Using Lean to Prepare for M4.0

Chuck Wetherington
President, BTE Technologies

Chuck's History

Hired into GE's Edison Engineering Program in 1983 from University of Illinois

Held jobs at GE's Major Appliance business in quality, manufacturing engineering and production management

Harvard Business Review

Product Development

Cold Competition: GE Wages the Refrigerator War

by Ira C. Magaziner and Mark Patinkin

https://hbr.org/1989/03/cold-competition-ge-wages-the-refrigerator-war

Moved to Black & Decker and then Fypon before becoming one of the buyers of BTE

Joined the NAM board in 2007, Executive Committee in 2012 and became SMM Chair in 2018

National Association of Manufacturers

- Serve as the nation's largest manufacturing industrial trade association for every sector and segment

- Advocate for the interests of 14,000+ manufacturers across the country comprising 90% small and medium manufacturers

- Work for the success of 12+ million people who make things in America

NAM Leadership

Jim Fitterling
NAM Board Chair
Chairman and Chief Executive Officer

DOW

Kathy Wengel
NAM Board Vice Chair
Executive Vice President and Chief
Global Supply Chain Officer

Johnson&Johnson

Jay Timmons
President and CEO

M. NATIONAL ASSOCIATION OF Manufacturers

Charles T. Wetherington
Chair, Small and Medium
Manufacturers Group
President

BTE

Courtney Silver
Vice Chair, Small and Medium
Manufacturers Group
President & Owner

KETCHIE
Since 1947
Precision Machining Solutions

Operational Excellence

Serving operations, supply chain, IT/digital teams

Manufacturing Leadership Council

The MLC provides a forum to share operational best practices used by the most innovative adoption of Manufacturing 4.0.

Best Practices and thought leadership on Manufacturing 4.0 transformation

Quarterly plant tours with executive roundtables on M4.0-related topics

Weekly working group virtual meetings on M4.0-related OpEx, Supply Chain, Technologies, and Leadership requirements

Why M4.0?

Industry 4.0 can unlock significant value across multiple areas of a factory network.

Example areas of value potential in Industry 4.0 (factory network)

Data, computational power, connectivity
- Blockchain
- Cloud technology
- Internet of Things
- Sensors

Human–machine interaction
- Virtual and augmented reality
- Robotics and automation (collaborative robots, automated guided vehicles)
- Robotic process automation, chatbots

Analytics and intelligence
- Automation of knowledge work
- Big data, advanced analytics, and AI

Advanced production methods
- Additive manufacturing (including 3-D printing)
- Renewable energy

Value potential

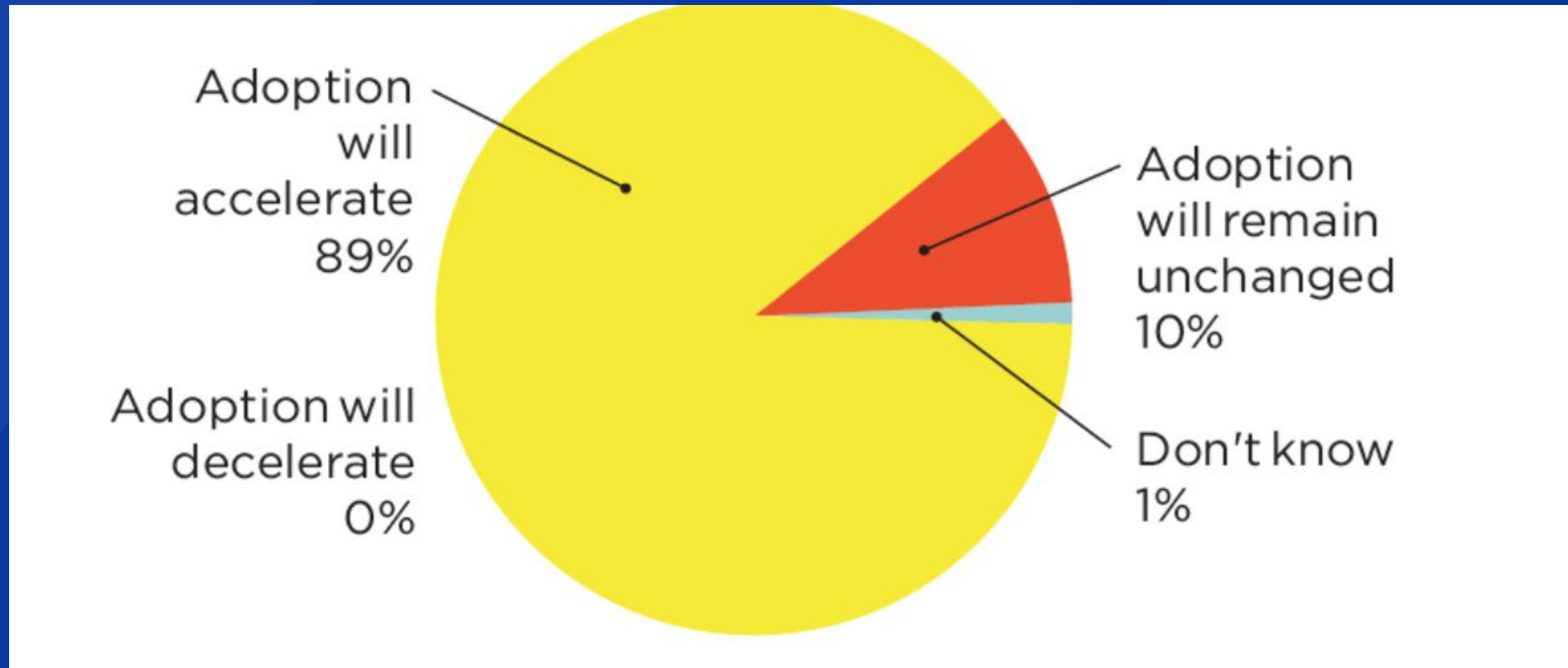| 15–20% inventory-holding cost reduction	15–30% labor productivity increase	30–50% machine downtime reduction	10–30% throughput increase	85% forecasting accuracy improvement	10–20% cost-of-quality improvement

Massive Acceleration of M4.0 Adoption Over the Next Two Years

Do you expect you company's rate of adoption of M4.0 technologies to increase or decrease over the next two years?

Adoption will accelerate 89%

Adoption will decelerate 0%

Adoption will remain unchanged 10%

Don't know 1%

History of Manufacturing

BTe™
The Technology of Human Performance

1.0 — Implementation of machines, powered by steam, water and wind in the manufacture of 'things'
- 1770's-1840's
- Credited with the creation/increase of the middle class

2.0 — Introduction of electricity as power source. Advent of railroads, telegraph and the production line
- 1870's-WWI
- Great economic growth, and shifts in worker skill sets

3.0 — The digital revolution, marked by computerization, use of information, automation, supply chain management
- Late 20th century – marked by vast productivity improvements

4.0 — Interconnectivity, information availability, AI and decentralization of decision making, often autonomously
- Integration between manufacturing, processes and designs

Manufacturer of medical devices for physical therapy, sports medicine and industrial rehabilitation

Our History

BTE
The Technology of Human Performance

Founded in 1979

Purchased in Nov 2001
- 32 employees
- $0 international sales

Merged with Canadian company in 2004
- 49 employees, international 30% of product revenue

Started Workforce Solutions in 2004

Sold in 2019 to public company
- At time of sale, 167 employees

Formed BTE, LLC a 'remain co' that was back to being a products only business – 41 employees

![BTE™ — The Technology of Human Performance]

BTE Situation Analysis

2019 brought about huge changes for BTE

- Trade wars brought Chinese market from 16% to 0% of top line
- In order to maximize return on sale of Inc., LLC carried a lot of balance sheet burden

2020 brought COVID

- Sales stopped!
- Implemented salary reductions and furlough-in-place
- Very successful implementation of virtual work – able to reduce office footprint by 70%

2021 – sales began to return, but our supply chain broke

- Our volumes masked the problems with supply chain until Q4
- Engineering focus turned to supply chain driven redesigns
- A very strong sales year limped to the finish with record backlog

2022 – as material availability improved it unmasked an underlying labor utilization problem

BTE is a very low volume manufacturer

- Our 8 products range in production quantities of 10 to 75 per year
- This makes training difficult, and cross training even harder
- Scheduling process has been make-to-order in batch size of one
- Labor content of product COGS is only 6.5 - 8%
- We have had a difficult time finding electronics techs
- Labor utilization was running at 62%
  - Utilization = Std Cost Applied Hours/Paid Hours
- Analysis showed that material handling time and training were the two biggest contributors to low utilization

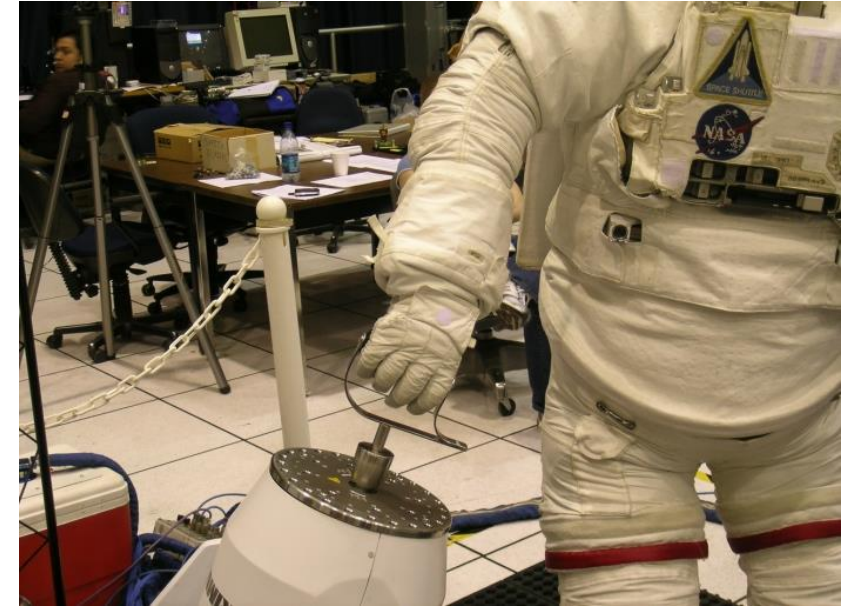- **1,132 unique components**
- **28 hours of labor content**
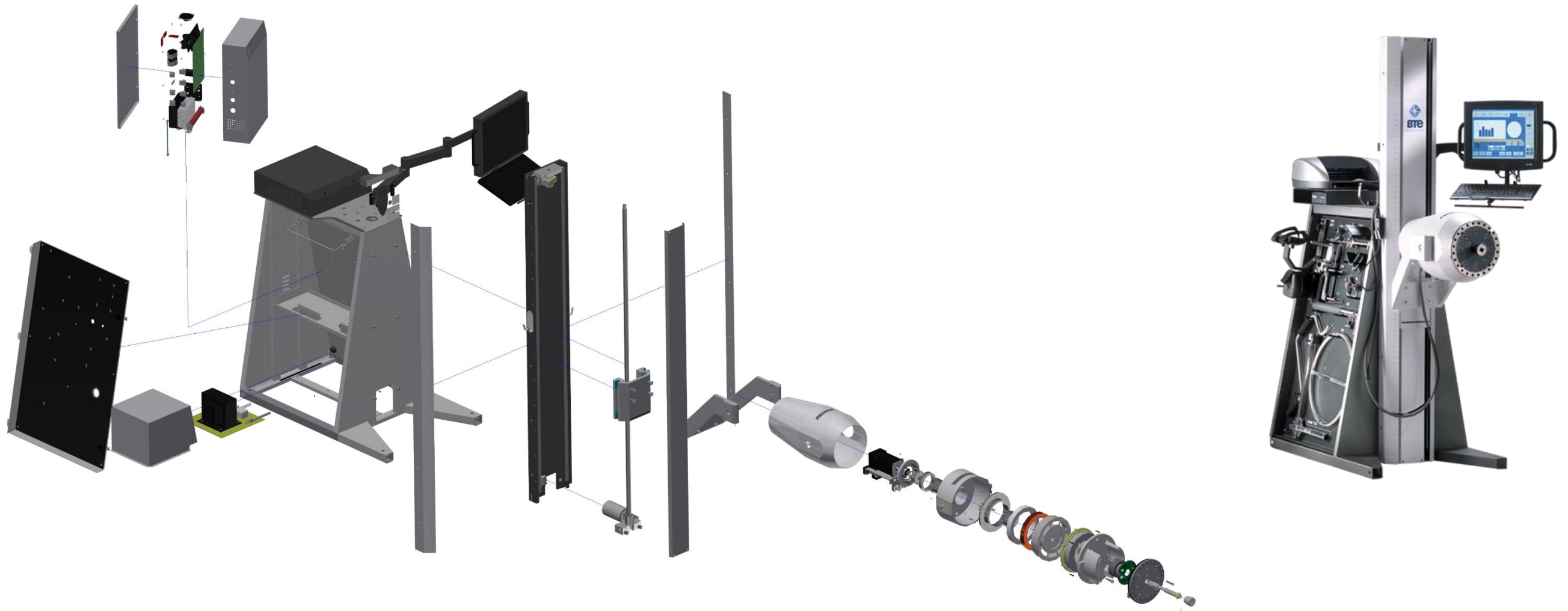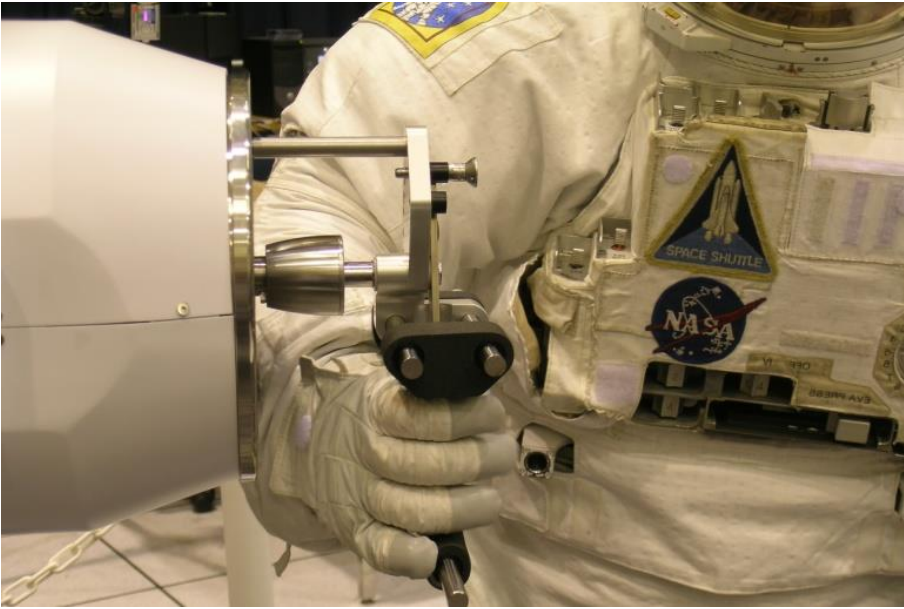
The Technology of Human Performance
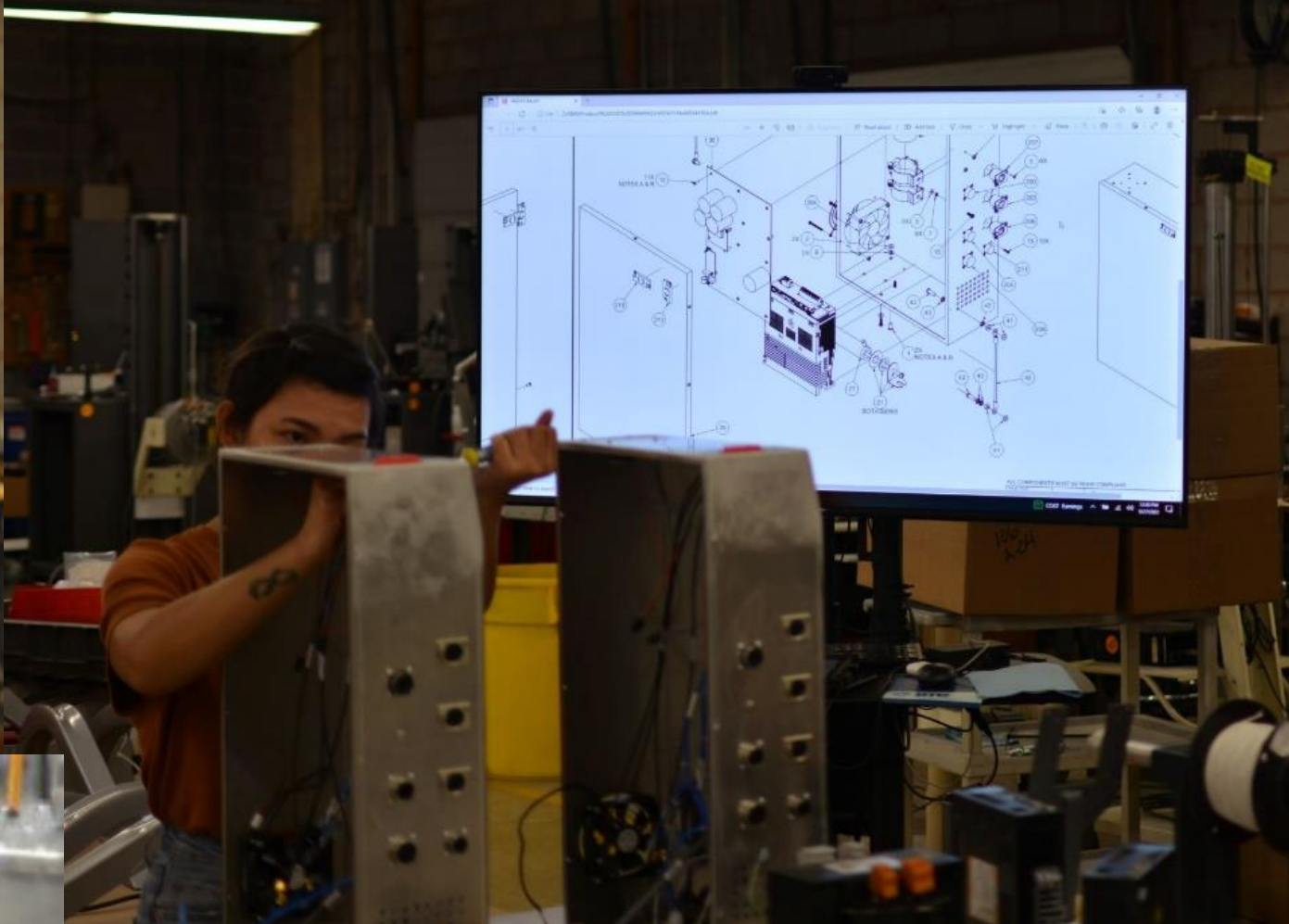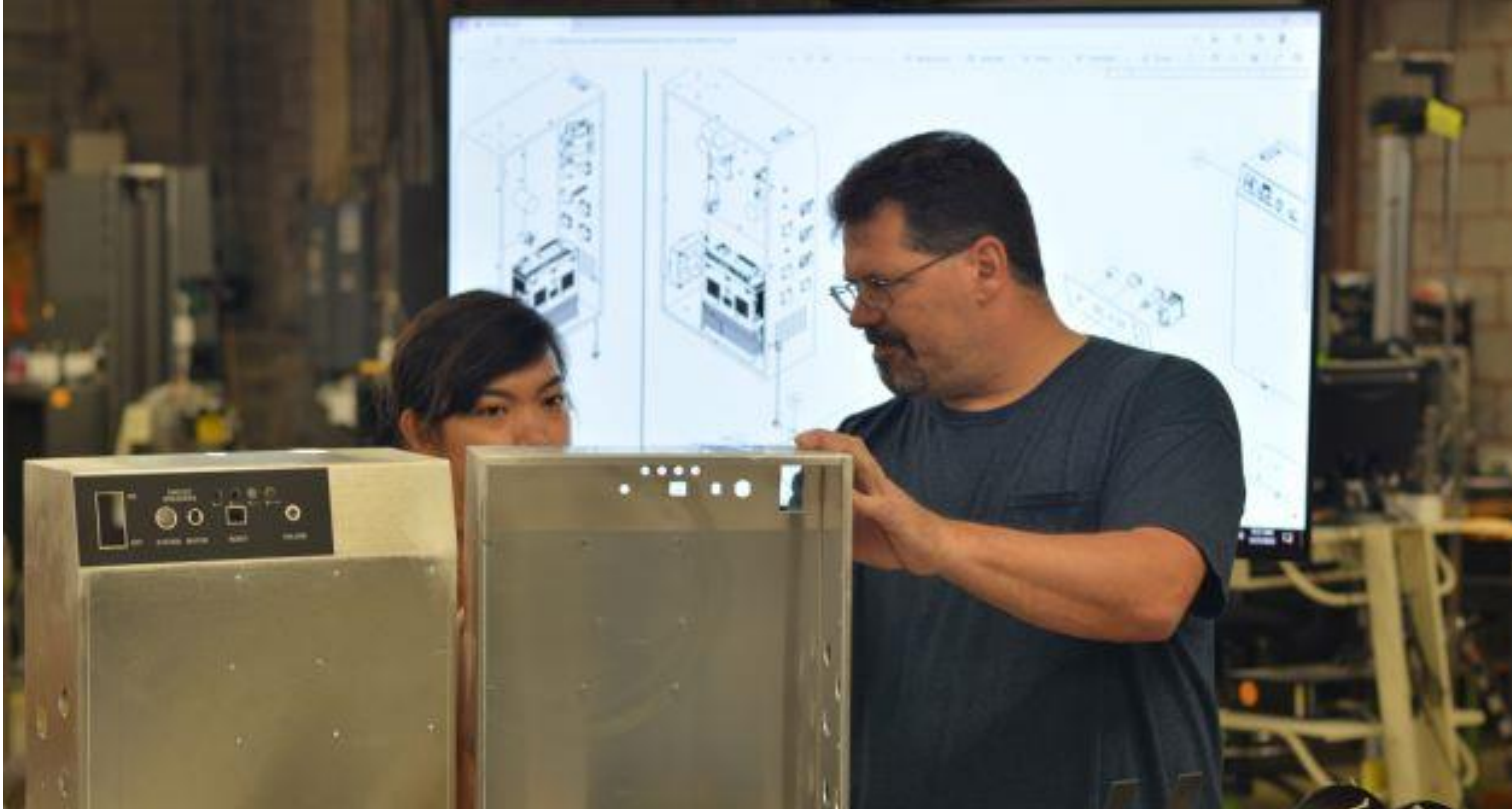
Solution – Batch Manufacturing

- Time to gather material for 5 units is virtually the same as 1

- Focus entire assemble team on working on same modules at the same time. Also changed floor layout and workflow.

- Implement on-floor wifi, portable information displays for drawings, work instructions, routings, etc.

- Given low labor content, impact on FG inventory is not high

Batch Manufacturing Pilot

Set up three manufacturing zones

Attachment assembly	Major subassembly – workhead and electronics drawer	Final assembly, burn-in and final inspection

Batch Manufacturing Pilot

Set up three manufacturing zones

| Attachment assembly | Major subassembly – workhead and electronics drawer | Final assembly, burn-in and final inspection |

Results

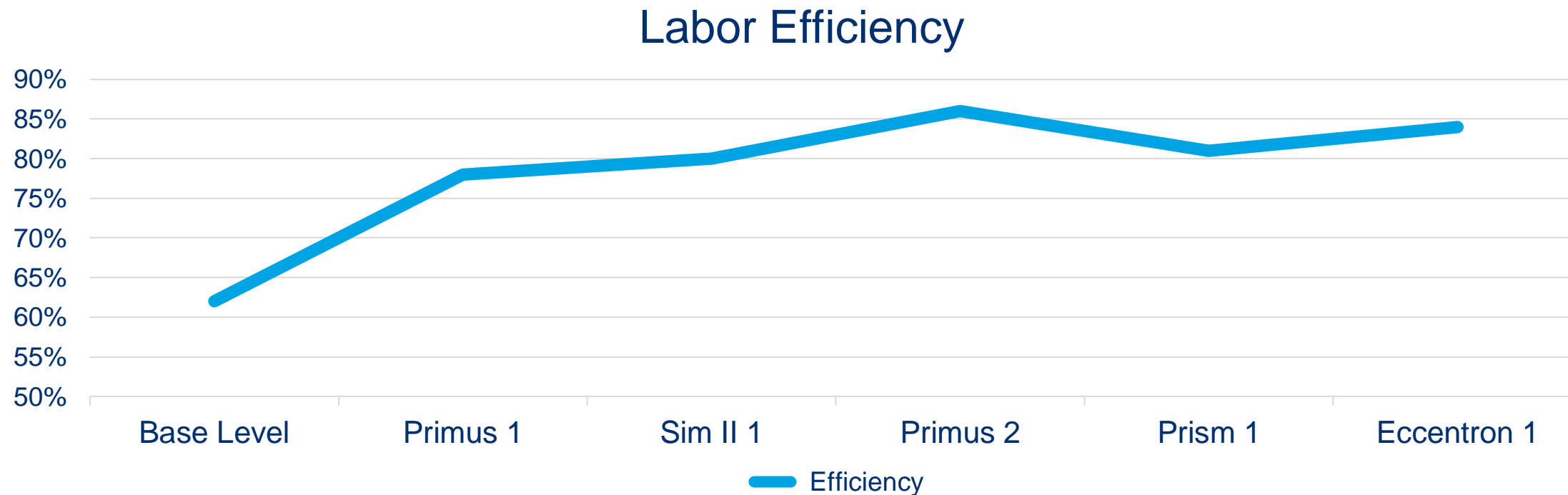| 5 Primus built | Achieved 78% labor utilization | Anecdotally, team enjoyed working together as opposed to individual workstations |

Batch Manufacturing Subsequent 4 Batches

The Technology of Human Performance

Batch runs 2 thru 5

- Since our first batch of Primus, we have run batches of 4-6 units in Sim II's, Primus, Prism and Eccentron
- A few growing pains, but all-in-all steady improvement

Labor Efficiency

	Base Level	Primus 1	Sim II 1	Primus 2	Prism 1	Eccentron 1
Efficiency	62%	78%	79%	86%	81%	84%

— Efficiency

Key Takeaways

- M4.0 is a toolbox, not a rote methodology

- Assess your business, factory, processes

- Determine where the best opportunities lie, and don't chase the easy in lieu of the valuable

- Include your people in the change – up front and often

"It is not the critic who counts; not the person who points out how the strong stumbles, or where the doer of deeds could have done them better. The credit belongs to the person who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiantly; who errs, who comes short again and again, . . . who spends themself in a worthy cause; who at the best knows in the end the triumph of high achievement, and who at the worst, if they fail, at least they fail while daring greatly, so that their place shall never be with those cold and timid souls who neither know victory nor defeat."

Theodore Roosevelt

BTe™

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Theodore Roosevelt

"I don't care if you fall down, as long as you fall on your face, not your butt."

Chuck Wetherington