

# Robotics in Construction

## “Nothing for New Zealand” ?

Armin WERNER  
MINAS LIAROKAPIS  
COLAB23, 21Jun2023

# **Robotics in some of NZ's Key Industries**

# Robots in Agriculture

## Milking Robots

(DeLaval, Lely, BouMatic; 2023)





# Robots in Agriculture

## Weeding Robots

(Naio, 2023)





# Robots in Agriculture

## Harvesting and Planting

(Boston Engineering, 2023; Horsch 2023)

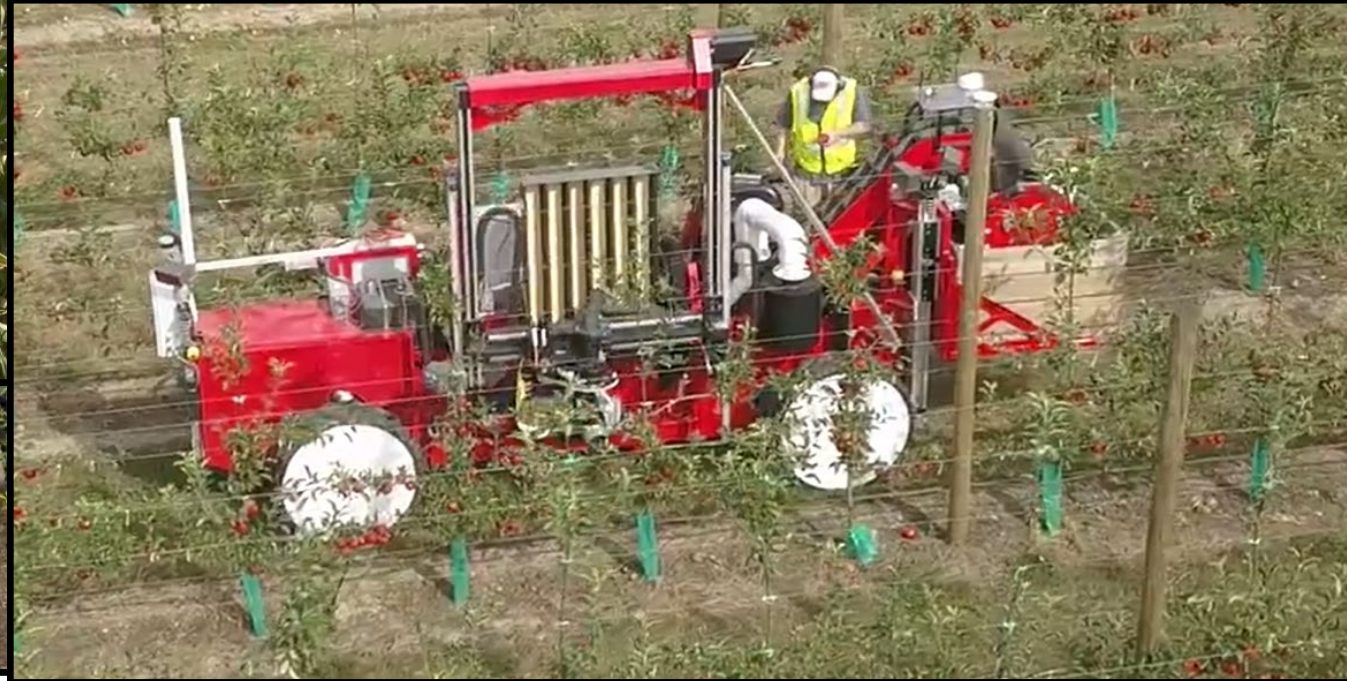




# Robots in Agriculture

## Fruit picking Robots

(Tevel, 2020 ; FF Robotics 2022; Abundant Robotics, 2019)





# Robots in Forestry

➔ Conditional Automation: planting, harvesting  
(Risutech, 2023; John Deere, 2023)





# Robots in Civil Engineering

➔ Conditional Automation: paving; piles for solar panels  
(RPS, 2023; Built Robotics, 2023)





# ***Success Models in Robotics***

- Single Tasks
  - low complexity
  - high accuracy
- Working at Scale
- Making Tasks for People ..
  - less hazardous
  - less monotonous

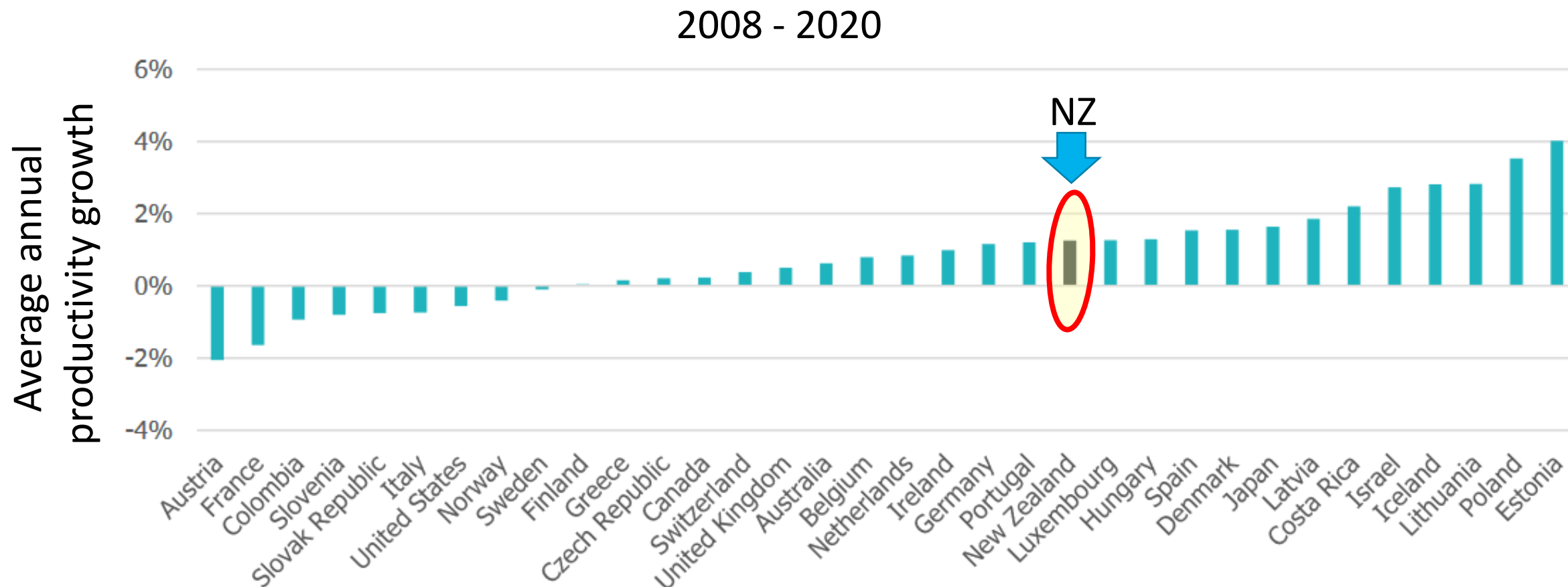
# Robotics in Construction

## *Why?, What for?*



# Growth in New Zealand's construction labour productivity

Te Waihangā – NZ Infrastructure Commission (2022)



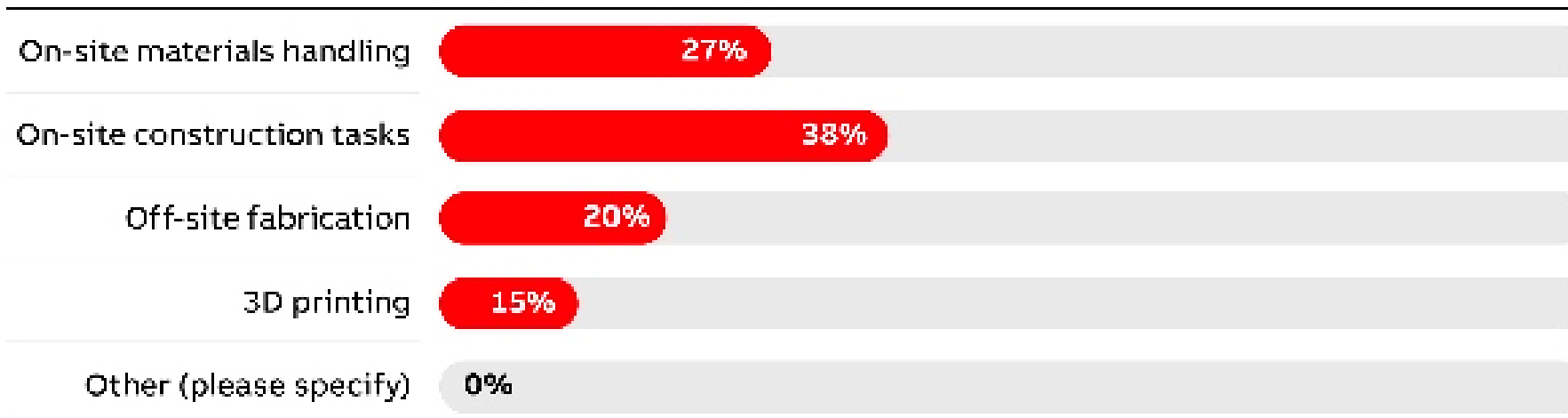
# ABB Robotics 2021 Construction Survey

Surveyed 1,900 small and large construction businesses in 10 countries (North America, Europe, China)  
[41% residential construction, 27% commercial construction]

## *Expectations about the Future in Construction*

- 44% struggle to recruit for construction jobs
- 90% expect skill shortage crisis by 2030
- 81% will introduce robots in the next 10 years

## *Intended use of robots*





# Robotics in Construction

## *On-Site*

# On-site autonomous construction robots

Automated mature technologies used for *site preparation*

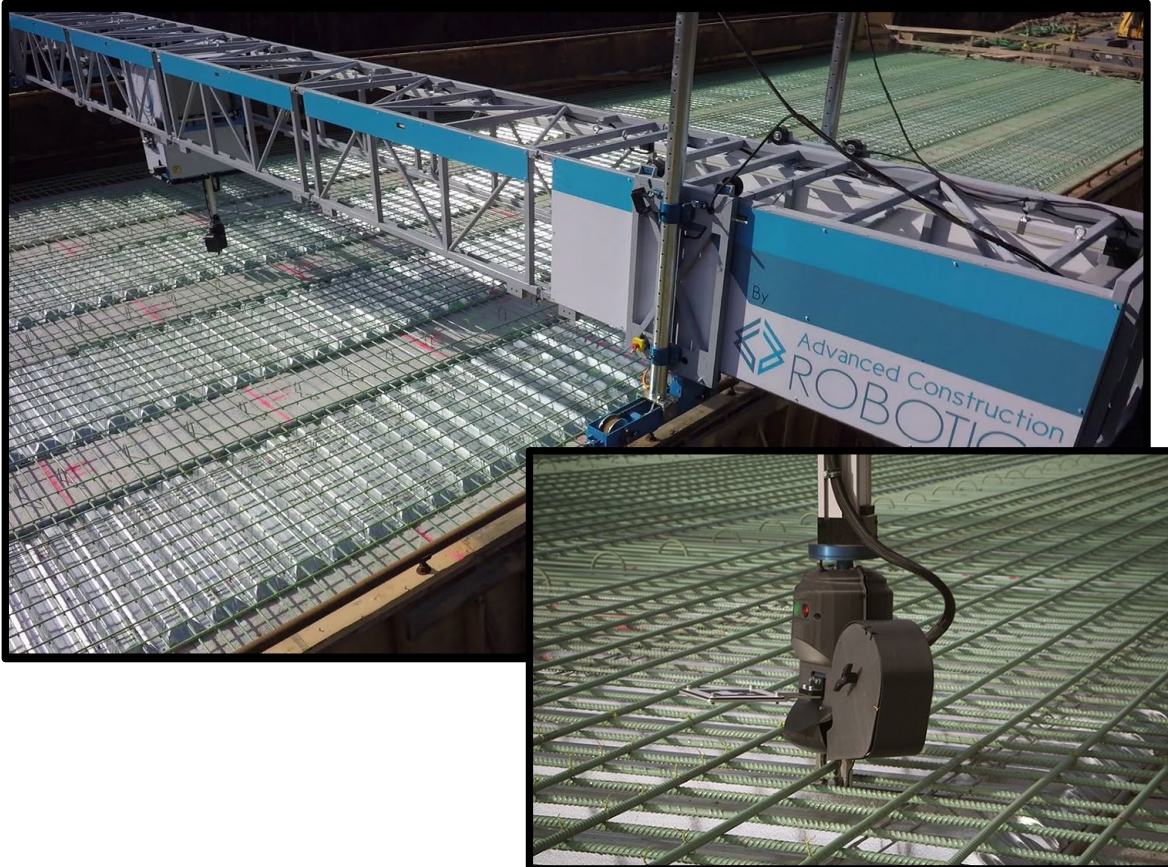




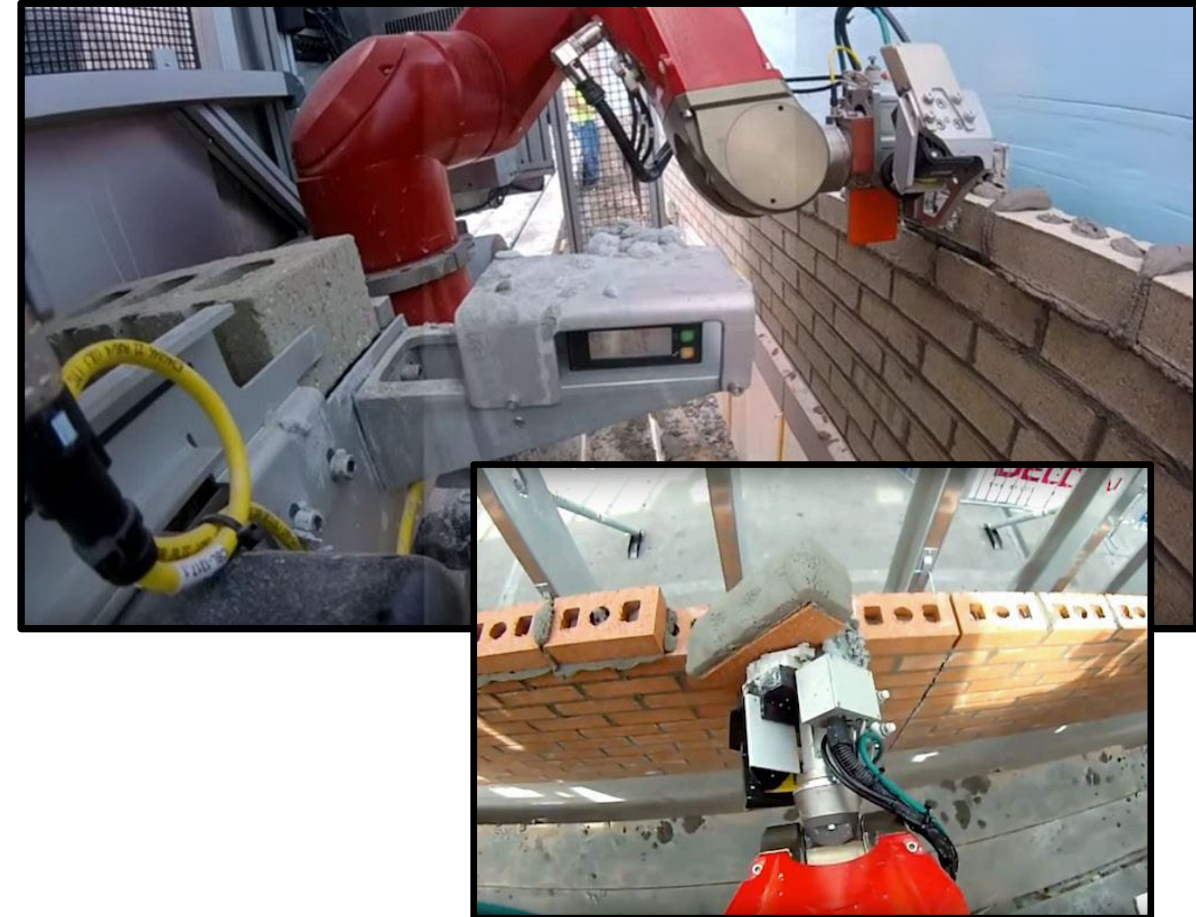
# On-site construction robots

Various Robots in replacing manual labour

**TyBot** (autonomous, USA)



**SAM** (Semi Automated Mason, USA)





# On-site construction robots

## Brick Laying Robots

**Hadrian** (autonomous, AU)



**Mule135** (assistive, USA)



# On-site construction robots

## Various Robots in supporting manual labour

**Jaibot** (supervised)  
(overhead drilling robot; Hilti, CH)



**FieldPrinter** (supervised, CH)  
(layout lines, components; Dusty Robotics; USA)





# Wall painting Robots

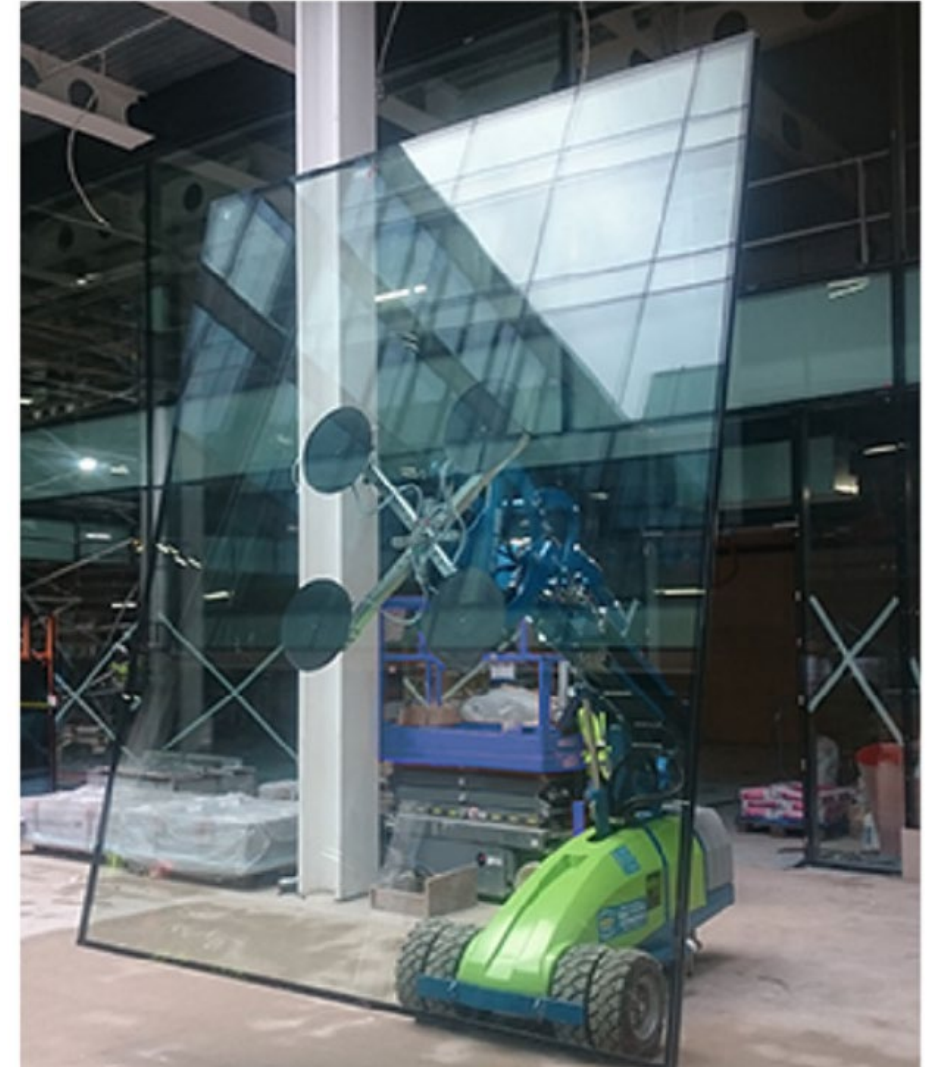
*Paco* (France)





# Rapidly deployable robots

**People Support** & Transporting of *building elements*



# Robots for heavy lifting in large areas

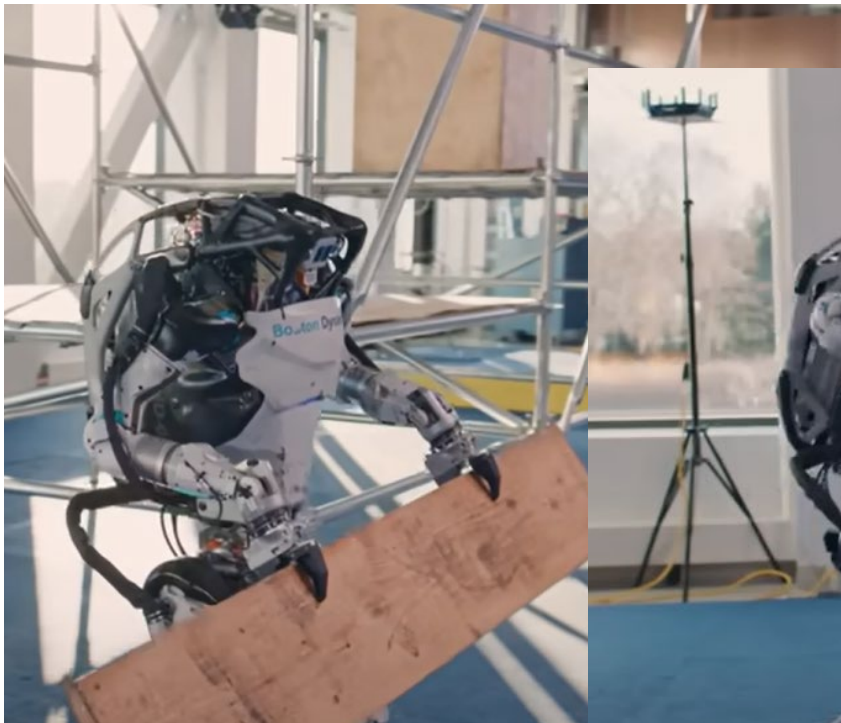
*RoCap* (France)





# Bipedal Robots in Construction?

Possible, but **not very likely** in the next two decades



BostonDynamics  
2013



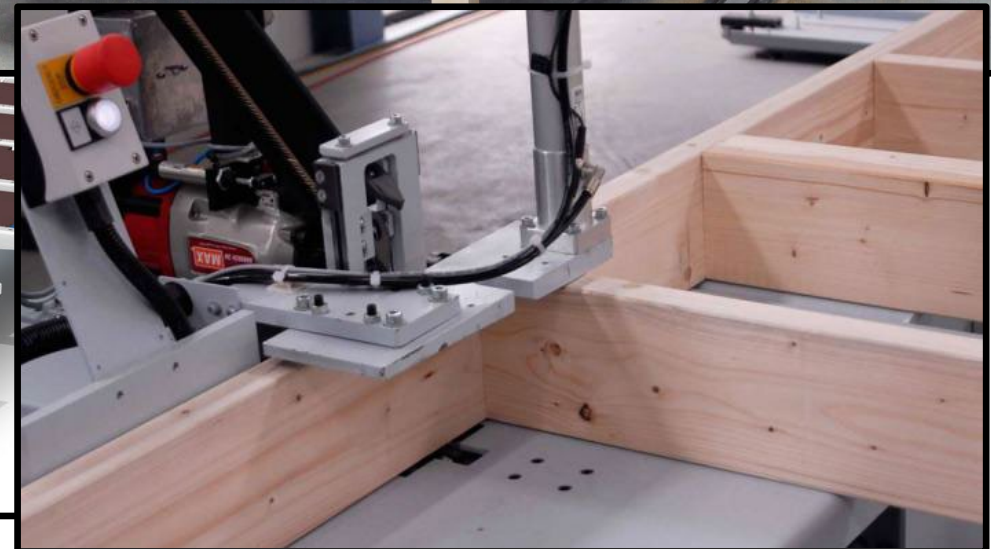
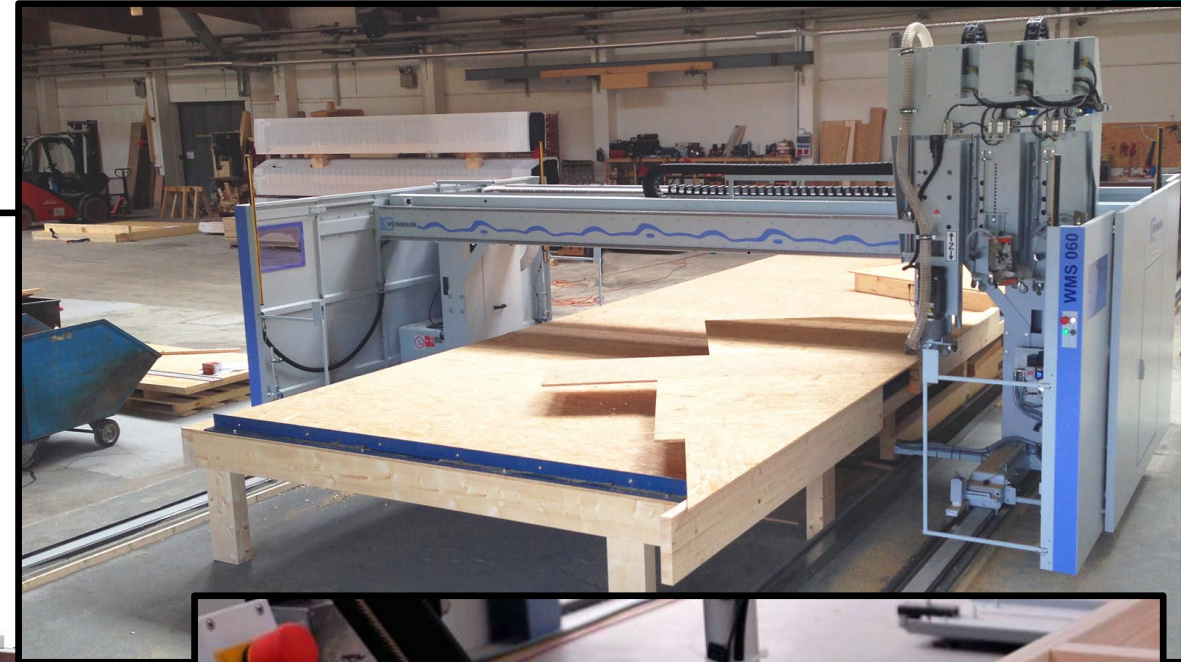
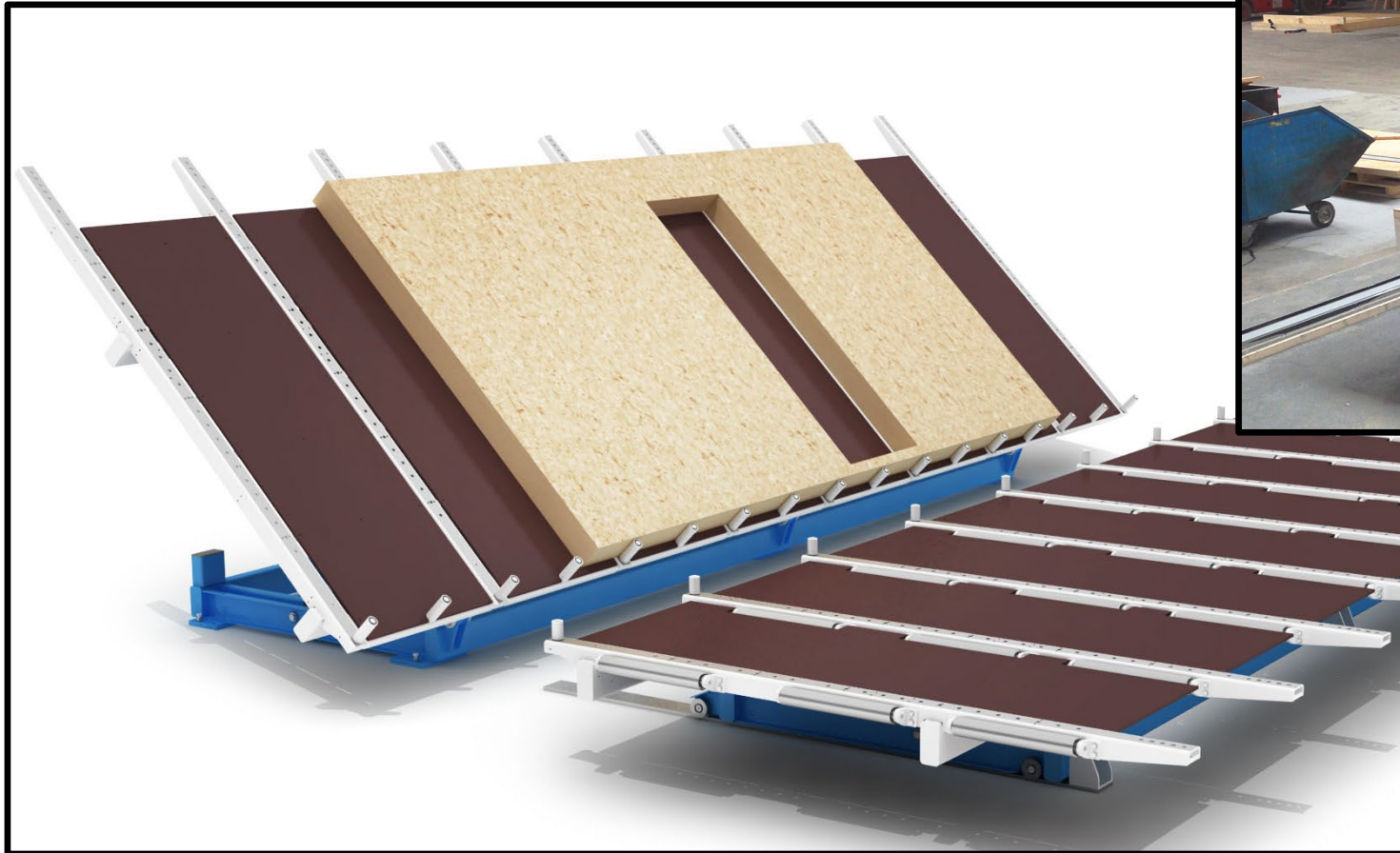
# Robotics in Construction

## *Off-Site*



# Automation assimilates Robotics

Robot/Automat: butterfly table, router/saw, nailer





# Offsite/Prefabrication in New Zealand

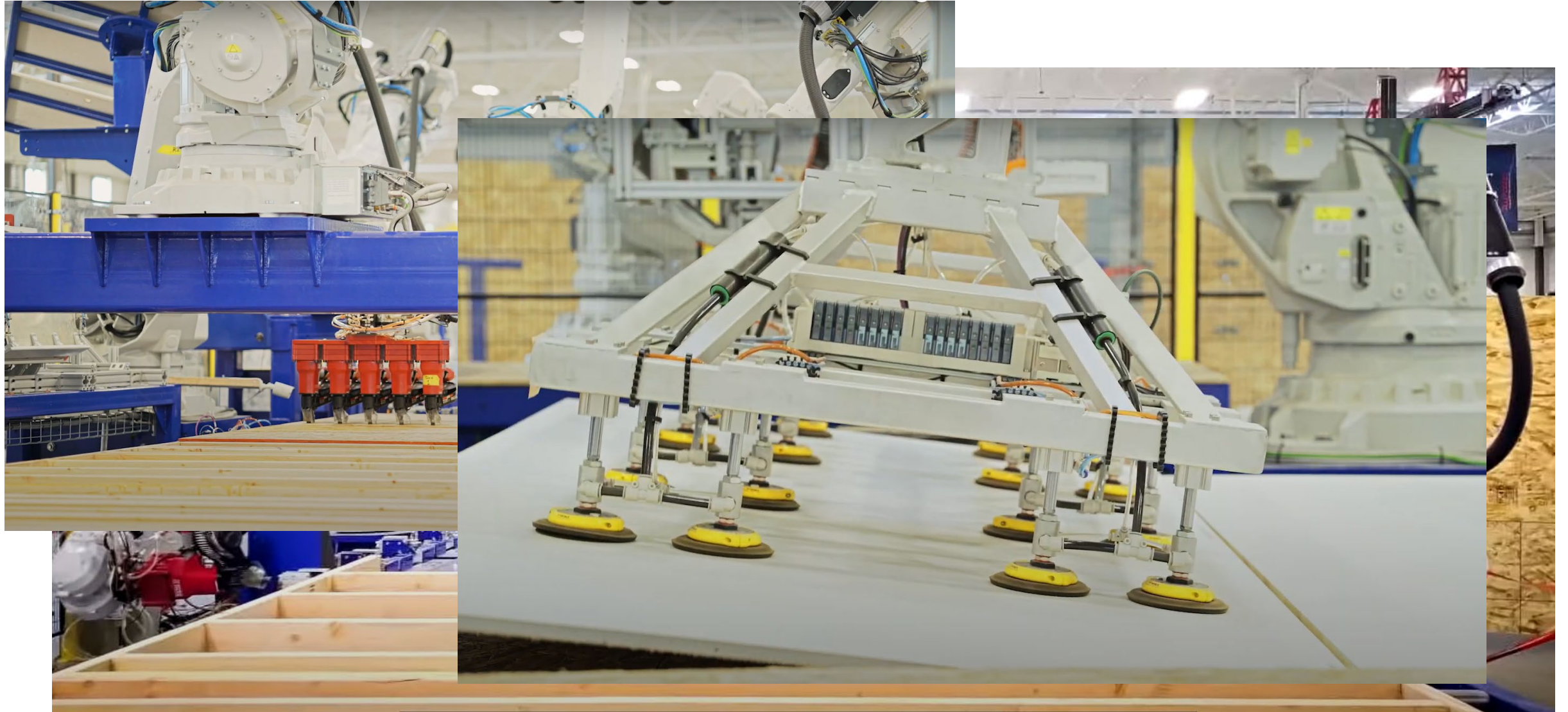
*Manual work still dominates*





# Robots for Prefabrication at large Scale

## *AutoVol* (Idaho, USA)





# Robots for Prefabrication at large Scale

*AutoVol* (Idaho, USA)





# Robots for Prefabrication at large Scale

## *AutoVol* (Idaho, USA)



# Robotics in Construction

## *Sustainability*



# Sustainability of construction robots

## ➔ Economic Pillar

### TYPICAL FINANCIAL MODELS

- ➔ Robots as a Service
- ➔ Renting Robots for a job
- ➔ Leasing Robots

### FINANCIAL BENEFITS

- ➔ Less Rework (higher accuracy)
- ➔ Gaining / Retaining Workforce
- ➔ Higher Profitability (local wage dependent)

# Sustainability of construction robots

## → Ecologic Pillar

- *Reducing Waste*
- *Circular Economy* (reuse of material)
- *‘Green’ Construction* (energy, renewable materials ..)



Robots as *,natural‘ Agents* for *Building Information Models (BIM)*





# Sustainability of construction robots

## → Social Pillar

- ***Inclusive Workplaces / Industry***
  - *Gender Equality*
  - *People with Disabilities*
  - *Ethnicity / Race*
  - *Age*
  - ...

### City of Boston (7<sup>th</sup> June 2023)

.. applicants filing for ***residential and nonresidential projects*** over 20,000 square feet (red: 1,859 m<sup>2</sup>) to submit plans that include economic participation, employment and management roles ***for people of color, women and certified minority*** and women-owned businesses within the scope of their projects.”

# NZ's Advantages in Construction Robotics

- Tech-savvy Population
- Constant Search for Innovations; NZ as a Testbed
- Constructive and future-oriented Labour Unions
- Entrepreneurship as a Culture
- Business-Supportive political Environment
- Māori Economy



# Robotics in Construction

## *2050 Vision*

## ***Expectations about future robotics***

- Working in harsh and risky environment
- Rapidly deployable robots
- 'Learning' & collaborative
- Highly adaptable
- Safe for people



## Short-Term Vision for (Construction) Robots:

### Large Language Models in AI

*The AI helps break the problem and task into smaller pieces*

"I spilled my drink, can you help?"

I can help clean up the mess  
I can help you with that  
Vacuum the spill  
Use a plastic bowl to collect fluid  
Call a cleaner  
I can bring you a towel  
Sorry about the mess  
I can bring you a sponge

# *Mid-Term Vision* for Construction robots

## Skill Transfer with Robotics for Assisting **Construction Workers**

### Requires

- Adaptive behavior (algorithms)
- Smart collaborative control by humans
- Flexible tools/end-effectors in collaboration





## ***Long-Term Vision*** for Offsite Construction robots

### **COLLABORATIVE ROBOTS ('ROBOT APPRENTICE')**

- Learns from an Expert: *measure, cut, 'give a hand'*  
e.g. Insulation material, Cladding
- Access to *Large Knowledge Models* in AI  
e.g. Installation of Services

### **OFFSITE ROBOTICS IN A (FEW) CONTAINERS ('Prefabrication close to Site')**

- Local Trade Staff & Local Material
- Reduced Transport; oversized components

### **NEW ZEALAND'S OFFSITE ROBOTICS ('Global Regions with similar Demand')**

- Developed and tested in NZ
- New Manufacturing Industry in NZ

The background features a large, abstract composition of overlapping geometric shapes. A large, light blue triangle points towards the top left corner. A darker blue shape, also a triangle, points towards the top right corner. The bottom right corner is a green triangle pointing towards the bottom right. The remaining space is white.

# Your Questions?

MEASURE. MODEL. MANAGE.®