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發展局
Development Bureau
The Government of the Hong Kong Special Administrative Region
of the People's Republic of China

CONSTRUCTION
INDUSTRY COUNCIL
建造業議會

CIC Global Construction Sustainability Forum And Exhibition 2023

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Construction Industry Council

Table of Contents

Speakers

Day 1

Ms. Bernadette LINN
Secretary for Development
Government of the Hong Kong Special Administrative Region

Ms. Winnie HO
Secretary for Housing
Government of the Hong Kong Special Administrative Region

Ir Ricky Lau
Permanent Secretary for Development (Works)
Government of the Hong Kong Special Administrative Region

Dr. Samuel CHUI
Director of Environmental Protection
Government of the Hong Kong Special Administrative Region

Ir John KWONG
Head of Project Strategy and Governance Office, Development Bureau
Government of the Hong Kong Special Administrative Region

Prof. CHEN Yong
Academician
Chinese Academy of Engineering
Chairman
Guangdong Provincial Association for Science and Technology

Prof. Li Xiangdong
Dean, Faculty of Construction and Environment
Director, Research Institute for Sustainable Urban Development
Chair Professor, Environmental Science and Technology
The Hong Kong Polytechnic University

Ir Thomas HO
Chairman
Construction Industry Council

Ir Albert CHENG
Executive Director
Construction Industry Council

Mr. Ivan FU
Chairperson
Committee on Environment of Construction Industry Council

Ar. Donald CHOI
Executive Director and Chief Executive Officer
Chinachem Group

Ms. Katherine CHU
General Manager (Project Management)
Hong Kong Housing Society

Mr. Barry KWONG
Director of Sustainability
Hong Kong Science and Technology Parks Corporation

Prof. Wei PAN
Head, Department of Civil Engineering
Executive Director, Centre for Innovation in Construction and Infrastructure Development
The University of Hong Kong

Day 2

Mr. Christopher HUI
Secretary for Financial Services and the Treasury
Government of the Hong Kong Special Administrative Region

Ir Ricky Lau
Permanent Secretary for Development (Works)
Government of the Hong Kong Special Administrative Region

Mr. Michael FONG
Director of Civil Engineering and Development
Government of the Hong Kong Special Administrative Region

Prof. CHEN Xiangsheng
Academician
Chinese Academy of Engineering
Dean, College of Civil and Transportation Engineering
Shenzhen University

Prof. Jack CHENG
Chairperson
Committee on Building Information Modelling and Construction Digitalisation of Construction Industry Council

Ir Rocky POON
Chairperson
Committee on Construction Business Development and Mainland Liaison of Construction Industry Council

Mr. Michael CAMERLENGO
Partner - Head of Government Sector, Asia Pacific
KPMG

Mr. Jonathan CREW
Head of Global Banking Sustainability, Asia-Pacific
HSBC

Mr. Mark ENZER OBE FREng
Strategic Advisor
Mott MacDonald

Prof. FENG Wei
Associate Professor (Tenured)
Shenzhen Institute of Advanced Technology

Mr. Steve LEWIS
Partner & Head of Infrastructure, Major Programmes and Construction Advisory
Ernst & Young Transactions Limited Hong Kong

Mr. LI Jin
Vice President
Guangzhou Design Institute Group Co., Ltd.

Dr. LIANG Huqing
Chairman
Guangzhou Municipal Construction Group Co., Ltd.
Foreign Member
The Russian Academy of Engineering

Mr. LUO Shenghui
Deput General Manager, General Manager of Southeast Asia Region
Xuzhou Construction Machinery Group Imp.& Exp. Co., Ltd

Mr. Kevin O'BRIEN
Chairman
Business Environment Council

Ms. Carmen TSANG
Head of Sustainable Investment Banking
Credit Agricole Corporate & Investment Bank

Ms. Tracy Wong HARRIS
Executive Vice President
Hong Kong Green Finance Association
Managing Director, Head of Sustainable Finance Asia
Standard Chartered

Ms. YE Qing
Chairman
Shenzhen Institute of Building Research Co., Ltd.

Day 3

Dr. LAM Ching-choi
Chairman
Council for Carbon Neutrality and Sustainable Development

Mr. Terence LAM
Principal Assistant Secretary (Works)
Government of the Hong Kong Special Administrative Region

Mr. Edward TSE
Director of Architectural Services
Government of the Hong Kong Special Administrative Region

Sr Eddie LAM
Chairperson
Construction Industry Training Board of Construction Industry Council

Mr. Rex WONG
CEO
Kum Shing Group

Mr. Ivan FU
Chairperson
Committee on Environment of Construction Industry Council

Ir Dr. Derrick PANG
Chairperson
Committee on Construction Safety of Construction Industry Council

Ir Prof. CHUNG Kwok-fai
Director, Chinese National Engineering Research Centre for Steel Construction (Hong Kong Branch)
The Hong Kong Polytechnic University

Mr. Stephen COPPIN
Strategic Technical Director
SJU Risk Management Solutions Limited

Mr. Robert DIJKSTERHUIS
Special Envoy on Sustainable Building
Ministry of the Interior and Kingdom Relations of the Netherlands

Ms. Ayla DINCAY
Technical Buildings Manager,
Science Based Targets initiative

Dr GOH Yang-miang
Associate Professor
College of Design and Engineering
National University of Singapore

Mr. Lawrence HUNG
President
Hong Kong Institute of Human Resource Management

Dr Robin KENNISH
Partner, Asia Lead-Renewables & Climate Change Services
ERM Hong Kong, Limited

Mr. Matt LYON
Global Partner and Head of Consulting
Arcadia Consulting Limited

Mr. Jakub MALICH
Vice President, ESG & Climate Research
MSCI

Dr Serge STINCKWICH
Head of Research
The United Nations University Institute in Macau

Mr. SEAH Yeow-teck
General Manager
Keller Foundations (S E Asia) Pte Ltd

Dr Felix YIP
Associate Director, Centre for Human Resources Strategy and Development, School of Business
Hong Kong Baptist University

Day 1 AM

Grand Opening, Charter Signing Ceremony and Award Ceremony

Welcome Remarks

Ir Thomas HO
Chairman
Construction Industry Council

Honourable Ms. Bernadette Linn Hon-ho, Secretary for Development of the HKSAR, distinguished guests, ladies and gentlemen, good morning.

It's my great pleasure to welcome you all to the opening ceremony of the CIC Global Construction Sustainability Forum and Exhibition. As the first of its kind in Hong Kong, GCSFE serves as a platform for dialogue and knowledge sharing, for the display of cutting-edge technologies, and to ignite discussions and imaginations that contribute to the sustainable construction in Hong Kong.

As one of the most impactful concepts in modern day society, sustainability is the hottest topic of conversation all over the world. But there's never too much.

The record-high rainfall and serious flooding that hit us in September still dwells in our memories, not to mention the number of very hot days in Hong Kong has reached a record high of 54 this year, compared to 17 a decade ago. The climatic changes have placed the construction industry in a very vulnerable position, posing a threat to the wellbeing and health of our workers, frontline supervisors and the generations to come.

Afterall, the building and construction sector accounts for 36% of worldwide energy usage and 40% of CO_2 emissions worldwide. We have to bear the consequences of our actions. It's our responsibility and duty to fix it, and to turn things around.

But we can't do this alone, together we change! It's not only a catchphrase but actions that can actually be seen.

To show our determination in achieving sustainable development, we have more than 160 leaders, agreeing to put their companies' names on the "Sustainable Construction Charter", covering a full spectrum of the construction value chain with significant representatives of every segment. They will commit to design, construct and operate building and infrastructure facilities with a vision of achieving carbon neutrality by 2050 in Hong Kong, develop a decarbonisation roadmap with measurable targets, promote and devise site decarbonisation measures such as reducing construction waste, so as to establish corporate ESG governance mechanism in the organisation. Very importantly, efforts will be devoted to enhancing manpower resources, workers' safety and community well-being.

Kudos to these insightful leaders who are fully committed and willing to lead by example, rallying their co-workers to unite in achieving the grand objectives of sustainable construction and zero carbon emissions. That is one small step for us, but one giant leap for our future generations.

Nevertheless, no matter how grand our sustainable construction plan is, or how advanced our technologies are, we are only building on sand if we fail to address an essential sustainability issue, that is, maintaining a sustainable workforce.

The UN defines sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." And yes, the construction industry has to meet the needs of the society without compromising the wellbeing of our workers.

Despite the "Golden Era" ahead, with the average age of our workers at 47-year-old, and a projected shortage of skilled labour of 40,000 by 2027, they become two big obstacles on our way. Adding to this, numerous serious fatal accidents have cast a shadow over our industry. No way can we achieve sustainable construction without facing up the safety issue.

Something must be done, and here is a summary of our manifesto.

My fellow counterparts, there's no shortcut to safety but determination and persistence. I would like to introduce the "Combination Strategies on Safety"（安全組合拳）to you, it would definitely help to safeguard the life of our co-workers.

Firstly, apply the Smart Site Safety System. With successful cases on hand, 4S is proven to improve safety, alongside with the support of the policies and financial incentive provided by the CITF, I don't see the reasons for not adopting it. Seize the opportunity and we can definitely save lives.

Secondly, prioritise "Design for Safety" by taking away safety risks as early as on the planning and design stages. CIC has published different sets of reference materials as well as organising master classes and webinars to promote DfS, join us in building a safe working environment.

Thirdly, consider formulating the temporary works management plans. Risks are often being overlooked at this stage. Draw up a plan to promote the awareness of the importance of managing temporary work, enhance the competence of those engaged in.

Above all, your attitude determines your altitude. What we need today is a mindset change. Define roles and responsibilities, for safety is everyone's business regardless of your positions or your experience, we all are held accountable. As a management, go visit your sites frequently. As a supervisor, always carry out dynamic risk assessment and conduct field-control briefing with your counterparts onsite. As a worker, don't take risks when something has changed.

In our industry, the only constant is change, and we have to make sure we are changing in a positive way. The CIC has steered the adoption of the innovative Modular Construction for years, and we are excited to see that we are finally on the track to "Mi Infinity". With joint efforts made by the Development Bureau, Housing Bureau and some enlightened clients, more than 100 Mi Projects are on the way. Now every new job developed will incorporate the element of Mi-Infinity, just as the saying goes, "to infinity and beyond!" Ranging from precast lift shaft to eliminate safety risks, modular operating theatre with Mi-interior which can greatly reduce the time required for different procedure, and new Mi-Landscape erected in our Zero Carbon Park to demonstrate how the Mi-concept can help enhancing the well-being of the community. We build fast, we build safely, we build with quality, and we build in a sustainable way, all attributed to the Mi method.

Mi has made sustainable construction feasible, while digital transformation has laid the foundation to make it possible. Sustainable construction means we have to design, build and manage our assets as if they are going to stay here forever. The omnipresence of digitalisation is crucial to the integrated total life cycle management. With the aid of technologies like IoT, sensors, AI and Common Data Environment and Digital Twin, we are hence able to streamline workflows, saving time, energy and cost, and reducing safety risks.

Promoting digital transformation is always at the heart of CIC, this year we have opened the Digital Twin Hub and Smart Facilities Management Control Centre, as well as organising Master Class on AI applications, with the sole purpose of providing support to the industry by creating a collaborative platform and an array of technological showcases.

In today's construction, the competitive edge of a company depends on how many BIM talent and Digital Twin applications you have. In view of the growing role of AI in modern life, we must equip the next generation to master AI as the large language model will certainly become essential to the development of our industry.

Our sustainable mission is a collective task that requires everyone's contribution, partners and cooperation are what we cherish the most. I would like to take this opportunity to thank our co-organiser, the Development Bureau of the Government of HKSAR, without your support, we would not be here today.

I wish you all a fruitful and enriching time ahead. Thank you.

Opening Address

Ms. Bernadette LINN
Secretary for Development
Government of the Hong Kong Special Administrative Region

Chairman Thomas, the Honorable Legislative Council Member Mr Chan Siu-hung, ladies and gentlemen,

Good morning.

The Chairman is always very good. He always speaks with enthusiasm, starting the conference with a wake-up call, reminding us of hard realities and giving us hard thoughts. Surely, this is a forum for all the experts, both locally, from the Mainland and from all around the world, to gather together to find means to resolve the issues in front of us. Thank you Chairman for the wake-up call just now.

The key objective of this forum is, of course, to address the pressing challenge of construction sustainability for Hong Kong. As part of our commitment to combat climate change, the Hong Kong Special Administrative Region Government has already set out targets for achieving carbon neutrality under our Climate Action Plan 2050. The construction industry certainly plays a pivotal role in meeting this target. On the other hand, the Government will invest in major infrastructure development programmes in the coming years, including those in the Northern Metropolis and the reclamation and formation of the Kau Yi Chau Artificial Islands, amongst many other projects. The overall annual construction expenditure, including both public and private sectors, will rise to HK$300 billion annually in the coming years.

Together, they present a golden opportunity for the construction industry to embrace sustainable construction practices and incorporate the principles of ESG (Environmental, Social and Governance) into the coming massive construction programmes. So this is a prime time for us to gather together and look for smart solutions. Our objective is, of course, very clear: to build a more sustainable and livable Hong Kong and to achieve our carbon neutrality goal. Earlier this year, the Financial Secretary established a Green Technology and Finance Development Committee to better promote green technology and green finance in Hong Kong. I also noted that green construction technology, construction digitalisation and green finance are brought up as part of the theme of the forum this year, and they are all instrumental in achieving our sustainability goal.

As we strive towards the development of a sustainable built environment, we must also consider the long-term development of the construction industry itself. The biggest challenges we are facing these days, as the Chairman has mentioned just now, include ageing workforce, low productivity, rising construction cost and unsatisfactory construction site safety performance. To address these issues, we must embrace high-productivity construction methods to maintain the competitiveness of the construction sector; prioritise smart and safe construction practices to improve the work environment and well-being of practitioners and workers; and invest in talent development to ensure continued advancement of the construction industry. Furthermore, we shall actively seek extensive collaboration within the Greater Bay Area to leverage the collective experience and resources of this dynamic region.

I am very glad that this forum has managed to cover all the above key development areas of our construction industry through its line-up of events. I am sure this four-day global forum can foster cross-sector and cross-border collaboration, catalysing synergy on different aspects of industry transformation in innovative ways, and demonstrate to stakeholders and the public how our commitment to construction sustainability can be put into practice through different means.

In concluding, let us draw inspiration from President Xi's vision of a beautiful China in 2035, as highlighted during the third meeting of the Central Commission for Comprehensively Deepening Reform earlier this month. Sustainable development is a fundamental national strategy of China. Riding on the unique advantage of "背靠祖國、聯通世界",. i.e. enjoying strong support of the Motherland and being closely connected to the world, Hong Kong's construction industry has an important role to play in helping our country realising this grand vision. We must contribute our talent, passion and dedication to make it a reality.

Once again, I extend my warmest welcome to all participants of the Global Construction Sustainability Forum and Exhibition 2023, friends from the Mainland and from all around the world. Last but not least, because we have a huge gathering here today, let me make an appeal. Please remember, for those of you who have the right to vote, to cast your vote in the coming District Council election on 10 December. Together, we can not only create a greener and more prosperous environment for our future generations, but also a more harmonious and better community for Hong Kong. Let us seize this opportunity to collaborate, innovate and shape the future of sustainable construction. Thank you, and I wish the event all the success.

Opening Address

Ir Ricky LAU
Permanent Secretary for Development (Works)
Government of the Hong Kong Special Administrative Region

Chairman Thomas, distinguished guests, fellow construction practitioners, ladies and gentlemen. Good morning.

It is my great honor and pleasure to be here with you all at the CIC Sustainable Construction Award 2023 to celebrate the remarkable achievements of the construction industry in promoting sustainability and innovation. This event serves as a platform for us to show appreciation of the exceptional efforts made by project owners, contractors, and construction practitioners in shaping a greener and more sustainable future for the Hong Kong construction industry. It is so exciting to see that there is a very positive response for the award this year, with over 220 applications from the construction and industrial practitioners, which is a testimony of the invaluable contributions of the construction industry towards our sustainable development.

As stated in the Chief Executive's policy address this year, we shall continue to invest in infrastructures to stimulate the economy, improve livelihood, create job opportunities, and attract talents for enhancing the Hong Kong's long-term competitiveness. We are taking forward two mega development projects, the Northern Metropolis and Kau Yi Chau Artificial Islands, as well as a large portfolio of projects in the pipeline, including public housing, hospital development, railway and road, infrastructure, and so on, which will open up more opportunities to provide a smarter, greener, and more resilient city for the public.

Though there are good opportunities, the construction industry in Hong Kong is also facing a host of challenges, of which construction sustainability is undoubtedly one of them. The Hong Kong SAR Government has been advocating environmental sustainability through public works. Under the "Green Government Buildings" Policy, government buildings are required to achieve at least the second highest rating under the BEAM Plus certification, that is, Gold rating, and fulfil various targets on environmental aspects such as energy efficiency, renewable energy, indoor air quality, waste and water management, greenhouse gas emissions, and others.

Earlier this year, we have uplifted the requirements on the provision of renewable energy installation, electric vehicle charging facilities, and food waste handling facilities with an aim to further enhancing the environmental performance of our public works.

Moreover, the Hong Kong SAR Government is taking a proactive approach and spearheading the use of high-productivity construction methods, such as Modular Integrated Construction (MiC) and Multi-trade Integrated Mechanical, Electrical and Plumbing (MiMEP) to enhance productivity while improving sustainability performance of construction. MiC and MiMEP, by means of offsite manufacturing and assembly, will significantly reduce resource consumption, minimise environmental impact, and enhance the overall efficiency of the construction process. They will also improve the quality and safety of our construction sites.

The use of smart and innovative technologies is also encouraged in public works to improve environmental performance in construction. We have been adopting Digital Works Supervision System (DWSS) and Building Information Modelling (BIM) to streamline construction processes while serving as a backbone of different smart site applications. Furthermore, we are exploring technologies such as electrification for plant equipment to reduce carbon emissions from construction activities. On this, I would like to congratulate the new Smart Sustainability Award this year, which commends organisation and projects with excellent adoption of smart and innovative solutions.

On the other hand, we shall also take the lead to make our industry sustainable. That is, attracting young talents to join our industry and encourage them to take up the torch.

Site safety is one of the cornerstones of the sustainability of our construction industry. On this front, we have attached the greatest importance to improve site safety performance. Recently, our industry has suffered from too many fatalities. We shall join hands to fortify our site safety culture and widely adopt smart site safety systems. Everyone plays a key role and has a responsibility for site safety.

In closing, our construction industry has embarked on another golden era, which will bring along with many opportunities and challenges. We will continue to work hand in hand and walk an extra mile along our journey to drive innovation, prioritise sustainability, and empower talents in order to maintain the competitive edge of Hong Kong on the global stage.

This Sustainable Construction Award is a call to action, urging all of us to continue pushing boundaries and collaborating towards a more sustainable future. I would like to congratulate all the awardees of the Sustainable Construction Award today. Together, we will build a brighter, greener, and more sustainable tomorrow for Hong Kong. I wish you all a fruitful event today. Thank you very much.

Welcome Remarks

Mr. Ivan FU
Chairperson
Committee on Environment of Construction Industry Council

Dear ladies and gentlemen, distinguished guests, Secretary for Development

As the Chairperson of the Organising Committee and one of the judges of the CIC Sustainable Construction Award, it is my honour and privilege to congratulate the winners together with all of you today.

This year marks the third year of this prestigious award, and I am thrilled to share that we have received an overwhelming response from the industry. We received over 200 applications, representing the dedication and commitment of over 85 organisations and more than 140 industrial practitioners. This remarkable participation demonstrates the growing recognition and importance of sustainable construction within our community.

Looking back, observing how sustainable and innovative solutions that were once ground-breaking have now become common practices is truly inspiring. This trend signifies a tremendous leap forward for our industry–a movement that we wholeheartedly embrace.

Sustainable practices are no longer considered an exception; they are becoming the norm. This is a trend we should celebrate and encourage, as it reflects our collective commitment to creating a more sustainable world.

In line with our commitment to recognising and promoting excellence, we have introduced a new award – the “Smart Sustainability Award” under the “Organisations” category this year. This novel award acknowledges those with outstanding performance applying digitalisation to contribute to sustainable construction and whole life cycle management.

Thanks to the esteemed panel of judges and technical committee members. They dedicated their time and expertise to evaluate the submissions for the Award. Their meticulous and stringent evaluation ensures that deserving projects are recognised and celebrated today.

Today, we gather to celebrate the winners and the entire construction community. On this occasion, I would like to take this opportunity to introduce the forthcoming Smart Waste Management Tool, which is a centralised digital platform designed to streamline the current waste management process for construction projects. This tool represents the initial step towards digitalizing waste reduction efforts, aiming to reduce substantial manual and paper-based waste flow reporting and recording procedures. By doing so, we can free up valuable man-hours per project, allowing us to focus more on devising practical and effective solutions for waste reduction and resource utilization.

In our commitment to spearheading the industry's decarbonization journey, in line with the city's goal of carbon neutrality by 2050, the CIC has initiated a study early this year for mapping out a plan for decarbonisation of the construction industry to enable the industry to pursue a carbon neutral target. Coming forward, our focus will be on three key areas: site electrification and clean energy adoption, waste reduction, and high-productivity construction and digitalization. These tasks present significant challenges like resources, technology readiness, and other external factors beyond our boundaries, yet we will explore the feasibility and practical pathways in these areas under this study.

Once again, congratulations to all the winners. You and your projects embody the spirit of innovation, sustainability, and excellence we strive to foster in our industry. Your work inspires us to push boundaries, challenge conventions, and continue our journey towards a more sustainable future.

Thank you for being a part of this momentous occasion. Let's enjoy this prestigious event together.

Day 1 PM

Global Construction Sustainability Forum (Environmental) – High Productivity and Sustainable Construction

Welcome Remarks

Ir Thomas HO
Chairman
Construction Industry Council

Good afternoon! It is my great pleasure to stand before you today and welcome you to this remarkable event. This afternoon, we gather here to celebrate the power of High Productivity and Sustainable Construction.

China has issued an outline to improve the overall quality of its economy amid efforts to promote high-quality development this year. Among several key tasks, China will promote engineering quality management standardization in the field of engineering construction, comprehensively improve the quality of construction projects, give full play to the supporting role of standards in promoting industry transformation and upgrading, leading innovative development, and promote high-quality development of the construction industry.

The Policy Address outlines several measures and key performance indicators (KPIs) aimed at addressing the manpower requirements for infrastructure development. These include expanding training opportunities for skilled workers, introducing the Vocational Professionals Admission Scheme, and enhancing funding support for enterprises through the Construction Industry Innovation and Technology Fund (CITF). These initiatives exemplify a "result-oriented" approach to policy implementation. Us, (CIC) will remain committed to implementing a range of measures to support the Government in achieving the set KPIs.

As the government promotes a number of large-scale land development and infrastructure projects in the future, it is expected that the construction volume of Hong Kong's construction industry will rise to more than HK$300 billion annually in the next ten to twenty years, and the demand for public housing plus private housing will reach a total of 440,000 units. In addition, healthcare facilities expenditure is expected to reach HK$500 billion. Therefore, Hong Kong's construction industry has entered a golden era that requires rapid development. Improving productivity will be the top priority of the construction industry.

We are pleased with the Government's multi-pronged approach to using innovative technologies for increasing housing supply. The Policy Address emphasizes the use of Modular Integrated Construction (MiC) to enhance speed, efficiency, and quality. It also mentions the trial adoption of smart estate management in design, construction, and property management stages. The CIC will continue promoting the adoption of innovative technologies such as Smart Site Safety System (SSSS), Internet of Things (IoT), Artificial Intelligence (AI), MiC, and robotics. These measures aim to improve construction safety, productivity, and sustainability.

"Digitalisation is key to improving efficiency, uplifting productivity, enhancing safety and sustainability as well as driving innovation for the construction industry." To further accelerate construction digitalisation and promote the use of digital twin in the construction industry, we have established the Digital Twin Hub at MegaBox Kowloon Bay, which is a virtual representation of real-world entities and processes, synchronised at a specified frequency and fidelity.

The Smart Site Safety System (SSSS) utilizes AI, Internet of Things (IoT), and cloud-based technology to collect real-time project data and transmit it to a centralized management platform on site. This enables the project team to have an immediate overview of the entire site situation, facilitating accurate decision-making. By leveraging these technologies, the SSSS reduces safety risks and enhances cost estimation while streamlining workflows. Additionally, artificial intelligence aids in task planning and optimizing resource allocation, improving managerial decision-making for efficient and cost-effective outcomes. This advanced system accelerates progress, boosts productivity, and introduces innovative approaches to work practices.

To promote the digitalisation, intelligentisation, and low-carbonisation of the industry, the Centre is connected to IoT sensors distributed throughout the CIC's premises, enabling management staff to monitor the status of each premise at all times. This facilitates remote monitoring and control of the comfort level of the indoor environment and building maintenance.

Since the introduction of the first relevant policy in 2017, the Modular Integrated Construction (MiC) method, which truly achieves "speed, quantity, quality, and efficiency," has been continuously implemented in Hong Kong. Every year, numerous MiC projects have been completed. As of now, there have been over 35 completed and operational projects, with over 40 projects currently under construction and more than 25 projects in the planning stage.

The following are some representative projects. Nam Cheong 220, located on Nam Cheong Street, is Hong Kong's first Modular Social Housing Project that adopts "Modular Integrated Construction." It consists of 89 housing units. The Dedicated Rehousing Estate at Hung Shui Kiu utilizes 1,225 MiC modules, resulting in a two-thirds reduction in on-site manpower. This approach has also led to decreased construction waste and carbon emissions. Last, the Student Residence at Wong Chuk Hang Site comprises 17-floor towers with a total of 952 modules across six different types, but it is still under construction.

Our vision for the future of the construction industry is to foster a safer, more efficient, and higher-quality sector. We recognize the significant potential of construction robotics in driving this transformation. As construction robots continue to advance and play an increasingly prominent role in the construction process, this emerging technology can attract new talents. Under the supervision of intelligent systems, robotics can increase speed and quality while ensuring human safety. So, we firmly believe they serve as a crucial catalyst for realizing our aspirations and shaping the future of construction.

Last month, we successfully launched the pioneer Workshops on Construction Robots showcasing a diverse range of over 20 ready-to-market construction robots, including building surveying robots, wall-finishing robots, and inspection robots that revolutionize various aspects of construction projects. To accelerate the adoption of innovative technologies such as robots in the industry, we are offering subsidies through the Construction Innovation and Technology Fund (CITF). Eligible robots can receive subsidies of up to 80% of their cost, incentivizing companies to embrace technological advancements in the construction sector. In addition, until now, the Housing Department has identified 37 projects that will gradually incorporate construction robots. Some of the robots will be exhibited at the CITAC for further exploration by public visitors. We believe that this workshop will serve as a new starting point and open a new chapter for the development of the industry.

I would like to express my deepest gratitude to all the organizers, sponsors, and participants who have made this event possible. Your presence here today is a testament to your commitment to embracing the future and shaping a High Productivity and Sustainable Construction. Thanks!

Speech

Ms. Winnie HO
Secretary for Housing
Government of the Hong Kong Special Administrative Region

Thank you Chairman Thomas and Executive Director Albert. Good afternoon, ladies and gentlemen. My deep appreciation to the CIC for organizing this highly stimulating and informative symposium-cum-exhibition.

Before I came up to the venue today, I have spent some time around the Sky 100 and found myself enjoying all the exhibitions here very much. They are so inspiring and have brought three words to my mind, i.e. Innovation, Sustainability and Safety. These are indeed the very important elements for the construction industry and I am extremely glad to note that the three elements have been working with amazing chemistry together in bringing positive growth to the industry in recent years. In the early days, our professionalism had allowed us to notice safety risk on site, to be aware of the issue of ageing workers and their relatively higher chance of getting hurt. The industry as a whole also faced great pressure for more civil engineering and building works, which had placed huge pressure on both labour and materials. We had demonstrated a high level of professionalism in tackling these issues but given the development back then, we could only handle them in a sporadic manner, I would say, if you would all agree, rather time and manpower consuming.

With the latest innovation and developments, I am excited to witness the beginning of a new era of the construction industry lately, which has weaved the three elements of Innovation, Sustainability and Safety together for more comprehensive solutions and infinite possibilities. On one hand, we have new construction methods, such as MiC, MiMEP, etc. There are also new technologies which have brought us with different robotic and digital platforms. But what I perceived as the most critical element in turning this page for the industry is the advancement in our professional mindset and attitude. I met many experienced professional friends and saw numerous young faces here today, both blinking with energies and the commitment to serve. I am sure by staying hungry and open, we would be welcoming a lot of opportunities into the industry. For instance, I have come to meet some new friends from the banking sector recently and am greatly thrilled by the interests that they have expressed over green technology and sustainable construction. They perceived it as a potential area for developing green financing in Hong Kong or even in the international platform. The ball is now in our court to fill them with more knowledge about the latest development and capabilities of our industry and professions. May I call upon my fellow friends and partners here today to join me in bringing our industry and professions to a new height, in building and realizing our dream for an even better home together.

Thank you.

High Productivity and Sustainable Construction of I·PARK1

Dr. Samuel CHUI
Director of Environmental Protection
Government of the Hong Kong Special Administrative Region

ABSTRACT

A huge amount of wasteloads, including municipal solid waste (MSW), is produced in Hong Kong each year, and this amount increases as the economy grows. The Integrated Waste Management Facilities (IWMF) using advanced incineration technology was identified as one of the solutions to handle the MSW challenge. Using these facilities, the amount of MSW disposing of at landfills will be reduced significantly, thereby extending the usable life of landfills. The IWMF will be developed in phases. The IWMF Phase 1 (I·PARK1) was located on an artificial island near Shek Kwu Chau.

In this paper, a detailed description of the I·PARK1 project, which utilizes high productivity and green construction technologies adopted, is presented.

INTRODUCTION

The amount of wasteloads produced in Hong Kong, including municipal solid waste, has been increasing as the economy grows. Municipal solid waste (MSW) includes waste from households, industry and commercial operations[1].

After extensive review, the Environmental Protection Department (EPD) has identified the Integrated Waste Management Facilities (IWMF) as one of the solutions to handle the MSW challenge. It is planned to develop the IWMF using advanced incineration technology to reduce bulk waste volume and to recover energy in the coming years. By using these facilities, the amount of MSW disposing of at landfills will be significantly reduced, thereby extending the usable life of landfills.

The IWMF will be developed in phases. The IWMF Phase 1 (I•PARK1) will involve the use of advanced moving-grate technology for incineration. Additionally, a demonstration-scale mechanical sorting and recycling

[1] https://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/WFdev_IWMF.html

facility for recovery of useful resources from the mixed MSW is also included. The facilities will have a treatment capacity of 3,000 tonnes of MSW per day and generate about 480 million kWh of surplus electricity per year, which will be sufficient for the consumption of approximately 100,000 households. The bulk size of the waste will be reduced by 90%, which will help extend the usable life of landfills.

The consultant for the I•PARK1 project is AECOM, and the contractor is Keppel Seghers-Zhen Hua Joint Venture. It is a Design-Build-Operate (DBO) contract with an operation period of 15 years. With a DBO contract, it is possible to pursue a design of high productivity and green construction, as well as enhancing the facility's sustainability during operation.

In this paper, a detailed description of the I•PARK1 project, which utilizes high productivity and green construction technologies adopted, is presented.

INTEGRATED WASTE MANAGEMENT FACILITIES PHASE 1 (I•PARK1)

Site Location

The site is located on an artificial island of about 16 hectares near Shek Kwu Chau, as shown in Figure 1.

Key Components and Layout

The I•PARK1 consists of the following functional systems/units: incineration units employing advanced moving grate technology, flue gas treatment system, power generation system and electricity substation, ash and residues treatment system, desalination plant for providing a sustainable water supply for use in the plant, wastewater treatment plant for recycling wastewater for reuse in the plant and a demonstration-scale mechanical sorting and recycling plant.

FEATURES OF HIGH PRODUCTIVITY AND SUSTAINABLE CONSTRUCTION

Application of BIM

For I•PARK1, a cloud-based "BIM 360 Document Management and Design Collaboration" for design, construction and future operation was adopted. The 3D Design Coordination and Space Programming was featured for checking variations and clashes, and ensuring constructability; the 4D Phase Planning was used for reporting, review and decision making during the interactive design and build; and the 6D Integration of the BIM model with the associated asset information in the Facility Operation Management System (FOMS) and Computerised Maintenance Management System (CMMS) was also made. The project was awarded with the Gold Award in the HKIBIM Award 2021 for its achievements. The I•PARK1's BIM Model is on exhibition at the CIC-ZCP STEAM Lab.

Design to Operation

Waste-to-Energy

Upon full operation of the facility, about 480 million KWh of surplus electricity (amounts to about 1% of the total electricity consumption in Hong Kong) will be produced and exported to the existing power grid every year.

Preservation of Natural Shoreline and Marine Ecology

The plant layout and space utilisation were designed to minimise the reclamation area. The I•PARK1 was designed as an artificial island off Shek Kwu Chau, instead of an inshore reclamation connecting to the existing shoreline, as so to preserve the natural shoreline of Shek Kwu Chau.

Figure 1: Location of I•PARK1

Provision of Eco-shoreline and Enhancement of Marine Ecology and Fisheries Resources

The following were provided:

(a) an artificial eco-shoreline of about 360 m long, mimicking the form of a natural rocky coastline and simulating the natural habitat variability to increase values;

(b) about 500 ecological holes with the size suiting for fishes, shellfishes and other creatures to inhabit and thrive in their natural marine habitat; and

(c) designated South Lantau Marine Park and designed fisheries enhancement measures, so as to conserve marine ecology and enhance fisheries resources in the vicinity.

Design to Construction

Green Construction of Reclaimed Land, Seawalls and Breakwaters

In the land formation, the underlying marine clay/mud was improved using the non-dredged method of deep cement mixing, followed by construction of seawalls and breakwaters (except eco-shoreline) with precast concrete caissons. The design and size of the concrete caissons used were continuously optimised, so as to minimise the number of marine delivery trips and time and thus the carbon footprint of transportation.

Adoption of Modular Integrated Construction (MiC) in the Construction of Major E&M Modules

MiC was adopted in the construction of the major E&M modules in consideration of the below reasons:

(a) there were no works areas for the construction of the major E&M facilities before completing the reclamation of the artificial island;

(b) the site is located in a remote area without convenient transportation, and it is difficult to employ sufficient workers for the works (it takes 2-3 hours per day for travelling by boat); and

(c) there was a lack of some special skilled labours (e.g. mechanical installation workers and high-pressure welders)

Maximised Use of Core E&M Components from Different Countries and Manufacturing Capacity and Capability at Greater Bay Area (GBA)

The core E&M components from different countries were delivered to the prefabrication yard at Zhuhai for assembly, as shown in Figure 2. The E&M modules prefabricated included 6 nos. of furnace-boiler modules (each about 50 m x 25 m x 58 m in size and about 6,000 tonnes in weight) and 6 nos. of flue gas cleaning modules (each about 35 m x 25 m x 40 m in size and about 2,500 tonnes in weight). E&M equipment and pipework, steel structure frames, stairs and platforms, and temporary transport steel supports were included in the modules. The modules were then transported from Zhuhai to the site by barge.

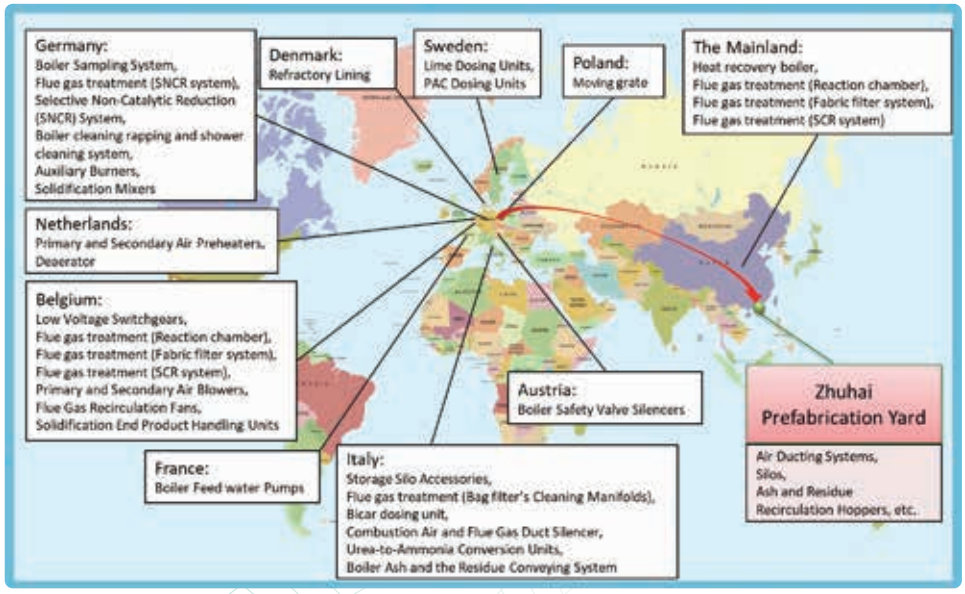

Figure 2: Use of Core E&M Components from Different Countries

The GBA manufacturing capacity and capability have been maximised: reinforced concrete structures were prefabricated in the precast yards at Xinhui and Dongguan; steel structure and E&M modules were constructed in the prefabrication yards at Zhuhai; hot dip galvanization was conducted at Dongguan, etc.

While the E&M modules were prefabricated off-site, foundation works and erection of steel structure for the Process Building were carried out on the artificial island concurrently, resulting in a significant time-saving in the construction programme.

Green Construction of Chimney Stack

A comparison of the original and optimised design of the 150 m chimney stack is given in Table 1. There is a huge saving of materials and time of construction using the optimised design and construction.

Design-Build-Operate: Climate Change Resilience

The breakwaters and seawalls were designed to take into account the recommendations of the Intergovernmental Panel on Climate Change (IPCC) to address the projected long-term sea level rise.

The ground level of the artificial island is set at 6.0 mPD. The ground level of the buildings is elevated by 0.5 m to 6.5 mPD to enhance flood protection. Buildings and major equipment are positioned away from the shoreline to minimise the impact of overtopping waves. A dual-layered wavewall design, featuring a high and low barrier, is implemented. The protection works for the foundation of the seawalls and breakwaters are reinforced. Floodgates are installed to mitigate the impact of backflowing seawater on the facilities in the artificial island.

CONCLUSIONS

The following conclusion can be made:

(a) EPD is committed to developing sustainable infrastructure with increased resource-use efficiency and adoption of clean and environmentally sound technologies. EPD is also committed to attaining green building certification (e.g. BEAM Plus) at Platinum level for all the buildings at I•PARK1.

(b) I•PARK1 is an excellent demonstration of "High Productivity and Sustainable Construction". In terms of economical gains, it increases efficiency and reduces construction time. In terms of environmental gains, it minimizes potential environmental impacts, balances development and conservation; reduces waste to landfills, for achieving "Zero Landfill"; and reduces carbon footprint and energy consumption, for achieving "carbon neutrality" before 2050. In terms of social gains, it minimises impact on nearby stakeholders for improving harmony in communities.

Table 1: Comparison of the Original and Optimised Design of Chimney Stack

Feature	Original design	Optimised design
Shape	Symmetric circular shape	Oval-egg shape with cladding as façade, forming a "sail" at the sea (together with a wooden viewing deck on top of the wavewall, meaning "Smooth sailing with leading the way forward")
Wall Thickness of Reinforced Concrete	Same thickness throughout	Gradually decreases with height
Foundation	Over 100 nos. of H-piles	11 bored piles
Formwork	Jump-form	Slip-form
Construction Time	~300 days	~120 days

Utilising MiC and MiMEP for Sustainable Construction

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ABSTRACT

Modular Integrated Construction (MiC) is a cutting-edge construction solution. It helps alleviate some of the present issues experienced by local construction sector by embracing the concept of "factory assembly followed by on-site installation". Free-standing integrated modules are manufactured and assembled in a factory completed with finishes, fixtures, and fittings. Buildings will be significantly constructed off-site by shifting on-site construction operations to a controlled industrial setting. In Multi-trade Integrated Mechanical, Electrical and Plumbing (MiMEP), multi-trade building services components are integrated into a single volumetric assembly of prefabricated modules, manufactured offsite, which are then be transported to site for connection of modules to complete various trades of building services installations to minimize on-site works.

Weather-related problems, labour shortages, and site limits may all be mitigated to a large extent using MiC and MiMEP. They can increase construction efficiency, safety, and sustainability by providing a high level of production quality control.

In this paper, a detailed description of the Tonkin Street Redevelopment project adopting concrete MiC and other projects using MiC/MiMEP is given.

INTRODUCTION

The Secretary for Development, Ms Bernadette Linn, mentioned in Chinachem Group Sustainability Conference a week ago that Modular Integrated Construction (MiC) could uplift work efficiency by reducing site work processes, site labour and construction period, enhance sustainability and improve site safety. MiC is one of the innovative high-productivity construction methodologies. In recent years, Chinachem Group has spared no efforts to promote the wider adoption of MiC to expedite housing supply. The construction industry is facing a number of challenges, the notable ones are high accident rate, ageing construction workers, unsatisfactory work environment, extensive construction waste, annoying construction noise, inconsistent construction quality, etc. To overcome these challenges, extensive use of technologies is needed to improve work quality and efficiency. MiC and MiMEP are for sure a solution.

In this paper, a detailed description of the Tonkin Street Redevelopment project adopting concrete MiC and other projects using MiC/MiMWP is given.

TONKIN STREET REDEVELOPMENT PROJECT

MiC (Modular Integrated Building)

Tonkin Street Redevelopment project is a joint project with URA. This is the first private residential project adopting concrete MiC. This is also the first MiC project using concrete composite wall technique and including curtain wall installation in factory. It has the thinnest composite wall system.

Using MiC, modules are produced in factory. The benefits of factory assembly are better quality control, reduced construction waste, reduced number of local labours, work progress not affected by weather, and improved efficiency and safety.

The MiC factory of GMC Grand-Bay Intelligent Manufacturing and Technology Co., Ltd. is located in Guangzhou. Chinachem Group and GMC Grand-Bay Intelligent Manufacturing and Technology, which is a subsidiary of Guangzhou Municipal Construction Group Co., Ltd. among the Fortune Global 500, have signed a MoU for a strategic partnership for development and use of the MiC system. Currently, they can produce 5,000 modules in a year in its Huangpu factory, while they have also planned to build a new larger factory in Qingyuan to produce 10,000 modules in a year.

Quality Assurance

Many advanced technologies were used in ensuring the quality of the products. These include robot dogs, Radio Frequency Identification (RFID) system, etc. Robot dogs were used to check the accuracy of the reinforced concrete (RC) structure produced. The robot dogs have high sensitivity, high productivity and real time data output. The RFID system was used for quality assurance in the factory and construction site.

Safety

In the factory assembly, the maximum working at height is limited to 1 floor (3.2m), and the work environment is sheltered. All the heavy works were completed in factory, and heavy duty workload on site was minimized. Automated guided vehicles (AGVs) were used to transport the modules in the factory to minimize accidents. The teams from Chinachem Group and Gammon have been stationing in the factory to monitor the construction process. These all help to reduce safety risks.

Technology

Chinachem is steadfast in the development and application of property technology (PropTech) to bring revolutionary changes to the industry. The technologies applied in the MiC processes include ultrasonic scanning on composite wall, full BIM coordination and common data environment.

With the use of digital technology like GPS, modules were transported seamlessly from the Guangzhou factory to site in Hong Kong, achieving a 'Just in Time' effect. The common data environment provided real time data to increase efficiency and quality.

Construction Productivity

The achievement using MiC was given in Figure 1. Using MiC, the construction efficiency was increased. There was a 70% reduction of on-site labour. The risk for heat stress was reduced by 35%. Construction noise and construction waste was reduced by 65%. Construction accidents and carbon emissions were reduced.

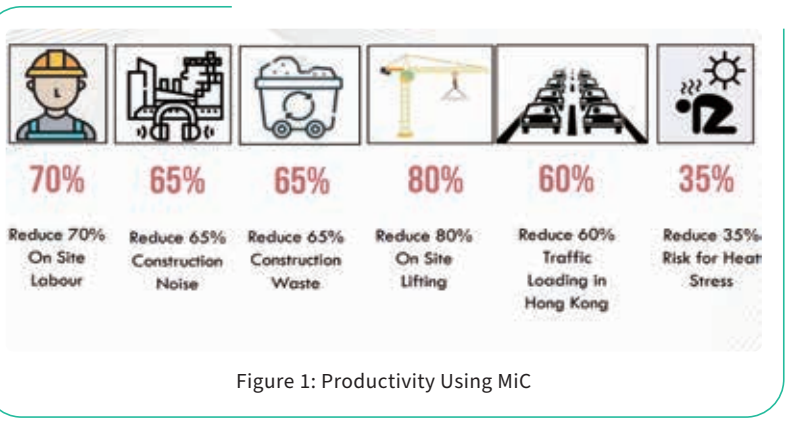

Figure 1: Productivity Using MiC

Typical Module Layout

A typical module layout is given in Figure 2. All bathrooms were designed with openable windows. There is a non-structural wall in between the bedroom and living room, which can be removed to allow flexibility as needed. The AC platform is located next to the balcony, which is accessible from the balcony, to facilitate easy installation and maintenance of air-conditioners.

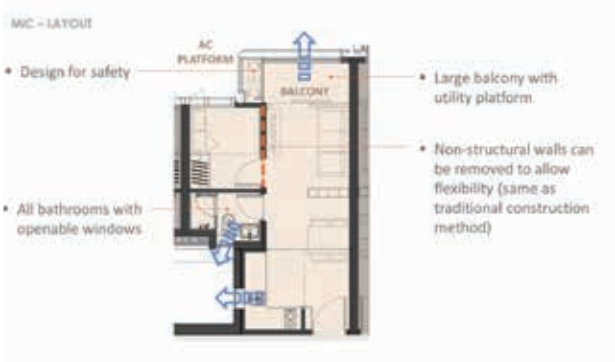

Figure 2: Layout of a Typical Module

OTHER MiC AND MiMEP PROJECTS

Other MiC project in the pipeline is Tung Chung Traction Substation. This project is larger in scale. It will offer approximately 2,000 units, and will be the tallest residential development in Hong Kong built using the MiC.

In the development of the Kwai Chung Cold Storage Logistic Centre, a joint project with ESR, Multi-trade Integrated Mechanical, Electrical and Plumbing (MiMEP) was adopted. This is the largest of its kind in Hong Kong in 20 years and is due to be completed in 2027.

At the design stage, a Building Information Model (BIM) is developed and used in MiMEP adoption. Through BIM, feasibility of MiMEP adoption is identified upon consideration of spatial requirement, technical feasibility, factory assembly requirement and logistic consideration. Module fabrication drawings that are detailed drawings for MiMEP module fabrication in factory are produced through BIM. At the off-site fabrication stage, MiMEP module fabrication are arranged in off-site factory. MiMEP modules quality assurance process are carried out in controlled factory environment. MiMEP module off-site storage and delivery are arranged and completed with good supply chain to suit the on-site progress of planned works. At in-site installation stage, MiMEP modules are transported to site for installation.

Global Construction Sustainability Forum (Environmental) – High Productivity and Sustainable Construction

Several MiMEP installation will be implemented at different locations in the Kwai Chung Cold Storage Logistic Centre project, as shown in Figure 3, as follows:

(a) MiMEP of toilet assembly in toilet cubicle completed with water closet, water pipework, drainage pipework and associated flushing sensors in a steel rack;
(b) MiMEP of equipment-based module such as prefabricated central AC plant module, water pump set modular assembly and switch room components modular assembly.
(c) MiMEP modules installed in ceiling and riser ducts at typical lift lobbies, property management office and carparking area.

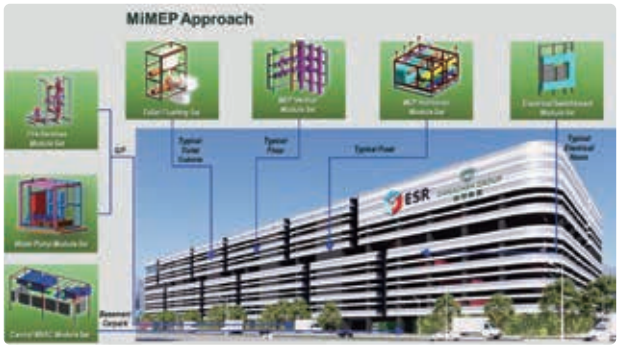

Figure 3: MiMEP Approach Adoped in the Development of Kwai Chung Cold Storage Logistic Centre

CONCLUSIONS

The following conclusion can be made:

At Chinachem Group, the aim is to balance people, prosperity and planet, which is the 3Ps mission of a project. The use of MiC and MiMEP is a human-centric approach, speeding up the production processes and housing supply, as well as reducing carbon emissions and pollution, ultimately leading to a more livable Hong Kong.

MiC Enhanced High-Productivity and Sustainable Construction

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ABSTRACT

This paper reports on a new construction productivity measure, namely, Building Construction Productivity (BCP). The BCP from 2013 to 2023 for public building and private development projects in Hong Kong is evaluated and compared. Different measures of modular integrated construction (MiC) enhanced high-productivity and sustainable construction are described. The results show that with the use of smart and sustainable MiC technologies, the challenges to handling the high construction volume in the coming years in Hong Kong can be effectively addressed.

INTRODUCTION

The number of storeys of modular buildings constructed has increased over the years (Pan et al. 2019). In 1967, the first high-rise modular building was constructed with 12 storeys. In 2022, the number of storeys built was increased to 56. Modular construction has been demonstrated with multi-faceted benefits, such as accident reduction, in-factory waste reduction, on-site waste reduction, site labor saving, to-site delivery reduction, labour productivity increase, construction cost-saving, and construction time-saving. It is now well recognized that modular integrated construction (MiC) in Hong Kong can enhance quantity, time, efficiency, and quality, as evidenced by the achievement of the completed MiC projects. For example, in the completed married quarters for the Fire Services Department at Pak Shing Kok, there was 32% time saving and 70% labour reduction (Pan and Zhang 2023).

In this paper, the methodology of industry-level Building Construction Productivity (BCP) is proposed. The BCP from 2013 to 2023 was measured for both public and private building sectors. Different measures of MiC enhanced high-productivity and sustainable construction are described. It was established that with the use of smart and sustainable MiC technologies, the challenges to handling the construction volume in the coming years can be effectively addressed.

CONSTRUCTION PRODUCTIVITY MEASUREMENT

There are different ways to measure construction productivity, such as those given in the Productivity in Construction (UK), Builders' Guide on Measuring Productivity (Singapore), etc. Depending on the aspects measured, different methods of measurement give different perspectives. It became necessary to develop a systematic framework and methodology to measure the BCP in Hong Kong.

The scope and method of BCP are shown in Figure 1, which is defined as *completed CFA/year over man-days*. In simple terms, it compares output to input.

The BCP from 2013 to 2023 for the public building and private development projects has been evaluated and the results are discussed. The following observations are made:

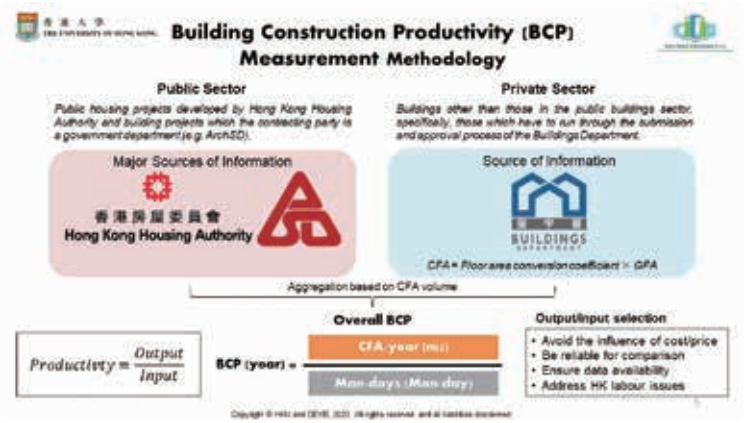

Figure 1: Scope and method of BCP measurement

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(a) There was a slight decline in the overall BCP (e.g. 16% decrease from 2013 to 2021) due possibly to ageing workforce and declining skilled labour. The downward trend was dominated by private sector.

(b) The BCP in the public sector is larger than the BCP in the private sector (e.g. 40% higher in 2021) due possibly to the use of higher standard of finishes and more complex designs in private sector projects, as compared with the use of standardised design (e.g. 4 types of flats) and MiC in public housing projects (e.g. 20-30% PC). There is also a larger project variety in the private sector projects.

(c) MiC can help enhance the labour productivity by at least 100% compared with conventional construction, according to Pan and Zhang (2023).

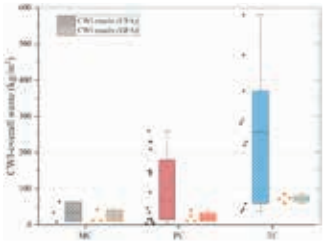

Figure 2: Construction waste reduction through using modular construction

MiC ENHANCED HIGH-PRODUCTIVITY ABD SUSTAINABLE CONSTRUCTION

The MiC productivity can be further enhanced through the use of smart MiC transportation planning (Zheng et al. 2022) and smart technology for safe lifting (Zhu et al. 2023). In safe lifting, RGB camera and LiDAR can be used for live video streaming and load tracking, and real-time obstacle detection.

The sustainability of MiC can be further enhanced based on the concept of MiC Total Factor Sustainability, by AI-based TFS Optimizer, low-carbon materials, structural innovations, and operational energy modeling and optimization of MiC buildings.

Innovative MiC solutions can also help with the reduction of embodied carbon. Multi-level embodied carbon of concrete MiC high-rises and construction waste reduction were assessed (Zhang et al. 2024). In the assessment of seven completed MiC projects, it was established that MiC projects had a low waste generation and high waste reduction performance of around 50% to 85%, as shown in Figure 2.

Notes: MC: modular construction; PC: precast construction; TC: traditional construction

There will be a high construction volume in the coming years, e.g. the 129,000 private housing units, 308,000 public housing units, and 30,000 light public housing units. With smart and sustainable MiC technologies, these challenges can be well addressed.

Acknowledgements

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"Zero Waste Society" Development

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ABSTRACT

The "Zero Waste Society" development aims to achieve near-zero solid waste emission through resource conservation, waste reduction and recycling. This paper presents the pilot practical experience of the "Zero Waste Society" and introduces cases of implementing and exploring the "Zero Waste Society" development in Mainland China.

INTRODUCTION

Background of the "Zero Waste Society" Development

The Central Commission for Comprehensively Deepening Reform has placed the "Zero Waste Society" development as one of the prioritised tasks since 2018. The Ministry of Environmental Protection has taken the initiative in formulating the Work Plan for the Pilot Program of the "Zero Waste City" Development. The concept of the "Zero Waste" development is to achieve near-zero solid waste emissions through resource conservation, waste reduction and recycling, thus achieving a win-win situation, in terms of energy, environment, economy, resources and society, and its connotation includes the three aspects of emission reduction, recycling, and harmless disposal.

The realisation of the "Zero Waste Society" is a long-term endeavour. In 2018, the General Office of the State Council issued the Work Plan for the Pilot Program of the "Zero Waste City" Development with Document No. 128[2018] of the General Office of the State Council, which designated the first batch of the 16 cities, including Shenzhen, as pilot cities for the "Zero Waste City" development. These pilot cities have been under development for about 3 to 4 years, and after evaluation, it was concluded that though there is still room for improvement, the overall result has been significantly positive.

In 2021, in the Opinions of the Central Committee of the Communist Party of China and the State Council on Comprehensively Winning the Battle Against Pollution, the continuous promotion of the "Zero Waste City" development was highlighted. In the same year, 18 organisations including the Ministry of Ecology and Environment jointly issued the Work Plan for "Zero-Waste City" Development during the "14th Five-Year Plan" Period, which promoted the "Zero Waste City" development in 100 cities of prefectural level and above. The active participation of all regions increased sharply, culminating in the selection of 115 cities. There were also 6 provinces/municipalities (Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Shanghai) that proposed the "Zero Waste Society" development across the whole region and formulated their own programmes.

Enlightenment on the Pilot Program of the "Zero Waste Society" Development

On the basis of the preliminary study of the pilot programmes, the following insights into the Pilot Programs of the "Zero Waste City" have been summarised:

(1) The proper and accurate disposal of solid wastes in the "Zero Waste City" Pilot Program has established the reduction of waste at the source, the recycling during the course of the process, and the harmlessness of the waste at the end. A crucial element in recycling during the course of the process is waste categorisation. The waste categorisation in some districts has not been very effective as the purpose of categorisation should be utilisation rather than categorisation itself. Therefore, some districts have formulated rules on waste categorisation in light of their own actual situation, instead of adopting a standardised approach of categorising waste into 3 or 4 categories, thus achieving better results.

(2) The "Zero Waste Society" begins with a "Zero Waste Community", a "Zero Waste School", a "Zero Waste Construction Site", and every other building block.

(3) Without economic benefits from solid waste disposal, it is impossible to achieve sustainable development. The disposal of various types of solid wastes can be coordinated through developing circular economy industrial parks to improve the efficiency of disposals and generate economic benefits.

(4) Digital management provides vital support in the "Zero Waste City" development.

(5) The "Zero Waste Society" must proceed to a higher level. One level is to deal with new solid wastes, generated by the development of new businesses and new industries, as the equipment for solar energy, wind energy, electric batteries, electric vehicles and other technologies have limited lifespans. Another higher level is shifting from the past practice of developing the city before dealing with the wastes, to considering future development, including the consideration of space for urban development in the future, the capacities for waste accommodation and the recyclability of resources in the process of urban renewal and new urban development, so as to "build the city on waste" and "set production on waste".

CASES OF SOCIETY DEVELOPMENT OF THE "ZERO WASTE SOCIETY"

"Zero Waste School"

The "Zero Waste School" development starts with primary and secondary schools. Take a secondary school in Henan as an example. The school began with waste categorisation into the standardised four categories, and built a landscape buried garbage equipment and smart recycling bins. The buried equipment was used mainly for the collection of food waste, keeping insects away, and eliminating dirt and odour issues associated with traditional waste collection.

As wastes generated in schools require minimal pre-processing, the materials can be recycled with higher quality, thus achieving greater economic efficiency. In addition, schools have also implemented the recycling of teaching materials and the recycling of waste materials in practical education (e.g. 3D printing).

Most importantly, placing recycling bins in critical areas of the school would help cultivate children's understanding of a "zero waste society" from an early age and promote the formation of good habits.

Circular Economy Industrial Parks

By centralising the disposal of various types of waste through circular economy industrial parks, a synergistic effect will be created, which is conducive to the avoidance of secondary solid waste emissions and pollution, significantly increasing the economic benefits of scale, and avoiding over-dependence on government subsidies.

The Dongguan Haixinsha Resource Recycling Base is the first national resource recycling base in the Guangdong-Hong Kong-Macao Greater Bay Area, which is able to collect 11 types of solid waste from the entire city of Dongguan for synergistic disposal, resource recycling, and the production of water, electricity, steam, and natural gas, generating exceptional economic benefits. The Guangdong East Solid Resources Recycling Centre has been transformed from a waste incineration plant into a circular economy industrial park, which is the largest waste incineration power plant in China in terms of planned treatment scale. It has turned the park into a national 4A scenic area while generating economic benefits.

Therefore, circular economy industrial parks are the most important technical support in the process of the "Zero Waste" development.

"Zero Waste Construction Site"

The "Zero Waste Construction Site" development will lead to the formation of new environmental protection industries and new environmental protection equipment in the future, such as portable processing equipment on-site to achieve a closed processing, and efficient recycling of resources.

Chongming Island has established a new model of solid waste treatment by circulation among the three islands, which proposes that all the waste produced by the three islands shall be self-circulating, self-regenerating and kept within the islands. It is expected that in the Shanghai Lingang Special Area, the amount of the annual residue discharged will be reduced to approximately one-third of that produced in Shanghai. They further proposed to fully recycle the residue to achieve no residue disposal outside the area.

"Zero Waste Village"

The Heibei Deshun poverty-stricken village achieved an environmental shift through the international green building competition, which led to the development of industries, from a poverty-stricken village to a tourist attraction, with the average per capita income of RMB3,000/year increasing to RMB80,000/year now.

Recycling New Wastes

In 2021, the State Council issued the Action Plan for Carbon Dioxide Peaking Before 2030, proposing to put focus on the implementation of green and low-carbon energy transformation, the development of new energy industries with an emphasis on the adoption of a circular economy to reduce carbon emissions, and vigorously promote the development of recycling industry for retired new energy equipment. In particular, it highlights power batteries, photovoltaic components, wind power components and other parts. These could become the wastes to be disposed of in the future, which had consumed many strategic mineral resources, such as copper, gold, cobalt, nickel, and lithium in the manufacturing process. Only through recycling can the environmental issues be addressed while achieving waste resource utilisation.

CONCLUSION

From the practical experience in building the "Zero Waste Society" discussed above, it can be concluded that proper and accurate disposal of solid waste is an essential part of the "Zero Waste Society" development. The key requirements for the accurate disposal of solid waste in the "Zero Waste Society" development are the reduction of waste quantity, waste resource utilisation and harmless disposal. The "Zero Waste Society" development should take recycling as the root, and economic protection as the guarantee. The capacity of solid waste disposal should be fully considered in developments such as new urban development, urban renewal, and industrial development so as to achieve the goal of "building the city on waste" and "set production on waste".

Key Issues and Technology in Sustainable Urban Development

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The Hong Kong Polytechnic University

ABSTRACT

Innovative technology development is important in sustainable urban development for Hong Kong. In this paper, the notable R&D projects carried out at PolyU are presented.

Waste glass is a major component in a solid waste system. It can be utilized as aggregates, powder and activator forms to produce various concrete products, such as low-carbon glass cement, architectural and self-leveling mortar, high strength permeable concrete, ultra high-performance concrete, etc. These materials can be used to develop a high-performance lightweight concrete for modular integrated construction (MiC) applications. To combat deterioration problem of concrete structures in coastal/marine environments due to corrosion, the use of fibre-reinforced polymer (FRP) to replace steel reinforcement in concrete structures has attracted significant attention. FRP is well known for its many advantages, including excellent corrosion resistance, high strength-to-weight ratio and durability. Furthermore, the use of FRP reinforcement in concrete structures opens a new avenue for concrete production with the direct use of locally available seawater and sea-sand for marine infrastructure, thereby offering compelling economic and environmental advantages through savings in freshwater and material transportation cost as well as reduced river-sand mining.

FACULTY OF CONSTRUCTION AND ENVIRONMENT (FCE)

There are four departments in the faculty, as follows:

- Building Environment and Energy Engineering
- Building and Real Estate
- Civil and Environmental Engineering
- Land Surveying and Geo-informatics

There are five research institutes in the faculty, as follows:

- Research Institute for Smart Energy
- Research Institute for Sustainable Urban Development
- Otto Poon Charitable Foundation Smart Cities Research Institute
- Research Institute for Land and Space
- Research Centre for Resources Engineering Towards Carbon Neutrality

NOTABLE RESEARCH PROJECTS

Recycling Waste Glass in Low-carbon Construction Materials (Prof. C.S. POON)

In HK, there is some 7% CO_2 emission coming from wastes. Average 315 tonnes of waste glass (over 80%) are disposed of at landfills every day. It is essential to provide large-scale outlets for the collected waste glass.

Waste glass can be recycled and used as aggregates in dry-mixed concrete, aggregates and binder in cement concrete; and precursor and activator in alkali activated material.

Dry-mixed glass products had been produced in a local factory in a pilot-scale production. Permeable concrete blocks and permeable concrete slab with a strength larger than 50 MPa were produced. These product had been put on trial use in a site and had received a 2020 Green Innovations Award (Silver). Low carbon architectural products, alkali activated glass materials and low-carbon glass concrete were also produced.

Waste glass, in combination with cementitious materials, additives and water, can be used to produce lightweight concrete. Lightweight concrete can be used as non-structural wall and concrete slab in steel MiC modules, as shown in Figure 1. Lightweight foam concrete and lightweight high strength concrete have a density of 1200 kg/m3 and 1600 kg/m3 respectively. Lightweight concrete has better thermal insulation. Use of the lightweight concrete could increase span and reduce thickness of slab thickness, and increase crane lifting capacity.

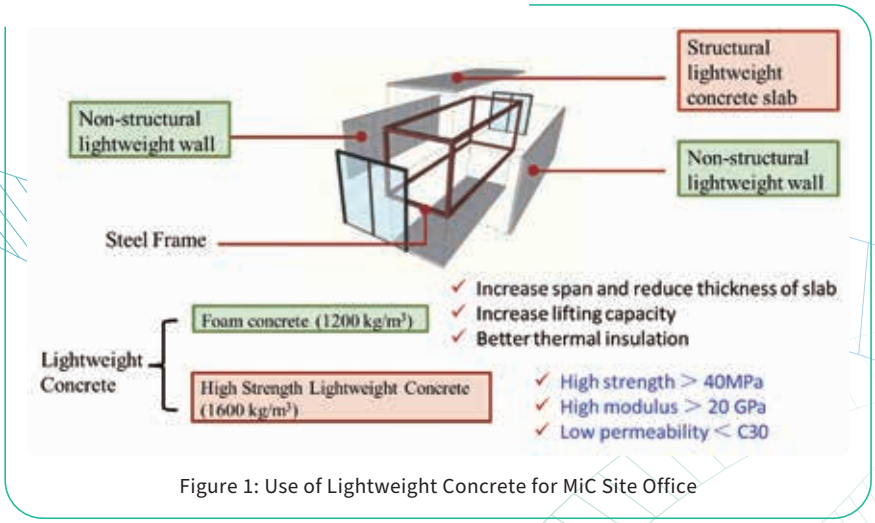


Figure 1: Use of Lightweight Concrete for MiC Site Office

Fiber-Reinforced Polymer (FRP) products for new construction (Prof. Jin-Guang TENG & Prof. Tao YU)

Fibre-reinforced polymer (FRP) composites are formed by embedding continuous fibres in a polymeric resin matrix. FRP products can be used in bridge deck, stirrups, rebars and tube in civil engineering works. Types of FRPs used are: glass FRP (GFRP), carbon FRP (CFRP), aramid FRP (AFRP), and basalt FRP (BFRP), etc. Focus is placed on GFRP made of glass fibers and vinyl ester resin.

FRP tube has a corrosion-resistant skin, and can be used as a stay-in-place formwork for casting concrete or a confining device for improved strength and ductility. It can also be used to strengthen RC structures in marine structure, such as the Friendship Trail Bridge.

It was predicted that FRP could retain 75% of strength after 100 years.

The life-cycle cost of FRP-SSC is only half of that of steel-RC for a large structural member with a service life of 100 years.

There is huge potential of FRP applications in Hong Kong in the construction of bridge, port, pier, underwater tunnel, sewer system, waste treatment plant, buildings, roads, etc.

Large-scale flexural tests had been carried out on the FRP tubes, and good results were obtained as compared with those of RC tubes.

FRP composites have a great potential for the development of sustainable coastal and marine infrastructure.

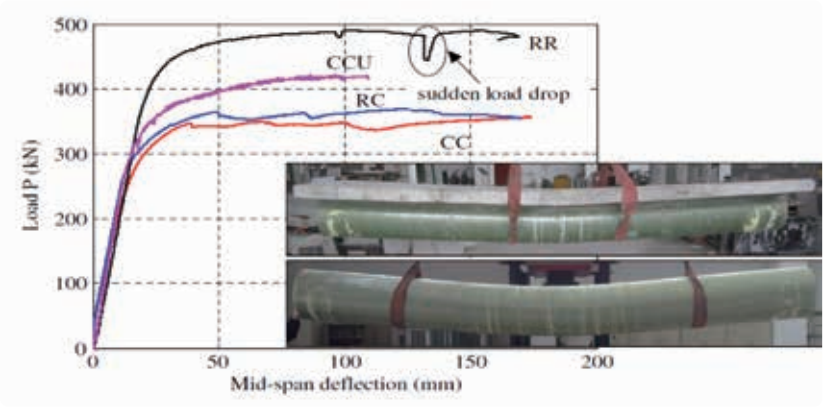


Figure 2: Large-scale Flexural Tests

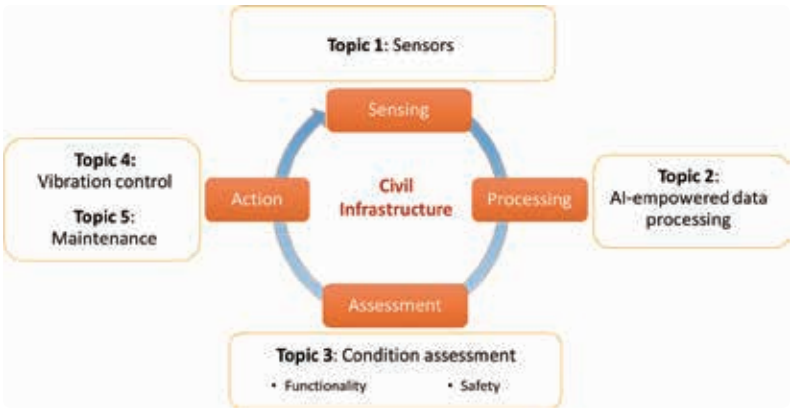


Figure 3: R&D Work

Safety Monitoring and Inspection of Civil Infrastructure (Prof. Yong XIA)

The objectives of this projects are to develop: a real-time safety monitoring system (hardware + software), robot-assisted inspection systems (hardware + software); and decision-making and maintenance system (hardware + software). The R&D work puts focus on development of sensors, AI-empowered data processing, condition assessment, vibration control and maintenance, as shown in Figure 3.

Multi-sensing Technologies for Safe and Optimal MiC Logistics and Assembly (Prof. Tarek ZAYED)

The work carried out under this theme consists of the following:

(i) Optimum module logistics: Simulation and artificial intelligence (AI) based dashboards are developed to evaluate and monitor the optimized project duration, overall cost, and carbon emissions for different logistics and assembly scenarios.

(ii) Optimum crane layout: Robust multi-objective algorithms are used to create a safe and efficient crane layout(s) on MiC assembly site.

(iii) Real-time crane safety monitoring: An IoT-based real-time monitoring system is developed to prevent the collapse and collision of tower cranes.

(iv) Optimum module lifting schedule: A system dynamics-based simulation model is designed to optimize and visualize the module assembling schedule.

(v) Blockchain for MiC stakeholders: A blockchain framework for financial and procurement management is designed to ensure transparency, effective decision-making, and collaboration among supply chain stakeholders.

(vi) IoT-enabled BIM platform: The IoT and BIM are integrated to enable the real-time information flow across the project stakeholders for whole lifecycle of the project. The developed platform is well demonstrated on a MiC project.

Closing Remarks

Ir Albert CHENG
Executive Director
Construction Industry Council

Distinguished guests, professionals in the construction industry, and esteemed attendees,

Thank you for gracing us with your presence at today's closing ceremony. On this special occasion, we not only reflect upon the efforts made by the Construction Industry Council (CIC) in enhancing productivity within the industry, but also delve into crucial topics and technologies that play a vital role in sustainable development for the construction industry and the sustainable urban development of Hong Kong, our vibrant city.

With the advent of the digital era, CIC has actively raised awareness and promoted the application of digital tools and technologies through seminars, workshops, and training courses. Tools such as Building Information Modeling (BIM) and the Internet of Things (IoT) have the potential to improve the design, construction and management processes, thereby enhancing productivity and sustainability. Additionally, CIC is dedicated to promoting the application of Modern Methods of Construction (MMC) and robotics technology. MiC adoption can boost productivity in construction projects by employing modular and off-site manufacturing methods, resulting in reduced construction time, waste, and carbon emissions. Simultaneously, the application of robotics technology can automate repetitive and high-risk tasks, enhancing efficiency and safety. By promoting these technologies, CIC encourages the industry to embrace innovative approaches and tools while enhancing the sustainability of construction projects.

We collaborate with academia, industry, and the government to foster technological innovation and the development of solutions addressing the challenges faced by sustainable construction. In addition, the CIC Sustainable Construction Award is one of our significant initiatives to promote sustainable building practices. By acknowledging outstanding contributions in sustainable construction projects and professionals, we aim to drive sustainable development and transition towards a low-carbon paradigm.

Furthermore, in line with the Hong Kong SAR Government's "Hong Kong Climate Action Plan 2050" and the drive to transform Hong Kong into a sustainable and green city, we, as a member of the industry, have launched the CIC Sustainable Finance Certification Scheme. This scheme aims to provide the construction industry with a universal framework and a user-friendly assessment system, convenient industries include developers, contractors, subcontractors, suppliers, etc. and facilitating green sustainability assessment and certification for engineering projects and building materials. Through this certification scheme, we hope to expedite industry access to green financing support, thereby promoting the development of more green and sustainable projects.

Global Construction Sustainability Forum (Environmental) – High Productivity and Sustainable Construction

As of September this year, over 800 products have been certified as green products by the Construction Industry Council. The database within the CIC Carbon Assessment Tool has accumulated over 2000 entries. In this event, we have developed an electronic platform for intelligent management of construction waste and showcased it. Additionally, we have conducted a study on carbon neutrality for the Hong Kong Construction Industry as part of the Carbon Neutrality Strategy and Plan.

Through our collective efforts, the development of Hong Kong's construction industry is moving steadily towards sustainability, serving as a model for sustainable building and urban development. Let us work together to build a highly productive and sustainable construction industry, promote the application of innovative technologies, and achieve greener and more sustainable urban development. Thank you all!

Day 2 AM

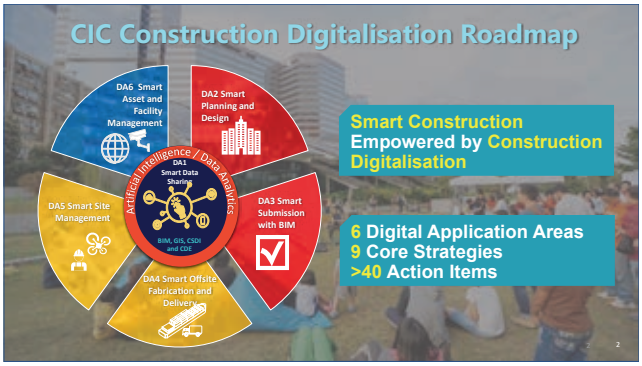
Award Ceremonies and Charter Signing Ceremony

Welcome Remarks

Prof. Jack CHENG
Chairperson
Committee on Building Information Modelling and Construction Digitalisation of Construction Industry Conuncil

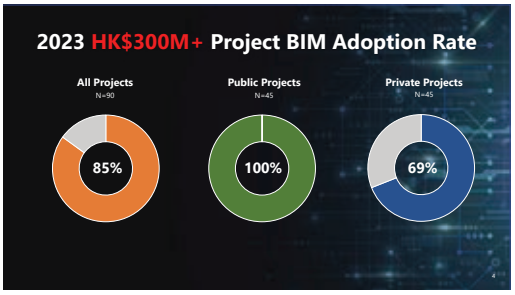
The potential of digital transformation within the construction sector is unlimited. It's important for us to embrace this opportunity to spearhead the Hong Kong construction industry towards digitization.

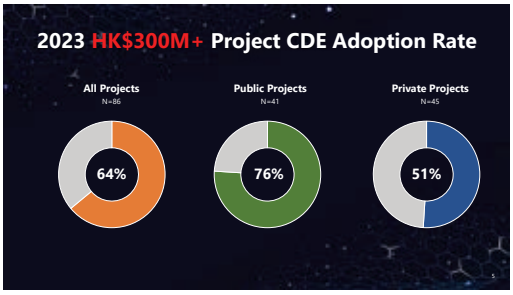
The Construction Industry Council have worked with many key stakeholders and published the Construction Digitalisation Roadmap in November 2021. We have a vision of smart construction empowered by digitalisation and our goal is that all processes involved in the real asset lifecycle are streamlined and digitalised to enhance productivity, safety and sustainability during planning, design, construction, and operation stages. To achieve the vision, there are six high value digital application areas, nine core strategies and more than 40 action items identified in the roadmap in line with the government Smart City Blueprint.

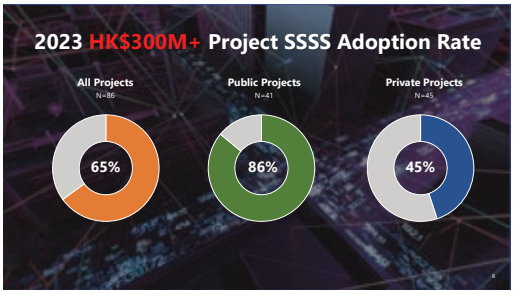


We hope that by 2026, all the projects, no matter public or private, with HK$300 billion project sum will have the full adoption of Building Information Modelling (BIM), Common Data Environment (CDE) and Smart Site Safety System (SSSS). We believe that one day, through the collective effort of our industry, all processes are streamlined and digitised to continuously improve our productivity, safety and sustainability. I would like to share some notable insights from a recent digitalisation adoption survey conducted by CIC in early this year. We can see that with our ambitious 2026 targets. The survey reveals that the adoption rate of BIM in Hong Kong stands at an impressive overall rate of 85% among projects with over HK$300 million at project sum. Notably, public projects have full adoption of BIM, while private projects are at an average of 69%. With acceleration of adoption of BIM, we can envisage BIM becoming a norm across the whole construction industry.

On the other hand, CDE has an adoption of an overall rate of 64% among all the projects over HK$300 million and public projects have shown a high adoption of 76%, while private projects have achieved 51%. By implementing integrated CDE, various benefits can be realized, for example, efficient project delivery, single source of truth and effective information flow and reduction in waste and carbon and overall CDE realized construction processes promoting digitalisation, hence achieving sustainability. For the SSSS the overall adoption rate is 65% among the major projects and public projects show a leading adoption of 86% and the private project demonstrate a rate of 45%. Safety is very important in our industry and by adopting SSSS we can significantly enhance onsite safety measures and minimize accidents through our industry collective effort. With more adoption of SSSS and all the digitalisation, we can enhance safety.







And you can see that we still have three years to go to 2026 and we are confident that we can achieve full adoption of BIM, CDE and SSSS by that time.

Recently, we renamed the CIC BIM Space to CIC Digital Twin Hub. We aim to provide a collective platform to showcase the technological innovations. The Digital Twin Hub serves as a one stop location to facilitate knowledge sharing, nurture talents and also inspire innovations in the field of digital twin and construction technologies.

The **Di**gital Twin Hub consists of four key areas. It will provide a variety of functions, such as Digital Twin experience sharing, guided tours and also advisory workshops. You are welcome to book our group Guided tour at the CIC Digital Twin Hub.

The coming year will be a Year of Digitalisation, and it holds great significance as it marks the 10th anniversary of the BIM Year by CIC. Two signature events will be organized.

First, the Construction Digitalisation Award 2024 will be organised to recognize projects and organizations that have made significant contributions to the adoption of digitalisation tools and workflows for construction.

Second, the upcoming Global Construction Digitalisation Forum & Exhibition schedule for December 2024. Moving towards to the future of Construction Digitalisation, we should include artificial intelligence (AI), ChatGPT, etc. for better decision and enable prediction of future operation blockchain. For data security, we can secure information flow through blockchain and encryption which avoid repetitive works and reduce high risk tasks.

CIC will have more promotion of new technologies so that better design, construct and operations can be achieved and we can reshape the way that we build and manage our facilities. The best time to get ready for digitalisation and realize its benefits is NOW, to achieve safety, productivity, and sustainability in our construction industry.

Opening Address

Ir Ricky LAU
Permanent Secretary for Development (Works)
Government of the Hong Kong Special Administrative Region

Chairman Thomas, distinguished guests, fellow construction practitioners, ladies and gentlemen. Good morning.

I have great pleasure in joining you here today at the Global Construction Sustainability Forum on Construction Digitalisation. I am delighted to share in the joy of the winners of the Common Data Environment Award 2023, and to take part in these memorable moments for Construction Digitalisation Charter Signing Ceremony and Construction Digitalisation Award Launching Ceremony.

It is so existing to have an engaging and diverse programme for this Forum, bringing together local and overseas elites for sharing their insights this morning. This serves as an excellent platform for all of us to exchange global wisdom and best practices on construction digitalisation. The main theme of the Forum is Global Construction Sustainability. Undoubtedly, achieving sustainable development stands as one of the most crucial objectives for the construction industry, particularly with the vast construction volume that lies ahead.

As highlighted in the Chief Executive's Policy Address this year, the Hong Kong SAR Government will continue the commitment to investing in infrastructure, with a focus on stimulating the economy, improving livelihood, creating job opportunities, and attracting talents for enhancing Hong Kong's long-term competitiveness. We have an extensive portfolio of projects in the pipeline, including the Northern Metropolis and Kau Yi Chau Artificial Islands. When considering both the private and public sectors, the annual construction expenditure is projected to reach HK$300 billion in the coming years, representing a significant increase from the current HK$250 billion.

However, amidst these opportunities, we face significant concerns about the sustainability of our industry. Challenges such as an ageing workforce, manpower shortage, declining productivity, and unsatisfactory site safety performance cannot be ignored. The median age of our skilled construction workers is 54, and their

productivity is declining. Moreover, attracting young people to join our industry has become a challenge as they perceive it as a "3D" industry, characterized by being "Dirty", "Dangerous", and "Dull" industry. It is evident that we must bring about changes to address this pressing challenge.

Digitalisation has emerged as a key catalyst in this transformative journey, enabling us to unlock new possibilities and drive positive changes. By embracing digitalisation, our industry holds tremendous potential to shape a sustainable future, attract young talents, uplift productivity, and address global climate change.

Digitalisation empowers us to reimagine the way we plan, design, construct, and operate our built assets.

Since 2018, the Hong Kong SAR Government has been proactively promoting digital means of delivering and managing public works across different phases of the asset development lifecycle. Our efforts include the development of the Digital Planning and Design System (DPDS) and the adoption of the Digital Work Supervision System (DWSS) along with smart applications and Smart Site Safety Systems (SSSS) in public works contracts to enhance productivity, work quality, and site safety by reducing the required workforce and minimising human errors and workers' exposure to danger during construction. Additionally, the use of Building Information Modelling (BIM) has facilitated collaboration and optimisation throughout the entire lifecycle from planning to design, construction to operation and maintenance.

Furthermore, we are developing the **Integrated Capital Works Platform (ICWP)**, a centralised common data environment hub that collects, integrates, and analyses project data from various digital systems. This platform enables continuous monitoring of projects and built assets at a portfolio level, facilitating informed decision-making by the Government in a timely manner. In managing the Government's built assets, we are leveraging cutting-edge technologies such as Internet of Things (IoT), artificial intelligence (AI), and digital twin solutions. These technologies strengthen our capabilities to effectively tackle uncertainties, and forecast potential hazards like flooding, landslides, structural failures, and traffic impacts.

Digitalisation has had a profound impact on various domains and people's lives worldwide, and the construction industry is no exception. Digitalisation is the driver and catalyst for the transformation and evolution of our industry. By mastering digitalisation and smart technologies, we can shape a future where sustainability and construction go hand in hand, transforming our industry from the perception of being a 3D industry to "3A" industry, which stands for "Advanced", "Agile", and "Attractive".

I would like to take this opportunity to express my heartfelt gratitude to our honorable speakers for their valuable sharing today, and extended warm congratulations to the winners of the CDE awards, whose remarkable achievements in construction digitalisation deserve recognition. Fellow audience, I am sure that this Forum will prove to be a rewarding experience for each and every one of you. I wish today's Forum a great success. Thank you.

Day 2 AM

Global Construction Sustainability Forum (Environmental) – Construction Digitalisation

Digital Transformation for Sustainable Development-The Journey of Civil Engineering and Development Department

Mr. Michael FONG
Director of Civil Engineering and Development
Government of the Hong Kong Special Administrative Region

ABSTRACT

The Civil Engineering and Development Department (CEDD) of the HKSAR Government plays a crucial role in land supply and infrastructure projects. CEDD is also taking part in asset operation and management, e.g. maintenance of public marine structures and drainage tunnels, as well as achieving environmental sustainability. Over the years, CEDD has adopted various digital technologies to enhance the quantity, speed, efficiency and quality in project delivery. This paper highlights some of the CEDD's experiences in using digital technologies in different stages of a project life cycle. It showcases the use of digital technologies in enhancing project management, improvement of design and planning such as evaluation of sustainability measures, blue-green network and creation of highly livable and environmentally sustainable communities, as well as asset operation and management.

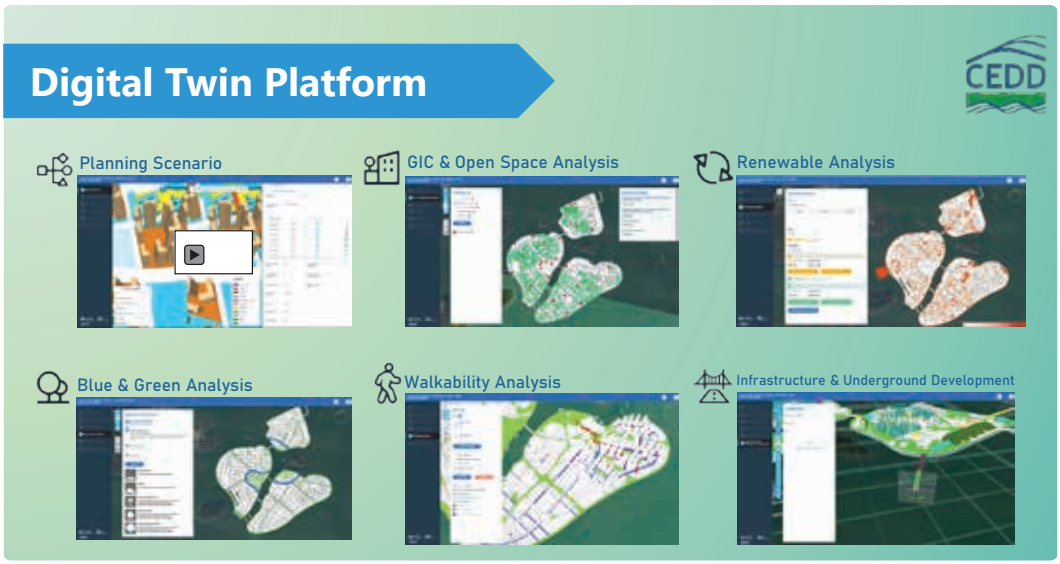
INTRODUCTION

The Civil Engineering and Development Department (CEDD) has been endeavouring to undertake infrastructure construction and land supply projects for the sustainable development of Hong Kong. Taking forward the smart and digital initiatives and realising the vision of making a smarter and livable future is absolutely not easy, which will require strong commitments at all levels within CEDD. CEDD has set up a Technological Innovation Steering Group which is led by Deputy Director of CEDD with members of selected colleagues to provide necessary support, resources and decision making on innovation matters.

CEDD has embarked on a journey of digital transformation of the whole project life cycle. Surfing on the waves of global digitalisation, CEDD strives for bringing new technologies to the projects, covering all stages in the whole project life cycle:

(a) Planning Stage
(b) Design Stage
(c) Construction Stage
(d) Asset Operation and Management Stage

Kau Yi Chau Artificial Islands



Digital twin platform

DIGITAL TECHNOLOGY TRANSFORMS PROJECT DELIVERY

Digital Twin Platform at Planning Stage

Being an important part of the Harbour Metropolis, the Kau Yi Chau Artificial Islands is an important land supply project for meeting the medium to long term housing, economic and social needs of Hong Kong, among which, CEDD plans to provide a new "work-live-play" Central Business District (CBD) and carbon neutral communities on the artificial islands.

The project adopts a "three-island" design to match with the surrounding environment and a "15-minute neighborhood" concept for planning of a livable community.

To facilitate the planning of this mega project, a digital twin platform has been developed. Six applications being used are detailed below:

(1) Planning scenario assessment

This application provides functions to visualise planning design morphology on a 3D map, allows project teams to instantly visualise and compare the changes in building morphology and related parameters including building placement, building height and land use, etc..

(2) GIC and open space analysis

This analysis allows project teams to get hold of the spatial distribution of facilities and the corresponding service areas, and thus ensure (i) the design can cater for the intended population, and (ii) GIC and open spaces provisions are located within walkable distance of communities.

(3) Renewable analysis

It helps to plan for carbon neutrality, allowing project teams to assess carbon reduction proposals and contributions of renewable energy on a 3D map.

(4) Blue and green analysis

It can give project teams a comprehensive picture of the effects of different tree planting and blue-green infrastructure proposals.

(5) Walkability analysis

This application evaluates pedestrian network proposals and arrangements, providing an efficient tool to assess whether the "15-minute neighbourhood" initiative can be achieved.

(6) Infrastructure and underground space development

It allows 3D visualisations of intricate multi-layers above and below ground infrastructures to facilitate better planning and analysis of their spatial disposition.

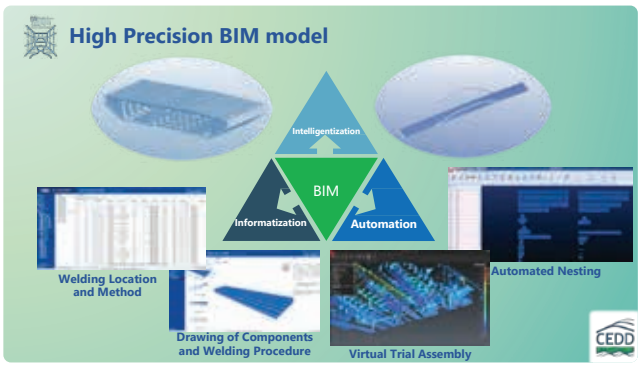
Through the digital twin, the planning proposals can be visualised and assessed on a 3D map platform, thus enhancing the land use design, the planning for carbon neutrality and walkability, as well as the design of various infrastructures and underground space development. In addition, the digital twin enhances the efficiency of the planning study.

Cross bay Link

Digital twin for the design of precast V-piers

BIM Application at Design Stage

CEDD embraces the vision of developing smart and green infrastructure for the betterment of Hong Kong. The Cross Bay Link (CBL) project is one of the mega projects of this kind. This project also demonstrates CEDD's excellence in using digital technologies to enhance project delivery and achieve environmental sustainability.



High precision BIM model

BIM is adopted to facilitate the formulation of the design scheme of the CBL, where significant usage of prefabrication units was involved, for buildability evaluation and progamme planning. For example, BIM is used to develop the design of the precast V-piers of the CBL and simulate the corresponding construction process. This has allowed all relevant parties to have a comprehensive appreciation and understanding of the overall design intent starting from the very early stage. The BIM does not only cover the permanent works design but also the prefabrication and assembly sequence as well as temporary works arrangement. It gives an accurate full picture to facilitate decision making by the designers.

The high precision BIM model allows off-site automated fabrication of the bridge. The 3D visualisation technology, the design, welding, assembly, quality control and even construction safety are all integrated in this BIM model. This has greatly enhanced the coordination and management of the design development process, resulting in significant improvement of the quality and productivity.

The use of digitalisation can also achieve the completion of the design in a paperless environment. Through the use of "VR3D" CIM Platform, the project team managed the BIM, GIS, 3D survey data, site photos with GIS information under one single platform, allowing seamless coordination among designers and relevant stakeholders.

Common Data Environment at Construction Stage

CEDD has commenced the journey of digitalisation in construction works for quite some time. CEDD's current focus is not only on the applications of digitalisation in individual construction contracts but linking up all smart devices and centralising project data from multiple contracts for better overall management. To this end, CEDD is actively developing an all-in-one Common Data Environment (CDE) for its projects. Kwu Tung North and Fanling North New Development Area project is one of the examples.

The first phase of this project has a total of seven numbers of contracts. The single CDE platform centralises data from all these 7 contracts. There are various stakeholders using the same platform. Apart from CEDD project teams, consultants, contractors, and Development Bureau sharing the synchronized data, other relevant Government Departments, e.g. future maintenance departments also access the data through the platform to enhance the coordination and decision-making process.

In this project, drone survey is conducted regularly over the site for preparation of 3D digital maps using photogrammetry technique. The maps are shared into the CDE platform. Together with the project BIM models, the CDE platform allows the project teams to visualise the construction sites in their office, and facilitate remote real-time monitoring, project management, design, coordination and interface review.

Kwu Tung North and Fanling North New Development Area project

Cross organisational CDE platform

For site works monitoring, over 100 nos. Artificial Intelligence (AI) cameras and over 300 nos. sensors have been installed. The project teams can monitor different key work fronts on the CDE platform and any alert messages that required follow-up actions. This CDE platform helps the project teams promptly react to the situations brought up by e.g. severe rainstorms and typhoons. Project teams can receive real-time information in the office, and work out action plans immediately for follow up by frontline teams. The CDE has also been connected to Smart Site Safety System to enhance the site safety control.

The first project in HK to integrate GIS, photogrammetry and BIM of 7 contracts in a single platform

All-in-one CDE manages AI cameras for round-the-clock site monitoring

IoT and Digital Twin Application at Operation and Management Stage

Digitalisation and use of IoT technology transform the operation of built facilities. To control the groundwater level in the Po Shan hillside, CEDD's project team has designed and constructed an innovative and sustainable groundwater regulation system, the "Po Shan Drainage Tunnel".

In recent years, the project team has developed a digital twin groundwater monitoring system for better control the groundwater level. The project team can visualise the alignment of the drainage tunnels, sub-vertical drains, piezometers as well as the surrounding site environment and geological profile on a 3D platform.

Smart sensors are installed for 7/24 real-time monitoring of the groundwater. The groundwater data are transmitted to the digital twin by IoT technology. 3D visualisation of any change in the groundwater regime can be made to enable control of groundwater level by adjusting valves attached to sub-vertical drains in all-weather conditions.

With the aid of this innovative technology, project team can manage the landslide risk, ensure public safety while maintaining a balanced ecosystem in the area, that is, not to drain too much groundwater out from the hillside that may result in adverse effect on the vegetation on the slope.

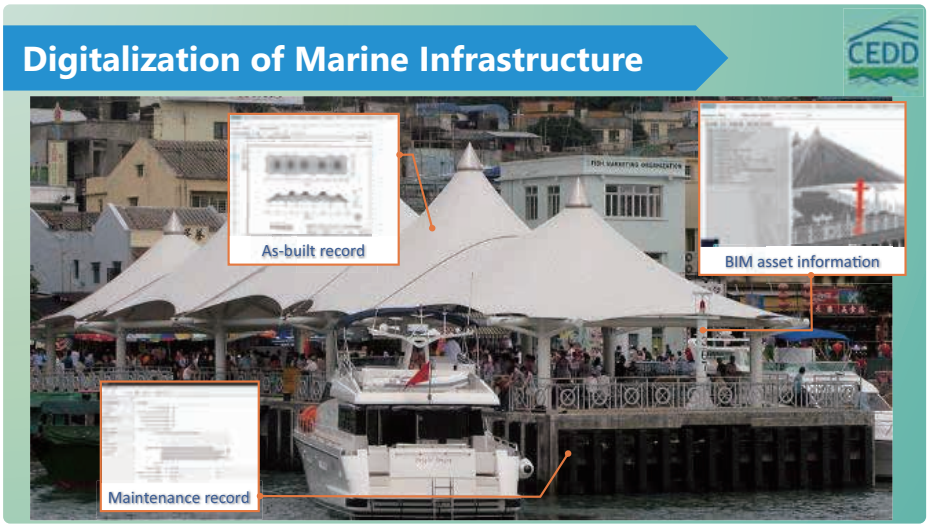
Po Shan Drainage Tunnel

Digital twin groundwater monitoring system

Furthermore, CEDD also digitalises the asset management system for the marine infrastructures. CEDD maintains more than 900 marine structures, including breakwaters, piers, seawalls, landings, etc. As part of the maintenance works, project teams are managing a huge volume of as-built drawings, inspection records, etc. over the years. Therefore, the project team has integrated BIM into the Port Maintenance Information System to enhance the quality and efficiency of the maintenance works.

CONCLUSION

CEDD has been actively adopting digital technology to improve its services. Many of the applications do not only drive service improvements, but also bring about environmental sustainability. CEDD will continue to collaborate and partner with academics and industrial practitioners on taking forward numerous smart and digital initiatives to drive further advancements of the services. CEDD's vision is clear – that is, developing a strong culture for embracing smart and digital initiatives as well as innovation in CEDD to serve the society better.



Digitalisation of the asset management for the marine infrastructures

Smart, Lean and Green-How Data Underpins Innovation in Built Environment Performance

Mr. Steve LEWIS
Partner & Head of Infrastructure, Major Programmes and Construction Advisory
Ernst & Young Transactions Limited Hong Kong

ABSTRACT

This paper explores the challenges and opportunities associated with meeting sustainable targets for infrastructure development. The three trilemmas faced in achieving sustainable infrastructure, namely finance, energy, and supply chain sustainability are discussed. It emphasizes the need for collective investment and collaboration across the entire industry to ensure a sustainable future. The role of data and technology are also discussed in driving innovation and efficiency throughout the asset lifecycle. The overarching ambition of creating better information, better efficiency, and better outcomes is examined, along with the economic, societal, and environmental benefits of investing in sustainable infrastructure. The paper concludes by emphasizing the importance of clear objectives, implementing necessary digitalization, and embracing innovation to address the challenges faced by the industry.

INTRODUCTION

Infrastructure development plays a crucial role in meeting the growing public demand for improved living standards and transitioning to a low-carbon economy. However, achieving sustainable infrastructure presents a complex set of challenges. This paper delves into the key points raised in the speech to provide a comprehensive understanding of the trilemmas faced and the need for sustainable practices throughout the industry.

THE TRILEMMAS OF SUSTAINABLE INFRASTRUCTURE

The three trilemmas faced in achieving sustainable infrastructure are, namely finance, energy, and supply chain sustainability. The finance trilemma encompasses challenges related to inflation, interest rates, and liquidity. Balancing the financial aspects of infrastructure development is essential to ensure long-term sustainability and avoid economic burdens. Careful financial planning and investment strategies are needed to address these challenges effectively. Moreover, investing in ways of making the industry sustainable is crucial to secure the necessary funds for sustainable infrastructure projects.

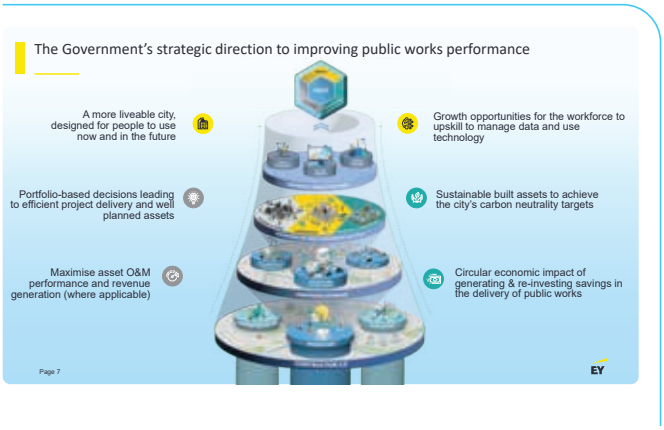
The energy trilemma focuses on three critical aspects: reaching net-zero emissions, ensuring energy affordability for all, and maintaining energy security and accessibility. Transitioning to renewable energy sources, such as wind and solar power, is paramount to reduce greenhouse gas emissions and combat climate change. Investing in ways to reach net zero requires collaboration between the public and private sectors to develop innovative energy solutions. Additionally, ensuring affordable energy for all is crucial to promote inclusivity and equitable access to resources.

The supply chain trilemma highlights the need for holistic sustainability throughout the infrastructure development process. Considerations such as the cost of materials and labour, environmental impact, and adaptability to change are vital for creating resilient and sustainable infrastructure. Investing in holistic sustainability through the supply chain ensures responsible sourcing of materials, promotes eco-friendly construction practices, and fosters long-term resilience in the face of changing environmental conditions.

COLLECTIVE INVESTMENT FOR INDUSTRY SUSTAINABILITY

While the government plays a significant role in leading sustainable infrastructure initiatives, collective investment from the entire supply chain is necessary. The importance of government investment in driving sustainable infrastructure development shall be emphasized. Governments must allocate adequate funding and create favourable policies and incentives to encourage private sector investment in sustainable infrastructure projects.

Data and technology offer immense potential for driving innovation and efficiency in infrastructure development. By leveraging technology, processes can be improved, and manual, paper-based systems can be replaced. The generation and analysis of data critical to addressing the trilemmas allow for informed decision-making and improved outcomes. Integration of smart technologies and the use of data analytics enable proactive maintenance, optimize resource allocation, and enhance overall project efficiency.



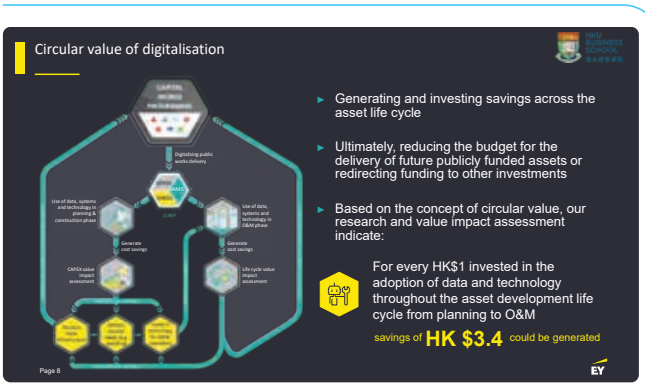
THE AMBITION OF SUSTAINABLE INFRASTRUCTURE

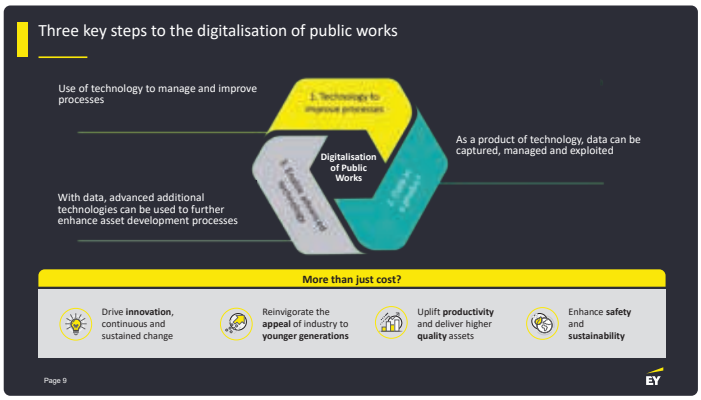
The Hong Kong government's Construction 2.0 strategy, initiated in 2018, sets the stage for achieving sustainable infrastructure. The strategy focuses on three core pillars: professionalization, innovation, and revitalization. Building upon these pillars, the industry aims to embrace innovation and digitalization, enhance productivity, and apply research and development to drive continuous improvement. Innovation, digitalization, and applied research and development are key elements in realizing the ambition of sustainable infrastructure.

The ambition of sustainable infrastructure lies in creating better information, better efficiency, and better outcomes. This goal encompasses three perspectives: societal, economic, and environmental. Societal benefits include designing more liveable cities, providing growth opportunities for the workforce, and upskilling in data and technology utilization. Economic benefits focus on efficient project delivery, planned asset management, and revenue generation. Environmental benefits aim to achieve carbon neutrality targets and promote circular economic practices. Better information, efficiency, and outcomes are crucial for creating sustainable infrastructure that meets the needs of present and future generations.

THE CIRCULAR EFFECT AND ECONOMIC IMPACT

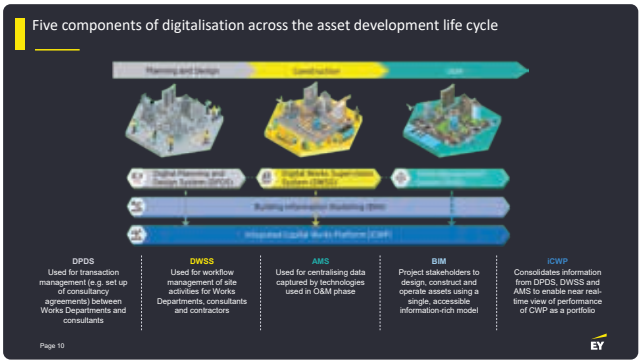
The circular effect plays a crucial role in maximizing the economic impact of sustainable infrastructure. By saving costs during the construction phase and reinvesting those savings into operational improvements, assets can be optimized throughout their lifecycle. Investing in sustainable infrastructure not only enhances economic growth but also promotes job creation and stimulates local economies. Additionally, sustainable infrastructure projects contribute to environmental stewardship by reducing carbon emissions, minimizing waste generation, and promoting resource efficiency. The economic impact of sustainable infrastructure is substantial, with studies showing a significant return on investment. For every dollar invested across the asset lifecycle, there is an estimated $3.4 return to the economy, demonstrating the potential for sustainable infrastructure to drive economic prosperity.

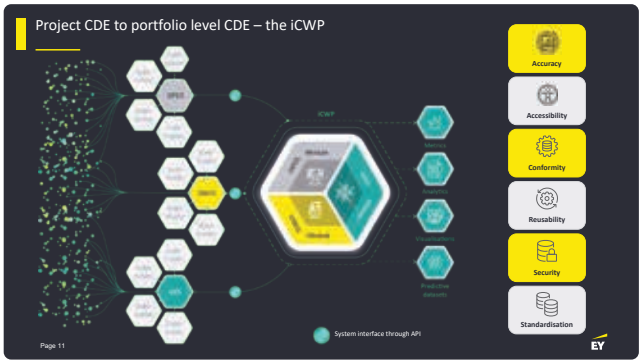




IMPLEMENTATION AND BEST PRACTICES

To achieve sustainable infrastructure, it is essential to implement data-driven solutions effectively. The paper emphasizes the need for a clear purpose in digitalization efforts and highlights the importance of innovation, attracting and retaining skilled professionals, improving productivity, and enhancing safety measures. The Integrated Capital Works Platform (ICWP), along with other digital solutions, consolidates data and facilitates informed decision-making at both project and portfolio levels. Implementing data-driven solutions enables efficient project management, enhances collaboration among stakeholders, and improves overall project outcomes.





CONCLUSION

Sustainable infrastructure development faces complex trilemmas that demand collective investment, innovative approaches, and robust data-driven decision-making. The paper has explored the finance, energy, and supply chain challenges and emphasized the need for collective investment and collaboration. It has highlighted the role of data and technology in driving innovation and efficiency throughout the asset lifecycle. The overarching ambition of creating better information, better efficiency, and better outcomes has been examined, along with the economic, societal, and environmental benefits of investing in sustainable infrastructure. By embracing clear objectives, adopting necessary digitalization, and embracing innovation, the industry can address the challenges it faces and pave the way for a sustainable future. Through these efforts, infrastructure can become a powerful enabler of economic growth, social well-being, and environmental stewardship. Investing in sustainable infrastructure is not only a responsibility but also an opportunity to create a better future for generations to come.

A Systems-based View of The Built Environment to Deliver Better Outcomes for People and Nature

Mr. Mark ENZER OBE FREng
Strategic Advisor
Mott MacDonald

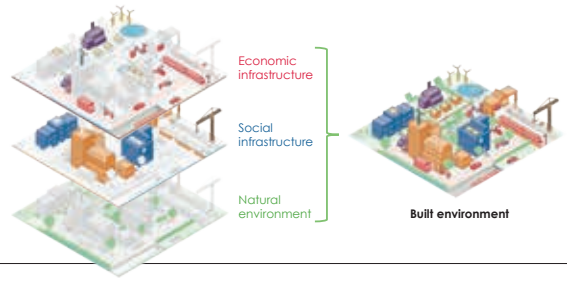
ABSTRACT

The built environment is a complex and interconnected system comprising economic and social infrastructure, with an interface to the natural environment. To address the challenges of climate change, sustainability, and resilience, a systems-based approach is crucial. This paper explores the significance of the built environment as a system of systems and the urgency to adopt a holistic perspective. It highlights the role of digitalization, including the establishment of a Common Data Environment (CDE), in integrating systems and driving transformative change. The paper discusses how a systems-based approach is necessary to address key systems-level challenges such as achieving Net Zero carbon emissions, providing climate resilience, delivering infrastructure equity and creating a circular economy. It emphasizes the importance of collaborative governance and stakeholder engagement in realizing a sustainable and resilient built environment. By recognizing the interconnectedness and complexity of the built environment, we can shape a future that prioritizes the well-being of both people and the natural world.

INTRODUCTION

The built environment plays a critical role in shaping the lives of individuals and the natural world. It encompasses a vast network of interconnected systems that contribute to economic infrastructure, social infrastructure, and their complex interface with the natural environment. The paper emphasizes the need to move beyond project-centric approaches to adopt a systems-based view of the built environment. By recognizing the inherent complexity and interdependency of these systems, the pressing challenges can be tacked, such as climate change, achieving sustainability, and promoting equitable and resilient infrastructure. This paper aims to explore the significance of the built environment as a system of systems, the urgency for a systems-based approach, and the role of digitalization and ecosystem connectivity in driving transformative change.

The built environment is a system of systems



THE BUILT ENVIRONMENT: AN INTERCONNECTED WEB OF SYSTEMS

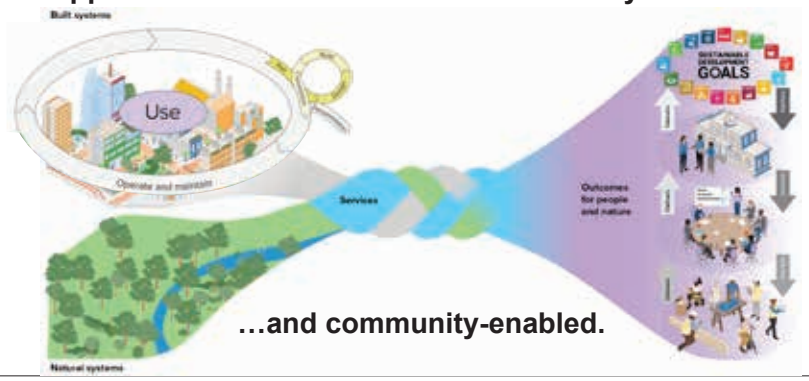
To grasp the true value of the built environment, we must acknowledge its interconnected nature and its role as a system of systems. The various layers of economic infrastructure, including energy, transport, water, waste, and telecoms, each intricately connected to one another. Furthermore, social infrastructure, encompassing hospitals, schools, commercial and residential buildings, relies on economic infrastructure. The complex interface with the natural environment further reinforces the interconnectedness of the built environment. This interconnected web of systems illustrates the intricate relationship between various components, emphasizing the need for a holistic approach.

THE URGENCY FOR A SYSTEMS-BASED APPROACH:

While the built environment itself is interconnected, the institutions that are responsible for it often operate in silos and lack integration. This fragmented approach can hinder progress and create inefficiencies in addressing system-level challenges. Climate change, as a prime example, affects the entire system rather than isolated components. To effectively combat climate change and other systemic challenges, a systems-based approach becomes imperative. By adopting a holistic perspective, we can develop comprehensive solutions that consider the entire ecosystem of the built environment.

An approach that is outcomes-focused and systems-based

An approach that is outcomes-focused and systems-based

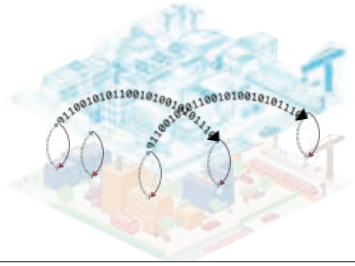


THE ROLE OF DIGITALIZATION IN SYSTEMS-BASED SOLUTIONS

Digitalization has emerged as a powerful enabler in transforming the built environment and driving systems-based solutions. It emphasizes the need to look beyond the digitalization of individual projects and to explore the potential of the digitalization of whole built systems. Digital twins, virtual replicas of physical assets, allow for right-time monitoring, simulation, and optimization of infrastructure assets, processes and systems. By federating digital twins to create ecosystems of connected digital twins, we can start to understand whole systems better and intervene more effectively. This digital ecosystem would enable stakeholders to make informed decisions, optimize resource utilization, and enhance overall system performance.

Connected digital twins

An ecosystem of connected digital twins



SUSTAINABILITY AND THE SYSTEMS PERSPECTIVE

Sustainability lies at the core of driving long-term benefits for both humanity and the natural environment. Sustainability is not merely an issue for individual projects but a concern that permeates the entire system of the built environment. Sustainability demands systems-based solutions in achieving net-zero emissions, providing climate resilience, promoting infrastructure equity, fostering a circular economy and protecting biodiversity. By making more sustainable material choices, such as using recycled or locally sourced materials, the environmental impact of the built environment can be significantly reduced. However, there is potentially even more environmental benefit from making better use of existing built systems. This approach recognises the role of built systems in delivering better outcomes for people and nature. It must align local, regional, and global outcomes to work harmoniously towards a sustainable future.

HARNESSING THE POWER OF COLLECTIVE ACTION

It recognizes that the responsibility for shaping a sustainable built environment lies with those who work within its industries. It emphasizes the agency and privilege we hold to effect positive change. It is not enough to passively witness the challenges faced by the planet but should actively engage and contribute to systems-level solutions. Adopting a systems-based approach enables the built environment to become a catalyst for achieving the SDGs, fostering sustainable development and a more inclusive and equitable future. By embracing a shared vision for the built environment, one that prioritizes the well-being of both people and nature, also fulfil duty to future generations.

CONCLUSION

The adoption of a Common Data Environment (CDE) is integral to a systems-based approach with centralizing data which supports collaboration, promotes decision-making, and facilitates the use of digital twins. This digital ecosystem enhances the understanding of the interconnectedness of the built environment's systems and empowers stakeholders to optimize performance, reduce carbon emissions, and contribute to climate change mitigation efforts.

The built environment is a complex and interconnected system, with profound implications for society and the environment. The paper shed light on the importance of adopting a systems-based view to address systemic challenges and promote sustainable outcomes. By acknowledging the intrinsic interdependencies within the built environment and leveraging digitalization and ecosystem connectivity, it is possible to unlock transformative potential.

By embracing a systems-based approach, Hong Kong can create a more sustainable, liveable, and climate-resilient city that serves as a model for others facing similar challenges. It is the collective responsibility to recognize the urgency and act as catalysts for change, shaping a built environment that enables people and nature to flourish together for generations to come.

TRUST: From Crisis to Sustainability... A Digital Construction Story

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KPMG

ABSTRACT

The global construction industry has reached a critical juncture, finding itself at the intersection of trust, crises and digital transformation. These dynamics represent an unprecedented set of challenges and opportunities for the industry. A real-world example that showcases the connections between these forces is the Opal Tower incident from Sydney, Australia.

The Opal Tower incident was a pivotal moment for the New South Wales construction industry with far-reaching consequences. This incident highlighted the importance of trust in business, how failures in trust can cause industry-wide crises, and the potential for these events to spur innovative and sustainable digital solutions.

The article will also turn to Hong Kong and draw parallels with the opportunities for innovation and transformation in the Hong Kong construction industry and potential to share insights and knowledge across leading global construction cities.

INTRODUCTION

The construction industry plays a crucial role in shaping cities, economies and communities but it is not immune to crises that bring far-reaching consequences for many stakeholders. This article delves into the relationship between trust, crisis and digital transformation in the construction sector, drawing insights from the Australian context. It examines the Opal Tower incident as a case study to understand the repercussions of failures in trust and the subsequent efforts that were required to rebuild confidence through industry reform and digital solutions. This article explores the potential of digital technologies to revolutionize the construction industry and foster sustainability. Finally, this article will draw parallels with Hong Kong and the unique opportunity for its construction industry to embrace increasingly proactive approaches towards the adoption of innovation.

THE SIGNIFICANCE OF TRUST

Trust is a fundamental pillar of any successful business endeavour, where the actions of a single company, project, or individual can have wide-reaching consequences for an entire business sector. Enron of the early 2000s, Cambridge Analytica and the FTX downfall are examples of the actions of one company or individual(s) having negative consequences for entire industries and communities – economic downturn, loss of employment, and erosion of public confidence are just some of the potential outcomes of such incidents.

The same potential consequences hold true for the construction industry – whether it be caused by engineering fraud, destruction of data, or megaproject time and cost blowouts. These and many other failures of trust continue to plague the construction industry around the world. Whilst many business and construction crises begin with a failure of trust, these circumstances also create opportunities for transformation, reform, innovation and growth – and the state of New South Wales provides an example of such, when it turned the Opal Tower construction failure in Sydney into an exciting reform opportunity supported by digital solutions.

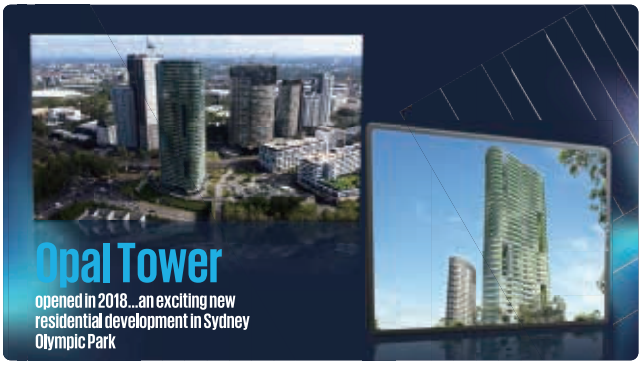
THE OPAL TOWER INCIDENT

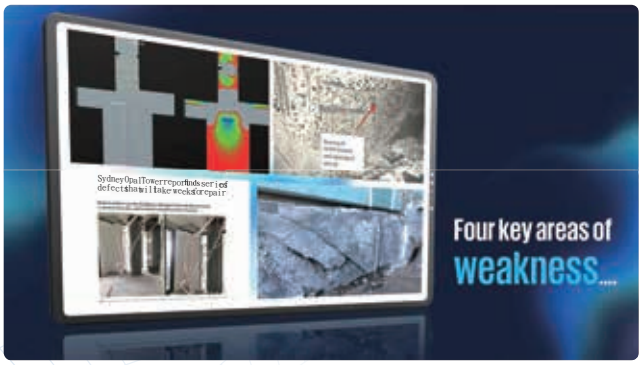
The Opal Tower incident served as a wake-up call for the New South Wales construction ecosystem, highlighting the need for enhanced governance, improved quality control, policy intervention and greater oversight to prevent similar incidents in the future.

The Opal Tower is a residential high-rise building located in Sydney Olympic Park, New South Wales, Australia – the home of the Sydney 2000 Olympic Games, approximately 15 kilometres west of the Sydney Central Business District. The tower was completed in 2018 and comprises 392 apartments across 36 above ground storeys and 3 basement levels. However, on Christmas eve 2018 crisis struck. On that evening, residents of Opal Tower reported hearing loud cracking noises and observed significant damage, including cracked walls and floors, leading to the evacuation of residents and the implementation of emergency measures to ensure the building's safety. This was the first of two large scale egress incidents, the second occurring just days later following more detailed reviews of structural aspects of the building[1].

In response, the New South Wales Government engaged Professors John Carter and Mark Hoffman to investigate a series of issues related to the cracking observed in the building. The investigation revealed the core causes of the damage were related to hob beam (a structural beam that typically rests on a concrete slab acting as a base for other pre-cast panel structures) design and construction in a series of locations across the building – these included:

- Inadequate hob beam/panel assembly, according to the National Construction Code and Australian Standard for Concrete Structures
- Partial grouting of joints between hob-beams and panels, which raised the stress levels on certain hob beams
- Construction and materials deficiencies, including the use of lower-strength concrete in certain hob locations[2]





1 Unisearch, Opal Tower Investigation – Final Report, 19 February 2019

2 Ibid

The incident generated immediate cost consequences for a series of project stakeholders. The building developer and its insurers spent approximately A$42million on rehousing, relocating and broader services to affected tenants[3]. There was also a dramatic fall in the volume of apartment sales (recording an approximate decline of 30% in strata sales volumes across New South Wales for the quarter ended March 2019 compared with the previous March quarter[4]) and new tenancies in the aftermath – having a material financial impact on dwelling owners. Buyer confidence in the broader Sydney residential apartment market also fell –leading to reduced development and investment in this market for an extended period. The latter factor arguably being a contributor to the housing crisis that is being widely reported in the Sydney media in the current time[5].

This incident has also had a prominent impact on consumer attitudes and behaviour. A 2022 analysis from the New South Wales Government[6] confirmed that trustworthiness is one of the greatest barriers to entering the housing market, with 30% of survey participants saying they don't trust developers and 24% saying they don't believe apartments are well constructed. Reinforcing the importance of trust, 60% of prospective buyers indicated that a lack of knowledge as to building defects is a major disincentive to purchasing and 77% of prospective buyers strongly agree that a building compliance measure would give them more confidence to purchase an apartment – with 68% willing to pay more for that peace of mind.

This failure also became a highly visible and dramatised source of news media across Australia – national television, newspaper, online and social media formats reporting the story for many weeks and months – sparking public outcry, raising concerns about the quality of construction in the local industry, and was arguably the prompt for investigations into issues affecting the construction industry in New South Wales. In short, this singular failure of trust triggered far-reaching consequences for the entire residential (and arguably wider) apartment construction ecosystem in New South Wales.

SIX KEY AREAS OF REFORM

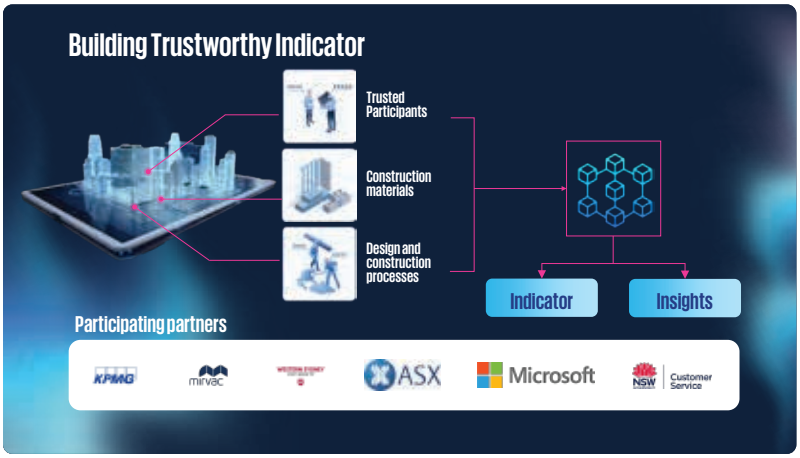
In the aftermath, the Government of New South Wales took a series of steps to address the vulnerabilities that surfaced during the Opal Tower incident. This started with the appointment of a Building Commissioner in 2019[7], Mr. David Chandler OAM, to transform the industry and embark on a major reform program. This subsequently led to the formal establishment of the New South Wales Building Commission in 2023, a new buildings regulator designed to provide an integrated and consistent approach to ensuring confidence in residential building quality[8].

In the midst of these governance initiatives, in 2021 the New South Wales Government released Construct NSW, a policy initiative focused on 6 areas of reform[9]:

1. Regulation: Customer focused regulatory framework
2. Key player ratings: Ratings system of builders to provide greater transparency
3. Education: Programs designed to lift skills and capabilities across the industry
4. Contracts: Strengthening contracts and standards between builders and project owners
5. Digital tools: Using digital platforms to drive enhanced accountability
6. Data and research: Using data and research to deliver continual improvement in practice

3 Australian Financial Review, Opal Tower builder Icon claims victory in $42m stoush over costs, 11 November 2020
4 New South Wales Government Sales Report, by DCJ Statistics
5 Sydney Morning Herald, The shocking statistic that illustrates Sydney's housing crisis, 2 January 2024
6 Construct NSW, The state of consumer confidence, May 2022, McCrindle
7 New South Wales Government, *Building Commission NSW*, 2023, https://www.nsw.gov.au/housing-and-construction/building-commission#:~:text=David%20Chandler%20OAM%20was%20appointed,in%2Da%2Dlifetime%20reform
8 Ibid
9 New South Wales Government, *Construct NSW Update Report*, 2021, https://www.nsw.gov.au/sites/default/files/2021-02/Construct%20NSW%20Update%20Report%20February%202021.pdf

Under each of these areas, a series of programs and initiatives have been released that are designed to help enhance the quality of practice and behaviour across the industry, rebuild trust within and into the construction space as well as paving the way for a more resilient and stable built environment.



RESTORING TRUST: BUILDING TRUSTWORTHY INDICATOR

As part of this program of reforms, major efforts have occurred in developing data-driven digital tools to drive increased accountability across the building supply-chain, prevent builders from cutting corners, mitigate cost and risk constraints and support the rebuilding of trust. One such solution is the Building Trustworthy Indicator. The Building Trustworthy Indicator is designed to enhance trust, transparency, and data enablement throughout the construction process and the entire supply chain. It evaluates the trustworthiness of participants based on their industry track record, licenses, reputation and other data sets. It gathers evidence on compliance associated with all materials used in a building project, including their origin, composition, and manufacturing processes.

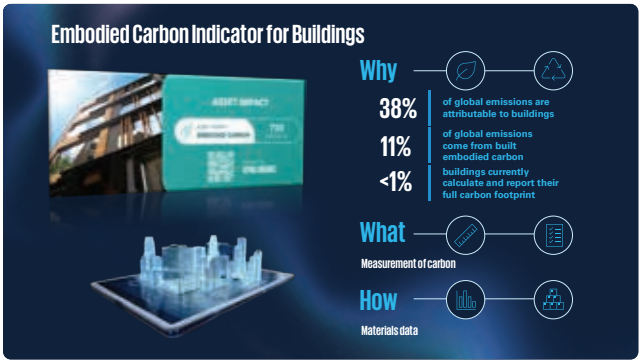
By analysing the documents and processes involved, this solution provides insights into the underlying quality and veracity of a building project. All of this data is stored on a blockchain ensuring complete traceability, auditability, and encryption. The indicator employs advanced mathematical modelling and offers an easy-to-understand dashboard that assesses the trustworthiness of individual buildings across multiple dimensions, such as structure, building envelope, fire safety systems, waterproofing, and building services.

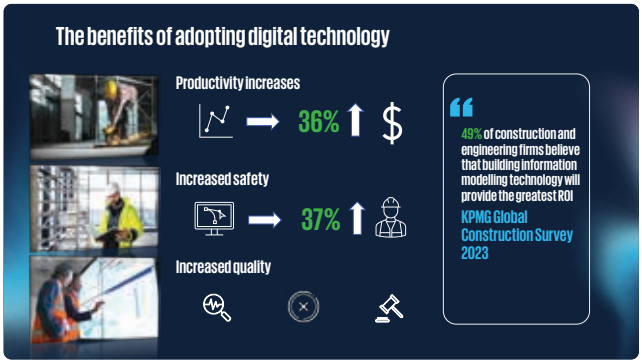
At the time of writing, the solution has been embraced by a range of real estate developers and project owners in New South Wales, working in partnership with their construction partners to increase the integrity and quality of their projects. This solution has been developed by KPMG Origins with the support and contribution of New South Wales Government.

INNOVATION LEADS TO INNOVATION: THE EMBODIED CARBON INDICATOR

A positive consequence of the development of the Building Trustworthy Indicator was the subsequent development of the Embodied Carbon Indicator for buildings. With construction and building operations being a major contributor to global carbon emissions (approximately 39%)[10], the industry value chain has a major responsibility towards reducing global emissions. However, according to a 2023 KPMG survey only 7% of project owners currently calculate embodied carbon in their buildings[11], confirming the high volume of transformation required across the global industry.

The Embodied Carbon Indicator was developed using the same blockchain technology as the Building Trustworthy Indicator and offers a digital solution that enables the measurement, benchmarking, and reporting of the carbon intensity associated with building materials across all aspects of a building. By providing this data, it creates a feedback loop that allows participants to learn from previous projects and improve future designs, aiming to reduce carbon intensity and shift the narrative from the construction industry being a sustainability laggard, to that of a proactive industry taking big strides forward in the race to net zero. This solution has been developed by KPMG Origins with the support and contribution of NSW Government[12].





CRISIS TO SUSTAINABILITY: BENEFITS AND FUTURE IMPLICATIONS

From crisis to sustainability, the Building Trustworthy Indicator and the Embodied Carbon Indicator demonstrate how technological advancements can lead to further innovations, enabling continuous industry improvement and broader environmental and socio-economic benefits to communities.

At an industry level, the implementation of these digital solutions and wider industry reforms led by the New South Wales Government have yielded material benefits for the local construction market. These include enhanced governance, improved transparency, increased accountability and greater levels of industry confidence – helping to re-establish the virtuous circle of innovation to investment to growth. These factors are important in driving greater levels of public and private infrastructure investment, growth in industry employment opportunities across the social spectrum, as well as new and exciting career pathways for industry practitioners.

These and other digital solutions have also been shown to improve productivity when it comes to cost, carbon intensity and resource intensity – and whilst significant investment will be necessary in the future, the industry is increasingly alert to these benefits. According to KPMG's 2023 Global Construction Survey[13], approximately

10 World Green Building Council, *Bringing embodied carbon upfront*, 2019, https://worldgbc.s3.eu-west-2.amazonaws.com/wp-content/uploads/2022/09/22123951/WorldGBC_Bringing_Embodied_Carbon_Upfront.pdf

11 KPMG, Familiar challenges, *new solutions*, 2023, https://kpmg.com/au/en/home/insights/2023/06/global-construction-survey-trends-2023.html

12 Embodied Carbon Indicator, KPMG Origins, https://kpmgorigins.com/embodied-carbon-measurement

13 KPMG, *Familiar challenges, new solutions*, 2023, https://kpmg.com/au/en/home/insights/2023/06/global-construction-survey-trends-2023.html

36% of all global construction companies are experiencing the greatest return on their investment in research and development through data enablement.

Last but not least, digital solutions such as these also provide strong impetus to ensure the highest levels of governance and practice when it comes to site safety. With data visibility enabling traceability and personal accountability, less corners will be cut resulting in reduced building failure incidents and improved safety practices – leading to safer sites and greater trust in the system.

HONG KONG: WHY WAIT FOR A CRISIS TO INNOVATE?

Turning the discussion to Hong Kong, this Australian story of crisis to transformation demonstrates how innovation can emerge from failures of trust. Hong Kong has also faced its share of challenges in the construction industry in recent years, and both the industry and Government have responded with a wide range of reform initiatives, industry innovations and digital solutions.

The central question that arises from this discussion is why should the construction industry wait for a failure of trust or crisis before embarking on an innovation program or commitment to invest in growth? Whilst trust can undoubtedly be re-built off the back of crises, trust can also be built from proactive investment in research and development, adoption of best practice governance, technology adoption, modern methods of procurement and initiatives designed to attract the brightest and best talent from across the world.

This proactive model represents a tremendous and potentially unique opportunity for Hong Kong to position itself as a global leading city in construction innovation. With a record construction pipeline projected to be over HK$300 billion (approximately US$39 billion per annum equivalent) in the coming years, in addition to the exciting Northern Metropolis[14] and Kau Yi Chau Artificial Islands[15] Mega Cities Projects on the horizon, this pipeline creates a helpful testing ground for piloting and implementing new solutions across procurement, design, data, construction, governance, asset management and other innovations – learning from successes and failures and passing them onto future projects and partners.

Whilst many ingredients will be required to succeed on this journey, to seize the opportunity and build resilience against future trust crises, partnerships across the construction industry will also be key. The reforms and digital solutions generated from the New South Wales experience were the result of collaborations between government, academia, consultants, developers, and technology companies. The same approaches can be applied in Hong Kong (and indeed other construction markets) to unlock new innovations with the potential to drive significant industry, social, environmental and economic benefits – whilst providing a showcase for knowledge sharing and further innovation with other leading construction cities and geographies around the world.

14 Northern Metropolis, https://www.nm.gov.hk/en/

15 KYC Artificial Islands, https://www.centralwaters.hk/en/

Digitally Enabled Carbon Reduction & Management for Construction

Mr. Kevin O'BRIEN
Chairman
Business Environment Council

ABSTRACT

This paper discusses the imperative need for carbon reduction and management in the construction industry in the face of the ongoing climate crisis. It focuses on Gammon Construction's commitment to achieving net-zero emissions and highlights the importance of setting interim targets and utilizing science-based initiatives to drive ambitious climate action. The paper emphasizes the role of data and innovation in achieving sustainability goals and explores various strategies and technologies that can be adopted in the construction sector to reduce carbon emissions. Furthermore, it emphasizes the significance of collaboration, particularly with the younger generation, in creating a collective effort towards a sustainable future. It concludes with a call to action for the construction industry to actively participate in the energy transition and take immediate steps to remove carbon from their projects.

INTRODUCTION

In a recent speech, professionals and construction people are urged to recognize the climate crisis as their personal responsibility and aware an opportunity to make a positive impact on Hong Kong's future. It emphasized the importance of aligning with the government's climate action plan and highlighted the journey towards achieving net-zero emissions within the industry. The key points include setting interim measures, removing coal from our power stations, reducing carbon emissions through sustainable materials, fostering collaboration across the supply chain, and engaging the younger generation in driving sustainable change.

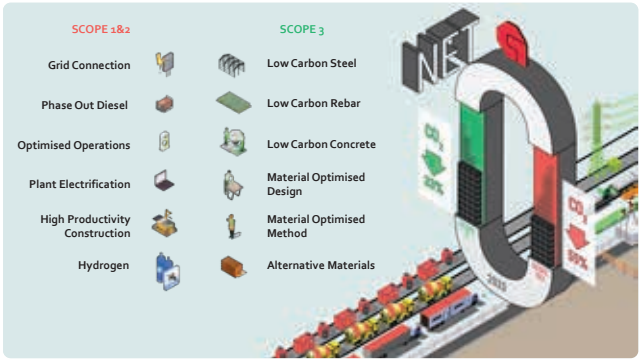
SETTING INTERIM MEASURES: A PATH TO NET ZERO BY 2050

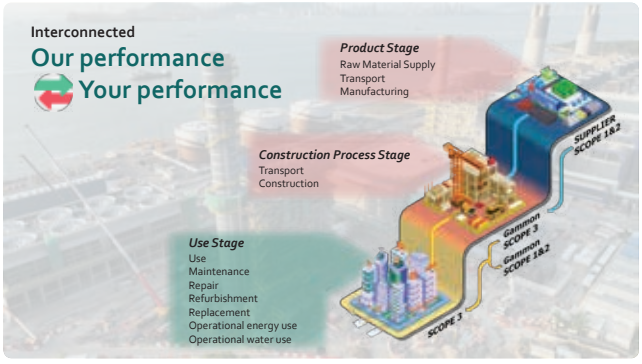
There is an importance of setting interim milestones to ensure progress towards long-term sustainability goals. Acknowledging the urgency of the climate crisis, the construction industry must take immediate action. By embracing interim measures, such as transitioning to renewable energy sources and implementing energy-efficient technologies, the industry can begin to address its environmental impact. Notably, initiatives like the Science Based Target Initiative (SBTI) provide a framework for businesses to set near-term ambitious targets aligned with climate action plans, facilitating the reduction of emissions.

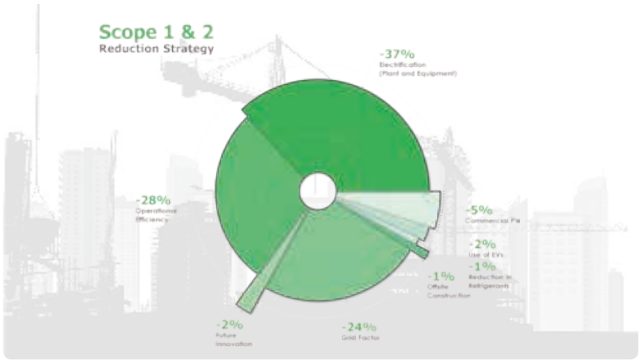
SUSTAINABLE MATERIALS AND CARBON PERFORMANCE

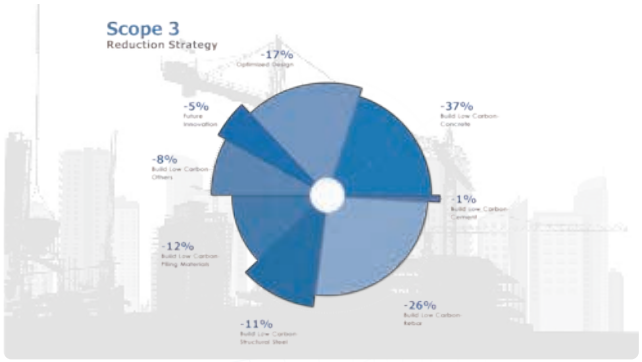
To achieve net-zero emissions, the construction industry must prioritize the adoption of sustainable materials and evaluate their carbon performance. It is important to shift towards materials with a lower carbon footprint throughout the project lifecycle. By utilizing less carbon-intensive materials, such as low-carbon concrete and recycled steel, the industry can significantly reduce its climate impact. Traditional concrete production is a significant contributor to carbon emissions due to the high energy requirements for cement production. Alternative cementitious materials and optimizing the concrete mix design can reduce the carbon footprint of concrete significantly. These solutions can maintain or even improve the structural performance of buildings while minimizing their climate impact.

Recycled steel is another sustainable material that can contribute to emissions reduction. Steel production is energy-intensive and generates substantial carbon emissions. By incorporating recycled steel in construction projects, the industry can reduce the demand for primary steel production, thereby decreasing the associated carbon emissions. Additionally, recycling technologies have made it possible to achieve high-quality steel with properties comparable to virgin steel, ensuring its suitability for various applications in the construction sector. Evaluating the carbon performance of materials within the supply chain allows for informed decision-making and promotes the use of greener alternatives, thereby reducing emissions and fostering responsible sourcing practices. By considering factors such as embodied carbon, resource depletion, and environmental toxicity, construction professionals can make more sustainable choices that align with their net-zero goals.









DIGITAL SOLUTIONS

Optimized design is a crucial component in achieving sustainability goals, but often, the decision-making power lies with design and build transactions. Collaboration with customers and consultants becomes essential to realize optimized designs and bring sustainable solutions to life. Integrating digital solutions for decarbonization is a key aspect, as it enables various benefits such as safety improvement, cost efficiency, and productivity enhancement.

For instance, the deployment of sensors across the entire plant fleet has allowed for real-time monitoring and analysis. Engineers, project managers and stakeholders can identify opportunities for optimization which provides insights into asset capacity, potential inefficiencies, real-time carbon performance and safety margins.

Furthermore, the Common Data Environment (CDE) provides a framework for managing and sharing project data, facilitating collaboration and knowledge exchange. The CDE ensures that stakeholders have access to accurate and up-to-date information, enabling them to make informed decisions that align with sustainability objectives.

COLLABORATION ACROSS THE SUPPLY CHAIN: A COLLECTIVE RESPONSIBILITY

The paper highlighted the significance of collaboration across the supply chain to achieve sustainability goals. Supply chain members were urged to understand the carbon performance of the products and services they provide, ensuring that small and medium-sized enterprises (SMEs) are aware of the sustainability journey and actively participate in improving their carbon performance. Effective collaboration enables exchange knowledge, share best practices, and identify opportunities for collective improvement. For instance, construction companies could collaborate closely with material suppliers to promote the adoption of sustainable materials, encourage product innovation, and drive down carbon emissions. Training programs, engagement workshops, and industry events can provide valuable platforms for sharing expertise and raising awareness about sustainable construction practices.

The introduction of hydrogen fuelling for buses and the groundbreaking of a fuel station in Kam Tin represents crucial steps towards a sustainable future and demonstrate the industry's commitment to embracing innovative solutions. Each of these small steps contributes to the collective effort of the industry in achieving sustainability goals.

Furthermore, it is possible to establish performance metrics and targets that incentivize sustainable practices throughout the supply chain. For instance, construction companies could implement supplier evaluation processes that consider environmental criteria, including carbon performance and responsible sourcing, as key factors in supplier selection. By incorporating sustainability metrics into procurement decisions, the industry can incentivize suppliers to improve their sustainability practices and promote the availability of greener alternatives.

Collaboration across the supply chain also extends to contractors, designers, and other stakeholders involved in the construction process. By fostering a collaborative spirit, the industry can overcome challenges collectively and drive systemic change. Sustainable construction practices should be embraced as a shared responsibility, where all participants actively contribute to the industry's transformation.

ENGAGEMENT WITH THE YOUNGER GENERATION

Recognizing the unique perspective of the younger generation, the paper appealed to the audience, particularly the younger individuals, to actively participate in shaping the industry's sustainability efforts. The speech highlighted the difference in upbringing, with younger generations growing up with heightened awareness of environmental issues. Organizations were encouraged to engage with young employees, tapping into their ideas and aspirations. By listening to their voices, the industry can align its objectives with the future generation's vision, ensuring a sustainable and inclusive future.

CONCLUSION

There is an urgent need for the industry to address the climate crisis and work towards achieving net-zero emissions. By embracing measures such as setting interim targets, reducing carbon emissions through sustainable materials, fostering collaboration across the supply chain, and engaging the younger generation, the industry can make significant progress towards a sustainable future. The speech serves as a call to action, urging industry professionals to take responsibility for their actions and contribute to Hong Kong's journey towards net-zero emissions. By embracing these measures, the construction industry can play a pivotal role in mitigating climate change and creating a greener and more resilient Hong Kong.

Day 2 PM

Global Construction Sustainability Forum (Governance) – Green Finance

Welcome Remarks

Ir Rocky POON
Chairperson
Committee on Construction Business Development and Mainland Liaison of Construction Industry Council

Distinguished,
Mr. Christopher HUI,
Ir John Kwong,
Ir Thomas HO,
Prof. CHEN Xiangsheng（陳湘生院士）,
and all honorable speakers, ladies and gentlemen. Good afternoon. Welcome to Green Finance and GBA Construction Session of GCSFE.

First of all, let me thank the Secretary Mr. Christopher HUI, for coming to GCSFE and share the opening address with us. Let us give a round of applause!

It comes to second day of GCSFE which is signature event of CIC. So far we have attracted thousands of experts, entrepreneurs, government officers and construction industry partners here to exchange our knowledge, experience and business about the construction sustainability. Hong Kong has been positioning itself as Asia's green finance hub for raising green capital. The construction industry is a significant contributor to Hong Kong's GDP, and it has high potential to meet the trend of green finance. Green finance can mobilize capital for green and low-carbon investments in the construction industry, and stakeholders can seek opportunities for long payback initiatives and low-interest rates when adopting advanced and innovative measures.

Today, we are honored to have top experts from Standard Chartered, Credit Agricole Corporate & Investment Bank, and HSBC, to share their insight and best practice on this area.

Besides, the development of construction sustainability relies not only Hong Kong itself, but also need collaborate with our GBA and even mainland's advantage. GBA is a rapidly growing economic region that has enormous potential for green development.

Hong Kong has to leverage its advantages of "背靠祖國、聯通世界", and make good use of the technology and talents in the GBA, to apply their best practices of sustainability construction in Hong Kong. Today, we are honored to have Prof. CHEN Xiangsheng, Academician of Chinese Academy of Engineering, to share the cutting-edge construction technology in GBA. Besides, we also have Associate Professor FENG Wei, and entrepreneurs and executives from Guangzhou Municipal Construction Group, Shenzhen Institute of Building Research Co., Ltd, and Xuzhou Construction Machinery Group to share the development of construction sustainability in GBA.

Sincerely, I thank all speakers for your valuable sharing, and I wish all the guests here would have an enjoyed and fruitful afternoon!

Opening Address

Mr. Christopher HUI
Secretary for Financial Services and the Treasury
Government of the Hong Kong Special Administrative Region

Distinguished guests, ladies and gentlemen, good afternoon.
It is my great pleasure to join you at the CIC Global Construction Sustainability Forum today. I am very pleased to see that the forum will feature lots of insightful topics and has gathered many industry experts here to share views on creating a greener and sustainable future for Hong Kong.

Undoubtedly, the global community is facing huge and urgent climate challenges, and financial services will be a key tool for mitigation and transformation. Market estimates show that in the coming three decades, the Asian region alone will require US$66 trillion in climate investment and global gross climate mitigation investment will need to reach about US$5 trillion annually by 2030. These reflect the immense demand for green finance.

On this Hong Kong is well positioned to contribute our part, as our green and sustainable finance market is developing with rapid growth. The total green and sustainable debt (including both bonds and loans) issued in Hong Kong increased by over 40 per cent from 2021 to reach US$80.5 billion last year, among which the volume of green and sustainable bonds arranged in Hong Kong accounted for 35 per cent of the Asian green and sustainable bond market, topping the league table of the region.

As a green and sustainable hub, Hong Kong is unwaveringly committed to achieving carbon neutrality and strives to expedite our position as a leading international green financial centre. As announced in the 2023-24 Budget, the Government will proceed in five directions, including (a) building a green technology ecosystem; (b) green finance application and innovation; (c) green certification and alignment with international standards; (d) training for talent; and (e) enhancing the exchange and co-operation with the Guangdong-Hong Kong-Macao Greater Bay Area and international markets. In the

future, we will actively engage relevant stakeholders to build Hong Kong into an international centre for green technology and finance so as to leverage the tremendous opportunities across the Mainland, Asia and the rest of the world.

Data and technology play an important part for green transformation, and it is one of our key priorities for development. In June this year, the Financial Secretary has set up the Green Technology and Finance Development Committee to provide an important platform to promote Hong Kong as an international green technology and financial centre and to showcase Hong Kong's advantages to the world.

Also, the Green and Sustainable Finance Cross-Agency Steering Group announced in December last year that it had entered into a collaboration arrangement with CDP and developed a Climate and Environmental Risk Questionnaire for Non-listed companies/small and medium-sized enterprises. The Questionnaire is intended to assist the sustainability reporting processes of corporates concerned and raise their sustainability visibility to lenders, investors and supply chain clients for better accessing sustainability financing. It will also facilitate financial institutions' collection and assessment of company-level data for risk assessment and relevant business decisions. We will also develop a data portal to increase the availability and accessibility of climate-related data collected through the SME Questionnaire.

With a view to boosting Hong Kong's competitiveness in capturing the business opportunities and supporting net-zero transition, the Government has been making significant efforts in cultivating our talent pool required to empower green transformation. Meanwhile, we will continue to encourage the participation of market practitioners and related professionals in training through the Pilot Green and Sustainable Finance Capacity Building Support Scheme launched in December 2022. Market practitioners and related professionals as well as students and graduates of relevant disciplines can apply for a subsidy of up to HK$10,000 after completing eligible programmes or accomplishing relevant qualifications.

At the end of this month, the COP28 conference will convene in Dubai, United Arab Emirates, to gather the global efforts in combating climate change. We look forward to hearing the inspiring discussion for fostering sustainability on a worldwide scale.

Ladies and gentlemen, green economic transformation will be the new engine for global economic growth. Our collective commitment and efforts will be crucial in establishing the foundation for a sustainable economy benefitting all of us. We value the opportunity to engage you to embrace sustainability and continue to develop Hong Kong as an international green finance centre.

Thank you, and I wish you all a most rewarding forum today.

Green & Sustainable Finance Market and Products Overview

Ms. Tracy WONG Harris
Executive Vice President
Hong Kong Green Finance Association
Managing Director, Head of Sustainable Finance Asia
Standard Chartered

ABSTRACT

The paper provides an overview of the sustainable finance market and product development before presenting the main findings of a Greater Bay Area (GBA) decarbonization report. The report analyzed various decarbonization pathways and solutions for key sectors and made recommendations on using finance to facilitate businesses' transition to carbon neutrality.

INTRODUCTION

In recent years, sustainable finance issuances and borrowings have been steadily and increasingly growing in both Asia and globally. The market's sophistication is also evident through rising volumes in issuance and lending in various formats such as green bonds and green loans. As of YTD 2023, over USD 1.1 trillion in sustainable debt instruments were issued, bringing the total volume of the sustainable market to over USD 6 trillion. Asia contributes approximately 25% of the total market size and has demonstrated even stronger growth in recent years, particularly in the previous year. While we have observed a global decrease in the market, Asia continues to experience double-digit growth. Additionally, the market is exhibiting increasing sophistication, as evidenced by growing volumes in issuance and lending in various formats, including Social Bonds, Sustainability Bonds, Sustainability-linked Bonds, and Loans. Although green bonds remain a prominent component in the global and Asia markets, the sustainability-linked market has experienced substantial growth over the past two to three years.

The Hong Kong Green, Social and Sustainable (GSS+) debt market has emerged as a market leader in Asia. According to the 2022 report, it has seen substantial growth, reaching $80 billion with a strong year-on-year increase of 43%. It is noteworthy that more than 50% of the use of proceeds from Hong Kong government's green bond program is allocated to the green building sector. Additionally, sustainability-linked loans (SLLs) accounted for over two-thirds of the GSS+ loan market, with 50% from financial institutions and the real estate sector.

DECARBONISATION PATHWAYS AND HOW FINANCE CAN ACCELERATE THE BUSINESS TRANSITION TO A LOW-CARBON ECONOMY IN GBA

Green and Sustainable Finance Products

The main Green and Sustainable Finance products in the market are presented in Table 1.

Other than Green Bonds and Green Loans, there are additional financial products worth noting. Sustainable Deposits enable firms and individuals to allocate their funds to green and sustainable assets. Derivative transactions linked to green products have also been observed. In the construction industry or within the supply chain of small and medium-sized enterprises, sustainable trade plays a critical role in various forms of financing such as import financing, import line of credit (LOC), letter of credit, and bank guarantee.

Additionally, cash management options such as current accounts and saving accounts can be converted to green and sustainable formats.

Lastly, a well-functioning carbon trading market can expedite the transition to sustainability. In China, there are national and regional markets. In Europe, the EU Emissions Trading System (EU ETS) is utilized. In Hong Kong, a voluntary carbon market has been introduced.

These are a brief description of the green and sustainable financing products currently available in the Hong Kong market.

Product Suite			
Loans 貸款	**Bonds 債券**	**Deposits 存款**	**ESG Advisory**
• **Green Loans** 綠色貸款: Green use of proceeds • **Sustainability-linked Loans (SLL)** 可持續發展掛鉤貸款: pricing is linked to ESG performance • **Transition Loans** 轉型貸款: for companies which are in greenhouse gas (GHG) intensive industries such as extractives, chemicals and transportation, but do have financing needs to reduce their GHGs	• **Green Bonds** 綠色債券: enable capital-raising for new and existing projects with environmental benefits • **Social Bonds** 社會債券: proceeds exclusively applied to finance social projects • **Sustainability Bonds** 可持續發展債券: bonds with a mix of social and green elements • **Transition Bonds** 轉型債券: for companies which are in greenhouse gas (GHG) intensive industries such as extractives, chemicals and transportation, but do have financing needs to reduce their GHGs	• **Sustainable Deposit** 可持續發展存款: deposits which allow the customer to have their capital referenced against sustainable assets*	• Provide thematic and bespoke advice to support our clients on environmental and social issues across topics such as • **ESG ratings advisory** 評級顧問 • **ESG KPI Benchmarking** 關鍵績效指標基準對比 • **ESG Strategy Advisory** 策略諮詢顧問 • **Climate Risk** 氣候風險 • **Framework creation** 框架建設
Derivatives 金融衍生工具	**Trade Finance 貿易融資**	**Cash Management 現金管理**	**Carbon Trading 碳排放權交易**
• **'Use of Proceeds' ESG Derivatives** 募集資金於ESG用途衍生品: Derivatives that hedge market risks arising from ESG financing • **ESG Performance Linked Derivatives** ESG績效掛鉤衍生品: Derivatives that link the payoff with ESG performance	• Sustainable use of proceeds or sustainability linked structures to support your Trade Financing flows: • **Import and Export Letter of Credits** • **Guarantees** • **Supplier Finance** • **Receivables Services** • **Import and Export Invoice Financing**	• **Sustainable Accounts:** Funds deposited will be used to fund projects that are aligned to Green and Sustainable Product Framework.	• Emissions trading products that will assisting clients in the • **Trading** 交易, • **Financing** 融資, and • **Investment** 投資 emissions reduction / carbon credits

Table 1: Green and Sustainable Finance Products

GBA Overall Emission Gap and Sectoral Specific Decarbonisation Pathways

Three distinct pathways to achieve carbon neutrality by 2050 are studied and compared: those outlined by the 13th Five-Year Plan (FYP), the "30-60" Scenario, and the ambitious "25-50" Scenario. The analysis indicates that adhering to the carbon intensity reduction goals set out in the 13th FYP could lead to an emission peak in 2030, but with 355 million tons of emissions still remaining in 2060. Under the 30-60 Scenario, carbon emissions in the GBA must reach their peak by 2030. Moreover, annual emissions need to have a reduction of approximately 7.5% during the 2030-2060 period, along with a 90% decrease in emissions and a 10% offset through negative emissions technologies, such as carbon capture, utilization and storage (CCUS), and forest sink. Meanwhile, the 20-50 Scenario aims to achieve an ambitious emission peak in 2025. For the achievement of GBA's carbon neutrality by 2050, an annual reduction rate of approximately 16% should be maintained from 2025 to 2050.

The GBA's energy-related carbon emissions primarily stem from three sectors: manufacturing, the building sector, and road transport. To decarbonize the manufacturing sector, it heavily relies on the power sector's ability to decarbonize. Regarding the road transport sector, shifting modes leads to the most significant reduction in emissions in the short term (before 2030), while promoting NEVs (electric and hydrogen fuel cell vehicles) is the primary contributor in the medium and long term (2030-2060). To effectively reduce carbon emissions from road transportation, it is worth considering alternatives such as shipping or mass transit railway, and even going so far as to remove cars altogether. In the building sector, Public and commercial buildings are responsible for 60% of emissions, with electricity accounting for 89% of carbon emissions. Therefore, energy efficiency and green retrofits are key for the near term, while transitioning to a cleaner electricity system is critical in the long run.

Investment needs for GBA's Carbon Neutrality and Key Challenges Faced

The transition to carbon neutrality in the GBA will necessitate an estimated investment of US$1.84 trillion between 2020 and 2060. Of this, US$696 billion will be devoted to road transport, US$314 billion for the Building Sector, and US$830 billion for the Manufacturing Sector. Financing mechanisms that could support decarbonization include Transition bonds and loans, Sustainability-linked loans and bonds, Carbon market-based transition financing tools, Insurance and guarantee products that support transition, and Private Equity funds.

To better attain carbon neutrality in the GBA, it is recommended to establish a cross-regional agency coordination mechanism that promotes the development of financing decarbonization, particularly in emerging transition finance. Local policymakers and regulators should play a vital role in accelerating the sectoral transition by mobilizing policy incentives and financial resources to support transition activities and investments, drawing on the experiences of green finance development. A core coordinating agency could be established by building upon the existing Greater Bay Area Green Finance Alliance (GBA-GFA).

Secondly, our initiative encourages financial institutions and enterprises to establish net-zero targets, with the support of green finance associations in the GBA. These targets should be based on the decarbonization pathways outlined in the report, SBTi and HKEX's Guide. It is crucial that the net-zero targets are ambitious, with the aim to achieve net-zero well before 2060. Some global banks have the potential to serve as examples and take a leadership role in setting targets, sharing information, and engaging with corporate clients.

The third suggestion is to promote compatibility among the taxonomies for transition finance, information disclosure, and the Chinese mainland, international, and/or Hong Kong. To improve interoperability of transition taxonomies, it is recommended to use the PBoC's current development and other international/HK standards whenever they become available. We need to reach a consensus among regulators regarding mandatory disclosure of information for transition activities. Supporting measures include encouraging mandatory information disclosure, such as TCFD, and promoting market readiness for the adoption of international climate disclosure standards such as ISSB.

Additionally, a recommended action is to facilitate the regional carbon market, which comprises two types: the voluntary and compliance carbon markets. In the voluntary carbon markets, it is important to connect domestic standards with international ones. For instance, the Integrity Council for Voluntary Carbon Markets (ICVCM) has already issued the Core Carbon Principles (CCPs). Furthermore, the GBA boasts a well-established regional compliance market. Additionally, Shenzhen has announced plans to expand the regional compliance market to include the building sector as one of its industry categories. Hong Kong Exchanges and Clearing Limited (HKEX) has signed a Memorandum of Understanding (MOU) with the China Emissions Exchange Shenzhen (CEEX Shenzhen) to collaborate in expediting the development of the carbon market ecosystem in Hong Kong and throughout the GBA. Further details will be provided regarding compliance, voluntary participation, and onshore/offshore connectivity.

The fourth recommendation is to develop sector-specific financial solutions, such as scaling up green retrofitting in existing building populations, identifying sustainable funding structures, or adopting international green building certifications with clear net-zero pathways. The Hong Kong Green Building Council has launched a new climate certification that examines how the building industry can reduce carbon emissions step-by-step through a certification process in Hong Kong. Financing plays a crucial role in scaling up the supply chain for both manufacturing and construction industries, specifically for contractors beyond tier one to tier two. To facilitate this process, specific financing options should be made available.

Additionally, developing a transition-related financing toolbox can further enhance financing capabilities. Hong Kong has already established an effective green and sustainable grand scheme for loans and bonds, and it is important for the GBA to have a comparable grand scheme with a focus on decarbonization.

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Taxonomies and Regulatory Development in the Sustainable Finance Market

Ms. Carmen TSANG
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ABSTRACT

The paper introduces the taxonomies development in the sustainable finance market and its implication in addressing the building sector's sustainable financing activities. It highlights the implication of a taxonomy to the industry considering its complex value chain, long asset life, and reliance on technological advancements. Three key documents in the taxonomy regime, including the EU Taxonomy, Common Ground Taxonomy, and the Prototype of a Green Classification Framework for Hong Kong and their relevance in facilitating green financing practices are discussed. The paper points out emerging trends in transition finance and the mainstream integration of ESG considerations, positioning taxonomy as a vital tool in driving sustainable development and decarbonization efforts in the building sector and beyond.

INTRODUCTION

The building sector is responsible for around 40% of global energy-related greenhouse gas (GHG) emissions. There's an immense financing need for the building sector to align with the Paris Agreement. For example, International Energy Agency (IEA) has projected an annual investment of around $536 billion between 2026 and 2030 for energy efficiency improvements in the building sector alone to align with the net zero scenario. And the United Nations Environment Programme (UNEP) has come up with a close figure of $3.4 trillion in energy efficiency and low-carbon technology investments needed by 2030 to bring the building sector in line with two-degree scenarios. While different data providers come up with slightly different numbers, the point is that the financing needs are there and they are huge. The sustainable finance market is a key solution to meet this financing challenge.

The Taxonomy is a tool that provides a common language and framework for identifying and prioritizing environmentally sustainable activities across sectors and regions. It can help different stakeholders such as policy makers, regulators, banks, financial institutions and investors to align their objectives and strategies and

facilitate the development and growth of the sustainable finance market. The Taxonomy can also enhance the standardization, transparency and credibility of the sustainable finance market by reducing the risk of greenwashing.

CHARACTERISTICS OF A TAXONOMY MEETING THE NEED OF BUILDING SECTOR

Alignment with the Building Sector's Value Chain

The building sector encompasses a vast and intricate value chain. Consequently, the decarbonization of this sector would vary significantly depending on our position within that value chain. For example, within the downstream context, there is a strong preference for double or even triple-glazed windows to enhance heat insulation and reduce overall building energy consumption. However, when considering the upstream perspective, particularly from the standpoint of the glass manufacturer, the process of double glazing a window actually results in heightened carbon intensity.

In essence, the approach may inadvertently require upstream companies to embrace heightened carbon intensity in order to facilitate downstream decarbonization. This simplified analogy demonstrates the need for a coordinated perspective when designing the decarbonization strategy for the building sector. Furthermore, it also calls for a common metric to benchmark and evaluate the decarbonization efforts by different stakeholders within the value chain. The stakeholders shall share a collective understanding of the overarching goal. In this context, taxonomies often consider green building certifications as a common metric for assessing impact. However, some stakeholders may use a more result-driven metrics, evaluating the impact of specific activities on final greenhouse gas (GHG) emission intensity per gross floor area (GFA).

Suitability for the Buildings' Asset Life Time

Buildings have a long asset life. A taxonomy, serving as a point-in-time assessment tool, should comprehensively encompass the entire life cycle of a building asset from design and supply chain, construction, operation, and maintenance phase. Moreover, this taxonomy should also adopt a forward-looking perspective, striking a delicate balance between reducing the embodied carbon and strengthening resilience towards climate change. Even if a net-zero emission is reached today, climate change is still coming. Therefore, the ideal taxonomy for the building sector should also encourage circular economy concept throughout different life cycle stages of a building, especially the design phase.

Consideration of Building Sector's Demand

The construction sector is experiencing high demand. The GCP and Oxford's projections indicate that the global construction sector will expand by a staggering eight trillion dollars, representing an 85% increase by 2030, with an annual growth rate hovering around four percent. Asia is leading the majority of this growth. The consequence could be all the energy efficiency improvement made could be compensated by the growth of the sector. When explaining the taxonomy and the sustainable finance market or evaluating what qualifies as 'green', it is worthy to consider the absolute emission on top of the intensity metrics.

A Living Document following the R&D Development

The decarbonization of the building sector rely on technology advancements, no matter they are currently being commercialized or to be developed in the future. A taxonomy should be flexible enough to accommodate the research and development (R&D) expenses to support commercialization of emerging technologies. It should also be a dynamic and regularly updated, mirroring the rapid pace of technology advances.

BENEFITS AND APPLICATIONS OF TAXONOMY

Benefits for all Stakeholders

Taxonomy serves as a vital role in connecting the key stakeholders of the market and promoting the sustainable development of the sector. By providing a common language and a robust framework, it enables identification and prioritization of environmentally sustainable activities in the building sector.

Taxonomy plays a pivotal role in various contexts:

Policymakers and regulators:

Taxonomy enables the establishment and enforcement of the ESG standards and requirements in the building sector. It can be acted as a foundation document for government bodies to develop policies to support growth of green industries in the region; and used as the blueprint to develop green financing ecosystem in the local market.

Banks and financial institutions:

Taxonomy acted as an important driver for banks to tilt lending effort towards green sectors and transition away from carbon intensive sectors.

Investors:

In some regions, the financial sector, including investors are required by regulatory bodies to conduct mandatory disclosure on its taxonomy-aligned holding in its portfolio.

Companies along the value chain:

Taxonomy provides clearer views on eligible green assets, facilitating their access to the sustainable financing market. As regulators, banks, investors are increasingly adopting taxonomy worldwide and integrate it into their lending and investment decisions, its alignment becomes a critical factor affecting capital market access and funding costs for companies.

Development of Taxonomies Worldwide

Regulators in APAC, China, India, Hong Kong, Singapore, Australia, and other regions have recently launched or are in the process of launching their sustainable or green taxonomy. According to some studies, there are around 200 taxonomies in the world, including the most common green ones and the transition ones. The transition taxonomy means classifying activities that are not purely green but promote the green transition for carbon intensive sectors. As the taxonomy is still a new development in the global market, it is recommended to understand its applicability before seeking formal alignment. Some questions to ask before establishing the taxonomy include: Is the standard applicable to the concerned jurisdiction? Is there a benefit to the concerned project stakeholders in seeking formal alignment? Whether to seek formal alignment or simply making reference to it?

EU Taxonomy

The EU taxonomy, launched in 2020, is considered the key market standard with significant reference value. Although APAC entities are not under the EU's regulatory regime, the concept of this taxonomy is a breakthrough in defining what is a sustainable activity. An activity would need to meet the following four criteria:

(i) it should substantially contribute to at least one of the environmental objectives, including climate change mitigation, climate change adaption, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, and protection and restoration of biodiversity and ecosystem;

(ii) it should meet the technical screening criteria, such as a minimum GHG emission threshold for manufacturing activity;

(iii) it should do no significant harm to any other environmental objectives; and

(iv) it should meet minimum social safeguards.

This holistic definition of sustainable activity can help identify activities that may seem green one-sidedly but may not be environmentally friendly at all when looking at the long-term lifecycle of the project. For example, certain large-scale hydroelectric dams could cause habitat destruction and alteration of river ecosystems. They can also emit a large amount of methane, which is a GHG with stronger global warming potential. Although hydropower itself is labeled as a green and renewable energy, it is important to consider the long-term environmental impact of such projects.

Common Ground Taxonomy

In 2021, the People's Bank of China (PBOC) and the European Commission jointly launched the Common Ground Taxonomy (CGT), which is an initiative to map and compare the EU and China's existing taxonomies. The CGT provides a dictionary to compare and allow cooperability among taxonomies.

Prototype of a Green Classification Framework for Hong Kong

The prototype was freshly published in May 2023, and the construction sector is included as one of the four pilot sectors, given its importance to the Hong Kong economy. For the green building sector, the criteria are mainly based on green building certification levels and the final estimated energy or emission performance of the buildings. It is very straightforward to use.

Crédit Agricole CIB CACIB's Green Banking Practices

From the bank's point of view, when corporations talk about green loans and green financing, they need to talk about green banking on the other side. A taxonomy is relevant and vital to the development of green banking practices.

Crédit Agricole CIB (CACIB) has been exploring and practicing green banking for over a decade. The Alliance of Green Commercial Bank, launched by the International Finance Corporation (IFC) in Hong Kong with the Hong Kong Monetary Authority (HKMA) as the regional anchor, recently co-authored with CACIB to launch the Thought Leadership Paper to share CACIB's journey and lessons learned so far in a structural way in green banking via five key elements. The following three elements have a stronger linkage to taxonomy.

One characteristic of the finance sector's carbon footprint is that more than 90% of it is generated via lending and investment. The first element is to build a green lending portfolio and set a strategy to increase the significance of this portfolio. Since CACIB has started green lending long before the EU taxonomy, its aim now is to match the EU taxonomy over time.

Secondly, CACIB strives to integrate ESG and climate readiness in the credit and renting process. A concrete action by CACIB was taken back in 2015, CACIB became one of the first banks in the world to introduce the internal Liquidity Discount Mechanism for green loans, to encourage green financing products by offering more favorable internal costs for accessing funds. Other financial institutions can follow this approach as they may potentially benefit from a lower cost of fund with the green funding instrument. Some are encouraged by regulators, such as PBOC, which offers cheaper funding to onshore banks to subsidize their green lending. Taxonomy alignment could be a qualification element to access such discounted green funding.

Finally, another important element in green banking is to provide ESG and climate-related advisory services. After all, banking is a service industry, and it is not enough just to divest. It is important for the banking industry to act as an enabler to help clients to decarbonize.

CONCLUSIONS

As a new development area, it is expected to see a rise in transition finance, especially in Asia. Asia is responsible for over half of the world's carbon emissions and is home to more than 60% of the world's population. Not to mention, Asia hosts many carbon-intensive manufacturing activities for the world. Asia's decarbonization story will look very differently from that of Europe, and transition finance will potentially be the key to that solution. Up till now, the transition finance is still a developing, and taxonomy provides a clear definition for certain sectors, for a certain time span, and for a transition project.

Another trend so far is that taxonomies are designed more for climate-related issues. It is expected that to expand and cover more environmental objectives including biodiversity conservation, and circular economy.

Cooperability amongst taxonomies is also a key market development trend to look into, where taxonomies should act as "connectors" to different sections of the economy, and the CGT initiative is the key development in this area.

The last point worth noting is that the financial market is mainstreaming ESG integration, and CACIB is doing it beyond incorporating taxonomy. Stakeholders are analyzing a company's overall ESG performance, so it is important to put in place a strong ESG decarbonization strategy, strong governance, disclosure, and pay attention to the ESG rating, etc. These are all important aspects for corporations interested in tapping this market.

Day 2 PM

Global Construction Sustainability Forum (Governance) – GBA Construction

State of the Art Development of Urban Rail Transit in Mainland China

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ABSTRACT

This paper will focus on the current status, challenges and achievements of urban rail transit development in Mainland China. It highlights the innovative practices in the urban metro transit in the Mainland through the twelve elements under the principle of "people-oriented", including green and low-carbon, intensive land use, prefabricated subway stations, and waste recycling, etc., and presented the successful cases of rail transit construction in the Mainland under each element.

INTRODUCTION

The Development History and the Current Progress of Urban Rail Transit in Mainland China

The development of rail transit in Mainland China is divided into six stages as shown in the red parts of Figure 1:

Stage 1: Between 1908 and the 1950s, Mainland China's first tram line operated in Shanghai.

Stage 2: Between the late 1980s and the mid-1990s, transit-oriented railways were built.

Stage 3: The years between 1995 and 1998 were an important period of adjustment, as Shenzhen Metro Line 1, Shanghai Pearl Line and Guangzhou Metro Line 2 were designated as equipment localisation projects by the State Planning Commission in 1998, marking the development of urban rail transit construction resumed at the end of 1997.

Stage 4: The years between 1999 and 2008 were a period of vigorous development, where single-functional transportation was transformed and became multi-functional.

Stage 5: The years between 2008 and 2017 symbolised the stage of rapid development of multi-standardisation and multi-functionality.

Stage 6: Since 2018, it is a phase of improvement from quantity to quality.

Mainland China's rail transit is currently in Stage 6, i.e. the stage of improvement from quantity to quality. Mainland China has the world's largest scale of rail transit construction with the world's longest operating mileage in its railway network. Nine of the world's top ten cities with the longest operating metro system mileage are in Mainland China, except for Moscow. As of 30 June 2023, Mainland China have nearly 10,000 kilometres of rail transit in operation, with 5,200 kilometres are under construction and an investment of approximately RMB560 billion.

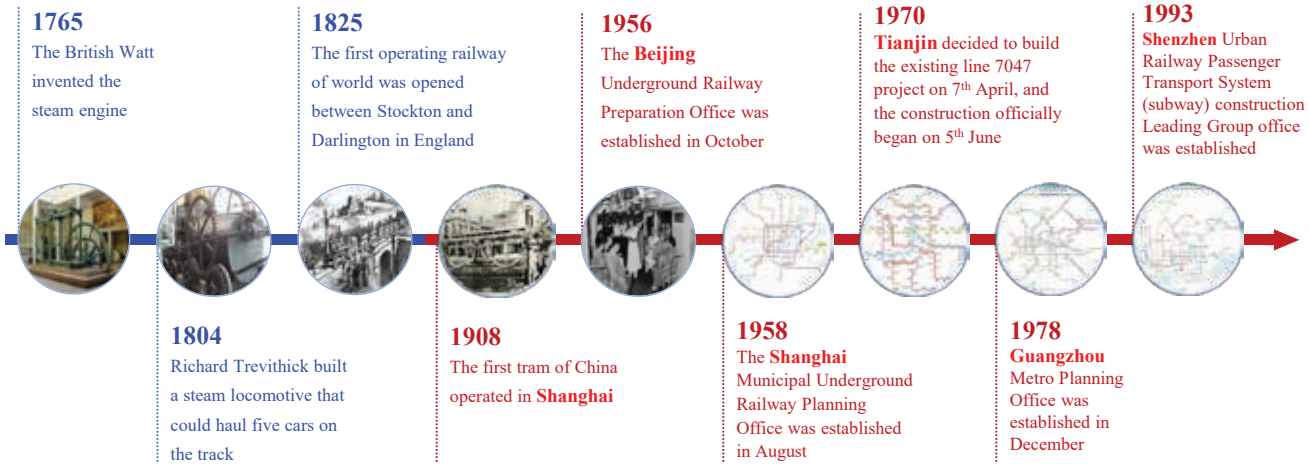

Figure 1: The development of rail transit

Challenges to the Rail Transit in Mainland China

Rail transit in Mainland China has been facing challenges. The first challenge is a green and low-carbon rail transportation system throughout its life cycle. The second is both economic and land challenges to the construction of rail transit in Mainland China. On the economic aspect, the investment scale in rail transit construction is enormous, which has brought a heavy financial burden to local governments, while metro enterprises have incurred financial difficulties in operation and maintenance, due to the externalisation of internal benefits and the socialisation of economic benefits from its quasi-public nature, making full costing profitability difficult. On the land aspect, the process of urbanisation has rapidly led to the scarcity of urban land resources, as the train depots and protection areas along the metro lines have taken up a large amount of land resources. Thirdly, in addition to the demand for safety, convenience, efficiency and comfort in urban rail transit, the public has also emphasised on ecology, sustainability and resilience under extreme conditions. Therefore, in response to the new demands, it is necessary to reframe the old rail transit concepts.

THE DEVELOPMENT OF RAIL TRANSIT IN MAINLAND CHINA

The Direction for the Development of Rail Transit in Mainland China

At the General Debate of the 75th Session of the United Nations General Assembly, President Xi announced that "China will scale up its Intended Nationally Determined China will increase its national contribution, adopt more powerful policies and measures, strive to peak CO_2 emissions by 2023, and endeavour to achieve carbon neutrality by 2060." These were all complementary not only to the evolution of human civilisation, but also the Chinese civilisation over the last 5,000 years.

The development of rail transit in Mainland China must first be planned and designed on the basis of "people-oriented" and ultimately achieve the goal of sustainability in urban development, economic growth, ecological environment and social prosperity. This could be achieved through the adoption of a new approach to urban rail transit construction that meets residents' needs, introduces modern concepts, reshapes safety regulations in a scientific and technological way, uses new models of construction equipment and safety controls technology, establishes a comprehensive

transportation network with multi-network integration, and implements solid waste recycling, non-fossil energy use, intensive land use, as well as green and low-carbon buildings in the process of construction.

Innovative Practices Introduced in the Development of Rail Transit in Mainland China

Shenzhen has optimised the city's spatial structure in terms of population density and distribution of industrial parks with the use of urban rail transit. Based on the population distribution and the distribution of industries and industrial parks of the whole city, Shenzhen has set up its railway transport hubs and interchange stations in the most densely populated locations or places with demands for the development of industrial parks. The arrangement of transport hubs that correspond to the distribution of Shenzhen's population and industrial parks has resolved the housing problem and considered the city's future resilience. In the design of each transport hub, the three-dimensional surface and underground spaces of points, routes and networks were taken into account in the overall integrated planning, reshaping the urban space and realising the overall integration and enhancement of the region.

The "people-oriented" philosophy

The "people-oriented" integrated hub includes twelve development elements, which are also the new requirements for building Beautiful China, including Efficient Central Business District (城市高效客廳), Urban Stitching (城市縫合), Integrated Transportation Hub (綜合運輸樞紐), City-Station Integration (城市-車站一體化), Sustainable Development (可持續發展) Garden City (花園城市), Vertical Pedestrian System (垂直行人系統), Smart Building Informatisation (智慧樓宇資料化), Sponge City (海綿城市), City Linkage System (城市連接系統), Vertical skylines (垂直天際線), and Seamless Integration System (無縫一體化系統). Under these elements, ten pleasant and liveable urban transportation hubs have been built in the Mainland.

Intensive Use of Land Resources

The Shenzhen Metro has achieved remarkable results in terms of the efficient use of land resources. The Shenzhen Futian Underground Hub has over 9 million square meters of underground space in the heart of the city, and seamlessly connects the high-speed rail stations with seven metro lines, making it the second-largest underground high-speed rail hub in the world. In the past, a significant portion of the land resources in the protection areas along the metro lines were explicitly restricted from use, limiting the effective optimisation of the three-dimensional space. Now, the technology of the integrated use of underground spaces through the metro tunnels has effectively removed the limitations of the metro lines on urban spatial development, from the scale of the surrounding stratum to the structural safety standards, releasing land that was previously unavailable as protection areas for rail transit. These innovations have enabled the deformation of the original and new structures to be non-interference with each other in limited space, and the stability of metro tunnels to be maintained throughout its construction process and operational life. As a result, the land use in Qianhai, Shenzhen, has been transformed from extensive to a refined form, resulting in direct economic benefits of RMB6 billion.

Prefabricated Subway Stations

Being characterised as green and low-carbon, prefabricated subway stations have developed rapidly in the Mainland. The Shasan Station of Shenzhen Metro Line 12 used a rectangular pipe jacking construction technology which was jointly developed by China Railway Engineering Equipment Group (CREG). The use of slurry balance pipe jackings with the largest diameter in the world enables a station to be built with only two jacking pipes, reducing carbon emissions by more than 40%, shortening construction period by 20% and lowering the costs by more than 30%.

Waste Recycling

Since 2007, Shenzhen has been conducting metro construction under the concept of "Ecological Civilisation", where all debris and cement slurry from the metro construction process have been recycled, and was rewarded the International Tunnelling Association's "Beyond Engineering" award. By the end of 2023, Shenzhen will have upgraded the "Ecological Civilisation" metro construction model from 1.0 to 2.0, with 75% of full utilisation of slag, and 100% of recycling of slurry.

Systematic Energy Saving

The Mainland has made great efforts in new energy, such as photovoltaic power generation and geothermal power generation. The photovoltaic project at the Yuzhu Depot, Guangzhou has commenced operation, occupying an area of 76,000 m^2 with a total installed capacity of 5MWp and an annual power generation capacity of 4.5 million kWh. The total installed capacity of the photovoltaic power stations at the twenty-one elevated stations at Xinhe, Zhongluotan and Line 14 was 1.326MWp with an annual generation capacity of 1.4 million kWh. In addition, the use of geothermal energy in the Dalian Metro was expected to provide about 2,000 kW of energy, contributing to a saving of about 28 tonnes of standard coal in winter and reducing electricity consumption by about 30%.

Sponge Cities and Green Buildings in Metro

Guangzhou Metro has incorporated the concept of Sponge City into the construction of its stations, with a total green area of nearly 160,000 m^2. It integrates green roofs with ecological landscapes, and introduces rainwater storage devices to divert rainwater and sewage and to achieve rainwater recycling. In terms of green buildings in metro, the Shanghai Metro has constructed the "near-zero carbon" station, fully materialising the utilisation of new energy.

Digitalisation and Intelligenlization

The Mainland has learnt from Hong Kong's experience in the refinement and quality management of its metro construction, and has begun the practice of digitalising metro management since 2007. The Shenzhen Metro has used digital technology to monitor unauthorised or unsafe behaviour in its stations. The Shanghai Metro has conducted real-time environmental quality monitoring at its stations to provide passengers with quality air and enhance the spatial quality in the metro. The information obtained from this experimental project has helped to establish environmental quality standards for urban rail transit in the Mainland, which have been promoted nationwide.

Development of a New System

The static investment in medium-low speed maglev system is tremendous, but it reduced carbon emissions and labour costs given its full life-cycle cost that is 75% of traditional rail transport. Therefore, Changsha has built China's first fully self-developed medium-low speed maglev system, with a total length of 18.55 kilometres.

Cultural Heritage

As rail transit should embody its own cultural elements, cities in Mainland China such as Xi'an, Suzhou and Hangzhou have incorporated their own featured cultures into the construction of metro lines and have built rail transit systems with cultural heritage.

CONCLUSION

China's urban rail transit industry has comprehensively implemented innovative concepts and technologies to promote carbon emission reduction and sustainable development, efficient use of land resources, green development, diversified use of energy-saving with renewable energy, and recycling of solid waste and cement slurry. In Shenzhen, which has a land area of less than 1,000 square kilometres, the available land supports 24 million people, but its underground space that developed from the metro construction reached a total of 60 square kilometres, laying the foundation for the city to become an ecological and liveable city.

The new mode of sustainable development of urban rail transit that driven by the "Hub (Interchange) Economy" (「樞紐(換乘站)經濟」), brought about the sustainabilities of urban development, economic growth, eco-friendliness, social prosperity and risk-resistance, fully demonstrating the concept of "people-oriented".

Innovate Construction Methods, Optimise Industrial Structure, and Lead the Sustainable Development of the Construction Industry

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ABSTRACT

Guangzhou Municipal Construction Group Co., Ltd., or GMC, has an extensive business scope covering various specialised fields of the construction industry and related supporting industrial chains. This article aims to introduce the development achievements and experience of GMC by innovating construction methods and optimising the industrial structure with the goal of high-quality development.

INTRODUCTION

Overview of Guangzhou Municipal Construction Group Co., Ltd.

Guangzhou Municipal Construction Group Co., Ltd. was established in 1950. After decades of development, its business scope fundamentally covers all the professional fields of the construction industry and its related supporting industrial chain. Looking back at the journey, its development process and management approach can be summarised into One Essence, Two Objectives, Three Pillars, Four Challenges, and Five Focuses. One Essence refers to the amplification of the party's leadership. Two Objectives refer to industry benchmark and skills nurturing. Three Pillars refer to the importance of well-being, the importance of leadership and the principle of diligence. Four Challenges refer to the escalated market competition, the competition for talented professionals, the competition for smart technology, and the normalisation of risk prevention and control. Five Focuses refer to production safety, market expansion, project performance, technological innovation, and transformation and upgrading.

DEVELOPMENT EXPERIENCE OF GUANGZHOU MUNICIPAL CONSTRUCTION GROUP CO., LTD.

One Essence

GMC established One Essence to amplify the party's leadership. The Group believes that the Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era is the fundamental guide for state-owned enterprises to grow and thrive. General Secretary Xi Jinping has stressed that high-quality development is the first and foremost task in the comprehensive construction of a modernised socialist country, and Guangzhou should take on the role of promoting Guangdong to be at the forefront of the construction of Chinese-style modernisation and the role of leading high-quality development.

Two Objectives

In order to establish a "China Model", GMC has set up Two Objectives, which are industry benchmark and skills nurturing.

Industry Benchmark

The international benchmark of Guangzhou Municipal Construction Group Co., Ltd. is Vinci SA, a French construction company, while its national benchmark is targeted at China State Construction, a state-owned enterprise. Over the past 5 years, GMC has seen year-on-year growth in its operating revenue and total profit, and has been on the list of the world's top 500 enterprises for three consecutive years from 2020 to 2022. Going forward, our goal is to reach RMB500 billion in revenue by 2025, achieving a total pre-tax profit of RMB15 billion; endeavour to achieve revenue of RMB760 billion by 2028, with a total pre-tax profit of RMB22 billion; to reach RMB1 trillion in revenue by 2030, with a total pre-tax profit of RMB28 billion in the medium-to-long term, transforming into a globally competitive world-class urban construction operator.

Skills Nurturing

"Hard power or soft power, ultimately it all depends on the power of talent," General Secretary Xi Jinping pointed out. GMC therefore proactively responded to his instructions of nurturing skills in our talented professionals. GMC has many high-level talented professionals and is committed to building a strong management team by implementing the Millennials Double Hundred Action. In the past three years, the average age of middle management promoted is 43 years old, and about 40% of those who were promoted were under 40 years old. GMC values the construction of its management team and has taken active steps to invest in the implementation of the Deputy General Manager Training Programme with a budget of RMB3 billion, the Double Hundred Action with a budget of RMB2 billion for deputy section-level officers and RMB4 billion for section-level officers for market expansion. Through these measures, GMC has built a team with excellent management ability and leadership. GMC actively builds advanced technical teams and expert teams with advanced technology and powerful capabilities. All chief engineers of its subsidiaries hold doctorate degrees or higher qualifications, and the Group's level of technological capability is ranked amongst the top in China and beyond.

GMC will continue to work towards the benchmark and invest in attracting talented professionals to establish a top-notch team in the industry to lead the development of the Group and ultimately the construction industry.

Three Pillars

Three Pillars are the cornerstones of the Group's development, and they are the key to success.

The first Pillar is the importance of well-being. In 2017, GMC increased its revenue target from RMB41.5 billion to RMB50 billion, taking the enterprise to a successful breakthrough. At the same time, the Group has been implementing "GMC's people-oriented development philosophy", which emphasises the happiness and welfare of its employees, fostering their sense of commitment and sense of belonging. For example, to address housing problems, GMC applied for public rental housing for its employees who are not homeowners. GMC has stimulated the well-being and motivation by securing the fundamental needs, infusing new energy into the Group's development in the next few years.

The second Pillar is the importance of leadership. During the Xinjiang Kashgar Guangzhou New City Project, a number of riots resulted in the suspension of many Xinjiang Aid projects. Despite the difficulties due to the riots, the management of GMC set an example by leading the workers on the Xinjiang Aid projects to work overtime to uphold the progress and quality of the Guangzhou New City Project, demonstrating true leadership and determination. The Group took the initiative to resolutely implement General Secretary Xi's instructions of "diligence brings happiness" and "true communists are those who step forward bravely and face difficulties at critical moments", and to be motivated to spring into action and to be ready to fight day and night, rain or shine.

The third Pillar is the principle of diligence. The Group will always be united, leading the way and staying ahead, and gritting its teeth and facing challenges head-on to conquer. During the pandemic, GMC proactively responded to the rallying call for fighting against the pandemic and sent workers to where urgent help was needed, to practically safeguard the health and safety of the people, contributing to the prevention of the pandemic in Guangzhou.

Four Challenges

Guangzhou Municipal Construction Group Co., Ltd. proactively tackled the Four Challenges, which were escalated market competition, competition for talented professionals, competition for smart technology, and normalisation of risk prevention and control.

The escalated market competition: The construction industry is under fierce competition in markets around the world including Mainland China and Hong Kong. Only by seizing and capitalising on opportunities and continuing the development of low-carbon technologies can we find a way to break through in this competitive environment.

The competition for talented professionals: GMC stays committed to building an efficient and advanced talent team to meet the greening, digitalisation, intelligence, industrialisation and globalisation requirements in the modern construction industry.

The competition for smart technology: The construction sector accounts for a huge proportion of energy consumption in China, while its carbon emissions account for more than half of the national total. In view of this, low-carbon and zero-carbon are the goals for technological research and product development of GMC.

The normalisation of risk prevention and control: GMC puts emphasis on prevention and control of risks including capital, legal, credit and integrity risks, in order to ensure the stable operation and sustainable development of the Group.

Five Focuses

Five Focuses refer to production safety, market expansion, project performance, technological innovation, and transformation and upgrading. These Five Focuses are conducive to expanding market share, improving profitability, realising long-term growth and securing competitive advantages.

GMC highly values occupational safety. To address safety issues, the Group has carried out more than 40,000 company-level dedicated investigations to inspect and rectify more than 200,000 hidden safety hazards. Meanwhile, the Group has promoted civilised construction, which is demonstrated by the 406 projects that complied with safe, civilised, and green construction site standards since 2018. The Group also strengthened its emergency management, which is illustrated by over 3,600 units of transitional resettlement houses constructed by GMC within two months after the 2008 Sichuan earthquake.

GMC has been actively expanding its market by consolidating its presence in the Guangzhou market and tapping into markets outside of Guangzhou, and ultimately heading towards the international market. GMC has been actively involved in the urban renewal in Guangzhou and has undertaken 87 projects of more than RMB1 billion in the past 5 years. The proportion of local projects in Guangzhou is about 64%, making the Group one of the seven municipal developers. GMC also devoted itself to tapping into markets outside of Guangzhou, as demonstrated by the 54 regional companies set up in other provinces. GMC strives to build an international brand by actively exploring overseas markets and going global. Despite the challenging market conditions, the Group has managed to maintain its market share, stand out as a leader, and accomplish a certain degree of success in global business deployment. GMC aspires to secure employment opportunities in China, safeguard the welfare of its employees and contribute to the nation's tax revenue.

With regard to project performance, GMC has always stressed the importance of project construction and considered the needs of customers as the Group's direction and goal. The Group persistently regards project performance as the foundation of the Group's development and the source of income, implements comprehensive refined project management, creates unique projects and achieves great results in creating excellence.

General Secretary Xi Jinping said, "We must regard science and technology as our primary productive force, talent as our primary resource, and innovation as our primary driver of growth." GMC built a platform for scientific and technological innovation, covering 48 high-tech enterprises, and 7 post-doctoral workstations and innovation practice bases, laying a solid foundation for the Group's development. At the same time, GMC has been exploring digital construction to build the largest data centre in China. The Group also values the development of new construction industrialisation and has built the most technologically advanced and largest prefabricated construction industrial base in South China, GMC Grand-Bay Intelligent Manufacturing and Technology Co., Ltd., taking Guangzhou as the centre, supplemented by other areas in the province, with 1 national demonstration base and 5 provincial demonstration bases, proactively pushing forward the new construction industrialisation characterised by digitalisation, greening and internationalisation.

GMC endeavours to accelerate the promotion of transformation and upgrading, propel the advancement of the industrial base and the modernisation of the industrial chain, and build a modern industrial system with a profound integration of industries and services. It makes great efforts on productivity development, research and development of new energy and new materials, and photovoltaic power generation, and builds an industrial chain focused on the low-carbon and zero-carbon goals to achieve comprehensive and deep-reaching development and ensure dominance in the production process.

CONCLUSION

Guangzhou Municipal Construction Group Co., Ltd. has always been adopting the Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era. Under the leadership of the Guangdong Provincial Party Committee, Provincial Government, the Guangzhou Municipal Party Committee and Municipal Government, with the strong support of governing bodies at all levels as well as each of the leaders gathered here, and by focusing on the Guangdong Provincial Party Committee's "1310" deployment and the Guangzhou Municipal Party Committee's "1312" initiatives, the Group has established itself in a new stage of development and implemented the new development concept. All these, combined with its relentless pursuit, unswerving determination, obligation undertaking and practical diligence, empower GMC to pursue its role as the leader and forerunner of high-quality development, to build a world-class enterprise, to contribute to the promotion of China's modernisation in Guangdong, to explore new horizons in Guangdong's high-quality development and to drive forward a new chapter in Guangdong's high-quality development.

The Power of Growth – Green Building Exploration from Shenzhen

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ABSTRACT

In face of severe climate challenges nowadays, green building is the inevitable path for future development. This paper mainly introduces the exploration and practice of green buildings by the Shenzhen Institute of Building Research, or the IBR, elaborates on the innovative ideas and achievements of the IBR Headquarter Building and the Future Complex, and provides a detailed account of the IBR's progress and accomplishments in promoting green buildings.

CARBON REDUCTION IS OUR STRUGGLE FOR HUMAN SURVIVAL

China is a traditionally agricultural civilisation, where everything is nurtured from the land and all living beings are interdependent. However, the land is not dynamic, and the lack of mobility in agricultural civilisation resulted in low efficiency. As humanity entered the era of industrial civilisation, the industrialisation development has led to a change in business logic, where people began to artificially shorten product lifespans. A century-old light bulb at a California fire station has stayed lit for 115 years, while it is extremely rare to find light bulbs that can last for more than 11 years nowadays. The industrial civilisation started with steam engines and internal combustion engines powered by fossil fuels. Fire was the centrepiece of the industrial civilisation, which increased efficiency, but the over-development has also seriously disrupted the balance of nature. Over the past couple of centuries, humans have emitted CO_2 into the atmosphere at a rate 20,000 times faster than nature, and the continued use of fossil fuels has driven the Earth's climate to an unprecedented condition in the last half-billion years. The CO_2 concentration has soared to over 400 ppm, surpassing levels during the warmest period in history by over 25%. Reaching carbon neutrality and reducing carbon emissions are in fact our struggle for human survival.

GREEN BUILDING DEVELOPMENT

Urban Decarbonisation Development

Industrialisation and urbanisation have been complementing one another, and construction is the largest industrial product. Nowadays, cities are becoming increasingly identical, regardless of geographical, religious and cultural differences. Congested cities with glass facades can be found all over the world. Construction works use about 50% of the natural resources consumed by humans, while urban activities are responsible for over 50% of waste production. In the urban development process in China, the carbon emissions from entire lifecycle of buildings, including the production, construction, transportation of building materials, and building operation, accounted for more than 51% of total carbon emissions in the country. The cost of industrialisation and urbanisation is that 3 species in nature face extinction every hour and 75 species become extinct every day. Humans may be the most significant threat to the natural world. Every living being on Earth has the right to survive. The melting icebergs, extreme heatwaves, wildfires, global pandemics, tsunamis, typhoons and other disasters are the self-balancing effect of nature, a painful cry of the Earth. The French philosopher Sartre is famously quoted as saying, "Life is a C (Choice) between B (Birth) and D (Death)". In the agricultural civilisation, we chose the harmony between nature and humans; in the industrial civilisation, we chose the benefits from economies of scale. In the intellectual economy era, what should be the choice of ecological civilisation? President Xi Jinping declared, "Respect the nature, adapt to the nature, and preserve the nature are the intrinsic requirements for building a modern socialist country in an overall manner. We must uphold and pursue the concept that lucid water and lush mountains are invaluable assets, and plan the development based on the principle of harmonious coexistence between human beings and nature. We have to expedite the green transformation of the development pattern, implement a comprehensive conservation strategy, develop green low-carbon industries, advocate green consumption to encourage the formation of a green low-carbon pattern of production methods and lifestyles." He also mentioned "Mountains, rivers, forests, farms and lakes form a life community, the analogy is that the vitals of human life are the farms, which have the vitals of rivers, which have the vitals of mountains, which have the vitals of land, which have the vitals of trees. Metal, wood, water, fire and earth, the Supreme Ultimate generated the two polarities, the two polarities generated the four symbols, and the four symbols generated the eight trigrams, and the cycle continues." Water is the core element in the ecological civilisation era, and cities will be brimming with water. Laozi said, "The greatest virtue is just like water, nurturing all things but never competing with them, dwells in the position all people loath, thus close to Dao." This has been taken as the way of life by intellectuals and noble people for thousands of years. Some scholars today claim "The greatest virtue is just like water" in fact is the criticism of Laozi on the greed and selfishness of humans. Water never competes; when cold, it turns to ice, leaving space under the ice for life to survive; when hot, it turns into steam, which becomes manna and reappears in the world; it streams to low and stops at flat, following nature rather than confronting it.

Currently, CO_2 emissions are associated with the production and our lifestyles relevant to different industries, transportation, energy, construction, and other aspects. The ecosystems of mountains, rivers, forests, farms, lakes, and oceans will absorb CO_2. The key to urban development is to strike a balance, but where is it? This point is known in Chinese history and culture. China's development emphasises the preservation and balance of natural resources, while developed Western countries prioritise efficiency by focusing on key factors, with nature playing a relatively smaller role.

Redefining Building

Buildings are the mountains of the cities. The height and density of buildings affect wind and water, thereby impacting the entire ecosystem. In the past, humans turned mountains into flat land or mines to smelt cement. Now, it shifts to integrate nature and humans aiming to restore harmony between nature and humans. Green buildings represent green mountains in cities. According to the *Assessment Standards for Green Building* National Standards prepared by China in 2019, a green building is a high-quality building that conserves resources, preserves the environment, reduces pollution, provides people with healthy, functional, and efficient use of space, and maximises the harmonious coexistence between humans and nature through its life cycle.

According to a report by the World Health Organisation in 2010, more than 87% of a person's life is spent in buildings. Studies indicate that over 62.5% of diseases are related to buildings. In the intellectual economy era, where 90% of the cost in a building is the salary of the employees, thus improving the performance of the employees can be an essential driving force for the adoption of green building. A 2016 study conducted by Harvard University revealed that individuals who worked in green buildings scored over 25% higher on tests measuring thinking and planning skills. Additionally, they reported better sleep quality when compared to those who did not work in green buildings. Therefore, the value of green buildings is not merely about conserving resources and improving building quality, but also about changing lifestyles and reshaping the values of human habitation.

IBR Headquarters Building

Since China began implementing green building standards in 2006, Shenzhen has been following the pace of the national green development. The IBR has been exploring how to incorporate technological innovation into the traditional civil engineering practice in this era, exploring a cost-effective, sophisticated, and green path aligned with the Chinese characteristics and lifestyle. Completed 20 years ago, the IBR Headquarters Building was designed as a local, communal, low-consumption, and replicable green office building, which was featured on the cover of a U.S. magazine in 2014 as a model for the future buildings in China.

The IBR Building originated as an idea and has since evolved into a thriving office community through exploration, innovation, and love. It features various facilities, such as cafeterias, gymnasiums, apartments and nurseries. The design of the IBR Building has a boundary-free lobby, and communal gardens, providing 4,000 m^2 of greenery and water recycling. Its green roof and water storage system facilitate natural plant growth. The IBR Building reduced its air-conditioned area by 30% and air-conditioned energy consumption by 63% through natural ventilation. With the use of natural lighting, the IBR Building consumes 71% less energy than similar buildings for lighting. It achieves a coexistence of humans and nature in its operation, bringing joy to people while they work. The third floor was converted into a nursery to provide a space for children's development. The space of the building is endowed with the power of life, allowing those who work in it to feel a connection to love and life.

Over the past 12 years, the IBR Building has withstood 37 typhoons, including 18 of level 12 or above, without any damage to its plants, outer envelope, or glass. This remarkable resilience is attributed to the building's integration with nature, which reflects the strength of urban architecture.

The Future Complex

A decade ago, the IBR extended these ideas to the Future Complex community. The Future Complex is built for people born between 1998 and 2014 (Generation Z). The Future Complex adopts the principle of "three fixed, six variable, one open" in its design concept. This means that 30% of the space, including the main structure, elevator equipment rooms and public auxiliary rooms is fixed, 60% is a variable functional space, and 10% is open space. 60% of the rooms in the Future Complex are open for variable functions, which will be co-designed by the users. The Future Complex is transitioning from designing individual buildings for energy efficiency and energy-savings to integrating and utilising energy and resources on a city-wide scale. The Future Complex is not only an ultra-low-energy building, but also the origin and incubator of new technologies. The Future Complex adopted a full steel structure and a three-body separation concept, which could provide versatile shared spaces for different application scenarios, such as forums, farms, and exhibitions, without generating excessive construction waste. The Future Complex is a pioneering PEDF (photovoltaics, energy storage, direct current, flexibility) project that has been implemented outside of laboratories, boosting the energy revolution in China. The power generated by solar energy is stored directly or integrated into the power grid, and the building uses direct current electrical appliances. The Future Complex achieves real-time matching of electricity supply and demand, with the generated electrical energy playing a role in peak shaving and valley filling, acting as a city power bank and an everlasting beacon in times of emergency. The Future Complex can accommodate up to 6,000 people for a 72-hour "golden period" for rescue when the city is cut off from water, electricity, and labour, acting as a lifeline for sustaining life. The Future Complex creates spaces that are organic, engaging, and nurturing through the incorporation of boxcar rooms, vegetable and fruit gardens, and beekeeping. It ensures that fresh vegetables and fruits can be served on plates within 40 minutes, and the five-minute neighbourhoods allow people to save commute time. The ventilation ducts in the mezzanine of the modular structure also functions as a rainwater harvesting system for the gardens, enabling the Future Complex to self-consume rainwater without discharging it into the city in 77% of urban rainfall conditions. The Future Complex is an exploration that adapts to the present and facilitates the future. It incorporates the concept of modular Lego-like design, allowing for flexible use of space. Users can modify the space within a minimum timeframe of forty-eight hours of a new demand arising. Meanwhile, the Future Complex acts as a platform for fostering technological innovation, promoting market applications and incubating industries investments.

The same approach has also been applied to water plants and large-scale projects in Xiong'an. The Xiong'an Project with an investment of RMB9 billion, covering an area of 900,000 sqm, was completed in three years. The entire process, from planning and conceptual design to comprehensive consultation and supervision, was completed by industry fellows led by the IBR. Along the journey, the IBR has provided green building design and consultation for over 120 million m^2, as well as ecological city planning and consultation for over 60 million km^2.

CONCLUSION

The city raised in is the shelter of the heart. Shenzhen at the age of 43 is still young and growing. The listed companies, subway lines, parks, trees, sewage networks, connections between the city and the rest of the world are all growing. The Shenzhen Bay of 2023, with its beautiful scenery of Hong Kong, the sea and nature, is the place where humans live. Humans have struggled to rise from the land and stand on firm ground, only to find themselves constantly looking down at mobile devices. We look up from the windows of super high-rise buildings just for a limited view of the blue sky, while we have to look down to watch our feet as the flattest paths are for cars. Mrs Jiang Yang said, “Don’t look up to yourself, nor look down on yourself. Look straight and you’ll find your true self.” Hence, the General Secretary said we shall build a city of well-being, with a view of the mountains and water for nostalgia, a city of landscapes for better living. As we propel the rapid financial development with technological advancements, it is of utmost importance to remain mindful of our roots and the ultimate objective of ensuring the well-being of humans. A philosopher remarked that ordinary individuals who struggle to survive throughout their lives possess only one life, “to survive”, whereas extraordinary individuals who pursue the quality of life possess two lives, “to survive and to live”. Meanwhile, industry fellows possess a third life – the mission to record the history of sustainable development, to build a bright future, and to perceive the power of growth in the future.

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Green & Low-carbon Design Goes First

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ABSTRACT

It has become a consensus that human beings should recognise and take actions on climate change, and that green and low-carbon construction is the only way to achieve the carbon peaking and carbon neutrality goals. This article aims to introduce the development process and outstanding achievements of Guangzhou Design Institute, or GZDI, in the field of green and low-carbon construction, and summarises a set of efficient solutions it has developed by combining Lingnan architectural elements with modern advanced technologies. Finally, it introduces GZDI's successful projects and its future development directions.

INTRODUCTION

Building Carbon Reduction is the Only Way to Carbon Peaking and Carbon Neutrality

From Ukraine to Palestine, the world is full of contradictions, and the conflicts of interests, races and faith have never ceased for human beings. However, when it comes to the rapid changes in the ecological environment caused by climate change, such as glacier melting, rising sea levels, and the frequent extreme weather, surprisingly there was a unanimous agreement among the human race. It is a rare consensus in this complicated world that human beings must follow a green and low-carbon path for sustainable survival. Figure 1 shows the cumulative contribution of carbon dioxide emissions by the world's major carbon emitters since the Industrial Revolution, with the United States taking the top spot at 26% and China at 11%. Figure 2 shows that the global carbon dioxide emissions in 2021 were 34 billion tonnes, of which China accounted for nearly 31%, topping the list, while the United States accounted for 13.25%. This shows that although China currently emits more carbon than the United States, its cumulative emissions are significantly lower. When it comes to carbon reduction, the principle should be "common but differentiated responsibilities". As a responsible power, China has its international obligation to reduce carbon emissions.

Cumulative CO_2 Emissions Contribution Rate

Global cumulative carbon emissions, 1870-2013

U.S.: 26%

EU (28 nations): 23%

China: 11%

(Source: Carbon Neutrality Professional Committee of China Energy Conservation Association)

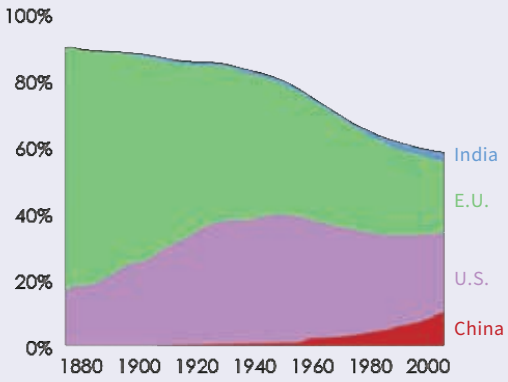

Figure 1. Global Cumulative Carbon Emissions Contribution Rate by Country

Global CO_2 emissions of about 34 billion tonnes in 2021

U.S. accounted for 13.5% of the global CO_2 emissions

China accounted for 30.9% of the global CO_2 emissions

(Source: Carbon Neutrality Professional Committee of China Energy Conservation Association)

Figure 2. Global CO_2 Emissions by Country in 2021

In 2019, China's leader proposed the concept of carbon peaking and carbon neutrality. Figure 3 shows that the lifecycle carbon emissions of building and construction in China reached 5 billion tonnes, accounting for 50% of the national total carbon emissions. Therefore, carbon reduction in the construction industry is a must for realising the carbon peaking and carbon neutrality goals proposed by President Xi.

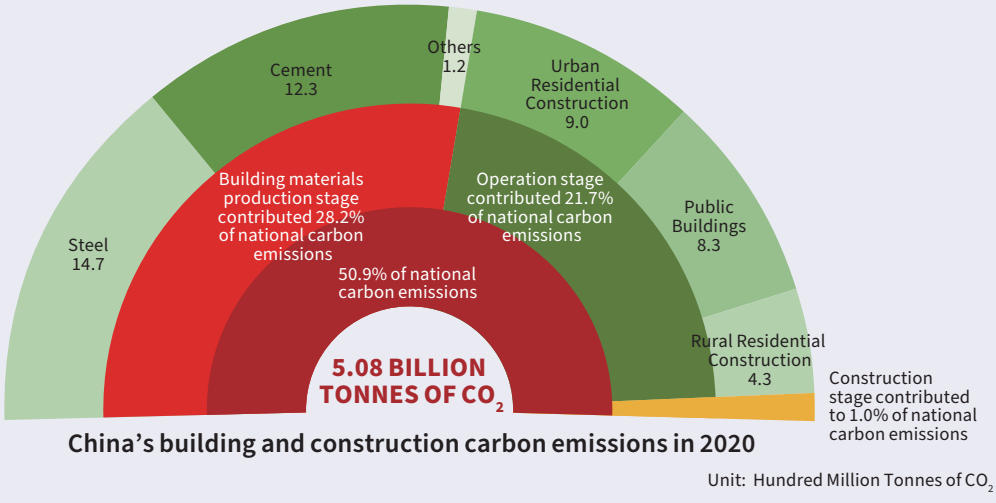

Figure 3. Distribution of National Building and Construction Carbon Emissions in 2020

Lingnan Building Characteristics

Lingnan climate is characterised by high temperature and humidity, and is prone to heavy rain and strong wind. In order to adapt to this climate, Lingnan architecture has developed wok ear gables, patios, verandahs, water feature design, cold alleys and other architectural elements. The wisdom of our ancestors greatly improved the indoor living conditions during times of low energy consumption, while also demonstrating a humanistic care. In 2016, the Guangzhounan Railway Station received numerous complaints from travellers about the waiting hall temperature reaching 32 degrees Celsius. Through the study, the waiting hall canopy was made of EFTE film, and the original shading coefficient required for energy saving was 0.18, while the measured value was 0.38. In addition, due to a lack of experience in the construction of similar large-volume spaces, Guangzhounan Railway Station has an air infiltration rate of more than 2 million cubic meters per hour, resulting in the inability of the air conditioning system to retain cold air. To improve the performance of numerous future large-scale public projects in China, it is important to draw on our ancestors' valuable experience in shading and insulating techniques in Lingnan architecture and to consider the control of natural ventilation in air-conditioned environments.

GREEN AND LOW-CARBON PRACTICES OF THE GZDI

The History of Green and Low-Carbon Development of the GZDI

Guangzhou Design Institute is the inheritor of the Lingnan architecture. Mr. Lin Keming, the founding director in 1952, was a master of Lingnan architecture. Before the reform and opening-up of China, many public buildings were not equipped with air-conditioning due to economic constraints. The previous generation of architects made full use of Lingnan architectural elements and improved the comfort of buildings through design features such as sun shading and natural ventilation, creating many modernist works. These buildings have stood the test of time and met the user's needs for building comfort. Overall, the Lingnan architectural spirit is a combination of Chinese and Western cultures, inclusive, and daring to be the first.

After the reform and opening-up, China's economy flourished. The Lingnan region was at the forefront of this movement, with a large number influx of Hong Kong and Macau compatriots investing in the region. And many Hong Kong and Macau architects, consulting firms and contractors entered the Mainland. During this period, the GZDI incorporated many advanced modern architectural concepts and technologies, gradually growing. After China joined the World Trade Organization (WTO) in 2000, its economy developed rapidly and the scale and volume of China's entire construction industry reached world-class levels. Many large-scale buildings emerged at that time. Based on the advanced technologies learnt from the West in the last 20 years, the GZDI turned into independent innovation and became a pioneer in energy-saving buildings in the Greater Bay Area, constructing a number of masterpieces which had a great impact on the industry, such as the Guangzhou Tower, the Guangzhou Development Centre Building and the Pearl River City. Since 2010, after the last 10 years of practice, the GZDI has developed a green and low-carbon approach for the entire Lingnan architecture, based on a technical route with Lingnan architecture features as its foundation and high-efficiency air-conditioning as its core.

Green and Low-Carbon Dilemma of Modern Construction in the Greater Bay Area

Figure 4 shows that public and commercial buildings account for 60% of the energy consumption in the Greater Bay Area. The modern buildings in the Greater Bay Area are large-scale and highly commercial, which contributes significantly to the high energy consumption. Air conditioning accounts for 55% of energy consumption in public and commercial buildings in the Great Bay Area, making it the largest contributor to building energy consumption. Since natural ventilation and external sun shading systems in these buildings are difficult to implement due to various factors, energy saving in air conditioning is the best way to achieve green and low-carbon building in the Greater Bay Area, provided that the lighting, survival and power equipment have already reached a relatively high level of efficiency.

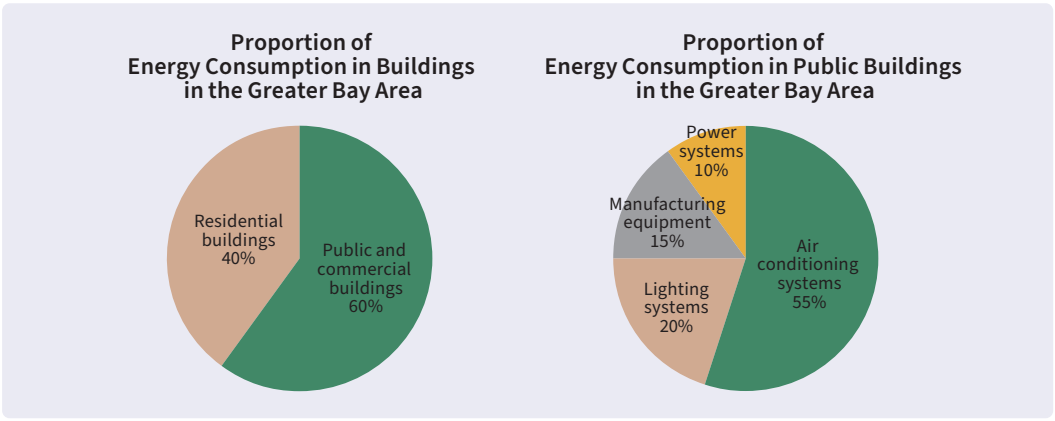

Figure 4. Proportion of Energy Consumption in Buildings and Composition of Energy Consumption in Public Buildings in the Greater Bay Area

In Figure 5, refrigeration plant rooms account for 70% of the entire air conditioning energy consumption, making them the key area for energy conservation. The current challenge in air conditioning energy conservation is the lack of systematic evaluation tools and of multi-disciplinary management throughout the process. First of all, when purchasing air conditioners for personal use, customers can refer to energy consumption labels; however, for air-conditioning systems cost tens of millions of dollars, there are no systematic tools available to evaluate energy consumption. Secondly, unlike electrical and mechanical systems, energy-saving in air conditioning systems requires coordination between air conditioning and automation professionals, and among design, construction, adaptation and operation and maintenance teams to maximise the effect of the technology in practice.

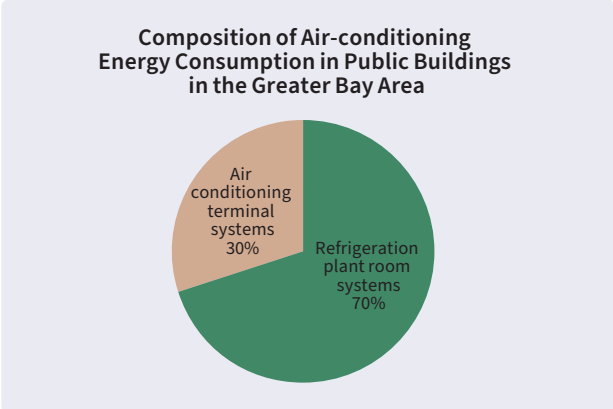

Figure 5. Composition of Air-conditioning Energy Consumption in Public Buildings in the Greater Bay Area

Solutions for High Efficiency Air Conditioning

Establishment of System Energy Efficiency Evaluation System

The GZDI has established a system to evaluate the energy efficiency of high-efficiency refrigeration plant rooms in different climate zones across the country, and categorised the energy efficiency ratios (EER) into Leading Class, Tier 1, Tier 2, and Tier 3 from highest to lowest. The GZDI recommends that refrigeration plant rooms in public commercial buildings in the Greater Bay Area should achieve an EER of 5.0, with a Leading Class EER of 5.2 or higher. This evaluation system has been proven to be scientific and reasonable through numerous practices.

Production of System Energy Efficiency Simulation Tools

To achieve energy-saving goals, modern information technology must be used for energy consumption simulations. The GZDI has developed its own air-conditioning energy consumption and energy efficiency simulation system, which uses automatic algorithms to simulate the operation logic control of the refrigeration plant room to complete energy consumption and energy efficiency simulation. This approach enables the prediction of results prior to commencing work, facilitating the comparison and selection of multiple systems and equipment schemes.

Comprehensive Realisation of Energy-Efficiency Monitoring of Refrigeration Plant Rooms

To create high-efficiency air-conditioning system, it is crucial to establish an effective and accurate monitoring system, which allows for precisely measurement of the energy consumption level and enables control the system through energy efficiency optimisation. The GZDI has developed an energy efficiency monitoring platform for refrigeration plant rooms, which could monitor the refrigeration capacity, power consumption and energy efficiency of refrigeration plant rooms and each sub-system in real-time. All results are based on data.

Multi-disciplinary Collaborative Design and Optimisation

High-efficiency air conditioning requires the collaboration among various professions, i.e., the air-conditioning professionals optimise equipment selection and reduce system resistance, while the automatic control professionals optimise the measurement system and energy-efficiency control system. The energy efficiency monitoring system's measurement uncertainty is closely monitored throughout the process. Integrated electric and electronic systems are used to reduce wiring errors and improve debugging efficiency.

Whole Process Project Management

In addition to the technical aspects, it is also important to improve the project management philosophy. As shown in Figure 6, the target oriented PDCAD design methodology for energy efficiency of refrigeration plant rooms requires the client to adopt whole-process management of energy efficiency consultancy services, so as to ensure that the established energy efficiency targets remain unchanged throughout the design, tendering and procurement, construction, debugging and operation and maintenance processes.

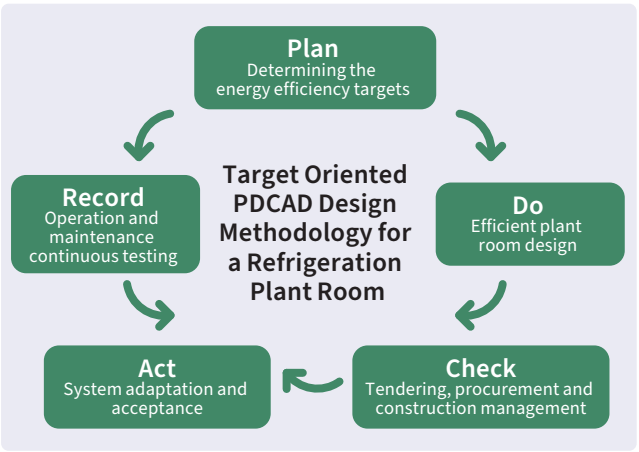

Figure 6. Energy Efficiency Target Oriented PDCAD Design Methodology for a Refrigeration Plant Room

ACHIEVEMENTS AND OUTLOOK

Based on the aforementioned ideas, the GZDI has implemented nearly 100 projects in China, with the highest energy efficiency rate of 7.1 achieved, reaching the top level in the industry.

The GZDI is dedicated to promoting high-efficiency air conditioning systems, and has edited the Energy Efficiency Monitoring and Evaluation Standard for Centralised Air-Conditioning and Refrigeration Plant Room Systems. In addition, the GZDI acted as a consultant in the study of the Guangdong Province Green and Efficient Refrigeration Action Plan (2023-2025), which was jointly issued on 8 March 2023 by seven departments, including the Development and Reform Commission of Guangdong Province and the Department of Housing and Construction.

With Lingnan architecture as its foundation and high-efficiency air-conditioning as its core, the GZDI has launched many high-quality green buildings. The recently opened Changlong Spaceship Park has been awarded the three star green building and LEED GOLD certification. High-quality green buildings are not only designed to be green, but their use and operation must also be green and low-carbon.

The GZDI aims to create a regional integrated energy system in the future. This will be based on our high-efficiency air conditioning storage system and will include more digital elements to improve efficiency, such as whole-process BIM+FM positive management, equipment and facilities KKS unified coding and DCS centralised control commonly used for the energy industry. The GZDI is committed to encouraging the clients to adopt green and low-carbon retrofitting for existing buildings through low-cost measures such as operational debugging and energy-saving management. In terms of near-zero energy consumption buildings, the Science and Innovation Building of the China Construction Fourth Engineering Division is a steel prefabricated building that incorporates the Lingnan characteristics of verandahs, cold alleys, natural ventilation with the ultra-high efficiency air conditioning systems and solar shading and photovoltaic integrated curtain walls to achieve near-zero energy consumption as a super-tall building. In addition, as a green and low-carbon think tank, the GZDI has undertaken a series of studies on related topics, including Synergistic Development between Green Finance and Energy Saving in Construction and Green Buildings.

Looking ahead, mutual trust, communication, cooperation and a win-win situation shall certainly be the main themes for the sustainable development of the construction industry in the Greater Bay Area. Our future of the construction industry in the Greater Bay Area must be built on green development.

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Building Energy and Carbon Emission Analysis in GBA Cities

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ABSTRACT

The paper introduces the energy and carbon emissions of the building sector in China and the Greater Bay Area. It compares the energy and carbon emissions of residential and commercial buildings and identifies the relationship between these emissions and social and economic factors. The paper also discusses the comparison between the energy and carbon emissions of the United States and China.

INTRODUCTION

Building sector energy and CO_2 emissions in China

Figure 1(a) illustrates the energy consumption of the building sector in China, including building operation and embodied carbon emissions. The data is taken from a collaborative work by the Shenzhen Institute of Advanced Technology, the Ministry of Urban Housing Development, and the China Association of Building Energy Efficiency (CABEE). In China, the building sector is responsible for approximately 50% of the country's total energy consumption when considering both embodied emissions and building operation. Figure 1(b) shows that over 90% of CO_2 emissions in this sector come from building operation and embodied emissions. The primary source of carbon emissions is embodied emissions, which account for more than 50% of the total carbon emissions in the building sector. In China, carbon emissions are produced by both residential and commercial buildings, with each contributing approximately half of the total emissions. The remaining share comes from rural buildings.

Over the past 15 years, China's building energy consumption and CO_2 emissions have experienced rapid growth. Figures 2(a) and (b) illustrate the trajectory from 2005 to 2020, indicating a significant development in building energy consumption. China experienced rapid urbanization in the past 15 years, which led to a tripling of building energy consumption and carbon emissions. However, growth slowed slightly during the 13th Five-Year plan period due to a slowdown in urbanization and real estate development.

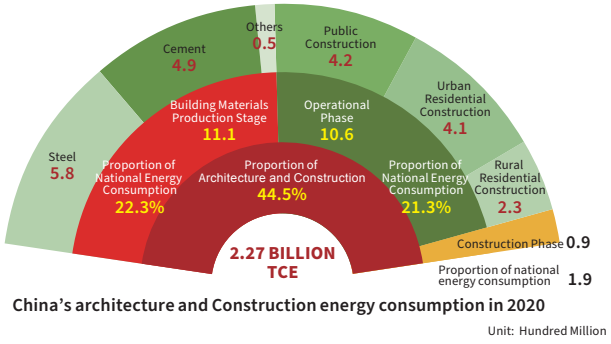

Figure 1(a) 2020 China's building energy consumption

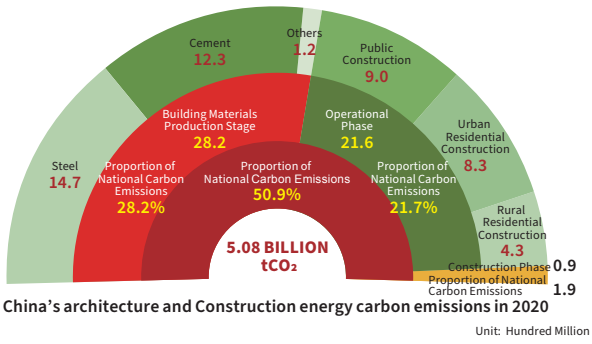

Figure 1(b) 2020 China's building carbon emission

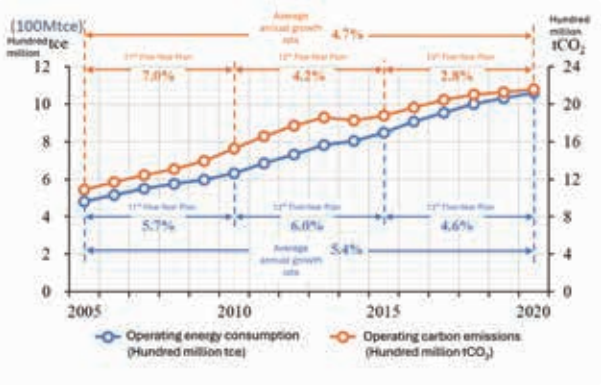

Figure 2(a) Trend of energy consumption and CO_2 emission in building operation

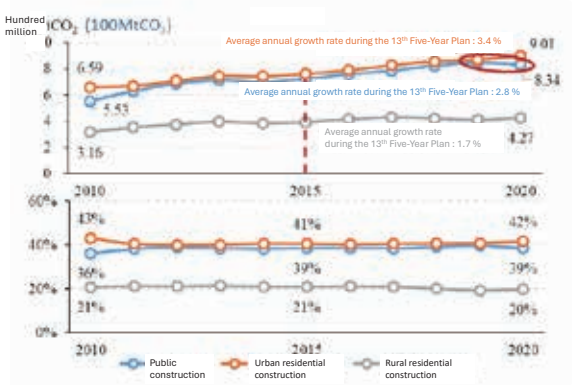

Figure 2(b) Trend of energy consumption and CO_2 emission by building type

Building operation CO_2 emissions in China

Figure 3 displays the CO_2 emissions from various sources, including direct emissions and emissions from electricity and heat. Direct emissions are from the fuel burned on building sites, which are considered Scope 1 emissions. Heat emissions are mainly for district heating in the northern part of China. It is observed that electricity consumption has increased dramatically in the past five years, while fuel burning on building sites has relatively slowed down, even decreased. One of the main reasons for China's rapid electrification process is the replacement of fossil fuels, natural gas, and coal with electricity. This is due to the belief that future clean energy, particularly zero-carbon energy from renewable, nuclear, and hydro sources, will primarily be in the form of electricity.

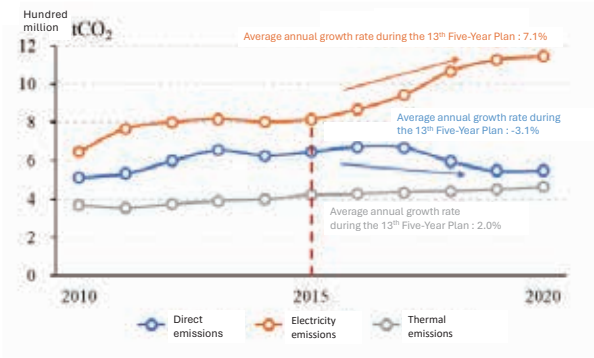

Figure 3(a) CO_2 emission in building operation by emission sources

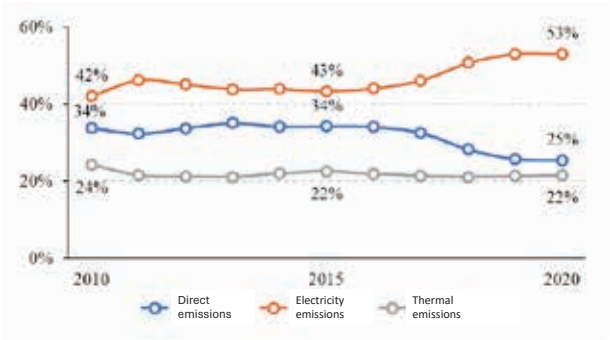

Figure 3(b) Proportion of CO_2 emission in building operation by emission sources

Building embodied emissions in China

Figure 4 displays the embodied emissions in the residential and commercial sectors, respectively, based on building materials. The embodied emissions in the residential sector have experienced rapid growth in the past 15 years, but have slowed down in the past 5 years, coinciding with the slowdown of real estate development. In contrast, the embodied emissions in the commercial sector have steadily increased. Cement and steel are the primary sources of embodied emissions in construction materials.

BUILDING SECTOR ENERGY AND CO_2 EMISSIONS IN THE GREATER BAY AREA (GBA)

Building CO_2 emissions in the GBA

In the Green Bay area, building operation accounts for approximately 80% of carbon emissions, which differs from the total carbon emissions in China, where there is a 50-50 split between building operation and embodied emissions. The GBA has a relatively high urbanization rate, but its construction activity is not as high as the national average.

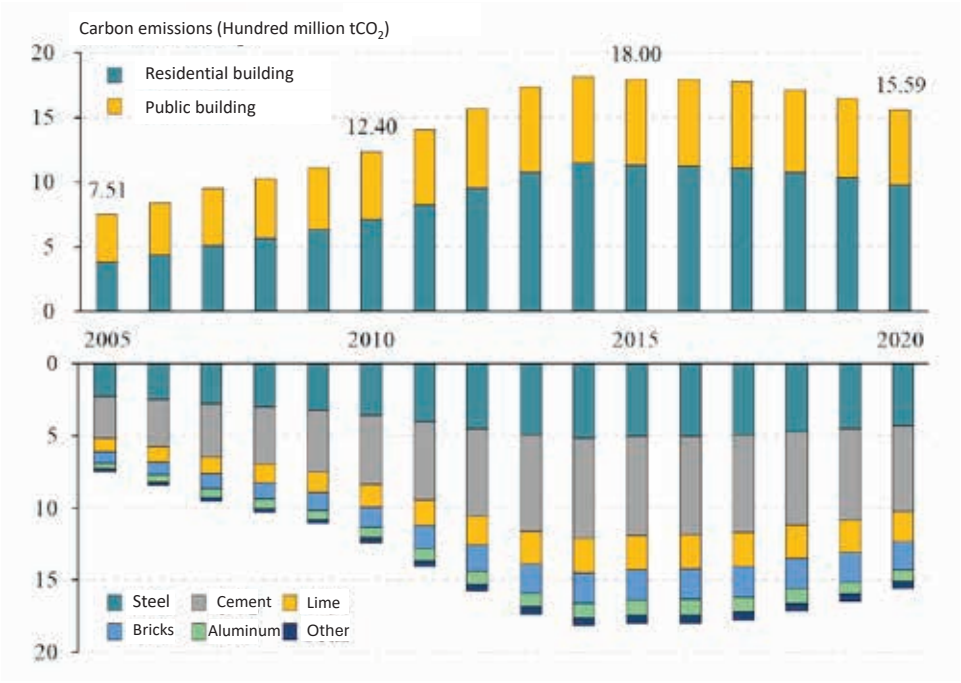

Figure 4 Building material CO_2 emissions by building and material types

Figure 6 illustrates the urbanization rate and the proportion of operational emissions to total emissions for the GBA cities. Cities with high urbanization rates, such as Hong Kong, Macau, and Shenzhen, demonstrate a larger share of operational emissions due to fewer construction activities compared to cities in the fast urbanization stage, such as Zhaoqing, Jiangmen, and Huizhou. It is likely that these cities will experience a similar trend to Hong Kong, Shenzhen, and Macau in the next 10 to 15 years.

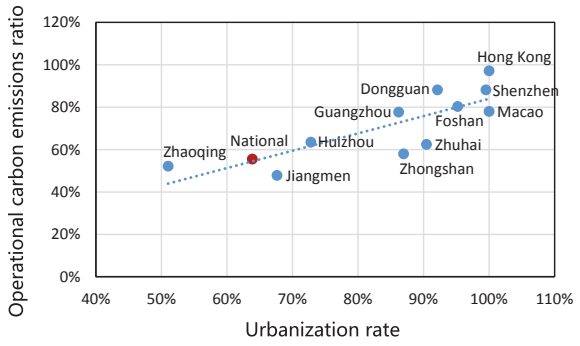

Figure 6 Share of the operational carbon emission for the GBA cities under different urbanization rate

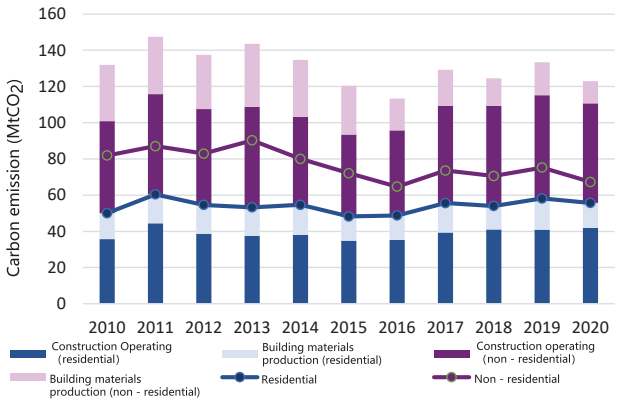

Figure 5 Building CO_2 emissions in the GBA

Building CO_2 emissions at cities level in the GBA

Figure 7 displays the carbon emissions of various cities in the GBA. Guangzhou, Shenzhen, and Hong Kong are the top three emitters among the Green Bay area cities. Figure 8 illustrates the proportion of carbon emissions from the residential and commercial sectors. In Hong Kong, Shenzhen, and Macau, commercial buildings emit about two-thirds or more of the total emissions from the building sector. In contrast, cities like Zhaoqing or Jiangmen have a roughly equal distribution of commercial and residential buildings. In highly developed cities with advanced service sectors, the service sector contributes significantly to total emissions, while in developing cities, CO_2 emissions from residential buildings are more prominent.

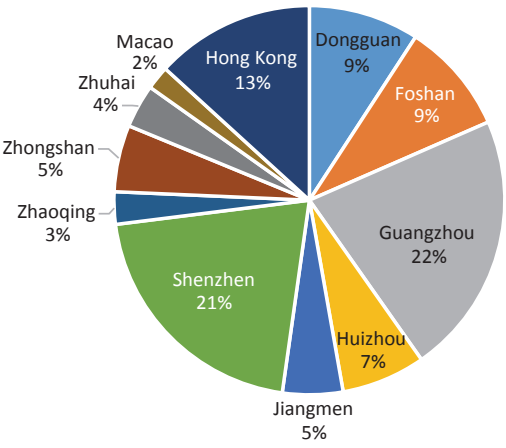

Figure 7 (b) Carbon emissions across different cities in the GBA

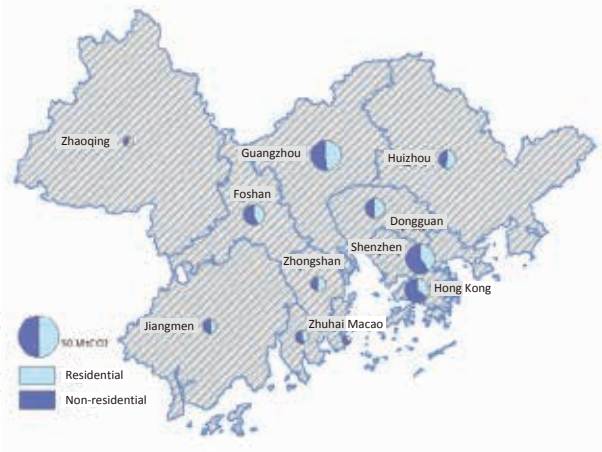

Figure 8 Building sector CO_2 emissions in the GBA by building types

Building operation CO_2 emissions in the GBA

Figure 9 shows that building-related energy consumption in the GBA accounts for approximately 5% of China's total operational energy consumption and about 70% of the total number in Guangzhou province, Hong Kong, and Macau. The electrification rate in the GBA is up to 85%, while China's average is still below 50%.

When comparing the carbon emissions of residential areas in the GBA to the national average over the past 10 years, it is evident that the GBA outperforms the national average (Figure 10(a)). However, in the commercial sector, the per square meter energy consumption (Figure 10(b)) is actually higher than China's average due to the advanced service industry. This is due to the GBA's increased use of clean electricity. As electrification progresses, the emission intensity is decreasing.

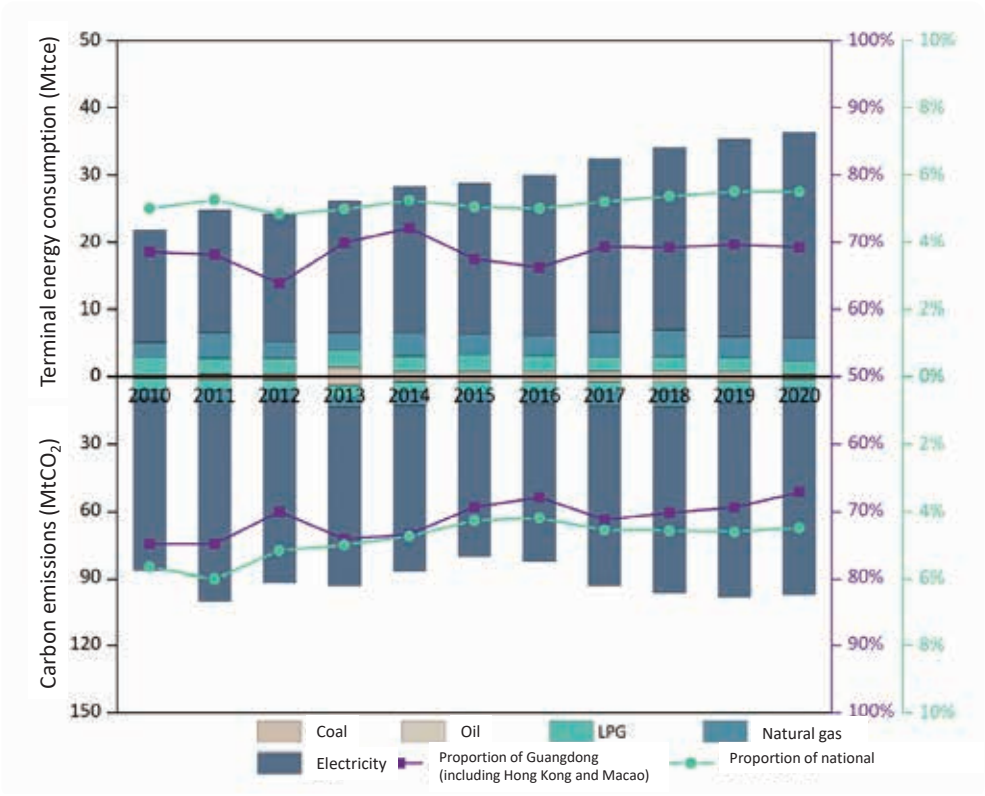

Figure 9 End energy consumption and CO_2 emissions of building operation in the GBA

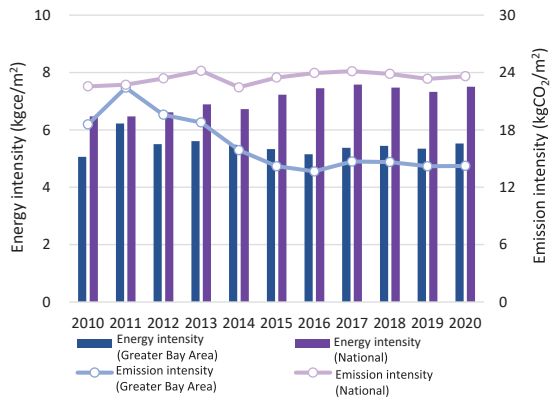

Figure 10(a) Energy intensity of residential buildings

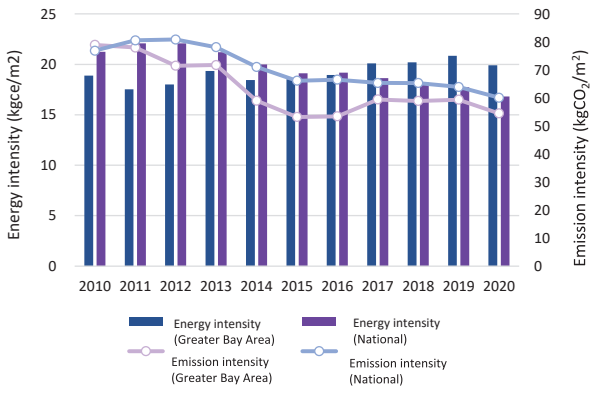

Figure 10(b) Energy intensity of non-residential buildings

CO_2 emissions of building operation at city level

The emissions of a building, both in terms of embodied and operational emissions, are highly related to economic growth factors in cities. As per capita income levels increase over time, residential buildings are required to provide more services, resulting in a relatively higher CO_2 emission per square meter. This suggests that as the per capita income level in mainland cities increases, it is expected that a similar trend in CO_2 emissions per square meter will prevail. This poses a challenge for improving the energy efficiency of buildings to control this increase. However, the per capita service sector GDP emission efficiency in Hong Kong and Macau is significantly higher than that of other mainland cities. This means that, for the same amount of GDP, the GBA cities use less energy and emit less carbon.

CO_2 emissions of material production

The peak of CO_2 emissions from material production in the GBA occurred in 2013, which was related to a decrease in the floor area of non-residential buildings. The main sources of CO_2 emissions arise in the material production of cement and steel.

CO_2 emissions of operation stage: China vs U.S.

In 2020, China caught up with the US in terms of carbon emissions and energy use for the total building sector, and has since emitted more than the US. However, the per capita end-use consumption and CO_2 emissions of the US are nearly four and three times higher than those of China and the GBA, respectively, as shown in Figure 11. In terms of residential buildings, the end-use consumption of the US is higher than that of China. However, due to a higher emission factor of electricity, China's CO_2 emissions are higher than those of the US. China has a high electrification rate, which presents a good opportunity to utilize future clean energy in the electricity sector and decarbonize the building sector. In terms of commercial sector emissions, the end-use consumption unit tertiary industry GDP of the US is lower than that of China and higher than that of the GBA. China and the GBA show a positive trend in decreasing their GDP per capita CO_2 emissions.

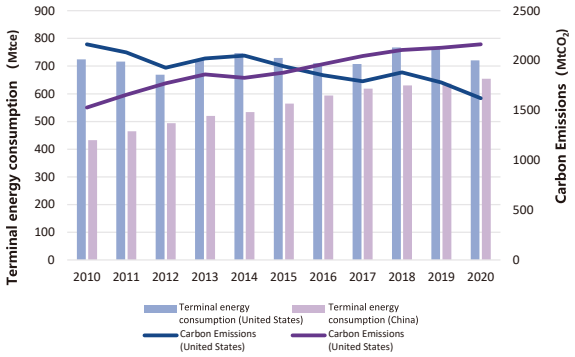

Figure 11(a) End-use consumption and CO_2 emissions of operation stage

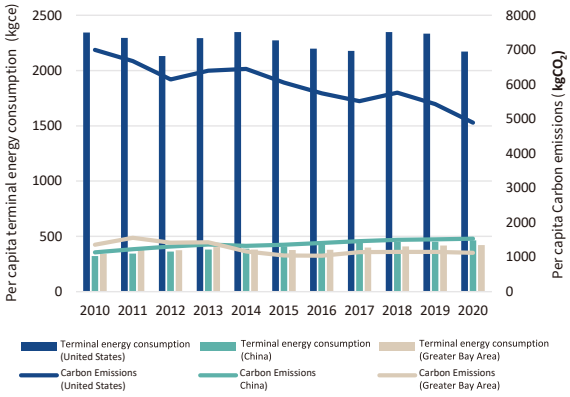

Figure 11(b) Per capita end-use consumption and CO_2 emissions of operation stage

CONCLUSIONS

In the GBA, carbon emissions have plateaued, while CO_2 emissions from building operations continue to increase. Electricity accounts for more than 85% of the end energy. Material production reached its peak in 2013, with the cement and steel production being the major sources of CO_2 emissions. Additionally, there is a positive correlation between the urbanization rate and the ratio of operation to building-related CO_2 emissions.

The relationship between energy (emission) intensity and socio-economic parameters is positive. In the United States, the end-use energy consumption for building operations is higher than in China, while CO_2 emissions are lower. To reduce carbon emissions, five key steps can be taken: improving material efficiency, improving energy efficiency, making process changes, using alternative cement, and switching fuels.

XCMG Carbon Neutrality Strategy

Mr. LUO Shenghui
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Xuzhou Construction Machinery Group Imp.& Exp. Co., Ltd

ABSTRACT

In this paper, the contribution and experience of Xuzhou Construction Machinery Group, or XCMG, in the research and development of green and new energy equipment and its endeavour to promote global sustainability are presented. The approaches used by XCMG in developing innovation and establishing ways for human beings to live in harmony with nature are given.

INTRODUCTION

About Xuzhou Construction Machinery Group

Xuzhou Construction Machinery Group, or XCMG, has a long history spanning over 80 years as a leading company in the manufacture of construction machinery. In 2002, the XCMG's construction machinery sector was listed, which brought a new angle and reinvigoration for the company. XCMG's construction machinery sales volume had been ranked third in the world for three consecutive years and first in China for more than 30 consecutive years. XCMG has over 45,000 employees, of whom 20% are research and development personnel, providing XCMG with solid and reliable strength in this area. With an operating revenue of more than $100 billion and a brand value of more than $110 billion, XCMG was ranked among the top 500 brands in the world. In recent years, XCMG's reputation has continued to grow with its brand influence, with its revenue from internationalised businesses reaching 40%. The exports of XCMG have reached over 193 countries and regions. XCMG is now operating in over 30 countries and has set up factories in the United States and Brazil with more than 350 overseas distributors. XCMG's products consist of 17 categories, covering more than 100 industries and 1,000 specification types, including lifting appliances and mining equipment. XCMG owns several national smart manufacturing pilot demonstration plants, which can annually produce 30,000 cranes, 100,000 excavators, 40,000 loaders, 15,000 road construction machines, 50,000 forklift products, and more than 50,000 other products.

As the world's largest manufacturer of lifting machinery, XCMG produces the most powerful 4,000-tonne crawler cranes and 3,000-tonne all-terrain cranes in the world. The wide use of XCMG lifting machinery in Oman's petrochemical project and Saudi Arabia's oil refining project in 2019 was a milestone for Chinese manufacturing to go global. XCMG's complete sets of equipment have been ranked first in the world, providing customers with complete and sophisticated solutions through a diverse range of large-scale equipment, including mining dump trucks, mining excavators, and graders.

Based on the five transformation and upgrading principles of internationalisation, upscaling, intelligentization, greening, and servitisation, XCMG is swiftly achieving the aim of becoming a world-class company. XCMG's new energy equipment is reliable and of high quality, making a positive impact on the industry. XCMG has aimed to reach 50% of the total revenue from export businesses by the end of 2027.

Introduction of Carbon Neutrality Strategies

The global green industry is moving fast. At present, many countries are driving the transformation and upgrading of their economies, new energy sources, and industrial structures to achieve sustainable economic and social development. In July 2021, the United Nations Global Compact released its Corporate Net Zero Pathway, calling for the reduction of anthropogenic emissions and the use of carbon offsets to balance residual emissions. China has proposed carbon neutrality through the establishment of a "Carbon Peak and Carbon Neutrality" leading team for a "1+N" policy framework in May 2021 by the CPC Central Committee and the State Council. China has set up the goal of achieving carbon neutrality by the end of 2060 by controlling the temperature increase to within 1.5°C, and it is expected that carbon neutrality will be achieved in about 40 years through the promotion and application of technologies related to energy-saving, emission-reduction, zero-carbon, and negative-carbon aspects. According to the United Nations, infrastructure-related industries account for 70% of global greenhouse gas emissions, and thus they should make the greatest contribution to carbon reduction for the goal of "carbon neutrality". While the world's green economy and sustainable development are facing challenges, the emergence of revolutionary innovation, new technologies and industries, and accelerated technological and energy transformation have brought about significant opportunities. By seizing these opportunities, the company can move forward, reignite its vitality, and infuse with it a renewed sense of energy.

XCMG'S CARBON NEUTRALITY STRATEGY

XCMG's Strategies on Sustainability Development

In terms of green development, XCMG has obtained successful results from its strategic deployment. Green and low-carbon practices have become an essential requirement for human development, social operation, and an ethical standard for the industry. As a prominent industrial manufacturing company, XCMG has gained widespread recognition for its ability to embrace the concept of carbon neutrality. The greening efforts of XCMG have covered the aspects of "research, production, supply, marketing and service", establishing a complete circle of low-carbon practices in the whole industrial chain and the overall life cycle.

Green Research and Development

XCMG has taken full advantage of digitalisation to drive a new mode of global research and development. It uses 3D printing technology for the synergistic development of electromechanical systems, hydraulic systems, and original equipment, and supports the synergistic research and development of the four global research and development centres in China, the United States, Europe, and Brazil, allowing them to complement each other's strengths and greatly increase the research and development efficiency.

Green Technologies

XCMG has widely used lightweight technology to reduce the waste of raw materials and lower production costs. Meanwhile, XCMG has greatly extended the life of its products through additive re-manufacturing of core parts with the use of laser cladding, supersonic plasma spraying, and other technologies. XCMG's re-manufacturing equipment was also exported overseas.

Green Materials

Spray-free materials have been largely used in the XCMG's equipment to reduce the pollution arising from the production and operation of equipment, which not only protects the environment but also improves the workplace for producers and users.

Green Environment

XCMG's factories have made extensive use of decentralised solar photovoltaic power generation systems and lighting systems to reduce energy consumption. Currently, XCMG has installed decentralised photovoltaic power generation systems in nine factories, which produce cranes, tower cranes, and excavators, with a total area of 400,000 m^2 and a total installed capacity of 420,000 watts, significantly reducing fossil energy consumption.

Green Logistics

XCMG has improved efficiency and reduced costs through the use of various types of efficient logistics systems such as AGVs.

Green Manufacturing

In recent years, XCMG has promoted the integration of informatisation and industrialisation, while accelerating the transformation of smart green manufacturing by applying new-generation information technology. Several of XCMG's factories were granted product carbon footprint certificates, making the company the first awarded in the industry.

XCMG has built the world's first smart production line for cranes, which increased the automatic welding rate from 40% to 90%, and lowered the first inspection failure rate to less than 1%. XCMG has invested in the construction of a national smart manufacturing pilot demonstration plant, which has shortened the research and development cycle by improving production efficiency and reducing production energy consumption.

Green Services

XCMG has enhanced its green service standards and reduced customer costs by using 5G technology. Through its Hanyun Internet platform, XCMG has been able to collect and address customer demands immediately and manage the resources of OEMs and services effectively, serving the global aftermarket.

XCMG's Hanyun Internet platform provides functions, such as equipment image, machinery quick repair service, vehicle operation optimisation, and vehicle environmental monitoring. Leveraging the industrial Internet, XCMG has worked on service model innovation by reducing the user's whole life cycle cost and realising value-added services.

XCMG's Green Products and Solutions

XCMG's green products consist of new energy products, unmanned product clusters, and complete sets of green product solutions. As early as 2013, XCMG took the lead in developing new energy products in the industry and was the first company to launch 25-tonne truck cranes with natural gas systems, 5 to 8-tonne series loaders, and 21-tonne hybrid excavators, which are more energy-efficient than the fuel products by over 25%.

XCMG's new energy equipment could be divided into three main energy sources, electric, hybrid, and hydrogen, which could be further subdivided according to their specific requirements.

XCMG's electric equipment in market operation includes more than 5,000 electric road vehicles, 4,400 electric mining trucks, and 2,000 electric loaders. Among them, the 120-tonne and 240-tonne wireline-assisted transmission trucks passed the test at the mine site, while the 80-tonne electric unmanned trucks will be tested soon. Currently, XCMG's new energy equipment, including mining trucks, excavators, loaders, aerial work platforms, and crawler cranes, has been used by customers all over the world.

At a New Zealand's largest construction machinery fair, Mr Michael Wood, New Zealand's Minister of Transport, highly praised XCMG's E700 battery-swapping truck after giving it a test drive. XCMG's fleet of unmanned rollers has also been used in many major highway projects in China. XCMG's new energy-efficient heavy-duty trucks and forklift loaders have also been delivered. XCMG's unmanned driving applications for pavements, mines, and machinery have also been gradually launched, while remote driving has been realised through smart driving. In terms of smart mining solutions, XCMG's first autonomous truck fleet, consisting of 3 autonomous dump trucks, 1 excavator, 1 wheel loader, and 1 service truck, has been put into operation, reaching a maximum speed of 30 km/h. Among them, the system of smart operation has been the core of the smart mine, which could be divided into four levels, i.e. driver assistance, remote control, semi-automatic control, and fully automatic control. XCMG is capable of fully automating excavator operations in mines, significantly improving driving safety in unmanned mines, saving operating costs, and improving efficiency.

In September 2023, XCMG's new energy equipment, including high-voltage lithium forklifts, pure electric loaders, and other new energy high-end products, was introduced at the BICES fair in Beijing, attracting wide attention.

CONCLUSION

With the vision of "making the world more low-carbon", XCMG will continue to lead and drive upstream and downstream enterprises to embrace high-quality and sustainable green and low-carbon practices. Embracing the "Made in China" label, XCMG is determined to expedite the deployment of green industries, foster fresh competitive advantages, inspire industry-wide excellence, and make a contribution to global development.

Day 3 AM

Global Construction Sustainability Forum (Environmental) – Carbon Neutrality

Welcome Remarks

Mr. Ivan FU
Chairperson
Committee on Environment of
Construction Industry Council

Good morning and a warm welcome to the Carbon Neutrality and Safety Forum. As we gather here on the final day of this remarkable event, we are about to delve into the two most critical ESG issues facing the construction sector.

Carbon, without a doubt, is the most significant topic of our time, and it will continue to dominate discussions in the coming decade. In our quest to protect our planet, we are employing a basket of cutting-edge and innovative approaches, such as high productivity construction methods, digitalization, and the introduction of green financing. Our ultimate objective is to unite the entire industry, as each stakeholder shoulders its responsibilities and contributes to the city's pledge of achieving carbon neutrality by 2050.

The Construction Industry Council (CIC) is firmly committed to the sustainable development of our industry. As pioneers in this endeavor, we are leading our stakeholders towards taking decisive actions on the path of decarbonization. In addition to our sustainable construction charter, the CIC has undertaken a comprehensive study to assess the major sources of carbon emissions within the industry. The findings of this study reveal that our industry accounted for 3.7% of Hong Kong's carbon footprint (40.2 MtCO2e) in 2019. The primary sources of carbon emissions include on-site construction activities, site processes, site offices, waste treatment, and transportation of waste and materials during the construction and demolition phases.

Building upon the identified emission areas, the CIC will be focusing on three key directions for decarbonization. These directions encompass the electrification of construction sites and the adoption of clean energy, waste reduction, and the implementation of high productivity construction methods through digitalization. We are particularly excited to conduct a feasibility study on construction site electrification and continue promoting the adoption of smart waste management tools. Undoubtedly, the journey towards carbon neutrality presents significant challenges in terms of resources, technological readiness, and external factors beyond our immediate control. Nevertheless, our dedication to exploring practical decarbonization solutions remains unshaken.

Safety, as always, remains a non-negotiable priority in our operations. Today, we are privileged to have three esteemed speakers from around the world who will share their experiences and insights on addressing safety from distinct perspectives. Their invaluable contributions will range from shaping a safety culture to establishing robust safety management systems and embracing digitalization. Given the backdrop of limited resources and an aging infrastructure, it is imperative that we adopt a multi-pronged approach to ensure safety.

Before we proceed, I would like to express my sincere gratitude for your passion and active participation in this forum. Together, we can propel our industry towards a greener and safer future.

Thank you.

Opening Address

Dr. LAM Ching-choi
Chairman
Council for Carbon Neutrality and Sustainable Development

Thomas, Ivan, Edward, Professor, Joan, Robert, distinguished guests, ladies and gentlemen.

It is a privilege to be here this morning to join the carbon neutrality section of the CIC Global Construction Sustainability Forum. First of all, I would like to express my gratitude to CIC for organizing the first of this kind of construction sustainability forum, one of the large-scale events in Hong Kong. CIC has all along been striving to raise the awareness of sustainability and promote green transformation across the construction industry. It has been continuously developing significant projects and schemes to promote decarbonization and sustainable development, including carbon assessment tool, which measures the carbon footprint of building and infrastructure projects, the Sustainable Construction Award, and relevant certification schemes, as just mentioned by Ivan. The efforts of CIC in accelerating low carbon transition in the industry are deeply appreciated. On our road to sustainability, climate change is no doubt one of the most urgent and challenging issues. Like other cities, Hong Kong is facing problems, such as rising temperatures and more extreme weather phenomenon, including the onslaught of super typhons. In the last four months, we have experienced three strong typhons requiring signal number eight or above, record breaking rainstorm events, and the hottest summer on record in Hong Kong.

Climate change has become an urgent global challenge that is putting sustainable development and all the economies at risk. It affects our health and daily lives, our living environment, our next generation, and also our industry. It is imperative that we work together to reduce our carbon footprint and transition towards carbon neutrality. China has made clear endeavor to achieve carbon emission peak before 2030 and carbon neutrality before 2060. To contribute to the achievement of the national goals, we published in October 2021, the Hong Kong Climate Action Plan, 2050, which provides comprehensive strategies for achieving our targets, namely, to reduce Hong Kong's total carbon emission by half before 2035 from 2005 level, with a view to achieve

carbon neutrality before 2050. While it is important for every government to lead their jurisdictions towards the goal of carbon neutrality through introduction of strategic decarbonization strategies and policies suiting the local situation, the success of this decarbonization efforts will depend on a significant extent the active participation of all sectors of the society. The construction industry is a vital part of every society, responsible for creating the physical infrastructure and forms the backbone of a city. On the other hand, the industry is also a significant contributor to greenhouse gas emission, accounting for nearly 40% of global carbon dioxide emission when considering the whole life carbon from the built environment.

It means that the changes that we make with the construction industry can have a pivotal impact on our path of achieving carbon neutrality. Achieving carbon neutrality in the industry involves a multifaceted approach. Carbon footprint should be minimized in each stage of a construction project, from planning, design to construction and operation. It would be crucial for the industry to develop strategies for wider application of renewable energy sources, improving energy efficiency in construction and building operation, as well as good resource and waste management practices, as just mentioned. In addition, innovation in design materials, as Professor Jones will introduce his wonderful work later, and construction methods such as DfMA and MiC are much welcomed. The mission to achieve carbon neutrality will undoubtedly bring challenges to the industry but will also open up new business opportunities. It is expected that countries will continuously invest billions of dollars to combat climate change. Many of these necessary investments will involve construction of public infrastructure, such as new and low carbon energy installations, net zero ready buildings, waste to energy facilities, blue, green infrastructure, etc. Companies can seize the opportunities brought about by the global quest for sustainable development and carbon neutrality.

Ladies and gentlemen, achieving carbon neutrality before 2050 is extremely challenging, but it is not an impossible mission. Hong Kong is fortunate to be endowed with highly qualified professionals like you who also share the vision for a sustainable and resilient future. Please rest assured that your journey to carbon neutrality is not going to be a lonely one. You will have the full support of many like-minded people, including our members of the Council for Carbon Neutrality and Sustainable Development, in which Thomas is one of our members. I look forward to more collaboration with CIC in building a sustainable future for us all. May I take this opportunity to wish this forum and exhibition a great success.

CO-create Green Momentum

Mr. Edward TSE
Director of Architectural Services
Government of the Hong Kong Special Administrative Region

ABSTRACT

This paper highlights the efforts of the Architectural Services Department (ArchSD) of HKSAR Government in Hong Kong to co-create green momentum and achieve carbon neutrality in the construction industry. ArchSD's strategy, known as the 3A approach, focuses on amplifying decarbonisation efforts, accelerating the adoption of smart and advanced technologies, and acting together with stakeholders. By obtaining at least second highest rating under the local comprehensive building environmental assessment system (named as BEAM Plus) and implementing sustainable building design measures, ArchSD has made significant progress in reducing energy consumption and carbon emissions. The department's commitment to renewable energy and sustainable construction practices, such as Building Information Modelling (BIM) and Modular Integrated Construction (MiC), further contributes to their carbon neutrality goals. Collaboration and stakeholder engagement are also crucial components of ArchSD's strategy, as they actively involve industry professionals and advocate for sustainable design principles. The paper also presents case studies that demonstrate ArchSD's achievements in low-carbon design, emphasising the importance of passive design strategies and the utilisation of renewable technologies. Overall, ArchSD's efforts serve as an inspiring example for the construction industry, demonstrating the feasibility and benefits of transitioning towards a sustainable and carbon-neutral built environment.

INTRODUCTION

Hong Kong government announced in early October 2021 the Hong Kong's Climate Action Plan 2050 outlined four major decarbonisation strategies, and one of them was energy saving and green buildings. The construction industry plays a significant role in global carbon emissions, making the transition to carbon neutrality a pressing issue. In this paper, the strategies and initiatives undertaken by the Architectural Services Department (ArchSD) of HKSAR Government in Hong Kong will be explored to co-create green momentum and strive for carbon neutrality by 2050. By amplifying their efforts, accelerating the adoption of innovative technologies, and acting together with stakeholders, ArchSD aims to lay a solid foundation for a sustainable and low-carbon built environment.

The Hong Kong government's Climate Action Plan 2050 identified energy-saving and green buildings as one of the crucial decarbonisation strategies. Buildings in Hong Kong account for approximately 90% of the city's electricity consumption, with over 60% of carbon emissions attributed to energy generation for buildings. Recognising its responsibility, the ArchSD, as the government department responsible for Hong Kong's public building facilities, has been actively involved in decarbonisation efforts to improve the Hong Kong's living environment.

CURRENT GREEN AND SUSTAINABLE BUILDING PERFORMANCE IN ARCHSD'S PROJECTS

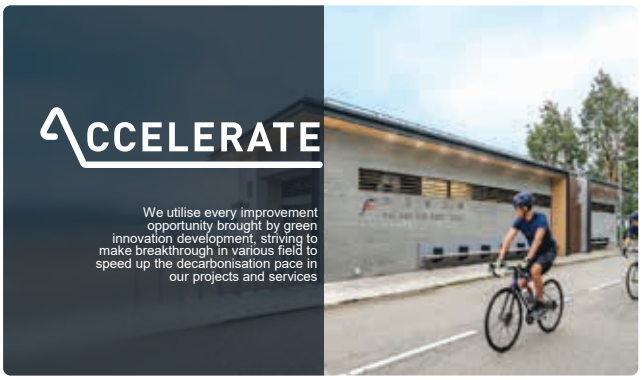
To ensure the provision of quality green and sustainable buildings, ArchSD is committed to achieving a minimum gold rating under the local comprehensive building environmental assessment system, known as BEAM Plus, for their projects. As of September 2023, ArchSD successfully obtained gold ratings or above for 91 projects, with 27 projects achieving the highest platinum rating, accounting for over 15% of all platinum projects in Hong Kong. ArchSD accomplishes this by adopting passive and active sustainable building design measures, harnessing building architecture, and utilising high-efficiency electrical and mechanical systems to achieve energy and water savings.

ArchSD's commitment to energy efficiency is evident in the substantial savings achieved over the past decade. Government facilities built by ArchSD in the last ten years have collectively saved approximately 580,000,000 kilowatt-hours of electricity in total which is sufficient for consumption by around 176,000 households for a year, and over 600,000 cubic meter water is saved, which is equivalent to around 250 numbers of Olympic sized swimming pool. These achievements demonstrate ArchSD's dedication to reducing carbon emissions and resource consumption.

THE 3A STRATEGY: AMPLIFY, ACCELERATE, ACT TOGETHER – TAKE A FURTHER STEP TOWARDS CARBON NEUTRALITY

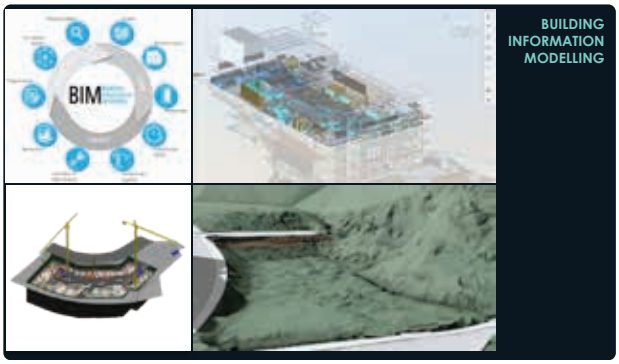
To further advance towards carbon neutrality, ArchSD has developed a strategic framework known as the 3A strategy: “Amplify”, “Accelerate” &“Act Together”.

Under the first pillar, Amplify, ArchSD aims to optimise building designs and maximise decarbonisation potential through scientific approaches. Performance-based engineering analysis, such as wind analysis, daylight and solar analysis, are conducted to assess different design options, balancing various design considerations, including maximising energy saving potential and minimising the adverse impacts on surrounding microclimates brought about by a project to yield environmental benefits. They conduct energy modelling simulation in every project to assess the energy performance. ArchSD’s projects consistently outperform statutory energy-saving levels by around 20%, demonstrating their commitment to excellence.



ArchSD recognises the importance of renewable energy and actively incorporates it into their projects. They have clear guidelines to install renewable technologies to cover at least 25% of available roof space. As of September 2023, the renewable energy facilities installed by ArchSD generate around 3.8 million kilowatt-hours of electricity annually, which is sufficient for the monthly use of over 13,500 households. Additionally, ArchSD embraces sustainable construction technologies such as Modular Integrated Construction (MiC), Multi-trade Integrated Mechanical, Electrical and Plumbing (MiMEP) and Design for Manufacturing and Assembly (DfMA), leading to improved productivity and sustainability performance.

The second pillar of ArchSD’s strategy, **Accelerate**, focuses on adopting smart and advanced technologies. These include Building Information Modelling (BIM) which allows digital visualisation of building data, facilitating project design, planning bridging communication to avoid clashing of different system installations, hence reduce double handling works and material wastage. ArchSD has invested in building internal capacity for BIM adoption. A dedicated BIM supporting team is set up to facilitate BIM development in ArchSD. Over 1200 ArchSD staff are CIC certified BIM viewers and they are encouraged to attend accredited BIM Manager and Coordinator course.



The third pillar, **Act Together**, emphasises collaboration and stakeholder engagement. ArchSD has established an Innovative Construction Focus Group to acquire global knowledge and practices, conduct field trials, and develop best practices for low-carbon design and construction. One example is the use of passive radiative cooling paint, which brings down the roof temperature in some of their trial projects, resulting energy reduction in air-conditioning use. ArchSD would continue to explore other new technologies to be adopted in their projects such as electricity generator driven by hydrogen, carbon capture building materials, low carbon Ground Granulated Blast-furnace Slag (GGBS) concrete. ArchSD actively engages with stakeholders through various communication channels, advocating sustainable design and green building initiatives. ArchSD's commitment to knowledge sharing and collaboration is evident in their stakeholder engagement workshops and the forthcoming publication of their corporate Carbon Neutrality Strategic Framework.

CASE STUDIES: REALISING LOW-CARBON DESIGN

ArchSD's dedication to low-carbon design is exemplified through various projects. The Lai Chi Wo Eco Smart Public Toilet targeted as the first net-zero public toilet in remote countryside areas, showcasing low-carbon design principles by utilising smart technologies, use of recycled materials, and application of PV technologies. Similarly, the Quarry Park project demonstrates a passive design approach, integrating natural ventilation, solar patterns in project planning, disposition, orientation, building form and material selection, and PV systems to achieve approaching net-zero. The Chinese Medicine Hospital in Tseung Kwan O adopts low-carbon building materials, such as recycled steel reinforcement and high percentage of PFA concrete further contributing to carbon reduction and sustainability efforts.

CONCLUSION

The Architectural Services Department (ArchSD) of HKSAR Government in Hong Kong has taken significant strides in co-creating green momentum and striving for carbon neutrality in the construction industry. Through their 3A strategy of Amplify, Accelerate, and Act Together, ArchSD has demonstrated a strong commitment to sustainable building practices, energy efficiency, and renewable energy adoption. Their emphasis on scientific approaches, innovative technologies, and stakeholder collaboration has paved the way for a low-carbon built environment.

Effective Use of High Strength S690 & S960 Steel in Construction – Efficiency for Sustainability

Ir Prof. CHUNG Kwok-fai
Director, Chinese National Engineering Research Centre for Steel Construction (Hong Kong Branch)
The Hong Kong Polytechnic University

ABSTRACT

Applications of high strength S690 and S960 steel to buildings and bridges are very attractive owing to their high strength to self-weight ratios, and their effective use will bring fundamental changes to the ways the design and construction will be carried out.

This paper highlights the latest research findings of work carried out on the high strength steel conducted at the Chinese National Engineering Research Centre for Steel Construction (CNERC), and the engineering applications which are supported by complementary technical documents and design standards. The effective use of the high strength steel will lead to significant savings in materials, costs and time to the construction industry as a whole, and hence, a considerable reduction in carbon emission.

INTRODUCTION

The Chinese National Engineering Research Centre for Steel Construction (CNERC) (Hong Kong Branch) was endorsed by the State Ministry of Science and Technology, PRC to be established at The Hong Kong Polytechnic University in October 2015 under the support of the Innovation and Technology Bureau of the Government of the Hong Kong SAR. The key collaborating institutes are the Development Bureau (DEVB), Construction Industry Council (CIC), China Iron and Steel Association, China Constructional Metal Structures Association and China Steel Construction Society. The major research institutes in partnership are Imperial College London, UK, Tsinghua University, Tongji University, University of Science and Technology Beijing, National University of Singapore, The Steel Construction Institute, UK, French Corrosion Institute and Singapore Structural Steel Society.

There has been a huge demand for steel in China. The steel production in China increased from 37.1 million tonnes in 1980 to 1032.8 million tonnes in 2021. In 2022 the unit price of steel in China was around HK$8,000 to HK$10,000 per ton.

The CNERC is the only designated Research Centre in Hong Kong for technological innovations and engineering applications in construction. The CNERC provides engineering R&D Directions to promote sustainable infrastructure development in Hong Kong and various parts of China, especially the Greater Bay Area (GBA) and to promote modern construction with the effective use of high performance materials. The CNERC also supports the Hong Kong construction industry to work with the Chinese iron and steel industry to demonstrate the effective use of high quality Chinese steel materials and the Chinese steel construction industry on international engineering and management practice in Hong Kong and overseas.

In this paper, the latest research findings of the work carried out on the high strength steel conducted at the CNERC and the engineering applications are given. The effective use of the high strength steel will lead to significant savings in materials, costs and time to our construction industry as a whole, and hence, a considerable reduction in carbon emission.

SUSTAINABLE DEVELOPMENT

Sustainable development was first defined in 1987 by the World Commission on Environment and Development that, in its broadest sense, to meet the needs of the present without compromising the ability of future generations to meet their own needs. In 2015, the UN Member States translated their vision of sustainable development into a blueprint for achieving it: the 2030 Agenda for Sustainable Development.

EFFECTIVE USE OF HIGH STRENGTH S690 AND S960 STEEL IN CONSTRUCTION – EFFICIENCY VS SUSTAINABILITY

Innovative Engineering Applications of High Performance Materials

The application will lead to higher efficiency and sustainability, by means of the effective use of high performance materials in construction and the reduced usage/tonnage of materials, manpower, time and energy to reduce carbon emissions.

Engineering Research into Chinese High Strength S690 and S960 Steel for Engineering Applications

The research has shown that use of high strength steel can reduce the amount of steel used, reduce self-weight of structures and save cost and time. There is a total cost saving of 35% using high strength steel.

The mechanical properties and structural behaviour of the high strength steel columns and beams have been studied and compared between the measured and design member resistances. It was found that existing design rules are readily applicable to S960 steel conservatively.

The welding technology for highly efficient engineering applications of Chinese high strength S690 and S960 thick steel plates was also developed by means of S690 steel coupons Gleeble heat treatment test. Advanced finite element modelling was used to simulate the effects of welding onto these S690 thick plates using Abaqus FEA and ESI SYSWELD.

IMPACT AND CONTRIBUTIONS TO THE INDUSTRY

Impact 1 – Construction of the Double Arch Steel Bridge of Cross Bay Link in Tseung Kwan O (TKO) Area of Kowloon East, Hong Kong

The TKO Cross Bay Link is a 1.8 km two-lane road across Tseung Kwan O Bay, as shown in Figure 1. Civil Engineering and Development Department is the client department, and AECOM Asia Co. Ltd. is the consultant. China Road and Bridge Corporation is the contractor. The project commenced in July 2018 and was completed in December 2022. The project costs HK$25 billion.

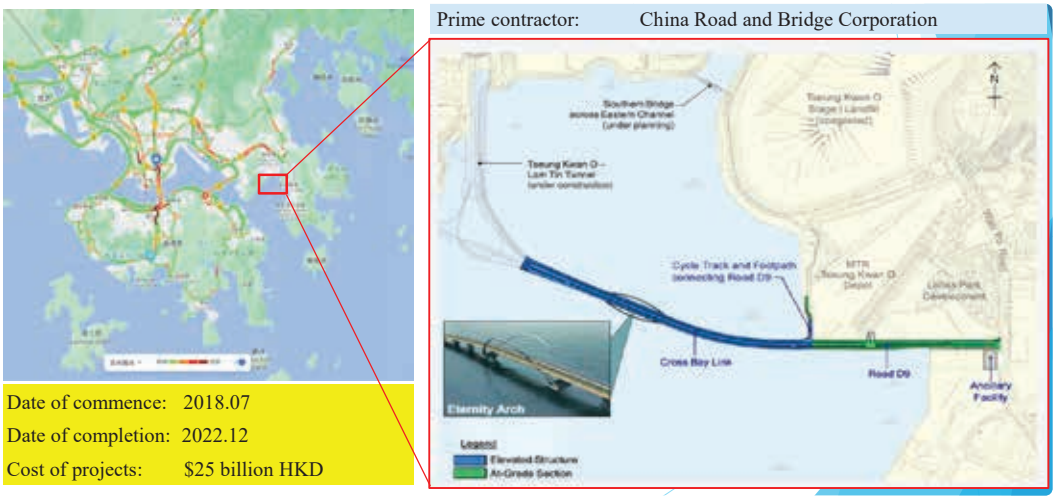


Figure 1: Double Arch Steel Bridge of Cross Bay Link in Tseung Kwan O, HK

A total of 4,400 tons S690 steel were used in 50, 60 and 70 mm thick plates to form the curved box sections of the arches, which were manufactured by the Shanghai by Zhenhua Heavy Industries Company Limited. The Double Arch Steel Bridge was transported from Nantong to Hong Kong. There was a 30% saving in carbon embodiment using S690 steel. This is a good demonstration of the Hong Kong and Chinese construction industry working together to successfully build a world class structure using high quality Chinese high strength S690 steel.

Impact 2 – Construction of the Fourth Macau Taipa Bridge, Macau

The 3.1 km long bridge with eight lanes will have a section of two 9 km over the sea passing over the shipping lanes of vessels that dock in Macau or travel towards Zhuhai and Guangdong Province, as shown in Figure 2. The bridge with a main span of 1,370 m will be completed in 2025 at a construction cost of 52 billion Pataca. The contractors are China Civil Engineering Construction Corp. Ltd., China Railway Major Bridge Engineering Group Co., Ltd. and Companhia de Construção e Engenharia Omas, Limitada.

A total of 1,625 tons S690 steel with 20 to 50 mm thick plates were used in the heavily loaded parts of the trusses of the bridge structures.

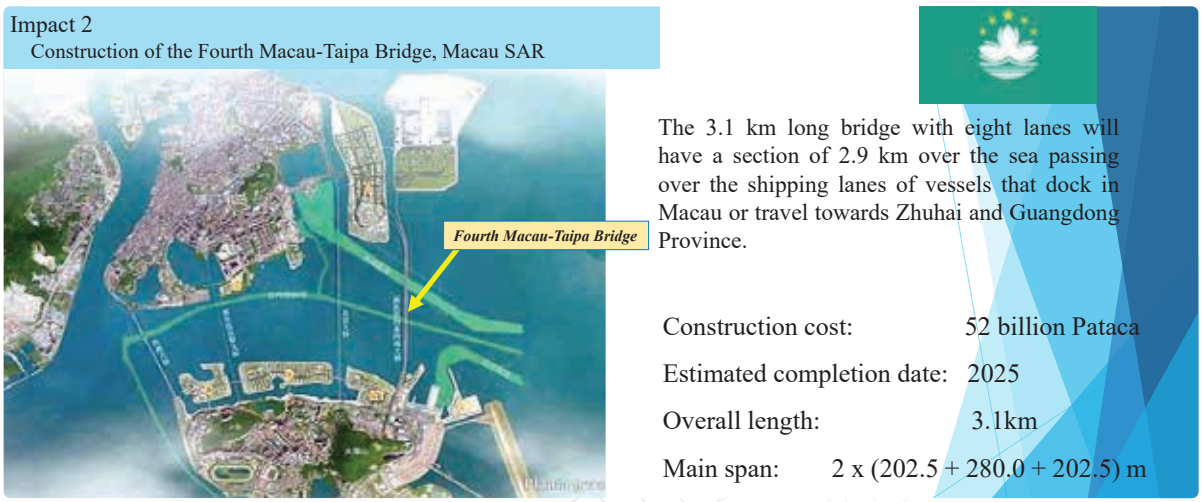


Figure 2: Fourth Macau Taipa Bridge, Macau

Impact 3 – Various Public Works Projects of the Development Bureau of the Government of Hong Kong SAR Using High Strength S690 Steel

In May 2021, the CNERC was appointed by the DEVB as an expert consultant to provide technical guidance to public works departments on structural design to enhance structural efficiency, reduce steel tonnages, and provide welding procedures.

It is expected that 100,000 tons of high-strength S690 steel will be used in the next five years, leading to a saving of about HK$4 to 5 billion in the costs of the public works projects.

A Technical Guide "Selection of Equivalent Steel Materials to European Steel Materials Specifications" incorporating steel materials specifications from Japan, the United States, and Australia in accordance with the requirements of the State Ministry of Science and Technology in 2018 (the equivalent design for the Russian steels) was developed. Another Technical Guide "Effective Design and Construction to Structural Eurocodes EN 1993 1 1 Design of steel structures" was also published to assist the technological upgrading of design and construction engineers in Hong Kong and the GBA to use Chinese high quality high strength steel effectively.

Impact 4 – Development of Codes of Practice for Structural Design of High Strength S690 Steel in Hong Kong and European Communities

The DEVB promotes a wide adoption of high strength S690 steel not only in large scale infrastructure and public works, but also in private construction projects. Improved design rules and provision of design data to allow S690 steel to be used normally in Hong Kong were also given in the Code of Practice for the Structural Use of Steel published by the Buildings Department.

Impact 5 – Development of Codes of Practice for Adoption in the European Communities

In mid-2021, the CNERC and SCI jointly compiled two technical reports on the scientific research findings of the CNERC on the S690 steel and their comparisons with relevant research conducted in China, Europe and the United States The technical reports are published as supporting documents for the updated version of EN 1993 1 1.

ACHIEVEMENTS

The following awards were received in respect of the works carried out on the high strength S690 steel:

(a) Science and Technology Award 2022 Grand Award Project Title: "Basic Theory, Key Technology and International Application of Chinese High Strength 690 MPa Steel Structures";

(b) Grand Award of the CSCS Science and Technology Awards 2022; and

(c) HKIE Grand Award on 9 March 2023.

CONCLUSIONS

In many countries, reinforced concrete construction is commonly employed because it is considered the most appropriate medium of construction. However, for those modern cities with a huge demand for infrastructure, steel construction is a viable alternative. It provides economical solutions to heavily loaded buildings and structures due to its high strength to self-weight ratios. Generally speaking, a steel construction sector will become technically vibrant and productive when its revenue reaches about 20 to 25% of that of the whole construction industry. Clients and project managers will then be able to explore various structural forms and construction methods based on a technical competition between a reinforced concrete solution and a steel solution.

After many years of technological development and adoption of advanced steel construction technology, many Hong Kong design and construction engineers are able to work with structural steel and steel building products manufactured by different countries to different materials specifications and codes of practice. Through the effective use of Chinese steel and in-depth technical collaborations with steelwork fabricators in the GBA, many Hong Kong design and construction engineers have significantly enhanced their competitiveness to meet the needs of Hong Kong, and also to contribute to international construction projects. This will become an impetus for growth in the Hong Kong construction industry.

The Transition towards a Carbon Neutral Built Environment: Experiences from The Netherlands

Mr. Robert DIJKSTERHUIS
Special Envoy on Sustainable Building
Ministry of the Interior and Kingdom Relations of the Netherlands

ABSTRACT

This paper discusses the transition towards a carbon-neutral environment in the Netherlands, highlighting the similarities and potential lessons for Hong Kong. The European Climate Law, signed by the Netherlands, sets ambitious goals of reaching climate neutrality by 2050 and reducing emissions by 55% before 2030. To achieve these targets, the Netherlands focuses on transitioning towards a circular and sustainable economy. The built environment plays a crucial role in sustainable development, accounting for a significant percentage of worldwide energy use, greenhouse gas emissions, raw material use, water consumption, and waste production. Therefore, strategies such as spatial planning, smart city design, improving building environmental performance, and reducing operational carbon are essential for achieving carbon neutrality. The paper emphasizes the importance of incorporating lifecycle analysis in building construction to address embodied carbon emissions. The Netherlands has implemented regulations and introduced the Environmental Performance of Buildings (MPG) method to assess and limit the environmental impact of constructions. By encouraging circular economy principles, the construction sector aims to meet increasingly requirements and contribute to a sustainable future.

INTRODUCTION

The transition towards a carbon-neutral environment is a global imperative, and nations worldwide are setting ambitious targets to combat climate change. This essay focuses on the Netherlands' efforts in achieving carbon neutrality and draws comparisons to Hong Kong. The European Climate Law, signed by the Netherlands as part of Europe, commits the country to reach climate neutrality by 2050, with a significant reduction of 55% in emissions before 2030. This essay explores the strategies employed by the Netherlands, emphasizing the role of the built environment in sustainable development and the importance of circular economy principles. Furthermore, it discusses the concept of embodied carbon and the need for lifecycle analysis in building construction to achieve carbon neutrality by 2050.

The Netherlands and Hong Kong share similar ambitions in combating climate change. Both regions recognize the urgency of reducing emissions and transitioning towards sustainable practices. The European Climate Law, applicable to the Netherlands, sets ambitious goals that align with Hong Kong's objectives. By 2050, both regions aim to achieve carbon neutrality and significantly reduce greenhouse gas emissions. These shared goals provide a basis for mutual learning and collaboration in addressing climate change challenges.

The European Green Deal

European Climate Law
(April 2021)

- Carbon neutrality in 2050
- 55% emissions reduction in 2030
- Transition towards a sustainable, circular economy

The role of the built environment

- 40% energy use
- 39% GHG emissions
- 50% raw material use
- 30% water use
- 40% waste production

THE SUSTAINABLE BUILT ENVIRONMENT

The built environment plays a critical role in sustainable development, accounting for a substantial portion of global energy consumption, greenhouse gas emissions, raw material use, water consumption, and waste production. In the Netherlands, approximately 40% of worldwide energy use, 39% of greenhouse gas emissions, 50% of raw material use, 30% of water consumption, and 40% of waste production are attributed to the built environment. To achieve carbon neutrality, it is imperative to address the environmental impact of buildings and implement sustainable practices in the construction and operation phases.

Three strategies are proposed to develop a carbon neutral built environment in the Netherlands. One of them is a spatial planning smart city design. The second one is to improve the environmental performance of the building and lower embodied carbon. The third is decrease operational carbon. All those combined will lead eventually to carbon neutrality.

A combination of pathways and strategies

1. Spatial planning / Smart city design
   - Greening cities to reduce heat island effect
   - The 15-minute-city
2. Improve environmental performance of buildings, lowering embodied carbon
   - Tighten building decree
   - Measure environmental impact of building materials
3. Decrease operational carbon
   - Improve energy efficiency, switch to renewable energy

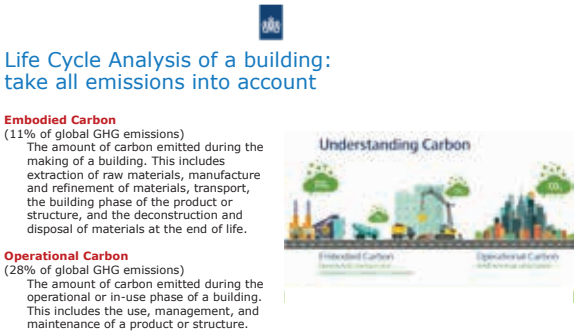
Spatial planning: designing the future of our country

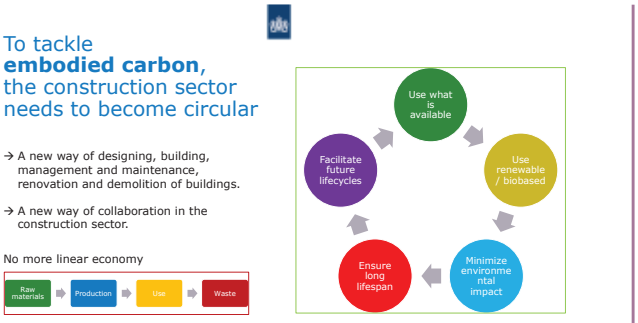
SPATIAL PLANNING AND SMART GREEN CITY DESIGN

One strategy employed by the Netherlands to achieve a carbon-neutral built environment is spatial planning and smart city design. Spatial planning aims to reduce the urban heat island effect and optimize land use. The Netherlands, with its unique geographical challenges, has invested heavily in spatial planning to protect areas below sea level. By creating a string of cities with green spaces in between, the country ensures a high quality of life, accessibility to green areas, and a more sustainable urban environment. This approach differs from the high-density city models observed in London and Paris, highlighting the importance of tailoring strategies to local contexts. To mitigate the urban heat island effect and enhance environmental sustainability, the Netherlands promotes greening initiatives in cities. Green rooftops, for instance, offer multiple benefits, including temperature reduction, improved air quality, stormwater management, and biodiversity preservation. By utilizing rooftops for green spaces, the Netherlands maximizes the potential for environmental enhancements and creates a more liveable urban environment. These initiatives not only address climate change but also improve the quality of life and well-being of residents.

EMBODIED CARBON AND LIFECYCLE ANALYSIS

Achieving carbon neutrality requires addressing both embodied carbon and operational carbon emissions in buildings. Embodied carbon refers to the emissions associated with constructing a building, including raw material extraction, manufacturing, transportation, and eventual demolition. Lifecycle analysis considers the entire lifespan of a building, including the replacement of materials during its lifecycle. By comprehensively assessing embodied carbon and operational carbon emissions, it is possible to identify areas for improvement and develop effective strategies to reduce emissions throughout a building's life.





CIRCULAR ECONOMY PRINCIPLES

To tackle embodied carbon emissions, the construction sector in the Netherlands is shifting towards a circular economy model. The linear economy, characterized by resource extraction, product manufacturing, consumption, and waste generation, is being replaced by a circular economy that focuses on reducing waste and maximizing material reuse. The circular economy approach involves utilizing available resources, minimizing environmental impact, ensuring the a long lifespan of materials, and facilitating future lifecycles. By adopting circular economy principles, the construction sector can optimize material usage, reduce waste, and contribute to a sustainable future.

REGULATIONS AND THE ENVIRONMENTAL PERFORMANCE OF BUILDINGS (MPG)

The Netherlands has implemented regulations and introduced the Environmental Performance of Buildings (MPG) method to assess and limit the environmental impact of constructions. The MPG method calculates the environmental performance of a building based on factors such as energy consumption, greenhouse gas emissions, and resource use. A limit level is set for getting building permit for building a house to ensure use less embodied carbon materials in the design of the building, such as the amount of concrete, doors, façade and floor installations. Architects, developers, and construction firms will use software to do the calculation to work out an MPG right for submission in order to get a permit. A database of construction materials (at present about 3000 different materials) has been developed by joint effort of the government and private sector for reference and making the calculations. By setting requirements and promoting sustainable practices, the Netherlands aims to drive the construction industry towards more sustainable and energy-efficient solutions. These regulations encourage the adoption of innovative technologies, renewable energy sources, and efficient building designs, ultimately contributing to the country's carbon neutrality goals.

The construction materials database will further expand to cover innovative 3D printed materials and bio-based materials, including re-use of waste to extend their lifespan and promote reuse. Deconstructing buildings instead of demolishing them allows for the reuse of materials, but challenges arise in terms of storage and knowing the qualities of these materials. The concept of "modaster," a library of materials present in current buildings that can be accessed for reuse in new construction projects.

Changing the Building decree

Minimum performance requirements on construction safety, fire-safety, health, usability, energy and *environment*

Environmental Performance of a Building

(Milieu Prestatie Gebouw - '**MPG**')

- Proscribed assessment method since 2013, initially without a limit value
- 1 January 2018 introduction of a limit value for all new homes and offices.
- Stricter requirements since July 2021.
- Further tightening per January 2025.

Environmental performance of a building (MPG) explained

Building parts that make the largest contribution to the MPG are facades, floors and installations. In total, this is often 60% to 80% of the MPG. However, this can vary greatly depending on the geometry and installation concept.

MPG of a building = the sum of the shadow costs of all materials used in a building.

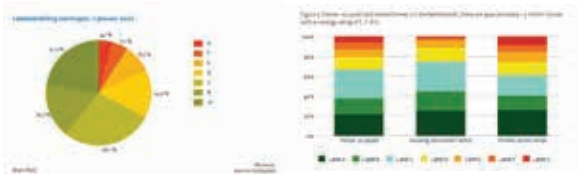
- This must also consider the materials that are replaced during the life of the building. The total sum is divided by the lifespan and by the gross floor area of a building. The MPG is then expressed in the shadow costs per square meter of gross floor area per year.
- To calculate an MPG, each material in a design must be identified and how much of it is used.
- The calculation rules are defined in the European standard EN 15978.
- The lower the MPG, the more sustainable the use of materials.

Reuse of materials

- Reusing material in building products (concrete) or reusing elements of a building.
- Mostly still experimental
- Transformation offices into housing (reusing foundation and casco)
- Old buildings can't be well disassembled
- Issues to tackle:
  - Logistic problems in time / Expensive storage
  - Quality guarantee construction
  - Fire safety

Decreasing **operational carbon** through improving the energy performance of buildings

- 89.5% of Dutch households currently have an individual heating system based on natural gas
- 6% district heating (460.000 homes)



OPERATIONAL CARBON AND REDUCTION OF CARBON EMISSIONS

The focus then shifts to operational carbon and the challenge of reducing carbon emissions during a building's lifespan. In the Netherlands, the speaker highlights the need to transition from gas-fired boiler systems to renewable energy sources and improve energy efficiency. They discuss the development of minimum energy performance standards and a website called "Forbidayourhouse NL" that helps homeowners identify the areas where improvements are needed in their homes. The website provides guidance on insulation and other measures to make homes more energy-efficient, considering factors such as the age and characteristics of the building. The speaker emphasizes the importance of homeowners investing in their buildings to mitigate rising energy costs.

Minimum Energy Performance Standards: renovating to the 'Standard for home insulation' (2021)

- Indicates when a home is well insulated and how much energy is still needed for heating and cooling.
- A *future-proof* level: no additional renovation needed before 2050 if the home is connected to sustainable sources with a lower temperature heat (delivery temp. 50C)
- Provides an *action perspective* for building owners in a situation where the availability and costs of the sustainable heating alternative are not yet known.
- *No obligation* for building owners to renovate to the level of the standard.

Four standards, for different building types:
- single-family homes built up to 1946
- multi-family homes built up to 1946
- single-family homes built after 1945
- multi-family homes built after 1945

Target values for individual building parts support smart renovations

Alles over je huis verduurzamen | Verbeterjehuis
website 'Improve your home'

	Target values	
Item	**Good insulation**	**Insulation value**
Outside wall	5-6 cm pearls, flakes or foam in the cavity wall	Rc = 1,6
Roof	13-14 cm (or 8 cm PIR)	Rc = 4
Floor	12-13 cm (or 7 cm resol)	Rc = 3,7
Windows	HR++ glass	U-value glass 1,0-1,2
Ventilation	Ventilation-unit with heat recovery and/or ventilation with demand management	

CONCLUSION

The transition towards a carbon-neutral environment is a global challenge that requires concerted efforts from nations worldwide. The Netherlands serves as an example of a country actively working towards carbon neutrality and employing innovative strategies to achieve sustainable development. By emphasizing spatial planning, smart city design, greening initiatives, and circular economy principles, the Netherlands aims to create a built environment that significantly reduces emissions and minimizes environmental impact. Furthermore, incorporating lifecycle analysis in building construction enables the identification and reduction of embodied carbon emissions, leading to more sustainable and energy-efficient structures. Through regulations and the implementation of the Environmental Performance of Buildings method, the Netherlands sets a framework for the construction industry to align with carbon neutrality goals. By learning from these strategies and experiences, other regions such as Hong Kong can adapt and implement similar approaches to address their unique challenges and contribute to a sustainable future.

Day 3 AM

Global Construction Sustainability Forum (Social) – Safety

Opening Address

Mr. Terence LAM
Principal Assistant Secretary (Works)
Government of the Hong Kong Special Administrative Region

Distinguished guests, esteemed speakers, ladies and gentlemen,

Good morning. It gives me great pleasure to attend the CIC Global Construction Sustainability Forum 2023. A warm welcome to the industry leaders, experts, and guests from near and far. In this session, we have the privilege of having our eminent local and overseas speakers, to share with us their insights into means of uplifting construction safety and health.

Before their sharing, I would like to take you on a journey to the "4S" about construction safety in my mind. They are: Synergy, Safety Leadership, Secure Design, and Smart.

SYNERGY

Let's begin with the first "S" – Synergy. Construction safety is not the sole responsibility of any single party. Instead, it needs everyone's commitment. It is the responsibility of the clients, the consultants, the contractors, the subcontractors, and the frontline workers. We fail even just one party is unable to keep up with the pace with the others.

Therefore, construction safety is about synergy. Every stakeholder plays a vital role in uplifting the safety performance of a construction project. Full collaboration, and close coordination amongst us, and the genuine care about the others, are essential for creating the remarkable synergy for uplifting site safety. We should embrace the spirit of teamwork and recognize that by working together, we can create a safer construction environment. I believe that if we come together and play our part, we can form a strong, robust and resilient construction safety team!

SAFETY LEADERSHIP

The second "S" is "Safety Leadership". Rules alone cannot ensure safety. Safety is also abour the mindset, the culture, and our commitments. A good safety leader can inspire, guide, and empower their teams to make safety their top priority, to make safety the responsibility of everyone. Today, we have the privilege of listening to local and overseas safety leaders. They all have made

great influences to the creation of a safer construction environment in their organizations and communities. I believe their stories will surely inspire us and remind us of the vital role that, "leadership", plays in creating a safe construction environment.

As for Hong Kong, the Hong Kong Government cares about construction safety. All along we have been adopting a multi-pronged approach to tackle safety matters, and we regularly review the safety management system of public works contracts to uplift construction safety performance.

Now, let us move to the third and fourth "S". The third one is "Secure Design", meaning "Design for Safety" and the last one is "Smart", which means "Smart Site Safety System". They are the two initiatives on site safety that are featured in Government's policies in recent years.

SECURE DESIGN – DESIGN FOR SAFETY

One of the initiatives for uplifting construction safety performance is the adoption of "Design for Safety", or in short "DfS". The Government has taken a pioneering role in the implementation of DfS in public works projects since 2006. We aim to ensure that all safety hazards posed to stakeholders involved in the construction, operation and maintenance of infrastructures have been systematically considered and adequately mitigated at the very upfront planning stage in the design process. We are glad that as at today, more than 150 public works projects have adopted DfS.

Merely implementing DfS in public works projects alone is not enough to shape a better construction industry. We need all stakeholders to buy in the concept. Thanks for the effort of the CIC to conduct the study on DfS. The study provides a good framework for implementing DfS. It outlines the guiding principles, including enhanced communication and coordination, encouraging industry stakeholders to uphold greater ownership of safety and health outcomes, and risk reduction at the source. The CIC has promulgated the reference material on DfS which is applicable to the Government and private sectors last year. Recently, it has also invited all project clients in Hong Kong to participate in the pilot trial of the reference material. I would like to encourage you to positively respond to this pilot trial by adopting DfS in construction projects. We hope that this would be impactful and would nurture new ideas in the industry for safeguarding the safety of everyone.

SMART – SMART SITE SAFETY SYSTEM

On a separate front, we witnessed a bottleneck in the safety performance of the construction industry in Hong Kong, as reflected by the recent slowdown in accident reduction rate. We need new ideas to drive a breakthrough and innovative technologies would be a beacon of hope.

New technologies have made possible the monitoring of high risk construction activities, early identification of dangerous incidents and timely issuance of alerts to site personnel for taking immediate follow-up actions. Integrating these latest technologies, the Smart Site Safety System keeps track of safety performance in a central database and enables statistical analysis and systematic improvement across construction projects. We have mandated the adoption of Smart Site Safety System in all capital works contracts with a contract sum exceeding $30 million since February this year. And in early April, through the Construction Innovation and Technology Fund (CITF), we rolled out a funding scheme that supports the private sector to adopt Smart Site Safety System.

In addition, the outreach team of the CIC has been visiting different construction sites, tirelessly, to promote the CITF fund and Smart Site Safety System to the industry. They are also assisting the industry in selecting suitable smart safety devices based on factors such as the type of project and site environment. We have reiterated on various occasions that we hope that everyone will actively support Smart Site Safety System. Our goal is to implement Smart Site Safety System in most construction sites within this year, and together we can embark on a new chapter of construction site safety.

Looking ahead, the Hong Kong construction industry will continue to play a vital role in the economic development of Hong Kong. A number of major infrastructure projects as well as public and private housing projects will be rolled out in the coming years. The industry will therefore be vibrant and will meet the dawn of another golden era. As such, we have to perform better than ever on construction safety, and explore every means to strive for further excellence in construction safety performance. This is the indispensable prerequisite for enhancing quantity, speed, efficiency and quality in the infrastructure project delivery.

In closing, may I express my sincere thanks to the CIC for making this inspiring and thought-provoking Forum happens. I also thank for your participation, and I am confident that you will be benefited from the upcoming insightful sharing from the speakers. Thank you very much.

Digital Engineering Enabling Collaboration Aiding Design Safety and a Positive Behaviour on Our Construction Projects

Mr. Stephen COPPIN
Strategic Technical Director
SJU Risk Management Solutions Limited

ABSTRACT

This paper discusses strategies for improving safety in the construction industry by bridging the gap between traditional and digital methods. One approach is to identify hazards and significant risks early in the planning, procurement, and design stages. Guidance on digital visualization and data exchange can help ensure that Exchange Information Requirements are included in the contract. Adopting the ISO 19650 Information Requirements can provide a suggested strategy for making this happen, including the adoption of a RAACI and Risk Register from inception to completion of a project. It is also important to ensure that the right people are providing the right information at the right times. By learning from past projects and adopting both lead and lagging indicators, the construction industry can realize the strategy and benefits of improving positive behaviours. This paper highlights the importance of using these strategies to improve safety and reduce the risk of accidents and injuries on the job site.

INTRODUCTION

In this paper, the importance of teamwork in creating a sustainable, safe and secure future in various projects is presented. The significance of digitalization technology and a holistic approach in ensuring that all project components fit together throughout the project and asset lifecycle is highlighted. The four P's (procurement, people, processes, and performance) and the nine C's (explained later and traditional versus digital, identifying hazards, managing significant risks, setting standards, bridging gaps with digital visualization and data, information management, adopting RAACI, and prioritizing risk register items) are discussed. The importance of having the right people to provide the right information at the right time, and the need to select the right people with the desired mindset and behaviours during procurement is stressed. Finally, the importance of learning lessons from projects and capturing what worked well to realize strategic benefits is emphasised.

TRAD V DIGITAL – IDENTIFYING HAZARDS AND SIGNIFICANT RISKS EARLY IN PLANNING, PROCUREMENT AND DESIGN

The importance of leading and lagging indicators in achieving a balance between the two and improving positive behaviours is stressed. With regards to digitalization, there is a need to identify hazards and risks, secure the design, and consider sustainable products, materials, and components early in the process rather than waiting for the main contractor to be procured for design and build. The information management and requirements should be included in the contract with the design team to create a single source of truth and capture golden thread information from inception to completion and beyond for deconstruction. It is important to keep information for dismantling assets in the future to manage the process better, save lives, money, and energy, and create a sustainable environment.

Regarding safety, it is necessary to capture significant risks in a risk library, which is a database of all potential hazards where data cannot be eliminated, possibly removed or reduced. This information needs to be stored in a tool related to a risk register with visualizations linked to the drawings, etc. Architects are encouraged to embrace this approach, along with engineers, early in the design to ensure a comprehensive approach to safety.

THE GUIDANCE ON BRIDGING THE GAP ON DIGITAL VISUALISATION AND DATA ENSURING EXCHANGE INFORMATION REQUIREMENTS ARE IN THE CONTRACT

An information management guidance document bridging between the old PAS1192-6 and the current ISO 19650 was developed by a team of five (of which the speaker was a member) for the HSE BIM WG in collaboration with an ATC from the HSE UK Gordon Crick. The journey involved educating Clients to embrace this new approach, which included 10 plain language questions to assess what project information was needed related to assets in a building information model. For Clients who do not have knowledge in the field, the questions served as a shopping list of due diligence to capture the necessary information. Facilities management team will be involved if it is already in place. The benefits of digitalization in making the process more efficient was emphasised. The team has now moved on to the term for BIM – "Better Information Management," which emphasizes the importance of having the right people in place and ensuring that the information is available, accessible, and archived accordingly in an all-in-one model for that asset.

A SUGGESTED STRATEGY FOR MAKING IT HAPPEN INCORPORATING THE ISO 19650 INFORMATION REQUIREMENTS

It is important to consider the organisation's information requirements now that the conversion to ISO 19650 has taken place. A strategy must be in place to capture digital information, including Project and Asset Information Requirements. Exchange information is crucial to consider, including what will be in the contract, the parameters, and the minimum requirements needed. The end goal is to install certified and insured durable assets, components, and materials. Project information and surveys must be established to build an information model for the building or infrastructure project. Exchange Information Requirements (EIR) must be discussed during the tender process and included in the contract to ensure the right information is captured at the start. The Project Information Model and Asset Information will change over time due to occupancy and use changes, making information management specific to project needs. Ultimately, having the right information is crucial for those tendering and delivering the project, no matter how small or complex it may be.

ADOPTING A RAACI AND RISK REGISTER FROM INCEPTION TO COMPLETION OF A PROJECT

It is evident from Figure 1 that the stages and gateways are used within Singapore and/or by the RIBA in the planning of work stages, which are also used in the UK by architects. The building safety gateways for high-risk buildings, Gateway one, Gateway two, and Gateway three, require information to be provided to the building safety regulator within a 12-week approved window. If the information is not correct, the project cannot proceed past these gateways, making it a go or no-go process. The stringent process enforced in England as of 1st October is due to the Grenfell incident, where lack of control, information, and compartmentation resulted in a tragedy. This highlights the importance of information management and requirements to get it right the first time. The RAACI chart is used to identify who is responsible and accountable for each role in the team, from the lead designer to the project manager, structure engineer, mechanical engineer, or any other discipline. It is essential to ensure that the design and delivery of the project are reviewed through each of the project lifecycle stages and that the right people are consulted, informed, and checking of the work has been undertaken. Communication, consultation, cooperation, coordination, competence and control are crucial, and team events help to share information. Capturing building or asset information and conducting any necessary surveys is also important.

Figure 1: Measuring and Tracking of H&S Performance across Project Lifecycle Stages – Courtesy of Steven Naylor HSE UK

ENSURING THE RIGHT PEOPLE ARE PROVIDING THE RIGHT INFORMATION AT THE RIGHT TIME

It is necessary to track all information in the design risk register and include exchange information in the contract. Minimum standards related to project information requirements, asset information, and the common data environment must be followed, making the information accessible to the entire team. The Project Information Model, Asset Information Model, and digital health and safety file must also be incorporated, following ISO 19650, which includes design for safety and sustainability. It is crucial for every Client and organisation involved in the project to consider the Organisation's Information Requirements and ensure information management from inception to completion, using a golden thread as a single source of truth.

The program diagram in Figure 1 shows the various disciplines relevant to the project, from the Client to the building Contractors tracking along with the RIBA plan of work stages in the UK. Coordination here is key to ensure that there are no clashes between the relevant disciplines, and communication, consultation, cooperation, and coordination are all necessary to make this mindset and behavioural aspect a reality, ensuring a bottom-up as well as a top-down approach is adopted. Next, there is an example of Digital rehearsals which are also essential, as shown in Figure 1, where a library of information on various types of plant, equipment, machinery, and components is used in relation to the project site, such as logistics and traffic management to rehearse the project several times before going out to tender. This ensures that the Contractors have a clear understanding of the project requirements.

REALISING THE STRATEGY & BENEFITS – LESSONS LEARNED FROM PROJECTS THROUGH ADOPTING BOTH LEAD & LAGGING INDICATORS IN IMPROVING POSITIVE BEHAVIOURS

In the Crossrail Tottenham Court Road station, the project team and the designers (James Bowles of Freeform) used the model to specify a particular type of 360 machinery. However, during the engagement with the Contractors, it was discovered that the type of machinery required would not work due to insufficient space, leading to a design change that enabled safe buildability and prevented potential delays. This positive collaboration and engagement prevented further delays, costs and highlighted the importance of early design identification and necessary changes to prevent issues, risks and problems later.

Regarding the operation and maintenance of building assets, a typical gondola is shown and used to identify associated hazards and risks, and the model is used to manage the asset and record any relevant information during inspections. Using the mobile elevating platforms, any cracks, defects, or situations are checked and recorded into a database during each lifecycle, as

part of a preventive maintenance strategy demonstrating the benefits of foresight rather than hindsight.

It is crucial to track relevant information throughout the lifecycle of an asset and set up an action plan to address the issues. The asset information must be managed and kept up to date by the relevant parties. Traditional and new reporting methods must be used to measure both lead and lagging indicators, such as issues, problems and risks, etc., to establish the lessons learned, and prevent near misses, let alone accident and incidents. Deconstruction is now included in the project lifecycle stages (i.e. future dismantling and demolition, let alone plant replacement and or removal), which still requires communication, consultation, cooperation, competence, and control of design and construction. These legal requirements are measurable, and commitment across all levels, including the supply chain, is essential for collaboration and establishing a just culture. Providing the right information to the right people at the right times is crucial, and the process should continue throughout the project (but procuring the right people and establishing the right processes in the first place). This is emphasized in the UK Construction (Design and Management) Regulations related to Health and Safety.

CONCLUSIONS: FOUR BIG OUTCOMES

The adoption of ISO 19650 principles supports Design for Safety & good Design Risk Management (DRM) promoting early risk studies. This requires collaboration, sharing, and the use of relevant risk information across design and building disciplines. Better Information Management, as it is called, is achieved by finding the best balance of the relevant information management, requirements, and tools for each project. 3D and 4D models help visualize risks and the opportunity to carry out digital rehearsals, while alphanumeric coding data is used to analyse risks and connect to models. Live documents provide audit trails, narrative, and support to the design and construction phases and beyond. Ensuring Design for Safety issues and risks are incorporated, owned, and acted on by Designers and Contractors early and throughout the project lifecycle stages takes and utilizes digital design information forward which is relevant for managing the asset. Learning the lessons from both lead and lagging indicators is essential to enable collective working and a positive culture on projects. Critical to this is applying and recording all the C's, starting with "Communication," consultation, cooperation, coordination, competence, control and commitment at all levels to obtain true "Collaboration" and just "Culture."

Safety Leadership in Creating Safety and Health Workplace

Mr. SEAH Yeow-teck
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Keller Foundations (S E Asia) Pte Ltd

ABSTRACT

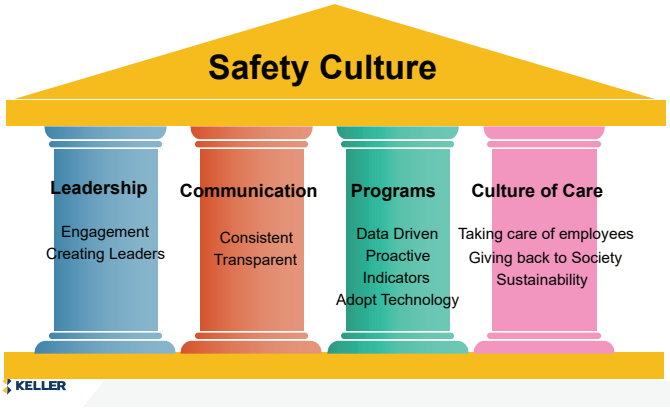
This paper explores key principles in creating a culture of safety in the construction industry, including leadership, effective communication, safety programs, and a culture of care. Leadership is highlighted as a vital factor in creating a culture of safety, emphasizing the need for engagement, trust, and openness. Effective communication is essential for transparency, encouraging employees to address safety issues openly. Safety programs, incorporating data-driven approaches and technological advancements, play a pivotal role in enhancing construction site safety. The cultivation of a culture of care, focusing on employees' well-being and support, is emphasized as the most crucial principle. The paper also discusses the significance of contributing to society and embracing sustainability efforts in the construction industry. By understanding and implementing these principles, construction companies can navigate the journey towards enhanced construction site safety ensuring the well-being of their workers and creating a safer and more sustainable future.

INTRODUCTION

Safety culture is vital in ensuring well-being of workers on site. It is important that companies focus their attention on these aspects. Keller Singapore is a construction firm specializing in ground engineering (such as vibro-compaction, stone column, cement mixing, soil and rock grouting) in the sectors of reclamation, MRT, energy, highways and ports. Keller Singapore has previously in 2019 faced safety challenges and needs to rethink about her approach towards safety. This paper discusses the thought process and approach to re-looking into the cultural aspects on safety.

FOUR KEY PRINCIPLES FOR SAFETY CULTURE

There are four key principles for creating a safety culture, namely good leadership, effective communication, safety programs, and a culture of care in fostering a safe working environment.



LEADERSHIP AS A GUIDING PRINCIPLE

The role of leadership is important to creating a culture of trust and openness. Management actions should be consistent with beliefs. For example, by dedicating time solely to safety matters during site visits, management sets a clear expectation for the entire organization. To ensure consistent engagement, dedicated resources should be committed despite business cycles. Safety leadership should permeate through all levels of the hierarchy, from senior managers to nonexecutives, creating a collective responsibility towards safety. Building competencies, encouraging active participation, and recognizing safety champions are essential in fostering safety leaders at all levels. When the entire organization is aligned, chances of success in achieving a safe working environment significantly increases.

EFFECTIVE COMMUNICATION FOR TRANSPARENCY

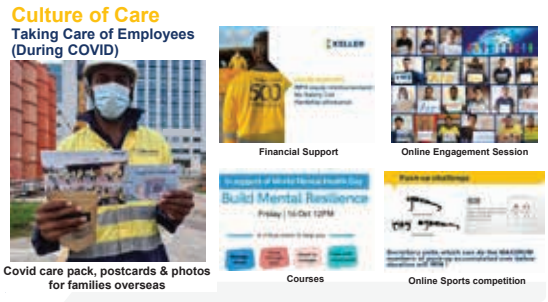
Transparency in communication is an important aspect in creating a culture of safety, particularly in encouraging employees to discuss project safety noncompliance. It is acknowledged that initially, individuals may find it difficult to openly address their own safety lapses. However, by creating an environment where employees feel supported rather than judged, organizations can foster a culture of open conversation. This open communication helps identify and address real safety issues effectively. The implementation of data-driven safety programs, such as hazard reporting systems and behaviour-based safety observations, further strengthens the organization's ability to proactively address safety risks. Analysing collected data aids in understanding the nature of risks, distinguishing between systemic and local hazards, and determining appropriate mitigation measures. By establishing mandatory work safe practices and developing key performance indicators (KPIs), organizations can ensure consistency, address behavioural issues, and reinforce a positive safety culture.

SAFETY PROGRAMMES AND TECHNOLOGICAL ADVANCEMENTS

In the journey towards construction safety, the development of effective safety programs plays a pivotal role. Safety programs should be proactive, data-driven, and incorporate KPIs to measure effectiveness. By leveraging technology and training programme, organizations can reduce manpower exposure to hazards. For instance, remote-controlled drilling operations minimize human proximity to high-pressure risks, while modified excavators can perform tasks traditionally carried out manually, reducing the risk of injuries. By embracing technology and exploring innovative solutions, organizations can significantly enhance safety measures. Incorporating virtual reality simulations and augmented reality tools can provide immersive training experiences, allowing workers to familiarize themselves with potential hazards and practice safety guidelines in a controlled site environment. Additionally, the use of drones for site inspections and monitoring can help identify potential safety hazards and ensure compliance with safety regulations. By continuously evaluating and integrating technological advancements into safety programs, construction companies can stay ahead of the curve and create safer work environments.

CULTIVATING A CULTURE OF CARE

Creating a culture of care is the most important principle in ensuring construction site safety. This involves taking care of the well-being of employees, both at work and in their personal lives. A well-being framework is introduced comprising five elements: body, mind, community, growth, and financial security. This framework encourages a balanced and healthy lifestyle, promotes mental resilience, fosters a sense of belonging, supports career growth, and ensures fair compensation. By implementing this framework, organizations can assess the maturity of their well-being programs and strive for continuous improvement. During challenging times, such as the COVID-19 pandemic, the importance of caring for employees and their families becomes even more evident. By understanding the individual needs of employees and providing support, organizations can alleviate stress and fears, ultimately strengthening the culture of care. Offering employee assistance programs, promoting work-life balance, and providing access to mental health resources are crucial steps in supporting the well-being of construction workers. Moreover, fostering a sense of community through team-building activities, recognition programs, employee appreciation day and open communication channels enhances employee engagement and promotes a positive and caring work environment.



CONTRIBUTING TO SOCIETY AND SUSTAINABILITY

Practicing good site safety has the significance of contributing to society and embracing sustainability efforts in the construction industry. By identifying causes close to the hearts of employees, organizations can foster a sense of common purpose and positive shared experiences. Encouraging volunteer and community outreach programs not only contribute to society but also enhance employee morale and teamwork. Additionally, sustainability initiatives, such as reducing carbon footprint through alternative foundation solutions and adopting low carbon materials, setup carbon KPIs for projects demonstrate a commitment to environmental responsibility. Integrating sustainability into construction practices not only benefits the environment but also enhances the commitment of workers. By implementing green building practices, such as energy-efficient design, waste management strategies, and the use of renewable materials, construction companies can minimize environmental impacts and create healthier and safer work environments. Furthermore, embracing sustainable construction practices can also lead to cost savings and increased long-term profitability.

CONCLUSION

To summarize the message of creating safety & a healthy workplace, there is a need to cultivate a culture of care through taking care of our employees, giving back to the society, and embarking a sustainability journey. The crucial principles are leadership, effective communication, safety programs, and a culture of care serve as guiding compasses in the journey towards enhanced construction site safety. By aligning actions with beliefs, fostering open communication, implementing data-driven safety programs, and caring for employees' well-being, organizations can significantly improve safety outcomes and achieve sustainability requirements. By continuously striving for improvement, embracing technological advancements, and fostering a culture of care, construction companies can create a legacy of safety, setting new standards for the industry and ensuring the well-being of their workforce for years to come.

Building a Safer Future: Embracing Adaptivity in Construction Safety and Health Management

Dr. GOH Yang-miang
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ABSTRACT

The paper shares a case study from Singapore that highlights the importance of managing adaptive behaviours among construction workers. The construction industry is a complex adaptive system, where individuals and the system always need to adapt and self-organise to the changing environment to perform their functions and achieve goals. To manage unsafe adaptive behaviours, the construction industry can learn from High Reliability organisations (HROs), which have five characteristics. These characteristics include a preoccupation with failure, a reluctance to simplify, sensitivity to operation, commitment to resilience, and deference to expertise.

INTRODUCTION

The construction industry is complex, with interacting tasks, materials, equipment, people, and companies coming together to complete projects within a short period. The industry is also facing challenges regarding climate change, innovative technologies, and attracting talent. Therefore, embracing adaptivity in construction safety and health management is crucial. Furthermore, individuals and the construction site, as a system, always adapt to the changing environment, and there is a lot of self-organising behaviours. Workers need to adapt to the environment and improvise based on the changing needs on a day-to-day basis. These characteristics indicate that a construction project can be classified as a complex adaptive system. This presentation uses a case study from Singapore to highlight the importance of safe adaptation to prevent accidents in complex adaptive systems.

In addition, learning from other industries is crucial in managing safety and health in construction. Different industries face different hazards, but many safety and health management approaches are transferable across industries. Therefore, the construction industry must be open and learn from others to improve safety and health management. This presentation suggests that the construction industry can learn from High Reliability organisations (HRO), which are characterised by their preoccupation with failure, reluctance to simplify, sensitivity to operation, commitment to resilience, and deference to expertise.

CASE STUDY

Not the actual buildings

Tower A: 11 storeys
Tower B: 18 storeys

Developer

Main Contractor
- Site Supervisor
- Foreman
- 1st Deceased
- 2nd Deceased
- 3 other employees

Subcontractor
- Responsible for Tower A's structural work

Figure 1

The case involves the construction of two towers, Towers A and B. The project commenced in 2011 and was expected to be completed by 2014. However, the accident occurred three months before the project's stipulated end date. The accident involved a site supervisor, a foreman, and five workers. Unfortunately, two workers fell from height during the project and lost their lives.

On the day of the accident, the subcontractor in charge of the structural works for one of the towers requested the movement of an air compressor. At the same time, the main contractor wants to shift a loading platform from one tower to another. Lifting works are high-risk activities that require careful planning and risk assessment. However, the supervisor decided to take a shortcut by moving the loading platform to the location of the air compressor, load the air compressor onto the suspended platform, then shift both objects to the destination.

Figure 2: Case chronology

The decision to not install the loading platform and move the air compressor onto the suspended platform to save time seemed like a smart improvisation. However, moving the air compressor onto the unstable platform and lifting both objects is extremely dangerous. At around 11:50 am, the site supervisor instructed the foreman to continue the work based on the supervisor's plan. The five workers and the foreman attempted to shift the loading platform from Tower B to Tower A on the seventh floor, where the air compressor was located. The subcontractor who was supposed to assist with the work was unavailable due to lunch. Nevertheless, the foreman and the workers decided to proceed without them, and the air compressor was mounted on a steel frame with four wheels, with the rear wheels being smaller. As they tried to move the air compressor onto the loading platform, the platform started to tilt, and the workers realised the danger and raised their concerns. However, the foreman insisted on continuing, and the workers used galvanised iron pipes to prop the air compressor onto the loading platform, which was the second adaptation by the team.

As the air compressor was being delivered onto the platform, the air compressor on wheels started rolling towards two workers on the platform who were trying to receive the air compressor. The workers could not move away in time, and both fell from height and lost their lives. The air compressor was also damaged in the accident.

DISCUSSIONS

In this case, the workers made two adaptations, probably due to resource and time constraints. In this case, the workers lacked competency in safe lifting, and the supervisor's and foreman's attitude towards safety was problematic. Frontline personnel's adaptive behaviours are influenced by the individuals' and organisational habits, which are related to safety culture. While safety management measures such as risk assessments, safe work procedures, and method statements are essential, deviations from the plan can occur in real life, and the adaptive behaviours arising from the deviations have to be managed. The common response to such accidents is to emphasise on compliance to safe work procedures, increase training, and conduct inspections and audits to ensure compliance. However, this approach assumes that all adaptive behaviours and humans are essentially hazards and are unsafe, which may not be true.

The reality is that workers are also safety heroes because many of them make timely adjustments and improvisations that preserve the safety of our imperfect systems operating in an uncertain and dynamic world. James Reason, known for his Swiss Cheese Model, states that human variability in the form of adaptations is a solution to many issues faced on the ground. While some see improvisations as problematic, they are critical to adapting the imperfect plans to prevent accidents.

LEARNING FROM HIGH RELIABILITY ORGANISATIONS (HROS)

The construction industry can learn from HROs, which arise from a stream of research in the 1980s focusing on normal accidents. Normal accident theory states that very complex systems, for example, nuclear plants, pharmaceutical plants, are so complex that accidents are normal. The same assumptions apply to construction sites. But researchers found that there are organisations that operate in complex environment and sustain for a long time without accidents, and they have the following characteristics, which promote safe adaptations.

Preoccupation with failure

They are proactive in monitoring risks and take safety procedures seriously. They are willing to use different technologies, like the smart system promoted by Hong Kong, to monitor construction sites proactively to facilitate safe adaptation.

Reluctance to simplify

They do not take shortcuts and seek to understand complex situation. They have a strong learning culture.

Sensitivity to operation

They pay attention to operational details and frontline workers, maintaining open communication and adapting operations based on feedback.

Commitment to resilience

They are committed to resilience through measures such as effective training and cross-training of workers.

Deference to expertise

They respect expertise over hierarchy and ensure that the right expertise is utilised at the right time.

CONCLUSIONS

The construction industry is a complex adaptive system. Even though the adaptations by frontline personnel can lead to accidents, their adaptive behaviours are also the key to safety. We can learn from the five habits and characteristics of HROs to assure that adaptive behaviours on the ground promotes better workplace safety and health in our construction sites.

Closing Remark

Ir Dr. Derrick PANG
Chairperson
Committee on Construction Safety of
Construction Industry Council

Distinguished Guests, Fellow Engineers and Ladies and Gentlemen.

We will bring this Global Construction Sustainability Forum and Exhibition Day Three Safety Forum session to a close. I would like to take a moment to reflect on the importance of safety in the construction industry.

I have learned a great deal from our speakers and Stephen highlighting the importance of data sharing, making data available and about construction, pre-construction, preparation, design for safety, etc., and about commitment to values and how we can cultivate leaders and a culture of caring, and the aspects of high reliability, organization and the promotion of adaptability. I believe all these aspects have the power to shape the future of our industry. However, amidst all the achievements, we must never lose sight of the paramount aspect of construction safety. Safety is not just a buzzword or regulatory obligation. It is a fundamental value that should be ingrained in every aspect of our work.

I managed to use AI to construct a photo of a future construction site with advanced technologies to ensure safe construction. There will be drones doing construction but there is still human in there. We are probably now somewhere in between. One thing for sure is we have come a long way to go for this. Each day, construction professionals around the world face numerous risks and challenges. In Hong Kong in 2023, there are already 20 fatalities. As for worldwide, the data from the International Labor Organization indicate that over 100,000 workers are killed on site every year, which represent about 30% of all occupational fatal injuries. The data also show that construction workers are three to four times more likely than other workers to die from accidents at work. There is so much more work to so.

There are many more improvements we can do. In this forum, we have had the privilege of hearing from esteemed experts, industry leaders and passionate professionals who have dedicated their lives to ensure safety in construction. Their insights have reminded us that safety is not just an individual responsibility, but a collective effort that requires collaboration, communication and a commitment to best practices.

While safety requires collective effort, I must remind all of us that there is a reason why leaders are called leaders. We, as leaders, have the utmost important duty in establishing an environment that cultivates.

A safe working culture, that is setting a legislation framework, will help develop proper systems and allocate appropriate resources. All these will ensure individuals discharge their respective duties responsively and properly. Today, I mean, I learned a new acronym RACI Stephen talked about. That is what CIC has been trying to promote for the last four years. RACI is an acronym that stands for Responsible, Accountable, Consulted and Informed. It is a matrix that helps you define and communicate the roles and responsibilities of different team members and stakeholders for each task and activity. And that is what is missing in Hong Kong right now.

Safety must be embraced by everyone, from the top decision makers to the frontline workers. Only then subsequent trainings, promotions and improved practices can make a material difference. By protecting the well being of our workers, we are also enhancing productivity, reducing costs, and ultimately building a more sustainable future. And more importantly, we are also making sure thousands of families are intact.

In conclusion, I would like to express my deepest gratitude to each and every one of you for your active participation, meaningful contributions and unwavering commitment in advancing construction safety. The conversations we have had and the connections we have made will continue to reverberate long after this event. Before AI and robots can take over mankind, there is still a lot of work for us to do in construction safety. Your leadership and continuous effort in safety will be the driving force in making our construction safer. There will be times that we will face with difficult decisions like when we push through unpopular legislations, or times apply for additional budget and construction time for slowing down progress for safety reason. And I ask you to choose the safety slogan “Life First” that CIC Chairman Thomas Ho and ED and I are advocating. We will continue to build a sustainable built environment for our future generations. But we are also here to save lives. Thank you all.

Day 3 PM

Clobal Construction Sustainability Forum (Governance) – Corporate ESG

Opening Address

Mr. Ivan FU
Chairperson
Committee on Environment of
Construction Industry Council

Ladies and Gentlemen,

Welcome to the Corporate ESG and Talent Development session. It is my great pleasure to stand before you today as we gather for this forum focused on Environmental, Social, and Governance (ESG) practices and talent development. This session may be the last one of the CIC Global Construction Sustainability Forum, but the topic certainly should not be underestimated. In fact, I think it is one of the most important and relevant topics for our industry and our society.

As an architect, I have always been fascinated by the interplay between design, environment, and society. We are living in a time of expectations and hopes, but also of growing contradictions, uncertainties and new risks. What would be the most pressing issue of our time? The answer could be climate change, conflicts, poverty, and the existential threat posed by humankind under the rapid growth of AI. Amid all these concerns, the importance of ESG or the Sustainable Development Goals has soared to new heights. ESG offers a holistic approach to evaluate and improve the performance and impact of businesses.

Construction, as one of the largest industries globally, has a significant impact on the environment and society. It is our responsibility to ensure that our actions align with the goals of environmental sustainability, social responsibility, and ethical governance. By incorporating ESG practices, we can make a positive difference in areas such as resource circularity, carbon footprint reduction, community engagement, and our wellbeing and development.

To achieve ESG excellence, businesses need to possess a clear vision, a strong commitment, and a robust framework. But most importantly, they need to have the right talent. Talent is the key driver of ESG performance and the core asset of any organisation, especially within the construction industry.

CIC is dedicated to cultivating talents for the industry. As the CIC continues to invest in and capitalise on innovative technologies, we need to pair it with skilled professionals to accelerate the growth and sustainable development of the construction industry. The Hong Kong Institute of Construction (HKIC) offers training aimed at enhancing technical expertise and professionalism within the industry. CIC also offers testing services for trades and different programs to connect skilled workers with construction companies.

Looking beyond the construction industry, Hong Kong, as a leading international financial centre and a gateway to mainland China and the rest of Asia, has a vibrant and diverse ESG ecosystem, with various initiatives and platforms to promote ESG awareness and practice. Hong Kong has a strong and supportive regulatory environment, with the Hong Kong Stock Exchange continuously enhancing its ESG reporting requirements and guidance. The city has a rich and talented pool of human capital, with many ESG professionals and experts, as well as students and graduates who are eager to pursue ESG careers. Given these advantages, I believe that Hong Kong will become a fertile ground for ESG practice and talent cultivation.

In conclusion, I would like to thank you again for your interest and participation in this forum. I am personally eager to witness the fruitful sharing of insights from our prestige speakers, and I hope you will be inspired too. Together, we can make a positive difference for our businesses, our society, and our planet. Thank you.

On the Unsustainability of ChatGPT: Impact of Large Language Models on the Sustainable Development Goals

Dr. Serge STINCKWICH
Head of Research
The United Nations University Institute in Macau

ABSTRACT

This paper explores the risks associated with language models, specifically the ChatGPT model, and how these risks can impact the construction industry. Language models, such as ChatGPT, are designed to generate human-like responses to text-based inputs. However, these models can pose risks, including the potential for hallucinations and other errors. The risks associated with ChatGPT are discussed, and potential solutions for fixing these errors are explored. The societal and environmental risks associated with language models are first established, including the potential for bias and the impact on the environment due to the high energy consumption of these models. The specific risks associated with language models in the construction industry are then examined. These risks include the potential for errors in communication between stakeholders, the potential for inaccurate predictions, and the potential for the misuse of these models. The paper concludes by discussing the importance of addressing these risks and developing strategies to mitigate them. By understanding the risks associated with language models such as ChatGPT, the construction industry can implement measures to ensure the safe and effective use of these tools.

INTRODUCTION

The United Nations University Institute in Macau Research Team is conducting policy-relevant research to address key issues from the UN 2030 Agenda on Sustainable Development Goals. The team is striving to achieve the 17 goals before the end of this decade, and digital technologies may have a significant impact on achieving these goals. The research team is multidisciplinary, comprising individuals from various backgrounds, including computer science, artificial intelligence, data science, educational technology, psychology, resource economics, public health, and computational social science.

The team is interested in understanding the positive and negative impacts of digital technologies on the world and how these technologies can help achieve the SDGs. The research interests of the team include complex system modeling and simulation, AI and ethics, smart cities, collective intelligence, digital well-being, and public health. By conducting policy-relevant research, the team can contribute to achieving the SDGs and creating a sustainable future for all.

LANGUAGE MODEL

A language model is not about facts but words. Language model task predicts the most probable words following a series of words based on them. Applications cover text summarization, machine translation, chatbot, etc. Transformer-based deep neural network was introduced by google in 2017 in the paper: "*Attention is all you need*". The attention means the system has some kind of long-term memory.

Neural networks are becoming increasingly complex, with some models with over 175 billion parameters and based on 45 Terabytes of text scraped on the Internet. Due to their complexity, nobody fully understands how they work. This is concerning, as it is similar to build a bridge without fully understanding if it will collapse or not. The computer science industry is still relatively immature compared to the construction industry, and there are many risks associated with the use of neural networks. The risks associated with neural networks include employment, education, compliance, and transparency. There is ongoing research in these areas to better understand and mitigate the risks associated with these complex systems. researching and addressing these risks to ensure the safe and ethical use of neural networks.

WHAT ARE THE RISKS OF CHATGPT?

The emergence of ChatGPT, a chatbot based on a language model that generates human-like responses to text-based inputs, has raised concerns in various sectors. In the employment sector, ChatGPT poses a potential risk to jobs in the creative industries, including skilled knowledge workers, journalists, software developers, and even academics. In academia, there are concerns that ChatGPT enables people without significant domain expertise to write scientific papers, raising questions about the future of research production and the nature of authorship. In education, ChatGPT can generate plausible essays across a wide range of topics, potentially encouraging cheating and plagiarism, and making student writing assignments obsolete. Some universities have even blocked access to ChatGPT. Compliance is another area of concern, as major banks in the US have banned and blocked the use of ChatGPT due to concerns over data and information leaks, potentially breaching government regulations. Finally, the lack of transparency around the ChatGPT algorithm, where the data comes from, and how it was curated raises concerns about the model's accuracy and reliability. These concerns must be addressed to ensure the safe and effective use of ChatGPT in various sectors.

I will focus just on two risk today social cohesion and environmental impacts of this ChatGPT. The first is social cohesion. ChatGPT's ability to generate plausible-sounding misinformation, disinformation and hate speech is seen to have potentially serious effects on the well-being of communities, and on democracy. The second is environmental impacts: Large Language model (LLM) can have a huge impact on greenhouse gas emission.

For social cohesion, maybe people have not heard about that in fact one of the first incidents. On February 2023, there was the first incident report about ChatGPT in the AAIC (AI, Algorithms and Automations Incidents and Controversies) repository database. A resident of the city of Hanghzou use ChatGPT to generate and announce that the city government they lift number plate driving restrictions starting from March 1st 2023. This become very viral on the Chinese internet. What was very interesting is that ChatGPT was not supposed to understand Chinese. Even the people from OpenAI were quite surprised that this is possible.

ARE HALLUCINATIONS FROM LLM FIXABLE?

Hallucinations are generated content that sometimes is nonsensical. This was discussed since a long time in 2017 in the paper written by Wiseman, Sam, Stuart M. Shieber, and Alexander M. There are lots of people, lots of industries, and lots of research on that to try to fix this problem this major problem, and even Sam Altman, the CEO of OpenAI said, "*there is no problem in one or two years we can fix this problem but apparently we'd be much more difficult than that*". But some people, including Emily Bender (Director of Washington's Computational Linguistic Laboratory) said that this is not fixable. The hallucinations problem is a major concern of using these kinds of tools. The technology now is built on autocompletion, not factuality. One mitigation way is to use prompt engineering to give more constraints and avoid hallucinations.

LLM SOCIETAL & ENVIRONMENTAL RISKS FIRST ESTABLISHED

If people in construction use these kinds of tools to produce text or images, people have to know that this problem exists and might be very difficult to solve at the end. Another unsustainable problem relates to the environment.

Companies like OpenAI, Google, and other in China produce models that can have an impact on the environment and generate carbon emissions. However, it is difficult to determine the exact amount of emissions as companies do not want to share the information for competitive advantage. For example, Google's BERT model, with 300 million parameters, emits emissions equivalent to a trans-American flight when trained on a GPU. In 2022, Hugging Face's BLOOM model emitted 25 tons of carbon dioxide emissions during training (equivalent to 30 flights between London and New York), but less than the equivalent LLM model as it used nuclear energy. OpenAI's GPT-3 model emitted 500 tons of carbon dioxide emissions during training, equivalent to 600 flights. As these models need to be trained multiple times, the carbon emissions can add up. Ongoing research is being conducted to reduce the size and economic cost of these models and develop more environmentally-friendly tools in the future.

SPECIFIC RISKS LINK TO CONSTRUCTION INDUSTRY

Establishing and maintaining public trust in AI technologies is crucial for the construction industry, as with other industries. Inclusive, transparent, and agile governance is necessary to achieve this. UNESCO recently made a recommendation about the ethics of AI, and all industries, including construction, should be involved in designing this governance. Accountability and transparency are significant issues, as seen in the trolley problem scenario of autonomous cars. The construction industry may face similar scenarios, such as with malfunctioning robots on busy construction sites. Regulations and scientists are needed to address these issues and prevent some firms from having an unfair advantage. Cybersecurity risks are also important, as breaching issues can lead to the discovery of a company's secrets. A more holistic approach is necessary, incorporating not only technical and computer science perspectives but also social science perspectives, to ensure the quality of construction, customer consumption, and safety of people.

Operationalizing ESG Through Integration and Collaboration

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ERM Hong Kong, Limited

ABSTRACT

This paper provides an overview of the evolving ESG/sustainability landscape and how it is enhancing integration. The paper explores the synergies among business partners and the challenges of operationalizing sustainability, specifically transitioning to a low carbon business case. The paper also presents case studies to illustrate how companies are successfully integrating sustainability into their operations. In addition, this paper discusses the importance of a unified ESG platform and a robust approach to ESG data management. By having a centralized platform, companies can better manage their ESG data and ensure that it is consistent and accurate. Finally, the paper highlights the role of executives in ESG integration and transformation. Executives play a critical role in setting the tone from the top and ensuring that sustainability is integrated into the company's strategy and operations. Overall, this paper provides valuable insights into the evolving ESG/sustainability landscape and how companies can successfully integrate sustainability into their operations.

INTRODUCTION: DEFINING ESG AND SUSTAINABILITY

ESG, or Environmental, Social, and Governance, refers to the non-financial risks or opportunities that impact corporate performance. ESG indicators are used to evaluate corporate behaviour and determine future environmental, social, and financial performance. Sustainability, on the other hand, is defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs while ensuring ongoing commercial success in a responsible and ethical manner. Examples of ESG issues include environmental factors such as biodiversity, energy, water and effluents, emissions, waste, and climate change. Social factors include data privacy, health and safety, human rights, consumer protection, employment, and non-discrimination. Governance factors include anti-fraud, anti-corruption, stakeholder expectations, regulation and public policy, strategy and resource allocation, and transparency. By addressing ESG issues and promoting sustainability, companies can improve their long-term financial performance while also benefiting society and the environment.

TRENDS REPORT EVERY SINGLE YEAR

The top 10 sustainability issues this year include responding to climate change, safeguarding natural systems, and applying technology to stakeholder sustainability. The first issue focuses on AI, particularly cybersecurity. As ESG involves a significant amount of data, including an organization's own and its supplier's, the security of that data is crucial. The sustainability landscape is changing, with an increasing convergence of financial and non-financial data. Many organizations are now producing integrated risk reports that cover all ESG reporting issues within their annual reports.

HOW IS THE ESG/SUSTAINABILITY LANDSCAPE EVOLVING TO ENHANCE INTEGRATION?

Companies are increasingly recognizing the importance of ESG factors in their long-term financial performance, leading to a trend towards the convergence of financial and non-financial reporting. Enterprise risk management is also becoming more holistic, with a focus on reviewing the impact and financial materiality of ESG risks and opportunities. In response to this trend, there is increasing regulation around ESG and sustainability disclosures, with regulators mandating greater transparency. These developments reflect a growing recognition of the importance of ESG factors in corporate decision-making and the need for greater accountability and transparency in this area.

WHAT DO THESE TRENDS MEAN TO THE CONSTRUCTION INDUSTRY

What do these trends mean to the construction industry? One of the most important things is governance and executive alignment. It's extremely important that the board is on the same page as sustainability teams, and that climate topics, decarbonisation, health and safety and other ESG topics such as diversity and inclusion are discussed at the board level. There are representatives at the board level that are embedding decisions around those key topics into the business agenda. It's important that the operating model and management systems are enhanced to include gathering all of this data and collaborating amongst different functions of the business. It's very difficult to implement a decarbonisation strategy if procurement is not involved. How to make sure procuring the right green options, if one doesn't have procurement, collaborating effectively with sustainability. As the markets are changing and new technology is evolving we are seeing the need to update skillsets particularly around health and safety. Investment needs to be made, not only in our workforce, but in future generations coming through.

INTEGRATED ESG STRATEGIES DRIVE VALUE CREATION

If one integrates the ESG strategy well into the business, it can increase the value. Companies are recognizing the importance of aligning with global ESG standards to achieve profitable growth and enterprise value. Investors and lenders are increasingly demanding that companies demonstrate their commitment to ESG factors, and companies are developing meaningful relationships with consumers, NGOs, and stakeholders to build trust and credibility. Financial regulators are also mandating compliance and disclosure obligations around ESG and sustainability issues, reflecting a growing recognition of the importance of these factors in corporate decision-making. By prioritizing ESG factors and building strong relationships with stakeholders, companies can improve their long-term financial performance and contribute to a more sustainable future.

SYNERGIES AMONG BUSINESS PARTNERS

The key success factors and recommendations for a sustainable business

The learnings from good practice and synergies in incorporating sustainability issues into business include operationalizing sustainability and ESG within the organization. This involves regular discussions at the board level and collaboration across functions and business group areas. Digital systems can be adopted to collect and collate data transparently and accurately, giving organizations confidence in their own and their supplier's data. As Scope 3 emissions can make up a significant portion of an organization's overall footprint, having accurate and transparent data is becoming increasingly important. Executive leadership for sustainability or transformation should also be a priority, with boards being adequately trained on ESG and sustainability topics.

Operationalising sustainability – transitioning to a low carbon business

If one deep dives into some of these issues, particularly around decarbonisation, many companies are now aligning with net zero goals, whether they are looking to align with Hong Kong's carbon neutral strategy or whether they themselves have investors or customers that require them to have a detailed Net Zero strategy. Some mishaps and errors that are seen right from the beginning include making sure that their net zero strategy is actually aligned with their business goals and business strategy. There has to be strong alignment, ensuring that carbon targets are set so that they are actually realistic. As of 2023, many companies are

setting peak emission goals for 2030, which is only a seven-year timeline and will soon be reduced to six years. It is important to determine whether these targets are realistic and achievable.

It is crucial to have strong engagement with suppliers, as most companies have very large scope three emissions. Have they already started engaging with their suppliers about what is expected from them in terms of gathering data and making sure that there is an adequate data reporting system to track progress? This will help determine whether they are getting to where they need to be year on year so that they can all meet the important 2050 Zero goal.

Case study | Operationalising sustainability – collaboration to decarbonise

There are good examples of collaboration that can be seen in decarbonizing and reducing greenhouse gas emissions. Hong Kong is an important financial centre, and banks such as JP Morgan have produced something called the carbon compass, which is sector-based guidance to achieve a 1.5 degrees future. They have recently published their sector guidance for the cement sector and the iron and steel sectors, focusing on the hardest to abate sectors. Private equity and portfolio companies in Hong Kong and elsewhere in the region are working closely together to align on net zero commitments. This often means that the private equity companies need to train the portfolio companies on what greenhouse gas emissions mean, how to gather scope data, and how to report it back to the private equity firms. Most private equity firms in Hong Kong are now aligning with UN PRI (Principles for Responsible Investment) disclosures, which means they themselves have to report on the performance of their portfolio companies.

In the fast-moving consumer goods sector, many products produced in Hong Kong are being made according to a company that has a net zero guideline. For instance, a drinkware brand is working towards producing cups in a carbon neutral or net-zero manner. This involves engaging with suppliers, factories, and doing energy audits to map out a credible and realistic pathway to net zero. Collaboration and support from customers are necessary for these small drinkware brand producers and manufacturers to achieve a credible and zero journey.

Case study | Operationalising sustainability – integrating net zero into business strategy

One of the most important things for companies is to set their ambition and understand their baseline emissions. Without understanding the baseline, it becomes difficult to plan a path to net zero. It is essential to have workshops or brainstorming sessions to determine the decarbonization levers that can be pulled to reduce scope three and scope one emissions. Companies also need to consider compensation for removing residual emissions and explore nature-based solutions, which are an excellent way of removing carbon from the atmosphere. However, credible nature-based solutions may take some lead time, so it is important to start exploring them early on, especially if the net-zero target is set for 2030 or 2050.

Case study | Operationalising sustainability – integrating climate change

In addition to understanding baseline emissions and exploring decarbonization levers, companies need to incorporate the resilience of their assets to climate change in their decarbonization strategy. The recent floods in Hong Kong have highlighted the intense effects of extreme weather on assets. Companies need to consider typical climate hazards under different climate scenarios and incorporate that information into their climate change investment strategy. This will help them make informed decisions about the climate resilience of the companies they invest in. It is important to start looking at these topics now to ensure that companies are prepared for the effects of climate change and can make informed investment decisions.

Case study | Operationalising sustainability – integrating DE&I

Another key topic that companies need to address is diversity, equity, inclusion, and belonging. The construction sector in Hong Kong still has a long way to go in terms of achieving a truly diverse workforce, from the board level to the workforce level. Companies need to embrace diversity, equity, inclusion, and belonging in a strong way by embedding it in their purpose, people strategies, and brands. This requires a top-down vision where DE&I is discussed at the board level and integrated into all business activities. Finally, companies need to address the tricky topic of data to ensure that it is auditable, transparent, and secure.

UNIFIED ESG PLATFORM ROBUST APPROACH TO ESG DATA MANAGEMENT

To effectively implement a decarbonization strategy, it is crucial to gather data and ensure that it is auditable, transparent, and secure. The Data Challenge is becoming more significant every year, and it is essential to choose the right providers for emissions reporting and disclosures. Companies need to ensure that their reporting and data management processes are efficient, accurate, and allow for analysis and visualization of the data. This will help complete the feedback loop and inform the company's strategy to achieve good progress. Key takeaways include having ESG at the board level, discussing it regularly, linking it to remuneration, and auditing it to ensure its effectiveness.

ROLE OF EXECUTIVES IN ESG INTEGRATION & TRANSFORMATION

Companies need to make sure that executive committees and subcommittees are focused on specific ESG issues such as DE&I, climate change, and HSE. This requires embedding these issues in group functions to encourage cross-collaboration between different teams for successful integration of ESG. In conclusion, some key takeaways include the importance of setting net-zero targets, addressing biodiversity and nature, engaging all stakeholders, incorporating the resilience of assets to climate change, gathering auditable and transparent data, and embracing diversity, equity, inclusion, and belonging. Companies need to integrate ESG into their purpose, people strategies, and brands and ensure that it is discussed regularly at the board level.

CONCLUSIONS

The first step towards achieving a net-zero transition is for companies to set net-zero targets and back them up with a strong transition plan, including the necessary investment. Secondly, companies need to ensure that their climate approach addresses biodiversity and nature, with nature-based solutions being an effective way of removing greenhouse gases from the atmosphere. It is important to make sure that the transition plan brings people along with it and to be transparent and accountable in ESG disclosures. Companies should view disclosure as a mandatory process and engage with their customers, investors, and suppliers. The net-zero transition presents opportunities for businesses to evolve and find opportunities in the net-zero carbon economy. Collaboration among different industry peers is crucial in achieving the 1.5 degrees goal. Finally, companies need to engage all stakeholders, including government, customers, suppliers, employees, and society at large.

Promoting Sustainable Development in Hong Kong Construction Industry

Mr. Rex WONG
CEO
Kum Shing Group

Good afternoon. Following the insightful presentations delivered by the experts in the earlier sessions, we have gained valuable knowledge about the methodologies, the target setting and performance measurement in the realm of ESG. In the next few minutes, I would like to provide a local Hong Kong perspective, specifically on how we capture the performance across all the three dimensions of ESG. To achieve this, we have implemented the Hong Kong Construction Association (HKCA) ESG Recognition Scheme.

Before delving into the details, I would like to provide some context for our overseas guests. HKCA has a rich history spanning 100 years, representing more than three-quarters of the construction activities in Hong Kong. While Hong Kong's annual construction expenditure is expecting to be amounted at a staggering 300 billion Hong Kong dollars, the significant activity prompted us to initiate the recognition scheme within HKCA, which entails the establishment of 33 key performance indicators (KPIs) covering the three ESG areas. I would like to highlight some initial findings upon the first year of implementing this initiative.

In terms of environmental indicators, it is evident that during the construction phase of infrastructure building asset lifecycle, or referred to as stages A4 and A5, is contributing to around 4% of Hong Kong's total carbon emissions, according to a research conducted by the Construction Industry Council (CIC). While 4% may not seem significant, we, as members of the construction sector, feel a strong sense of responsibility to address this impact. The focus of the scheme lies on two key areas within the environmental domain: Energy & Water Consumption and Waste Management, as those are the two major items in the construction site. We have also developed comprehensive KPIs for the aspects relating to Social and Governance because a sustained construction industry requires a strong workforce and good governance as well.

Over this last year, we have had over 100 construction sites and 53 member companies in Hong Kong

participating in this scheme. The diversity of activities participated vary from the smaller contracts of 30 million Hong Kong dollars to projects worth 30 billion Hong Kong dollars. These projects span various natures from civil engineering, building to foundation works, repair &maintenance etc. The data we collected through the scheme allowed us to establish a baseline for Hong Kong and measure the performance of our members against this baseline and strive for better performance in each of the 33 identified areas.

And aside from the member companies, we also have engaged over 200,000 frontline workers through the scheme. Every action they take on-site, whether it is recycling a plastic bottle or taking care of their own well-being by staying hydrated in hot weather, contributes to the sustainable development of themselves, the site as well as the company. These actions are rewarded, and a record of their performance is kept through a blockchain token system. So far, we have recorded over 200,000 activities that have contributed to positive ESG performance.

Another area we deem highly significant is the adoption of technology and innovation to drive sustainable performance on construction sites. In recent years, the Government of Hong Kong SAR has been actively promoting the implementation of advanced technologies at the construction sites. These technologies go beyond conventional construction practices and encompass applications such as Building Information Modeling (BIM), Virtual Reality (VR), mixed reality training and apps that perform dynamic assessment etc. These technologies have been adopted across the construction sites in our database. It's evident that the industry is no longer content with maintaining the status quo but is actively progressing towards the implantation of new technologies. Some sites have adopted more than four or more items of innovative technology.

Another crucial area we have identified is the training provided to the frontline workforce, which holds significant social importance. Our findings indicate that over 8% of the working hours are dedicated to training for these workers. While we acknowledge this as a positive development, it is essential to compare our data with international and the Mainland to assess our progress and identify areas for improvement within Hong Kong. It is also worth noting that environmental professionals and sustainability experts are becoming increasingly vital in the construction sector. Nearly all construction sites have qualified professionals dedicated to these areas.

Safety is another paramount concern. Our data reveals that, on average, nearly 10% of a frontline worker's time is allocated to safety-related training. However, we must determine if this baseline is sufficient, considering global comparisons, and assess whether more emphasis should be placed on safety training. These questions will be addressed in the next phase of the scheme. Once a baseline is established, we can chart the progress and collective efforts towards improved performances and outcomes.

Lastly, I would like to emphasize our commitment to contributing to the net zero target by 2050, which is a commitment shared by the Hong Kong community, including the construction industry. Our dedication extends beyond environmental performances and encompasses the social and governance aspects as well. We eagerly anticipate learning not only from the experts who have spoken today but also from the rest of the speakers this afternoon. We hope that we can count on your support as we collaborate with CIC and the Government to propel the entire sector forward on the journey of sustainability.

Thank you for your valuable time and attention.

Day 3 PM

Clobal Construction Sustainability Forum (Social) – Talent Development

On Attracting Talents for Construction Sustainability

Mr. Lawrence HUNG
President
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ABSTRACT

The construction industry is experiencing a resurgence post-pandemic, resulting in increased demand for construction manpower. However, challenges arise from an aging workforce and a lack of interest among the younger generation for a career in the industry. This paper provides an overview of the global construction workforce landscape and focuses on strategies for attracting and nurturing young talents to sustain industry growth. It highlights the importance of understanding the needs and perceptions of the younger generation, dispelling misconceptions, and building the employer brand. The paper explores reinventing talent strategies, including revamping the compensation and benefits programme, prioritising career development and growth opportunities through upskilling and reskilling, and building the employer brand to align with evolving expectations. By implementing these strategies, the construction industry can bridge the gap and secure a reliable pipeline of young talents for long-term sustainability.

INTRODUCTION

The paper focuses on two areas: the global construction workforce landscape, and how to attract talent for construction substitutability. The speaker cites figures from a research project by Global Construction Perspective and Oxford Economics, which projects that global construction output will reach 15.5 trillion by 2030, with China, the United States, and India contributing 57% of the global growth. However, the speaker notes that there are challenges to overcome, particularly climate change and attraction of talents. The speaker presents figures based on the LinkedIn membership database, which show a high turnover rate in the industry in Asia and Hong Kong.

According to the 2021 American Community Survey, there has been a drop in the percentage of people aged 25 to 54 who are interested in joining the industry. This trend is not just limited to the US, but is also seen in the UK and Asia. The challenge is that experienced workers may not be able to pass on their knowledge and skills to

younger workers before they retire. Another challenge of the global construction workforce landscape is the lack of interest from the young talents in joining the industry. Survey has identified that young talents have a diverse array of career options, and they may find other industries, such as technology, media and telecoms, as well as pharmaceuticals and life sciences, more appealing. However, it is important to note that the construction industry still has a promising future with a projected output of 15.5 trillion in the years ahead. To address this challenge, HR may need to re-evaluate their recruitment and retention strategies, as well as consider offering training and development programs to attract and retain talent.

The discussion covers several topics, including compensation and benefits (C&B), upskilling and reskilling, and leveraging the company's employee value proposition through employer branding. It was noted that C&B is a basic need for employees and a key factor in attracting and retaining talent. The survey conducted by the company revealed that money is a top factor in attracting talent. Additionally, the importance of employee wellness, including physical, financial, and mental wellness, was emphasized. It discusses the need to close the expectation gap between employees and the company, and to deliver on promises made to employees. Finally, the conversation touched on the importance of differentiating the company from other employers in the construction industry to attract talent.

SHIFT IN EMPLOYERS' EXPECTATIONS – CLOSING THE GAP

The HR department can use the top five factors that attract talent as a starting point to attract potential employees. Additionally, it is important to close the gap between employee expectations and what the company can offer. According to the survey, work-life balance is the most critical factor for young people when evaluating career options. However, only half of the respondents believe that the construction industry offers good work-life balance. This may be due to the high number of projects and a shortage of staff. Therefore, the company should focus on improving work-life balance to attract and retain talent. The company can address this by offering alternative options, such as flexible work schedules, part-time work arrangements, or additional paid time off, to help employees balance their personal and work commitments. The third factor that is important to potential employees is job stability. Another concern for potential employees, particularly young people, is the risk of work-related injuries, mental health hazards, and the perception of demanding physical work in the construction industry. The company should address these concerns to attract and retain talent.

Promoting a Safe and Inclusive Work Environment

To address the misconceptions about the construction industry, employers should highlight the diverse range of roles that are available, including project management, design, engineering, and ESG. Promoting a safe and inclusive work environment is also important to attract and retain talent. The company should have rigorous safety protocols and offer regular safety training to ensure that employees feel comfortable and well-supported at work. By showcasing a commitment to safety, the construction industry can appeal to younger generations and bridge the gap in the talent pool.

Leveraging Technology

Youngsters are interested in technology, and employers can attract and retain talent by embracing digital transformation. New technologies such as MiC and MiMEP can help to improve the quality and accuracy of work while enhancing productivity and reducing manual labor. Employers should also consider leveraging AI for safety training and addressing safety issues. Upskilling and reskilling are also important to retain employees who may only stay with the company for a short period of time. Employers should invest time and energy in providing learning and development opportunities to their employees.

UPSKILLING AND RESKILLING

Employers can refer to the LinkedIn insights to identify the most in-demand and fastest-growing skills to focus on upskilling and reskilling their employees. If employees are unsure of where to start, they can consider going back to school or joining professional organizations like CIC to acquire the necessary skills for future jobs. It is important to remember that upskilling and reskilling is an investment, not a cost.

EVOLVING YOUR EMPLOYER BRAND

Employer branding is important to attract and retain talent. According to various surveys and findings, compensation is the most important factor for young people in Asia, followed by career progression, wellbeing, upskilling opportunities, and job security. Employers should focus on these elements in their branding strategy but should also consider their unique values and purpose. Employers must prove it through their policies, team structure, and employee journey from hiring to exit. Employer branding is not just a slogan, it is a reflection of the organization's culture and values. Another way to approach employer branding is to focus on delivering on the promises made to employees. This is how the organization can stand out and attract the best talent.

TALENT ATTRACTION AND RETENTION

Collaboration between employers, schools/professional societies, and the government is vital for the long-term sustainability of the construction industry. Employers can engage in partnerships with schools, offer internship programs, participate in career fairs, and showcase the rewarding career paths available in construction. Schools and professional societies can collaborate with employers to develop curriculum and training programs that align with industry needs. The government can support the industry through policies and incentives promoting sustainable construction practices, skills development programs, and infrastructure projects that create job opportunities.

Internship programs are an effective way for both employers and young people to gain real-life experience and assess whether the organization and its culture are a good fit. Employers should work with schools and professional organizations to offer internships and apprenticeships to attract and retain young talent. The government can also play a role by making internships mandatory for all university students and providing funding and subsidies. These are important initiatives to enhance HR standards and attract young talent to the industry. HKIHRM looks forward to working with employers on all HR topics.

Building Success: Developing and Retaining a Multigenerational Workforce in Construction

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ABSTRACT

This paper addresses two key challenges facing technical roles and industries today: talent and leadership development and managing a multigenerational workforce. The paper explores strategies for bringing out the potential of a multi-generational team using the 4C Toolkit. The first strategy is collaboration and cross-generational mentoring, which encourages team members to work together and learn from each other's unique strengths and perspectives. The second strategy is capability-building opportunities, which provide training and development to help team members grow and improve their skills. The third strategy is communication, which emphasizes the importance of open and transparent communication within the team. The paper suggests being intentional and flexible in communication channels to ensure that everyone is heard and understood. The fourth and final strategy is curiosity and understanding, which fosters a culture of curiosity and understanding by recognizing and valuing the unique strengths of each generation.

INTRODUCTION

The purpose of this paper is to discuss how to retain talent once it is acquired. Arcadia focuses on helping clients work on their culture and capabilities, specifically the interactions that people have in a working environment. Looking forward, it is essential to identify the skills, knowledge, and cultural pieces that need to be in place to retain talent. This includes creating an inclusive and diverse workplace culture, providing opportunities for growth and development, offering competitive compensation and benefits, recognizing and rewarding employees' contributions, and fostering a positive work-life balance. Companies also need to provide a sense of purpose and meaning to their employees and ensure that they feel valued and supported in their roles. By creating an environment that fosters growth, development, and well-being, companies can retain their talent and attract new talent in the future.

TODAY'S CHALLENGES

It discusses today's challenges, including the technical leadership challenge and the changing dynamics of a multigenerational, multicultural workforce. The question is whether there is a talent and leadership challenge or issue in technical roles, and if so, what HR leadership can do about it.

ARE TECHNICAL LEADERS BETTER OR WORSE THAN NON-TECHNICAL LEADERS?

The data from Zenger Folkman includes 74,125 leaders from STEM (science, technology, engineering, mathematics), while McKinsey's data covers 65,000 people. This sample size is statistically significant. The data reveals that technical leaders, on average, score five percentage points lower than leaders in other industries or roles, indicating that they are less impactful and less effective. However, at the high end of the bell curve, where there are extraordinary leaders, the impact of leadership is more significant. Zenger Folkman correlates competencies to business outputs, such as engagement or results, and finds that technical leaders have fewer leaders scoring at the extraordinary level. This results in less impact of leadership in technical roles. The reasons for this trend are worth exploring.

DO TECHNICAL LEADERS HAVE A SIMILAR OR DIFFERENT CAPABILITY PROFILE TO NON-TECHNICAL?

The analysis the 19 competencies and splitting them by gender shows that non-technical competencies have a reverse correlation of negative 0.43 between men and women, indicating that men and women have complementary skill sets. On the other hand, technical competencies have a positive correlation of 0.54 between men and women, meaning that they have the same set of competencies and do not balance each other out. This scarcity of the same nine competencies is consistent across all splits, highlighting the need to develop leaders who possess these capabilities. The focus should be on leadership development rather than recruitment to create an environment where people want to stay and feel valued. The changing environment makes it harder to be a leader, and leaders need to adapt to meet the cultural and generational differences of their employees.

It is a development issue that organizations are not developing leaders who can create an environment that meets the cultural and generational differences of their employees. The employee value proposition cannot just be words on a page; it has to be an experience. Additionally, being a leader is becoming increasingly challenging, and leaders need to adapt to the changing environment. The Marshall Goldsmith idea of "what got you here won't get you there" applies to the current situation, and leaders need to be equipped to meet the demands of the changing environment.

FEMALE AND MALE LEADERSHIP COMPETENCIES, IS THERE A DIFFERENCE?

Organizations are currently operating with structures, systems, and competencies that were developed years ago and have not been updated to accommodate the multi-generational workforce. This can result in cultural shaming, generational issues, and conflicts that create an environment where newer employees do not want to stay. Micro-aggressions in technical functions are prevalent, where people are made to feel small or stupid because they are not subject matter experts. Leaders who believe that subject matter expertise is what sets them apart can create an environment where everyone else is there to listen to them. To attract a diverse workforce, organizations need to change the way they lead and be more inviting to the new generation. The challenge is to adapt to the changing workforce and incorporate the best that each generation brings to the marketplace.

The modern workplace is characterized by up to five generations operating at the same time, with the addition of Gen Alpha by 2030. Each generation is driven by different values and ways of working, bringing diverse thinking to the workplace. However, creating an inclusive environment where they feel valued and want to stay is crucial to retaining them. Financial rewards may keep them for a period, but it is not a long-term solution. In Hong Kong, there is a significant drop in the workforce, and the changing demographics pose a challenge. To address this, organizations need to create an environment that is welcoming to all generations and values their diversity.

GENERATION-DEFINING INFLUENCES

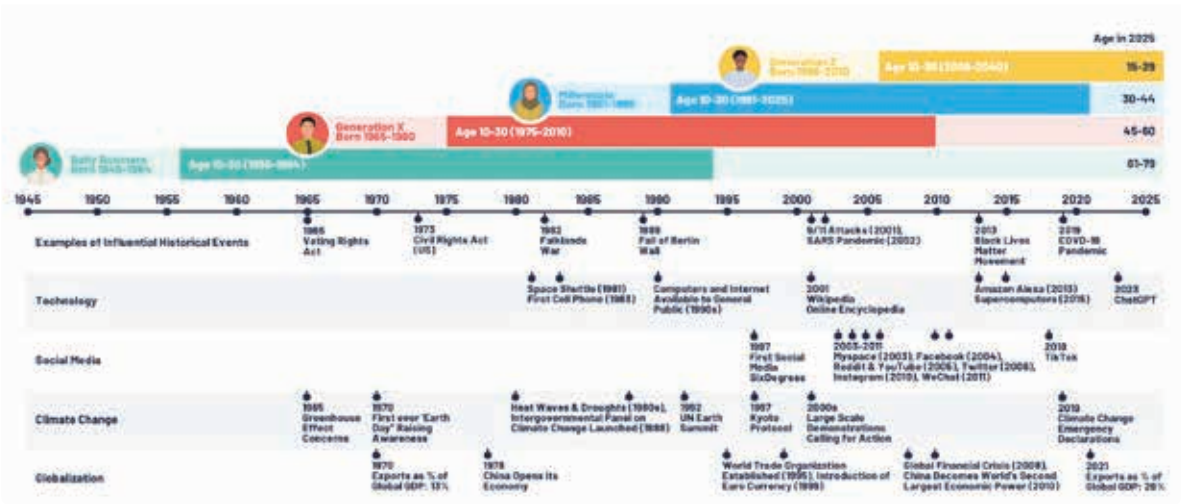

Figure 1: Generation-Defining Influences

People don't know what the impact on the next generation will be for those differences, and one can track them all the way back. But each different country has its own unique experiences. For example, the phrase "baby boomer," which refers to one of the biggest generations, doesn't exist in India and may not exist in China because they didn't go through the same post-World War II experiences. Shared experiences create generations that create stereotypes, but each individual has their own values and behaviours based on where they are in life. Factors such as having a small young family can determine behaviour. When looking at generational differences, one must learn about them and let them go, focusing on the people in front of them and understanding their values. Inclusive leadership is necessary to deal with a team in an individual way, to be flexible in how they engage, motivate, inspire, and handle change. The population growth and working population growth in some countries are in massive decline, leading to a senior isolation of the working force and an aging population, which can be compounded by their expertise in their subject matter.

It may be difficult to attract people to join a workforce that is not growing, especially when there are countries with larger growth workforces. The UK is facing this challenge and must look to other countries to find a workforce, which can create cultural challenges in the workplace. In addition to intergenerational challenges, there are now intercultural challenges that leaders and teams must address to ensure that everyone feels engaged with the organization and its culture. Technical leaders are in short supply, especially at the 90th percentile where leadership has the biggest impact on business results. The median for technical leaders is also lower than the median for non-technical leaders by 5 percentile points. Both men and women in technical roles are between the 35th and 45th percentile in nine critical leadership competencies.

HOW TO SOLVE: THE 4C TOOLKIT

Collaboration and Cross-Generational Mentoring

Encouraging collaboration and mentorship across generations is important to bring together unique strengths and perspectives within a team. It is necessary to create an environment where everyone contributes to making the work better and where people want to work together. Breaking down cultural and generational differences is crucial in achieving this goal. Technical leaders should focus on bringing out the best in people, encouraging them to share, speak up, challenge thinking, and innovate to foster collaboration. It is not enough to have subject matter experts and people who listen; leaders must also bring the best out of people to encourage collaboration.

Capability-Building Opportunities

Creating more capability building is crucial to the development of technical professionals. Many people have discussed the need for more training, but only 8% of the hours are spent on training. It is essential to determine how much of that training is technical or safety training and how much spills into other competencies. Technical professionals require training that goes beyond technical and safety training to develop critical competencies such as customer and external focus, the ability to champion change, and a strategic perspective.

Curiosity and understanding

Fostering a culture of curiosity and understanding is essential to recognize and value the unique strengths of each generation. Understanding what drives behaviors and categorizing generations is acceptable, but treating people the same way is not. It is necessary to recognize the differences between generations and think about why those differences exist. As leaders, it is essential to flex to those differences instead of making assumptions based on generational stereotypes. Leaders should engage with employees, bring them in, and be more curious and understanding to foster a culture of curiosity and understanding.

Communication

Communication is vital in understanding organizational culture, values, and cultural communication between cultures. A recent research survey showed that 100% of people surveyed wanted to know more about organizational culture, values, and cultural communication between cultures, but they feel it is underrepresented in what they do. It is crucial to develop communication strategies that promote cross-divisional, cross-generational, and cross-cultural communication to foster collaboration and understanding.

Technical leaders must develop the nine critical competencies, including customer and external focus, the ability to champion change, and a strategic perspective, to drive the future. Leaders are built, not born, and it is essential to provide experiences and opportunities to develop leadership skills. Ignoring the need for leadership development will only perpetuate the same problem, where leaders have the same set of competencies and do not bring diversity to the industry. It is crucial to consider how leadership develops, engage cross-generational and cross-cultural cultures, and build a value proposition in the culture for the future.

WHAT ARE THE HARD TO FIND COMPETENCIES IN TECHNICAL?

In the technical field, there are several competencies that are hard to find and highly valued. These include customer and external focus, the ability to champion change, and a strategic perspective. Additionally, inspiring and motivating others to high performance, innovating, and communicating powerfully and prolifically are all critical competencies. Establishing stretch goals, developing others, and collaborating effectively with teams are also highly valued competencies in technical roles. By possessing these competencies, technical professionals can excel in their roles, drive innovation and change, and contribute to the success of their organizations. Therefore, individuals who possess these competencies are highly sought after in the technical job market.

Talent Acquisition and Retention in Construction Industry for Sustainability

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ABSTRACT

The paper explores the challenges currently faced by the construction industry in Hong Kong, including an aging workforce, a high turnover rate, and a lack of interest from younger generations. It discusses possible reasons for the high turnover rate, such as demanding work conditions and a lack of work-life balance. The paper also provides an overview of the working attitudes of multi-generations, highlighting the differences in motivations and expectations. Additionally, it finds that the reasons for leaving a previous job are largely the same across age groups. Understanding the attitudes of young people towards jobs, career guidance, and work experience is crucial in attracting and retaining them in the construction industry. The paper proposes strategies to address these challenges and attract younger generations, such as providing comprehensive career guidance and work experience programs, embracing innovation and technology, and creating a supportive work environment. It also explores the use of artificial intelligence (AI) to enhance employee behaviour and safety in the construction industry. By addressing these challenges and implementing effective strategies, the paper concludes that the construction industry in Hong Kong can attract and retain younger generations, contributing to its long-term success and the sustainable development of the city.

INTRODUCTION

The construction industry is facing numerous challenges that are impacting its performance, including labour shortages, cost increases, geopolitical issues, environmental concerns, and epidemic risks. One of the most significant challenges is the aging workforce and skills shortage, which is leading to health and safety issues and delays in projects. The industry is struggling to keep up with the pace of technological innovation and development, and productivity levels are falling behind other sectors.

To overcome these challenges, the industry needs to focus on developing the skills of its workforce and investing in new technologies. This will help to improve productivity, reduce costs, and enhance safety. Additionally, the industry must address the issue of

scope creep, which is leading to delays and cost overruns. By addressing these challenges, the construction industry can remain competitive and meet the expectations of its customers.

POSSIBLE REASONS FOR HIGH TURNOVER RATE IN CONSTRUCTION INDUSTRY

The construction industry has been marked by a high rate of turnover in recent years. There are several reasons for this. First, monetary and reward issues have played a significant role. Many workers feel that they are not being adequately compensated for the physically demanding and often dangerous work they are doing. Additionally, the overall working conditions in the industry can be difficult, with long hours and limited opportunities for career development and growth. The lack of well-coordinated training programs and a tradition management style and corporate culture also contribute to these challenges. Social image and reputation problems are also a concern. Many workers feel that the industry is not respected, which can make it difficult to attract and retain talent. Finally, there are external factors such as the shift of jobs to other industries and immigration that are also playing a role in the high rate of turnover.

OVERVIEW OF THE WORKING ATTITUDES OF MULTI-GENERATIONS

The construction industry is facing several issues that make it difficult for people to work in the industry. These issues include poor working conditions, long working hours, physical demands, and dangerous work. Additionally, the social image and reputation of the industry may deter people from joining the industry, particularly those who are seeking career growth and training opportunities.

To address these issues, the industry needs to focus on providing career growth and training opportunities for its workers. This will help to upgrade manual labours into technicians and prevent the loss of workers from the industry. Training programs should focus on adjusting workers' behaviour and attitude to prevent accidents and promote safety. Additionally, the industry needs to provide a safe working environment and promote vehicle safety awareness.

Leadership skills are also essential in the industry, particularly at the operational level. Operational style management should prioritize taking care of workers and promoting communication and recognition of worker performance. By addressing these issues, the construction industry can improve its corporate and brand image to attract more people working in the industry.

REASONS FOR LEAVING A PREVIOUS JOB ARE LARGELY THE SAME ACROSS AGE GROUPS

Performance feedback is essential for workers in the construction industry, and managers should provide them feedback regularly. It is also important to consider the impact of minimum wages on the industry, as workers may leave for other industries with better pay and working conditions. The construction industry is dealing with multiple generations, including baby boomers, Gen X, Gen Y and Gen Z, millennials. It is crucial to manage these generations effectively and ensure that they are happy and motivated. Baby boomers and Gen X workers are essential to meeting construction deadlines, and their experience and knowledge are invaluable to the industry. If these workers are not happy, they may not provide a good model for younger generations, which can impact the overall performance of the industry.

YOUNG PEOPLES ATTITUDES TO JOBS, CAREERS GUIDANCE AND WORK EXPERIENCE

In Hong Kong, young people are facing several challenges in the job market. Many do not believe that the work available to them is of good quality, particularly in terms of teaching them new skills. They value support provided through vocational training, such as apprenticeships and traineeships, over other kinds, such as a university degree, but they feel let down by the quality of support they receive. Additionally, young people feel let down by the quality of careers support they receive, including career advisers. They struggle with their wellbeing in the workplace and feel less confident when trying to access good quality work life. These challenges can make it difficult for young people to find and maintain satisfying and fulfilling careers in Hong Kong.

WAYS TO ATTRACT AND RETAIN YOUNGER GENERATIONS IN CONSTRUCTION INDUSTRY

To address the challenges facing the construction industry, there are several steps that can be taken. In the short-term, importation of labour may be necessary to fill the skills gap. However, in the long-term, redesigning and redefining job and work processes is essential. Improving terms and working conditions for new recruits and current employees is also crucial. Building a safe-focused work environment and implementing effective safety protocols is necessary to reduce health and safety issues. Cultivating a culture of appreciation and recognition for performance can help boost morale and productivity. Offering growth and professional development opportunities can help retain employees and attract new talent. Asking for feedback

and taking it seriously can help identify areas for improvement. Initiating referral schemes can also help attract new talent. Finally, expanding the use of technology can help increase productivity and efficiency in the industry.

ENHANCING EMPLOYEE BEHAVIOUR AND SAFETY WITH AI

Artificial intelligence (AI) has the potential to enhance employee behaviour and safety in the construction industry. Performance tracking and analysis can help identify areas for improvement and provide real-time feedback to employees. Real-time monitoring of safety hazards can help prevent accidents and injuries. AI can also be used for environmental, risk, and hazards identification. Virtual training and simulations can provide employees with training for potential risky or dangerous tasks. Wearable technology, such as smart helmets and exoskeleton vests equipped with sensors, can help monitor employee health and safety. Autonomous vehicles and equipment, such as driverless vehicles on-site, can reduce strenuous lifting and carrying. Automated safety checks, such as static video surveillance or drones automatically scheduled, can help identify potential hazards and risks. By leveraging the power of AI, the construction industry can improve employee behaviour and safety, resulting in a safer and more efficient workplace.

CONCLUSIONS

All stakeholders in Construction Industry should jointly build and collaborate together for the upgrade of professional qualification and standard of its people and the mitigation of safety and hazard risk to the long term success with sustainability in mind!

Closing Remarks

Sr Eddie LAM
Chairperson
Construction Industry Training Board of
Construction Industry Council

CIC Chairman Thomas, CIC Executive Director, Albert, ladies and gentlemen. I think at this point of time, you may aware that it is symbolising the end of the forum for today and is also the end of the whole forum. Before my closing remarks, I trust that you will be patient for my long-waited remarks before the closing. I also irritated Hong Kong construction industry is set for enter a golden era over the next decades, as our annual construction volume is expected to which 300 billion per year, leading to a high demand for manpower. Today, there is already a shortage of 10,000 skilled workers, which is expected grow to four times larger by 2027. The manpower shortage is not only persons in the frontline workers, but also for technicians and supervisory personnel. What is making the issue worse is the workforce aging problem. We are having 45% shortage of workers over 50s today.

Therefore, there is an immediate call for action to find a new way to promote the sustainable development of our industry. To this end, CIC has been working with the government under a multi-form approach to address the issues and challenges, and enhancing the training and recruitment, uplifting the image of the construction sectors as well as encouraging the adoption of the innovative technologies. Hong Kong Institution of Construction is also taking a pivotal role in leading the new workforce cultivation for providing structured training and supporting career opportunities for graduates.

Our three distinguished speaker today, Mr. Lawrence Hung, Mr. Matt Lyon, and Dr. Felix Yip, you all shed fruitful insight and stimulating ideas on how the industry could work on attracting, developing and retaining talents. Among all these important things, it is a shared vision for the industry to embrace an open and dynamic culture of change and grow, building a capable and committed workforce to support the opportunity in constructions ahead. I hope the forum has served as an effective platform for the exchange of ideas, fostering a spirit of collaboration and growth. Thank you once again for your active participation and contribution. Let us still continue to build upon a meaningful dialogue, and engage the network formed today together pushing for continuous and high-quality talent development. Thank you, you all have a very good afternoon. Thank you.