

Thriving in a Circular Economy

RT-380 | Drs. Fernanda Leite and Mark Sanders, **The University of Texas at Austin**
Drs. Carl Haas and Olaf Weber, **University of Waterloo**
Scott Beckman, **PCL**
Sarah Drumming, **Smithsonian Institution**



Webinar Objectives

- Define Circular Economy and related concepts
- Understand potential benefits of Circular Economy to capital projects industry
- Learn how other companies in the built environment are adopting circularity
- Engage prospective team members to RT-380



RT-380 Initial Team Members

Preliminary Industry Representatives:

Scott Beckman, PCL
Sarah Drumming, Smithsonian Institution
Nancy Kralik, Fluor

We are currently accepting industry members for team kickoff this Fall

The University of Texas at Austin:

Dr. Fernanda Leite, Civil Engineering
Dr. Mark Sanders, Circular Economy Lead, Austin Technology Incubator
Beatriz Guerra, Ph.D. student

University of Waterloo:

Dr. Carl Haas, Civil Engineering
Dr. Olaf Weber, Sustainable Finance
Aida Mollaei, Ph.D. student
Nathalie Skaf, M. Eng. student
Sheida Shahi, Ph.D. student



Circular Economy Primer



“Adopting circular economy principles could significantly enhance global construction industry productivity, saving at least US \$100 billion a year.”

- World Economic Forum, 2016



Construction & Demolition Waste

- **569 millions tons** of construction and demolition (C&D) waste was produced in the U.S. in 2017 ^[1]
- Around **40%** of this C&D waste is reused, recycled, or sent to waste to energy facilities ^[2]



Construction and demolition debris generation ^[5]



Resource Consumption

- Today's economy relies on a “**fast turnover**” principle due to an abundance of cheap natural resources [3]
- **95%** of the value of virgin materials is lost after one use cycle* [3]
- The engineering and construction industry consumes more than **3 billion tonnes of raw materials annually** [3]
- Some resources, such as **aggregate, sand, and water** are becoming depleted in certain areas



Johor's Forest City under construction [6]



Resource Consumption

- Raw materials consumption is set to **double by 2060** [4]
- **50%** of the global urban infrastructure needed in 2050, has not been built yet [3]
- It is becoming ever more critical to find alternative means of sourcing and using materials

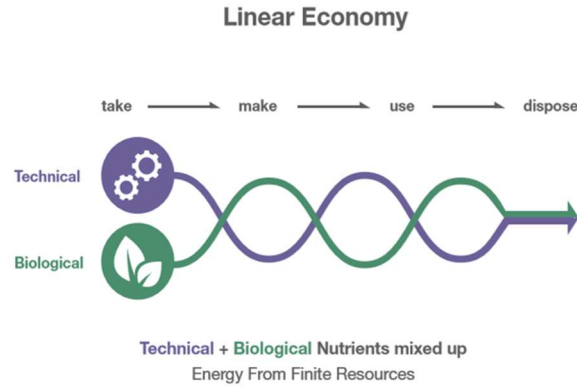


Ekati Diamond Mining, North-West Territories, Canada [7]



Linear Economy

- Economic growth has been tied to a **linear** consumption of finite resources
- Materials are sourced, used and finally disposed of as waste
- Known as "take-make-use-dispose"

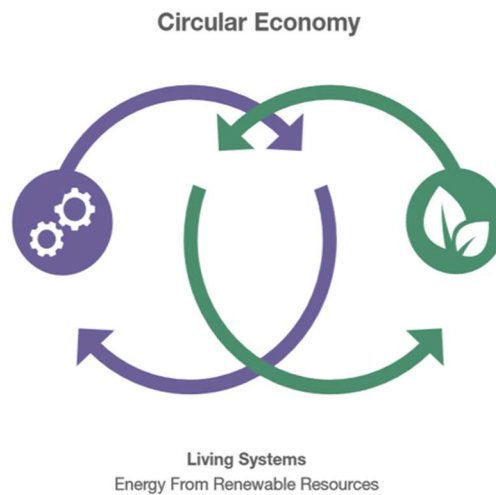


The Linear Economic Model [8]



Circular Economy

- **Circular Economy** decouples growth from resource consumption
- Circular Economy maintains components and their materials at the highest value as long as possible



The Circular Economic Model [8]



Circular Economy Benefits for Capital Projects Industry

- Preserved and enhanced natural capital
- Optimized renewable resources
- Waste prevention
- Materials, products, and components kept in repetitive loops
- Resources with highest intrinsic value

(Acaroglu, 2019)



Circular Economy Model [9]



Research Objectives/Plan



RT-380 – Research Objectives

- Understand the opportunities and value of implementing circular economy principles in capital projects industry
- Highlight changes required to business models to maximize the value of shifting to a circular economy paradigm

Project **goal** in a nutshell... ***“Develop knowledge and tools for CII members so that they can take advantage of opportunities, effective value propositions, and key business models for driving a circular economy in capital projects”***

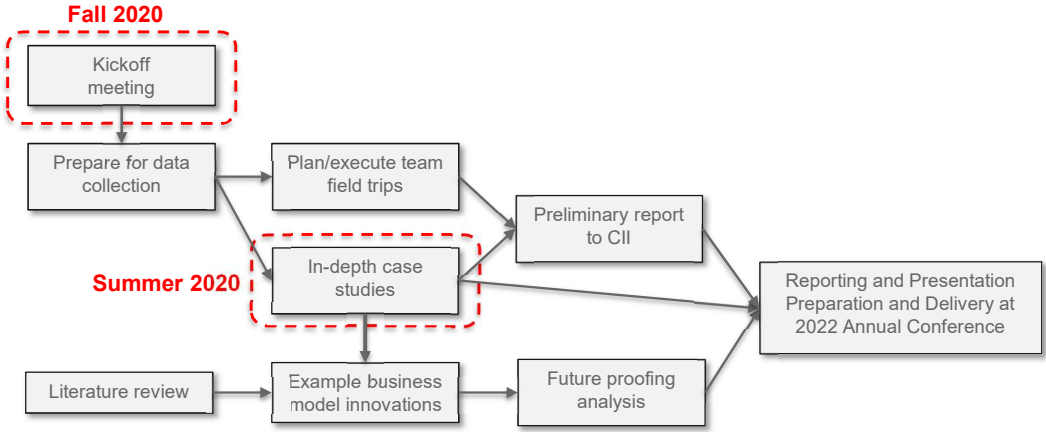


RT-380 – Relevance/Value

- Following the recommendations and guidelines provided in this research will enable innovations in business models of capital projects industry towards a sustainable circular economy
- Anticipating and preparing for future resource challenges will help build resilience in the capital projects industry
- Dependency on new materials will be minimized while value will be created through business models innovations



RT-380 – Research Approach



Preliminary Findings

State of Circular Economy in the Built Environment



Preliminary Global Scan

- Overview of **81 companies**
- According to:
 - 7 Business types
 - 9 Major Circular Economy business models
 - Continent
 - Size
 - Age



Image Sources:
<https://www.fujitsu.com/lu/about/resources/case-studies/cs-2017mar-h-b-fuller.html>
<https://reviews.canadastop100.com/top-employer-crh-canada-group>
<https://www.macrebur.com/>



Circularity Examples



Building Life Cycle + Circularity

Design

ALICE Technologies

Design Optimization
Software

Operate

PHILIPS

Lighting-as-
a-Service

Disassembly

AMP Robotics

C&D Waste
Recycling



Build

KATERRA
Modular
Construction

Maintain

KONE
Predictive
Maintenance
with AI



Alice [Design]

“ALICE, an AI assistant, can analyze millions of construction scenarios and arrive at the optimal solution”

Circular Economy Parameters

- Waste Minimization
- Design for Disassembly
- Circular Materials Optimization



Alice Technologies [10]

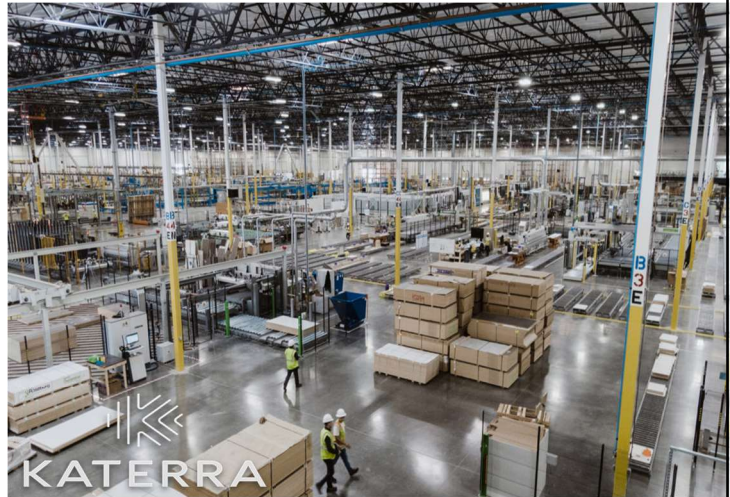


Katerra [Build]

Shifting increased levels of labor and finishing work into factories rather than the jobsite supports faster speed to market, consistent quality, and reduced waste.

Off-Site Construction and Modularity:

- Waste Reduction
- Greater Quality Control
- Circular Material Selection
 - Cross-Laminated Timber (CLT)



Manufacturing Offsite: Growing our U.S. Capabilities to Serve New Markets [11]



Philips [Operate]

Philips designed Light-as-a-Service (LaaS), a lighting solution that delivers instant energy savings with no upfront investment, a one-stop shop for performance, operations, maintenance and financing.

- Easy maintenance
- Traceability
- Disassembly
- Reuse & Recycling



Philips' light-as-a-service offering [12]



Kone [Maintain]

KONE will use the IBM Watson IoT system to analyze sensor data to help predict, identify and resolve issues, even before equipment breaks.

- Extended Life
- Repair vs Replace



Lifts and Escalators [13]



AMP Robotics [Disassembly]

AMP Robotics provides around the clock 24/7 operation, maximizing facilities to recover tons of material in an hour

- Separation for Reuse, Recycling, & Upcycling
 - Metals
 - Asphalt & Concrete
 - Gypsum
 - Plastic
 - Wood



AMP Robotics [14]



Reflection from Peers

Sarah Drumming, Assistant Director of Smithsonian Institution, National Museum of African American History & Culture Office of Facilities Planning & Business Programs, Smithsonian Institution

Scott Beckman, Director of Sustainability, PCL Construction

- Relevance of Circular Economy to our business
- Why are your organizations interested in being part of RT-380?



Key Lessons and Next Steps

UNDERSTAND VALUE	HIGHLIGHT CHANGES	DEVELOP TOOLS
Opportunities and value in implementing Circular Economy in the Capital Projects industry	Adaptation of business models to maximize value of shifting to a circular economy paradigm	Develop knowledge and tools to help CII member companies future-proof the capital projects industry via circularity

Join RT-380 and help shape the future of our industry!



Thank you!



CII *Changing How
the World Builds*