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THE ASSEMBLY SHOW ASSEMBLE. AUTOMATE. ACCELERATE.

Introduction to Parts Feeding

Parts Singulation for Robot Automation

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Robotics Today

Industries

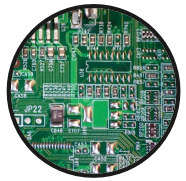
Automotive

Medical

Industrial

Consumer Electronic

Pharmaceutical



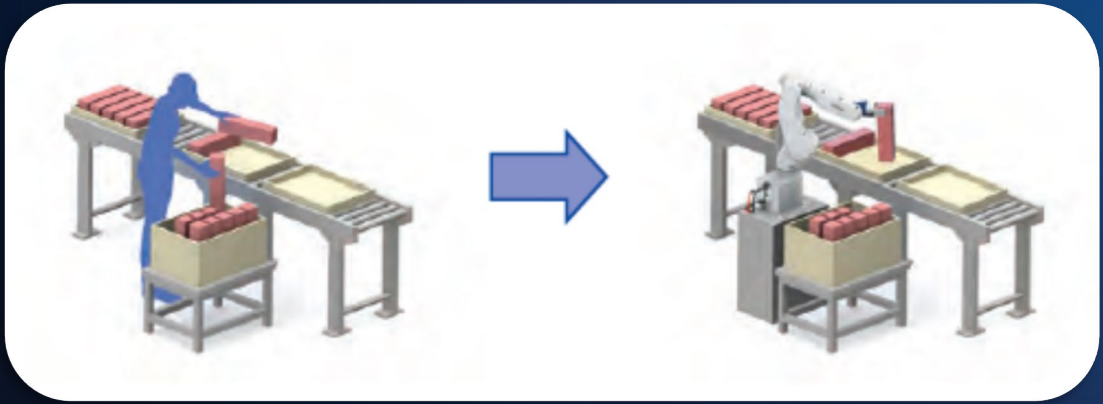
Electronics

Applications

- Assembly
- Injection Molding
- Kitting
- Machining
- Packaging
- Palletizing
- Screwdriving
- Handling
- Dispensing

Why Parts Feeding?

All products are made up of parts, components or subassemblies. In order to make those products, you need access to the parts and components.



- Need components available
  - Quick Access
  - Organized Fashion
- In the case of robotics, we need to know where to get that part and place it to particular tolerance.
- Process of having those components available is parts feeding.

What is Singulation?

- Separation of bulk parts so that a robot can efficiently pick each item.
- Machine vision and sensors may be used to enable robot to locate and orient the parts

Introduction to Parts Feeding

1. Selecting the Right Feeder
2. Feeder Type Comparison
3. Trends
4. Getting Started

1 Selecting the Right Parts Feeder

Important Considerations

1. Part Type & Complexity
2. Current and Future Part Needs
3. Volume vs. Variety (Part Mix)
4. Throughput (Parts per Hour)
5. Cost

Part Type & Complexity

Part Types

Part Features to Consider: Shape, length, width, thickness & weight

Materials: Plastic, Metal, Rubber

Examples: Fasteners, Clips, Diaphragms, Connectors, Components, Brackets, Tubes

Part Features to watch out for:

- Angles
- Grooves
- Flanges
- Protrusions
- Curved Surfaces

Simple parts = Faster throughput
Complex parts = Require special tooling

Part Complexity

- Part complexity determines feeder type requirement
- More part features (protrusions) = More different part orientations
- Wet or oily parts require special feeder lining
- Special feeder coating may be required
  - Polyurethane, nylon, nonstick coating and Brushlon ® can be applied to different feeder types to protect the parts and allow them to separate

ii Current and Future Part Needs

Consider both current part needs and those you may be processing in the future.

High Product Mix = Frequent Changeovers = Costly Retooling

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iii Volume vs. Variety

Part Volume will determine Feeder Type

High Volume / Low Mix

High quantities of same part

Bowl Feeder

Low Volume / High Mix

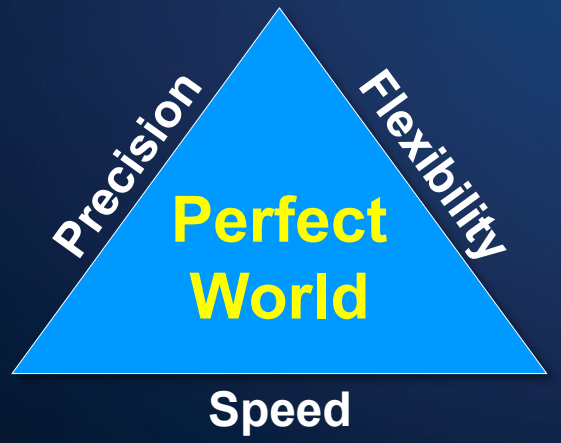
Small Batch with different parts

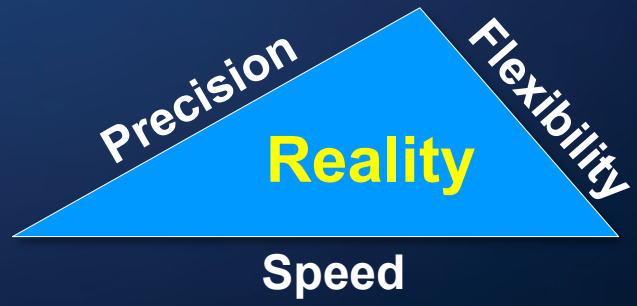
Flexible Feeder

iv Throughput

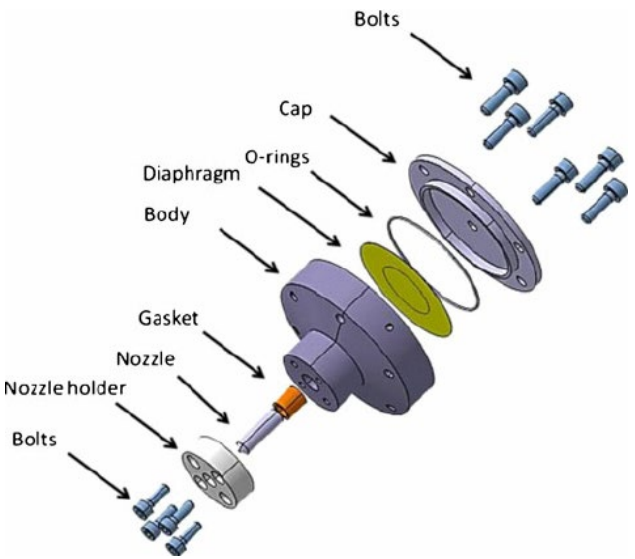
Tradeoffs: Cycle Time | Precision | Flexibility

- What is your desired throughput? Your parts per minute (cycle time)?
- What kind of precision does your process require?
- How many & how often do you anticipate changeovers?





V Total Cost of Ownership (TCO)



Different parts of Generator
(9 Different Parts)

Example

High Throughput = Bowl Feeders (avg cost $20,000 - $40,000)

9 parts x $20,000 = $180,000

- Cost justified if processing millions of parts
- Cost prohibitive if only processing thousands of parts
- Alternative: Flexible Feeders (avg cost $15,000 - $25,000) but can handle multiple parts

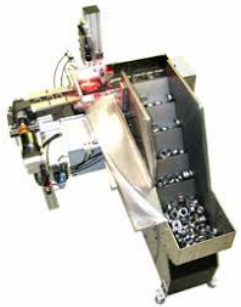
Calculate your TCO

- Include the purchase price
- How long you intend to use the feeder
- Expected changeovers
- Labor for set up and configuration
- Maintenance

2 Feeder Types

Bowl Feeder

Gravity Feeder



Step Feeder

Conveyor

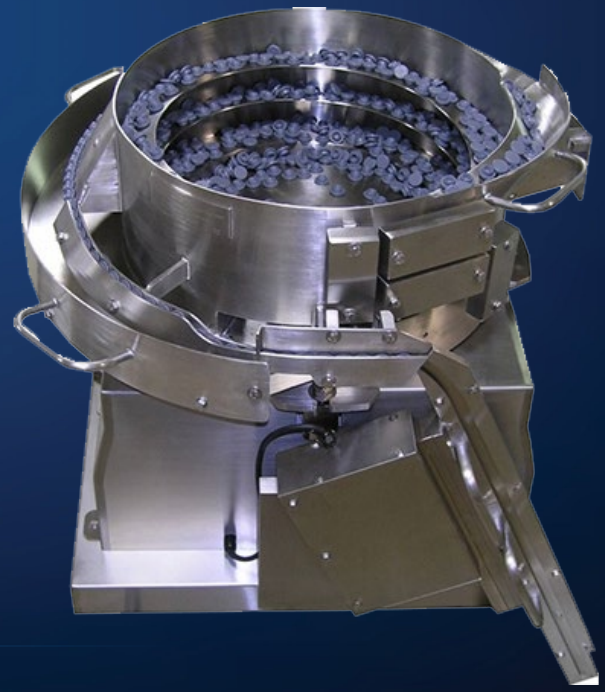
Flexible Feeder

Bowl / Centrifugal

Feeder Type	Part Volume	Cost	Changeover	Precision	Part Mix
Bowl / Centrifugal	● ● ●	●	○ ○	○ ○	●

Bowl Feeder - uses vibration to feed parts along a spiral track on the container walls to singulate parts.

Centrifugal – Similar but bowl spins at high speeds, force parts to the outside of the bowl to singulate parts



Gravity Feeder

Feeder Type	Part Volume	Cost	Changeover	Precision	Part Mix
Gravity Feeder	● ●	●	●	●	●

Gravity Feeder - Stationary track tilt at an angle that relies on gravity to feed individual parts.

Step Feeder

Feeder Type	Part Volume	Cost	Changeover	Precision	Part Mix
Step Feeder	● ●	● ● ●	Part Specific	●	●

Step Feeder - Typically cleated, vertical or horizontal conveyor – based feeder that moves multiple parts at a time by “scooping” parts out of a hopper

Conveyor

Feeder Type	Part Volume	Cost	Changeover	Precision	Part Mix
Conveyor	🟡 🟡	Varies	🟢 🟢 🟢	🔴	🟢 🟢 🟢

Conveyor - Belt, roller, or other. Used with tracking feature to sync with robots or other motion devices to provide indexed or continuous flow

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Flexible Feeder

Feeder Type	Part Volume	Cost	Changeover	Precision	Part Mix
Flexible Feeder	● ●	● ● ●	● ● ●	● ●	● ● ●

Flexible Feeding - Uses multi-axis vibration or conveyors to optimally distribute and singulate parts on a horizontal platform. High performance feeders can control the direction of part movement.

Feeder Comparison

Low Mix / High Volume

High Mix / Low Volume

Feeder Type	Throughput	Cost	Changeover	Precision	Part Mix
Bowl / Centrifugal	🟢🟢🟢	🔴	🟡🟡	🟡🟡	🔴
Gravity	🟡🟡	🟡🟡	🔴	🔴	🔴
Step	🟡🟡	🟡🟡	Part Specific	🔴	🔴
Conveyor	🟡🟡	Varies	🟢🟢🟢	🔴	🟢🟢🟢
Flexible Feeding	🟡🟡	🟡🟡	🟢🟢🟢	🟡🟡	🟢🟢🟢

3 Trends Impacting Parts Feeding

Mass Customization

- Increase need for customer specific products
- Shorter product life cycle
- Ramp up for new products must be quick and easy

Miniaturization

- High tech industries packing more features in smaller footprint
- Require smaller parts, difficult to handle by hand

Part Complexity

- Advanced technology creating more complex parts, combining different materials (metal – plastic, rubber, composites)
- Highly engineered products = difficult to feed parts

4

Getting Started

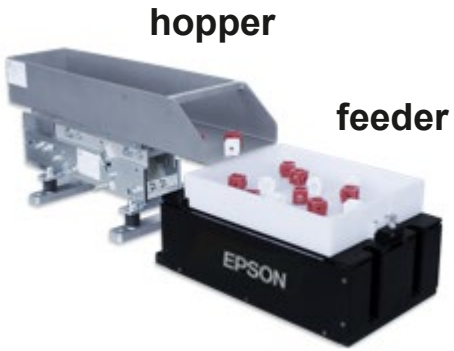
Important Considerations

1. Essential Components
2. When Do You Need Machine Vision
3. Parts Feeding Optimization
4. Pitfalls to Avoid
5. Integration

Essential Components

Feeder

- Evaluate your process needs for part volume vs. mix when selecting a feeder
- Consider tradeoff between cycle time, precision & flexibility



Hopper

- Used to provide continuous flow of parts to the feeding process
- Type of feeder will dictate type of hopper

Motion Device

- Electric or Pneumatic slide
- More flexible solution such as SCARA, 6-Axis or Delta robots
- Consider long and short term needs when selecting a motion device

Controls

- Robot controller
- PLC, Ethernet/RS-232 & I/O

Robot Selection

Payload: part weight
plus
end of arm tooling

Machine Vision

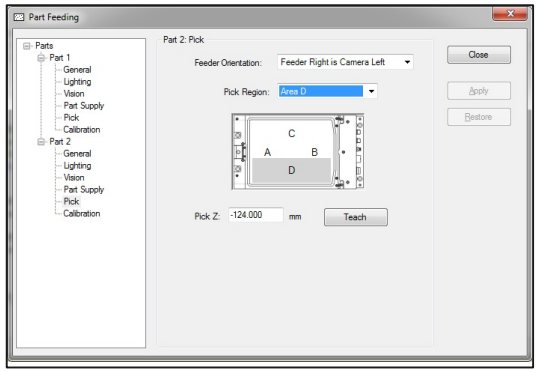
When is Vision Needed?

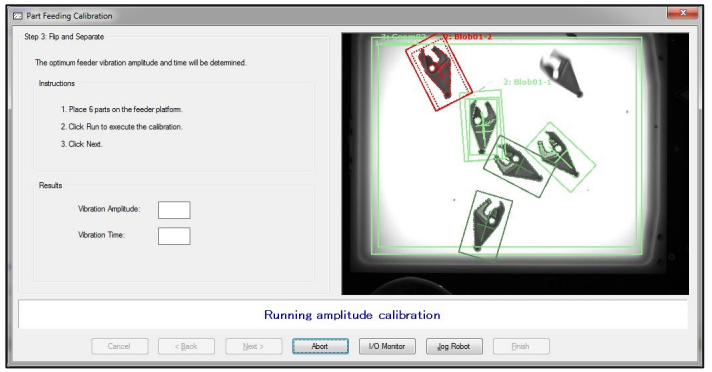
- Find parts when feeder does not put the parts in a fixed position

Conveyor Tracking
Flexible Feeders

Advantage

- Key component to flexible feeding and conveyor tracking
- Improves precision & placement
- Vision helps robots adapt to different parts, short runs and change overs





iii Parts Feeding Optimization

Staging Area

- Include staging area as a buffer when there are no parts ready to be picked up by robot
- Especially useful when fixed cycle times are critical

End-of-Arm Tooling

- Select right EOA Tooling for your part
- Rule of thumb is to pick from top of part, picking from side requires additional vision programming
- Multi-headed tooling or dual grippers can improve throughput

iv Pitfalls to Avoid

Part Types

- **Part Features to Consider:** Shape, length, width, thickness & weight
- **Examples**: Fasteners, Clips, Diaphragms, Connectors, Components, Brackets, Tubes
- **Part Features to watch out for:** Angles, Grooves, Flanges, Protrusions, Curved Surfaces

Part Complexity

- Part complexity determines feeder type requirement
- More part features (protrusions) = More different part orientations
- Wet or oily parts require special feeder lining
- Special feeder coating may be required

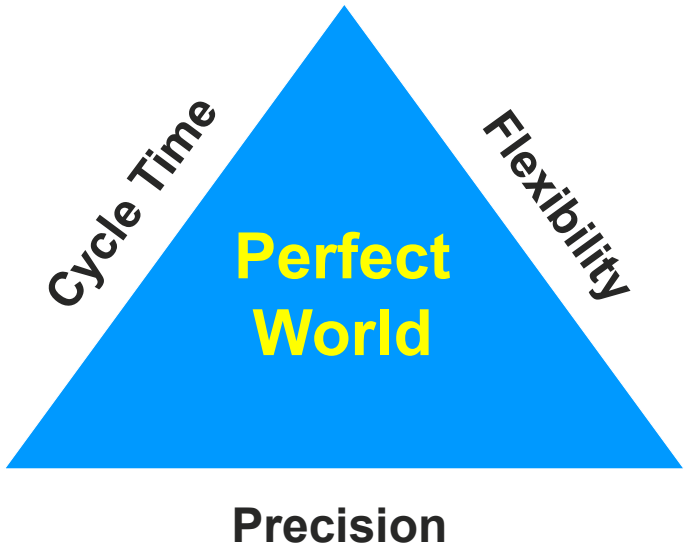
TEST YOUR PARTS

Difficult to Feed Parts

- Parts that can bind together (i.e. springs)
- Extremely thin & lightweight
- Silicon parts
- Magnetic parts
- Ceramic parts
- Soft, flexible parts that can change form
- Round or cylindrical parts

iv Pitfalls to Avoid

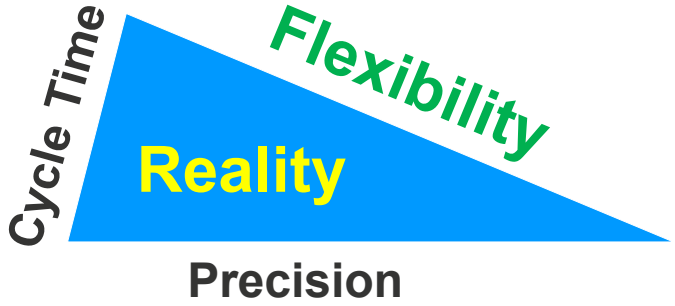
Determine Your Application Requirement Upfront



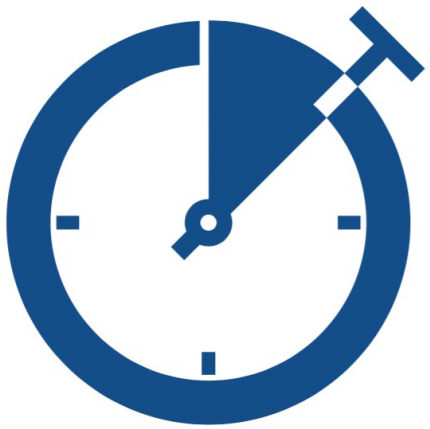
iv Pitfalls to Avoid

Bowl Feeder

Flexible Feeder



iv Pitfalls to Avoid



Fixed Cycle Time

- Parts must be fed at absolute time intervals
- Used with indexing machines

Average Cycle Time

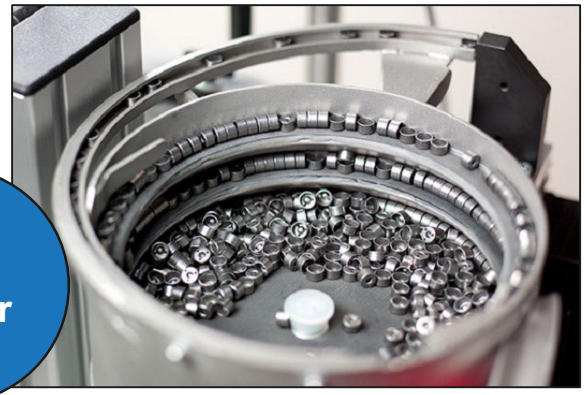
- Parts are fed at flexible time intervals
- Requires that an overall average is maintained to hit cycle times

Flexible feeders can accommodate <u>both</u> fixed and average cycle time

v Integration

Who will build your parts feeding system?

Manpower: In-House Resources vs. System Integrators



Components: Robot + Bowl Feeder
Interface: I/O
Integration Level: Easy

Components: Robot + Feeder + Vision
Interface: Ethernet
Integration Level: Difficult to Easy

Summary

1. Parts feeding is required for most assembly applications
2. Before feeder selection, think through your current and future part needs
3. There are many parts feeding solutions available depending on your part needs & requirements
4. Mass customization, miniaturization & part complexity are all pushing growth in flexible feeding
5. Avoid the Pitfalls (Tradeoffs, Changeovers, Fixed vs. Avg Cycle Time)

Test Your Parts!

Thank you!

For more information, please visit

www.epsonrobots.com

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