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SCENARIO 1 – MANUFACTURING BOTTLENECK ANALYSIS

Executive Summary

TechFlow Manufacturing is currently constrained by a single Testing Station, which limits production to approximately 12 batches per day—well below the target of 20. This station represents the **primary bottleneck**, while upstream inefficiencies in Assembly Lines A/B and Quality Control contribute as **secondary constraints**.

To achieve the target throughput, we recommend a three-pronged solution: (1) purchase and commission an additional tester (\$2.5M capex), (2) reduce upstream cycle time by 15% through Lean kaizen events, and (3) optimize labor distribution across shifts. This plan enables the company to scale to 21 batches/day within five months, remaining within the \$3M budget.

Risks such as equipment lead time and validation delays will be mitigated through proactive procurement and parallel onboarding strategies. Success will be tracked by throughput volume, on-time delivery (OTD), and cost per unit.

Detailed Analysis & Key Calculations

Bottleneck Identification and Capacity Utilization

- **Primary Bottleneck:** Testing Station, which operates 16 hours/day and processes 12 batches, resulting in a cycle time of **1.33 hours per batch**.
- **Secondary Constraints:** Assembly Lines A and B, which feed into the Testing Station and may delay flow if upstream cycle times aren't improved.

Current Station Utilization

Assumes 16-hour day for Testing; 24-hour day for others

Process Step	Time/Batch Daily Capacity		Utilization @ 12 Batches
Raw Material Receiving	2.0 hrs	12 batches	100%
Quality Inspection	1.0 hrs	24 batches	50%
Component Assembly Line A	4.0 hrs	6 batches	100%

Process Step	Time/Batch	Daily Capacity	Utilization @ 12 Batches
Component Assembly Line B	6.0 hrs	4 batches	100%
Testing Station	8.0 hrs	2 batches per shift	75% @ 2 shifts
Final Quality Check	2.0 hrs	12 batches	100%
Packaging	1.0 hrs	24 batches	50%
Shipping	1.0 hrs	24 batches	50%

Key Calculations

- **Current Testing Takt Time** = 16 hours / 12 batches = **1.33 hrs/batch**
- **Required Takt for 20 batches** = 16 hours / 20 batches = **0.80 hrs/batch**
- **Post-expansion Takt (with 2 testers)** = 16 hrs × 2 testers / 20 batches = **0.66 hrs/batch** → exceeds target
- **Lean kaizen impact:** 15% cycle-time reduction across upstream steps reclaims **~2.1 hours/day of labor** and reduces energy use by 6%
- **Labor cost addition:** 4 technicians to support expanded operation on two shifts = approx. **\$380K/year** (fully loaded)
- **ROI Calculation:**
 - Additional output = 8 batches/day × 1,000 units = 8,000 units/day
 - Unit margin = \$4 → **\$32,000/day**
 - Annualized benefit = ~\$8.3M/year
 - **Payback period: < 5 months**

Recommended Solutions

To address the identified bottlenecks and enable a scalable increase in daily throughput, we recommend the following actions:

1. **Procure and commission a second Testing Station immediately.**
Place a purchase order without delay to accommodate the 24-week lead time. This investment will directly double testing capacity and is essential to meet the target throughput.

2. **Conduct two rapid Lean kaizen events targeting Assembly Lines A/B and Quality Control.**

These focused two-week sessions will streamline non-value-added steps, reduce cycle time by an estimated 15%, and free labor and energy resources. The improvements will address secondary bottlenecks and improve flow efficiency upstream of testing.

3. **Implement cross-training for current testing personnel during the commissioning window.**

Preparing operators in parallel with equipment delivery reduces ramp-up time and mitigates the learning curve, enabling seamless adoption of the second tester.

These three initiatives are designed to work in concert and remain within the established \$3 million budget while maximizing both near-term impact and long-term scalability.

Implementation Plan & Timeline:

The following five-month plan outlines key milestones required to implement the proposed solution while remaining within the defined budget and operational constraints:

Timeline Key Activities

- Approve capital expenditure for new tester
- Month 0–1** - Place purchase order (24-week lead time)
- Establish project governance team and charter kaizen teams
- Month 1–2** - Complete value stream mapping of Assembly and QC processes
- Execute two focused kaizen events to reduce upstream cycle time
- Receive and install new tester
- Month 3–4** - Perform IQ/OQ/PQ validation
- Conduct cross-training of testing personnel
- Deploy second tester and begin production ramp
- Month 5** - Monitor daily output, shift patterns, and operator performance
- Achieve target throughput of 21 batches/day under steady-state conditions

This timeline ensures adequate time for validation, training, and risk mitigation while meeting operational goals and maintaining business continuity.

Risk Matrix / Mitigations

To ensure successful execution, the following risks have been identified along with proactive mitigation strategies:

Risk	Impact	Likelihood	Mitigation Strategy
Lead-time delays on new tester	High	Medium	Dual-source critical components where feasible; place order immediately and explore expedited shipping options.
Qualification and commissioning delays	Medium	Medium	Conduct early Factory Acceptance Testing (FAT) at the vendor site to catch and resolve issues pre-shipment.
Operator fatigue or overload during ramp-up	Medium	High	Implement staggered overtime schedules and rotate staff across shifts to prevent burnout and maintain morale.
Kaizen event participation conflicts	Low	Medium	Schedule value-stream mapping and kaizen sessions during low-demand periods and include cross-functional staff with coverage plans.

These mitigations will help maintain momentum, reduce unplanned downtime, and support a successful go-live with minimal operational disruption.

Success Metrics & Monitoring:

The success of the proposed improvements will be measured using the following operational and financial metrics:

- **Sustained Throughput:** Achieve **≥ 20 batches/day for 4 consecutive weeks** post-implementation (target: Month 5).
- **On-Time Delivery (OTD):** Maintain **≥ 95% OTD rate** across customer orders.
- **Labor Efficiency:** Reduce **overtime hours by 40%** within two months following go-live.
- **Cycle Time Reduction:** Improve end-to-end process time by at least **15%** through kaizen interventions.
- **Cost per Unit:** Lower cost per unit by leveraging improved efficiency and capacity utilization.

Progress will be tracked via daily production dashboards, labor utilization reports, and OTD metrics reviewed weekly by the operations leadership team. A formal post-implementation review will be conducted at Month 6 to validate impact and capture lessons learned.