, with its multiple focal-points—and 63 per cent of the Middle East's tall buildings—is a clear example.

Driven by hectic growth and the kind of masterplan ideas more readily implemented in greenfield developments, it is a model that could predict the future for expanding cities and those struggling with the snarled highways of excessive suburbanisation.

"The solution in localities where the suburban model is clearly becoming unsustainable is to create smaller central business districts along transit nodes that are on the periphery," says Safarik. "To some extent the Middle East is ahead of the game here."

Annual percentage of population at mid-year residing in urban areas, 1950 versus 2018



Source: United Nations, Department of Economic and Social Affairs, Population Division (2018)



Effective connections

But if polycentric cities are to be a solution to the challenge of urban sprawl, then lessons must be learned from the Gulf's shortcomings. Multiple centres need effective connections between them—connections not reliant on the car.

"Connectivity is probably the challenge for the entire region," says Thierry Paret, president of the American Institute of Architects International Region and founder of Resilient Design Group. "Getting cars off the roads is, to me, one of the greatest issues."

Reducing traffic will be key for the region's cities if they are to become environmentally friendlier, easier to traverse and more liveable. Effective mass transport has been slow to develop, but huge investment has seen metro systems added first to Dubai and now Riyadh. The \$22.5bn Riyadh Metro project is an unprecedented effort to effectively retrofit public transport to an entire city, overlaying connectivity onto an existing urban environment.

"The Riyadh Metro is going to be a game changer in terms of reducing traffic and will help to connect neighbourhoods in ways that they really are not right now," says Paret.

While multibillion-dollar infrastructure projects will not be within reach for every municipality, Paret points out that there are smaller-scale connectivity issues that design can address.

"I'm talking about connectivity in terms of sidewalks, bicycle paths, aspects that you would hope that the cities in the Gulf would progress to incorporate," says Paret. "It's one thing that is still sorely lacking."

Paret believes a way forward is best defined by a clear masterplan, something he saw the benefit of while

"Without a wealth of data to work with, regional efforts to deploy data-backed design to examine the detail of how Gulf cities and their residents interact could be hindered"

working as lead architect at the King Abdullah University of Science & Technology (Kaust).

"Kaust was masterplanned from day one. A very comprehensive concept and detailed masterplan was completed by HOK. It studied the current context of that particular site, looking at a five, 10, 15-year plan."

For more mature locations, Paret believes experienced urban planners can achieve a similar impact via detailed district-by-district analyses, stitching them all together into a cohesive whole "from the macro down to the micro". It sounds a formidable task, but one being made easier by advances around the use of data in urban planning.

Data driven, people focused

Data-fuelled technological advances are enabling design practices to more rapidly analyse and predict how people will behave and interact with elements of the built environment. This data is used to provide hard evidence for design decisions once based solely on experience and intuition.



Perhaps counterintuitively, some argue that more data is leading to a greater focus on the people the designs are for.

“What we’re seeing is really down to the influence of technology,” says Richard Fenne, principal and regional executive chair, Middle East region for Woods Bagot. “We’re seeing a shift in the focus of design to a much more human-centred experience, achieved through technology.”

New tools are making it easier for architects and planners to use data to drive design decision making, reaching conclusions in real time.

“Designers always use intuition,” says Fenne. “But now a big shift is that we’re really able to validate that intuition through data-backed design decisions.”

It is a technological promise that could positively impact go-to efficiency measures such as energy use and transit congestion. It is also the kind of technology already being applied by companies that facilitate urban travel and navigation, making reservations or improving their interactions with retail environments.

“We can do the same in public spaces as well,” says Fenne.

But making data useful means having enough of it available. It is here that GCC cities may face a challenge. While international centres have been gathering—and making public—detailed information for decades, the same cannot be said in the Gulf. Without a wealth

of data to work with, regional efforts to deploy data-backed design to examine the detail of how Gulf cities and their residents interact could be hindered.

Environmentally responsible

Reducing the future environmental impact of cities will be essential if they are to accommodate larger populations sustainably. The environmental drivers behind new build projects are likely to grow in strength and urgency as a result, something already being seen by architects in the Gulf.

“Most of our clients, particularly for the very large projects, are being driven by environmental responsibility,” explains Steven Velegrinis, head of masterplanning at Aecom.

How this environmental responsibility is pursued may be expressed in different ways. Conventional responses include meeting the requirements of an environmental rating system, or working to minimise a project’s environmental impact. But Velegrinis has seen outliers emerging, organisations prepared to push the boundaries of environmental responsibility further into the future.

Velegrinis cites the example of a large urban masterplanning project in Saudi Arabia where the client wanted to look at climate change and the environment in a deep way, prompting Aecom to provide solutions for future sea-level rise.

“For new projects now, this is not unusual. It’s almost like the do-less-damage model is the baseline nowadays and it’s really the reach goals where we’re looking at true sustainability and real responses to climate change,” he says.

The government connection to most of the Gulf’s major developments could press home potential environmental advances. Undertakings made on the international stage to climate agreements and sustainable development goals could gradually influence private development projects.

“The combination of concentrations of financial power, political power and political goals in private developers or semi-private developers in the Gulf means that you’re getting projects and project briefs that are really genuinely looking at world-leading solutions,” says Velegrinis.

While cautious authorities may still need some persuading to introduce new building methods and techniques, there is the political will to make a difference, which in turn can translate to change. It is these changes that may mark out the Gulf’s developing cities as models for the future and shape Riyadh and Dubai in the decades ahead.



A SMARTER URBAN FUTURE

Better technology practices must be adopted from stage one of development

Increasing urbanisation has long been the rationale behind the call for innovation in the built environment and it is a trend that is set to continue.

The United Nations predicts that 68 per cent of the world's population will be urbanised by 2050 (up from approximately 55 per cent today). By 2030, a projected 28 per cent of people worldwide will be concentrated in cities with at least 1 million inhabitants.

City leaderships are focused on achieving the best outcomes for their citizens in terms of quality of life, equity, resilience and long-term sustainability. However, the resources available to achieve these goals have been increasingly limited since the global economic slowdown in 2008. Existing patterns of urban and infrastructure development are often unaffordable at a scale to match global demand and smarter, more frugal solutions that provide a high quality of life at a more affordable cost are urgently needed.

The successful integration of technology will be key to delivering a smarter urban future.

Clarity of objectives

Developing a clear vision with city objectives and performance outcomes is the first step to improving urban

development. Plans should be structured to capture stakeholder needs and use case studies to act as a guide for future action. This will also help to define and measure the success of any interventions.

Flexible planning

Too often, plans for regions, cities and districts assume a fixed development trajectory or a business-as-usual inertia. They often do not reflect the actual or rapidly approaching urban challenges. Inadequate frameworks hold back urban areas and their communities from real economic opportunities. Therefore, municipal leaders need to develop strategic planning based upon the following:

- The combined, evolving objectives of major stakeholders
- The evidence of the real situation and trends for economy, society, natural resources, land planning and infrastructure systems.
- Emerging opportunities presented by growth, change, investment and innovation

All strategies require an understanding of the real linkages between multiple systems—planning an interconnected organisation, underpinned by city-specific models—making a clear link between resources, infrastructure and spatial planning and the real human and

“With the introduction of new technology systems that create new types of user experience, real time data and economic growth, the traditional way of evaluating benefits needs to be updated”

economic outcomes that must be delivered. This enables city leaders to establish clear frameworks, based on long-term visions and constraints, but with the flexibility to accommodate any changes driven by economic, environment and social issues.

Stakeholders and governance models

The governance structure put in place to solve the most pressing urban challenges is key for success. It is the ‘enabling environment’ that includes transparent administrative and legal processes that are equitable and respond to the needs of urban residents. These processes help align stakeholders to realise short and long-term objectives.

Stakeholder engagement at all times is a vitally important part of this process. Stakeholders that should be considered during this process are city leaders, academia, service owners, community groups, private sector and built environment professionals.

Appropriate business models

In order to justify the deployment of new technologies, a business case and model is typically required to support investment. Traditionally, the business decision is based upon capital cost of the system versus the system’s ability to deliver against or exceed performance metrics specified by the investor. The operational costs are rarely understood or even evaluated. This has begun to hamper smart city innovations, especially in an era of constrained public budgets. International law firm Osbourne Clarke identified a lack of investment as one of the greatest obstacles to the roll-out of smart technology.

Therefore, with the introduction of new technology systems that create new types of user experience, real time data and economic growth, the traditional way of evaluating benefits needs to be updated.

Delivering effective city systems

Our urban areas are served by city systems such as highways, utility, parks and mobility services that have

been typically designed, procured, delivered and operated in siloes.

This model is well understood in the built environment sector; it has evolved as the simplest form of procurement and supports the operational structures of design, construction and estate/facility management companies that have built up since the industrial revolution.

These systems typically follow a ‘take, make, dispose’ model of service delivery, which has long been identified as inefficient and resource intensive by organisations such as the UK-based Ellen MacArthur Foundation.

It is crucial that built environment professionals look for opportunities to create projects that include multiple benefits such as offering their clients and society a new way of delivering systems that not only reduce capital and operational expenditure while enhancing existing and creating new revenue streams, but also improve quality of life.

Digital services and systems are already being deployed in cities that begin to deliver against these opportunities. And projects such as Sidewalk Toronto offer the potential to lead the way in demonstrating how technology systems can be effectively deployed at scale, while also engaging citizens and stakeholders throughout the process.

Conclusion

It should be remembered that first and foremost, successful cities are places where people want to live, work and play. Successful delivery of a smarter urban future should therefore enhance the quality of life for its citizens using technology as an enabler.

However, since the industrial revolution, there have been many of examples of technologies introduced into cities that had a lasting negative impact on the environment and on the quality of life of the population.

While smart city technologies may appear less obtrusive than some of these legacy systems, which include highways, cars and fossil fuel power stations, they may have a similar impact unless coordinated planning, design, delivery and operation is undertaken.

The methodology that has been articulated in this article will enable cities and key stakeholders to make the most of technology and deliver long-term successful outcomes for cities and their citizens.



Rob Moyser is the smart cities expert and partner at BuroHappold Engineers

CONSTRUCTING RELATIONSHIPS

As one of the best-known, fastest-growing urban communities globally, Masdar City is changing the way cities are built around the world

With the UN predicting that the world's population will increase to 9.7 billion by 2050—and with 68 per cent of those people expected to live in cities—it is vital that citizen-centric, sustainable communities are developed.

One of the biggest challenges that cities face today is how to reduce energy usage while also providing innovative cost-effective services that deliver a high, but sustainable quality of life to their residents.

At Masdar, we began tackling this challenge more than 10 years ago with the development of Masdar City in Abu Dhabi. Starting with a blank canvas, our goal was to develop an innovative city that uses less energy, encourages

more outdoor activity and plays a leading role in the transition towards renewable energy. To this end, one of the first milestones we completed was the launch of a 10MW solar array in 2009—at the time, the largest renewable energy project in the Middle East.

Masdar City has become a leader in sustainable urban development partly through better master planning. Home to one of the largest clusters of low-carbon buildings in the world, Masdar City is fully aligned with global and local sustainability standards, such as Leadership in Energy and Environmental Design (LEED) and Abu Dhabi's Estidama ratings system, which prioritises occupant health and wellbeing, as well as reducing energy and water consumption.



Building Communities

The city's third-party developments also observe stringent green building standards. We work with contractors and developers to share knowledge and help them to attain the required sustainability targets, thus ensuring that every aspect of the project's lifecycle, from planning and construction to operations and maintenance, is undertaken with sustainability and the community at its core.

Some of our most recent residential developments include the Etihad Eco-Residence, a LEED Platinum-certified 500-apartment complex for Etihad Airways cabin crew, and the Leonardo Residences, the city's first private apartment building. These citizen-centric developments offer their own private amenities, but are also fully integrated within the Masdar City community.

In April, we will be launching our latest third-party development, My City Centre Masdar, a neighbourhood mall by Majid al-Futtaim that is the first shopping centre in Abu Dhabi to achieve an Estidama 3-Pearl sustainability rating, making it one of the UAE's most sustainable malls.

Connected transport

Meanwhile, Masdar City's transportation strategy, which recently earned a prize in the Mobility Management category at the prestigious Road and Transport Authority's Dubai Awards for Sustainable Transport, is central to the community. Based on a system that puts pedestrians first, it emphasises innovative, sustainable, public transportation that is supplemented with clean point-to-point services, and finally adds personal vehicles.

Masdar City became the first urban community in the region to use autonomous vehicles, thanks to its iconic personal rapid transit (PRT) system, which has carried more than two million passengers. In October 2018, the PRT system received its first Navya autonomous vehicle, a self-driving electric shuttle, and we will soon be launching a Tesla vehicle ride-share scheme.

However, the transportation strategy is only part of the overall sustainability story. This starts with neighbourhoods that provide all basic services within walking distance. It is more sustainable to walk to the store or cafe than to use an electric vehicle. This expands to a higher level of services in specific locations in the city such as schools and hotels that are accessible on bikes or with Masdar City transportation.

Community spaces

Masdar City also maximises the use of shading from trees and buildings to encourage residents to walk, cycle and enjoy a more active lifestyle throughout the year.

The city is now home to Masdar Park, a 2,500 square-metre park equipped with extensive sports facilities,



Navya won a competition to supply Masdar City with the latest models of autonomous electric vehicles

ties, and the 5.6 kilometre-long Al-Mamsha trail, which is ideal for cycling, walking and running.

Home farming

At Masdar City, we continue to explore new ways to improve sustainability and community wellbeing. One example is our smart home farming project 'Bustani'. The exhibition, which is being showcased at our Eco-Villa prototype throughout 2019, demonstrates how people can grow their own leafy greens and produce other essential food items in their homes with the help of modern technology.

Our collaboration with French manufacturer Saint-Gobain to build its energy-efficient multi-comfort house in Masdar City is another example of our commitment to sustainable urban development. Set for completion later this year, the multi-comfort house is designed to produce more energy than it consumes through the use of high-performance materials and construction methods.

As we look towards the next 10 years and expand new partnerships, Masdar City will continue to strengthen its position as a commercially viable city that offers the highest quality of life within the lowest environmental footprint, as well as retaining our position as one of the region's largest clusters of innovative high-tech businesses focusing on sustainable technologies, from solar renewable energy, batteries and electric mobility networks to biofuels, recycling and sustainable agriculture.



Yousef Baselaib is the executive director for sustainable real estate at Masdar



IN THE SPOTLIGHT

Cities in the Middle East grapple with urban planning and effective technology deployment, while addressing growing population needs

As the region's urban population grows, existing cities are being forced to re-evaluate their expansion and development plans in the interest of their citizens, while adopting best industry practices.

MEED has identified five major cities in the Middle East and North Africa (Mena) region that broadly highlight the driving forces behind development, the challenges facing this growth and the strategies adopted to continue their upward trajectory.

RIYADH

Population estimate:
6.5 million (2010 data)

The driving force behind Riyadh's urban development is Saudi Arabia's Vision 2030 plan. Challenges lie, however, in the kingdom's capacity to drive the ambitious plans and the speed at which the changes are expected by residents and government alike.

Compared to other global cities, Riyadh has an advantage in that it is not overly burdened by ageing infrastructure. Equally, its government is ranked second globally by the World Economic Forum for having a long-term vision.

This sentiment will be enhanced with the roll out of the city-wide project management office through the Arriyadh Development Authority, which will provide greater structure and direction to the city's ongoing development. The upcoming Riyadh Metro, part of the greater Riyadh public transport project, will support the growing population, addressing key challenges such as traffic congestion and air pollution.



DUBAI

Population estimate:
3.2 million

Dubai is at the extreme end of smart city development and has rolled out smart government initiatives. Furthermore, there is a drive to adopt new technologies, including 3D printing and autonomous vehicles.

Urban planning is focused on making sure individual projects are built safely and comply with safe building codes and standards, but there are few rigorously enforced overall policies—for example, controlling the number of hotels that are built or needed. Technology can help automate these types of analysis to ensure a balanced city is created that adapts to changing demands, be they environmental, social or economic.

The focus on introducing new technology should not overshadow the need to improve existing processes. Current facilities produce masses of data that needs to be structured and managed so that it can be analysed and trusted to make decisions.



KUWAIT CITY

Population estimate:
4 million (2016 data)



The main challenges facing Kuwait in its current and future urban development plans are delays in construction, poor project management and weak cooperation between government planning authorities.

These challenges can be addressed by activating the role of parliament in monitoring and surveying government and private sector planning projects. It is also necessary to promote the role of the Municipal Council in planning new cities. A joint committee involving all of the planning authorities can improve collaboration. Finally, it is essential to incorporate residents in the planning process so their needs and what they demand from future cities are understood.

ABU DHABI

Population estimate:
2.6 million (2016 data)



Fast urbanisation is one of the biggest challenges facing Abu Dhabi.

As a city with a shoreline into the sea, development risks for Abu Dhabi include extreme heat stress and urban heat island effect, sea level rise and water stress. This impacts design and urban infrastructure planning for the coastal areas, as well as the overall socioeconomic condition of Abu Dhabi.

Abu Dhabi can adopt whole carbon assessments to formulate the pathway to a low carbon city.

There is an urgent need of transitional policies that can bridge the existing urban planning laws, regulations and policies with the future smart city vision of the city.

Adopting a circular city model, in the urban planning and design can reduce wastefulness, utilise resource smartly, and lower greenhouse gas emissions.

CAIRO

Population estimate:
19.5 million



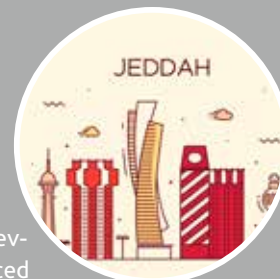
With a rapidly growing urban population, Cairo faces immense pressures to ensure that immediate needs are met, while also forecasting and planning for its future.

Climate change, energy, material availability and water are among the challenges that require immediate attention. It is essential to address these issues to ensure the flow and supply of goods and services along with a consideration of social and economic factors. There is also the question of safety and security in the face of the global increase in terrorism and instability.

Accommodating the historic fabric of the city, while allowing it to simultaneously grow towards a future vision is a challenging balance to strike.

JEDDAH

Population estimate:
4 million (2017 data)



Jeddah is the gateway to the Holy cities of Mecca and Medina. However, the area has experienced rapid, unmonitored and fragmented growth. The city is also burdened by flash floods due to poorly planned infrastructure.

The construction industry largely relies on foreign companies and expertise, but long-term foreign direct investment may be impacted by the fact that legislation favours Saudi companies. International firms often have to work with a local partner.

The emphasis now is on providing homes for the growing Saudi population. New projects aim to attract investors in sectors such as tourism, technology and green energy.

With input from:

- Khaled Tarabieh, assistant professor of sustainable design, American University in Cairo
- Mirette Khorshed, research associate, American University in Cairo

- Nayef Alghais, assistant professor, Kuwait University
- Farah Naz, head of sustainability and innovation, BuroHappold
- Aecom Future of Infrastructure report



A CONNECTED ECOSYSTEM

Urbanisation has forced city planners to reconsider their infrastructure strategies in order to meet growing demand

While I have never professed to being able to look into the future, I have always advocated the importance of looking towards it, and planning with sufficient foresight so as to avoid costly mistakes. This is particularly important when we are considering something as critical as a country's infrastructure asset.

It is all too common for a city to build for demand that is already there and then to experience constant constraint in its growth. Better to truly plan for the future and allow the city, and therefore its economy, to grow into it.

Luckily, the GCC has a solid track record of developing robust masterplans, with the intention of avoiding such pitfalls. The expansive road infrastructure arriving before housing, pricing technologies such as toll roads to manage demand, and the construction of metro systems prior to the saturation of highways are all good examples of avoiding this predicament and encouraging economic growth.

Regardless of advances in smarter working practices and technologies that attempt to reduce the need to travel, recent history has shown that there remains an

increased demand for networks and infrastructures that will move increasing quantities of people with ever-shorter journey times.

For the major cities in the world, getting this right can contribute as much to economic growth in terms of attracting business as any other single factor. My contention, however, is that we often get caught up in the 'what' rather than the 'how' when it comes to defining success.

Game-changing development

A good current example of this would be Hyperloop, and the hype that surrounds it. It is undoubtedly a project with truly breathtaking possibilities, but implementing it in a rush, or without consideration of a wider transport masterplan, could undermine the economic viability of the system and fail to deliver on such an exciting promise.

The reduction in journey times possible via such a system is truly game changing (imagine a journey of less than 60 minutes between Abu Dhabi and Riyadh), but will only be realised if the entire ecosystem that surrounds and supports it is planned and introduced in the correct way. If planned poorly, crowded terminals far from city centres, lengthy, airport-style immigration



“[Hyperloop] is undoubtedly a project with truly breathtaking possibilities, but implementing it in a rush or without consideration of a wider transport masterplan, could undermine the economic viability of the system”

processes and poor links to connecting transport modes could easily cause the end-to-end journey time to triple. Under these circumstances, much of the promised benefits over air travel are automatically lost.

To be clear, I'm not suggesting that any of these factors are besetting the current hyperloop projects, but merely that their consideration in planning this incredible vision for the future is as important as perfecting the technology itself.

Recognising opportunities

Significant gains can also be made through shifts in policy and utilisation of existing technologies to a greater advantage. With mass automation of road travel on the horizon, expansions in these technology platforms provide major opportunities in the shared mobility space.

US cities have seen mixed results in the introduction of shared taxi apps, where fares can be reduced for shared journeys. However, further incentives could be offered where congestion is problematic to increase the attractiveness of such schemes.

These would be great introductions for fully autonomous journeys where the end-to-end points must be

pre-set thus allowing the system to determine optimised sharing to reduce congestion.

As with all such technologies, there is a reliance on a core quantity of users to get them off the ground, and incentives to attract both users and technology providers could see the start of an exciting shift towards making shared mobility the norm in the future.

The true breakthrough here may need to wait for the technology to catch up, but the implementation of more local, autonomous vehicle solutions for the first and last mile could help both commuters and property developers, when integrated with systems already in operation, such as the region's metro networks.

Getting these systems in place on the metro line masterplans is an ideal first step, but there are significant pockets of land available around the existing systems to make this a reality right now in the region. Small steps such as these would certainly contribute to the overall wellbeing of the cities' inhabitants and make significant strides towards limiting on-going congestion challenges and supporting a greener transport agenda.

Whether it is the implementation of a ground-breaking technology or a small modal shift by a collective group of people, the opportunities to make major advances in the way we travel around our cities are there for the taking. The most successful cities will be those that adapt the fastest to the successful implementation of their masterplan, ensuring that the infrastructure can meet and indeed exceed the demands of their users right now, and well into the future.



Patrick Hallgate
is managing
director of trans-
port at Serco
Middle East

STEPPING STONES

Emerging technologies focused on urban growth present a wealth of opportunities for the construction sector

Today's construction market is filled with opportunities. Market trends including workforce globalisation and a growing population favour building transformation. The next generation of construction and building services should turn workplaces and home spaces into environments that are personalised, efficient, functional and profitable.

Technological advancements have always been ready for these market opportunities. Many new innovations in construction are developing at a breakneck pace, with the potential to revolutionise the industry and make future cities a reality. The overarching tool that will aid sustainable growth is artificial intelligence (AI) and machine learning. Coupled with blockchain, virtual reality (VR) and augmented reality (AR) will not only make infrastructures intelligent, but also improve security posture.

The internet of things (IoT) will also play a dominant role. Consider the enormous number of devices and objects becoming connected. These devices and objects are 'alive' and able to produce vast amounts of data on an unprecedented scale. With machine learning and automation,

we will see things happen that were never thought possible. Collectively, these technologies give us the formula for disruption of seismic proportions.

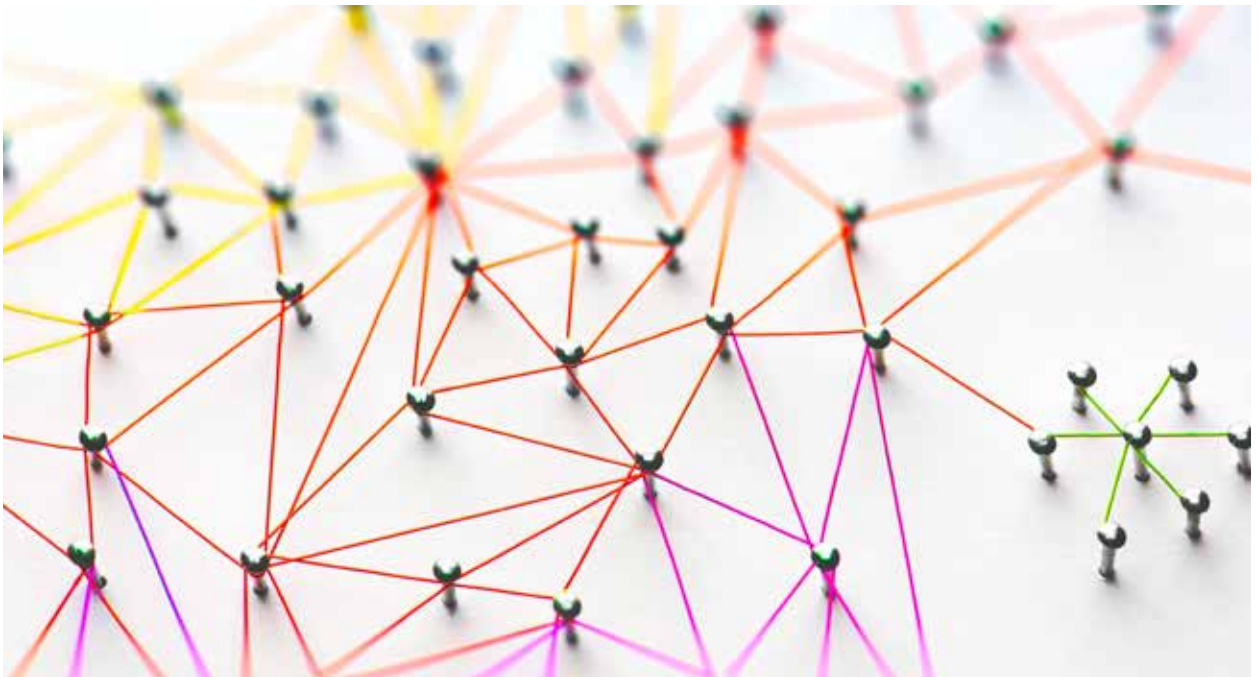
Software and mobile solutions

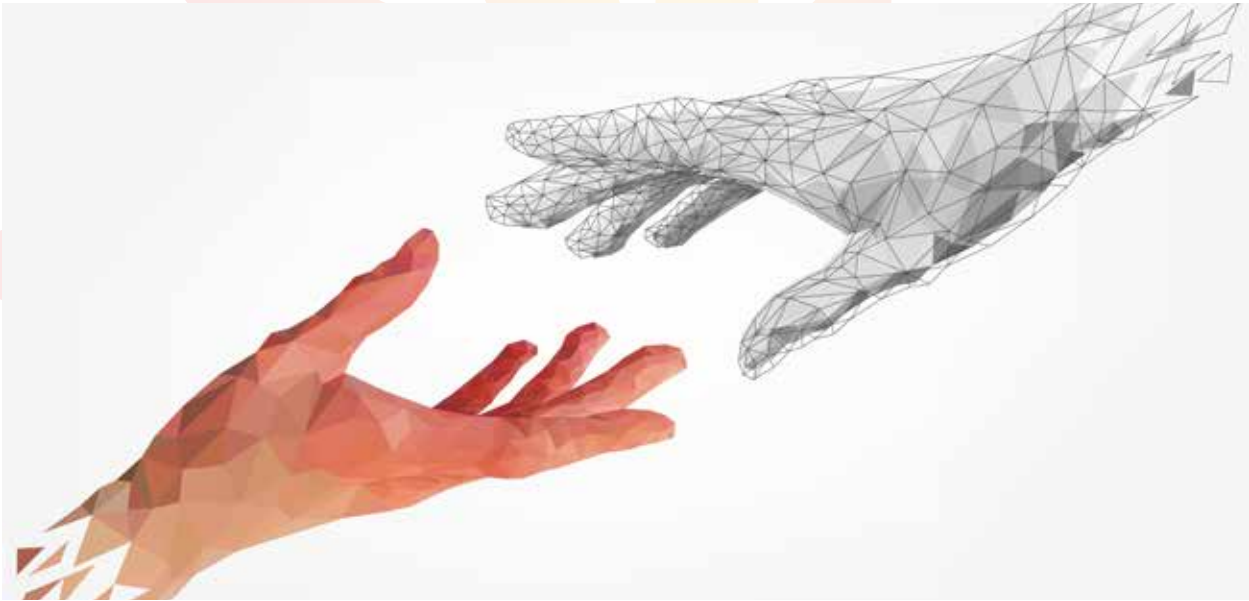
Today there are software and mobile solutions that can help manage every part of a construction project—from preconstruction to scheduling, project management and reporting to managing the back office. Most software solutions are now cloud-based, allowing changes and updates to documents, schedules and other management tools to be made in real time, facilitating better communication and collaboration.

Integration of data across multiple software platforms is another benefit of these systems, making it easier than ever to run your business.

AI and machine learning

Construction firms can use data to improve decision making, increase productivity and workplace safety, and reduce risks. With AI and machine learning systems, firms





“Many new technologies in construction are developing at a breakneck pace, with the potential to revolutionise the construction industry and help make future cities a reality”

can use the mountains of data they have collected over the years on projects to predict future outcomes on developments and gain a competitive advantage when estimating and bidding for construction contracts.

AI can improve worker productivity by reducing the amount of time wasted by journeys around the construction site to retrieve tools, materials and equipment to perform certain tasks. Workers can be tracked throughout the day using smartphones or wearables.

Rethinking reality

We believe that VR could have a strong impact on the construction industry from a safety and training perspective. With VR, any worker could get exposure to environments such as working at height in a safe and controlled way. VR simulators have been used recently for training purposes in different industries and could be used in exactly the

same way to train workers on everything relevant to the construction industry.

AR is another tool that can significantly improve safety on the construction site. Whether it's allowing for a more detailed safety plan to be developed or providing training on heavy equipment using actual equipment on real sites with augmented hazards, there are a number of ways that AR can be deployed in the workplace.

Traffic and accessibility

There is often a lack of data visibility across city departments. Crucial tasks such as monitoring traffic congestion, finding parking and moving around the city can be inconvenient and, in some cases, dangerous.

Statistically, the average American spends 42 hours sitting in commuter traffic each year. Furthermore, for the past two years in a row, there have been 6,000 pedestrian deaths in the US. Therefore, greater accessibility to traffic data should not be considered as merely a case for efficiency, but also increased safety.

People have the potential to thrive when they are afforded more time to work and be creative. With the right solutions highlighting vehicle traffic and crowd patterns, city agencies can learn from historic and real-time data to offer commuters and pedestrians safer and more efficient routes of travel.

Public safety and emergency response

With cities of the future, we can expect to see an increase in the number of people who need looking after. The

inability to coordinate across departments can slow down emergency response times and decrease public safety.

Under normal circumstances, a three-minute delay in traffic can be a case of life or death. Every minute matters. Each minute they go untreated, survival rates for cardiac arrest patients fall by 7-10 per cent. The average response time for emergency medical services in the US is seven minutes. Departments must make use of the most advanced technology available on the market to ensure more efficient coordination, allowing emergency services to get to patients quickly.

Environmental concerns

City operations, resilience and sustainability can often be hampered, and health concerns increased when cities are not able to effectively connect environmental data with other city data.

Almost 10 per cent of the urban population lives within 300 feet of a highway. Although convenient in terms of travel, studies have shown that exposure to harmful emissions and pollution increases childhood asthma rates significantly. Traffic congestion inevitably causes this risk to increase. Therefore, it is important to recognise the connection between efficiency and safety.

Looking forward

The city of the future must be ready to address a range of challenges, from economic development to liveability and every aspect in between. AI, IoT, blockchain and data

“The city of the future must be ready to address a range of challenges, from economic development to liveability and every aspect in between”

analytics will each play their own critical roles in building and enabling the future city.

Without a complete picture of the available data, it can be difficult for cities to reduce costs, drive new revenue streams and spur economic development. Once improved, these elements will help citizen engagement and increase liveability.

24/7 Wall Street's index measures factors such as crime rates, economic development and the environment to identify the 50 worst cities to live. The demand for this data indicates people's increasing desire to live and work in places that provide not just financial benefits, but also physical health and wellness of mind.

People have the choice to live in any city they wish. However, it is in smart cities where they will truly thrive. Sharing data across agencies can help cities to understand the nuances that affect each of these elements and create a more hospitable environment.

Clear priorities

Connecting data can create substantial value:

- 30-40 per cent fewer crime incidents
- 15-30-minute reduction in daily commute time
- 20-35 per cent faster emergency response time
- 90 per cent accuracy in predicting potholes, creating savings of up to \$1.5m
- 40 per cent less energy expenditure

Each city is different, yet the core services and challenges often overlap. Many of these issues can be solved without the need for a great deal of customisation.

According to the National League of Cities, the priorities of mayors across the US have been relatively consistent for the past five years. Economic development (58 per cent), infrastructure (56 per cent) and public safety (36 per cent) continue to dominate the list of priorities.



David Meads is vice-president for the Middle East and Africa at Cisco



THE ZERO-CARBON AMBITION

Renewable energy sources are garnering increased attention as the GCC moves towards a more sustainable future

Urbanisation or the aggregation of people in and around cities is a megatrend that will continue to be at the heart of global economic growth throughout the remainder of the 21st century.

Although there is no single agreed definition of a city, it is essentially a settlement of more than a few thousand people who live, work and socialise together. Cities today occupy only about 2-3 per cent of the earth's surface, but are home to about 55 per cent of the world's population. Globally, they generate approximately 80 per cent of economic output, consume 66 per cent of energy and generate more than 70 per cent of all carbon

emissions. It is expected that by 2050, nearly 70 per cent of the global population will live in cities. This means the way they are powered will essentially determine how we power our world.

Shifting approach

Methods of energy production depend on geography, infrastructure and regulatory context. Nonetheless, the trend is towards clean and sustainable supplies. By 2050, the majority of global demand for electricity is expected to be met by renewable sources.

The more optimistic scenarios, such as Bloomberg New Energy Finance's New Energy Outlook 2018,

project that by 2050, the renewable energy technology momentum will result in more than 70 per cent of total electricity coming from clean sources, with 50 per cent or more of this supplied by solar and wind energy.

With cities being the major consumers of global electricity, one would expect from such projections that they would be advancing rapidly in the adoption of renewable energy. Data from CDP (formerly the Carbon Disclosure Project) suggests that this is the case, with at least 100 cities worldwide sourcing 70 per cent or more of their electricity from renewables, and nearly 200 with solar or wind energy present in their mix.

Additionally, a 2017 study by C40 Cities Climate Leadership Group (C40) and McKinsey outlines the means by which nearly any city, regardless of size, population density and wealth, can achieve a 70-90 per cent share of zero-carbon electricity in its overall electricity supply.

Intermittent supply

Although such trends and perspectives are promising, benefiting from zero-carbon electricity, particularly when derived from intermittent wind and solar resources, will require technologies and operational practices that overcome the inherent limitations imposed by intermittency.

This is a system-level challenge that is context-dependent and requires both temporal and spatial considerations to achieve adequate system flexibility. Here, flexibility refers to the ability of a power system to respond to the simultaneous variability of electricity supply and electricity demand.

Although many conurbations are dependent on electricity supplied by utilities, authorities have a critical role to play in aligning with energy companies to enable the broad deployment of both centralised and distributed renewable energy sources.

In essence, cities must work constructively with utilities and government authorities in building the policy and regulatory frameworks that will allow for efficient and effective electricity systems to evolve and benefit inhabitants. Key areas of coordination are the setting of targets and incentives for centralised and distributed renewable energy generation as well as encouraging the adoption of technologies and operational approaches that provide power system firmness and flexibility.

Positive change

At the global level, cities such as Reykjavik in Iceland and Basel in Switzerland are already obtaining 100 per cent of their electricity from renewable energy due to excellent local hydropower resources.

“Cities must work constructively with utilities and government authorities in setting the policy and regulatory frameworks that will allow for efficient and effective electricity systems to evolve and benefit inhabitants”

A large number of other cities are adopting a more diverse power supply. For instance, 25 of the C40 member cities have established goals to reach net-zero emissions by 2050, through improved energy efficiency and increased use of renewables in urban buildings. These cities are geographically dispersed throughout North America, South America, Europe, Africa and Australia.

In the Middle East, cities historically powered almost entirely by fossil fuels are starting to shift towards alternative sources. At least 10 per cent of the electricity generation capacity in the GCC countries, where urbanisation is approximately 85 per cent, will be met by renewable energy if national targets are realised. This is significant, given that the share of renewable electricity capacity in GCC nation stands at less than 1 per cent today.

Renewables ambition

Among the GCC countries, the UAE and Saudi Arabia have the greatest ambition for clean energy. Though Saudi Arabia's renewable targets have been in flux lately, the UAE is still hoping to meet its 2017 target of 44 per cent of electricity from alternative sources by 2050.

According to the International Renewable Energy Agency's (Irena's) 2019 Renewable Energy Market Analysis, by 2030 the UAE's predominantly urban population may be obtaining electricity from a generation mix that includes as much as 6GW of concentrated solar power (CSP), 18.9GW of utility-scale solar photovoltaics (PV), 4.2GW of rooftop solar PV, 300MW of wind energy and 600MW of waste-to-energy.

This potential deployment of rooftop solar PV is by far the highest in the GCC and is based on the emirate of Dubai's target of 25 per cent of power coming from renewable energy, with rooftop solar PV on all of the emirate's buildings by 2030.



Powered by solar panels, Smart Palm Trees provide wifi connectivity and smartphone charging services at various locations across Dubai

“Even GCC cities, which have historically been powered by fossil fuels, will increasingly move towards renewables, simply because they are becoming the most efficient and effective source of electricity for highly urbanised landscapes”

Dubai’s ambition to increase distributed rooftop solar PV is only possible with an enabling set of government policies and regulations. Particularly important is the emirate’s net metering policy, which allows residents to offset their electricity bills through consumption of solar energy and carry forward credit for any generated solar energy that is not consumed in a given billing cycle.

Price incentives

Following Dubai, the emirate of Abu Dhabi has also initiated a net metering policy. The success of net metering in the UAE depends on the cost of electricity generation from rooftop solar PV being less than the cost of using the power grid.

The UAE energy policy is making this possible through ongoing electricity subsidy reforms that complement rapid reductions in solar technology costs.

In Dubai, The Sustainable City (TSC) by Diamond Developers is demonstrating, on a small scale, the opportunity for distributed solar energy in the UAE. The 0.5 square-kilometre development is expected to become the region’s first net-zero energy community and in its current phase has deployed 6.4MW of solar PV for its 2,800 residents at a cost that is less than the prevailing electricity tariff for Dubai expats.

Dubai has at least three other sustainable cities planned, while Abu Dhabi is already home to Masdar City, the Middle East’s first sustainable city and an early adopter of renewable energy.

Looking ahead, it is clear that cities of the future will be increasingly powered by clean energy. Although differences in local circumstances will lead to different patterns of adoption, the global electricity system is shifting towards renewable energy that is distributed, digitally enabled and integrated across end-use sectors.

Even GCC cities, which have historically been powered by fossil fuels, will increasingly move towards renewables, simply because they are becoming the most efficient and effective source of electricity for highly urbanised landscapes.



Steven Griffiths is senior vice-president (R&D) and professor of practice at Khalifa University of Science and Technology

DELIVERING PROMISES

The UAE's construction industry should focus on better collaboration, reworking legislation and promoting a sense of community

The best future city plans are where government, the private sector and the community interact and collaborate. The UAE operates a government-led city model. There are benefits to this approach in that project ambitions are high and speed of delivery is impressive, as has been demonstrated by the level of growth and investment over the past 20 years.

The local context in which we work has many defining features. Three of these are associated with the behaviour of the city population: the impact of construction on quality of life, the existing regulatory and policy context leading to a city form that results in island developments, and standard design. These provide different kinds of issues and potential opportunities to make a step change to build a future city.

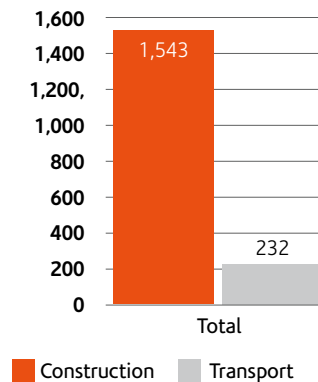
The population of the UAE is diverse and transient and while behaviours today may not be those required of a modern future city, the population is young and constantly changing. A large proportion of today's population will have been replaced by fresh, young talent in the coming years, bringing with them a readiness to take on whatever liveable and sustainable city systems have been created.

These could be cities with a different mobility framework such as more walkable districts with less private car use, reduced energy intake, a drop in waste generation or perhaps more flexible working practices.

The land allocation for development and fast-paced implementation often results in infrastructure upgrades in

existing urban areas or partial occupancy of areas that are still largely under construction. The traffic, noise, dust in the air or disrupted ground connectivity is impacting the quality of life of citizens and, within an increasing objective for well-being and happiness among the younger generations, a serious threat to attracting globally mobile talent.

Value of projects planned or underway in the UAE (\$bn)



Source: MEED Projects



The city form that is generated by the style of island developments creates a lack of connectivity across the city. This is particularly true for active modes of transport and public transport. The Dubai Roads & Transport Authority's cost-sharing approach, mandated in law, seeks to overcome this issue and requires developers to contribute towards infrastructure and public transport improvements. However, the development design process and approvals do still allow 'inward-looking' development to dominate and often prioritise road network upgrades over mass public transport infrastructure, since the latter requires wider strategic and long-term planning and has much higher initial funding needs.

Existing planning and design guidelines are based on older standards copied from elsewhere and are not fit for purpose when it comes to new technologies and planning concepts. At the MEED Mashreq Construction Club held in December 2018, a large number of attendees representing the construction sector agreed that existing standards and guidelines require a comprehensive revision.

So how can change happen and opportunities be realised?

In the UAE, broad city or country-scale agendas galvanise city stakeholders across government, private sector and communities. These agendas, often with the highest level of support, open up new opportunities to improve. An integrated approach based on collaboration and coordination will always be more successful for future city plans. Two such agendas that currently exist in Dubai are 'Smart' and 'Happiness'.

"The UAE can achieve behavioural change more easily than most cities through the attraction of globally mobile talent. The UAE is also ideally placed to become a frontrunner in new city designs and integration of new technologies, considering the willingness and, in fact, the need to reinvent itself constantly"



Smart agenda

This initiative is one of the most significant city-integrating agendas since the introduction of the concept of sustainability in cities. In order for any city to be smart, it must first be able to gain new insights about itself across sectors and stakeholders, and then be able to act on this knowledge to improve. New forms of technology and innovation, in addition to more traditional solutions, must be considered. We have to resist the temptation to be smart for the sake of being smart.

The city of Cascais, located within the Lisbon metropolitan area in Portugal, has implemented a variety of smart initiatives including the FixCascais app. Road or infrastructure damage can be easily reported through the app by taking a photo and sending a message directly to the municipality, which will be able to deal with the problem immediately. But the approach is reliant on close collaboration between the public sector and private construction companies, with the latter being expected to offer a high level of flexibility and quick response times.

Developing a city where high-quality data is routinely gathered and shared allows a city to learn from itself and others. Collecting quality open-data means gathering information from across the city and ensuring transparency and accuracy. Where several data forms are combined, new insights will often be found that create otherwise unknown efficiencies or areas for city improvement and thus shape future cities in a more informed way. The feedback loop of understanding, acting and learning from the outcomes of that action are where cities of the future will excel.

Smart infrastructure monitoring, which is already being implemented for large structures such as the Queensferry Crossing bridge in Scotland, will form a key aspect of a smart city. Sensors can be embedded into road surface materials to understand the quality and lifetime of the pavement in order to define maintenance requirements and

avoid major disruption. Considering the amount of heavy freight traffic and high loads observed across the UAE, monitoring of pavement health is even more important.

Happy days

Human happiness or wellbeing is a complex outcome to achieve due to its fundamentally integrated nature. Housing, incomes, mobility, safety and security, community, the environment, healthcare, urban environment, culture, recreation, social infrastructure and sense of belonging, among many other factors, contribute to a person's happiness or wellbeing. Cities are therefore under growing pressure to act as an enabler. There is a growing body of evidence-based research on how the built environment can help support wellbeing and sense of community and this must be taken into consideration in delivering future urban growth.

In this sense, the UAE can achieve behavioural change more easily than most cities through the attraction of globally mobile talent. The UAE is also ideally placed to become a frontrunner in new city designs and integrating new technologies, considering the willingness and the need to reinvent itself constantly.

There is also a growing interest in creating cities that allow people to be happy, beyond meeting the basic human needs of sanitation, food, water and shelter. To support wellbeing and happiness, agencies and construction companies will need to find a balance between tight construction programmes, efficiency of delivery, and ultimately cost and the impact on surrounding communities.

Smaller construction sites with a phased implementation and construction programme could reduce the areas affected. Also, successful cities are not built overnight—while there are ambitious plans in the UAE, building future cities in a way that allows learning from earlier phases to adapt and improve later phases will be necessary. New construction materials and methods can be introduced over time, but will require a higher level of flexibility from all parties involved, including the construction sector.

Collaboration and coordination

There is significant opportunity to develop ways of collaborating with the private sector to generate innovative funding mechanisms and to engage with civil society to develop and implement more inclusive and resilient designs.

Crossrail in the UK is an example of an innovative funding approach for major public transport infrastructure, combining various income streams, including developer contributions and local taxes for commercial property owners as well as infrastructure operators in order to reduce the central government grant to about a third of the total bill.

Authorities could also encourage an increased focus on connectivity and coordination of transport and mobility systems across development areas to stitch communities together across the city. Updated legislation and regulations need to support this initiative to meet community requirements. Pushing boundaries against outdated practices stifles innovation and change. The Dubai Transport Integration Manual, recently included into the formal urban planning and design process, serves as a great example for regulations adapting to community needs.

Ultimately, coordination throughout government departments and agencies is required to remove conflicts, delays and unnecessary ambiguity, which hinder the design and construction of future cities. Governments should also look at collaboration beyond their city boundaries and partner with other cities. The C40 Cities Climate Strategy connects more than 80 cities to share knowledge and best practice.

The increased availability of new technologies and focus on quality of life for every citizen requires seamless governance processes, which should also involve society. In Santa Monica, California, residents can influence the Downtown Community Plan which defines the development for the next 15 years, through a smartphone app by supporting or objecting to certain ideas and concepts.



This article was co-authored by a team from engineering and design firm Arup

Primary contributors

- **Joanne Carmichael** – director, Middle East planning leader
- **Joerg Tonndorf** – associate director, transportation leader

Collaborators

- **Irfan Khan** – associate, utilities infrastructure leader
- **Cara Westerman** – associate, senior urban planner
- **Omar al-Battaine** – associate, transport consultant
- **Hrvoje Cindric** – associate, Middle East urbanism leader

LESSONS LEARNED

Can the engineering and construction industry shoulder the responsibility of delivering future cities?



We live in a world where the most pressing question is ‘what’s next?’ Many city planners, engineers and builders are haunted by this question as they try to keep up with the latest trends in technology and innovation, while fulfilling consumer demand from citizens who are more aware than ever.

It is high time that the engineering and construction (E&C) industry prepared itself for the development of future, smart cities. In a world being overtaken by the likes of Google and Amazon, the E&C sector risks being left behind if it does not keep up.

The industry, however, should not fear the changes coming its way. While meeting evolving urban demands may be a challenge, it also paves a ‘constructive’ path ahead.

Future cities require innovation, which will ensure lucrative opportunities for construction. This also means a rise in jobs, not just for key positions, but even for unprecedented skills—such as drone operators and digital designers.

These projects will give built environment professionals the chance—and challenge—to think beyond traditional methods. Business models may have to be redone in order to meet the demands of future city projects, including funding and finance plans.

Information and communications technology (ICT) is now incorporated in almost every new building and infrastructure project. The construction sector needs to work closely with ICT companies to ‘reap the rewards’. Better understanding of ICT can help construction firms better plan their projects.

Firms can utilise digital software for better collaboration and analytics. Data can be useful for both operations and maintenance, and for planning future projects.

It is also important for E&C stakeholders to work in consumer needs and expectations when planning for future cities. Urban communities should be people-centric.

Industry stakeholders should also actively partake when it comes to influencing government legislation and policies. Ultimately, it is the engineers and architects who will be impacted if regulations are or are not approved. Working alongside the relevant government bodies can help the industry boost best practices for the longer run.

Internal issues such as low technology adoption rate, cash flow, dismal health and safety records and cut-throat competition need to be overcome if the E&C industry wants to achieve its goal of successful future cities.

Rome was not built in a day, but if the industry plays its cards right, it may well secure a way to deliver efficient, well-planned future cities within promised schedules.



ABOUT MEED

MEED has been integral to delivering business information, news, intelligence and analysis on the Middle East economies and activities for over 60 years. Attracting a key senior management audience through its content and activities, MEED is a media brand, publication and data business that covers a spectrum of services which inform, engage, connect and ultimately support our subscribers and partners in their business development and strategic growth.

Recently acquired by GlobalData Plc, MEED is now part of one of the largest data and insights solution providers in the world with the capacity to build global communities for our clients.

Our purpose is to support the region's companies make better and more timely decisions through our innovative data solutions and grow through our comprehensive and world-class marketing solutions.

To find out more email: info@meed.com

ABOUT MASHREQ

Established in 1967, Mashreq is the oldest bank in the UAE, with award-winning financial solutions and services. Throughout its 50 years' history, Mashreq has differentiated itself through innovative financial solutions, making it possible for its customers to achieve their aspirations.

Today, Mashreq has a significant presence in 11 countries outside the UAE, with 21 overseas branches and offices across Europe, the US, Asia and Africa.

Mashreq launched its new Vision and Mission recently, outlining its commitment towards its clients, colleagues and the community. In line with its vision to be the region's most progressive bank, Mashreq leverages its leadership position in the banking industry to enable innovative possibilities and solutions for its customers across corporate, retail, international, treasury and Islamic banking.

Mashreq is proud to be the first financial institution in the UAE to be awarded the Gallup Great Workplace Award for four consecutive years from 2014-17. Mashreq also continues to invest in recruiting, training and developing future generations of UAE national bankers.

