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ASSET MANAGEMENT: Infrastructure Asset Management and Technical Practices: from policy development to risk-based and data-driven decision-making **ENVIRONMENT & WATER ENGINEERING:** PUB boosts flood response capabilities

PROJECT APPLICATION: Structural strengthening and restoration work on Casa Batlló



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Design & layout by 2EZ Asia Pte Ltd

Cover designed by Irin Kuah

Cover images by HDB

Published by The Institution of Engineers, Singapore 70 Bukit Tinggi Road, Singapore 289758 Tel: 6469 5000 I Fax: 6467 1108

Printed in Singapore

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It is one of the most famous tourist and cultural attractions in Barcelona, Spain, and a UNESCO World Heritage Site, since 2003.

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Sustained construction demand in 2022 supported by public sector projects

The Building and Construction Authority (BCA) projects the total construction demand (i.e. the value of construction contracts to be awarded) in 2022 to be between SGD 27 billion and SGD 32 billion.

The public sector is expected to contribute about 60% of the total construction demand, that is, between SGD 16 billion and SGD 19 billion. This is supported by the strong pipeline of public housing projects including those under the Home Improvement Programme, as well as healthcare developments and infrastructure works such as the Cross Island MRT Line (Phase 1).

The private sector construction demand is anticipated to reach between SGD 11 billion and SGD 13 billion in 2022, which is comparable with the volume in 2021. Given the latest property cooling measures, residential building demand is anticipated to moderate year-onvear. amidst more cautious market sentiments. However, commercial building demand is expected to increase, as hotels and attractions undergo refurbishment to prepare for revival of inbound tourism, and older commercial premises are earmarked for redevelopment to enhance their asset values. In addition, the private sector industrial building demand is expected to see some support from the construction of energy storage facilities and biopharmaceutical manufacturing plants.

Preliminary actual construction demand in 2021

The preliminary total construction demand for 2021 increased by 42% to about SGD 30 billion compared to the preceding year, largely driven by public housing and infrastructure projects as well as an improvement in investment sentiments. This was about 7% higher than the upper bound of BCA's earlier forecast of SGD 23 billion to SGD 28 billion, mainly due to an increase in tender prices resulting from manpower and materials cost inflation.

The public sector construction demand increased from SGD 12.2 billion in 2020 to SGD 18.2 billion in 2021, underpinned by major projects such as the Cross Island MRT Line, Jurong Region MRT Line, Tuas Water Reclamation Plant and new Build-To-Order (BTO) units. Likewise, the private sector construction demand expanded from SGD 8.9 billion in 2020 to SGD 11.8 billion in 2021, supported by higher demand for residential, commercial and industrial building developments, as the economy recovers.

Forecasts for the period 2023 to 2026

Over the medium-term, BCA expects the total construction demand to reach between SGD 25 billion and SGD 32 billion per year, from 2023 to 2026.

The projection excludes Changi Airport Terminal 5 development and its associated infrastructure projects as well as the expansion of the two Integrated Resorts, due to the uncertainty of the global pandemic that could affect construction schedules of such large projects.

The public sector is expected to lead the demand and contribute

SGD 14 billion to SGD 18 billion per year from 2023 to 2026, with about half of the demand coming from building projects and civil engineering works. Besides public housing developments, there are also various major developments in the pipeline, such as MRT projects including the Cross Island Line (Phases 2 & 3) and its Punggol Extension, and the Downtown Line Extension to Sungei Kadut; the Toa Payoh Integrated Development; redevelopment of Alexandra hospital; and a new integrated hospital at Bedok.

The private sector construction demand is projected to remain steady over the medium-term, reaching about SGD 11 billion to SGD 14 billion per year, from 2023 to 2026, in view of healthy investment appetite amidst Singapore's strong economic fundamentals.

Construction output

The total nominal construction output (value of certified progress payments) is projected to increase and reach SGD 29 billion to SGD 32 billion, for 2022, from the preliminary estimate of about SGD 26 billion for 2021. This is due to a steady level of construction demand and the backlog of remaining work that has been affected by the COVID-19 pandemic, since 2020.

Year	Construction demand* (SGD billion)		Construction output [^] (Nominal) (SGD billion)	
	Public	Private	Total	Total
2021 p	18.16	11.78	29.94	25.9
2022 f	16 -19	11 - 13	27 - 32	29 - 32
2023 - 2026 f	14 - 18 per year	11 - 14 per year	25 - 32 per year	-

p: Preliminary; f: forecast

*Construction demand: Value of contracts awarded

^Construction output: Value of certified progress payments

Note: Construction demand forecast in 2023-2026 excludes any potential awards of construction contracts for the development of Changi Airport Terminal 5 and its associated infrastructure projects as well as the expansion of the Integrated Resorts, as their construction timelines are still under review, due to the impact of the COVID-19 pandemic.

Prospects for Singapore's Built Environment sector.

03

CPG Corporation commemorates a 188-year legacy of contribution to the Singapore urban landscape

The first office for public works was established in Singapore, in 1833. Since then, over the years, the public works scene has evolved, helping to support the urban landscape and propel the country into a world-renowned 'Garden City'.

Founded on this 188-year legacy, CPG Corporation (CPG), as the corporatised entity of the former Public Works Department of Singapore, is commemorating its journey in the Built Environment industry with the publication of a commemorative book titled 'CPG 188'.

"The evolving global environment is a catalyst for cities to be more versatile and adaptable. CPG has been an active contributor to the Singapore urban landscape throughout these 188 years. Our experience accumulated from this journey can inspire others in the built environment to create sustainable developments that work responsibly with the environment", said CPG's President and Group Chief Executive Officer Ar. Khew Sin Khoon.

Highlighting key and memorable projects the corporation has done, 'CPG 188' offers striking new insights into some of the company's challenges and unique circumstances. The book tells of how CPG's multidisciplinary teams worked to overcome the odds to build some of the most iconic projects in Singapore and overseas, particularly in the recent two decades, when the company exported its expertise to major cities across the Asian region.

These projects have proven to be not only solutions for society but also relevant to the times. For instance, the National Centre for Infectious Diseases, designed by CPG Consultants Pte Ltd (a subsidiary of CPG), played a significant role in the nation's battle against the pandemic and has boosted the resilience of its healthcare system.



CPG Corporation and its forerunner organisations have served Singapore's built environment for close to two centuries.

Today, Singapore and other global cities continue to evolve in a rapidly changing world. From the rise of digital technologies to the recent pandemic, various disruptions have profoundly impacted living and work arrangements as well as mobility patterns, bringing unprecedented challenges to cities.

CPG's rich and vast experience enables it to stay relevant and identify opportunities in addressing the call for a more sustainable form of development to address global population growth and increasing urbanisation.

The corporation believes that the solution lies in incorporating resilience, sustainability and technology, into its design philosophy and projects, in order to design better and more adaptable cities.

Some of CPG's ongoing efforts in creating a more climate-resilient urban environment include the Bidadari Park, slated to be completed in 2022. The corporation has harnessed its inter-disciplinary capabilities to integrate an underground stormwater retention tank with Alkaff Lake, a reservoir that stores and supplies drinking water to the surrounding residential estate.

Further, in 2021, CPG was appointed to undertake the task of formulating a climate-resilient masterplan for the



'CPG 188' is a commemorative book of the corporation's journey to-date, particularly in the recent two decades.

island's City-East Coast stretch which houses critical infrastructure such as Changi Airport, a water reclamation plant and the future Greater Southern Waterfront development.

"As many of the urban and built environment challenges are complex and intertwined with layers of economic, social and environmental issues, we firmly believe in taking a collaborative and transdisciplinary approach to co-developing solutions. We see CPG as the built environment integrator of such solutions", said Ar. Tan Shao Yen, CPG's Group Chief Innovation Officer.

De Nora awarded water disinfection projects at PUB's Johor River Water Works

De Nora, global leader in electrochemistry, water disinfection and filtration, recently announced that it has won the water disinfection project at the Johor River Water Works.

This project will see a ClorTec 2250 on-site, hypochlorite generator, from De Nora, replacing the existing liquid chlorine and ammonia systems at the water works. In total, De Nora will provide 11 ClorTec 2250 units across all three plants on-site. Each unit will have an electrolyser capacity of 1020 kg/ day – exceeding the tender requirements of 900 kg/day.

This win is on the back of other successful projects for PUB, Singapore's National Water Agency, which involved the installation of De Nora ClorTec systems at multiple locations, including at the Chestnut Avenue Waterworks, located in the west of Singapore.

De Nora ClorTec 2250 on-site hypochlorite generation systems use three common consumables – water, salt and power – to produce chlorine-based disinfectants by passing a solution of sodium chloride through an electrolytic cell and converting the chloride ions into sodium hypochlorite.

The use of sodium hypochlorite is a safe, economical and effective method for drinking water treatment, since it does not create hazardous chemicals and there is no need to transport such products. This ensures the safety of the personnel employed and of the surrounding community.

As part of the tender process for the Johor Water Works project, the ClorTec 2250 systems had to meet stringent performance and efficiency targets in Factory Acceptance Tests (FAT) over a relatively short period of six months. Of particular concern is the formation of by-products like chlorate, perchlorate and bromate. These by-products are emerging contaminants of concern in water sources globally, and awareness of these contaminants is increasing across Asia.

De Nora ClorTec on-site hypochlorite generation systems are optimised to help minimise production of these by-products, especially chlorate. In tests performed at the Chestnut Avenue Water Works, De Nora showed that on-site hypochlorite generation systems produced by-products such as chlorate and perchlorate at levels four to six times lower than the recommended value.

"We are excited to provide the Johor River Water Works with a safe, economical and effective solution to generate hypochlorite on-site. This win is a testament to our ongoing commitment to deliver innovative solutions for water treatment across the region, and we look forward to our continued partnership with other partners across Asia Pacific", said Mr Marwan Nesicolaci, General Manager, Asia Hub at De Nora Water Technologies.

With the benefit of the expertise in electrochemistry, acquired over more than 95 years, De Nora on-site generation systems feature market innovations including enhanced efficiency, remote monitoring, and simple installation and maintenance. At the heart of every De Nora electrochlorination system is the DSA electrode technology pioneered by De Nora.

The third generation of De Nora ClorTec on-site sodium hypochlorite generator uses an optimised electrochlorination process that delivers a 15% operating cost-saving over the previous system.

The ClorTec 2250 unit at Johor River Water Works is expected to be operational by March 2023.



De Nora ClorTec On-Site Hypochlorite Generation system.



Autonomous drones for painting of building façades

ISOTeam Ltd (ISOTeam, or together with its subsidiaries, the Group), an established and leading player in Singapore's building maintenance and estate upgrading industry, has signed a Memorandum of Understanding (MoU) with Acclivis Technologies and Solutions Pte Ltd (Acclivis) and Nippon Paint (Singapore) Co Pte Ltd (Nippon Paint) to develop and enable the use of autonomous painting drones for the painting of building facades or structures. The collaboration is part of ISOTeam's strategy to improve its productivity and manpower deployment through the use of technology.

Under the MoU, ISOTeam will contribute its expertise in painting and project management, while Acclivis, a provider of technology solutions in the enablement of Artificial Intelligence (AI), Video Analytics and Automation, in Asia Pacific, will spearhead the technology and development work in painting drones. Acclivis is a subsidiary of CITIC Telecom International Holdings Limited listed on the Hong Kong Stock Exchange. Nippon Paint, Asia Pacific's leading manufacturer and distributor of paints and coatings, and a strategic working partner of ISOTeam since 2004, will focus on marketing this new service through its global networks.

The Group recently announced that it intends to deploy AI and drone technology for building façade inspections. ISOTeam had entered into a five-year collaboration with H3 Dynamics Pte Ltd to work together exclusively for Housing & Development Board (HDB), town councils as well as commercial and condominium building façade inspection projects that are secured by ISOTeam. Following this, the Group has secured a building facade inspection and repairs contract for 154 HDB blocks and will work with H3 Dynamics to utilise

Al and drone technology for this project.

The Group expects the eventual use of autonomous painting drones in its operations to yield significant cost and time savings, as fewer workers are required, and the site preparation time as well as overall project duration are shortened, as the installation of scaffolding will no longer be necessary. Quality control is also improved as the drones offer standardised operations and multiple ways for quality assurance inspection and tracking.

Some of the key features of autonomous painting drones include remote control, high-precision position and posture control for spray quality assurance, the ability to perform with coating supplied from a ground station via a lift system and from an airborne container, and real-time status monitoring, among others.

Design consultancy appointed for new MTR station in Hong Kong

Following a tender process, Hong Kong's MTR Corporation has announced the award of a design consultancy to AURECON-WSP Joint Venture, to carry out the planning and design for Hung Shui Kiu Station of the Tuen Ma Line. The Hung Shui Kiu Station will serve the future transport needs of the Hung Shui Kiu/Ha Tsuen New Development Area, bringing convenience to residents and reducing travelling time.

The scope of the consultancy includes development of the scheme into an engineering design; preparation of the construction programme, gazette plans and project cost estimate; as well as liaison with government departments and other stakeholders. The AURECON-WSP Joint Venture will work closely with MTR Corporation's Capital Works team, in the execution of the consultancy work.

The new station on the Tuen Ma Line will be situated at the future town centre of the Hung Shui Kiu/ Ha Tsuen New Development Area and will provide residents with railway connection to other areas in Hong Kong. The Hung Shui Kiu Station project will serve the future transport needs of the new development area and also release the development potential in the vicinity. The team will maintain ongoing dialogue with the community during the design and construction of the project.

Other works relating to the Hung Shui Kiu Station project, including ground investigation and survey of existing utilities, are also expected to commence soon. The main construction works are expected to commence in 2024 for completion in 2030.



AURECON-WSP Joint Venture is planning and designing the new Hung Shui Kiu Station which will serve the future transport needs of the Hung Shui Kiu/Ha Tsuen New Development Area.



Lendlease announces new Chief People Officer for Asia

Lendlease announced the appointment of Ms Loh Chuan Hui as Asia's new Chief People Officer, with effect from 1 January 2022. Based in Singapore, Ms. Loh takes over from Ms Vicki Ng who has taken a sabbatical leave of absence.

In her role, Ms Loh will ensure that Lendlease's people and culture strategies and initiatives are aligned with the growth aspirations of the international real estate group's overall business.

In addition, she will continue to

champion diversity and inclusion as a key pillar across Asia and contribute to the development of an agile and future-ready workforce.

Ms Loh has been with Lendlease since 2011 and has held several roles within the people and culture team across Asia. She has been a business partner on the people and culture front, across Lendlease's different lines of business, and has held the role of Senior Country Human Resources Lead in Malaysia from 2015 to 2017. Most recently, Ms Loh was the Head of



Ms Loh Chuan Hui

Talent, Asia and Strategic Business Partner for Lendlease Digital Singapore.

In her new role, she will join the Asia Leadership Team and Global People & Culture Leadership Team.

Ms Loh graduated from Nanyang Technological University with a Bachelor of Communication Studies degree.



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For more information, please e-mail desmond@iesnet.org.sg or jiayu@iesnet.org.sg

HDB Awards 2021 recognises 16 projects for excellence

A total of 16 HDB Design, Construction and Engineering Awards were presented late last year to architectural and engineering consultants as well as building contractors, for projects that have demonstrated exceptionally good design, engineering and construction.



SkyParc @ Dawson sits along the 200 m long Dawson Community Eco-corridor, offering residents the experience of living within a park. Image: Design Link Architects Pte Ltd.

DESIGNING FOR RESIDENTS' WELL-BEING AND CONVENIENCE

SkyParc @ Dawson - Living within a Park

Among the projects that clinched the Design Awards, SkyParc @ Dawson stands out for its well-balanced blend of high-rise living with nature. Designed by Design Link Architects Pte Ltd, the project comprises three tower blocks rising from a forest green. Guided by the 'Housing-in-a-Park' vision for Dawson estate, the consultant used trees and plants to enhance outdoor comfort, stormwater management and ecological connectivity. These verdant provisions at SkyParc @ Dawson bring to life the vision of vibrant urban living in a park-like setting where residents can easily access nature at their doorsteps.

Residents of SkyParc @ Dawson enjoy green views at every turn, with more than 80 species of trees, palms and scrubs interspersed throughout the sky terraces, roof gardens, as well as expansive landscaped common greens at the ground level. The abundant green spaces, equipped with communal facilities such as fitness corners, playgrounds and community gardens, also provide a welcoming and conducive space for residents to come together and get to know each other. Those looking for a quiet space can follow the meandering landscaped trails within these green spaces to arrive at more tranquil green pockets with seating areas, where they can also enjoy the restorative benefits of nature.



A key feature of the precinct is the Dawson Community Eco-corridor – a 200 m pedestrianised corridor that was formerly part of Margaret Drive – where 18 mature trees, including Rain Trees and Broad-Leafed Mahogany, have been conserved. These mature trees provide the foundation to enhance the vegetation and retain the wildlife in the area, while also helping to cool the environment and provide shade on sunny days.

Eastlink I & II @ Canberra - Connecting Places to Your Home

Eastlink I & II @ Canberra by SAA Architects Pte Ltd also won a Design Award, for its thoughtful amalgamation of aesthetics and convenience. Designed around the central theme of connectivity, the mixed development integrates housing and green spaces with commercial and community facilities. Each of the 11 residential blocks is linked via a network of elevated sheltered linkways to Canberra MRT Station, Canberra Plaza and the Canberra Park Connector, providing residents and the community a safe and barrier-free commute to a wide array of amenities to meet their daily needs. These communal thoroughfares also maximise opportunities for people in the community to meet and interact as they go about their daily activities.

Canberra Plaza, a New Generation Neighbourhood Centre (NC) serving the residents of Eastlink I & II @ Canberra, is nestled conveniently in between the two residential precincts. Completed in 2019, when residents began to move in, the three-storey NC offers residents an array of amenities and services at their doorstep, with 55 shops providing food and retail options, as well as commercial services (e.g. hair salons, enrichment centres, clinics etc), a food court and supermarket. The NC's sprawling outdoor community plaza provides a conducive space for residents to participate in social and lifestyle activities together, such as exercise events and community bazaars. Such community activities encourage interaction among the residents and



Part of the former Margaret Drive was converted into a Community Eco-corridor to allow local biodiversity to thrive. Image: Design Link Architects Pte Ltd.



In a tribute to the local flora and fauna, a series of mosaic murals can be spotted throughout the development. Image: Design Link Architects Pte Ltd.



Insect hotels, nest boxes and drilled wood logs – a first in a public housing project – are designed to recreate natural habitats to help the local biodiversity thrive. Images: Design Link Architects Pte Ltd.





The network of sheltered linkways provides convenience for residents staying at Eastlink I & II @ Canberra, allowing them to access amenities in the area easily. Image: SAA Architects Pte Ltd.



The three-storey Canberra Plaza is now a one-stop destination that provides communal and commercial amenities for residents. Image: SAA Architects Pte Ltd.

promote the building of close community ties. Meanwhile, a linkway at the NC's ground level provides a sheltered passageway for residents directly to and from the precinct green and MRT station.

The design of the mixed development draws inspiration from the town's history as a naval base and forms a distinct landmark in the area. The linkways meander gently like waveforms, while the façade features undulating bands which create a sense of movement. Nautical-themed playgrounds can also be found within the lushly landscaped environment. Together, these design elements give Eastlink I & II @ Canberra its unique identity.



Nautical-themed designs and playgrounds harken back to Canberra's naval-base history, adding a unique character and identity to the development. Image (left): SAA Architects Pte Ltd. Image (right): Nanjing Dadi Construction (Group) Co Ltd (Singapore Branch).





Artist's impression of Parc Residences @ Tengah, an integrated development with public housing and a Neighbourhood Centre. Image: HDB.

PUSHING NEW FRONTIERS IN ENGINEERING INNOVATION

Parc Residences @ Tengah - Piloting smart solutions

On the engineering front, Parc Residences @ Tengah was conferred the Innovative Engineering Award (Design) 2021 in recognition of its engineering design and construction innovations. The award underscores the importance of innovative engineering solutions in laying the foundation for a quality living environment. Designed entirely by HDB's in-house team of planners, architects and engineers, the project, comprising 12 residential blocks and a Neighbourhood Centre, is slated to be completed in 2025.

Parc Residences @ Tengah is the first project to adopt the Integrated Building Information System (IBIS), a cloud-based collaborative platform which streamlines communication and data flow between various stakeholders during construction. The IBIS is a key feature of the Smart Integrated Construction System (SICS) which was developed with Nanyang Technological University (NTU) to transform traditional construction processes using radio-frequency identification (RFID) and automation.

The IBIS serves as a central digital database containing all the information on the project, and is accessible to industry partners in the entire construction supply chain. Using three-dimensional



The Integrated Building Information System enables real-time data sharing among industry partners for greater productivity and efficiency. Image: HDB.

modelling of HDB projects as a common platform, all parties can log in real-time information and progress updates on the project from their dispersed locations. This streamlines information and speeds up data-sharing (e.g. construction planning and scheduling) amongst the different stakeholders such as architects, contractors, precasters and construction material suppliers, enabling them to better keep track of construction timelines and budgets. With more effective communication and collaboration, potential construction issues can be detected and rectified early. Besides serving as a collaborative workspace, the IBIS is also used to track delivery of construction materials, allowing for better logistics planning. HDB will assess the system's performance, before considering the feasibility for wider scale implementation in other HDB projects.

Parc Residences @ Tengah was also conferred the Innovative



Artist's impressions of the fitness station (above) and staircases (below), at the MSCP. Images: HDB.

Design Award for its design approach that focuses on promoting residents' well-being. In line with HDB's 'Designing for Life' roadmap, HDB's multi-disciplinary team has infused health and wellness elements throughout the precinct to encourage healthy living, as part of residents' daily routines. For example, the multi-storey carpark (MSCP) has been reimagined as a social hub where the ground level will be designed as a car-free, sheltered community space for people of all ages, with amenities such as a childcare centre, fitness stations, and a playground. To encourage residents to adopt stairclimbing as a form of exercise, the staircases at the MSCP of Parc Residences @ Tengah have been attractively designed as fitness stairs with motivational messages. In addition, the project also features solar panels that will generate green energy to power common services such as lifts, lighting in common areas and pumps.

RECOGNISING CONSTRUCTION EXCELLENCE

At HDB Awards 2021, six building contractors were recognised for construction excellence in the development of housing projects that achieved CONQUAS scores above 90. The Construction Award underscores the importance of innovative construction solutions in overcoming site-specific challenges, while upholding the quality of the project and safety of the workers.

Forfar Heights

Among the award-winning projects is Forfar Heights by BHCC Construction Pte Ltd, which overcame major site constraints and attained a high CONQUAS score of 92. Located in a densely built-up area at the junction of Alexandra Road and Commonwealth Avenue, Forfar Height comprises a single 43-storey high residential block and a commercial block. To raise construction productivity, the contractor leveraged technological tools to conduct checks on the quality of architectural finishes. For example, drones were used to carry out façade inspections, while an

Artificial Intelligence (AI) software helped to identify minor paintwork issues using high-resolution images captured by the drones during the façade inspections. This helped to reduce the risk of working-at-height in order to conduct external façade inspections and reduce the time needed for physical inspections. As a result, the project achieved a good Safety & Health record throughout the construction period, i.e. there were no workplace incidents which could delay construction works.

STAYING THE COURSE WITH OUR INDUSTRY PARTNERS

Although COVID-19 has brought about many unprecedented challenges and constraints, HDB is heartened that contractors and consultants have responded to the disruptions, by innovating new solutions and pushing boundaries to build and complete quality homes, while upholding quality and safety. With the challenges of the pandemic still playing out, HDB will continue to engage closely with and support industry partners, to deliver quality homes for Singaporeans.



Innovative technology was used to raise construction productivity in the Forfar Heights project. Image: BHCC Construction Pte Ltd.

^{CC} The past year and a half has been particularly challenging for our contractors and consultants, but they have risen to the challenge. Thanks to their dedication, professionalism and resilience amidst the pandemic, HDB has been able to continually deliver quality homes to Singaporeans, with the flats delivered now surpassing pre-pandemic levels. Through the HDB Awards, HDB is happy to recognise and affirm the excellence displayed by our industry partners in the design and construction of our HDB projects. We look forward to their continued invaluable partnership to deliver quality and cherished homes to Singaporeans, and stand with them as we ride out the challenges facing the construction industry together ^{>>}

– Mr Tan Meng Dui, Chief Executive Officer, HDB

HDB DESIGN AWARD WINNERS

Design Award

Category (Completed)	Consultant	Project	Address
Housing	Design Link Architects Pte Ltd	SkyParc @ Dawson	Blks 94, 95, 96 Dawson Road
Mixed Development	SAA Architects Pte Ltd	East Link I & II @ Canberra and Neighbourhood Centre	Blks 116A, 117A, 117B, 118A, 118B, 131A, 131B, 131C, 132A, 132B, 132C, 133 Canberra Crescent
Rejuvenation	JYHa LLP	Neighbourhood Renewal Programme at Tampines Street 82/ Avenue 4	Blks 842A to 842H, 856A to 856F Tampines Street 82/ Avenue 4

Innovative Design Award

Category (To-Be-Built)	Consultant	Project	Address
Mixed Development	Building & Research Institute (HDB)	Parc Residences @ Tengah	Tengah Park Avenue, Tengah Drive

Certificates of Merit (Design)

Category	Consultant	Project	Address
Housing	P&T Consultants Pte Ltd	Clementi Crest	Blks 445A, 445B Clementi Avenue 3
To-Be-Built Housing	ADDP Architects LLP	Costa Grove	Blks 587 to 590 Pasir Ris Drive 3
	P&T Consultants Pte Ltd	Bishan Ridges	531 to 533, 532A to 532C Bishan Street 14 & 534, 535, 535A to 535C Bishan Street 13

HDB ENGINEERING AWARD WINNERS

Innovative Engineering Award (Design)

Category	Consultant	Project	Address
To-Be-Built Housing	Building & Research Institute (HDB)	Parc Residences @ Tengah	Tengah Park Avenue, Tengah Drive

Certificates of Merit (Engineering)

Category	Consultant	Project	Address
To-Be-Built Housing	KTP Consultants Pte Ltd	Tengah Park Contract 2	Tengah Road, Tengah Boulevard, Tengah Park Avenue
To-Be-Built Infrastructure	Surbana Jurong Consultants Pte Ltd	Construction of Common Services Duct within Tengah (Phase 3)	Tengah Road, Tengah Park Avenue, Tengah Boulevard

HDB CONSTRUCTION AWARD WINNERS

Construction Award

Category	Consultant	Project	Address
Housing	BHCC Construction Pte Ltd	Forfar Heights	Blk 53 Strathmore Avenue
	China Construction Realty Co Pte Ltd	Bedok North Vale	Blks 547A, 547B Bedok North Road
	Kay Lim Construction & Trading Pte Ltd	Teck Whye Vista	Blk 153 Jalan Teck Whye
Upgrading	Expand Construction Pte Ltd	Design & Build of Upgrading Projects – G23A	Blks 120 to 128 Geylang East Ave 1/ Central (HIP) Blks 156 to 166 Tampines St 12 (HIP) Blks 101, 105, 107 Lengkok Tiga (LUP) Blks 10 and 11 Jalan Batu (LUP)
	Kienta Engineering Construction Pte Ltd	Design & Build of Upgrading Projects – G18E	Blks 484 to 491 Jurong West Ave 1 (HIP) Blks 456 to 461 Jurong West St 41 (HIP) Blks 501 to 504, 506 to 508 West Ave 1/ St 52 (HIP) Blks 728 to 731 Clementi West St 2 (HIP)

Certificate of Merit

Category	Consultant	Project	Address
Housing	Nanjing Dadi Construction (Group) Co Ltd	Eastlink I & II @ Canberra	Blks 116A, 117A, 117B, 118A, 118B, 131A, 131B,
	(Singapore Branch)		131C, 132A, 132B, 132C, 133 Canberra Crescent

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Bentley Systems Announces Winners of the 2021 Going Digital Awards in Infrastructure

Organisations from around the world receive recognition.



Winners of the 2021 Going Digital Awards in Infrastructure were announced at a virtual event held in early December.

Bentley Systems Incorporated, a leading international infrastructure engineering software company, announced the winners of the 2021 Going Digital Awards in Infrastructure, during the 2021 Year in Infrastructure and Going Digital Awards virtual event, held in early December 2021.

The annual awards programme recognises the extraordinary work of Bentley software users in advancing infrastructure design, construction and operations throughout the world.

Sixteen independent jury panels selected the 57 finalists from nearly 300 nominations submitted by more than 230 organisations from 45 countries encompassing 19 categories.

Also at the virtual event, 22 Founders' Honorees were recognised, representing organisations or individuals whose undertakings contribute notably to infrastructure advancement and/ or environmental / social development goals.

WINNERS OF THE 2021 GOING DIGITAL AWARDS IN INFRASTRUCTURE

BRIDGES

New York State Department of Transportation

East 138th Street over the Major Deegan Expressway

New York City, New York, USA

BUILDINGS AND CAMPUSES

Volgogradnefteproekt LLC High-tech Multifunctional Medical Complex Yukki, St Petersburg, Russia

DIGITAL CITIES

Hubei International Logistics Airport Co Ltd, Shenzhen S.F. Taisen Holdings (Group) Co Ltd, Airport Construction Engineering Co Ltd

Ezhou Huahu Airport Project

Ezhou, Hubei, China

DIGITAL CONSTRUCTION

Clark Construction Group LLC SeaTac Airport International Arrivals Facility Seattle, Washington, USA

GEOTECHNICAL ENGINEERING

China Water Resources Beifang Investigation, Design and Research Co Ltd

Geological Survey of Water Conservancy and Hydropower Engineering Tibet, China

LAND AND SITE DEVELOPMENT

Liaoning Water Conservancy and Hydropower Survey and Design Research Institute Co Ltd

Dongtaizi Reservoir Project

Chifeng, Inner Mongolia, China

MANUFACTURING

WISDRI Engineering & Research Incorporation Limited

Converter-based Continuous Casting Project of Jinnan Steel Phase II Quwo Base Capacity Reduction and Replacement Project

Quwo, Shanxi, China

MINING AND OFFSHORE ENGINEERING

Polyus

Construction of the Blagodatnoye Mill-5

Krasnoyarsk, Krasnoyarsk Krai, Russia

POWER GENERATION

Capital Engineering and Research Incorporation Ltd

The World's First 60MW Subcritical Blast Furnace Gas Power Generation Project

Changshu, Jiangsu, China

PROJECT DELIVERY INFORMATION MANAGEMENT

Mott MacDonald Systra JV with Balfour Beatty Vinci

HS2 Phase 1 Main Civil Construction Works London, UK

RAIL AND TRANSIT

Network Rail + Jacobs Transpennine Route Upgrade

Manchester/Leeds/York, UK

REALITY MODELING

HDR

Diablo Dam Digital Twin Modeling Whatcom County, Washington, USA

ROAD AND RAIL ASSET PERFORMANCE

Collins Engineers Inc Stone Arch Bridge Rehabilitation Minneapolis, Minnesota, USA

ROADS AND HIGHWAYS PT Hutama Karya (Persero) Trans Sumatera Toll Road Project Section Serbelawan-Pematangsiantar Pematangsiantar, Sumatera Utara, Indonesia

STRUCTURAL ENGINEERING

HDR and the PennFIRST Team

The Pavilion at Penn Medicine Philadelphia, Pennsylvania, USA

UTILITIES AND COMMUNICATIONS

PowerChina Hubei Electric Engineering Co Ltd Suixian and Guangshui 80MWp Ground-based Photovoltaic Power Project of Hubei Energy Group Guangshui, Hubei, China

UTILITIES AND INDUSTRIAL ASSET PERFORMANCE

Canadian Energy Company

Asset Data Lifecycle Program Fort McMurray, Alberta, Canada

WATER AND WASTEWATER TREATMENT PLANTS

Larson & Toubro Construction

Khatan Group of Villages Water Supply Scheme (Surface Water Treatment), UP, India

Khatan, Uttar Pradesh, India

WATER, WASTEWATER AND STORMWATER NETWORKS

Companhia Águas de Joinville (CAJ) Contingency Plan to Ensure Supply in the Event of Drought (Joinville-

Santa Catarina) Joinville, Santa Catarina, Brazil

STUDENT WINNERS OF THE FUTURE INFRASTRUCTURE STAR CHALLENGE

JUDGE'S CHOICE WINNER

Elif Gungormus Deliismail Mini-Modular-Plant for Digitized Sustainable Campus Izmir Institute of Technology, Turkey

PEOPLE'S CHOICE WINNER Rodman Raul Cordova Rodriguez Innovative Dam and Hydroelectric Project Pontifical Catholic University of Rio de Janeiro, Brazil

Bentley Systems wins at 2021 Construction Computing Awards

Bentley Systems recently announced that it was selected as the Company of the Year, at the 2021 Construction Computing Awards.

Bentley attributes its success to its SYNCHRO software which offers a complete portfolio of integrated applications from field to office, for digital construction management. Together, the applications enable teams to win and deliver heavy civil projects more efficiently, by improving the use of data to optimise decision-making, resources and profitability.

The company was also a finalist in eight other categories in the competition, including BIM Software of the Year, Architectural Design Software of the Year, Collaboration Product of the Year, Project Management Software of the Year, Asset Management Software of the Year, Structural Engineering Application of the Year, GIS/ Mapping Product of the Year, and Product of the Year.

The winners were chosen, based on readers' online votes, over the course of six weeks, with a panel of industry-expert judges making the final decision. Competition was fierce, with the awards open to all software vendors within the AEC industry in the UK and Ireland.

The winners of the 2021 Construction Computing Awards were announced at the Leonardo Royal Hotel London City in downtown London. Over 200 supporting guests gathered to see the outcome of the readers' online voting and judging panel's deliberations.

> THE SINGAPORE ENGINEER January 2022

FOUNDERS' HONOREES

ES(D)G HONOREE FOR AFFORDABLE AND CLEAN **FNFRGY**

Fujian Yongfu Power Engineering Co Ltd

Fujian Changle Zone C Offshore Wind Farm

Changle/Fuzhou, Fujian, China

ES(D)G HONOREE FOR CLIMATE ACTION

Evides NV

Pumping Energy Optimization and CO₂ Reduction Evides Case Study Rotterdam, Netherlands

ES(D)G HONOREE FOR SUSTAINABLE CITIES AND COMMUNITIES

GenMap

Tree Modeling and Feature Extraction Using Mobile Mapping Mendoza, Argentina

FOR 4D DESIGN REVIEW

PT MRT Jakarta (Perseroda) MRT Jakarta Phase II Jakarta, Indonesia

FOR 4D DIGITAL TWINS **ADVANCEMENT** WSB

TH 169: Redefine Elk River Elk River, Minnesota, USA

FOR AS-OPERATED DIGITAL TWIN

CNOOC Energy Development Design and R&D Center

Digital Twin Project of the FPSO Offshore Oil Gathering and Transportation Platform South China Sea, Guangdong, China

FOR COLLABORATIVE SUCCESS Wood

Wood Bentley Digital Community **Collaborative Portal** UK

FOR COMPREHENSIVE COLLABORATION CES SDC Pte Ltd & AECOM Singapore Pte Ltd

Tuas Water Reclamation Plant - Contract C4A - BioSolids & Digesters Singapore

FOR COMPREHENSIVE PROJECT **DIGITAL TWIN**

China Railway First Survey and Design Institute Group Co Ltd

Application of BIM Technology in the Design of Xi'an-Shiyan High-Speed Railway

Xi'an, Lantian, Shangluo, Shanyang, and Shiyan; Shaanxi and Hubei; China

FOR DIGITAL ADAPTATION

AFRY & Tyréns Consortium East Link Stockholm, Sweden

FOR DIGITAL INTEGRATOR Mott MacDonald and National Grid

London Power Tunnels 2 London, UK

FOR DIGITAL TWINS R&D

Shanghai Investigation, Design & **Research Institute Co Ltd**

The Application of Digital Twin Technology in the Full Lifecycle of Offshore Wind Power Projects Beijing, China

FOR ES(D)G ADVOCACY

Nick Smallwood (on behalf of Infrastructure and Projects Authority)

Infrastructure and Projects Authority UK

FOR GLOBAL FUTURE-PROOFING

Brigantium Engineering ITER: In-Pit Activities for Tokamak Assembly

St Paul-les-Durance, Bouches-du-Rhone, France

FOR GOING DIGITAL IN EDUCATION

Center for Industrial Technological Studies and Services No 33

CETIS 33 BIM Workshop Mexico City, Mexico

FOR INFRASTRUCTURE IOT

GZA GeoEnvironmental USA

FOR ITWIN ENTERPRISE **Consilience Analytics** USA

FOR ITWIN ENTREPRENEUR SewerAl USA

FOR NATIONAL DIGITAL TWIN **Singapore Land Authority**

Advancing Singapore National 3D Reality Mapping for a Changing World Singapore

FOR PANDEMIC-PROOF EXECUTION

PT Hutama Karya (Persero)

Modification of Surabava - Gresik **Toll Road Interchange** Surabaya, East Java, Indonesia

FOR PROJECT DELIVERY VISIBILITY

Zachry Industrial Inc, a Zachry **Group Company** Golden Pass LNG Export Project Sabine Pass, Texas, USA

FOR VIRTUOSO INVENTION **NP Singh** GMW Pvt Ltd India



Infrastructure Asset Management and Technical Practices: from policy development to risk-based and data-driven decision-making

by Asset Management Technical Committee, IES

Benefits can be derived by leveraging data for informed decision-making and from alignment with the ISO 55000 series of standards.

INTRODUCTION

Asset Management is more than just managing infrastructure assets or physical assets in asset-intensive industries. Good Asset Management is an advanced discipline with engineering practices based on a lifecycle approach and coordinated activities to manage and realise the value of assets for organisational objectives so as to keep assets operating in a sustainable manner.

A traditional approach in managing assets often involves fixed criteria, which are normally being defined for each specific asset type in a way that takes no account of differences in operating condition history, or for the impact that such conditions may lead to, due to the risk of failure of the asset or the differing criticality of assets.

In order to overcome such challenges, a modern Asset Management framework such as the standard ISO 55001:2014 proposes riskand value-based decision-making processes in order to orchestrate [1] Asset Management activities to minimise the risk, to maximise the value, and eventually to meet the needs and expectation of stakeholders. Asset Management requires well-defined processes that can adequately identify, assess, and mitigate risks associated with critical assets, especially public infrastructure.

The essential components of such a modern Asset Management frame-work are:

(a) A risk-based decision-making policy in catalysing organisational objectives into logical decisionmaking criteria. (b) Comprehensive processes in enhancing Asset Management quality in various domains.

(c) Adequate data collection and management with appropriate data analytics techniques and methodologies in enabling accurate estimation/prediction of the risks, so that prioritisation of Asset Management activities can be planned and carried out.

The range of questions that Asset Management may seek to answer includes:

- What methods and what criteria can be used to identify assets and the 'potential' risks with their continued use (e.g. should asset age be one of the criteria)?
- What methods and criteria can be used to assess the 'real' risks of such assets (e.g. should asset condition, past reliability and defects be the criteria for consideration, instead)?
- How do we determine the optimum solution for mitigating these risks?
- What will be the needed asset investment, and operations and maintenance strategy, to sustain the desired level of service?

To answer these questions, we introduce practical insights on implementing good technical practices in Asset Management of critical infrastructure, through recommendations on how to formulate risk-based Asset Management policy, how to assess and manage risks associated with the assets and the use of techniques for data analysis.

ASSET MANAGEMENT SYSTEM UNDER ISO 55001:2014 FRAMEWORK

International standards, such as the ISO 55000 series of standards on Asset Management, recommend that asset-owning organisations, including infrastructure agencies and utilities, should have a structured approach to Asset Management-related activities and a risk-based decision-making process, as shown in Figure 1. Asset-owning organisations can develop a strategic Asset Management plan with their necessary technical expertise and experience. This can incorporate an asset replacement strategy that describes how to translate organisational objectives into an asset replacement plan, and define the methodologies and processes for risk-based decision-making in accordance with the following phases:

- Defining the business values based on organisational objectives (e.g. reliability, safety, environment, cost-effectiveness, customer satisfaction, regulatory compliance etc) and the Key Performance Indicators (KPIs) on how outcomes are to be measured, aligned to the applicable regulatory and legal requirements.
- Organising the line-of-sight and the working principles of the Asset Management activities.
- Detailing the overall Asset Management philosophy and approach towards risk-based Asset Management including, for example:

ASSET MANAGEMENT

(a) The approach towards maintenance – refurbishment – replacement.

(b) The choice for corrective, predictive, condition- or risk-based maintenance.

(c) The preference for proven or innovative practices.

(d) The ambition to follow or lead the industry practices.



Figure 1: Relationship between key elements of an Asset Management System [1].

BUILDING AN ASSET REPLACE-MENT POLICY DOCUMENT [2]

An asset replacement policy and related documents with their defined scope and content per document type (i.e., replacement policy, replacement programme/ plan, replacement guidelines etc) should be based on a clear set of definitions and aim at SMART (i.e. Specific, Measurable, Achievable, Relevant and Time-stamped) decision criteria. The development of a set of replacement policy documents requires careful selection of the right amount of details with adequate information to make the right choices without entering into detailed technical solutions [3, 4]. Terms such as replacement decision criteria, replacement assessment criteria and replacement drivers should be well-defined and used consistently. The policy document should not be restricted to high level considerations but provide a clear blueprint for developing a replacement process and associated replacement programmes/plans. The policy should comprise the following chapters:

• Business values and KPIs: One should start by mentioning the business values. This provides the



Figure 2: ISO 55001 line-of-sight, corresponding document structure and decision-making.





Figure 3: Designing a risk-based decision-making process for asset replacement.

link with the Asset Management policy and the business values centred on Asset Management. Examples are safety, reliability, costs, compliance, environment, customer satisfaction and reputation. Also, the policy should mention the KPIs that business values are measured by.

- Decision-making process: Secondly, one should describe the decision-making process. This process needs to describe how asset health/conditions are determined, risks are analysed and assets are ranked; how the replacement solutions are developed, weighed and prioritised; and how the asset portfolio is assembled and decided upon. This is a dedicated application of the overall decision-making process to be described in the Asset Management policy document.
- Generic triggers: As described above, decisions in a modern Asset Management organisation require a risk-based decision-making process rather than a process based on fixed criteria like time-based replacements. However, subjecting all assets to this decision-making process may not be efficient. In order to select the assets for which

this decision-making process is required, one needs to develop generic triggers like asset health/ condition or failure trends as a first filter.

DESIGNING A RISK-BASED DECISION-MAKING PROCESS [2]

Decisions to be made by asset owners and managers may represent key cost outlays, especially when asset replacements are just to maintain the asset performance due to aged assets, as part of the replacement strategy. As an alternative, the following decision-making process illustrates a risk-based process involving the following phases, as shown in Figure 3:

- Asset analysis: The purpose of the asset analysis process is to identify the list of assets with possible risks to one or more business values, by means of triggers.
- Assessment of the risks: The risks are then analysed against the business values specified in the policy and the criteria specified in the guidelines for individual asset types. The risk analysis should include business values, probability and impact of risk, and the organisation's risk appetite. The

outcome is a list of assets with categorised risks from 'negligible' to 'unacceptable'.

- Assessing the optimum solution: The risks identified may be mitigated by refurbishment, replacement, maintenance adjustment etc, or be accepted by continuing business-as-usual. The optimum solution should be chosen, based on criteria defined in the guidelines (e.g. maximum risk reduction per monetary value). If none of the mitigation options can sufficiently reduce all the risks, measures should be formulated to define alternatives, such as adjusting specification or design.
- Prioritisation of the solutions: The required information and data shall be collected in a standardised and consistent way to provide a clear and unambiguous iustification of the replacement (or other mitigation option). Prioritisation criteria (from the guidelines) should be used to provide a list of proposed replacements, which may contain information such as the type of asset, the asset ID number, the reason for replacement, the replacement cost and the expected completion date.

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• Planning: Based on the prioritised list, a proposal is then developed for a short-to-midterm plan, taking into consideration the available budget and resources, and the impact on the infrastructure. This proposal is then submitted for approval and incorporated in the operational planning process.

ENHANCING QUALITY OF ASSET MANAGEMENT SYSTEM AS COMPLEMENT TO THE ASSET MANAGEMENT SYSTEM UNDER ISO 55000 [5-6]

The adoption of the Asset Management System framework provided by the ISO 55000 series of standards can be complemented by a few technical quality aspects to build an effective Asset Management System. By understanding the current practices to determine the quality maturity, Asset Managers can then develop Asset Management roadmaps complemented by industry-recognised best practices and procedures in a corresponding implementation plan, so as to enhance the required technical quality in a cost-effective way.

Seven technical quality aspects cover different technical Asset Management fields needed by Asset Managers. Short descriptions and the breakdown of the sub-elements of these seven technical quality aspects are shown below:

- Asset Lifecycle Management: Asset Lifecycle Management includes strategic planning for further asset acquisition, tendering, asset acquisition, commissioning, operation, maintenance, life extension programme and decommissioning, and replacement planning.
- Risk Management and Mitigation: Risk is related to the probability and the consequences of asset failure. It is not only related to the assets or the infrastructure, but applies also to business value drivers. As public infrastructure industries are normally highly regulated and organisational reputation is important to asset owners, managers and

operators, proper risk assessment and management is vital.

- Asset Data Quality & Analysis: Complete, correct, quality and consistent data on assets is vital to extract meaningful information. This aspect involves asset data management, such as what kinds of data are required, who in the organisation should own the data, and how such data should be used and for what required analysis.
- Operation and Maintenance (O&M): O&M is one of the important factors to sustaining the assets in order to reach their anticipated performance and asset life. This aspect will cover how to set up and carry out detailed O&M plans and activities.
- Condition and Performance Assessment: Asset condition and performance information delivers essential information for asset decision-making.
- Knowledge Infrastructure: Building knowledge infrastructure in the organisation is an essential area for matured and competent asset-intensive organisations. The capture of practical lessons learned and regular knowledge-sharing are cornerstones of effective Asset Management.
- Monitoring and Evaluation: This aspect covers the setting of KPIs for continuous improvement of the Asset Management System with the above six individual, but closely linked, technical quality aspects in Asset Management.

LEVERAGING ON INFORMATION AND DATA ANALYTICS

For the technical aspect of asset data quality and analysis, good asset information and a single source of truth are fundamental in underpinning the Asset Management System and making informed decisions. To do so, an asset information system should be developed to allow asset information in terms of the physical attributes (e.g. configuration, hierarchy, location, quantity), its functional attributes (e.g. health, condition, lifecycle information), as well as its associated asset definition and business processes (e.g. work management, resources and finance), to be established.

Besides business and inventory information, the proper capture of asset information and data will provide insights on understanding the assets themselves, in terms of health and condition for operations assurance, as well as in predicting the remaining useful life of the asset, to better manage the risk of failure, with replacements. In recent years, developments in data analytics have helped to complement traditional asset life data analysis like statistical approaches using Weibull distributions, or prognostics models.

CONCLUSION

In this article, we have presented a risk-based Asset Management policy and process development, technical quality aspects to enhance Asset Management practices, and the leveraging of asset data and information for informed decision-making. For a good Asset Management System, the decision-making process may align with modern Asset Management standards, such as the ISO 55000 series on Asset Management, and adopt risk-based decision-making. Implementing such an Asset Management System requires various key ingredients such as high-quality asset data, well-defined risk appetite of the organisation, risk matrix, and risk reduction and mitigation plans, set against business value drivers. Lastly, in an asset-intensive organisation, the optimisation of asset replacement portfolios should be performed to manage the asset investment sustainably. This can be done through a risk-based decision-making process to substantiate asset replacement recommendations to the regulator and other stakeholders, from both technical and business perspectives.

The key success factors for smooth implementation of an Asset Management System are summarised as follows:

• An ISO 55001-compliant approach combined with technical quality aspects as industry good practice.



Figure 4: Asset information system and dataset attributes.

- Asset Management policy, strategy and objectives that are aligned with organisational objectives and stakeholder requirements.
- An effective risk management approach, including assessment, prioritising and adequate mitigation.
- A clear set of business values, KPIs and decision-making criteria.
- Asset data and information as the foundation with a single source of truth, coupled with use of analytics for data-centric insights.
- Communication, awareness and commitment at different levels internally.
- An evaluation system for quality

assurance and continual improvements.

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Report on the Remote Asset Management software and systems market

Remote Asset Management is a system that allows one to monitor assets remotely and schedule asset maintenance while one is away from the office. The Internet of Things (IoT), combined with Asset Management, can provide accurate asset location, enhance security and improve uptime.

The increasing adoption of IoTbased Asset Management and the various other advanced technologies available are leading to a tremendous growth of the Remote Asset Management market globally. It also helps improve the life cycle of an asset.

Remote Asset Management Software And System Market Growth Report 2021-2027, from A2Z Market Research, is an intelligence report based on information on the existing top players and upcoming competitors.

The business strategies of the key players and the new entrants are studied in detail. Well explained SWOT analysis, revenue shares and contact information are included in the report.

The Remote Asset Management software and systems market is expected to grow at 21% CAGR during the forecast period 2020-2026.

The report provides a detailed and analytical look at the various companies that are working to achieve a high market share in this market, globally.

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New public waste collection contract for the Woodlands-Yishun sector commences

Services will be provided, emphasising sustainability and improving productivity in refuse and recyclables collection.

The National Environment Agency (NEA) has awarded the new public waste collection contract for the Woodlands-Yishun sector to ALBA W&H Smart City Pte Ltd (ALBA W&H) through an open competitive tender.

ALBA W&H is a joint venture between the ALBA Group, an established environmental solutions company, and Wah & Hua Pte Ltd, a home-grown recycling and waste management company. ALBA W&H will provide refuse and recyclables collection services for domestic and trade premises in this sector from 1 January 2022 to 30 June 2029.

The Woodlands-Yishun sector covers Woodlands, Yishun, Sembawang, Mandai, Choa Chu Kang, Bukit Panjang, Lim Chu Kang and part of Ang Mo Kio. There are about 261,720 premises – comprising 257,160 households and 4,560 trade and institutional premises, such as hawker and market stalls, shophouses, schools, community centres and clubs, places of worship, and government buildings.

Increasing productivity and the use of innovative technologies

As part of transformation efforts in the waste management industry, NEA advocates the use of innovative concepts and technologies to improve productivity and sustainability in the collection of refuse and recyclables, in public tenders for appointing Public Waste Collectors (PWCs).

More efficient refuse collection

To improve the efficiency of refuse collection, a total of 95 stationary refuse compactors will be progressively deployed at 80 selected HDB residential blocks and 15 markets, HDB trade premises and army camps across the Wood-



Map of the Woodlands-Yishun sector. Image: NEA.

lands-Yishun sector. Unlike mobile compactors that need to be individually hauled to the incineration plants, refuse from multiple stationary compactors can be consolidated by the same refuse collection truck, for disposal. This method is also currently used in other sectors, including the Jurong sector which is served by ALBA W&H. To achieve greater operational efficiency, ALBA W&H has also integrated vehicle and equipment monitoring and deployment capabilities into its command centre. These capabilities enable the provision of timely services to residents.

Upskilling workers to improve efficiency

To further improve operational efficiency and equip workers with new skills, ALBA W&H's truck drivers will be upskilled under a new training programme that will impart proficiencies such as operation of the stationary refuse compactors, advanced truck manoeuvring and digitalisation skills.

New vehicle fleet

Residents in this sector can look forward to a new fleet of 55 refuse and recyclables collection trucks that will be deployed progressively from 1 January 2022, for the collection of refuse, recyclables, and garden waste. Thirty-one trucks in the new fleet will be fitted with particulate matter air filters on the trucks' cabin tops. The filters, which are made from an innovative glass fibre medium, are currently used on the vehicle fleet in the Jurong sector. As the filters can clean the surrounding air, they compensate for some of the emissions from the trucks. About 30% of the new fleet will be electric vehicles (EVs).





Rear-end loader refuse collection truck with PM air filter. Image: ALBA W&H.



Rear-end loader refuse collection truck with overhead solar panels. Image: ALBA W&H.



Side-loader recycling truck for HDB estates. Image: NEA.

Forty refuse and recyclables collection trucks in the new fleet will be fitted with overhead solar panels to harness solar energy to power ancillary equipment such as on-board cameras. For recyclables

collection, four EV rear-end loader (REL) trucks, one diesel REL truck, and three diesel side-loader trucks will be progressively deployed. There will also be two dual-compartment diesel trucks for the



ALBA W&H's Reverse Vending Machine. Image: NEA.

collection of recyclables and garden waste at landed premises. The dual-compartment trucks, which have separate compartments to collect recyclables and garden waste concurrently, will help to reduce the number of collection trips.

Initiatives to improve household recycling

To encourage residents in the Woodlands-Yishun sector to recycle, users can collect green bonus points by scanning QR codes found on the blue recycling bins via a mobile application called 'STEP UP', when they deposit their recyclables. The bonus points, also known as 'CO₂ points', can be used to redeem rewards.

In addition, 10 reverse vending machines (RVMs) will be progressively deployed across the Woodlands-Yishun sector to increase recyclables collection. Residents can exchange used aluminium drink cans and PET drink bottles for rewards via the 'STEP UP' mobile application when they use the RVMs. The application will also show the locations of the nearest recycling bins, RVMs and Cash-For-Trash stations in the sector.

PUB boosts flood response capabilities

A slew of new initiatives have been rolled out.

As climate change brings about more frequent and intense rainfall that could temporarily overwhelm the country's drainage capacity, the ability to forecast and monitor impending heavy storms becomes more important than ever.

PUB, Singapore's National Water Agency, has recently doubled the number of X-band radars to six, creating a more robust monitoring network with greater coverage and improving the accuracy of rainfall measurements and forecasts. X-band radars provide precipitation data at high temporal and spatial resolution, which will enable PUB to issue public alerts and deploy resources to potential flood locations in a timelier manner.

To further boost PUB's flood monitoring capabilities, the Catchment and Waterways Operations System (CWOS) for real-time monitoring of reservoir and drainage operations has been expanded to also capture and include all flood-related data from across the island (from water level sensors, flood response vehicle locations, CCTV cameras and rainfall forecasts), on a single platform. This integrated dashboard greatly enhances monitoring efforts at PUB's Joint Operations Centre (JOC).

The Catchment and Waterways Operations Systems was first implemented in November 2016 for real-time monitoring of reservoir and drainage operations in the Marina Catchment.

Quick response time is crucial before and during flash flood incidents. A fleet of 13 new flood response vehicles, modified according to PUB's requirements, is now equipped with features such as GPS trackers and pan-tilt-zoom cameras to stream real-time vehicle location and flood conditions on the road to PUB's JOC. These enhancements enable PUB to better coordinate the vehicles' deployment remotely, direct and assign the response



PUB officers monitor data from across the island round-the-clock, at the Joint Operations Centre (JOC), and alert the relevant teams quickly in the event of a flash flood.



PUB has unveiled a fleet of 13 dedicated flood response vehicles which are built for driving through floodwaters of up to 700 mm.



teams more quickly to locations where heavy rain is expected.

The vehicles are also able to drive through higher floodwaters of up to 700 mm and are stocked with portable flood barriers and inflatable flood bags. When onsite, PUB officers may need to close off affected road sections, direct traffic away from floodwaters and deploy flood barriers. The vehicles have been progressively deployed since April 2021.

Strengthening Community Resilience

Mr Yeo Keng Soon, PUB's Director of Catchment & Waterways Department said, "Over the years, PUB has been enhancing our capabilities in flood monitoring and response with new technologies and carrying out ongoing improvements to the drainage system for long-term resilience. However, we can never predict nature or cater to every extreme rainfall event to eliminate floods".

"It is thus imperative for us to strengthen our resilience, as a community, to flood incidents. Preparing and responding to flood incidents is an essential component of achieving greater resilience. For example, building owners must ensure that flood protection measures in their developments remain effective and consider suitable flood barriers to keep out stormwaters. Contractors must check that the drains and canals at their worksites are not clogged with silt and debris. Members of the public can prepare themselves for sudden changes in weather and potential flash floods by subscribing to flood alerts. We will continue to invest in new flood management capabilities while working closely with all stakeholders to improve public preparedness to flood incidents", he added.

Automated flood barriers

An automated flood barrier (AFB), that was trialled at Fortune Park condominium in July 2021, is a new flood protection solution that building owners can consider. Installed at the entrance of the condominium leading to the basement carpark, the AFB is a low-maintenance solution that utilises approaching



The flood response vehicles carry LED signages to warn drivers and pedestrians of floods in the area.



Each of the new vehicles is equipped with portable flood barriers, inflatable flood bags, life buoys, a fire extinguisher, traffic cones and red baton lights.



A pan-tilt-zoom camera is fixed on the roof of the vehicle to monitor real-time flood conditions on the road and stream the images back to PUB.



In the absence of heavy rain, the AFB, which stretches across the entrance of Fortune Park condominium, remains inconspicuous below ground level.

floodwaters to buoy itself up and block flood water from entering the premises, and then lowering back underground as water levels subside – thus eliminating the need for any human or mechanical activation. The barrier itself comprises a line of individual panels, making it easily customisable for various types and sizes of buildings.

Following the trial, PUB has determined that the AFB is a viable and cost-efficient solution for flood protection. PUB encourages building owners to implement the AFB as part of the flood protection measures for existing developments situated in low-lying areas. In recent years, PUB has introduced several new devices, such as Dam Easy Flood Panels, the Floodgate and Portable Flood Barriers, to its suite of portable flood protection devices. These can be deployed by home and building owners quickly during heavy rain. To date, PUB has loaned out 511 of such flood protection devices and distributed



The canal (Tampines Outlet Drain) outside the condominium has red, yellow and green markings to provide a clear indication of water levels during heavy rainfall.

around 10,000 inflatable flood bags to residents and businesses in locations which experience frequent flooding.

New communication channel

PUB has also recently launched a new Telegram channel that provides an additional means for the public to receive timely updates on heavy rain, potential flood risk locations and flash floods areas, on-the-go.

Continuous investments in drainage improvement projects

To improve Singapore's longer-term flood resilience, PUB continuously invests in enhancements to drain-



During heavy rain, water levels in the canal rise. Once water levels start crossing the yellow marker, the AFB is activated (together with its blinker light) and begins to rise automatically, buoying itself on the rising waters. It reaches a full height of 1 m when water levels reach the red marker.

age infrastructure, with almost SGD 2 billion spent on drainage works in the last decade, to alleviate flooding and support new developments. Another SGD 1.4 billion will be invested over the next five years on drainage improvement works. Ongoing projects include Bedok Canal, the widening and deepening of Bukit Timah Canal, improvements to Opera Estate Outlet Drain, improvement of drains at Seletar North Link, and the construction of the Syed Alwi Detention Tank.

Existing flood protection devices

Inflatable flood bag

Inflatable flood bags are compact and lightweight alternatives to traditional sandbags. These sandless bags are semi-porous and filled with biodegradable polymer crystals which inflate within minutes upon contact with water. Inflatable flood bags are easy to move and can be stored away easily. It can absorb up to 22 litres of water. Upon inflation, residents can arrange and stack them up to form as a barrier and reduce the flow of floodwaters into their property. Around 10,000 of these bags have been given out to-date.



As the rain subsides and water levels drop, the AFB begins to automatically lower itself back underground. The AFB does not require any electricity or human intervention to be activated and provides robust protection for residents and their possessions within the building.



Flood bag before absorbing water (left) and after (right).



Floodgate

The Floodgate comprises a 25 mm thick steel frame, wrapped in a waterproof 7 mm thick rubber sleeve that can be installed at doorways or entrances to protect premises from floodwaters. It is able to expand horizontally and vertically, creating a waterproof seal against the doorway. It is also extendable, with the addition of extra units, to help protect wider entrances.

Dam Easy Flood Panel

The Dam Easy Flood Panel (DFP) is an extendable panel with an inflatable seal, that provides temporary flood protection for doorways. Each DFP is 0.6 m high and weighs about 20 kg. The panel is reusable and can be adjusted to fit securely within door reveals ranging between 0.78 m and 1.10 m.

The flood panel allows for quick and simple installation without tools and, unlike conventional door barriers, does away with unsightly fixings that damage doorways. To install, the panel is positioned across the doorway and a lever is used to extend the side panels until it touches the doorframe. A pump is then activated to inflate a watertight seal around the panel.

Portable Flood Barrier

The Portable Flood Barrier (PFB) is a self-anchoring flood barrier. When installed, it creates a 0.5 m high dam which helps divert or contain floodwaters away from an area. It is lightweight and is designed for use on firm surfaces such as roads and pavements.

Each PFB set consists of 10 sections, each weighing about 3.4 kg. Due to its modular nature, it can be set up quickly via a coupling and locking mechanism to protect buildings and key installations from water damage, and to keep roads open. A complete PFB set extends about 6 m in length. No tools are needed for installation and the sections can be stacked up to minimise storage space and for ease of transportation.

All images by PUB, Singapore's National Water Agency



A Floodgate set up at the foot of a stairwell.



A Dam Easy Flood Panel set up at a doorway.



Assembling a set of Portable Flood Barriers.



Formwork solutions for the Stockholm Bypass

A new superhighway, mostly designed as a tunnel, is intended to guide traffic around the Swedish capital.

Stockholm is growing faster than London and faster than any other European city. But when it comes to traffic, the Swedish city is at a 'standstill'. The frequently congested Essingeleden, the 60s-era motorway in the west of the city, is still the most important northsouth connection.

But traffic is soon set to flow again. For years, construction has been underway on a new road, the Förbifart Stockholm, better known as the Stockholm Bypass. The Trafikverket, Sweden's traffic authority, has commissioned the excavation of a tunnel under the rugged land of skerries and holms to the west of the metropolitan region for this project. It is a mega project and a feat of strength, too, as a good 18 km of the 21 km route run through the rocky underground.

Special solutions for special projects

The team formed to implement the project includes Spaniards, Poles and Austrians, as well as representatives from the local branch of Doka, who have applied their expertise in formwork at various points of the western bypass. The main focus of their work has been two circular tunnels, 130 m and 160 m long, in the Skärholmen district, southwest of the city centre, built using the open-cut method.

The Swedish team broke new ground by working on this tunnel type. The project also demonstrated Doka's expertise in formwork for large and unique types of construction projects. The engineers were able to adapt proven systems with special elements to on-site circumstances.

The underground railway concept for cars

An example of this is using the SL-1 all-round model structure to create an SL-1 'model Stockholm bypass' structure. The construction of the route involved circular tunnels, like the ones in underground railways. So the team adjusted the system and took it from the world of rail travel to the world of road travel.

The local contractor received an economical rental solution intended to implement a tunnel format of this kind without complications.

A design like this depends on more than just a few additional structures. Maximising every solution to make formworking quick and easy is just as important as delivering the best solution.

Doka came up with constructive ideas to optimise the solutions, and helped in the planning of the formwork cycles so as to ensure staying on schedule.



Special projects, such as the Skärholmen tunnel in Sweden, require special solutions.



In Stockholm's district Skärholmen, Doka's heavy-duty supporting system SL-1 is being used to shape two circular tunnels using the cut-and-cover method.

PROJECT APPLICATION

Ensuring efficiency

In order for the formwork to be quickly converted and easily moved from one place to another, wheels and winches provided the necessary mobility for the systems, while an on-site service for precise cutting of wooden formwork beams shortened working distances. Processes were optimised and streamlined for efficiency, wherever possible.

In the case of material use, for example, instead of keeping two or three spares of each of the parts, their use is timed so that the construction company can manage with less material, without experiencing shortages. For safety, the edge protection system, XP, was chosen. It is user-friendly and can be used universally for all edge protection needs.

The Swedish branch of Doka has been entrusted with several construction sections. As well as the two circular tunnels, including entrances and exits, the work includes two 20 m long routes in rocky terrain as well as a pair of trough structures, the expansion of existing infrastructure and numerous stabilisation measures along the route.

A matter of form

As well as identifying the ideal solution and getting the most out of it, at least one more question is on the minds of the formwork specialists – how to position the system to make pouring concrete easy.

In Skärholmen, Doka provided a modular system and an all-round service.

Application of BIM

Since the geometry is complex, it was more important to fully map the building space. Doka also drew the underlying model so that the customer could visualise it.

The benefits are clear. All employees are connected via their mobile devices and therefore are always up-to-date, when construction data changes or an update is available. Problems are evaluated more



In addition to the two tunnels, Doka systems are also in use during the construction of trough structures.



Trough close-up on Doka's wall formwork, Framax.



PROJECT APPLICATION



For a better understanding of the tunnel geometry, the formwork solution was visualised with BIM 360 and the design software Revit.

quickly and errors rectified more easily than if everyone had to be individually briefed on the vast construction site.

BIM 360 and the design software Revit helped in visualising the challenging tunnel geometries down to the smallest detail, especially the formwork constructions. When different countries are involved, data and sketches help everyone understand what is going on. And participation means understanding. BIM enables project partners to perform their tasks every day and to discuss all manner of issues surrounding the tunnel construction.

The BIM model helped to plan the works before execution, since it provided the possibility to see how everything looked in reality. This was very helpful when it came to production and crane planning.

Six construction sections

Every tunnel is different. This

PROJECT DATA

Project FSE215 Tol Skärholmen

Location Stockholm, Sweden

Method of Construction Round and open-cut

Tunnel length 160 m and 130 m

Project Owner Trafikverket

means that experience is just part of a continuous learning process and there is always something new to learn.

As things stand, the six sections involving Doka will be handed over to the client on time and within budget after roughly five years of planning and construction.

Construction Company Comsa

Duration of forming operation 2019-2023

Doka products & services in use Products – Framed formwork Frami and Framax, large-area formwork Top 50, heavy-duty supporting system SL-1, load-bearing tower, timber-beam floor formwork Dokaflex, edge protection system XP

Services – Planning, BIM, on-site service, pre-assembly service

When the junctions between Kungens kurva in the south and Häggvik in the north are approved for traffic, as is due to happen from 2025, the Stockholm Bypass will be one of the three longest road tunnels in the world.

All images by Doka

Structural strengthening and restoration work on Casa Batlló

It is one of the most famous tourist and cultural attractions in Barcelona, Spain, and a UNESCO World Heritage Site, since 2003.

Casa Batlló is located at number 43 in Paseo de Gracia. It was originally designed in 1877 by Emil Sala Cortés but owes its fame mainly to the architect, Antoni Gaudí.

In the era in which the Paseo, which used to connect Barcelona and the city of Villa de Gracia, became one of the city's main thoroughfares and started to become the site of the residences of the city's most notable families, the building was bought by the textile businessman, D. Josep Batlló y Casanovas who commissioned its reconstruction by Gaudí in 1904.

The first project was to destroy the building, which Gaudí, however, managed to prevent, by redesigning its interior and completely changing the façade. He also transformed it into a more functional place as well as an artistic and architectural jewel which, according to a few experts, was pioneering work in the 20th century avant-garde movement.

Today, Casa Batlló, which over the years has changed ownership and type of use several times, belongs to the Bernat family who have completely renovated it and opened it to the public for cultural visits and the hosting of social events.

Structural strengthening in the interiors

Since 1940, the building has undergone restoration, renovation, as well as structural and consolidation work, several times, with the aim of turning it from mainly residential use to more public use (administrative, commercial and cultural), and to bring the structure in line with new norms and standards.

A Master Plan, prepared by a team of technicians, including Joan Olona, was approved in 2014,



Casa Batlló was built in the centre of Barcelona in 1877. In 1904, Antoni Gaudí redesigned it and turned it into an artistic and architectural jewel.

to bring the building in line with current fire norms and standards and to improve the route followed by visitors through the internal spaces of the building. As a result, between 2015 and 2017, a stairway and lift were designed and installed to improve access between the various floors of the structure, from the basement to the attic. The lift runs between the second floor and the roof, whereas the staircase connects all the floors and occupies an area measuring 5.5 m by 3 m.



PROJECT APPLICATION



A view of the interior.

The staircase has a metal structure which has been deliberately kept at a certain distance from the nearby walls, apart from several points on the walls where the ceramic covering has been partially removed.

The staircase does not create any stresses or loads on the nearby walls but, to make them stronger and, at the same time, more ductile, the masonry has been strengthened using composite materials from the Mapei structural strengthening and masonry restoration lines.

Work started with the application of a first coat of PLANITOP HDM RESTAURO two-component, pre-blended, fibre-reinforced, high ductility mortar made from natural hydraulic lime (NHL) and Eco-Pozzolan to level off the substrate.

MAPEGRID G 220 alkali-resistant glass fibre mesh was then placed on the mortar. It is a product which is particularly recommended for 'reinforced' structural strengthening work on stone, brick, tuff and mixed masonry structures.

The strengthening work was carried out before demolishing the part under the wall, leaving just the right amount of MAPEGRID G 220 mesh so that it could be folded back onto the opposite side and the reinforcement intervention could be completed by making an overlap.

Holes were drilled in the masonry

and MAPEWRAP G FIOCCO unidirectional high strength glass fibre cords were inserted into the holes, creating a series of 'structural connections' inside the existing masonry. Then, a second layer of PLANITOP HDM RESTAURO was applied to complete the intervention. A final skim coat was applied to the masonry, using MAPE-ANTIQUE FC CIVILE, a transpirant, salt-resistant, fine-grained mortar made from lime and Eco-Pozzolan.

The same system was used for the structural strengthening work on the arches and vaulted ceilings in several areas inside Casa Batlló and in the attic.

PLANITOP HDM RESTAURO, reinforced with MAPEGRID G 220, was also applied on the substrate for the trencadis (or broken mosaics), the glass and ceramic mosaic covering of the façade, to repair the old cracks and prevent them opening up and fracturing the ceramic coverings. Instead of using a mortar, MAPEROD G pultruded glass fibre bars were used for crack-stitching, as this product is ideal for repair and structural strengthening work on damaged concrete, wood and masonry elements.

New spheres for the chimneys on the roofs

Mapei also left its mark on the 'highest' points of the work by Gaudí. In fact, through its subsidi-



Structural strengthening work was carried out on the arches, vaulted ceilings and masonry, using a system consisting of PLANITOP HDM RESTAURO, MAPEGRID G 220 and MAPEWRAP G FIOCCO.



On the external faces of the vaulted ceilings, some of the cracks were 'stitched' using MAPEROD G glass fibre rods.

ary Mapei Spain, the Mapei Group was involved in the restoration work on the crystal spheres positioned above the chimneys towering over the roof of Casa Batlló. To fasten the spheres to the mouths of the chimneys, MAPEWRAP G FIOCCO glass fibre cord was used again, this time impregnated with MAPE-ANTIQUE I super-plastic, salt-resistant, fillerised hydraulic binder made from lime and Eco-Pozzolan, which is normally used to make injection slurry for consolidating stone, brick, tuff and mixed masonry.

New materials deployed to restore the ambience of the original building

Mr Joan Olona, a member of the technical team that drew up the Master Plan, provides more information on the restoration of Casa Batlló.



Mr Joan Olona



Fragments of ceramic cover the façade.

Question: The restoration of historic buildings has always been a complex undertaking. Are the works on buildings by Antoni Gaudí even more complex?

Answer: Because of the construction techniques, layouts and materials employed by Antoni Gaudí, his works are a constant source of surprise. The solutions he chose are an indicator of his enormous creativity and ingenuity and this is one of the reasons behind the decision taken by UNESCO to include seven of his works in the list of World Heritage Sites.

The Master Plan for the work on Casa Batlló, approved in 2014, established a baseline – that the restoration of any work by Gaudí must ensure that his original architectonic decisions are maintained. It should not be limited to a purely practical intervention, but should attempt to reconstruct the critical context of the architecture. What is more, Casa Batlló is itself the result of work by Gaudí on a pre-existing building. For us, this was an even more complex challenge because, when carrying out restoration work, we have to verify what is the actual work of Gaudí, what came before him and what, on the other hand, came after him.

Q: What were the various works carried out according to the Master Plan on Casa Batlló?

A: The first phase was dedicated to a thorough analysis of solutions that would improve accessibility to, and evacuation from, the building, to bring the functionality of this house/museum in line with the requirements of its new type of use. As far as the actual restoration work was concerned, there were three main areas we worked on.

The first area was the main floor, with renovation work on the original render that had either disappeared or become unrecognisable. The second area concerned restoration work on the façade and attic that completes the building, while the third area was the chimneys on the roof.

In addition, work was also carried out on the upper and lower parts of the courtyard.

Q: What did you discover while carrying out the restoration work?

A: As far as the façade was concerned, we discovered that two different types of mortar had been originally used to bond the fragments of ceramic used to cover the façade – a white one, presumably lime-based, and a grey one made from Portland cement. Two different mortars had also been used on one of the groups of chimneys on the roof. In this case, we found that mortar made from Portland cement had been used along with a natural cementitious mortar.

Thanks to an interview that the architect Bassegoda gave, in 1970, to Josep Bayó, the owner of the construction company that built Casa Batlló, we know that these chimneys used to be adorned with crystal spheres containing coloured sand. So, while carrying out the restoration work, we also had new crystal spheres made and, instead of the steel cornices originally used, that had caused them to break, we adopted a system consisting of fibre-reinforced mortar and glass fibre cords, to fasten the spheres to the mouths of the chimneys.

Q: Over the last few years, has there been an evolution in the construction techniques and solutions employed in restoration work on our historic and cultural patrimony?

PROJECT APPLICATION



New crystal spheres were fastened to the mouths of the chimneys, using fibre-reinforced mortar and glass fibre chords.

A: The biggest problem is due to the need to have skilled craftsmen on hand, who are able to reproduce the original construction techniques. In spite of this, there are industrial materials available today which, thanks to research & development work carried out by companies, allow us to adapt even more accurately to traditional solutions.

Mortars made from natural hydraulic lime (NHL), strengthened with fibres or glass fibre meshes, enable the impact of an intervention to be reduced, minimising the increase in weight and increasing the load-bearing capacity and deformability of walls far more than what could be achieved with systems made up of cement and metallic mesh.

Nowadays, thanks to their enormous adaptability, systems consisting of glass fibre or fibre threads open up a wide spectrum of new possibilities in restoration operations on our historic and cultural heritage.

Q: Are sustainability criteria applied when designing work packages on historic buildings?

A: Any work carried out on an existing building or construction can be considered, by its very nature, sustainable.

The '3 R' rule exemplifies this. If you avoid destroying a building or the parts that make up the building, this implies a 'Reduction' in the use of materials but also in the consumption of energy and, therefore, there is less impact on the environment.

It also means 'Re-using' a material in a process that requires less energy.

If it is, then, necessary to demolish and break up materials, 'Recycling' becomes a valid alternative to having to dispose of waste material.

PROJECT DATA

Project Casa Batlló, Barcelona, Spain

Year of construction 1877

Original design Emil Sala Cortés

Year of reconstruction 1904

Design Antoni Gaudí

Period of renovation 2015-2020

INTERVENTION BY MAPEI

Period of intervention 2015-2020

Contribution by Mapei Supply of structural strengthening and masonry restoration products

Mapei distributor Siesmo

Structural strengthening contractor Constructora D'Aro

Mapei products used

Structural strengthening and consolidation of masonry – PLANITOP HDM RESTAURO, MAPEGRID G 220, MAPE-ANTIQUE FC CIVILE, MAPEWRAP G FIOCCO

Fastening the crystal spheres to the chimneys – MAPE-ANTIQUE I, MAPEWRAP G FIOCCO

Website for further information www.mapei.es www.mapei.com

This editorial feature is based on an article from Realtà MAPEI INTERNATIONAL Issue 89. Images by Mapei.

Liebherr unveils mobile crane with 90 m telescopic boom

Liebherr has extended its portfolio of all-terrain cranes with another 300-tonne model. With its 90 m telescopic boom, the LTM 1300-6.3 sets new standards in the six-axle class and goes well beyond what current cranes on the market have to offer. It is designed to be used as a fast-erecting crane with a high capacity at great hoist heights with a raised boom. That makes it ideal for erecting tower cranes and antennae as well as for wind turbine maintenance work.

The LTM 1300-6.2 with 78 m telescopic boom, offered by Liebherr in parallel, is the economical entry into the luffing jib class and in this configuration already offers high load capacities for a six-axle mobile crane.

Liebherr has made it possible to drive the LTM 1300-6.3 with different axle loads and gross weights, to ensure that it can be driven economically all over the world. Components such as the telescopic boom and outriggers can be installed and removed quickly and easily to achieve axle loads of less than 12 t.

One particularly interesting feature, in this respect, is tele-separation which enables individual telescopic sections to be removed particularly quickly. This makes it straightforward to set up the crane for the road with a gross weight of less than 60 t and axle loads of under 10 t.

Liebherr can also deliver a self-assembly solution which enables the telescopic sections to be removed without the need for an auxiliary crane. This is compatible with other models such as the LTM 1650-8.1 and the LTM 1450-8.1. The flexibility and economy of the crane is increased as a result.

RECORD-BREAKING BOOM

The record length of 90 m is achieved by the new LTM 1300-6.3

using an eight-section telescopic boom – the pivot section plus seven telescopic sections. That is one section more than similar cranes in this class. To ensure that the complete boom as well as all the outriggers plus the hook block can be carried on public roads with an axle load of 12 t, Liebherr has optimised the entire steel construction of the crane for lightweight construction.

Although the LTM 1300-6.3 is not designed for use as a luffing jib crane, it has a wide range of lattice jibs available – 11.5 m to 20 m double folding jib, two 7 m lattice sections to extend the telescopic boom, a 39 m powerful fixed jib and a 43 m hydraulically adjustable fixed jib. That enables the new 300 t crane to reach hoist heights of up to 120 m. Various lattice sections are also compatible with other models in the Liebherr portfolio.

WIDE RANGE OF INNOVATIONS

Wind speed load charts

Load charts for various wind speeds are available for the LTM 1300-6.3. They deliver enhanced safety and longer operating times for crane work in windy conditions. Load charts for cranes are generally only valid for gust wind speeds of up to 9 m/s. To ensure that work can continue safely in even higher wind speeds, Liebherr has optimised the load charts for additional maximum wind speeds and programmed them in the crane control system.

For the LTM 1300-6.3, for example, it is 11.2 m/s, or even 13.4 m/s when using lattice equipment. In pure telescope mode, the tables even allow for a speed of 15.6 m/s. If the wind speed measured on the crane's boom during a job exceeds the set chart wind speed, the crane operator can simply switch to a load chart with a higher maximum wind speed which will often allow the job to be continued.

VarioBase Plus

The rear supports have a double-stage design and achieve a support width of 9.4 m, 2 m wider than the front supports. This increases the capacity over the rear supports even more. The single-stage front outriggers have a lower weight which also benefits the boom length.

ECOdrive

An eight-cylinder Liebherr diesel engine in the undercarriage which develops 455 kW / 619 bhp and torque of 3,068 Nm provides the LTM 1300-6.3 with all the power it needs. The power is transferred to the crane axles by the 12-speed ZF TraXon torque gearbox. A torque converter ensures good manoeuvring. The additional ECOdrive mode delivers enhanced drive properties which save fuel and reduce noise.

Single-engine concept with ECOmode

Liebherr has continued its singleengine strategy on the new LTM 1300-6.3 with a mechanical power unit for the superstructure. The weight reduction created by removing the superstructure engine has been used to deliver a longer boom and more ballast with an axle load of 12 t. ECOmode in crane operation helps to reduce fuel consumption and noise emissions.

The complete pump drive is disconnected automatically when the engine is idling and then reconnected by the intelligent controller in a matter of seconds when required.

VarioBallast

The new LTM 1300-6.3 can be operated with two different ballast radii – 4.94 m or 5.94 m. The ballast radius can be reduced quickly



and easily by 1 m using standard mechanically adjusted ballasting cylinders. This solution is one of the main benefits of the new 300 t model when used in constricted conditions. The large ballast radius achieves maximum capacity. In fact, with its VarioBallast feature, the new crane can be operated with 8 t less ballast compared to the LTM 1300-6.2 without any significant reduction of its lifting capacity. That reduces both transport logistics and CO₂ emissions.

Auto-Ballast

A single touch of a button is all that is required to secure the ballast to the turntable. That takes the strain off the crane operator as the automatic ballasting process is simple, fast and convenient. In addition, safety is also enhanced, particularly for routine procedures.

The maximum ballast on the LTM 1300-6.3 is 88 t. The 10 t suspended ballast blocks on the right and left are compatible with the LTM 1230-5.1 and LTM 1250-5.1 crane models. That makes them another economical solution for operators with these cranes in their fleets.

There is also the fact that the individual ballast slabs have been modified in terms of their weight and dimensions to make them suitable for economical transport and fast, easy set up on site.

All the ballast can be placed on the crane with just five hoists. The basic ballast of 42 t has a width of just 3 m which means that it fits within the overall width of the vehicle. This makes it significantly easier to move the fully set-up crane on constricted sites.

New options

The optional central lubrication system for the king pin bearings on the chassis is a new feature. It delivers grease to 24 lube points on the six-axle crane automatically.

Another highlight is that a total of six LED rear lights are available to order, which illuminate the working area with bright light for manoeuvring on the site.



The new Liebherr LTM 1300-6.3 mobile crane sets new standards in the 300 t class.



The highlight of the new LTM 1300-6.3 is its 90 m telescopic boom.

Volvo Construction Equipment develops full power of electric ecosystem with E-Worksite

Together with multiple municipalities. cities and academic and industry partners, Volvo Construction Equipment (Volvo CE) is thoroughly testing every part of how an electric machine is put to work from a system perspective – from charging infrastructure through to energy supply and more. The Electric Worksite (E-Worksite), which was launched in 2021, in Gothenburg, Sweden, not only sets the global benchmark for electric jobsites but also tests electric machines' specific requirements across different tasks within a demanding urban environment. It is a vital next step in the manufacturer's electrification journey and a testament to its commitment to achieving net zero value chain greenhouse gas emissions by 2040, as validated by the Science Based Targets initiative.

Innovation powered by partnership

E-Worksite is a long-running research project that explores the site requirements for electromobility over the next two years, across a variety of different applications. It has now completed the development of a new recreation area within the major city park, Färjenäsparken, and is currently working on the redesign of the Drottningtorget city square, both in the heart of Gothenburg, the second largest city in Sweden. Here, the customer transformation from diesel machines into more sustainable environmental solutions is guided by a fully holistic exploration of every aspect of site management.

The project is funded by the Swedish Energy Agency, with Volvo CE working in close collaboration with Gothenburg City, NCC, Gothenburg Energy, Lindholmen Science Park, Chalmers University of Technology and ABB Electrification Sweden, among many others, to conduct a large-scale machine demonstration in Gothenburg.

In this first phase, a number of electric machines already available to buy on the market are being put to the test, including the Volvo L25 Electric wheel loader and Volvo ECR25 Electric excavator, which are carrying out minor construction work, material moving and landscaping. A larger 30-tonne grid-connected excavator will be tasked with more energy-demanding jobs at different construction sites.

No one size fits all

Project planners are answering questions such as how to ensure best value for money, for customers, and what are the most energy-efficient methods of supplying electricity to power the machines. Beyond the technology itself, business models, infrastructure and support systems, regulatory frameworks and a mindset change are all required, for full acceptance. It is a complex puzzle to solve, as there will be no one size that fits all applications. The findings will prove important not only for municipalities, in deciding how to develop the appropriate legislation, but also for industry partners, in bringing technical solutions to market - both in the immediate future and over the next two decades.

Launching the project in an urban application allows for a demonstration of the advantages electric machines bring to city life – low noise, low emissions and a much more peaceful environment for society, in general.



In the first phase of the E-Worksite research project, electric machines, already available on the market, are being put to the test, including the Volvo L25 Electric wheel loader (left) and Volvo ECR25 Electric excavator (right), which are carrying out minor construction work, material moving and landscaping.

New smart creep feature for Cat D3 series Skid Steer Loaders and Compact Track Loaders

Caterpillar will soon launch a new smart creep feature for the full range of Cat D3 Skid Steer Loaders (SSL) and Compact Track Loaders (CTL) for operating Cat cold planer and wheel saw attachments.

Smart creep senses the load on the attachment and automatically adjusts the drive command to keep the cold planer or wheel saw running at the most productive speed.

A combination of attachment sensors and proprietary software optimally balances attachment load and machine speed to maximise productivity. By continually sensing the load on the attachment, smart creep increases machine speed when encountering less resistance and automatically slows the machine when encountering higher load. Engine load remains constant, while the operator can monitor hydraulic pressure on the in-cab display panel.

Smart creep takes the guess work out of setting the right creep speed for operating the attachment. Without the aid of this feature, setting creep speed too fast can lead to stalling the attachment, and setting it too slow results in productivity loss. Smart creep software smoothly and efficiently determines the optimal machine speed for cutting conditions.

With this new smart attachment feature from Caterpillar, the operator needs only to activate the standard creep control system and set the maximum creep speed on the advanced display inside the cab. Once the tool engages the cut, smart creep measures load on the attachment and adjusts the drive command automatically as cutting begins. In the event of the cutter jamming or stalling, an auto reverse feature within smart creep quickly changes machine direction to allow the tool to clear the jam.

Targeted availability for smart creep on Cat D3 SSL and CTL machines is the third quarter of 2022. A field installation kit consisting of sensors and machine software for operating the new feature will be made available for existing fleet loaders and attachments. Once commercially available, new cold planer and wheel saw purchases will be shipped from the factory with the required hardware installed, and new D3 SSL and CTL models will come smart creep ready from the factory.



The new smart creep feature for Cat D3 Series Skid Steer Loaders and Compact Track Loaders maximises work tool productivity.

IES UPDATE

CHARTING A CAREER PA IN TRANSPORTATION ENGINEERING

Kickstarting the second half of the ten Young Engineers Career Series webinars was "Pathway to **Chartered Engineer on Transport** System", which took place on 13 December 2021.

The two invited speakers were IES President Dr Richard Kwok and Council Member Lew Yii Der.

Dr Kwok, who is also the Deputy President of Trains and the Chief of the Joint Readiness Inspection team at SMRT Trains, began by sharing more about his personal learning journey over the past 48 years of his career.

He split it into three phases, starting with his years as an apprentice, where he learned through working, before moving on to what he coined the 'working and learning' phase, where he advanced his knowledge through completing his masters and doctorate. Currently in the third phase, he has found great passion in imparting knowledge to colleagues and friends in the engineering community.

Noting the need to reskill and upskill the land transport engineering workforce for future work demands, he introduced the IES Chartership Scheme for National Engineeering Accreditation, which would contribute to the development of workforce competency and recognition through the Chartered Technologist -Chartered Technician - Chartered Engineer pathway.

Mr Lew, who is the Group Director of the Safety & Contracts Group at LTA, spoke next. Echoing Dr Kwok's observations, he mentioned that the number of workers in the rail transport sector was expected to rise from current 10,000 to about 15,000 by 2030.

The projected increase includes emerging roles to support the deployment of new technologies, such as data analytics, autonomous vehicles, and cybersecurity. This means that skills upgrading is a key linchpin of the strategy to cater to future land transport needs.

Mr Lew encouraged webinar participants to work towards Chartered Engineer accreditation. This would enable them to stand out from the crowd as a significant player in the world of engineering and technology, be recognised by their peers, enhance their employability, and gain an internationally recognised qualification.

During the Q&A session, both Dr Kwok and Mr Lew clarified the main differences between Professional Engineers (PE) and Chartered Engineers (CEng).

PEs, as defined by the PE Act of 1991 and subsequent amendments, are suitably-qualified and certified professionals who practise in the following specified branches of engineering, Civil, Structural, Mechanical, Electrical, and Chemical. Their work, which can include consultation, design, and supervision, concerns the public interest and requires the application of engineering principles and data. As such, there is considerable professional liability involved.

CEng, on the other hand, is an external validation of an engineer's experience, expertise, and competence. A quality mark to distinguish one's professional standing, it currently covers 10 sectors of engineering.

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