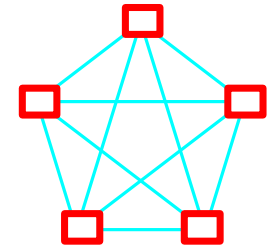


Analogy between 1355 and Japanese World-class manufacturing technology

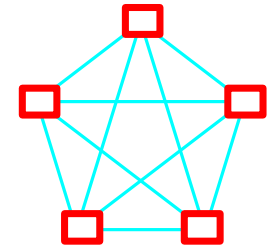
(One way to build a factory)



- ***Large fast-moving conveyor belt***
- ***Conveyor belt passes every machine in the factory***
- ***Only one tray of components can be on the conveyor belt at any time***
- ***As factory grows, conveyor belt has to go faster***
- ***Belt can have faster sections, but these have to slow down for any tray going outside the faster section, and there can still be only one tray at a time.***

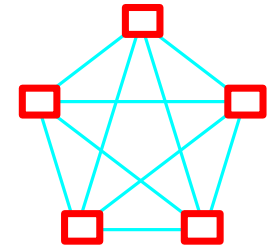
Not the way you would build a factory?

(Japanese Manufacturing Technology: Concepts)

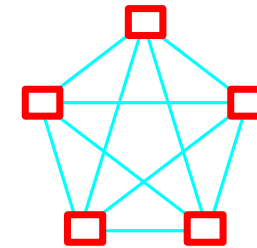
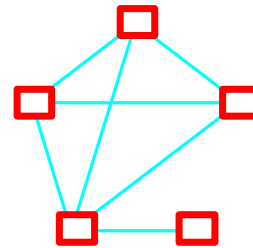
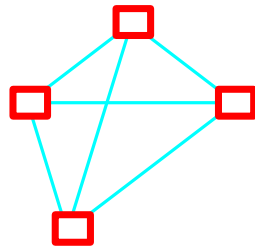


- ***Continuous Improvement***
- ***Minimise Working Capital/Work-In-Progress***
- ***Maximise (process-time/queuing-time)***
- ***Minimise Waste***
- ***Minimise Overheads***
- ***Small Batch Sizes***
- ***Eliminate Bottlenecks***
- ***Flexible***

(Japanese Manufacturing Technology: Analogies)



- ***Continuous Improvement :***



Bisection bandwidth:

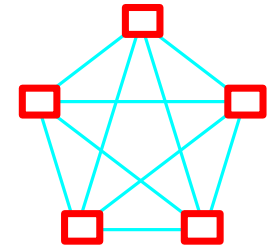
4 links

5 links

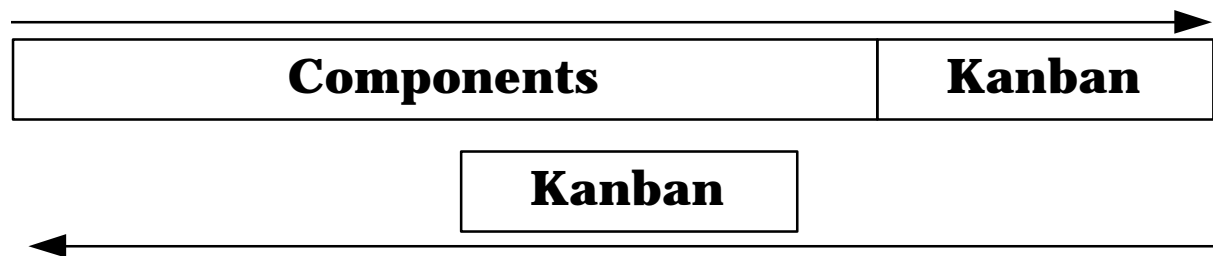
6 links

- ***As you add nodes or links to the network, you add bandwidth***

(Japanese Manufacturing Technology: Analogies)

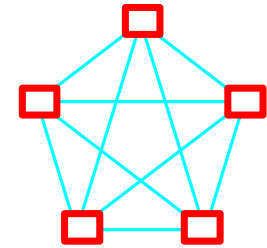


- ***Minimise Working Capital/Work-In-Progress***

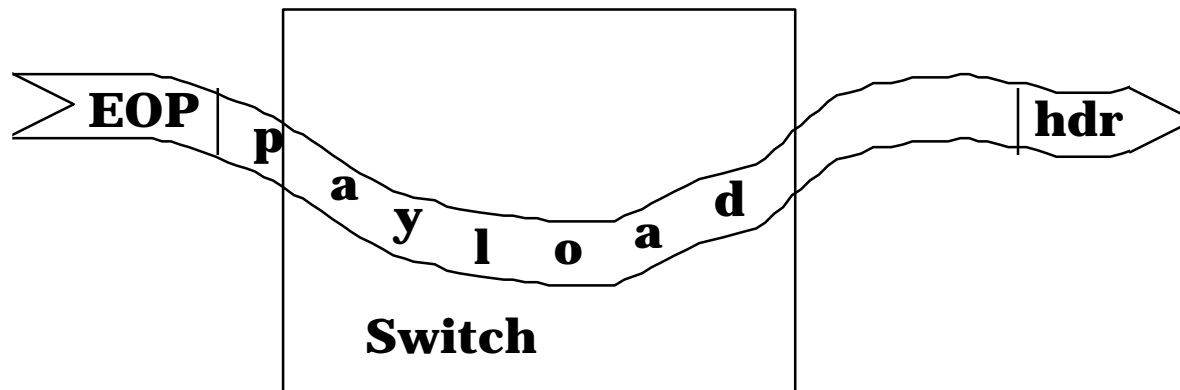


- ***Header on packet is like Kanban Label***
- ***Ack is like return of Kanban Label when components are used***
- ***Link-level and end-to-end flow-control minimise buffer sizes, minimise delay***

(Japanese Manufacturing Technology: Analogies)

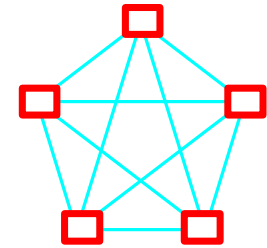


- ***Just-In-Time/ Minimise delay,***
- ***Maximise (process-time/queuing-time)***

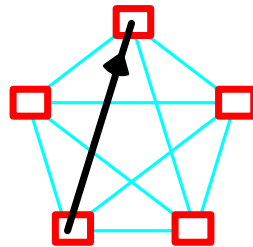


- ***Worm-hole routing outputs front of packet before end of packet has arrived***

(Japanese Manufacturing Technology: Analogies)

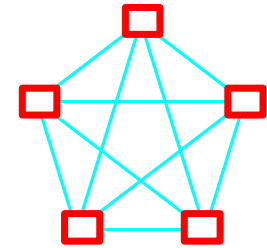


- ***Minimise Waste***



- ***Traffic only travels down necessary link(s),
does not waste bandwidth, power, RFI***

(Japanese Manufacturing Technology: Analogies)

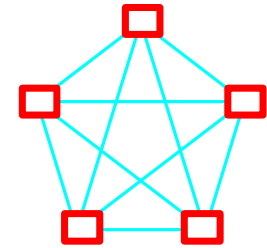


- ***Minimise Overheads***



- ***Header can be as small as one byte***
- ***EOP can be less than one byte***

(Japanese Manufacturing Technology: Analogies)

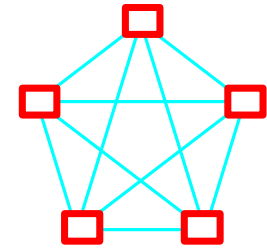


- ***Small batch sizes***

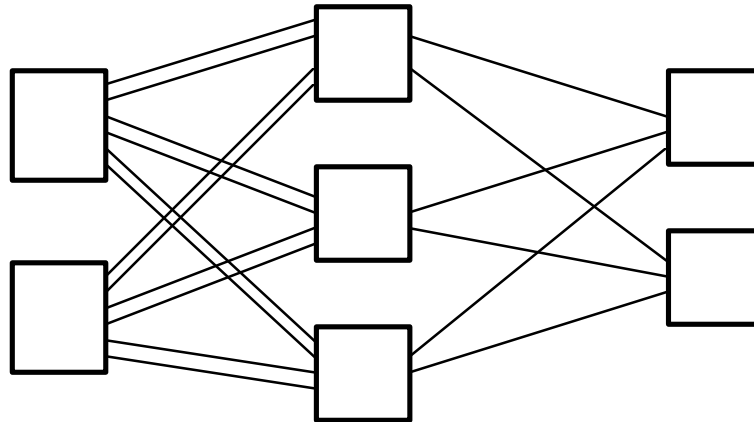


- ***Payload can be as small as necessary --- even zero bytes if terminated by EOM (End Of Message)***

(Japanese Manufacturing Technology: Analogies)

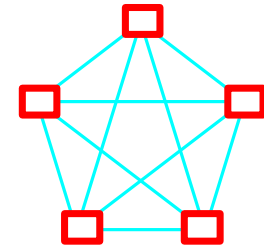


- ***Eliminate bottlenecks***

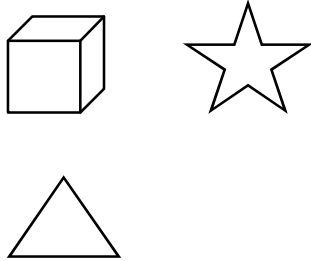


- ***Grouped adaptive routing spreads traffic across available links***
- ***Universal/random routing avoids hot-spots***

(Japanese Manufacturing Technology: Analogies)



- ***Flexible***



ATM cell

MPEG frame

T9000 packet

Disk sector

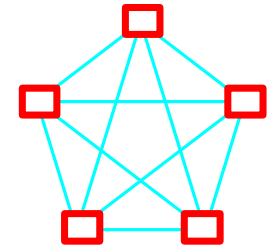
- ***Any network topology***

- ***Simple mapping of most protocols***



Single byte command, such as “Switch on the lights”

Conclusions from analogy



- **1355 learns from what Japan has taught us about world-class manufacturing --- to provide world-class networks**