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RFID-Enabled Building Information Modeling (BIM) Platform for Prefabrication Housing Production in Hong Kong

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2018.4.11

Summary of the Impact

This project develops a RFID-enabled BIM platform (RBIMP) to enhance prefabrication housing production in Hong Kong. The impacts of the project can be summarized as follows:

1. The effectiveness and efficiency of the prefabrication housing production are enhanced via:

- Seamless communication and coordination among multiple stakeholders through improved information and interoperability between processes;
- Streamlined cross-border logistics and supply chain management through improved real-time information visibility and traceability.

Summary of the Impact

2. The quality and sustainability of the construction work are improved via:

- Less time spent on checking the on-site assembly of the prefabricated components;
- Remote access which allow real-time information to timely check the quality of construction work;
- More resilient on-site assembly when facing design changes, order changes, or changes due to repairing defective components.

Overall, the accuracy rate of on-site assembly is increased from 99.85% to 100%.

Summary of the Impact

3. Contribution to the wide implementation of BIM and RFID in the construction industry in Hong Kong:

- The proven success of RBIMP implementation contributes to a positive political environment that allows the government to demand developers employ RBIMP before approving and/or financing a capital project.
- The RBIMP helps to implement the Hong Kong Construction Industry Council's "Roadmap for BIM Strategic Implementation in Hong Kong's Construction Industry."

Underpinning Research

The project is supported by:

- Public Sector Trial Scheme (ITT/003/18LP). Title: Trial: RFID-Enabled Building Information Modelling (BIM) Platform for Prefabrication Housing Production in Hong Kong. HK$2.99million. April 2018 – October 2019.
- Innovation and Technology Fund (ITP/045/13LP). Title: RFID-Enabled Building Information Modelling (BIM) Platform for Prefabrication Housing Production in Hong Kong. HK$8.88million. March 2014 – July 2016.
- Innovation and Technology Fund (ITF) Internship Programme 2014. Title: RFID-Enabled Building Information Modelling (BIM) Platform for Prefabrication Housing Production in Hong Kong. HK$0.29million. March 2014 – March 2016.

Underpinning Research

- PC and PIs of the project:

Professor George Q. Huang (IMSE, Faculty of Engineering, HKU)

Dr. Wilson W.S. Lu (REC, Faculty of Architecture, HKU)

Professor Thomas Ng (CE, Faculty of Architecture, HKU)

- External PI of the project:

Professor Geoffrey Shen (BRE, Faculty of Civil and Environmental Engineering, PolyU)

Underpinning Research

The project addresses challenges in prefabrication housing production

Client

Architect

Engineers

Existing challenges:

(1) Multiple stakeholders as different self-guarded interest centers
(2) Fragmentation and discontinuity
(3) Lost information/knowledge
(4) Speaking in different languages/lack of interoperability
(5) Poor communication and coordination
(6) Constant changes and variations

Raw Material Supplier

Prefab Factory

Shipping

Cross-border Logistics

Customs Control

Construction Site

Residential Household

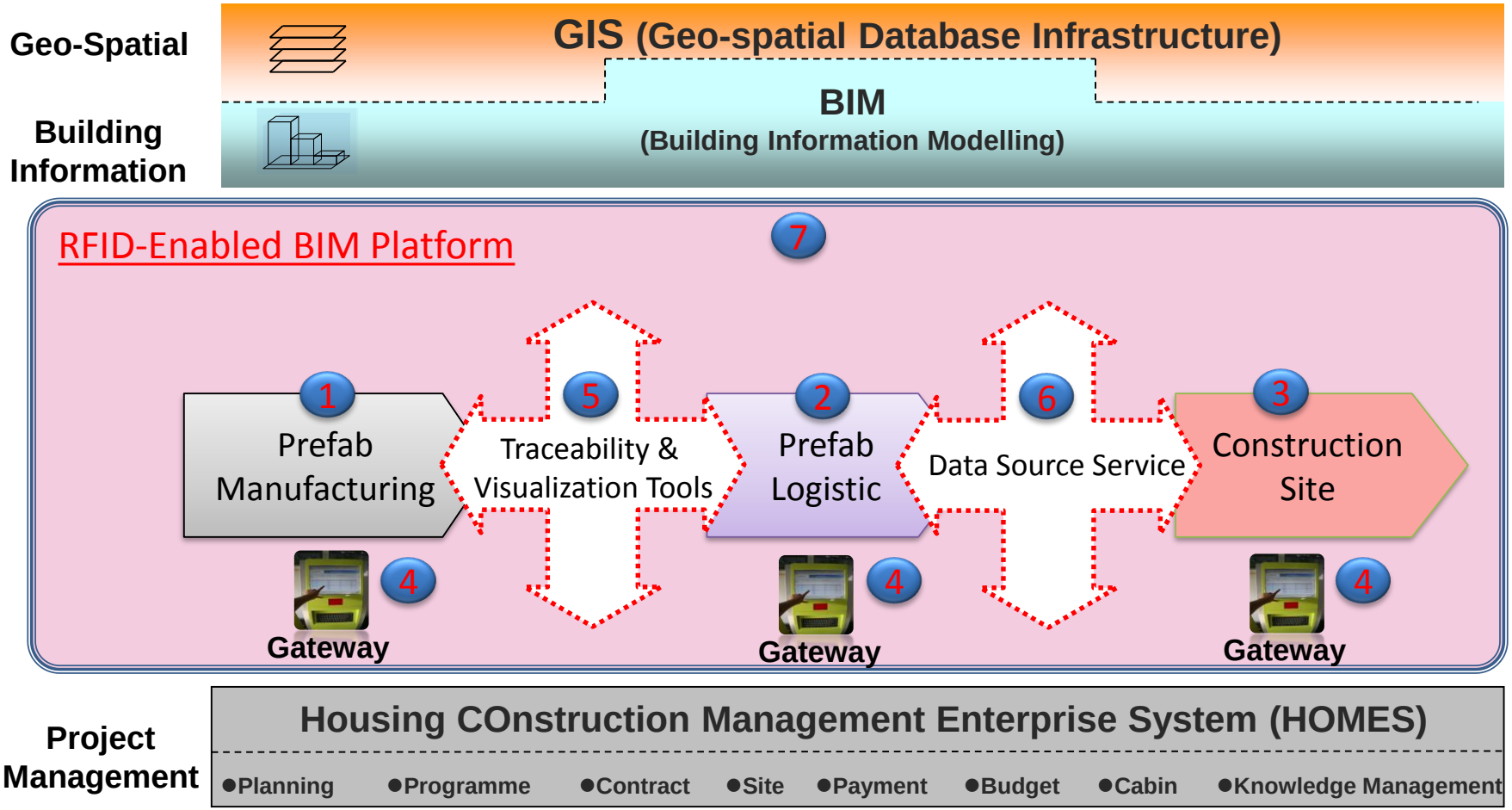
Maintenance

Emerging challenges:

(a) Prolonged logistics and supply chain
(b) Increasing number of parties involved
(c) Cross-border systems
(d) Increasing transportation costs
(e) Improved coordination needs

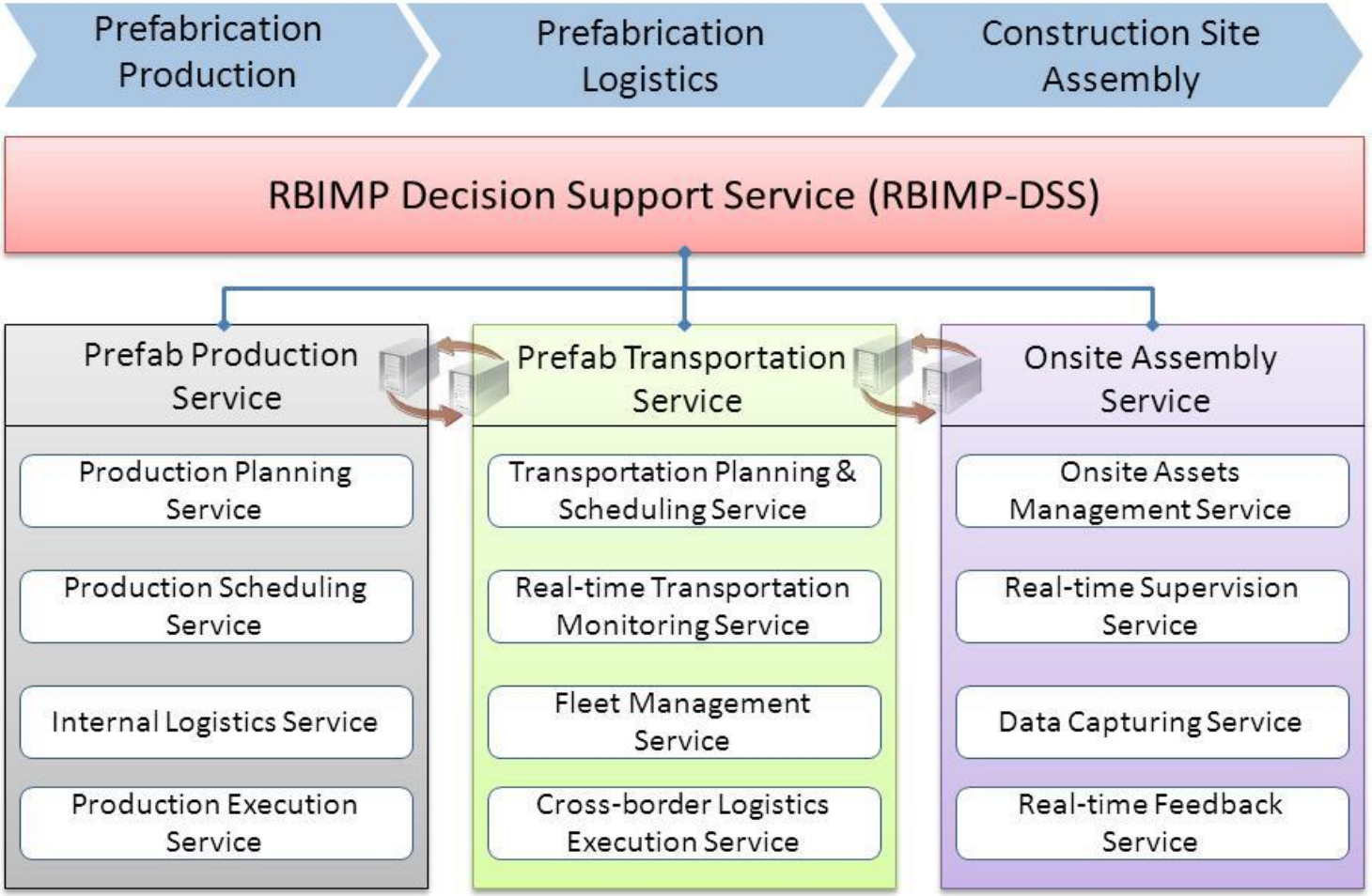
Underpinning Research

Technical Deliverables of the project:



Underpinning Research

RBIMP Decision and Support System



Underpinning Research

Key innovations of the project:

- A connected and dynamic nD building information modelling (BIM) for reengineering offshore prefabrication construction processes
- Three BIM plugin services along house construction lifecycle including prefab production, logistics and onsite assembly
- Construction gateway
- Data source integration service for heterogeneous BIM, ERP and Plugin systems
- Service-Oriented Architecture (SOA) for RBIMP components and its integration platform
- Standard and Component-Based Development of User Interfaces

Engagement

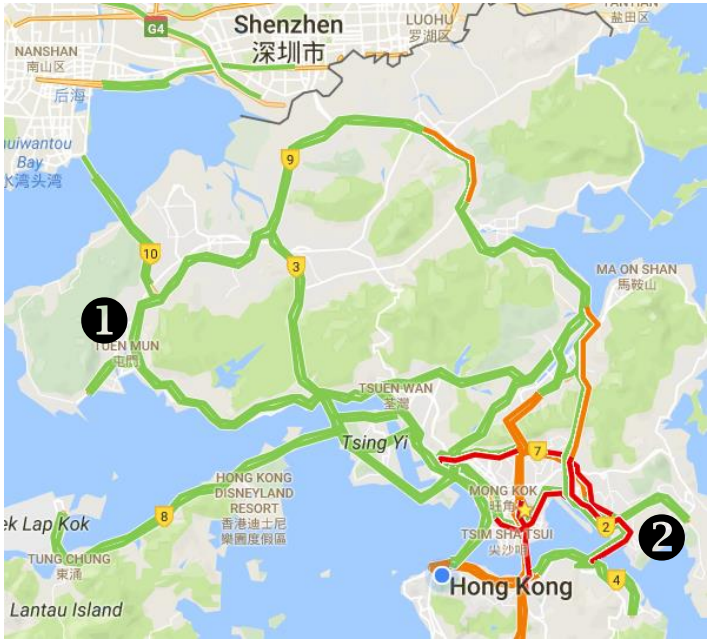
External partners of this project include:

- HKHA-Tuen Mun Area 54 Site 2 Phases 1 & 2
- Construction Industry Council (HKCIC)
- Hong Kong Construction Association (HKCA)
- The Civil Engineering and Architectural Society of Shenzhen
- Guangdong University of Technology (GDUT)
- Unicon Concrete Products (Unicon)
- Yau Lee Construction (Yau Lee)
- Huizhou Jinze International Logistics Ltd. (Jinze)
- Openplatform Technology Company Limited (Openplatform)
- Afina Data Systems Limited (Afina)
- Guangzhou Wanzhi Information Technology Company Ltd. (Wanzhi)

Engagement

The RBIMP has been implemented in actual housing projects in Hong Kong for which various stakeholders were trained to use the RBIMP in their daily operation.

	Yan Tin Estate	Mount Verdant
Location	Area 54, Tuen Mun	48 Chui Ling Road, Tseung Kwan O
Transport	Light (See ❶)	Heavy (See ❷)
Free site space	Abundant (about 76,000 m^2 for 5 blocks)	Tight (about 2,000 m^2 for 1 blocks)
Unit GFA	151-386 sq.ft. (for rental)	271-684 sq.ft. (for sale)



Impacts Achieved

Improved prefabrication production

Training workers to use the RBIMP for prefabrication production

Impacts Achieved

Improved prefabrication transportation

Training workers to use the RBIMP for prefabrication transportation

Impacts Achieved

Improved on-site assembly

Training workers to use the RBIMP for on-site assembly

Impacts Achieved

Company	Causal Elements (Average Value)	Previous Performances	Enhanced Performances
Prefabrication Production	Production cycle	10 days	6 days
	Working-in-Process (WIP) inventory	110 sets	98 sets
	Time length for locating a component	7-8 minutes	5-6 minutes
	Paper work	200-300 sheets of A4-sized paper per day	110-140 sheets of A4-sized paper per day
Prefabrication Transportation	Paper work	5 sheets of A4-sized paper per car	3 sheets of A4-sized paper per car
	Waiting time for delivery	2 hours	1.5 hours
	Time used for order picking	2 hours per car	1.2 hours per car
On-site Assembly	Time length for locating a component	6-7 minutes	3-4 minutes
	Accuracy rate of on-site assembly	99.85%	100%
	Time used for recording the installation of a wing	30 minutes	16 minutes

Impacts Achieved

Feedback from end-users

- HA (Client)

✓ …we are now able to track and trace through an *n*-dimensional BIM approach, which can reflect real-time situations…
✓ …with our concerted efforts on making the building industry greener, safer, and with better productivity…

- WHS (Factory)

✓ By adopting the RFID technology, prefabrication components are converted into smart construction objects.

- YY (Logistics)

✓ By using the PTS (*one subsystem*), the transportation planning and scheduling of our company are facilitated, as the real-time data and status could be obtained.

- GCL (Contractor)

✓ The OAS (*another subsystem*) enables us (the contractor) to perform real-time monitoring… with smartphone by a few simple commands.
✓ Data input is faster than traditional methods…