Modular Integrated Construction (MiC) for Buildings of Higher Quality, Productivity and Sustainability in Hong Kong

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Summary of the Impact

- This ‘project’ refers to “a series of KE work on a particular issue or subject” which is Modular Integrated Construction (MiC).
- The project develops a new approach and disruptively innovative solutions for policy for, research on, and practice of delivering high-rise buildings in Hong Kong of higher quality, productivity and sustainability.
- The project has contributed predominantly or significantly to the MiC government policy and strategy, academic and applied research, government and industry training and learning, public engagement, MiC pilot projects implementation, and knowledge dissemination.
- The specific impacts of the project are summarised in the next slide and elaborated later.
Summary of the Impact

The specific impacts of the project are summarised below.

- Co-created the basis for a new policy initiative (MiC) in the Policy Address and facilitated the transformation of industry thinking and practice towards MiC
- Produced a MiC Strategy Paper via study for Government and provided strategies with vision
- Led research into the new area of MiC in HK and in the world
- Largest RGC RIF project & sizeable grants from Government and industry (over $25m)
- Provided expert advice on MiC to Government and industry via initiatives and MiC pilot projects setting examples for wide industry learning
- Provided academic support for the MiC International Conference co-organised by Development Bureau and Construction Industry Council
- Provided MiC training for Government and industry benefiting wide-ranging participants
- Coordinated / organised many overseas MiC study visits and delegations for Government, public sector clients and industry, and nurtured innovation culture
- Delivered many invited Keynotes/Plenary/Speeches at international and local conferences for wider impact and raised reputation of HK MiC
Underpinning Research

The challenges (that motivate the KE):

• The buildings in HK are the most expensive to construct in the world and the housing in HK is notoriously the least affordable.

• The HK government announced a very ambitious housing development programme to construct nearly 190,000 new housing units by 2022. However, the HK construction industry is facing severe challenges including ageing workforce, skills shortages, and cost escalation.

• The productivity in the construction industry has been alleged to lack far behind that in manufacturing industries.
Underpinning Research

The background (what is MiC?)

- MiC is a new policy initiative to promote innovative construction to address the challenges listed above, as stated in the Policy Address 2017 of the Chief Executive of the HKSAR Government.
- MiC is also a key element of the construction innovation and technology being promoted in the Financial Secretary’s Budget Plan 2018-19 Speech.
- MiC is again emphasized for wide adoption in the Policy Address 2018 of the Chief Executive of the HKSAR Government.

The Government will also take the lead in piloting Modular Integrated Construction (MiC) in public projects. We are considering extending the current gross floor area concessions for promoting green and innovation buildings to cover buildings adopting MiC. We are also conducting studies on relevant manufacturing facilities to promote the wider use of such a construction method in Hong Kong.
Underpinning Research

The underpinning research projects include:

• RGC Research Impact Fund (RIF) “Modular Integrated Construction MiC 2.0+ for Quality and Efficient Tall Residential Buildings through Advanced Structural Engineering, Innovative Building Materials and Smart Project Delivery”, HK$14.3million, PC/PI: Dr Pan

• CIC Research Fund “Modular Integrated Construction (MiC) for High-rise Building in Hong Kong: Supply Chain Identification, Analyses and Establishment”, HK$4.95million, PI: Dr Pan

• DEVB Fund, “Feasibilities of Adopting Modular Integrated Construction (MiC) for High-rise Buildings in Hong Kong”, funded by Development Bureau (DEVB), HKSAR Government, HK$2.77million, PI: Dr Pan

• DEVB Fund, “Study on Performance of Modular Integrated Construction (MiC) Pilot Project”, funded by Development Bureau (DEVB), HKSAR Government, HK$1.85million, PI: Dr Pan

• HA Fund, “Viability Study of Modular Integrated Construction (MiC) Application in Public Housing Construction”, Funded by Hong Kong Housing Authority (HA), HK$598,000, PI: Dr Pan
Underpinning Research

**Innovativeness** of the knowledge:

- Co-created the basis for a *new policy initiative* (*MiC*) *in the Policy Address*
  
  - The new concept of MiC was developed through collaboration between HKU CICID (led by Dr Pan) and the Development Bureau of the HKSAR Government.
  
  - Dr Pan and his team contributed the knowledge underpinning the development of this new concept and policy initiative in the Policy Address 2017 and 2018.
  
  - MiC is defined in an explicit manner *in the first ever journal publication on MiC in the world* authored by Dr Pan, and Mr CK Hon (the then Permanent Secretary for Development (Works) of the HKSAR Government), as:

    "A game-changing disruptively-innovative approach to transforming fragmented site-based construction of buildings and facilities into integrated value-driven production and assembly of prefinished modules with the opportunity to realise enhanced quality, productivity, safety and sustainability"

    (Pan and Hon, 2018, ICE Journal Municipal Engineer)
Underpinning Research

Innovativeness of the knowledge:

- Produced a Strategy Paper on MiC entitled “Modularisation for Modernisation: A Strategy Paper Rethinking Hong Kong Construction” which elaborates on the MiC policy initiative and provides strategies for MiC development in HK (to be published soon), Commissioned by Development Bureau, HKSAR Government.

- Dr Pan and his team have published all of the three academic journal articles (ISI listed) on MiC, which ever appear as of March 2019 in the world.

- Dr Pan led his team to have also presented their MiC research at several international conferences including the ASCE Construction Research Council (US, Apr 2018), the International Conference on Construction Futures (UK, Dec 2018), etc.
Underpinning Research

Innovativeness of the knowledge (Dr Pan and his team):
- Developed structural solution for up to 40-storey MiC building using steel-framed modules (1st in HK & world-leading to our knowledge)
- Studied viability of 40-storey MiC public residential building using precast concrete modules (1st in HK & world-leading to our knowledge)
- Developed performance measurement system for MiC project (1st in HK & world-leading to our knowledge)
- Studied MiC supply chain with developed smart-tech digital platform and mobile App (1st in HK & world-leading to our knowledge)
- Proposed approach of MiC 2.0+ for quality and efficient tall residential buildings through advanced structural engineering, innovative building materials and smart project delivery (1st in the world to our knowledge)
Underpinning Research

Significance of the key insights or findings from the research:

• It is technically feasible for up-to-40-storey steel-framed MiC buildings to resist the wind loads specified in the HK code (which is most tough in the world).

• It is viable to construct 40-storey precast concrete MiC public residential buildings in HK (the tallest in the world to date).

• The benefits from MiC should be enormous, including: up to 50% construction time saving, up to 80% construction waste reduction, up to 100% accident reduction, up to 50% site labour reduction, up to 20% construction cost saving, etc. Nevertheless, these benefits are still to be witnessed in the MiC pilot projects.

• MiC should spearhead construction innovation & technology in HK, and will lead to enhance culture of the industry and society.
Engagement with Government & Industry via Research & Expert Advice

- Dr Pan and his team have been commissioned / engaged to conduct research and provide expert advice on MiC to HKSAR Government and industry, including:
  - Development Bureau, HKSAR Government (on feasibility of up to 40-storey steel MiC buildings in HK; MiC policy and strategy; MiC structural analysis);
  - Architectural Services Department, HKSAR Government (on performance of the FSD MiC Pilot Project);
  - Hong Kong Housing Authority (on viability of 40-storey concrete MiC public residential buildings in HK);
  - HKU EO (on the WCH MiC Pilot Project);
  - Hong Kong Construction Industry Council (on MiC supply chain).
Engagement with Government & Industry
via Conferences & Training

- Provided all academic support for the MiC International Conference co-organised by Development Bureau and Construction Industry Council, HK, 24 Apr 2018. Dr Pan and his team designed the conference theme, structure and contents, invited all overseas speakers, and liaised for all MiC technical issues.
- Dr Pan delivered an Invited Training session on MiC and productivity for HKSAR Government officials as part of the HKSAR Government’s ‘Project Capability Building Programme’, HK, 11 Apr 2018.
- Dr Pan organised one-day training on MiC for HKSAR Government officials and industry practitioners, HK, 25 Apr 2018.
Engagement with Community & Society via Media & Conferences Local and International

- Dr Pan and his team have organised many (most) overseas study visits and delegations with for Government, public sector clients and industry for MiC knowledge exchange and promotion in Hong Kong.

- Conducted interview by TVB and attracted significant media coverage:
  - 17-09-28 TVB 時事多面睇
    http://www.cpaoh.ku.hk/media/170928 TVB_News_iphone4.mp4
  - 港大擬首引入17層組合屋宿舍 [Apple Daily] 2017-09-29 A07 要聞
  - 港大組合屋宿舍「砌出」1228伙 [Hong Kong Economic Times] 2017-09-29 A26 港聞
  - 港大建組合屋宿舍裝修傢俬都預製 2座17層1228伙 3年起好快近半 [Sky Post] 2017-09-29 P02 新聞 頭條
  - 港大宿舍「砌積木」建17層高 預製組裝單位 工期減半人手省六成 [Ta Kung Pao] 2017-09-29 A06 要聞

- Delivered many invited Keynotes & Plenary at international and local conferences on MiC for knowledge sharing and dissemination.
Engagement with Partners & Supporters
via Academia-Community-Government-Industry Network

RGC RIF 'MiC 2.0+'

DEVB Fund 'MiC Feasibility'

CIC Research Fund 'MiC Supply Chain'

HA Fund 'MiC for Public Housing'

Development Bureau
Transport and Housing Bureau
Architectural Services Department

Hong Kong Housing Authority
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Hong Kong Housing Society
Paul Y

Architectural Services Department

Estates Office
Development Bureau

The University of Hong Kong

Yau Lee Wah

Development Bureau

Yau Lee Wah

Hong Kong Housing Authority

Wing Hong

Guangdong Hong Kong Construction Technology Company Limited
Impacts Achieved

Beneficiaries

• The Government
  — via the co-created basis for the new policy on MiC in the Policy Address and the MiC Strategy Paper

• The partners and supporters involved in the project
  — via access to the state-of-the-art research and knowledge on MiC for de-risked decision making and innovation culture

• Relevant government departments and public sector clients
  — via knowledge sharing over conferences, training and study trips

• The industry
  — via shared knowledge on MiC, developed systems solution for delivering buildings of higher quality, productivity and sustainability

• The public and community
  — via shared knowledge on MiC and its wide-ranging benefits of buildings of higher quality, productivity and sustainability

• The Hong Kong society
  — via the established leading role for MiC innovation for high-rise high-density buildings
Impacts Achieved

Nature and extent of the impact

- Co-created the basis for a new policy initiative (MiC) in the Policy Address:
  - Developed the new concept of MiC together with Development Bureau of the HKSAR Government. Dr Pan and his team contributed the knowledge underpinning the development of this new concept and policy initiative in the Policy Address.
  - Defined MiC explicitly in the first ever journal publication on MiC in the world together with Mr CK Hon (the then Permanent Secretary for Development (Works) of the HKSAR Government) (Pan and Hon, 2018).

- Produced a MiC Strategy Paper “Modularisation for Modernisation: A Strategy Paper Rethinking Hong Kong Construction” (to be published), commissioned by Development Bureau, HKSAR Government.
Impacts Achieved

Nature and extent of the impact

- Conducted research and provided expert advice on MiC to HKSAR Government and industry:
  - Our research and expert advice provided to government departments and industry bodies contributed to the successful development of the 3 MiC pilot projects.
  - Our research informed and backed up Government policy on MiC, leading to the initiation of more and more MiC projects in various sectors including hostel, public housing, staff quarter.
  - Identified and demonstrated the enormous benefits from MiC.
  - Contributed to the improved knowledge, confidence and culture of the HK government and industry about the use of MiC and innovation.
Impacts Achieved

Nature and extent of the impact

- Provided all academic support for the MiC International Conference co-organised by Development Bureau and Construction Industry Council on 24 Apr 2018.
  - About 350 participants directly benefited from the KE
  - Wide reach to community & society via the conference web & legacy
- Dr Pan delivered an Invited Training session on MiC and productivity for HKSAR Government officials as part of the HKSAR Government’s ‘Project Capability Building Programme’, HK, 11 Apr 2018.
  - About 200 government engineers and officials benefited from the KE
- Dr Pan organised one-day training on MiC for HKSAR Government officials and industry practitioners, HK, 25 Apr 2018.
  - Over 80 gov. officials and industry practitioners benefited from the KE
  - Wide reach to community & society via the training web & legacy
Impacts Achieved

Nature and extent of the impact

- Coordinated / organised many (most) overseas MiC study visits and delegations for HKSAR Government, public sector clients and industry.
  - Numerous participants benefited from the MiC KE.
  - This has made invaluable contribution to the promotion and uptake of MiC in Hong Kong.

- Dr Pan delivered many invited Keynotes / Plenary / Speeches at International and HK Conferences:
  - Significantly contributed to MiC knowledge sharing, dissemination and promotion internationally & in HK.
  - Contributed to the momentum of both academic research and industry uptake of MiC.
  - Firmed up the HK-leading research & development on MiC in the world.
Impacts Achieved

Our research suggests that enormous benefits should be achievable from MiC in HK, which will be verified in the MiC pilot projects. Those benefits as illustrated in the figure are based on our study.

Acknowledgements

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