UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

PRECAST CONCRETE BUILDING CONSTRUCTION PROCESS COMPARISON

Tian Xiaosheng, Graduate Student, Civil and Environmental Engineering Dept., University of Alberta, Canada, xtian4@ualbert

Farook Hamzeh, Associate Professor, Civil and Environmental Engineering Dept., University of Alberta, Canada, hamzeh@ualber

Agenda:

- Introduction
- Methodology
- Results
- Conclusions

Introduction

- Previous research applied Lean thinking to improve production to solve the common problems.

Long lead times

Jumbled flow

Process waste


(0311xue.com，2019)

- Seldom research focuses on comparing process status of PC construction between developing countries and developed countries.

UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

Methodology
Case study analysis

"How" and "Why" process differences occur in selected cases

Case selection → Cases analysis using VSM → Conclusion

- Multifamily PC projects
- Accessible information
- Local typical implementation methods

Current state map → Comparison → Future state map → Ideal state map

UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

CURRENT STATE MAPPING OF CASE 1.

Case 1

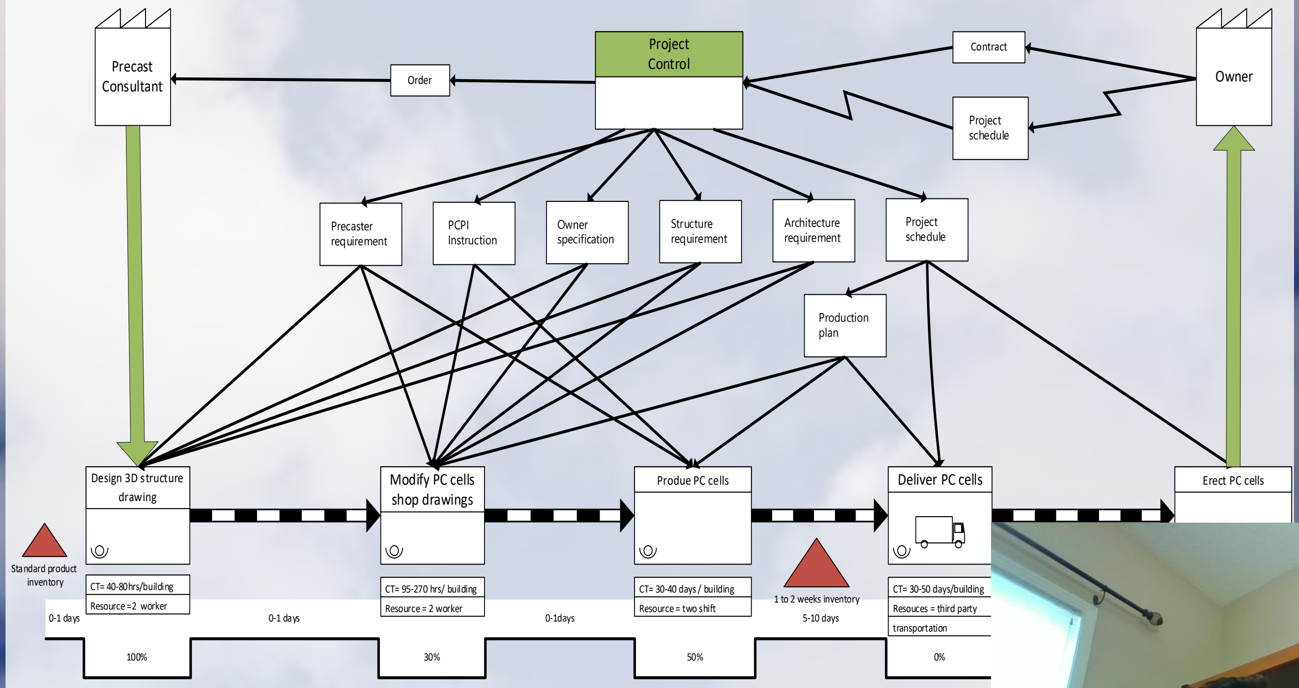
Location: Alberta, Canada

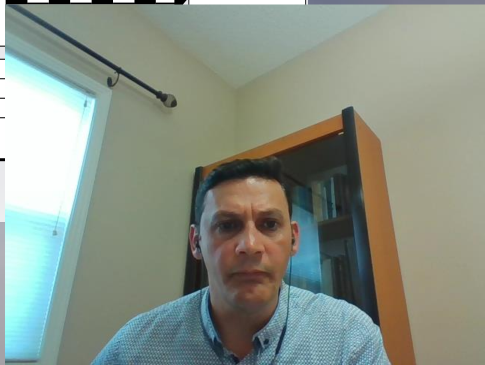
Project type: 6 story multifamily building

Precast concrete supplier (PS): Local large company

PS's scope of work : design, produce, delivery, erection

Use 3D modeling in Design

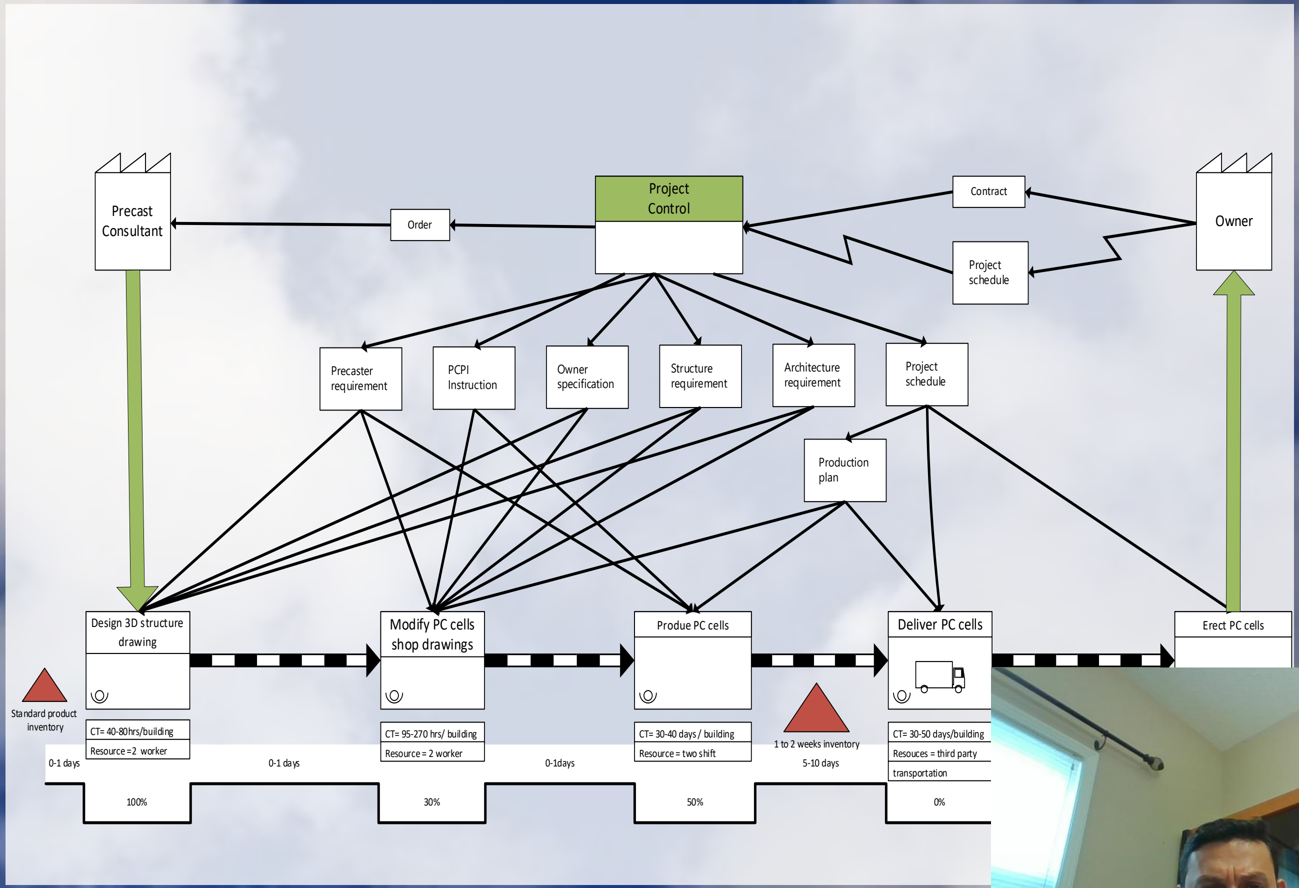


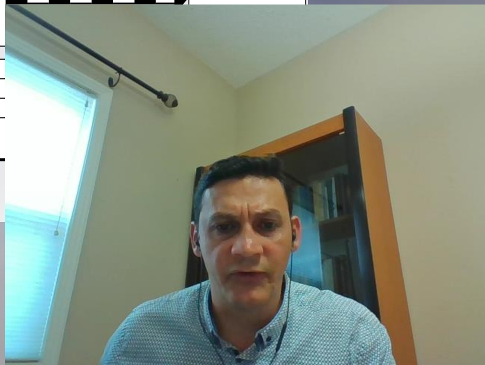


CURRENT STATE MAPPING OF CASE 1.

Current problems:

- Extra shop drawing modification ranges from 5 minutes to 1.5 hours was needed to modify each drawing.
- The lead time between the production and delivery could be 1 to 2 weeks.
- The lead time before erection was one-month long, which was caused by the slow production rate and the fast erection rate





Current state mapping of Case 2.

Case 2

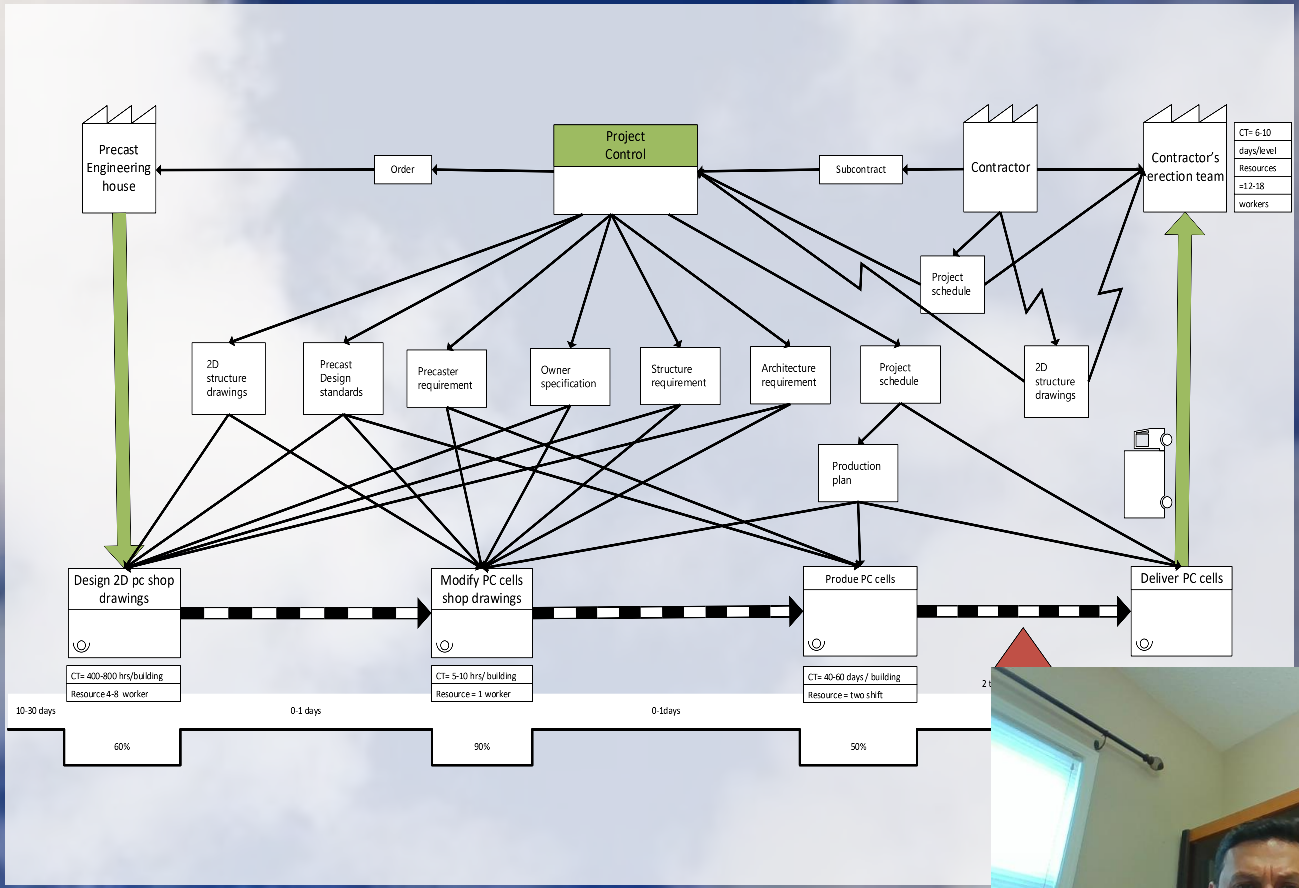
Location: Beijing, China

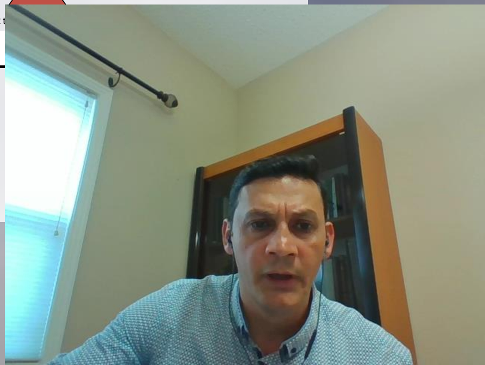
Project type: 12 story multifamily building

Precast concrete supplier (PS): Local large company

PS is subcontractor

PS's scope of work : design (2D drawings), produce, delivery





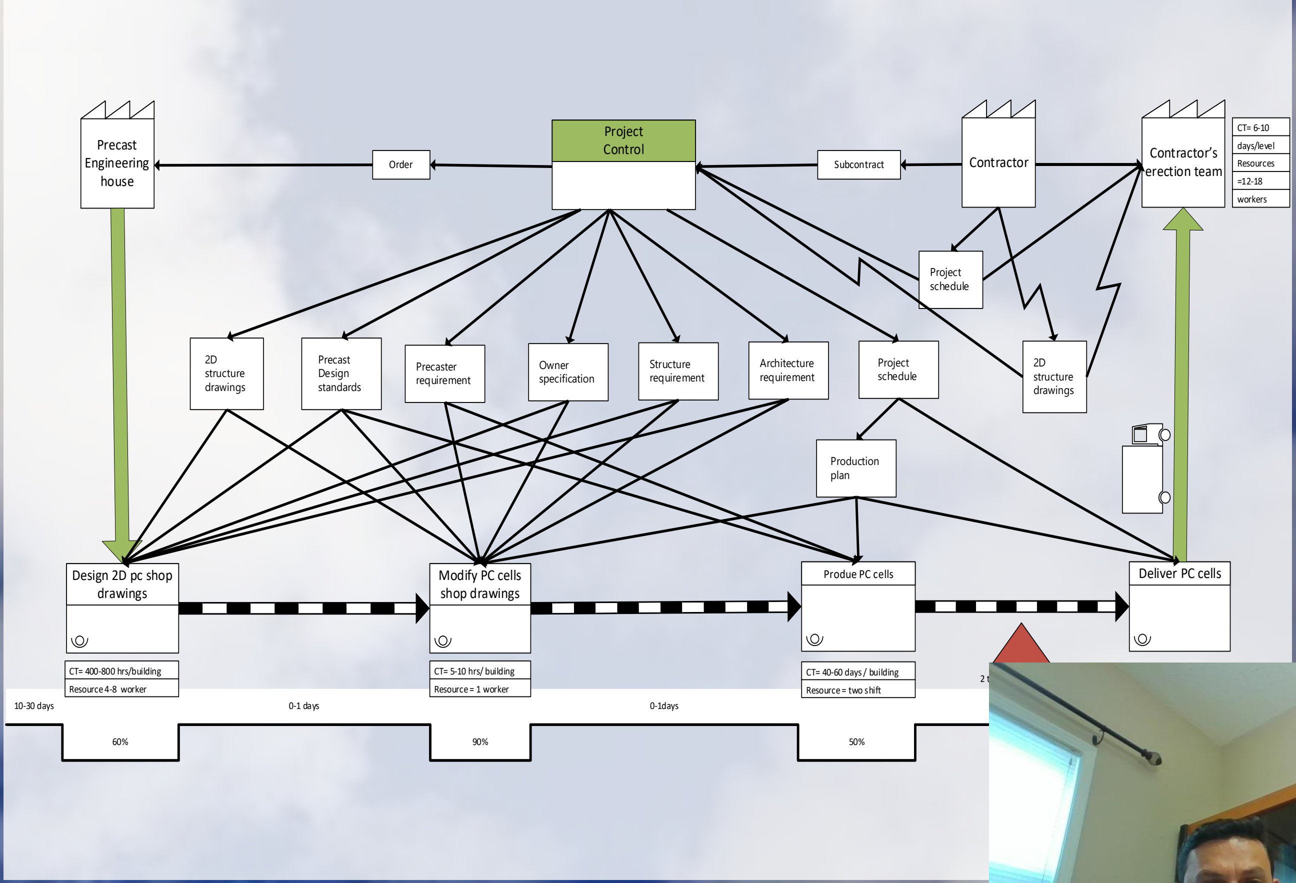
UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

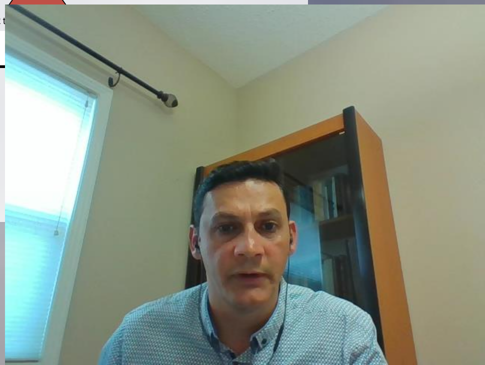
IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

Current state mapping of Case 2.

Current problems:

- Long lead times before the start of shop drawings caused by the subcontract agreement.
- Long shop drawing design duration caused by traditional 2D-drawings.
- 2- 8 hrs. per drawing
- The complex connection method increased the erection duration.



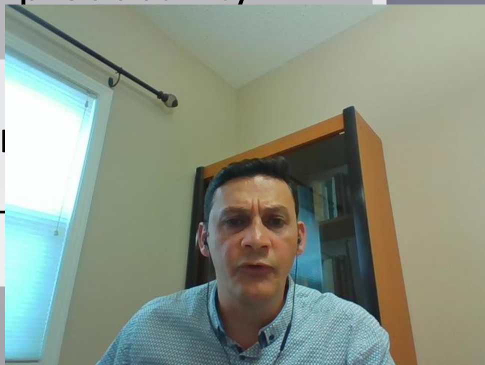


UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

Comparison of the Current State Processes

Case	Case 1 in Alberta, Canada	Case 2 in Beijing, China	Benefit
Involvement time	√ Early	late	Better synergies, less error and rework
Components design	√ More standardized	Less standardized	Shorter lead time, lower cost
Project participation	√ Whole project cycle	Limited project phases	Better synergies and productivity
Engineering design	Third party consultant	√ In-house engineering	Better shop drawi



UNIVERSITY OF ALBERTA

EDMONTON·ALBERTA·CANADA

IGLC 28

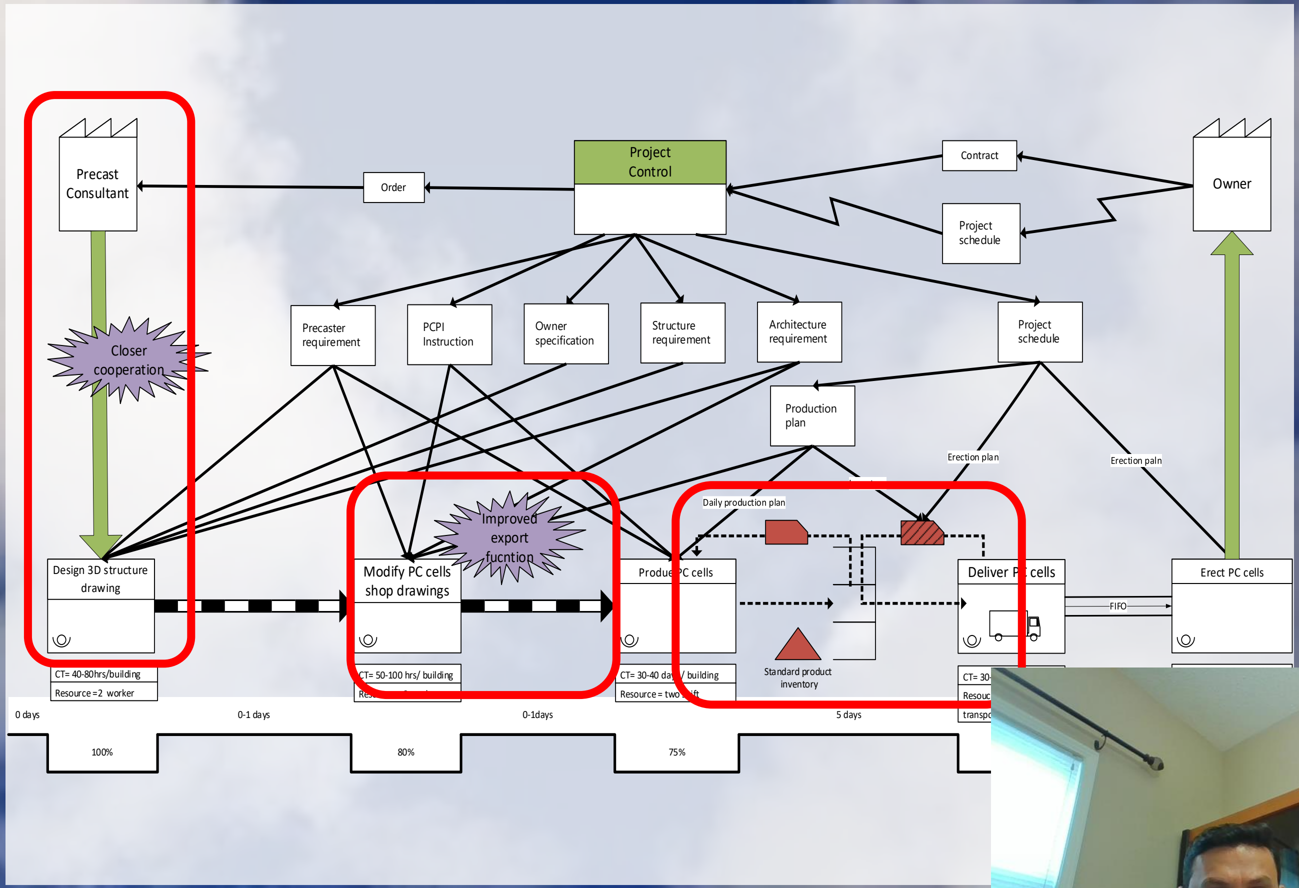
BERKELEY, CA 6-12 JULY 2020

28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

FUTURE STATE MAPPING OF CASE 1.

Kaizens (Improvement suggestions):

- Enhance the cooperation through an inhouse engineering department to improve quality of shop drawings
- Improve the shop drawing export function to reduce modification.
- Introduce a supermarket to
  - Reduce the lead time (duration)
  - Change the push system into a partial pull system



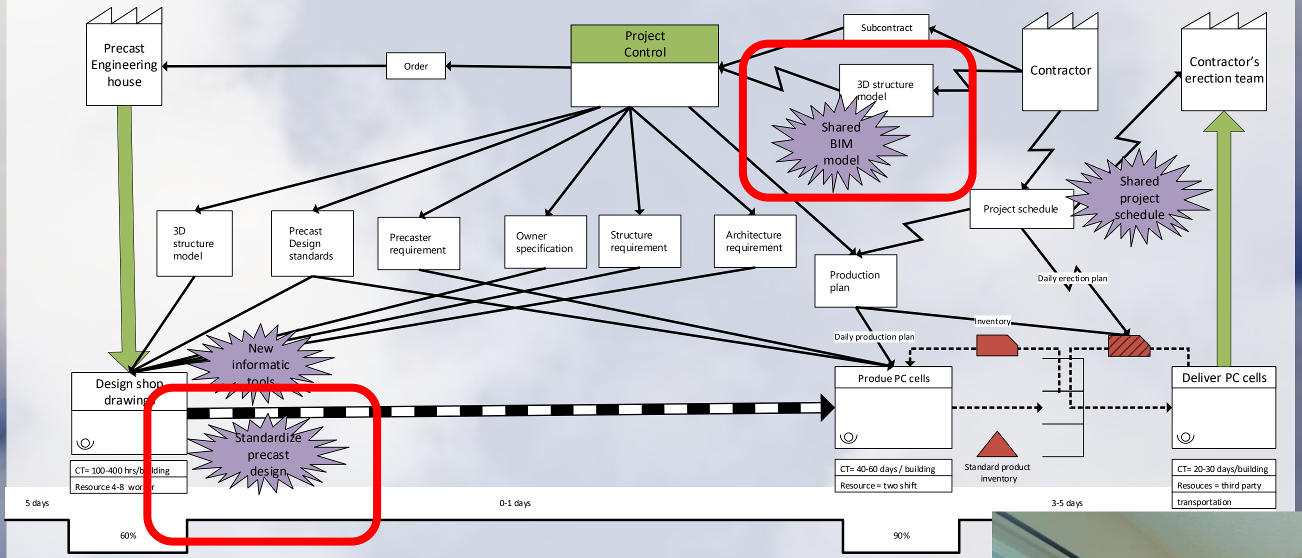
FUTURE STATE MAPPING OF CASE 2.

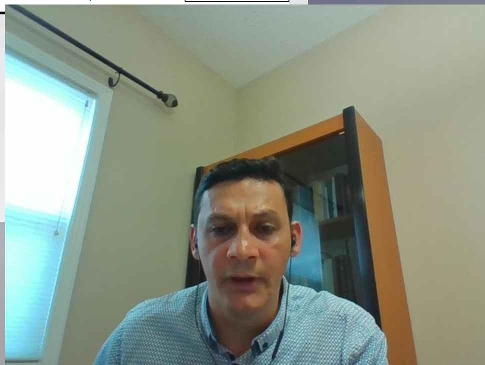
IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

Kaizens (Improvement suggestions):

- Apply BIM to improve the design efficiency.
- The precast supplier should positively participate in the project from early project phase to drive the design.
- Standardize the components design to improve efficiency and reduce cost.

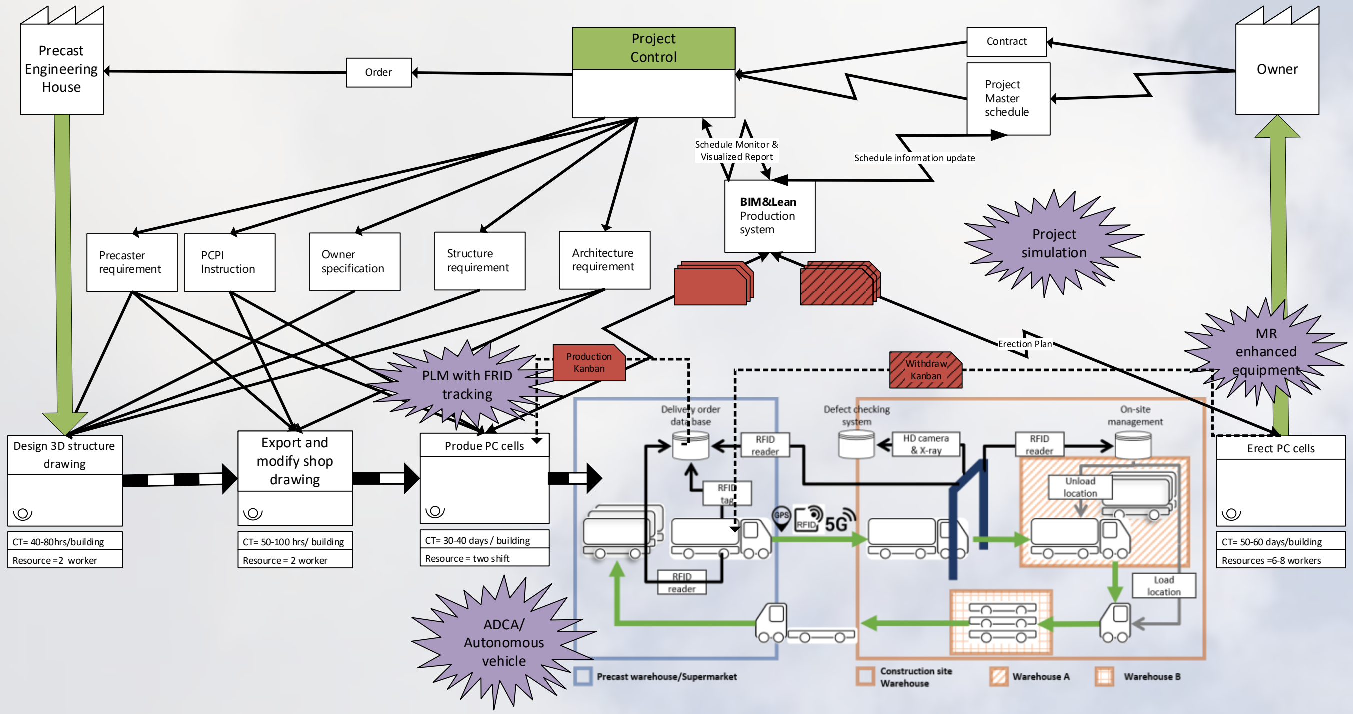


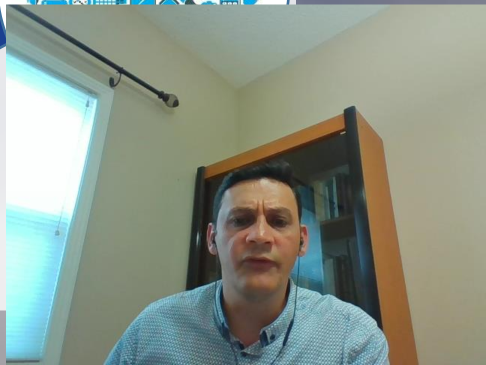


UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

IDEAL STATE MAPPING FOR FUTURE PROJECTS



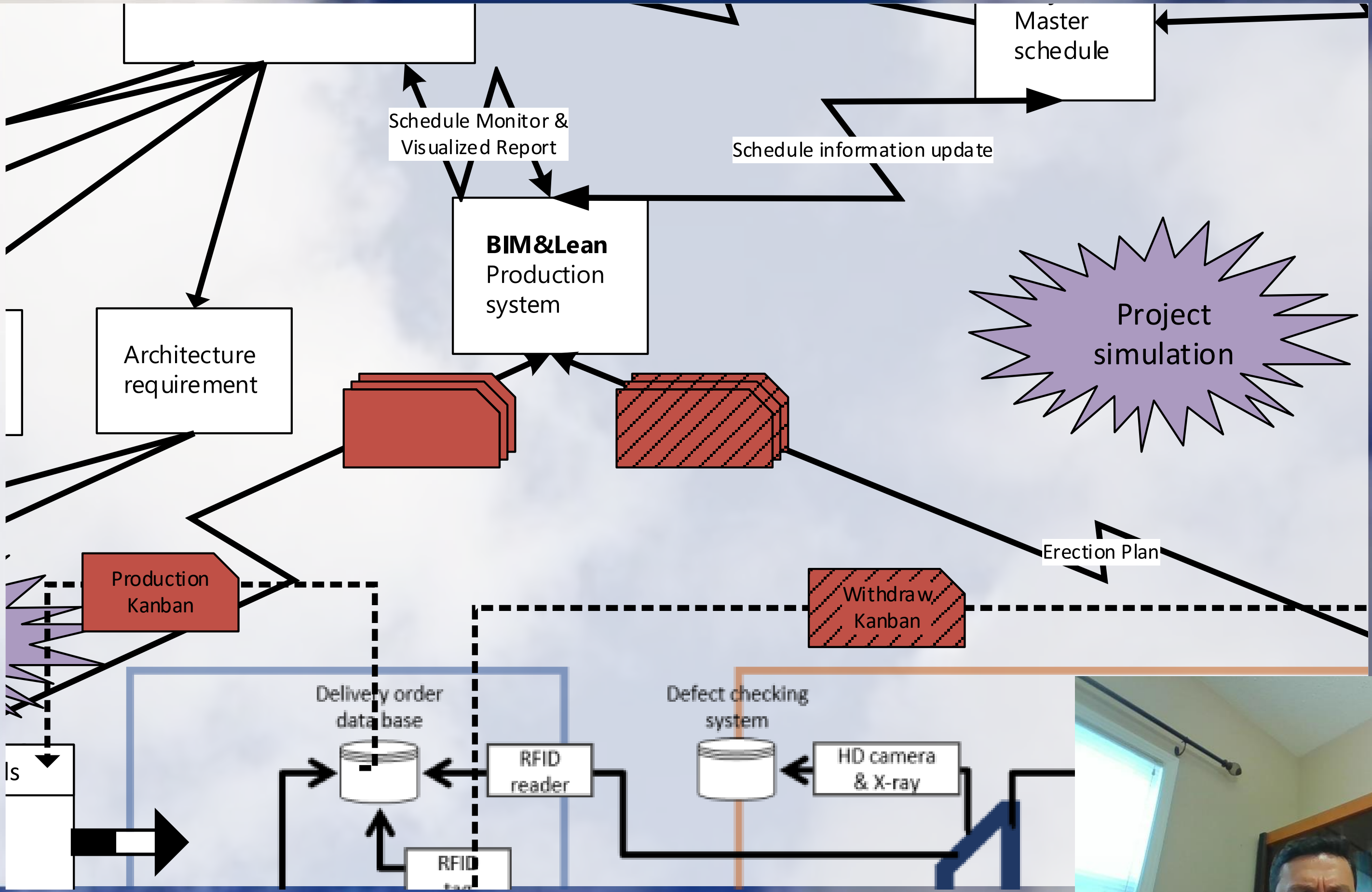


UNIVERSITY OF ALBERTA
EDMONTON · ALBERTA · CANADA

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

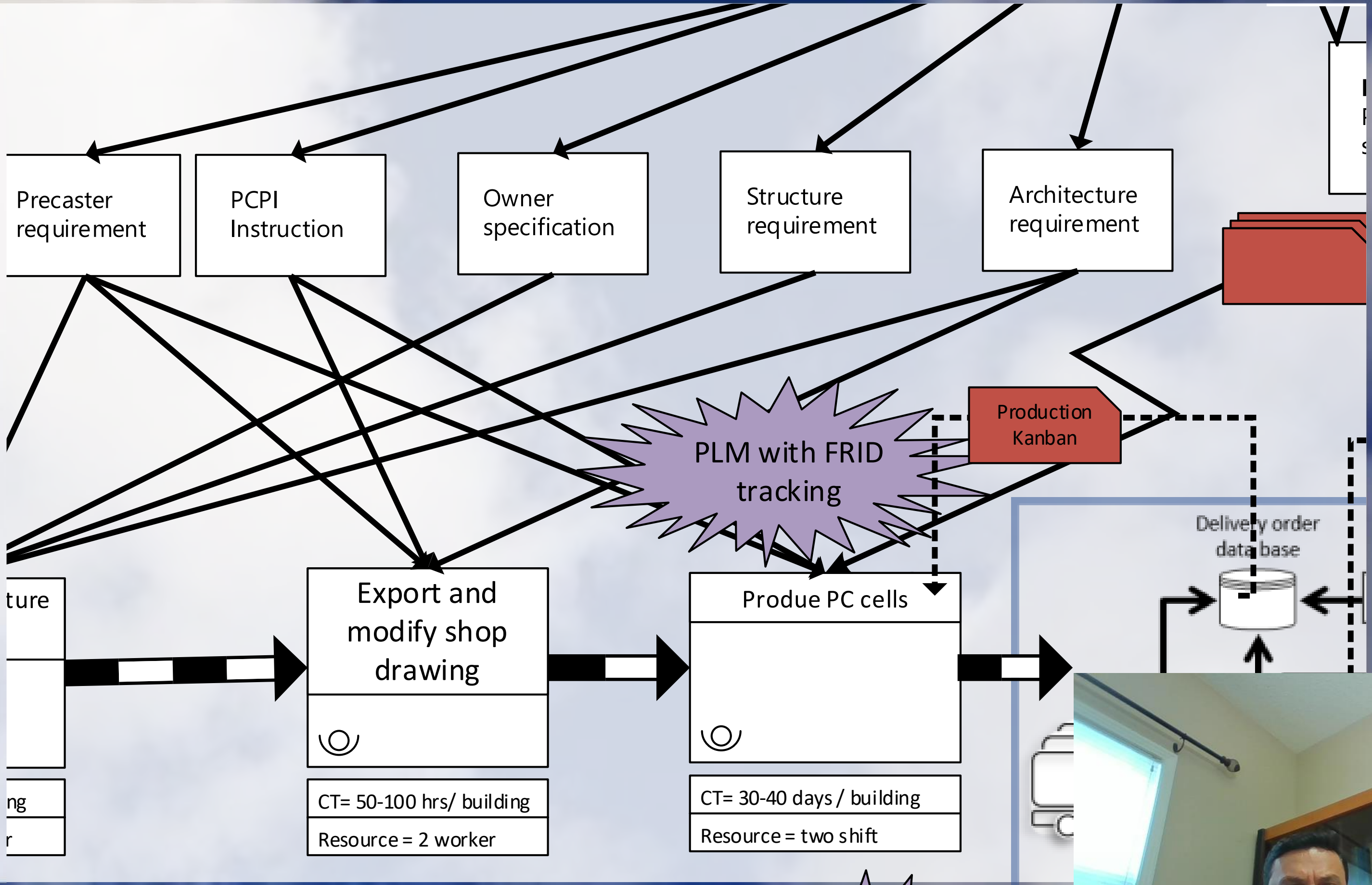
IDEAL STATE MAPPING FOR FUTURE PROJECTS

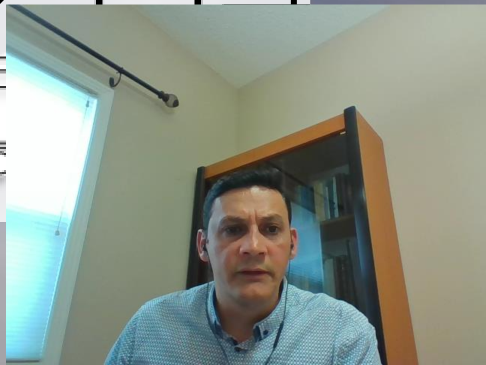
- Kaizens (Improvement suggestions):
  - Combine BIM & Lean to improve production system.
  - Use data driven simulating to inform project duration and cost.



IDEAL STATE MAPPING FOR FUTURE PROJECTS

- Kaizens :
  - Use RFID and other sensors to collect data in the value chain for product lifecycle management.



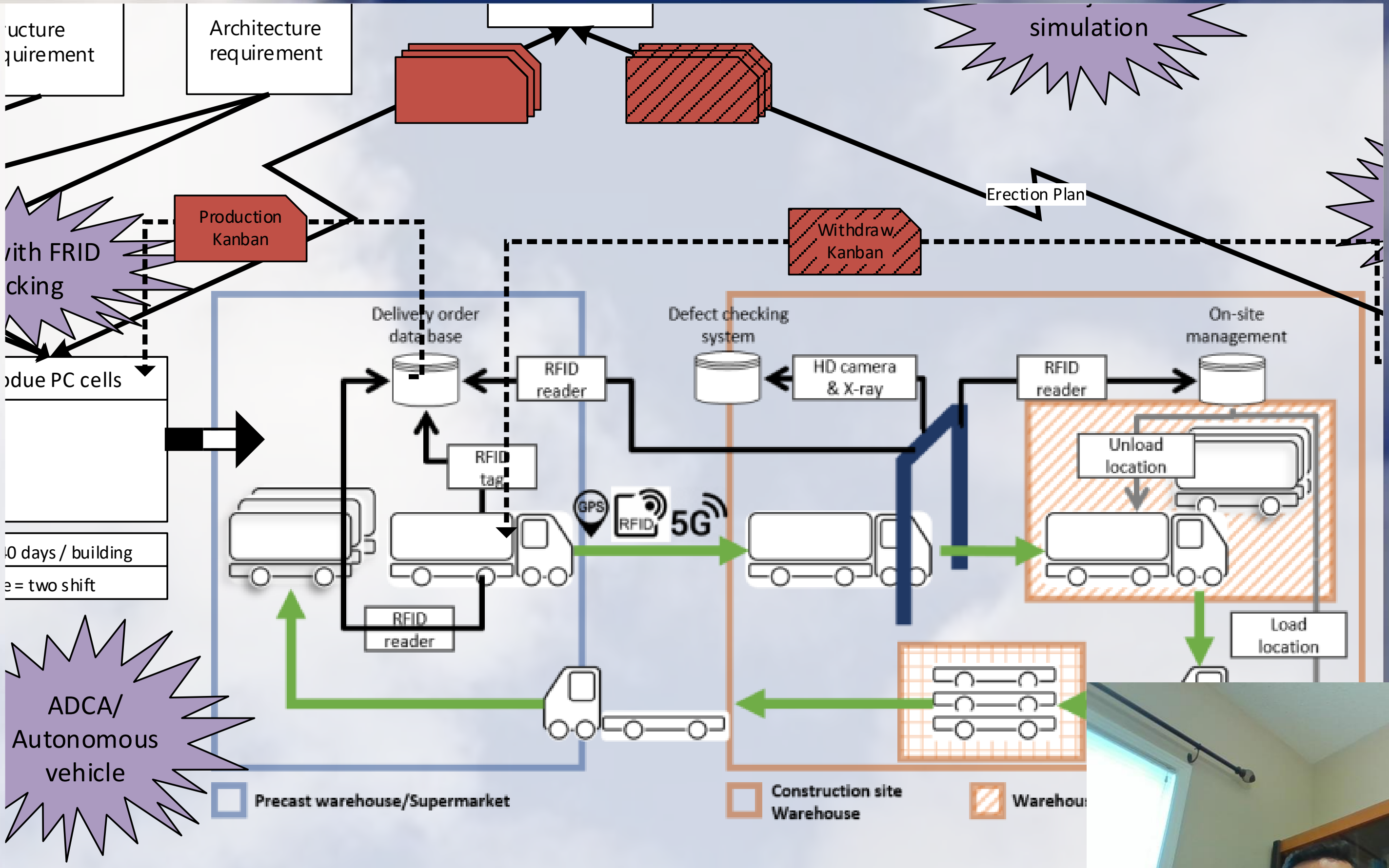


UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

IDEAL STATE MAPPING FOR FUTURE PROJECTS

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

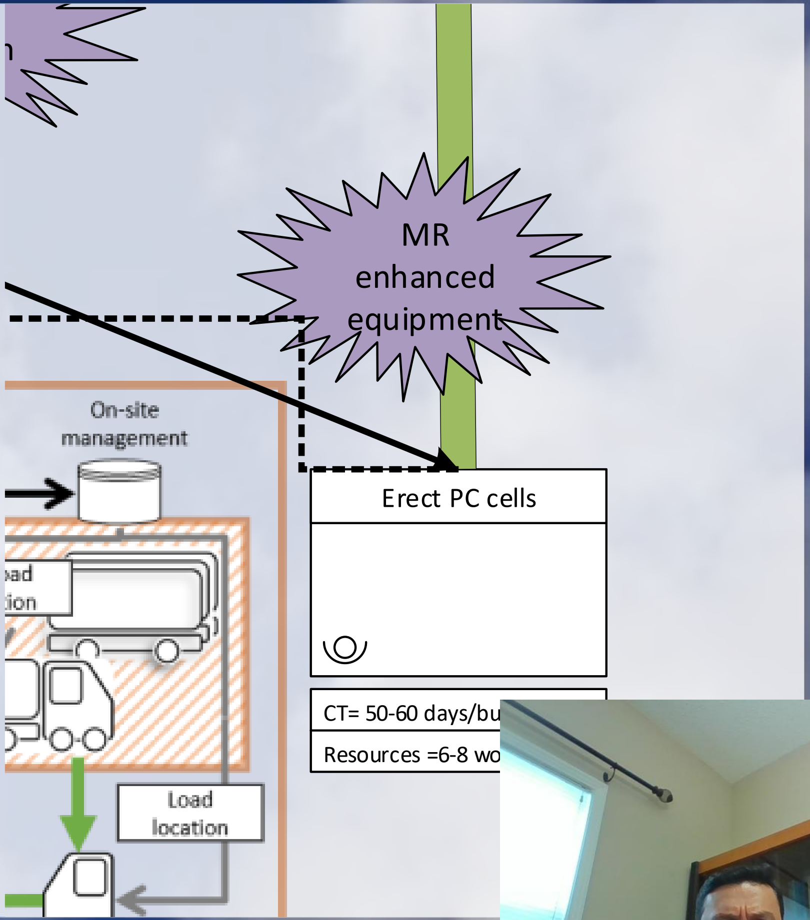
- Kaizens :
  - Use autonomous vehicles to improve logistics
  - An integrated system to utilize technologies in Industry 4.0 to improve the productivity

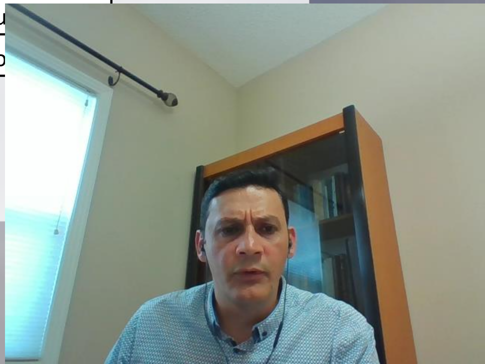


IDEAL STATE MAPPING FOR FUTURE PROJECTS

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

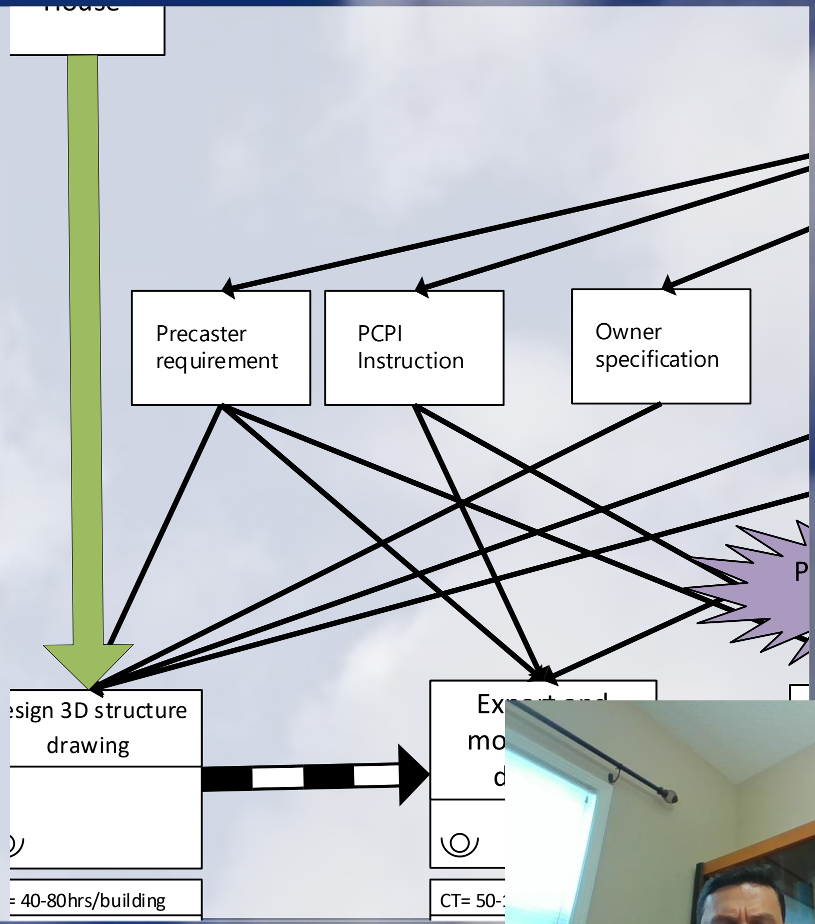
- Kaizens :
  - Use virtual reality (VR) or augmented reality (AR) to educate and assess the workers' skills and improve safety

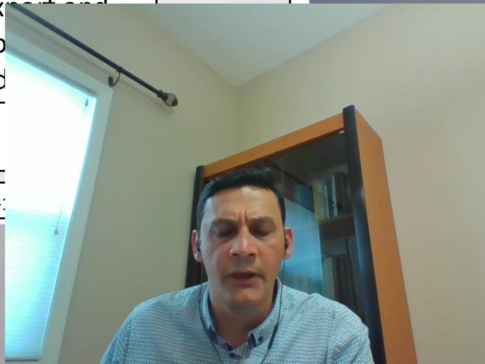




IDEAL STATE MAPPING FOR FUTURE PROJECTS

- Kaizens :
  - Educate students with lean construction concepts can reduce the knowledge barrier as lean experts are critical to the success of lean improvements for the precast supplier.





UNIVERSITY OF ALBERTA
EDMONTON·ALBERTA·CANADA

IGLC 28
BERKELEY, CA 6-12 JULY 2020
28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

Conclusions

- Compared the current processes of the two selected precast construction projects in Canada and China, both have some places for future improvement.
- The project in Canada has less rework, shorter lead time and better productivity because of the earlier PS involvement, application of BIM and higher ratio of standardized precast design.
- The project in China has higher quality of shop drawings because of the in-house engineering capability.
- Enhanced cooperation and improved shop drawing export function are suggested to the Canadian PS to reduce the design duration and shorten the lead time, and applying BIM to design precast elements from the project early phase is the solution for the Chinese PS.
- A comprehensive future state map is proposed for future precast
using a combination of new technologies in industry 4.0.