Industry 4.0’s Effect on NZ’s Supply Chains

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Outline

- Definition
- Tech trends and what they mean for NZ’s SCs
- Food-specific technologies (if time)

Acknowledgement: Parts of this talk are from “In lament of the NZ Farm” by Dr Rosie Bosworth, AgTech, November 29, 2016. Other sources acknowledged on the slides. Not all quotes marked with quote marks.
Industry 4.0

- The Industrial Revolution of the 18th century was the beginning of automation, e.g., mechanized looms were used to replace hand weavers.
- The Second Industrial Revolution was the technology revolution at the turn of the 20th century.
- The Third Industrial Revolution is the digital revolution that we have been experiencing since the late 1950s.
- We are now said to be experiencing the Fourth Industrial Revolution; the introduction of cyber-physical systems.
  - Automated systems that are also connected with both the internet and users.

1st
- Mechanization, water power, steam power

2nd
- Mass production, assembly line, electricity

3rd
- Computer and automation

4th
- Cyber Physical Systems

Figure by Christoph Roser at AllAboutLean.com
Tech Trends

- Advanced manufacturing technologies
- RFID
- The Internet of Things
- Last mile delivery
- Drones
- Robots
- Autonomous vehicles
- AI & Data analytics
- Blockchain

How do they affect the competitive priorities of cost, flexibility, speed, and quality?
**Advanced manufacturing**

**Enabling technologies**

- **Sensors and data analytics**
  - Across whole value chain
  - Predictive maintenance
  - Logistics tracking
  - Quality control

- **Advanced materials**
  - Proactive not reactive
  - Integrated at design
  - Multiple attributes

- **Smart robotics and automation**
  - Assistive
  - Human collaboration
  - Awareness, decisions
  - Full autonomy

- **Additive manufacturing**
  - Complete, complex, products
  - Lower capital investment
  - Consumer led design
  - Just in time production

- **Augmented and virtual reality**
  - Overlay designed with environments
  - Optimised equipment
  - Remote collaboration
  - Safe training

**Source:**
David Chuter, CEO and Managing Director, IMCRC
Additive Manufacturing

- Also known as 3D printing
- “The average consumer 3D printer costs around $700. The cheapest 3D printers start at around $200. High end consumer 3D printers can cost several thousand dollars.” [https://3dinsider.com/cost-of-3d-printer/](https://3dinsider.com/cost-of-3d-printer/)

- Widely used for spare parts
- How much of the SC will it be able to replace?

RFID

- Somewhat older technology now
- Promise in retail has not been fully realised
- Applications in: sheep and goat farming, hog and pig farming, equine facilities, poultry and egg production centers, dairy cattle ranching, beef steer ranching, and aquaculture
- Allows the farmer to have superior traceability, better breeding control, and better conservation efforts
  - Data collection about each and every animal of the herd
  - RFID can also play a role with automated feeding, weighing, and disease management

Source: https://gaorfid.com/rfid-uses-in-agriculture/
The Internet of Things (IoT)

- The network of devices, vehicles, and home appliances that contain electronics, software, actuators, and connectivity which allows these things to connect, interact, and exchange data
- Farm sensors collect data on temperature, rainfall, humidity, wind speed, pest infestation, and soil content
- Data is then used for (automated) decision making

Source: https://en.wikipedia.org/wiki/Internet_of_things
Last Mile Delivery

- Amazon now offers two hour delivery for some US and UK locations.

- In the UK “Prime members with a residential address in select areas receive unlimited Same-Day Delivery on a million items across Greater London, Liverpool, Leeds, Manchester, Edinburgh, Glasgow, Birmingham, Bristol, Leicester, Nottingham, Oxford, Maidstone, Cardiff, Basildon, and more.”

- Other companies are scrambling to match
Drones

- Two key farming uses
  - Surveying
  - Spraying

- Delivery trials
  - Particularly for pharmaceuticals
Robots in Agriculture

- Driscoll’s, the berry titan, has invested in several robotic strawberry harvesting start-ups which use imaging technology to assess a berry’s ripeness before it is harvested.
- Christopher Ranch, a giant in garlic, began using a 30-foot-tall robot to insert garlic buds into sleeves for sale in supermarkets.
- Bartley Walker now offers a robotic hoeing machine with a detection camera capable of identifying the weeds that sprout between row crops like broccoli and cauliflower. One machine replaces 11 workers.
- Taylor Farms has about 60% of the romaine lettuce and half of all cabbage and celery it produces harvested with automated systems.
- However, delicate fruit, like peaches, plums and raspberries will remain labor intensive for the foreseeable future.

Source: Jay, Barry and Chuck's OM Blog
Autonomous Vehicles

- Programmed to independently observe their position, decide speed, and avoid obstacles such as people, animals, or objects, while performing their task.
- Further ahead in agriculture than on our roads.
  - Currently, the majority of fully autonomous tractors navigate using lasers that bounce signals off several mobile transponders located around the field.

Source: https://en.wikipedia.org/wiki/Driverless_tractor
Precision Agriculture (AI/Big Data)

- Technologies include sensors, crop yield monitors, and satellite imagery.
- Smart farming hardware/software systems enable farmers and growers to digitalize, monitor and measure, and improve current conventional farming practices with more efficiency.
- Improves:
  - Productivity (e.g., crop yields)
  - Efficiency (e.g., energy and water use)
  - Sustainability (e.g., less effluent, emissions, and healthier soil)
- Not disruptive
Blockchain

- Distributed and secure ledger
- Allows information to be kept on the entire history of a product as it travels along the supply chain
  - Commonly accessed through QR codes
  - Increases trust in the SC
  - Increases food safety and decreases fraud
  - Food recalls are easier
- Allows for smart contracts
  - The contract is automatically triggered based on some externally verified event
Potential Impact on Operations Strategy

- Olsen and Tomlin, Industry 4.0, Forthcoming *M&SOM*
Food Specific Technologies

- Lab manufactured and bio-printed animal and plant proteins
- Indoor and vertical crop production (of almost any variety)
- Next generation of soil and seed technology negating the need for GMO and pesticide use
- CRISPR for food
- “Open sourced digital agriculture”
- Soylent green?
Perfect Day Food

- [http://www.perfectdayfoods.com/](http://www.perfectdayfoods.com/)
- Craft animal-free dairy products that taste like the real thing
- Developed a type of yeast that can produce dairy proteins (casein and whey). Using biotechnology, give this yeast a “blueprint” that allows it to ferment sugar and create real dairy proteins. This is the same blueprint, in the form of DNA, which cows use every day
- Proteins are made using “safe and proven fermentation techniques similar to how many common food components like vitamins, probiotics, enzymes, and natural flavors are made”
Impossible Foods

- [https://impossiblefoods.com/food/](https://impossiblefoods.com/food/)
- “Wheat protein and potato protein deliver that meaty chew and essential nutrition”
Ava Wines

- San Francisco start up
- Engineering top quality wine with no grapes or fermentation that even wine masters would be hard pressed to detect as fraud
- “Our pursuit of the molecular reconstruction of food will help push the envelope of the food tech revolution”
- Mature, earthy notes with delicate bubbles and savory flavor profiles without a grape or water intensive irrigation system in sight
More AgTech

- New Wave Foods, another Silicon Valley start up, is mastering the art of producing, using biochemistry, plant based shrimp and seafood alternatives that are healthier and better for the environment
- Insect protein start ups
- Technology that enables plant seeds to be bathed in carefully crafted concoctions of light spectra or ancient microbes, bacteria and fungi to make plants healthier, hardier, and more drought resistant without the need for pesticides, herbicides and fungicides
- Venture capital flooding into the agtech sector (protein, food, and seed and crop technology) was $25 billion in 2015
- Agricultural Development Bank of China has allocated at least 3 trillion yuan (US$435 billion) by 2020 to the modernization of China’s agriculture industry
Conclusions

- Supply chains are changing in many ways
- Some is non-disruptive but productive
  - Precision ag, tech assistance, etc.
- Some may change SC structure
  - Blockchain, co-ops, vertical farming
- High tech food may change how we eat
  - Too early to tell