ADM Unit 1 | Mission Brief 1.5

Manufacturing Throughput Investigation

Use production data to increase the number of parts processed per hour without reducing quality.

Customer	Department	Difficulty	Time
Orion Manufacturing	Continuous Improvement	Advanced	2 class periods

Production Goal: Increase hourly production using verified software improvements.

Background

Orion Manufacturing expects a surge in demand. The workcell is reliable, but engineers suspect waiting, excessive clearance, and repeated setup motions are limiting output. Teams will compete for the best verified throughput improvement.

Learning Objectives

- Measure throughput and identify bottlenecks
- Apply continuous-improvement methods
- Calculate production-rate improvement
- Present evidence-based recommendations

Equipment

- VEX CTE Workcell
- 6-Axis Arm
- Cubes or disks
- Python project
- Stopwatch
- Spreadsheet or graph paper
- Engineering notebook

Student Instructions

1. Define one production cycle and the required quality criteria.
2. Run ten baseline cycles and record total time, errors, and idle periods.
3. Create a process map showing robot motion, pickup, transport, placement, and waits.
4. Classify at least three examples of motion, waiting, or over-processing waste.
5. Propose three changes and predict their effect.
6. Implement one change at a time and collect new ten-cycle data.
7. Select the best reliable program and calculate parts per hour.
8. Prepare a short presentation with before/after data and remaining bottlenecks.

Engineering Requirements

- Improve verified throughput by at least 20%
- Maintain 100% successful transfers during the final ten-cycle run
- Use at least two different data displays
- Document each program change

Constraints & Safety

- No hardware relocation
- Robot speed may not exceed approved limits
- A controlled stop must remain functional
- Only one variable should be changed between diagnostic trials

Deliverables

- Baseline and final Python programs
- Process map
- Ten-cycle data tables
- Before/after graph
- Parts-per-hour calculation
- Three-minute presentation

Reflection Questions

1. Which bottleneck limited the original system?
2. Did the fastest trial also have the best reliability?
3. Why should engineers change one variable at a time?
4. What hardware investment would produce the next improvement?

Engineering Support

Engineering Tip
Throughput depends on the slowest repeated step, not simply the maximum robot speed.

Common Mistake
A single successful fast run is not proof of a reliable production improvement.

Stretch Goal
Run fifty final cycles and calculate reliability, mean cycle time, and range.

Career Connection
Continuous improvement and industrial engineers use cycle studies to increase output without buying new equipment.

Before You Submit

- Notebook evidence included
- Requirements checked
- Testing documented
- Reflection completed