

# M21 Knife Delay Lean Manufacturing Study

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## Overview

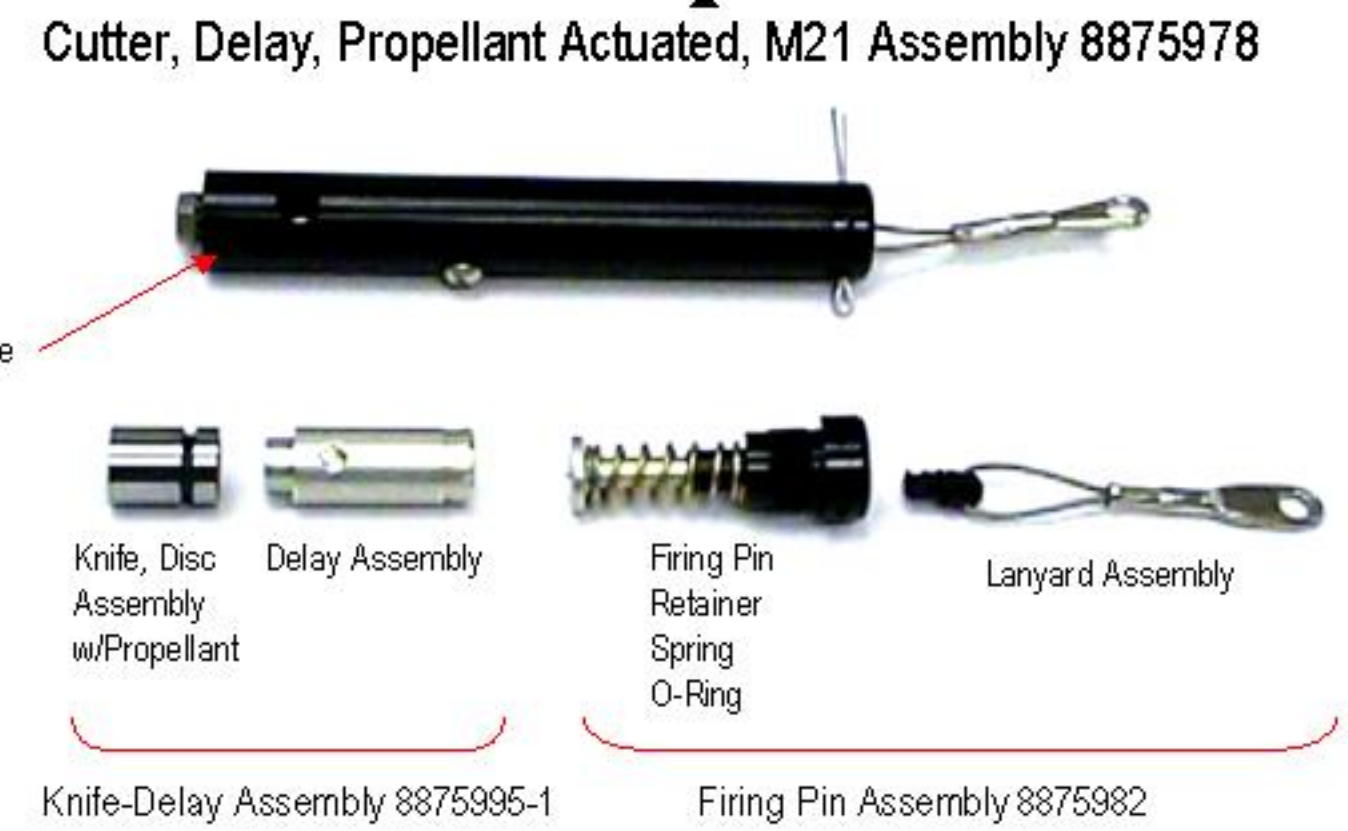
**Project Objective**  
To show how lean manufacturing principles can be applied to improve Indian Head manufacturing operations.

**Approach**  
An in-depth study of the M21 Knife Delay manufacturing process to identify improvement opportunities in CAD/PAD manufacturing and to predict potential benefits for the product family of delay cartridge and impulse cartridge programs.

**Primary Recommendations:**  
Create two manufacturing cells for manufacturing this product family and install leak test, right-sized X-ray, demag, demag test, and auto-weighing equipment.  
Consolidate operations and support activities when feasible.

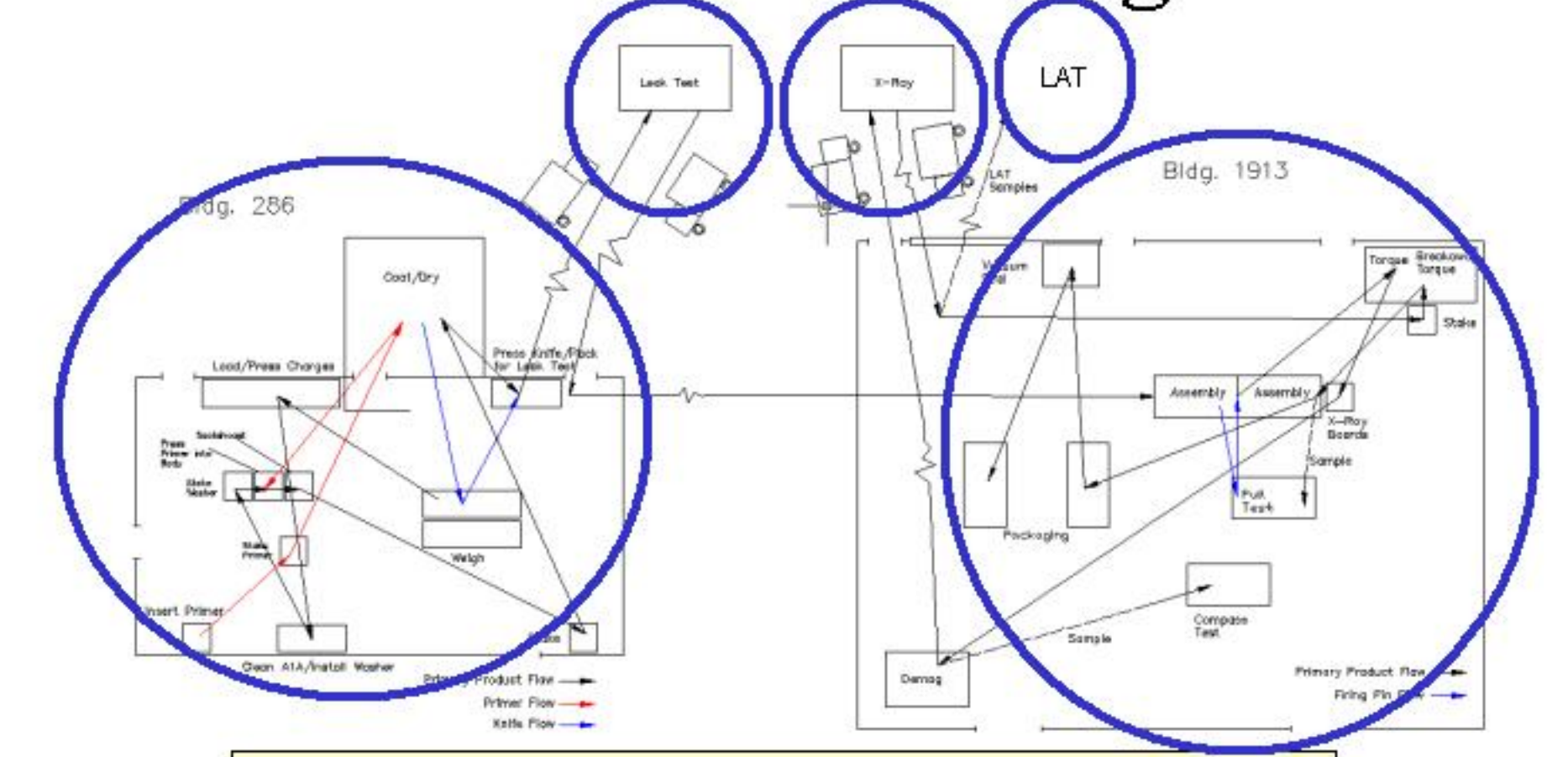
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## M21 Components



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## Current Manufacturing Process



Five facilities required to make devices.

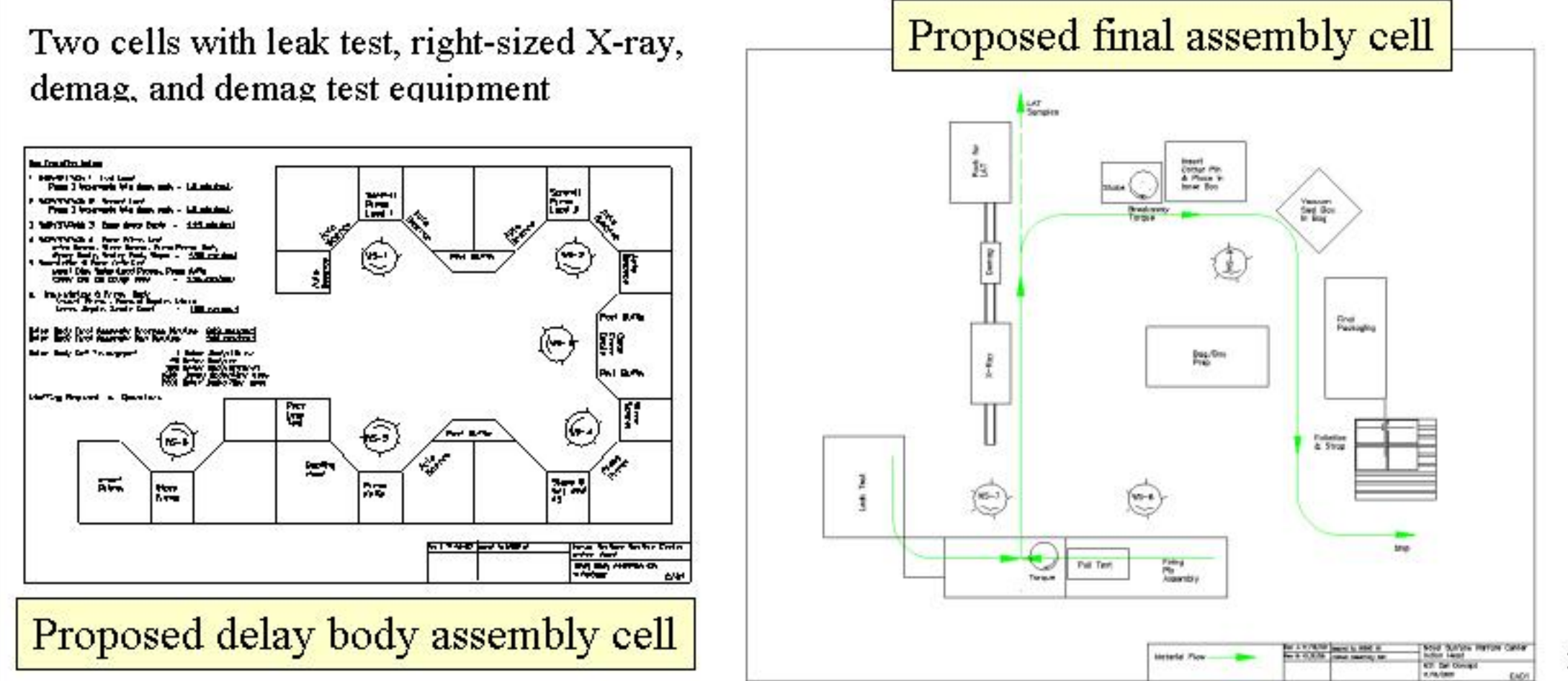
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## Methodology

- Darrin Krivitsky and Katie Macey from CAD/PAD Manufacturing Division participated in project.
- Project team visited all steps of manufacturing system to collect data:
  - Studied sample parts
  - Reviewed part drawings, standard operating procedures
  - Created charts of process flow
  - Videotaped operations
  - Made drawings of workstation layouts
  - Interacted with operators
- Analysis conducted with data collected on-site and that provided by CAD/PAD Manufacturing.
- Results validated by Indian Head collaborators.

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## Primary Recommendation (A)



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## Primary Recommendation (A)

**Return on Investment**  
Annual requirements of M21 and similar products: 24,000 units per year.  
Labor reduction: from 89 to 35 minutes per unit; from 35,600 to 14,000 hours per year.  
Cost savings = \$2,110,000 per year (at \$97.49 per hour)  
Estimated investment = \$415,000  
X-ray: \$95,000  
Demag: \$10,000  
Demag test: \$10,000  
Training and equipment relocation: \$100,000  
Education and consulting: \$200,000  
**Net savings = \$1,695,000 the first year, \$2,110,000 out years**  
**Payback period = 2 months.**  
**Increased capacity = 2,800 units per month (regular time).**

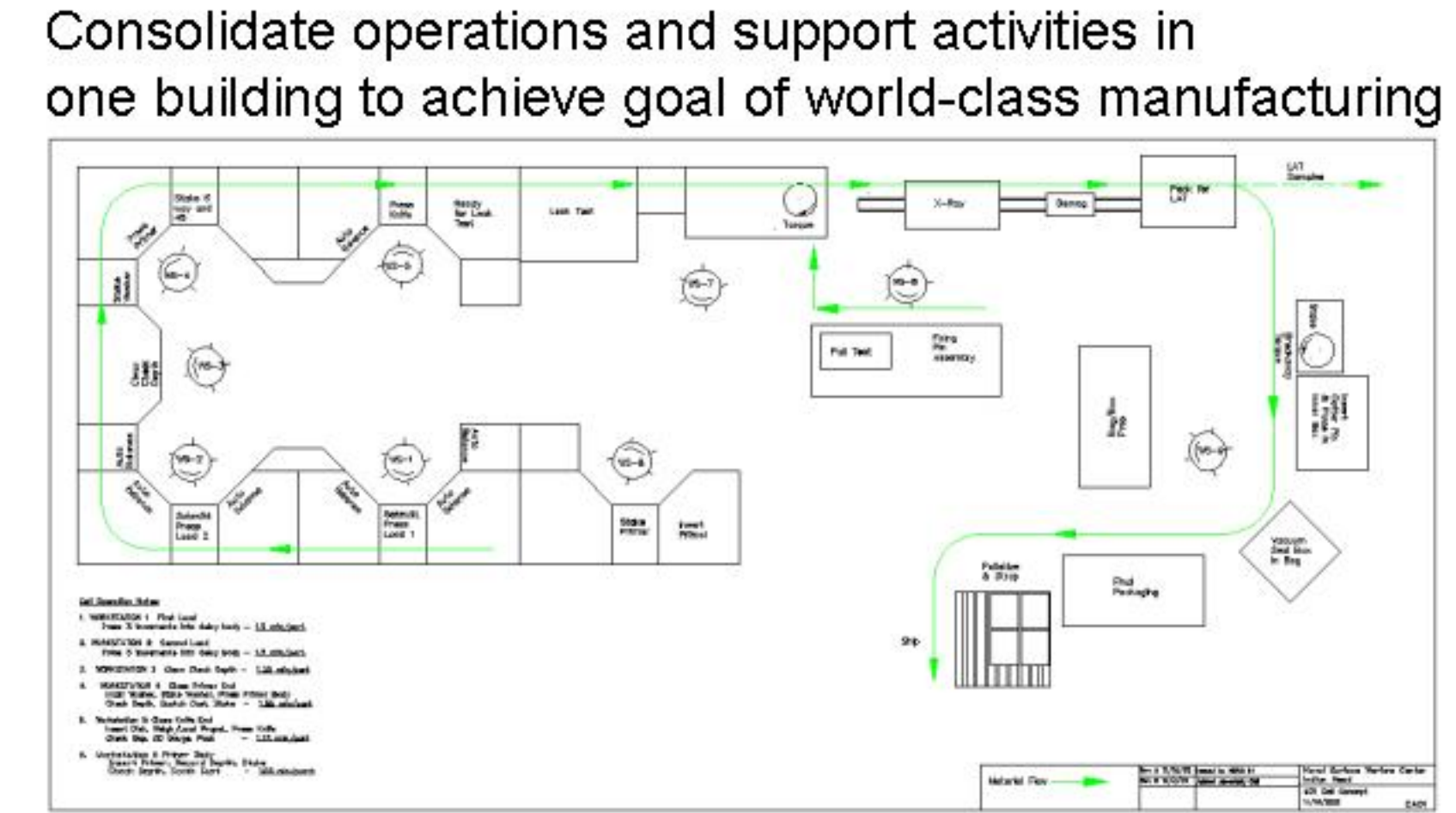
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## Primary Recommendation (B)

**Add auto-weigh equipment to delay body assembly cell.**  
**Return on Investment:**  
Annual requirements of M21 and similar products: 24,000 units per year.  
Labor reduction: from 89 to 18 minutes per unit; from 35,600 to 7,200 hours per year.  
Cost savings = \$2,770,000 per year (at \$97.49 per hour)  
Estimated investment = \$555,000  
X-ray: \$95,000, Demag: \$10,000, Demag test: \$10,000  
Autoweigh: \$120,000  
Training and equipment relocation: \$120,000  
Education and consulting: \$200,000  
**Net savings = \$2,215,000 the first year, \$2,770,000 out years**  
**Payback period = 2 months.**  
**Increased capacity = 5,500 units per month (regular time).**

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## Primary Recommendation (C)



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## Conclusions

The M21 Knife Delay study designed two lean manufacturing cells and estimated the operational benefits of these cells:

- Significant reductions in labor content,
- Cost savings of over \$2 million per year,
- Additional capacity for more on-site production.

This study also identified other opportunities for improvement:  
Design for manufacturing, better tooling and equipment, product & employee organization, and safety and housekeeping.  
An implementation project has begun transforming CAD/PAD manufacturing operations into a world-class manufacturing facility.

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