Would technology driven construction sector enhance Oman's progress?
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The Will to Lead; A Passion to Excel!
Editor’s note

At the beginning of 2017, Oman Society of Contractors (OSC) organized its annual conference ‘Construction sector needs an upturn.’ It highlighted the challenges brought in by oil crisis and addressed partnership issues, opportunities in the market and OSC’s role as a facilitator. It also urged for a technology driven construction sector.

Taking a cue from the resolutions in the conference, this issue of Contractors highlights the need for a technologically advanced construction sector. Conventional methods of building construction should be replaced by contemporary technology, as is the practice in other countries. Introduction of modern technology and equipment would make the sector considerably efficient and productive and thereby reduce time and project costs. Experts and observers have mixed reaction to this progressive stance. While some are in favour of it, some are more concerned about the dire need for relocating redundant workforce -- a challenge that automation will bring in. In the section 'Viewpoint', experts talk about this issue from their perspective.

We also have excerpts on new innovations and building materials used in other countries which will be interesting to glance through. Equally informative is Oman’s story in favour of using specific modern machineries.

The aim of this issue is to highlight the importance of keeping in pace with the present times and upgrading the technology profile of the sector. We have not done any research work here. We have just raised a thought provoking issue to decide whether or not the case in point is of any relevants.

As we stand at the threshold of 2018, let’s have a new beginning.
Carillion Alawi to build 10ha Oman hospital

Carillion Alawi, has been signed on to build a 10ha hospital in the Omani port city of Khasab. Prior to this, the UK contractor has entered an agreement with the Sultanate’s Ministry of Health to design and build the new Sultan Qaboos Hospital in Salalah. It mentioned that the Khasab contract was ‘on similar terms to those for the Salalah award and, if it were to go ahead, would have an estimated value of OMR60.8m to the JV’.

Oman’s health ministry said the hospital in Khasab would have a capacity for 150 beds.

The ministry also informed that it will have outpatient clinics, maternity wards, operation theatres, intensive care units, and burns and rehabilitation sections would be designed in the hospital.

According to the local press, the hospital projects in Khasab and Salalah were funded by UK Export Finance, in coordination with the Sultanate’s Ministry of Finance.

Steel experts urge anti-counterfeit measures

Members of the Steel Alliance against Counterfeiting (SAAC) presented a series of anti-counterfeit measures during an open conference at Abu Dhabi Petroleum Exhibition & Conference (ADIPEC) 2017. The conference was attended by engineering, procurement, and construction (EPC) contractors, and other stakeholders from the Middle East’s oil and gas industry.

A recent study commissioned by SAAC, which comprises 18 manufacturers of steel tubular products, revealed that 53 per cent of industry professionals in the GCC have personally encountered fake steel products during their regular operations. 79 per cent of respondents urged imposing stringent controls on steel products imported from specific markets.

SAAC members mentioned that to counter the risk of receiving fake products, they had designed and executed new anti-counterfeiting measures and conducted training workshops for their introduction. Speaking at the conference, association members supported the announcement of the latest UAE Fire and Life Safety Code, which they described as a crucial step towards increasing quality standards in the safety of building materials, design, and construction, as well regulating the responsibilities of stakeholders during project execution.

SAAC members also appreciated the implementation of the GCC Trade Mark Law, which they said would strengthen border protection and offer tighter controls against counterfeiters.

Contracts signed to fund Phase 2 of Muscat mall

Al Jarwani Group and Tamani International for Development and Investment signed contracts worth OMR22m with banks to finance the second phase of a mall project in Muscat. The project is expected to span an area of 20ha, with total investments in the project expected to exceed OMR150m.

Mahmoud bin Mohammed al-Jawwani, chairman of Al Jawani Group’s board said the mall was being extended as there is a good demand for the project. Phase 2 works would be completed “in conjunction with the first phase”, he added.

An aquarium spanning 8,000m², as well as a 5,600m² glacier park, will be developed within the mall. The mall would also feature an outdoor dining area and more than 200 retail outlets, creating up to 5,000 direct and 2,000 indirect jobs.

Tender Board awards OMR26.3m worth of tenders for 15 projects

The Tender Board of Oman has awarded OMR26.3m worth of tenders for 15 projects.

The projects include the development of Muscat International Airport and Salalah Airport and the design and supervision of the Al Batinah Southern Expressway, for which OMR12m and OMR378,805 were awarded respectively to the Ministry of Transport. The Ministry of Health was awarded OMR6.6m to upgrade Madha Health Centre in Musandam Governorate to a local hospital.

The Ministry of Agriculture and Fisheries was awarded OMR8,100 for additional construction works on an aquaculture centre. To cover additional consultancy services in relation to the design and supervision of the construction of the Innovation Complex Muscat, the Research Council was awarded OMR66, 500. To cover works concerning the design and implementation of the internal roads in the wilayats of Khasab and Bukha in Musandam Governorate, OMR992, 019 was awarded to the Ministry of Regional Municipalities and Water Resources.

The awarding was announced during the board’s ninth meeting of the year 2017.

NEWS UPDATE
Sustainable hotel coming up in Dubai

City will have a neighbourhood café and a speciality restaurant, both supplied by fresh produce from the community’s urban farming facilities and biodome greenhouses. The hotel will also offer indoor and outdoor event venues that are integrated into the landscape of the orchard and urban farms.

Standardized reporting to boost transparency

Construction professionals need to speak the same language to boost productivity and raise transparency within the sector, said Robert Jackson, director for the Middle East at the Royal Institution of Chartered Surveyors (RICS) at a seminar recently organized by RICS in Dubai. He cited a report published by McKinsey, saying that it detailed how poorly and slowly the construction sector as a whole has grown, in terms of productivity, over the years compared to other industries.

Jackson, noting that the report identified several areas that the construction industry needed to work on, continued: “We need to reshape regulation and raise transparency. We need to be talking the same language.” The report refers to International Construction Measurement Standards or ICMS, and how this body will drive consistency and transparency, and help investors make informed decisions. Jackson urged the absolute need for ICMS in the market that will enable stakeholders adopting it. Launched this July, ICMS is a benchmarking and reporting framework for international cost classification, reporting, and comparison, and was developed by more than 40 global standards bodies, also known as the ICMS Coalition.

UAE’s affordable property sector poised for growth

UAE’s property market is expected to get a boost next year owing to the significant growth and appreciation of affordable real estate in 2017. Recently released data has shown that up to 60 per cent of developers from Dubai are participating in the affordable property segment. Aqarat Dubai, a home finance website in the UAE said that as of Q3 2017, about 60 per cent of top Dubai developers had launched projects with affordable unit options, priced within the range of USD109,000 and USD190,600 (AED400,000 and AED700,000).

This October, Al Ghurair Properties revealed that its development plan, worth USD1.36bn (AED5bn), included localities such as Deira, Bur Dubai, Al Barsha, and Al Qusais. Due to be completed by 2020, these developments comprise 58 buildings featuring 8,000 residences and 3.25ha of retail space. Meanwhile, Aldar Properties launched its first mid-market project for Abu Dhabi this April – The Bridges, worth USD350m (AED1.3bn). The development has been designed to meet the demand for high-quality yet affordable homes in prime investment zone destinations across Abu Dhabi.

The affordable segment is a significant opportunity for builders and buyers alike, and the region’s public and private sectors are proactive to make the mood upbeat for the sector in 2018.

Phase 1 of Dubai’s Royal Pearls 10% complete

Construction works, underway for Phase 1 of Dubai’s USD5.7bn (AED21bn) Royal Pearls master development, are 10 per cent complete. Orient Pearls Real Estate Developers is developing the 42.7ha project in the city’s Meydan neighbourhood. Comprising 8,000 freehold apartments, the project’s timeline for completion is set for 2022.

Enabling works for the first 12 towers of the development have been completed, and the completion of enabling works for all units is scheduled for November 2019.

In addition to amenities such as a daycare centre and restaurants, the master development is also set to comprise technologies that support the Smart Dubai initiative. The latter category includes automation, smart security, and networked facilities management (FM) services.
BIM uptake for façade design is rising

Technology is becoming crucial for façade design in the Middle East. Belarmino Cordero, division manager for façades at AESG, a UAE-based consultancy, revealed that awareness about the sustainability aspects of façades, as well as their performance, quality, and durability is regionally increasing.

He added: "We also see that building envelope commissioning is now being demanded from design through to construction stages."

More and more, computational technology such as building information modeling or BIM, as popularly known and parametric design for façade optimisation is now being introduced to façade design, said he. He further emphasized on innovation in the façade design sector would be driven by regulations.

He elaborated: regulations are game changers — whether this involves new standards being implemented or old ones modified.

These regulations would include BIM being made mandatory for architects, new fire and life safety codes imposing more restrictions on materials and testing, and thermal regulations demanding the use of thermal breaks.

Façade is under the scanner in the UAE since local authorities announced that a new fire code would be launched for the country’s construction sector. Cladding is among the key components to be addressed in the UAE Fire and Life Safety Code of Practice 2017.

Solar project to begin inDuqm

A large solar panel project in Oman’s Duqm special economic zone will begin by the end of 2017. The USD94m project, which will generate around 1,000MW energy per annum, is being jointly promoted by China-based Ningxia Zhongke Jiaye New Energy and Technology Management Co. and the Oman Investment Fund.

It is learnt that the project will be ready by the end of 2019. The promoters of the solar panel project have already completed their feasibility study. They are now negotiating with some of the customers in the region for getting firm orders.

According to local press, Ningxia Zhongke will have a 51 per cent stake in the solar panel venture, while the remaining 49 per cent ownership will be held by the Oman Investment Fund. Ningxia Zhongke Jiaye New Energy stated that it anticipates USD215m in sales revenue per annum in the first phase. The Chinese firm, which signed a land lease agreement with Oman Wanfang, plans to export its products to overseas markets.

The Sino-Oman Industrial City in Duqm

Oman has entered an economic collaboration with China, and is building an entirely new, USD10.7 billion transit-oriented industrial city on the desert coast of the Arabian Sea, 550 kilometers south of Muscat. It is the port town of Duqm.

The aim is to turn a remote and underutilized seaport into a hub of global trade and manufacturing. The 11-square-kilometer venture, which lies within the Duqm Special Economic Zone (SEZAD), is expected to have not only a vibrant port but an array of other big-ticket endeavours which include an oil refinery, a multi-billion dollar methanol plant, a giant solar energy equipment manufacturing operation, an automobile assembly factory, an oil and gas equipment production site, and a USD100+ million building material distribution enterprise.

In addition to being a cluster of industrial operations, the Sino-Oman Industrial City will also have a city, providing homes for 25,000 people, complete with schools, medical facilities, office complexes, and entertainment centers — with the allure of a USD200 million 5-star tourism zone. The Chinese consortium has promised to develop 30 per cent of the project area in five years, for which funds and construction firms will be sourced from the mainland.
It is high time that Oman takes active steps to diversify its economy, reducing dependency on oil and gas industry. The National Programme for Enhancing Economic Diversification (Tanfeedh) is a pointer in that direction. It was during Tanfeedh sessions, held in late 2016, that Oman Society of Contractors (OSC) presented the Construction Initiative. After oil and gas industry, construction sector is the biggest sphere of activity in Oman. The initiative, approved by the Financial Affairs and Energy Resources Council and the Ministerial Cabinet, hopes to enhance the labour market within the construction sector, which is a critical factor for the industry.

The construction sector is the largest employer in Oman, providing jobs for 39 per cent of expatriates and 25 per cent of Omani workers according to National Centre for Statistics and Information (NCSI) data published in July 2016. Though the number of Omani workers is not meager in the sector, construction firms often strive hard to enroll nationals with the requisite skills and experience that would help them to meet the 30% Omanisation quota. As of now, the going is good for Construction sector though it has slowed down owing to the drop in oil prices. The Oman government’s support for construction sector through spending is nonetheless laudable. The country’s Ninth five year plan has allocated USD6.5bn for the construction sector, half of which goes for infrastructure development. At current prices, construction output amounted to RO2.06bn (USD 5.4bn) in 2015, accounting for 10.9% of non-petroleum activity, making it the third most productive non-oil sector after wholesale and manufacturing.

In 2015, the construction sector contributed RO 2.1bn (USD 5.5bn) to GDP at constant prices, a 10% increase over the RO1.79bn (USD 4.6bn) generated in 2014, as per NCSI figures. Between 2014 and 2015, the economic contribution of the oil and gas sector in Oman declined from 44.5% to 33.1%. In the same period, construction saw its contribution to overall GDP increase from 5.9% to 7.5%. Despite the current economic scenario, there is a positive outlook for the sector, in general.

Strategic initiative
With its pristine scenic beauty and hospitable environment, the government in a bid for economic diversification, aimed at turning Oman into a tourism hub, thereby creating new urban centres and relocating heavy industry out of the capital city. Eventually what we get to see is a huge construction activity happening in Oman’s infrastructure, real estate, healthcare, industrial and tourism sectors, facilitating economic growth in the Sultanate and an upward swing in its growth trajectory. The government intends to invest in projects that will help Oman’s government in its diversification policy, the immediate growth factors being increasing population, tourism and infrastructure development.

After agriculture, there is positive growth in construction as mentioned in CBO Monthly Statistical Bulletin August 2017. An indication is there that construction will be one of the most active parts of the economy and play a crucial role in the Sultanate’s growing diversification.

Projects and investments
While many construction projects are geared towards enhancing the tourism allure of the country, projects related to industry and transport infrastructure are also being implemented in Sohar, Salalah and Duqm. A major share is earmarked for transport and logistics infrastructure development in the Ninth five-year plan, which also looks for doubling the industry’s contribution to the economy to RO 3bn by 2020. Developing the South Al Batinah Logistics Area, which is 95 square kilometers in size, is of prime importance.
Road network: About 60 to 65 percent of all projects floated on the government’s Tender Board are in the road sector and road construction is the second highest category for project spending after airports. We have seen a remarkable growth in the development of road and other transport networks in Muscat and adjoining areas. With 6591 km of roadways in 1996, the national roadwork totaled more than 64,000 km by 2013. Many of these roads construction were tough owing to Oman's mountainous terrain.

Old style infrastructure is replaced by new ones to ease traffic in the city and outskirts and to link small towns and villages. Major projects are due to be completed between 2016 and 2018. Some challenging highway projects are also underway. One of the largest current projects is the 265-km Al Batinah Expressway. After completion, the Batinah Expressway will serve as a new all-weather, eight-lane super-highway extending from Muscat to Khmat Malaha on the Sultanate’s border with the United Arab Emirates. It will extend the Muscat Expressway to Sohar Port and Freezone and the UAE border. The project will fetch economic investment as well as enable Oman in emerging as a logistics gateway to the Gulf region.

The aviation sector: This sector demands heavy investments with six airport projects underway, two involving the expansion of existing airports – Muscat International Airport and Salalah Airport – and four new regional airports on greenfield sites – Sohar, Adam, Ras al Hadd and Duqm. The selection of the locations of four new regional airports is carried out according to the economic development potential of the area. However, Muscat International Airport has faced some delays and snags. MOTC finally awarded the contract to French group Thales, replacing the UK’s Ultra Electronics. When Muscat Airport's new 580,000-sq metre terminal launches, it will be able to handle 12 million passengers a year.

Water and power: The rapid development of numerous utility projects like the largest desalination plant in Barka, the Salala-2 independent power plant, the Ibri and Sohar -3 power plants --- all to satisfy Oman's growing demand for electricity and desalinated water will engage contractors gainfully in the Sultanate. New privately developed power and water plants, hospital complexes are the other areas of development.

Oil and Gas: Although the contribution of oil and gas sector to GDP has gone down in recent times, there is still scope for the construction sector to operate in this sector. In 2016, BP and Oman Oil signed an agreement with the government of Oman for the second phase of the Khazzan gas field in Al Dhahira Governorate. More than USD25.7bn is allocated for gas projects and USD14.7bn for the oil sector. Among the upcoming projects planned at Duqm are USD10bn China-Oman industrial park, a 1172-ha complex which will include an oil refinery, petrochemicals complex, among other industrial facilities.

Rail: The major asset to the country’s infrastructure, which will contribute to the sustainable development of the Sultanate, is the national railway project, overseen by the Ministry of Transport and Communications (MOTC). Scheduled to be operational in late 2018, the first phase of Oman’s stretch of the GCC railway will extend from Muscat to Salalah. To develop and build the estimated 2135km double track network that will carry 120-km per hour freight
trains and 220 km per hour passenger trains will connect Muscat with a host of other Omani cities. New mining areas across the country and ports of Duqm, Sohar and Salalah will also be in the loop and will stretch to the Omani border. However, progress is delayed on construction of this project which is part of a pan-GCC rail network, worth USD 15.4bn. In due course, rail will become the pivot of construction sector. Deloitte observes, "In Oman over past years, the focus has been on expansion of Muscat International Airport and Batina Expressway, whilst for the coming years the focus is planned to shift to rail." (Deloitte, GCC Powers of Construction Report, 2016).

Tourism: One of the five prime sectors in the Ninth five year Plan, has increased by 23 per cent. In 2012, the government set a target of attracting 12m visitors a year by 2020. Whether or not this target will be achieved, tourism continues to flourish, with an increasing demand for hotels, resorts and other leisure facilities such as marinas, golf courses and theme parks. Through ports, roads, airports and railways, Oman can gradually position itself as a tourist destination for the region.

Port Sultan Qaboos is renovated as a tourist destination with cruise liners enjoying access to historic Muttrah harbour. Omran, the government's tourism arm, has put forward its ROS500mn (USD1.3bn) waterfront destination (Mina Sultan Qaboos Waterfront project) in early 2015. According to local press, construction work is due to start in late 2017. The aim is to complete the project on time for the major upcoming cultural and sporting events in the region, such as Expo 2020 in Dubai and the 2022 FIFA world cup in Qatar. There are a significant number of projects in various stages of design, construction or tendering. Duqm Development Company has started developing the second phase of Duqm Frontier Town. The country's emphasis on conservation and pristine beauty are the two factors that make Oman unique in the region. The focus lies on high-end rather than mass tourism leading to an expansion of luxury hotel capacity across the country, kudos to projects like the Integrated Tourism Complexes (ITCs). In August 2016, work began on 250 room Muscat Hills Intercontinental Hotel Resort and Spa, which is due for completion by December, 2018. Al Mouj Muscat is involved in multiple expansion works, expecting to provide a flow of work for contractors for some time to come. Many of these plans that were shelved with the onset of the 2008-2009 global financial crisis and the subsequent decline in property speculation in the GCC were, however, resumed later.

Retail: Between 2011 and 2015, at 8.5 per cent Oman’s population growth is one of the fastest average annual population growth rates of any nation. It has spurred investment in the retail sector. Shopping complexes like Panorama Mall and Oman Avenues Mall covered more than 100,000 sq metres of gross leasable area. Larger still is the Mall of Oman, being built by Majid Al Futtaim at a cost of RO275mn (USD74.2m). The timeline for completion of this mega mall is 2020. Many other projects are in the pipeline.

Residential: The demand for residential rental properties has waned over the past two years, courtesy low oil prices and the decreasing number of expats in the country. In spite of this shift in demand, companies building villas and small apartment buildings have their hands full. Al Arkan Construction has completed nine projects in the city, including a 45-villa affordable housing scheme. Others are residential and commercial buildings coming up in various locations. It seems people are not worried about spending on real estate, in spite of the oil crisis.

An interesting trend is the urge for urban renewal in older suburbs. Developers see a potential of carrying out improvement work in older suburbs which have poor infrastructure.

Construction practices Green construction practices, with all its sustainable advantages of lower operating and maintenance costs, thereby reducing the environmental side
effects of rapid construction growth are gaining ground. All these go hand in hand with the strategy of developing parks and open spaces to create more green spaces in the city. The cement segment, after prices dipped during 2011, is expected a steady growth. The development of a new plant, at the Durrat Special Economic Zone (SEZ) heralds a new chapter in Oman’s cement industry. The two rival domestic companies, Oman Cement and Raysut Cement entered a JV to venture out into new markets. The new entity Al Wusta Cement will serve new developments around Duqm once feasibility study is done.

**Trusted partners**

In November 2015, Ali Massoud Al Sunaidy, Minister of Commerce and Industry, informed a conference that the government was planning a five-year investment strategy from 2016 to 2020 to promote private investment in sectors including transport and logistics, minerals and tourism, all of which require extensive inputs from the construction industry. The strategy is expected to prioritise private investment and management, with the government intervention taking place only in areas where private investors are less interested in delivering strategic projects.

As governments and the private sector are turning into committed partners within the construction sector, public-private partnerships (PPPs), as incorporated by the Sultanate, comes as a gainful open-doors policy to investment in these critical hours. By harnessing private financing, PPPs can bring in expertise and management skills and support knowledge and technology transfer in the longer term. If managed well, PPP can be a catalyst for creating leaner, more efficient, and thus more competitive companies. Compliant mindset during high oil prices will now get replaced by efficient management. Combined with regulatory moves and the government’s priorities in public project tenders will now zero in on delivery and value thereby bringing long-term benefit of the better contractors.

According to a KPMG report, if the government is successful in enhancing the role of private enterprise in all sectors, following the lead established by public private partnerships in the power and water industry, Oman may be able to navigate the current economic climate. However, not all observers are as optimistic. Many say that for PPP funding model to work, there needs to be a clear and transparent legal and contractual framework.

**Tough times hit hard**

There is an apprehension in the market that the downturn is likely to curtail public spending in the sector. However, the picture is not totally bleak. “A decline in project awards has impacted the construction industry first and most profoundly. The markets most affected are Saudi Arabia, Qatar and Abu Dhabi, while Dubai, Oman and Bahrain have been less affected due to a greater level of economic diversification,” (A Middle East point of view, Deloitte, 2017).

Though there is a decline in the total value of new contract awards in the GCC, The Middle East Business Intelligence (MEED) expects the value of contracts in Oman to remain stable at USD13bn.

UAE investment bank, Alpen Capital in its report,GCC construction industry (mid-2015), revealed that of the top 100 projects being carried out in the GCC member states in 2014, 2.4 per cent belonged to Oman, with a total value of USD29.6bn. In the same vein, it forecasted that Oman’s construction industry will grow at a CAGR of 7.6 per cent between 2014 and 2019.

All said and done, the government of Oman has adopted a cautious case-by-case approach to investments in projects. Many construction firms adopted a similar approach in first half of 2016, with stronger commitments on future public sector contracts in the latter half of the year. Though expenditure was curtailed and some schemes delayed, the constructor sector remains a significant and growing sector of the Omani economy, thanks to public sector spending and private sector developments.

The decline in the oil price has underscored the need to accelerate economic diversification and to increase the role of the private sector.
Hamed Hashim Al Dhahab, CEO of Al Watanyiah United Engineering and Contracting, told Oxford Business Group that 80 per cent of the sector activity is dependent on government spending. He said that the industry is central to Oman’s economic growth, as one of the largest employers, with 800,000 people dependent on construction for jobs, making it one of the most important employers of Omanis. He emphasised the importance of the sector to broader economic growth, with strong long-term economic and social multiplier effects from investment in construction. These reasons make it less likely that the government will impose severe cut backs on its investment in construction. The CEO of the Oman Society of Contractors, Shahswar Al Balushi, speaking in a conference, April 2015, said that the sector’s Omanisation rate stood at 9 per cent, which is significantly low for such a critical sector. The construction sector has an Omanisation target of 30 per cent. The government seems to recognise the extent of the problem and is seeking to implement effective solutions. The increased investment in education and vocational training, and a broadening of courses tailored for the construction industry, including surveying and engineering, are helping to ease the logjam on skilled labour in the Sultanate’s population. This will ease the process for the creation of jobs for Omanis in the medium and longer term. But it is a time consuming process.

Roundup

Strengthened by ongoing investments, in infrastructure, tourism, retail and commercial developments and residential endeavours, the outlook for Oman’s construction industry positive and is expected to remain so in the coming future. Oman’s population is growing and so also their need. Therefore, declining oil price and falling government revenues notwithstanding, there is always a growth potential in Oman. All that it needs is a collective effort. Balushi maintains, “No party by itself can carry the burden of prevailing challenges without participation of all stakeholders.”

Some challenges

There are challenges inherent in the sector. As pointed out by Yusuf Nalwala managing director of Al Ansari Group, these include the increased complexity of projects that have rolled out. For example, the development of very big-ticket projects that are of unprecedented scale for the Sultanate, require top level engineering, procurement and construction (EPC). This poses a challenge at a time when other countries in the region are also implementing similar projects, creating a strain on the talent pool, even with expatriate workers available. It is also noted that clients are becoming more stringent on both cost and pre-qualification, while also demanding shorter planning and completion periods.

Tougher pre-qualification is a positive move, ensuring that only companies with sufficient technical capacity win contracts. Closer adherence to payment schedules to better encourage timely delivery of projects, with a better understanding of payment cycles by contractor and client alike. Finally, a focus on vocational education from the government to broaden the skill sets of Omanis and encourage them to enter the construction workforce would qualitatively benefit the construction sector in Oman.

Omanisation is crucial for long-term economic sustainability, but as of now has presented employers with short-term challenges. If companies have to deliver projects at effective prices, then they need to have workforce with appropriate skill. Their availability is crucial for the implementation of the project on time. The challenge lies in two levels: One, there is a dearth of manpower in construction sector. Second, even if they are available, they are not appropriately skilled. Hence the ministry of manpower should develop a mechanism to expedite the process of providing the companies with their requirement of skilled workforce. There are many new infrastructure projects, awarded by the government for which construction firms will not be able to meet the aggressive timelines for completion without adequate skilled manpower.

The sector faces issues of a shortage of qualified local graduates for managerial positions. As the private sector cannot keep up with public sector salaries, Omani engineers are hard to come by. Few Omanis desire to be construction labourers as the job in this sector is perceived by many as low-wage and not in vogue. Companies point out that nationals are averse to join this labour-intensive sector due to the tough working conditions. The CEO of the Oman Society of Contractors, Shahswar Al Balushi, speaking in a conference, April 2015, said that the sector’s Omanisation rate stood at 9 per cent, which is significantly low for such a critical sector. The construction sector has an Omanisation target of 30 per cent. The government seems to recognise the extent of the problem and is seeking to implement effective solutions. The increased investment in education and vocational training, and a broadening of courses tailored for the construction industry, including surveying and engineering, are helping to ease the logjam on skilled labour in the Sultanate’s population. This will ease the process for the creation of jobs for Omanis in the medium and longer term. But it is a time consuming process.
In a labour intensive industry like construction, challenges are many when it comes to introducing new technology. This is a very complex issue, but nonetheless important. Stakeholders would like to follow conventional methods of construction. There are not many who believe in the precast method that might be beneficial for the industry. As is now, precast – a new method of building construction is more expensive and hence its potential takers are skeptical. But it has its advantages. First, very many steps can be saved when we do precast. Also, new methods to make buildings along with specifications and protections for heat transfer would be much better than provided by the conventional method. But still many in the industry believe that the conventional method is the best method. One reason could be that blocks are of good quality in a conventional method and that could be its winning point. People still prefer the old technique to the new.

So far timespan is concerned, precast would take almost around a third of the time that conventional method would consume to complete constructing a building. Even if it is expensive, one can save a lot of time in precast method. Time is crucial. If you could finish a building by six months, you can put it on rent and earn for one and a half year. So in this precast method, if clients save on time, they save on money as well. Maybe be initially it will be more expensive, but renting fetches good returns. However, clients and consultants have their reservations. They point out that any modification on precast building, after a few years have lapsed, is not possible whereas the conventional method makes allowance for desired changes throughout the life cycle of any building.

Truly speaking, disadvantages do exist. A precast building cannot be re-coated since the painting comes along with the precast materials from the manufacturer. Moreover, precast method by all means, need skilled hands as it calls for an enormous precision work. Its design is perfect to a millimeter. To achieve this accuracy, we need more skilled designers.

The advantage that the existing designers enjoy in the conventional method is missing in precast method. The old method gives the existing designers the opportunity to modify designs readily, while in precast method there is no scope for making even minuscule errors as it is very difficult to accommodate any change whatsoever. Even for the minutest of the mistakes, the entire design needs to be altered and re-designed from the onset. So it is imperative we have designers who would be able to handle a high level of precision. Even in consultancy, we need a first-rate skilled designer. However, to initiate change, the client and consultant both need to alter their mindset. If only they adopt the precast method, change begins, initiating the process of transformation. Hence, the requirement for workforce with a higher level of skill sets is the need of the hour as production processes are becoming mechanical. We need a workforce who knows the new technology. Technology is not only related to the site where the building comes up, it is related to design, manufacturing, the process goes on till installation. To be precise, this integrated approach, however prolonged, will change the face of the sector.

Precast technology is used commonly in Europe but here in Oman, at this point of time, it is very difficult to initiate the process. We need vision to bring a change. We need to urge the Municipality for the change because they are the apex body that approves the drawing. It is the only institute approving the materials, old or new, used for building construction. So it is they who should approve and advise.

The procedures are very clear when it comes to conventional methods. But for introducing new technology, it is imperative to have new procedures in motion. The need for a multifaceted change should infiltrate into every single institute related to construction.
For this major shift -- workers at all level need to be trained. I think a joint effort between the government and private sector is required here. If need be, then government can set up training centres and develop people in modern technology in construction sector. But if companies need to train their own cadres they should go ahead. We need to have a consensus on this.

What can be done to make clients more proactive in embracing new technology? The client dictates what he wants. When it comes to tendering, the price is competitive. Suppose a contractor bids six months to make a precast building, it would not be seen favourably, especially when other contractors bid for 12 months, as is the convention. The general outlook about the former is that either he is plain crazy or would end up using cheap material. Clients may not go for precast for this reason. So they are not responsible for introducing new technology. The sector represented by the contractor has the ability and capacity to introduce and explain the importance of the usage of new material to clients. If a contractor can convince them, they can be adaptive to new technology. The sector should be very forceful and persuasive to convince the client and all stakeholders. Once we tried to convince a client to do a precast car park for 600 cars. With precast technology it was to take only six months duration to complete, whereas the conventional method was to take around two years. Initially, they were convinced, but they ultimately refused to take the plunge. But I strongly believe precast will prevail sooner or later, after all time is money.

**What lies in future**

As is the trend so far, Oman’s construction sector is making progress in acquiring new materials, equipment and skills and it will continue to do so. The pace is a trifle slow when compared to other countries. Till now contractors apply the drawings approved by clients and do not enjoy the right to what we call value engineering. Clients would decline any error in the drawing, if correctly pointed out by the contractor. Clients view it as the contractor’s ploy to make big money.

So the day both the stakeholders will accept the value engineering, then only the contractor can convince clients and introduce technologies and new methods, introduce new products to be used in the building and provide the opportunity to clients to have the best products with reasonable price and good quality. But for the time being, bringing about these changes would be challenging. All the stakeholders in the chain should feel the need for this technological shift.
Technological advancement of the construction sector is a possible solution to address future cash flow concerns, says Shahswar al Balushi, CEO, Oman Society of Contractors. Susmita De reports

Why at this point, do you think, the need for technological advancement has become a recurring theme over the traditional way of constructing buildings?

One important element of harnessing any technology is to reduce the time span and the cost of construction to get the value for money. The local workforce would be incidentally benefitted. The traditional ways of working make it difficult for Omanis to join the construction sector. So the allure of the introduction of new technologies, building materials and modern ways of constructing buildings would address these challenges very effectively.

With economic down turn, contracting firms are facing challenges in meeting their cash flows, one of the obligations being the payment of salaries to the workers. So with the right technology and the latest construction material on hand, the sector will not need a large construction workforce. Once the workforce is trimmed down, the monthly obligations of the companies will also be reduced inevitably.
Also, the introduction of modern technology will allow them to move faster and implement projects without revamping them. We don’t need to vamp up our workforce; we need to vamp up our technological use. I believe the introduction of new technology will alleviate the challenges the sector is facing now.

Do you think the consultants need to be more proactive in introducing new technologies?

I think both consultants and clients have to be very proactive in acquiring new technologies. It is to their advantage that they should be doing so. That way the clients would be able to implement their projects faster and make them more cost effective and hence will get the value for money.

Some of the modern technologies used globally are very effective when constructing a building or a villa as they do offer a better energy consumption formula.

Over a longer period of time, the client ends up paying a reduced cost of energy. Therefore it’s an added value to the client. So it makes sense for the clients to request for the latest technology in construction, including construction material.

Clients should urge that this is the best technology for them, it will save them time, money and operation cost in the long run and ask the consultant to have this as part and parcel of designing a project.

What are the new technologies or equipment in particular that should be introduced in the construction sector in Oman?

I don’t have a list of those technologies but what I have to say is that one should look at the environment and nature of business in this country. It should be cost effective; it should bring value to the clients. And it should be a type of technology that can be easily learnt and used by the local workforce. It should be attractive to the local workforce by being user-friendly.

For example, there are some technologies in the construction panels that allow building a property within a short period of time span ranging from one month to one and a half month. On the contrary, the present technology or the existing construction methodology takes about a year and longer to build a house. If this paneling process is introduced, the implementation can be done fast. Probably eight villas could be turned out within a span of one year. This also means workers can refrain from hardship during the scorching summertime. It is a good return on investments for everyone.

Is Oman lagging behind the region when it comes to using modern technology in the construction sector?

I think the prevailing system for a big part of the region is using archaic methods for building construction. Some countries in the region, however, are more advanced in following construction code. They have a regulatory framework that enables smooth and easy introduction of new technology. So I think the first step for Oman is to put in a regulatory framework that would facilitate the utilization of new technologies and materials in construction projects.

Do we need more clarity in the procedures to introduce new construction material or technology?

I have already mentioned that we need a regulatory framework that will facilitate the introduction of new technologies and their approval. The regulator or the government agencies should have an appropriate team of technical experts to assess the new technology and comprehend the drawing of a particular project, which the client has presented, utilizing a particular technology. Questions should be raised as to whether the project is environmentally appropriate. In Japan, a seismic region, people build houses in a specific way to avoid earthquakes. We, at our end, must study Oman’s potential climatic changes like flood and other natural disasters. And develop properties by choosing the best technology that offer comfort and cost effectiveness along with the best price.

Do new skill sets need to be developed to initiate new technologies? Who will take charge of that?

Some of the technologies I have looked at particularly in building constructions are fairly simple to use. They do not call for enormous training processes. And if training is required at the moment, we have a number of training facilities in the country.

There are training providers who could churn out a team of workers who could be proficient in new technology. Companies could offer in-house training or could outsource the same to these training providers.
Would you like to highlight any issue other than these?

I believe it is the right time to take a step forward. We need to put together a small team from government consultants and contractors to bring this change. However, one thing is for sure that the people who can make a difference are the clients. Contractors or construction companies are only implementing what the clients want. Therefore the contractor may be able to propose ideas of new technology but if the client is not willing to pursue it, then everything falls apart. Since at the moment the client in Oman is predominantly the government, then the government as a client should be conscious enough to urge for projects at the best cost possible.

Sometimes the best cost possible is not only achieved through tenders. By utilizing the existing standard of building, a bidder’s cost is not necessarily the best possible, it is the best possible utilization of the existing coding of construction and materials.

However, when the tender process opens the door with another factor included, which is the utilization of technology, the construction company would be able to bring a cost-effective project and offer better pricing.

So if a contracting firm bids a million, another a million and a half, with the existing technology, may be another bidder with appropriate technology will be able to bid for RO700 thousand or less. It is a different formula for success.

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Building Oman’s future

Why construction is an essential industry for Oman’s technical elite, elucidates Peter Fischer, Managing Director, Doka Oman

Peter Fischer, Doka Oman’s managing director said, “While the construction sector has been slow to adapt new technologies, Doka has always prioritised listening to the demands of the global construction market and while many associate the construction industry with blue-collar manual labour, today’s construction sector is far more tuned towards engineers and technicians who will oversee the operation of 3D printing, drone application, big data, internet of things and smart equipment.”

Of course, with a transition in technical focus, there must also be a change in qualification as highlighted by Doka. For years now, a great deal of painstaking work and considerable expenditure has gone into research and (further) development of new processes, technologies and materials for Planning and Construction 4.0. Against this background, it is important not to forget that the people who make up the workforce must be qualified accordingly. Crucially, development of the technologies must go hand in hand with development of the organization, in other words the two have to be in parallel and closely interlinked.

As part of this process, more emphasis has been placed on ensuring the next generation is qualified and trained to support the country’s construction development, in particular its Omanization targets which will include a 35% domestic industry workforce.

Certainly, with the country continuing to diversify, the construction industry represents an exciting opportunity for Omanis to train and qualify in new and exciting technologies, and furthermore contribute towards their national heritage for future generations.
Innovation: For the contracting firm

Santosh Kadam, Head for Quality & Business Development, Arkan Majan International LLC, with his core expertise in quality management, ISO audits as well as business excellence assessments, writes on innovations for the contracting world, dismissing the myth that innovation is only for product manufacturers and not for contractors.

What is innovation?

Let me take liberty to define in my own way that innovation for the contracting industry is reengineering their traditional approaches by adopting the most advanced and effective resources (4Ms: Manpower, Methods, Machines and Materials), resulting into the faster, cost effective, safer and excellent (beyond specifications) results.

Innovation need not to be the highest level of the invention or research. The little changes in your approaches can also bring lots of positive changes.

Why innovation is important?

⇒ You can achieve the same results with less labor, less materials, less waste, less accident, less time and less costs.
⇒ Improvement in organization and management of the activities.
⇒ Improvement in the company’s competitiveness in the medium and long-term.
⇒ Better integration of the company’s management processes within the company’s overall strategy.
⇒ Efficient exploitation of the organization’s knowledge.
⇒ Overheads may be controlled.
⇒ Faster processes
⇒ Client’s satisfaction to take over the project on time and within budget.
⇒ Positive change in culture.

How to kick start process for the innovation?

There is no need to hire the consultant for innovation; you can do it with your team if they are committed to change.

⇒ Talk with your team and brainstorm. They may not know ‘what’s exactly to be done with innovation’. Don’t get panicked. Just tell them to write down their pain areas.
⇒ Meet your worker’s team (last in the line who executes). Trust me they will give you the most useful data for the innovation.
⇒ List down all the processes, break them into activities, and break further into the tasks and so on. This is similar to your Work Breakdown Structure (WBS). Present them in the format of ‘Flow Chart’. The flow chart will help you to probe where the process is unnecessarily roaming around various departments without adding much value.

⇒ To start with, please apply the rule of ‘20:80’ to identify the 20% of the common activities; those affect 80% of your operations.

⇒ Identify which are Value Added Activities and which are Non Value Added Activities. Try to drop the Non Value Added Activities to shorten the activities.

⇒ Off site event with your team with innovative games, YouTube videos, competitions, etc will add the excitement to the show. This will stimulate their minds to think out of box.

⇒ Support functions

Shun the belief that innovation is only for the site activities or technical stuff. It can be applied to your processes (you call them as the departments) like HR, Administrations, Transport, Logistics, Workshop, Procurement, Draughting, etc too have the huge scope for improvements and innovations. You can very well reduce your overheads through innovation in such support functions. These are the few questions that can trigger the spark to look at these processes differently:

• Why so many forms?
• Why so many signatures on a form?
• Why so many storage / box files?
• Why so many reports?
• Why the computer systems are underutilized?
• Why so much light bills / water bills / Fuel bills / phone bills?
• Why can’t we convert the support functions into ‘Profit Centers’?
• How to measure the results of the support functions -- whether they are profitable or not?
• Why so many assets?
• Why can’t we outsource?
• Why can’t we use some software’s?

Using the above brainstorming, the following innovative approaches can be adopted:

⇒ Reduce your budget by 20% every year of consumables, papers, etc. Make it as a policy fearlessly.
⇒ Empower the leaders and reduce signatures for faster processing. You can declare the signing authority limits as such few papers are going to the senior leaders; offering them quality time to plan for the organization.
⇒ Replace lights with LEDs and put energy meters at key places where they can be related to the process owners. Conduct energy audits for further improvements.
⇒ Use effective taps and valves (with zero leakages) for water consumption control and recycle water through waste treatment plants.
⇒ Switch off main supply for the camps when workers leave for the site.
⇒ Disconnect geysers during hot summer.
⇒ Give allowances to the staff (instead of paying their bills) for electricity, water, fuel and telephone charges. This motivates staff to control the cost. Also you don’t re-
Receive bills and waste your resources for their payment and issues.

⇒ Reduce workshop cost through the scheme like ‘own your vehicle’ where instead of company vehicle, you pay the allowance and eligible staff buys their own vehicle of their choice.

⇒ Evaluate carefully whether to buy or rent plants or equipment in the current situations. The old ones having repeat breakdowns can be written off instead of wasting money on their repairs.

⇒ Improve the accountability as well as responsibility for printouts. Photocopy machine can track down who is printing how much paper.

⇒ Get rid of your IT overheads by outsourcing IT processes through annual contract with a supplier

⇒ Get online for procurement and search the best options in the global market. One can buy bulk from China depending on the analysis of the past consumption.

⇒ Think of owning an agency of the material which is in good demand in your business. You can develop your business as a trader as well as consume the same material at a lesser cost.

⇒ Multi task the employees through training and support. This will reduce the number of employees required to carry out the same process.

⇒ Offer the best IT tools to your leaders and ask them to work independently without any secretary or assistance. They should display the best example and eliminate the culture of assistant / secretary / helpers.

Innovation for site activities

The site activities are more of technical and specification-oriented deciding the quality of the output. The construction methodology is more or less common in most of the places being followed for many decades.

When we started looking at the each processes or activities and their respective productivity, we realized that most of the construction activities are ‘manual’ by nature, which are purely based on human skills and all the risks associated with ‘human factors’ like fatigue, mindset, reduced productivity with the progression of time and age, etc.

In the given limited space let me brief you a few case studies where we successfully achieved the results by adopting innovations.

1. Rebar Steel Binding

Rebar Steel reinforcement is an integral part of all the construction projects where the rebars are tied with each other by the binding wires. It is a purely manual activity in almost all the sites wherever I visited. The steel fixers have achieved the highest level of efficiencies in these activities and they are very speedy in their trades.

We introduced Rebar Tying Gun which can be used by unskilled labours also. We could get three to five times of the productivity against our traditional norms. This Rebar Tying Gun is to be loaded with the re-loadable wire role (special material and costlier).

The supplier of the Rebar Tying Gun also supplies the number of wire roles.

If you are a good negotiator, then you can get a good deal for the set of Gun and wire rolls. The number of makes and traders are available in the local market. The gun is light in weight and comes with chargeable battery.

There may be other machines or tools also available to replace the traditional manual process to multiply your productivity at a lesser cost. See pictures below to compare manual and Rebar Gun wire binding.

2. Shuttering Works / Form work with plastic material

Plywood is the traditional material used for shuttering works/formwork by most of the contractors. It also needs skilled carpenters to read the drawing and cut the plywood accordingly.

It has many sub-activities like plywood procurement, cutting, joining, nailing, etc. Also the plywood cannot be reused for more than 4-6 times.

The best innovative solution will be to replace the plywood by plastic and similar materials. European and Chinese companies are offering plastic based formwork, which comes in a standard size; those can be joined to form as per your requirements. You do not need cutting, nailing, denailing, etc. Plastic formwork also can be reused for more than 75 times. Also it is unbreakable despite rough handling.

The initial cost may be 6-7 times of the traditional plywood shuttering, but it is worth to invest for the long term asset. You get many indirect benefits: no skilled carpenters needed, no procurement / storage / waste of plywood, no nailing and denailing involved and others.
3. Metallic Lintel
You can avoid time, material, labour lost in making concrete slab for the lintel purpose by adopting metallic lintels. There are designed to take a suitable load and you can use them for doors as well as windows.

4. Recycling thru Concrete Wash of Transit Mixers
You must be aware that the concrete transit mixers carrying concrete to site are loaded with 10 m$^3$ concrete and 1000 liters water. Immediately after concrete pour, concrete transit mixers are washed with water in order to avoid setting / hardening of concrete inside mixer’s drum. To wash a single concrete transit mixer, 200 liters water is generated at site without any cost. This water can be used to sprinkle at site in order to suppress the dust generation. Lesser dust generation will lead to smooth progress and reduced air pollution. To wash a single transit mixer, 10 kg (approx) cement slurry and aggregate particles are generated. Unfortunately these concrete transit mixers are washed at different locations of site which results in concrete spills, bad housekeeping and NIL storage of water. If concrete transit mixers are washed in a single location and water is allowed to settle for some time then cement and aggregate particles will sediment at bottom and clean water will be left at the surface.

To wash a single concrete transit mixer, 200 liters water is generated at site without any cost. This water can be used to sprinkle at site in order to suppress the dust generation. Lesser dust generation will lead to smooth progress and reduced air pollution. To wash a single transit mixer, 10 kg (approx) cement slurry and aggregate particles are also generated which can be mixed with backfilling materials. Washing transit mixers at one location protects site from concrete spills and hence soil pollution. Manpower required to clean the concrete spills at site is also saved.

Also try to keep some simple moulds ready which can be filled with the left out concrete as most of the time, some additional cubic meters of concrete is balanced after finishing your pouring.

Conclusion
I do not claim that we had great innovations or we changed the organization 360°, but we definitely had a humble beginning where our employees started to think differently and welcomed the change.

I express my thanks to all my current and earlier management and peers who supported me in this innovation drive as well as enriched me with their valuable feedback.
Challenges for project manager
Yusuf Nalwala Managing Director of Al Ansari speaks on the obstacles that the sector is facing

Today’s Project Manager (PM) faces many challenges, stemming from a variety of sources. These challenges have an impact on project success as well as the prestige and reputation of the company if not dealt suitably. PMs must be aware of these risks and implications of these challenges to ensure that they are under control. Many of these challenges are direct results of construction operations, while others are results of indirect activities.

Construction issues include workforce considerations, safety, time constraints, and the changing nature of the work itself. Non-construction challenges that PMs face include legal issues, government regulations, environmental concerns, and socio-political pressures.

Nature of Construction Industry
Construction projects represent a unique set of activities that must take place to produce a unique product. The very nature of construction introduces challenges typically not encountered in other industries. For example, some of the unique features of the construction sites are:

- The work is often seasonal.
- Each project is unique.
- Often involves remote sites with various access and logistics problems.
- Difficulty in applying automation.
- High potential for encountering unforeseen and unfavorable conditions.
- Costs can vary according to conditions and often contrary to what was assumed.
- Difficult to manage and supply utilities and other resources.
- Innovations are adopted slower.
- Project can be of mind-boggling size, cost, and complexity.
- The work is not performed in controlled conditions and therefore highly impacted by weather and other environmental conditions.
- There is a need to meet the expectations of the local Social and Political forces.

The success of a project is judged by the Client and the Contractor from two sets of considerations:

- From the client’s point of view:
  - Timely completion
  - Keeping the cost under the budget
  - No safety issues
  - No Regulatory concerns arising out of the Project in short term or long term.
- From the Contractor’s Perspective:
  - Minimizing the utilization of the losing items
  - Maximizing the utilization of the profitable items
  - In case of delays get the Extension of Time with the cost
  - No safety hassles
  - Project can bring Social or community attention if the project is a landmark

Weather
Weather and construction have been at odds since the beginning. Today’s meteorologists have a vast array of tools that enable them to predict weather patterns and events with some degree of accuracy. Even if meteorologists could predict weather to a degree of accuracy of ±5%, the impending weather events cannot be modified or delayed. The impact of inclement weather is not only slowing down the work but also redoing some work done earlier, bringing down the morale of the people and loss of time.

Safety
Safety remains an ongoing concern for the Project manager. Construction by nature is inherently dangerous, with a high degree of hazard and risk. The toll of construction accidents is high in terms of both costs and human suffering. Accidents add a tremendous burden of needless and avoidable expense. Financial losses pale when compared to bodily injury and death, and the resulting human, social impacts. Insurance (such as workmen’s compensation) protects the contractor from certain direct expenses, but accidents also involve substantial costs that are not insurable, referred to as hidden or indirect cost. Direct costs include medical cost, compensation and productivity from the affected person. Indirect or hidden costs include:

- Loss in earning power, economic loss to injured worker’s family.
- Mental trauma on the other work force who witness the tragedy or disability of the affected colleague.
- Diminished quality of life for the injured party.
- Loss of efficiency by breaking up crew.
- Cost of training new or replacement employees.
- Loss of production.

A good PM has to carefully plan contingency and alternative ways to minimize the delays
The Project Manager remains at the mercy of the weather. This fact is particularly troublesome to those engaged in heavy civil work, site development, and activities that involve earthwork or other weather sensitive operations. A good PM has to carefully plan contingency and alternative ways to minimize the delays, risks and disruption due to inclement weather.
not build things; people build things. Proactive rather than reactive control by the PM is a key to staying on schedule. Events or conditions that cause delays and require appropriate action include weather, lower productivity than anticipated, delivery problems, resource constraints, changes in scope, cooperation from the Consultants and differing site conditions. The PM must manage or mitigate these situations in order to deliver a constructed project on time. Time is the essence!

Legal Issues
The Challenges in Oman are further aggravated by the Standard Conditions of the Contract, which is used across all the contract in the Government and the Ministries. This is an age old book, developed when the contract values were much smaller, the complexity and the duration of the contracts were much lower than the projects released now. The overall economic scenario, the Socio-political issues influencing the minds of the work force – all are contributing against the success of the contractor. All this has resulted in many claims and disputes and this conflicts and disputes have been steadily on the rise in recent times. A claim is a request by a contractor for additional compensation or time extension for occurrences beyond the contractor’s control. The contractor must prove entitlement and quantify the associated damages. Claims in general are bad for the industry. All parties must work to reduce the frequency and magnitude of claims. The PM plays a central role in claims avoidance and resolution.

Specifications should be simple and straightforward, clearly stating what is expected. PM input during preconstruction reviews is invaluable. The Contractor must have a clear understanding of contract requirements prior to bidding. The PM plays a central role in claims avoidance and resolution. The PM must manage or control by the PM is a result the ability to bid more work (opportunity cost). Efficient time management results in higher labor and equipment costs. A reputation for late completions is bad for business, especially in the atmosphere where the number of the clients are fewer. In today’s intensely time driven business environment, superior planning, scheduling, and control are very vital. The PM is faced with the challenges of completing high volumes of work within tight time frames, and generally finite resources.

Good schedules are critical to project success; however, they are only a tool. Schedules do not build things; people build things. Proactive rather than reactive control by the PM is a key to staying on schedule. Events or conditions that cause delays and require appropriate action include weather, lower productivity than anticipated, delivery problems, resource constraints, changes in scope, cooperation from the Consultants and differing site conditions. The PM must manage or mitigate these situations in order to deliver a constructed project on time. Time is the essence!

Time Constraints
Time is money to Owners, Contractors, and users of the constructed facility. From the owner’s perspective, there is lost revenue by not receiving return on investment, cash flow crunch, potential alienation and loss of clients/tenants, extended interest payments, and negative marketing impacts, if the project is delayed. From the users’ perspective, there are financial implications similar to owners. Extending project durations limits the Contractor’s capacity for providing bonds, guarantees and as a result the ability to bid more work (opportunity cost). Efficient time management results in higher labor and equipment costs. A reputation for late completions is bad for business, especially in the atmosphere where the number of the clients are fewer. In today’s intensely time driven business environment, superior planning, scheduling, and control are very vital. The PM is faced with the challenges of completing high volumes of work within tight time frames, and generally finite resources.

Good schedules are critical to project success; however, they are only a tool. Schedules do

Cost incurred by delays
Failure to meet contract demands (completion, etc)
Overhead costs associated with disruption of work
Administrative costs of investigations and reports
Increased insurance premiums
Loss of future projects due to adverse publicity

The Organization has the responsibility of providing a safe place to work; safe appliances, tools, and equipment; developing and enforcing safety rules and regulations.

Keys to a successful construction safety program includes: support and enforcement from top management, front line management (supervisors & foremen) consistently following and enforcing the safety program, on-going and comprehensive training, and recognition by all employees that safety is everyone’s job.

Socio-Political Pressures
Political pressures and community involvement affect public sector work. Pressures emanate from adjacent property owners and the public at-large, including existing businesses, institutions, and residences adjacent to the construction facility. Today’s PM has substantially greater accountability to the public than previous generations. Increasing the number of stakeholders further complicates an already complex process.

Socio-political pressures also stem from the utilization of the local workforce. There is a greater need to employ Omanis who need training in skills and moulding behavioral aspects that would translate them to be active members of the Project team. This also is a daunting task as there are not adequate and competent or...
Some Omanis demonstrate outstanding commitment, skills and the energy that can put to shame many expatriate workers. However, there is a lot of room for improvement in this area—currently not being handled adequately—resulting in some more challenges for the Construction Sector.

Conclusion

The list above shows that an able PM must be an expert on administration, HR functions, Accounts, finance, PR skills and of course the technical skills to lead the operational team. To summarize, excellent PMs must:

- understand the business, legal and social aspects of construction.
- act as responsible stewards of the environment and observe all applicable laws and ethical practices.
- value the people they employ and work to ensure their safety and promote their well-being.
- proactively manage operations to achieve the project's quality, cost, time, and scope requirements.
- strives to avoid and resolve conflict.
- promote harmony among all project stakeholders.
- adapts to the changing business, social, and legal environment,
- and leads the organization through the challenges it faces.

Bibliography

This is the era of knowledge and great technological revolutions. A museum showcasing innovations and inventions, as an outcome of nurturing sustainable solutions to world challenges, has been unveiled in Dubai recently.

"The future belongs to those who can imagine it, design it and execute it. It isn’t something you await, but rather create." This is the vision of Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE, said in the context of the foundation of Museum of the Future, Dubai.

This museum is not commonplace. Not a treasure trove of collections from the past. It’s different. The USD136 million museum will feature innovation labs and permanent exhibit for future inventions as well as offer advanced courses and specialized workshops, public talks and events. Its focus will remain at par with the contemporary world. It is a museum – the first of its kind, creating futuristic visions for a better tomorrow. It speaks of an entrepreneurial government being the patron of the best and brightest inventors and entrepreneurs. The metallic oblong-structure, located near Dubai’s central financial district next to the Emirates Towers on Sheikh Zayed Road, is set to allure tourists across the globe. A massive hologram is shown to fill the structure’s oval-shaped void. 'See the future, create the future,' this is the motto of Dubai’s Museum of the Future.

Technology in use
Keeping In line with this forward thinking, the technology used to build the museum is also futuristic. Parts of the building were constructed using 3D printing technology. The building itself looks futuristic. It has a ‘curved, oblong, oval-shaped structure' - hard to visualize without a picture. It was challenging for everybody whoever was involved with creating this structure -- but not without opportunities.

In 2016, Richard Poulter, Construction Recruitment Specialist in Middle East said, “It may even take some of the headaches out of quantity surveying as this process should bring the building on a much lower budget and in a tighter timescale.” Experts say that this technology is environmentally positive. It is known that the 3D printing process for construction can save as much as 30-60 per cent of construction waste and save production time by 50-70 per cent. Although with a budget of USD136million, not a meagre amount, there are many who question the usage of this technology.

Set up by Dubai Future Foundation, the museum will be managed by it, headed by Sheikh Hamdan Bin Mohammad Bin Rashid Al Maktoum. The Board of Trustees will involve Mohammad Abdullah Al Gergawi, Ministry of Cabinet Affairs as its Vice President.
1. Self-healing Concrete

Widely used in construction, cement is evidently world’s most popular building material, but not devoid of flaws. Cracking is a major problem in construction, eventually leading to the collapse of the material. No matter how carefully it is mixed or reinforced, all concrete eventually cracks and leakage starts and then water seeps to the interior of the building. When water gets to the steel reinforcements, steel rebars start corroding and the structure collapses.

Caused by exposure to water and chemicals, cracks are hard to detect at an initial stage, and manual intervention is imperative for periodic inspections and repairs. Self-healing materials come in handy as they counter degradation through a repair mechanism that responds effectively to the micro-damage. For making concrete more durable, researchers in UK and other developed countries have come up with a self-healing concrete or bio concrete that heals itself using bacteria. The idea is to fill a microcapsule with a mix containing bacteria, which will germinate as water seeps through a crack in the concrete to produce limestone. This will plug the crack before water and oxygen corrode the steel reinforcement, thus giving concrete a longer lease of life.

2. Modular Construction

No matter what purpose -- from office extension to temporary school or college structures, modular constructions are smart solutions to a builder’s immediate challenges. Modular construction is an upcoming process where a building is constructed off-site using the same materials and designed to the same standards as conventionally on-site built facilities, in much less time. To be precise, buildings are produced in ‘modules’ so that when assembled on site, reflect the identical design and specifications of site-built facility. Its delivery of components and quick and clean installation, devoid of waste, keep environmental disruption in check. With up to 70 per cent of a building produced as components, modular construction allows a shift towards ‘just in time’ manufacturing and delivery.

This process is popular in the United States and UK. The Chinese developer Broad Sustainable Building recently completed a 57-storey skyscraper in 19 working days using this method.

3. Thermal Bridging

Effective insulation material is gaining ground in the construction industry all across the globe. Heat that gets transmitted through walls passes directly through the building envelope, the physical separator between the interior and exterior of a building, to the internal facade or drywall. This is applicable for masonry, block or stud frame and the process is termed ‘thermal bridging.’

Aerogel, a technology developed by Nasa for cryogenic insulation is one of the most effective thermal insulation materials. The US spin-off Thermablok has adapted it to insulate studs, which can reportedly increase overall wall R-value (an industry measure of thermal resistance) by more than 40 per cent. Thermablok aerogel insulation is made up of a composite material consisting of aerogel embedded within a fiber type matrix. Aerogel is not very flexible to most uses owing to its fragility. The Thermablok material compensates for this by using a unique fiber to suspend a pro-

INNOVATIONS

New developments

Be it design tools, new materials or digital technology, the construction industry has made major strides in expanding its scope of work through technological innovations. Here we have listed a few that are worth mentioning.

1. Self-healing Concrete

2. Modular Construction

3. Thermal Bridging

CONTRACTORS
4. Predictive Software
A building is an integrated process. The way its single parts fit together, along with the choice of materials and its specific location, all speak about the ultimate structural integrity of the building which reflect on its performance under any conditions, favourable or not favourable.

Civil engineers meticulously undergo the process of integrating a huge number of pieces into building designs, complying with safety and government regulations. At Wembley Stadium in England, working on the structural integrity of the arch rotation brackets, Bennett Associates have used ANSYS software, which simulated the stresses on the brackets that hold the distinctive arches above the stadium. This groundbreaking new technology has simplified simulation, turning it into a useful ploy for professionals, thereby helping to transform product development.

5. Photovoltaic Glazing
The whole building envelope can be turned into a solar panel now. Buildings can generate their own electricity with the help of building integrated photovoltaic (BIPV) glazing. Companies such as Polysolar provide transparent photovoltaic glass as a structural building material, forming windows, façades and roofs. Its high performance in producing energy even on north-facing and vertical walls at raised temperatures means it can be double-glazed or insulated directly. The cost is marginal over traditional glass, and the owner enjoys a low energy bill.

6. Kinetic footfall
Kinetic energy is another technology that needs to be mentioned here. Generating off-grid electricity by walking around or powering streetlights with footsteps are for real now. It enables indoor or outdoor flooring in high traffic areas to harness the energy of footsteps.

Footfalls that powered the floodlights around the football pitch in Rio de Janeiro stadium can be cited as an example. As the name kinetic footfall suggests, it generates electricity from pedestrian footfall using electromagnetic induction process and flywheel energy storage. The technology is very suitable for transport hubs that attract a large flow of footfall. Kinetic tiles that generate power from human movement, eventually help to produce renewable energy. Currently a temporary installation outside London’s Canary Wharf station is powering street lights. No longer just visions of a sustainable future, kinetic footfall is a reality now.
7. 3D Modelling
For better governance and citizen welfare, sustainable smart cities are becoming the future of urban development. CyberCity3D (CC3D), a geospatial-modelling innovator is specialising in the production of smart 3D building models. It creates smart digital 3D buildings to enable the architects, engineers and other stakeholders in construction sector visualise and communicate design and data with CC3D proprietary software. The models integrate with 3D geographic information system platforms, such as Autodesk and ESRI, and can stream 3D urban building data to Cesium’s open architecture virtual 3D globe. It provides data for urban, energy, sustainability and design planning, and works in tandem with many smart city SaaS platforms such as Cityzenith.

8. Cloud Collaboration
BaseStone is a mobile and web application built for construction teams to access and communicate information. In a project, BaseStone digitises and streamlines processes for better project delivery. It is a system allowing the remote sharing of data on a construction site in real time -- primarily a review tool for engineers and architects, which digitises the drawing review process on construction projects, and makes way for effective teamwork. The cloud-based collaboration tool is focused on the installation of everything from steel beams to light fittings. The system is used to add snags during construction, on to pdfs, then users can mark or add notes through BaseStone. Cost-savings of around 60 per cent is possible against traditional paper-based review methods. This game-changing software will take your operational efficiency to the next level.

9. Asset Mapping
Asset Mapping is a scalable database, essentially designed to assemble data from numerous devices and systems into a single map. Asset mapping focuses on operational equipment, including heating and air conditioning, lighting and security systems, collecting data from serial numbers, firmware, engineering notes of when it was installed and by whom, and combines the data in one place.

Also, it allows anyone to see the location and condition of equipment in real-time, from any device. When conditions change, Asset Mapping triggers alerts and provides the correct information to the service engineers. This enables them to address issues faster and at a reduced cost. The system can show engineers in real time on a map where the equipment needs to be installed and, once the assets are connected to the real-time system using the internet of things, these can be monitored via the web, app, and other remote devices and systems.

Asset Mapping helps customers build databases of asset performance, which can assist in proactive building maintenance. With quick access to a complete list of all assets, insightful analysis and reports, it is easier to make informed decisions and bring new business value to the organisation.

Sourced mainly from Felicia Jackson’s article published in Raconteur -- Future of Construction 2015. Some relevant websites were also referred to for putting together this compilation.
Whether modest bricks created from bacteria or unique timber skin fashioned from plywood or fashionable and sustainable recycled building materials, successful experiments have made the construction sector dynamic all across the globe.

Intelligent windows

View Dynamic Glass has raised USD150 million to fund their specialized Dynamic Glass tints to maximize natural light and unobstructed views while reducing heat and glare. The new technology automatically responds to outdoor conditions or from a mobile phone, resulting in a reactive tint that reduces heat and glare. This, as the company said in a press release, allows for "greater occupant comfort and energy savings without ever compromising the view." The tinted windows have been installed in more than 100 locations across North America. The funds will be used to accelerate product development.

Smart Masonry

By its very nature, the architecture produced with stone masonry is often heavy, massive, and incorporates less natural light than alternative methods. However, with their research proposal for "Smart Masonry," ZAarchitects are proposing to change masonry buildings as we know them and open opportunities for digital fabrication techniques in stone and other previously antiquated materials.

One of the most significant challenges in designing masonry structures throughout history has been ensuring structural loading requirements and minimizing building mass wherever possible to encourage the flow of light and air. Because modern technologies allow us to optimize and minimize dead-weight, the structural skeleton of Smart Masonry is incredibly light. Additionally, complex geometries can be achieved through the use of robotic construction techniques, ensuring that each element can be replicated with the same precision each time. Conceptualized as a seamless mesh, overlapping and wrapping elements replace walls, columns, and beams. Saving on material and costs, the entire area of the building is designed as a 'minimal surface' whose stress-pattern is optimized and materialized as a load-bearing pattern. Mixing advantages of 3D printing and large prefabricated elements, the concept seeks to maximize construction efficiency, further reducing costs and enhancing precision.
Revolutionizing Concrete Fabrication

Malleability makes fluid concrete an ideal building material, but in practice, creating complex forms out of concrete is challenging. Pouring on site requires formwork, painstakingly made by hand and precast concrete is usually limited by orthogonal molds. Concrete has become restricted to a few simple forms that are easy and cheap to produce when, in many cases, a building would benefit from concrete casting that is optimized for its structural and economical needs. How do we make such optimization feasible? This is the question that the EU sponsored research consortium TailorCrete has attempted to answer. It is exploring new technologies that could make non-standard concrete structures commonplace. The project explores construction technologies, such as alternative formworks and robotics. The goal, according to the TailorCrete website is to “replace the use of traditional formwork and thus enable greater flexibility in producing singular concrete structures with different geometric designs. Through the development and use of self-compacting concrete with robots, a link will be created between digital design and the fabrication of materials and components and ultimately to the on-site construction processes.”

The outcome of this research has already been demonstrated. Their Full Scale Demonstrator (FSD) is a sculptural form built from concrete plates that have been folded via robotics before fully setting. This optimized structure spans 23 meters in length and 6.5 meters in height while having a thickness that is, at maximum, only 25 centimeters.

Growing bricks from bacteria

A unique biotechnology start-up company has developed a method of growing bricks from bacteria and naturally abundant materials. bioMason has developed a method of growing materials by employing micro-organisms. Arguing that the four traditional building materials - concrete, glass, steel and wood contain a significant level of embodied energy and heavily rely on limited natural resources, their answer is in high strength natural biological cements (such as coral) that can be used “without negative impacts to the surrounding environment.”

According to bioMason, “global cement production in 2008 amounted to 2.8 billion tons, with equivalent quantities of CO₂ released into the atmosphere”. The energy intensive series of processes, ranging from extracting of the raw material, transportation, and fuel sources for heating kilns, contribute to the fact that “40 percent of global carbon dioxide emissions are linked to the construction industry.”

“Bacteria, which provide a precise environment to form in combination with a nutrient, nitrogen and calcium source allow for the formation of natural cement in ambient temperatures, taking less than five days to produce a precast material.” bioMason has created a market viable model which involves licensing existing masonry manufacturers to begin growing. The inputs for bioceements are inexpensive, globally abundant, and can be sourced from waste byproducts.

Flexible Timber Skin

Have you ever wanted to create delicate, complex shapes from plywood, but couldn’t because it’s too stiff and unforgiving? Well all that might soon change, thanks to Milan-based design studio MammaFotogramma. They have created a type of flexible, ‘Woodskin’ triangular tiles of Russian plywood. Inspired by the potential they saw in the material, team members Giulio Masotti and Gianluca Lo Presti incorporated the material into the design of a rock-climbing gym in Montreal, which they were working on. However, while the material was there in concept, the exact manufacturing technique had still to be worked out. To do this, the two moved to Montreal and lived near the...
Modular Plastic Blocks

LEGO enthusiast Arnon Rosan has created a full-scale, interlocking "LEGO" block that allows users to quickly assemble life-size structures. The LEGO-like 'EverBlock' is a modular system of polypropylene blocks with raised lugs that can be stacked to form furniture, installations or even emergency shelters. As Wired reports, the blocks come in 14 colors, three sizes - full (one-foot-long), half (six-inches), and quarter (three-inches) - and vary in weight from a quarter to two pounds.

"Each module is designed to connect easily with the parts above and below, using a pressure fit which creates a strong link between blocks. Because of its unique lug system, you can stagger EverBlocks in 3" increments, to create all types of patterns," says EverBlock.

3D Printed Salt House

The architects of Emerging Objects have devised a scheme for a 3D printed house made from locally harvested salt and concrete. Known as the ‘3D Printed House 1.0,’ the case study residence was commissioned by the Jin Hai Lake Resort, Beijing. It integrates traditional construction methods with renewable 3D printed materials, manufactured by Emerging Objects, to build a house that is sustainable, structurally sound and beautiful.

Major structural components of 3D Printed House 1.0 are constructed of cast-in-place concrete and plastered white. Enveloping the house is an exterior cladding made from a special 3D printed fiber reinforced cement polymer developed by Emerging Objects utilizing their Picoroco Block, a modular 3D printed building block printed from sand. The facade’s pore-like exterior is supported by an underlying geometry of interconnected pentagons, hexagons and quadrilateral shapes whose terminus is a circle. Each protruding oculus ranges in size, depending on the amount of light, views and privacy desired for that particular area of the house. Puncturing the ‘concrete box’ is a series of double-height, 3D-printable interior ‘salt volumes’ made from a salt polymer based on ‘Saltygloo.’ The semi-transparent components illuminate the interior and define the home’s layout, forming the personal spaces - bedrooms, bathrooms and family dining room.
Recycled Building Materials

In today’s world ‘going green’ has become a top priority in our society and sustainable buildings and design are at the forefront of this green revolution. While many designers are focusing on passive and active energy systems, the reuse of recycled materials is beginning to stand out as an innovative, highly effective, and artistic expression of sustainable design. Reusing materials from existing on site and nearby site elements such as trees, structures, and paving is becoming a trend in the built environment. Most common building materials today have recyclable alternatives. Concrete, metals, glass, brick and plastics can all be produced with some form of the previously used material, and this process of production lowers the energy requirement and emissions by up to ninety percent in most cases. Another popular trend regarding recycled building materials is the use of site provided materials. As environmental designers, we continually replace natural landscapes with our own built environment, and today our built environment is embellishing the natural environment in a responsible (while still aesthetic) manner.

The architects at inFORM researched the site for the Ann Arbor Library to find that ash trees from the surrounding forest were being destroyed by insects and could be salvaged into various surfaces within the building. Ross Barney Architects responded to the more urban site of a synagogue with a similar tactic by repurposing demolished trees into exterior sheathing, torn up paving and pre-existing structure into gabion walls, and even reusing part of the existing building foundation. When a site has little to give, designers have begun to search within other demolished environments. Juan Luis Martinez Nahuel has found new uses for building elements from other architectural projects in his Recycled Materials Cottage in Chile. The design revolved around the available materials from demolished buildings including glazing from a previous patio as the main façade; eucalyptus and parquet floors as the primary surface covering; and steel and laminated beams from an exhibit as the main structure for the house.

As the process of recycling materials continues to increase as a fashionable and sustainable statement in the architectural world, designers are proposing groundbreaking and futuristic methods that push the boundaries of how we think and build. NL Architects submitted an idea for The Silo Competition that transformed the structure of an old sewage treatment silo into a rock climbing facility and mixed-use residential and commercial spaces. This design addresses the structure and form as a reusable material able to contain an extremely efficient program.
This section highlights critical indicators of national accounts, notably Gross Domestic Products (GDP).

All figures in RO.
Gross Fixed capital formation at current prices

- Construction:
  - 2014: 167.9
  - 2015: 182.8

Government Expenditure classified by Major items

- Capital expenditure on construction projects of civilian nature:
  - 2014: 788.6

(Source) (Statistical year book 2017)
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