A Preliminary Case Study on Circular Economy in Taiwan’s Construction

Yun-Tsui Chang & Shang-Hsien Hsieh
Department of Civil Engineering, National Taiwan University
Introduction—basic information of Taiwan’s construction

• Taiwan is an island country populated by 23 millions people with the total land area as 36 thousands km$^2$
• Every year there is about 25 thousands buildings being built with the total floor area as 30 millions m$^2$
• Every year there is about 2.5 thousands buildings being demolished with the total floor area as 2 millions m$^2$
• Around 70% of floor area of new building projects are built with RC structure
• Around 20% of total construction waste is recycled

picture of capital city in Taiwan- Taipei
Introduction—recent trends of Taiwan’s construction

- In 2008, first BIM project has been constructed in Taiwan
- In 2013, Taipei city has established BIM system
- In 2017, Taiwan central government has set BIM Implementation Roadmap
  - In 2017, Taiwan central government has included Circular Economy into new Industrial Innovation Plan
  - In 2018, Taipei city has released implementation plan for Circular Taipei
  - In 2018, first circular building has been constructed
Introduction - Research Questions

- What is the current awareness, challenges and enablers for CE in Taiwan’s construction?
- What is the current adoption, limitations and potentials of BIM applications for CE in Taiwan’s construction?
Literature Review - CE in Construction
Literature Review - BIM for Circular buildings

BIM uses
- design authoring
- design review
- phase planning
- quantity takeoff
- engineering analysis

Circular Economy (CE) aspect
- deconstruction
- reuse of component

End of use
- design for standardization
- design for flexibility
- design out of waste
- eco-design principle

In use
- minimal maintenance
- adaptability & flexibility
- easy repair & upgradation
- take back scheme

Construction
- prefabrication
- minimize waste
- procure reused materials

Maintenance scheduling
- space management
- asset management

3D coordination
- digital fabrication
- phase planning
- quantity take-off

SBE19 Brussels - BAM: CIRCPATH

05-07 February 2019

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 642389.
Methodology - Interview & Case study

Part 1. Awareness, challenges, enablers of CE in Taiwan’s construction

1. What is your understanding of CE in construction?
2. What is the current awareness of construction industry towards CE? (Please share your view towards different stakeholders, e.g. clients, designers, contractors, manufacturers, government)
3. What are the current challenges and future potentials for CE in Taiwan’s construction? (Please share your view towards three aspects, i.e. technical, financial, organizational)

Part 2. Adoption, limitations and potentials of BIM application for CE in Taiwan’s construction

1. Which BIM uses have been adopted in your project? (e.g. design authoring, design review, cost estimation, phase planning, performance analysis, code validation, etc.)
2. What are the benefits of BIM application for circular buildings in your project?
3. What are the limitations and potentials of BIM application for circular buildings in your project?
Result- 3 Pilot Projects

- Project A: pavilion (private)
  - Phase: constructed, to be destructed
  - Size: small (SC structure)
  - Interviewee: architect (junior)
- Project B: housing (private)
  - Phase: designed, to be constructed
  - Size: medium (SC structure)
  - Interviewee: architect (senior)
- Project C: housing (public)
  - Phase: designed, to be constructed
  - Size: large (SC structure)
  - Interviewee: architect (senior)
Result - Project A

- CE in construction
  - Understanding: BAMB (material passport & modular design), C2C, product service (lighting)
  - Awareness: high for government, low for manufacturers
  - Challenges: lack of incentives for manufacturers
  - Enablers: green purchase of government
Result- Project A

- BIM for CE in construction
  - Adoption: design review, quantity take-off (material passport)
  - Benefit: information management of building components
  - Limitation: incomplete label information for material passport
  - Potential: phase planning for demolition
Result - Project B

- CE in construction
  - Understanding: BAMB (material passport & modular design), resource management (urban agriculture), sharing economy (cohousing)
  - Awareness: high for government, low for manufacturers
  - Challenges: lack of incentives for manufacturers
  - Enablers: financial incentives by government, platform for material exchange
Result - Project B

- BIM for CE in construction
  - Adoption: design authoring, design review, quantity take-off (material passport), engineering analysis (energy)
  - Benefit: information management of building components
  - Limitation: unclear relevant information for material passport
  - Potential: engineering analysis for building circularity
Result - Project C

- CE in construction
  - Understanding: BAMB (material passport & modular design), product service (electronics, furniture), sharing economy (coworking)
  - Awareness: high for government
  - Challenges: barriers by existing regulation for public building
  - Enablers: new policy and regulation
Result- Project C

- BIM for CE in construction
  - Adoption: design authoring, design review, quantity take-off (material passport), phase planning (construction)
  - Benefit: information management of building components, construction management
  - Limitation: unclear relevant information for material passport
  - Potential: facility management
Conclusion

• CE in construction
  - Understanding: BAMB (material passport & modular design), product service, sharing economy
  - Awareness: high for government, low for manufacturers
  - Challenges: lack of incentives for manufacturers, barrier by existing regulation
  - Enablers: financial incentives by government, new policy and regulation, platform for material exchange
Conclusion

- BIM for CE in construction
  - Adoption: design authoring, design review, quantity take-off (material passport), phase planning (construction), engineering analysis (energy)
  - Benefit: information management of building components
  - Limitation: unclear relevant information for material passport
  - Potential: engineering analysis for building circularity, phasing planning for demolition
Future Work

• More interviews to be carried out with other stakeholders (e.g. manufacturers)

• Comprehensive survey over construction industry sector

• BIM for material passport
• BIM for building circularity assessment
• BIM for circular building design
THANKS FOR YOUR ATTENTION ANY QUESTIONS?