



Pick, Pack, Pallet

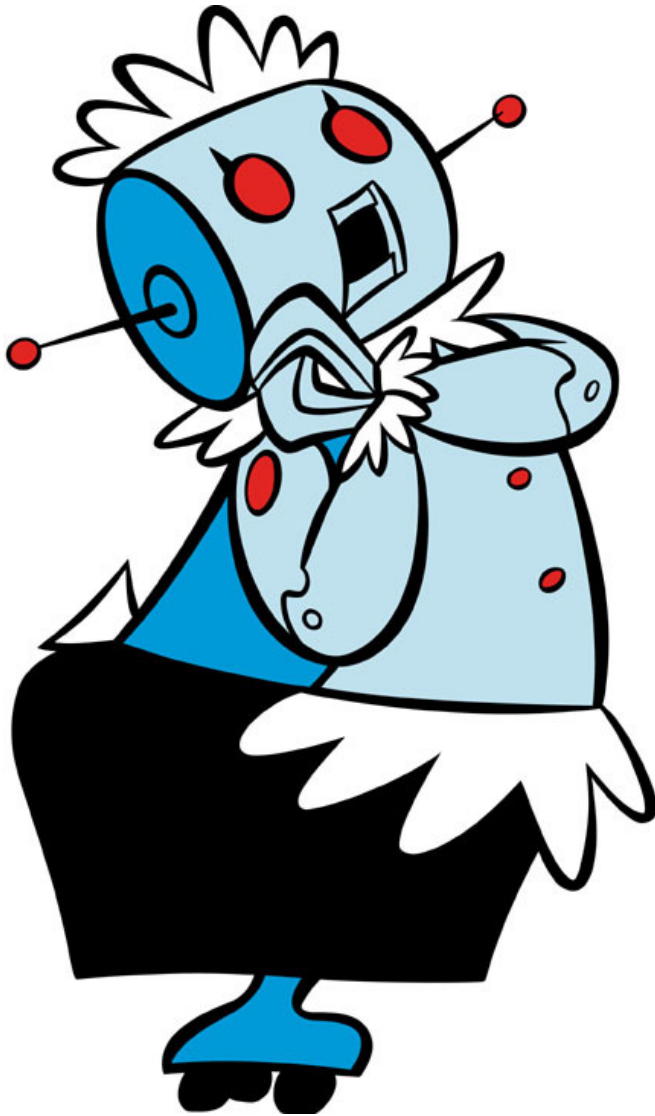
Can one robot do it all?



MODEX2012
SOLUTIONS THAT MOVE SUPPLY CHAINS
GEORGIA WORLD CONGRESS CENTER
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YASKAWA
MOTOMAN ROBOTICS

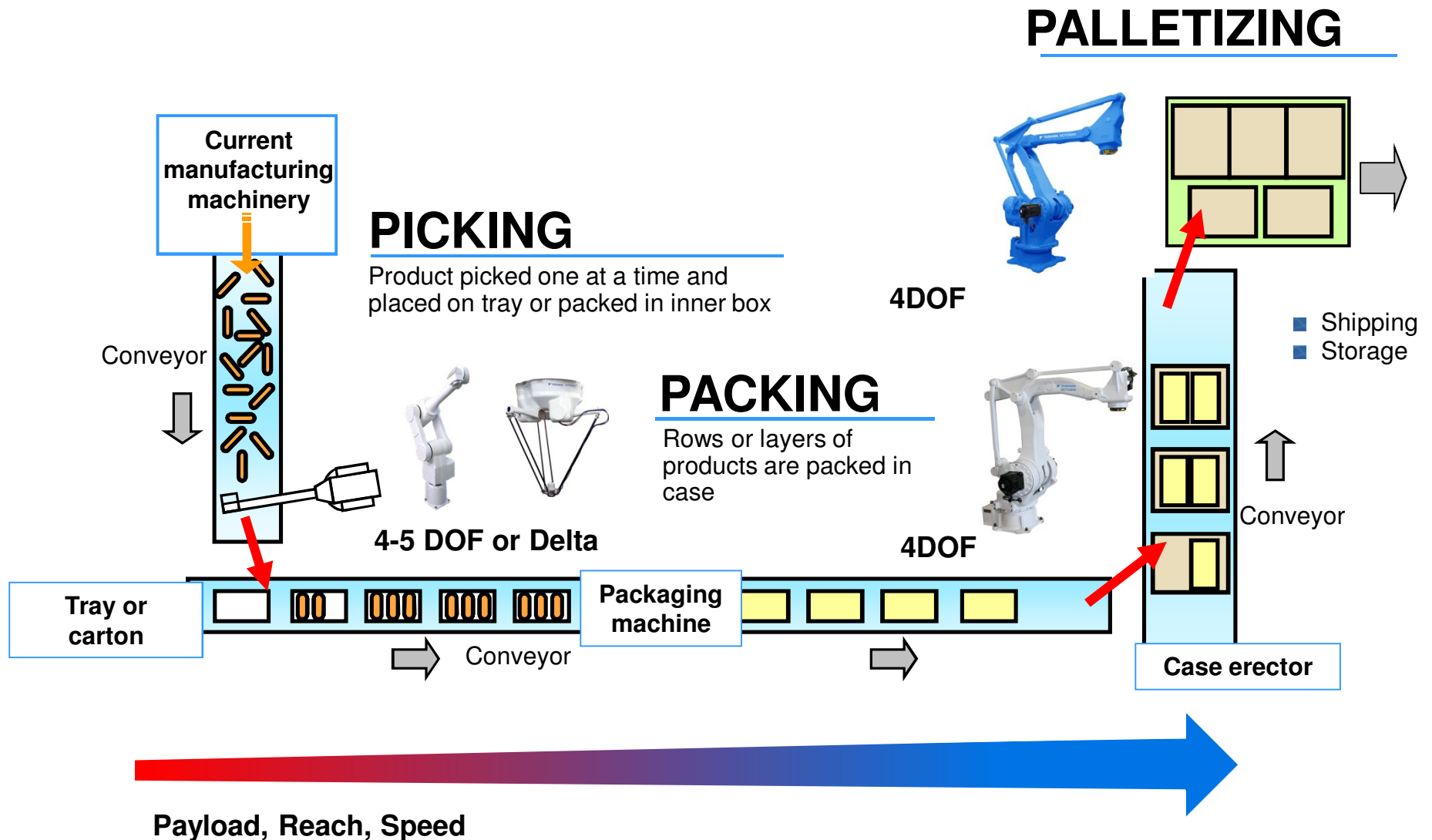
The one robot that can do it all...



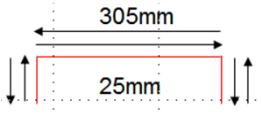
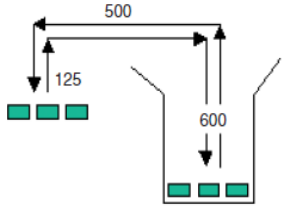
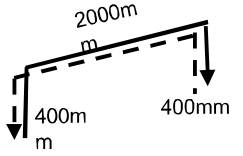
Should

~~Can~~ one robot do it all?

Taxonomy of Packaging Robots



Typical Packaging Robot Lineup

Application	Picking: Food	Picking: Food	Picking: Other Products	Packing	Palletizing
# of Axes	4	5	6	4	4
Robot Payload	3 kg	2kg	5 kg	50 kg	160 kg
Maximum Reach	1300 x 300 mm	900 mm	706 mm	1,917 mm	3,159 mm
Rate	Cycle time: (continuous operation) 0.32 sec (185 cycle/min): 1 kg 	Cycle time: (continuous operation) 0.45 sec (133 cycle/min): 1 kg 0.50 sec (120 cycle/min): 2 kg	Cycle time: (continuous operation) 0.45 sec (133 cycle/min): 1 kg 0.48 sec (125 cycle/min): 2 kg	Cycle time: 1.1 sec (55 cycle/min): 30 kg 	Cycle time: 2.18 sec (27.5 ppm) 

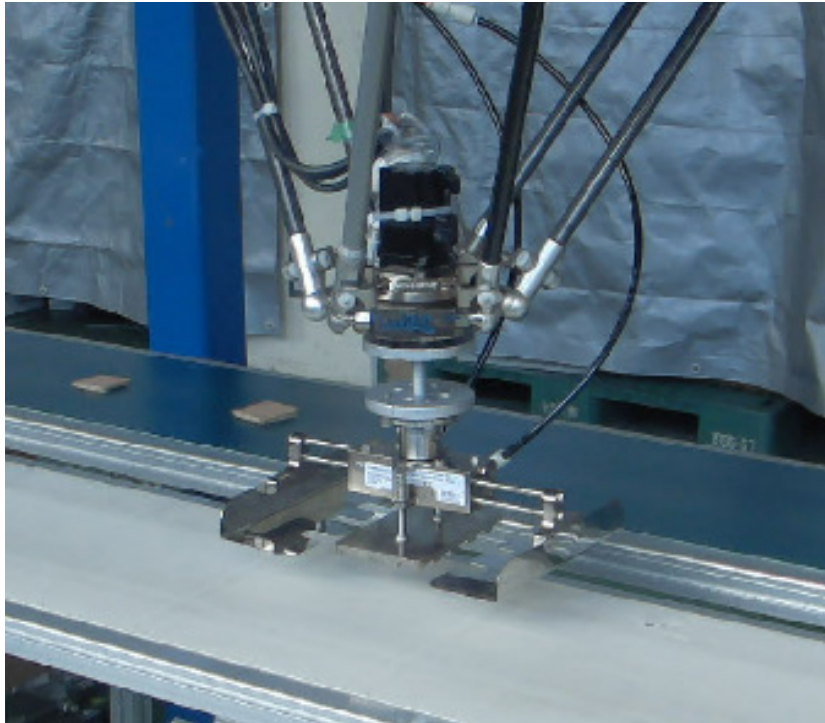


Picking Robots – essential elements

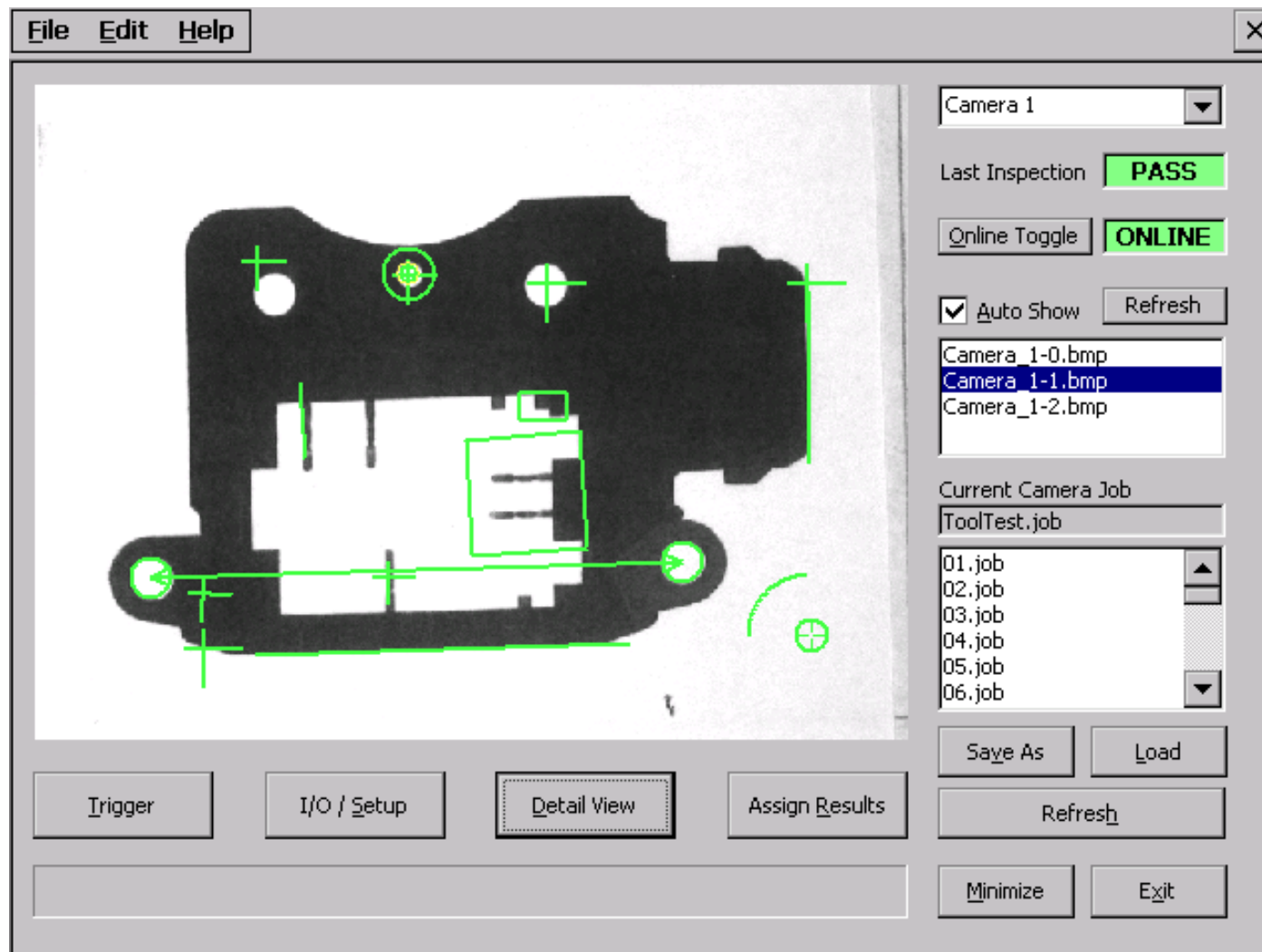
- Manipulator
 - 4-5 DOF
 - High acceleration
- End effector
 - Vacuum (best actuation time)
 - Paddle, low friction
- Vision system
 - Determine position in 2 ½ DOF
 - Lighting, optics, lensing
- Conveyor tracking
 - Read external encoder and offset the robot pose in real time
 - Future development will also use visual servoing
- Programming utility
 - Determines pick sequence, especially with multiple robots
 - System flow configurator



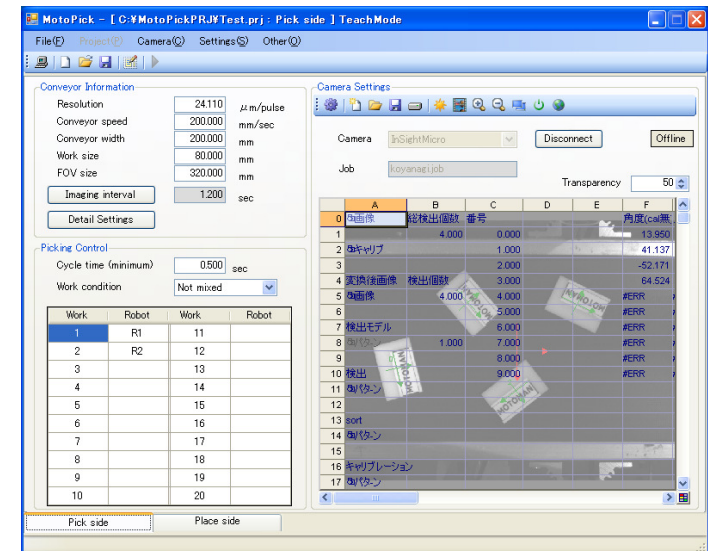
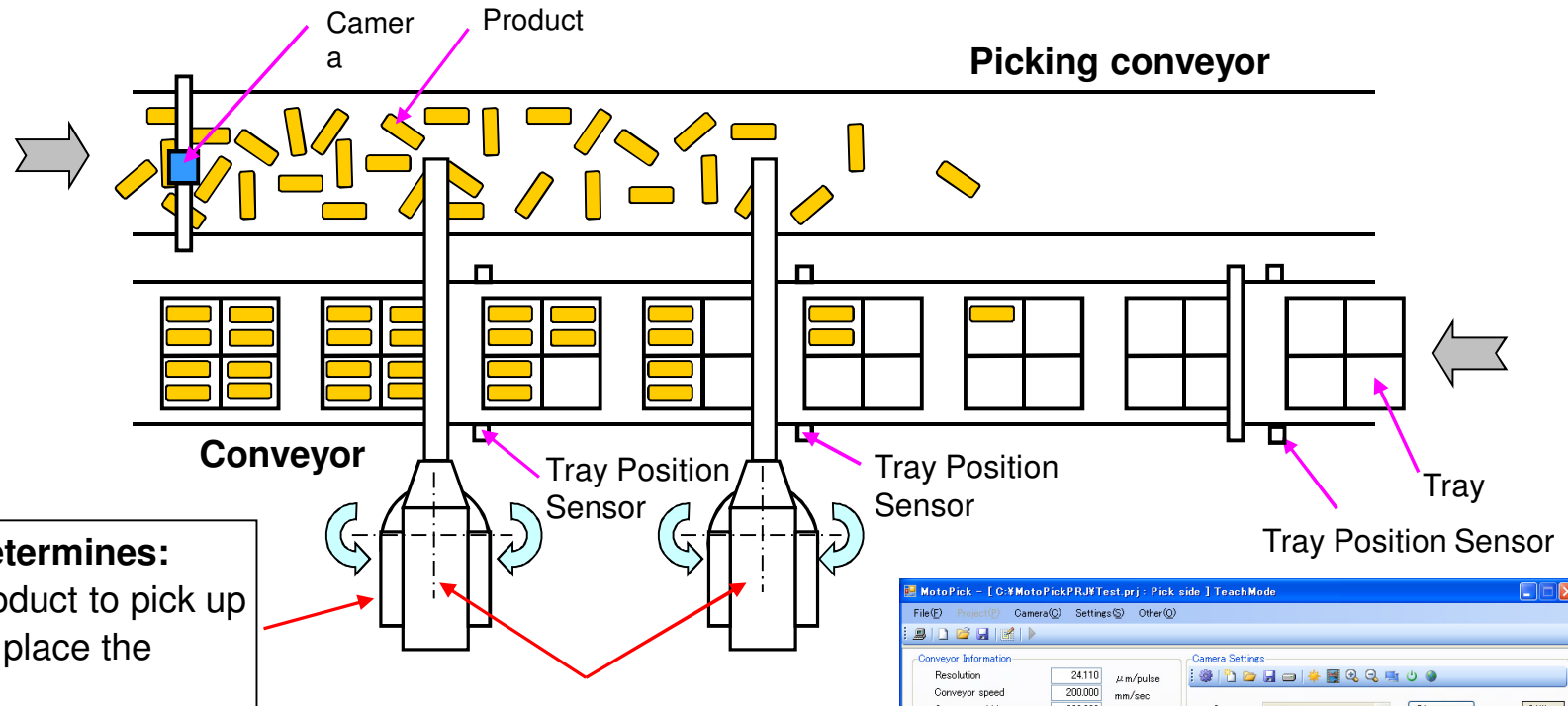
Picking Robots – end effectors



Picking Robots – vision

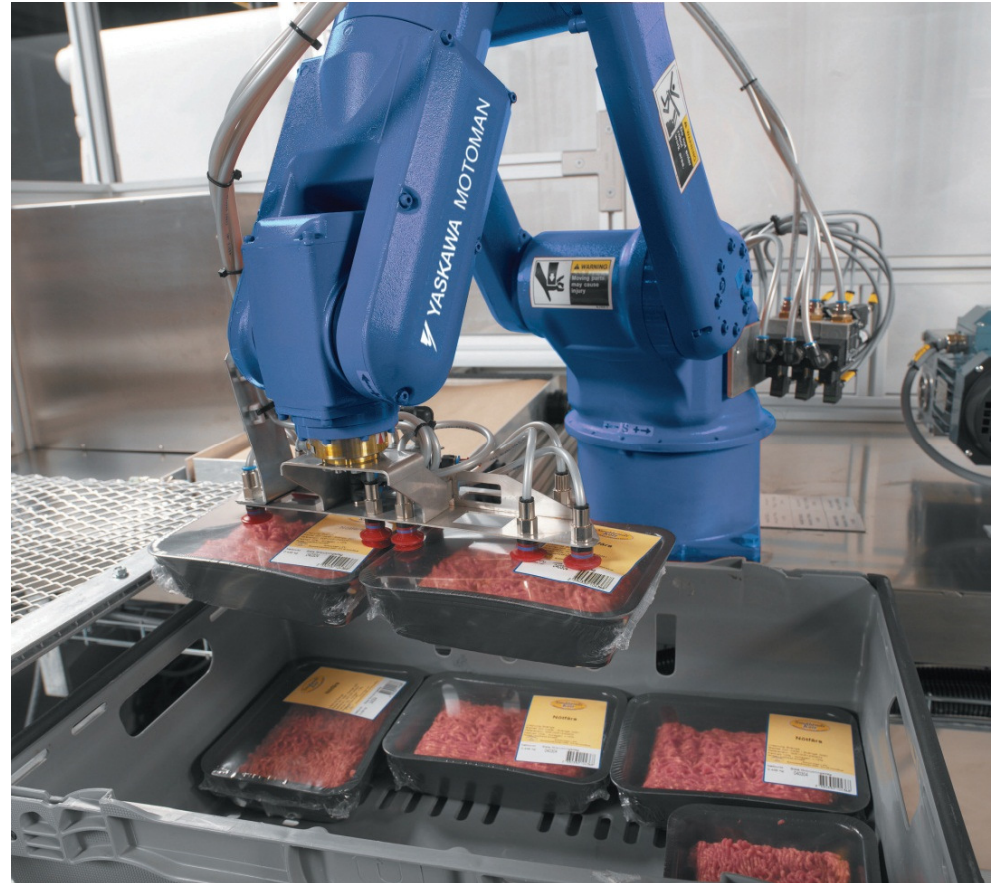


Picking Robots – scheduling software

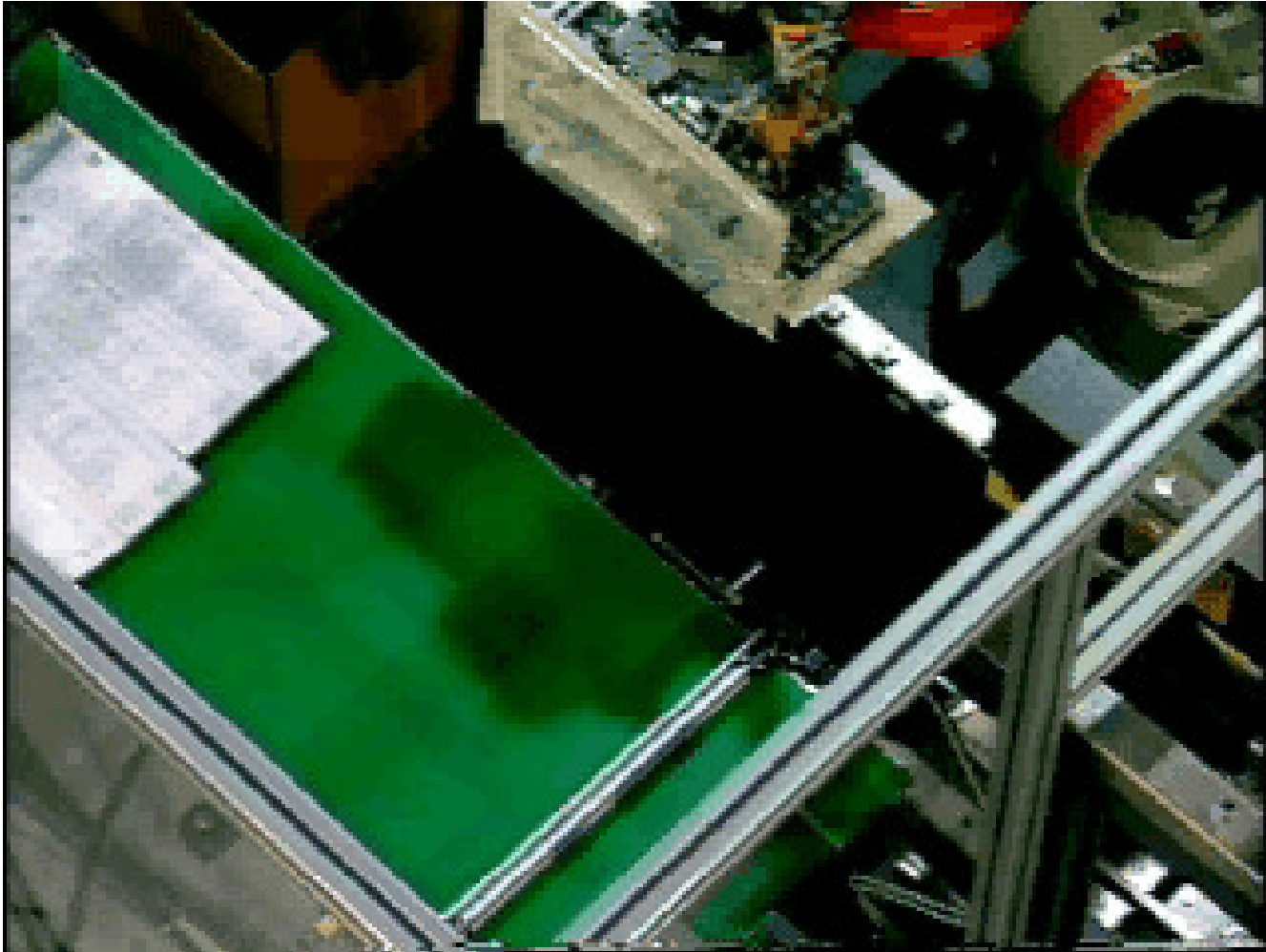


Packing Robots – essential elements

- Manipulator
 - 4-6 DOF
 - Range of motion
- End effector
 - Vacuum (access inside case)
 - Actuated
- Vision system
 - Determine position in 2 ½ DOF
 - Lighting, optics, lensing
- Conveyor tracking
 - Read external encoder and offset the robot pose in real time



Packing Robot – actuated end effector



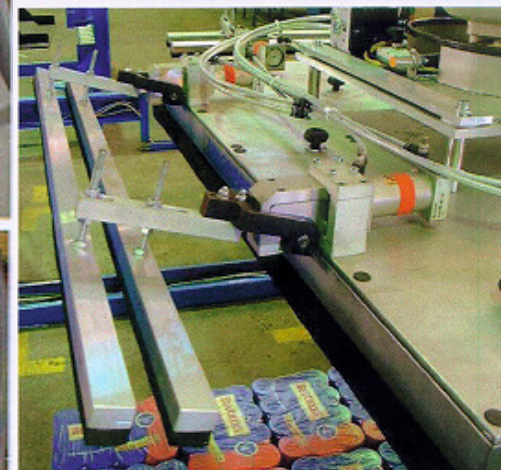
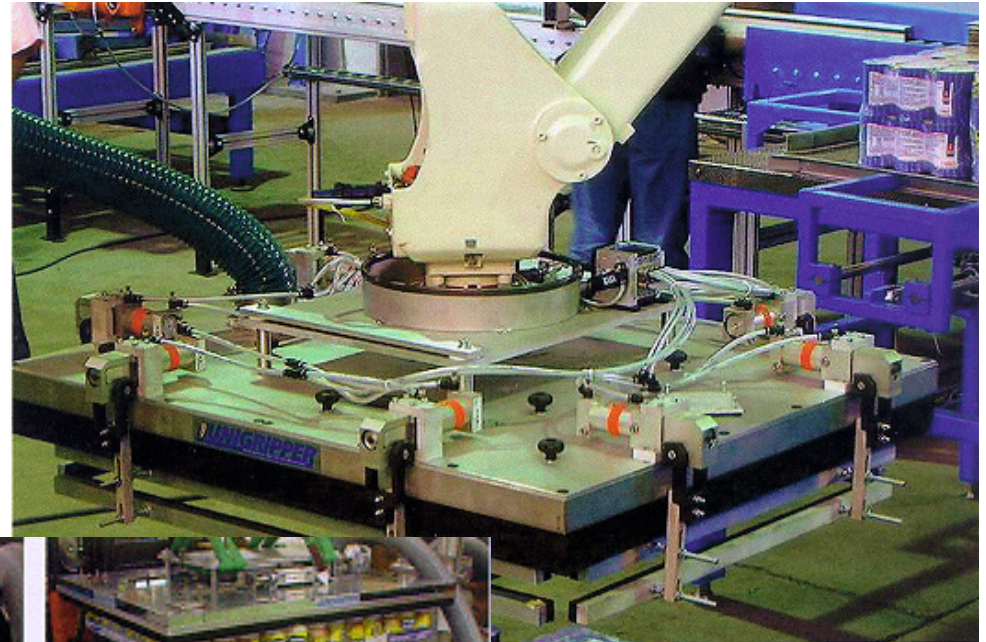
(video)

Palletizing Robots – essential elements

- Manipulator
 - 4-6 DOF
 - Payload 50kg~300kg
 - Range of motion
- End effector
 - Vacuum, platen, paddle, fork, bag
 - Dunnage/slip sheet/pallet
- Vision (Depalletizing)



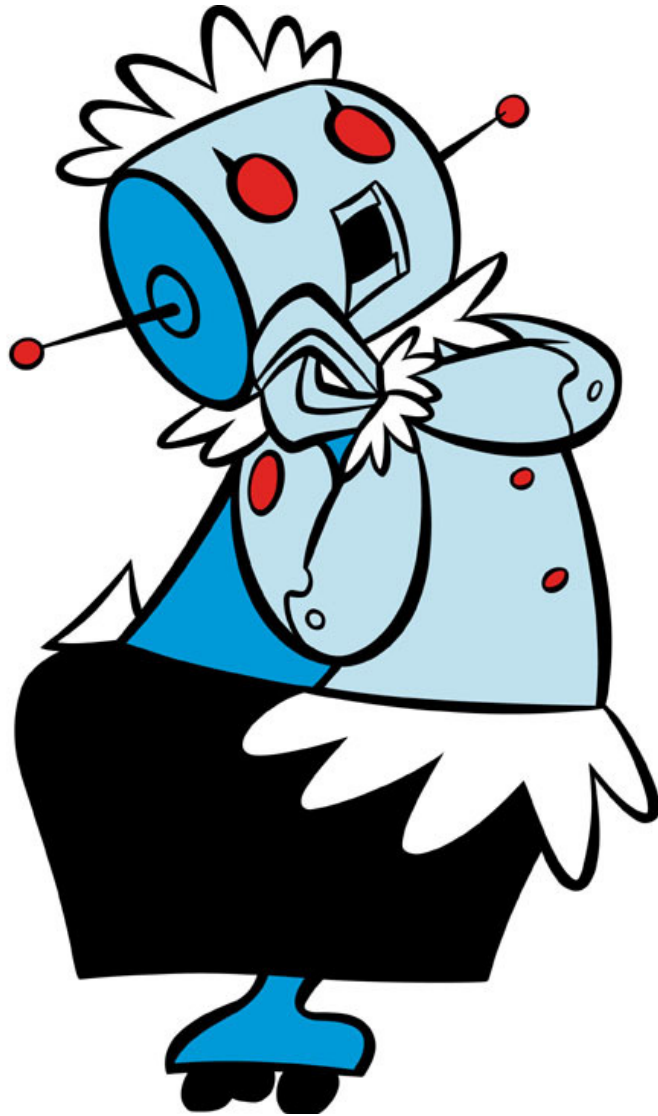
Palletizing Robot - platen



(video)



The one robot that can do it all...



- Successful language
 - Defined vocabulary
 - Ubiquitous

Where are the robots?

- Market drivers are evident
 - Health care, cost of compliance
 - Rising labor rates
 - Efficiency gains (turns per sq ft)

Where are the robots?

Why are there so few robots in 3P?

■ Task level

- Well understood
- Robust solutions available

■ System level

- Multiple SKU is the norm, hence 3P is less structured than industrial assembly or other typical robot markets
- Loose or semi-structured environments require more intelligence than “robots out of a box.”
- 2 ½ DOF vision is not enough, so new developments are being introduced

Where are the robots?

- Task level
- System level
- Enterprise level
 - Business model for robots does not work in 3P
 - 3P throughput surges require either building robot capacity to peak demand, or supplementing with labor.
 - Lack of robotics expertise on staff means On/Off simplicity is required
 - Aversion to capital investment for equipment. 3P model is limited to capital for facilities during initial build.
 - A model that treats robots like labor (expense) instead of equipment (capital) will be required for the technology to be widely adopted.
 - Like labor, the robots must move to the work.