

TOC World® 2002

~ a legendary conference ~
November 4-7





Reg Begin

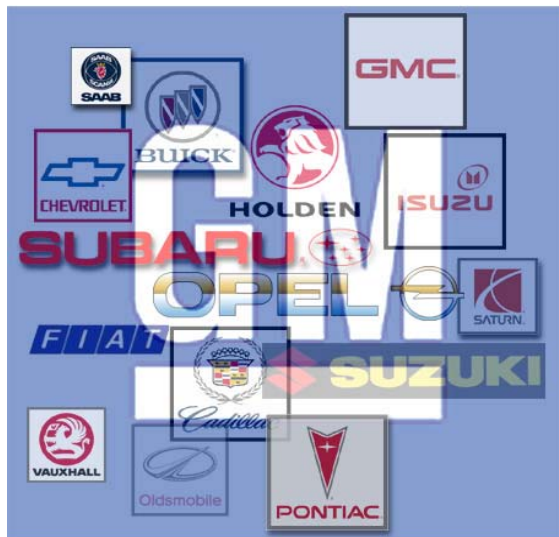
Manager, Supplier Development
GM Worldwide Purchasing

Peter Ellis

Assistant Plant Manager
Delphi Corporation
Sandusky, Ohio Operations

GM's Global "Footprint"

GM and Alliances



- \$80 Billion Annual Direct Material Purchases
- Product Suppliers in 53 Countries
- Total of 9,000 Supplier Manufacturing Locations



Dynamics of Global Supply Base

Dynamics of automotive supply sector have changed dramatically over past 10 years

- **Rationalization / Consolidation**
 - Ten years ago, 30K+ Tier 1 Suppliers;
 - Today less than 8K;
 - Ten Years from now less than 250
- Top 10 global suppliers average just under \$12B in annual sales



Strongly competitive environment

- ***Perhaps at no other time has competing for business been so challenging.***
- ***Demands for price cuts have hit a new high.***
- ***Maintaining sound financial performance is proving too much for many.***

***We are deeply entrenched in a
“ Cost World ” mentality.***



Emerging trend...automotive

In an effort to remain competitive and profitable, new manufacturing system designs try to incorporate the latest thinking to minimize their costs.

Everyone is trying to cut costs...

- Capital investment**
- Equipment capacity**
- Inventory**
- Tooling**
- Material**
- Labor**



Manufacturing designs

Rarely validated using math based throughput modeling

Rarely incorporate a designed in constraint

***Buffers are rarely based on true system variation and...
achieving balanced flow***

***Balanced capacity is thought to be of more value than
balanced flow***

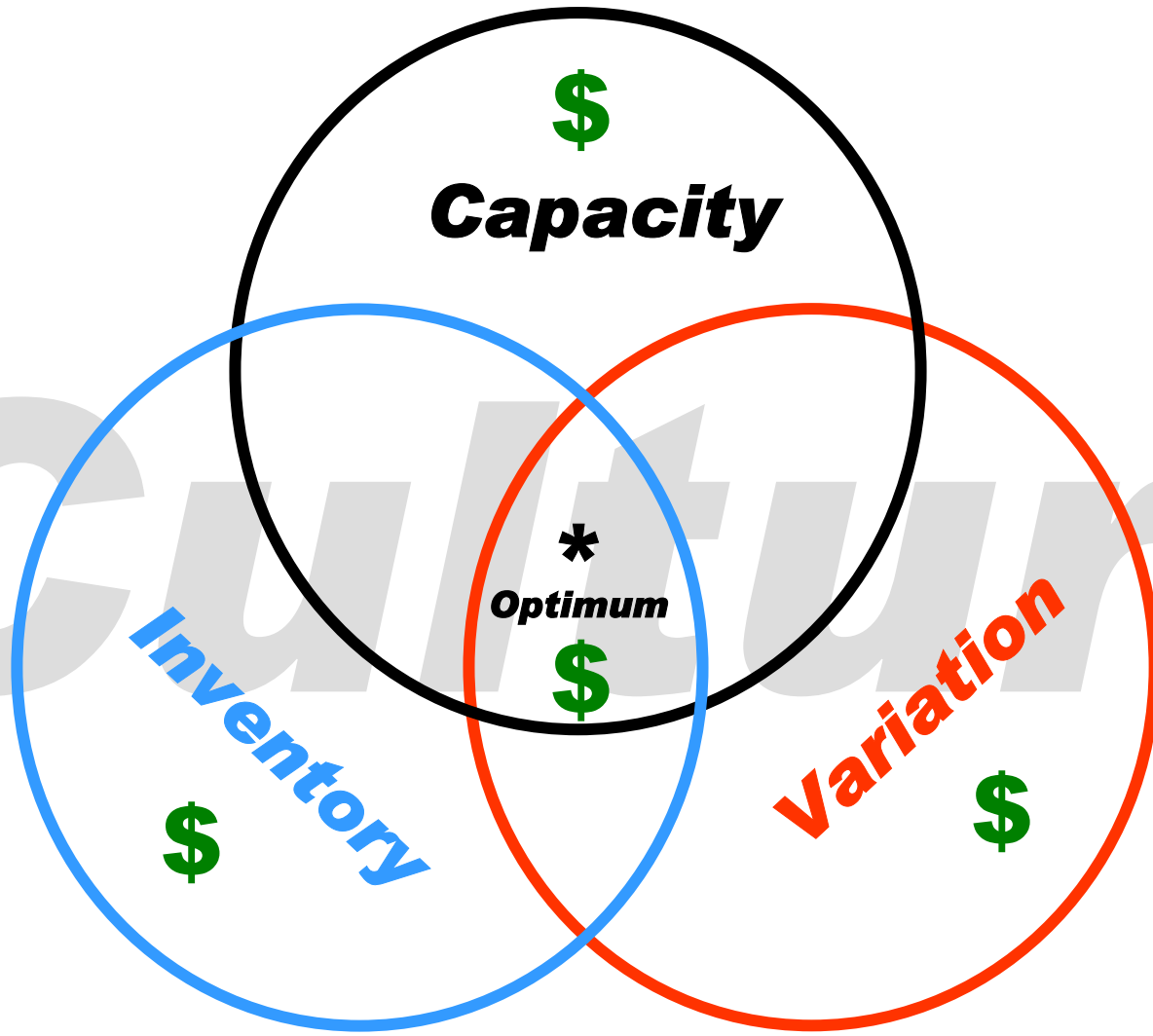
Variation

in combination with

Dependency

Possibly still the most misunderstood phenomenon

Achieving balance



**** Optimal balance of investment / return***



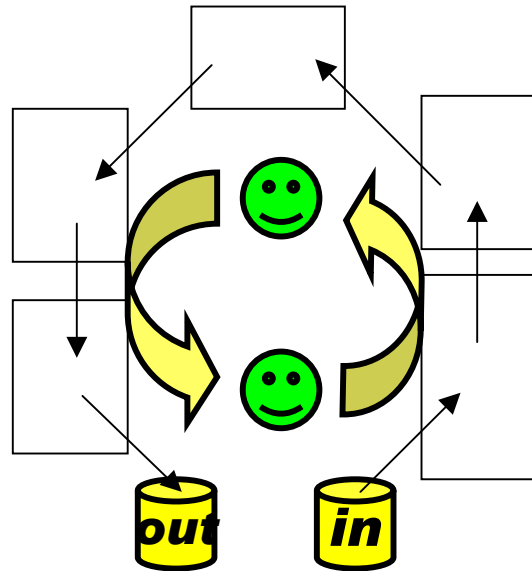
From my experience..

Most North American manufacturers have between 20% and 40% additional throughput potential, with little to no investment required.

“Those who know who don’t know how, don’t know nothing.”

GMT 800 Catalytic Converters....

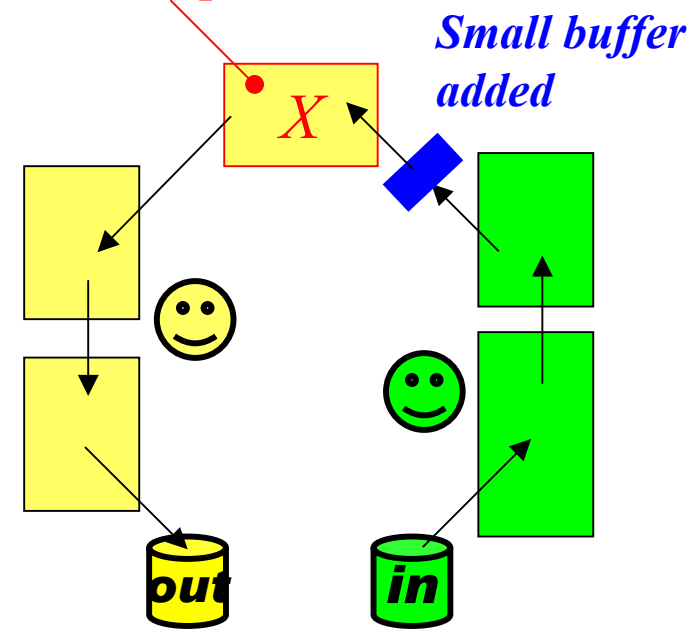
1 of 4 cells
3 shifts
7 days/week



Operators work pattern was a rabbit chase style

1 of 4 cells

Constraint operation



Cell was split to de-couple the effect of variation

Operators work pattern changed to two separate loops

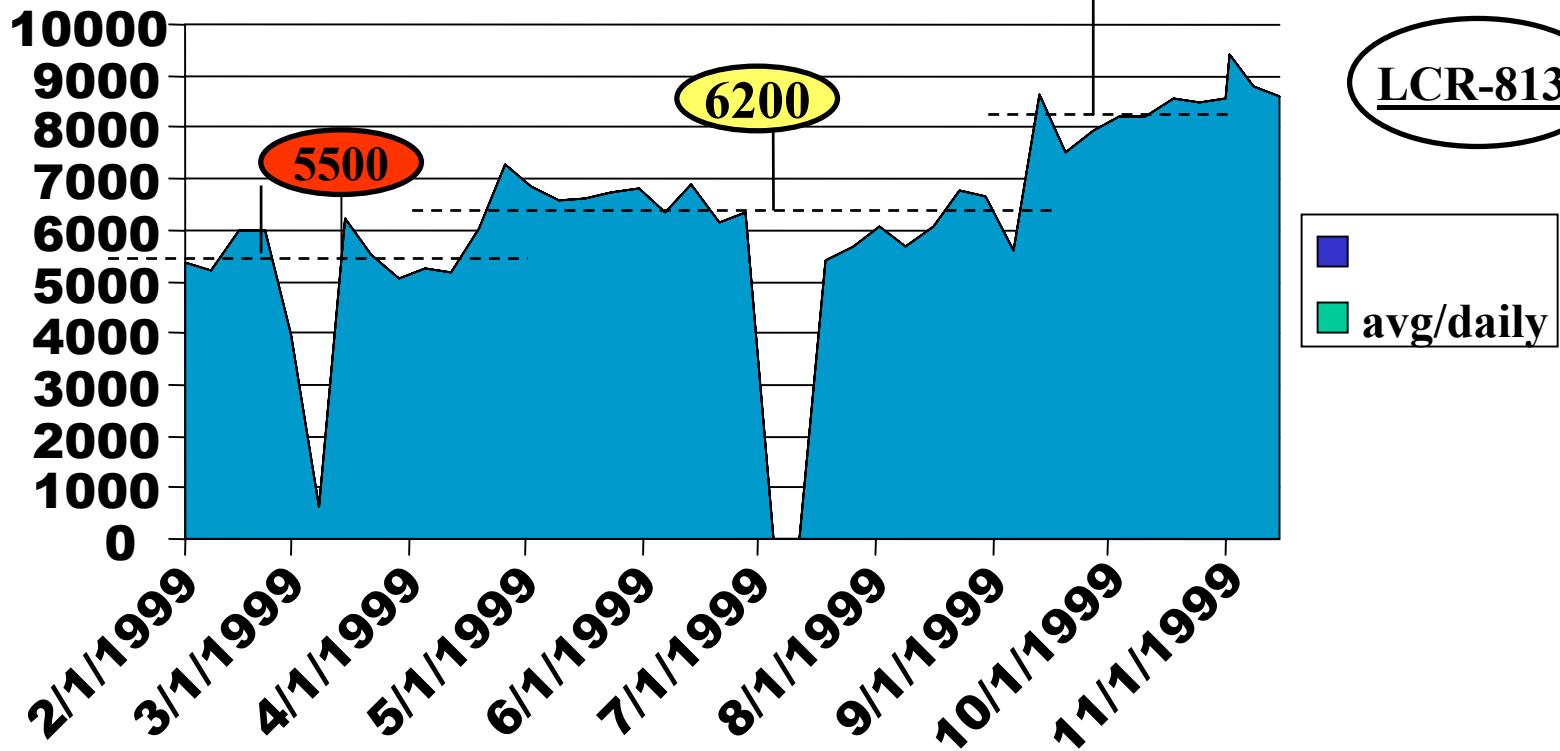
GMT 800 Catalytic Converter Throughput

From 7 days to 5 days/week

65.8%

“8351”

LCR-8138

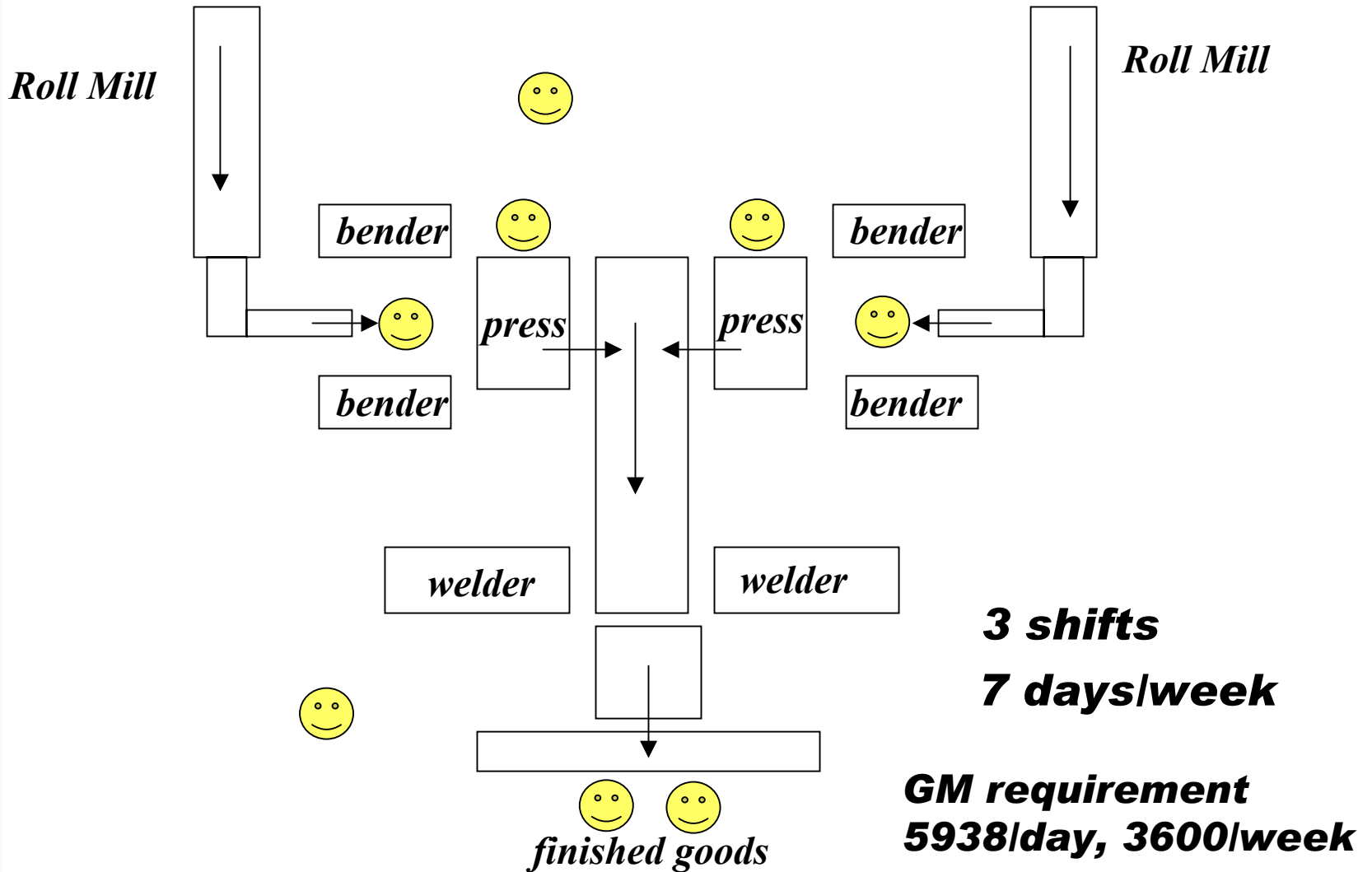


Average Daily Straight Time Build Since Sept 13th (10 weeks), Has Been 8351Units/Day.
(week of 10/25/99 based on only 38 of 60 available shifts having been run)

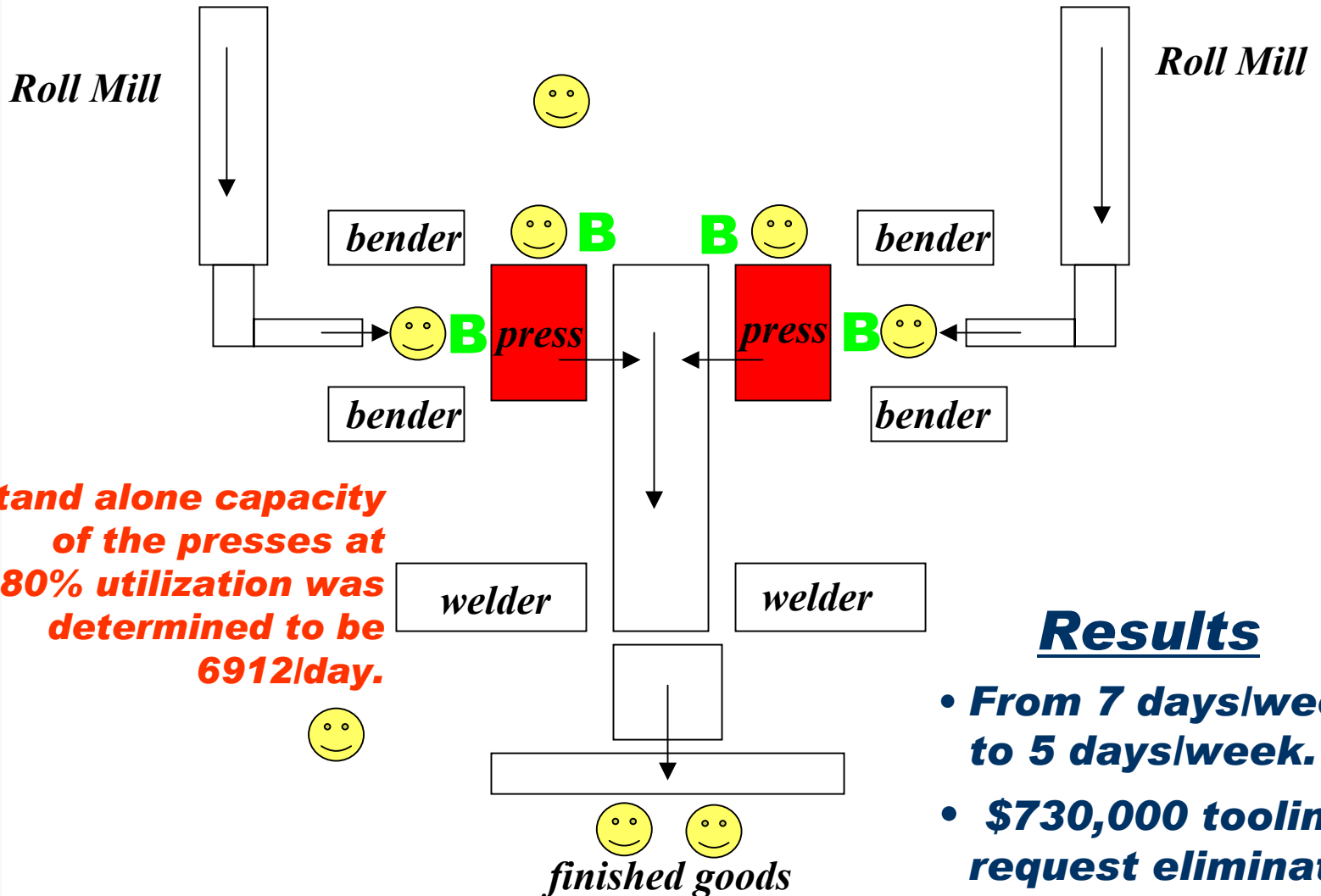
GMT 800 Rear Tail Lamp Assembly Cells

	Current Situation	Proposed Scenario
Total Operators per cell per shift	9	10
Shifts per day cell needs to operate to meet target	3	2
Total Operators needed per cell per day	27	20
# of days/week each cell operates	7 (5 straight + 2 OT)	5 (No OT)
Weekly Straight Time Wages	\$20,973.60	\$15,536.00
Weekly Overtime Wages	\$12,584.16	\$0.00
Weekly Total Wage Expense	\$33,557.76	\$15,536.00
Annual Total Wage Expense	\$1,677,888	\$776,800
Weekly Savings (BOTH cells)		\$36,043.52
Annual Savings (BOTH cells)		\$1,802,176

GMT 800 Header Process



GMT 800 Header Process





Delphi Corporation

- **World leader in mobile electronics, transportation components and transportation systems**
- **179 manufacturing sites**
- **192,000 employees**
- **\$26 billion in annual sales**
- **Largest GM supplier at \$15 billion**

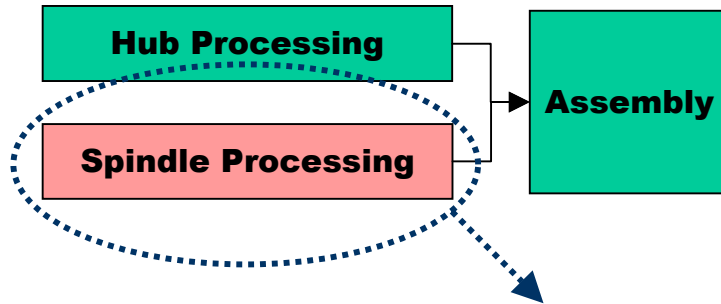


Delphi Energy and Chassis in Sandusky Ohio

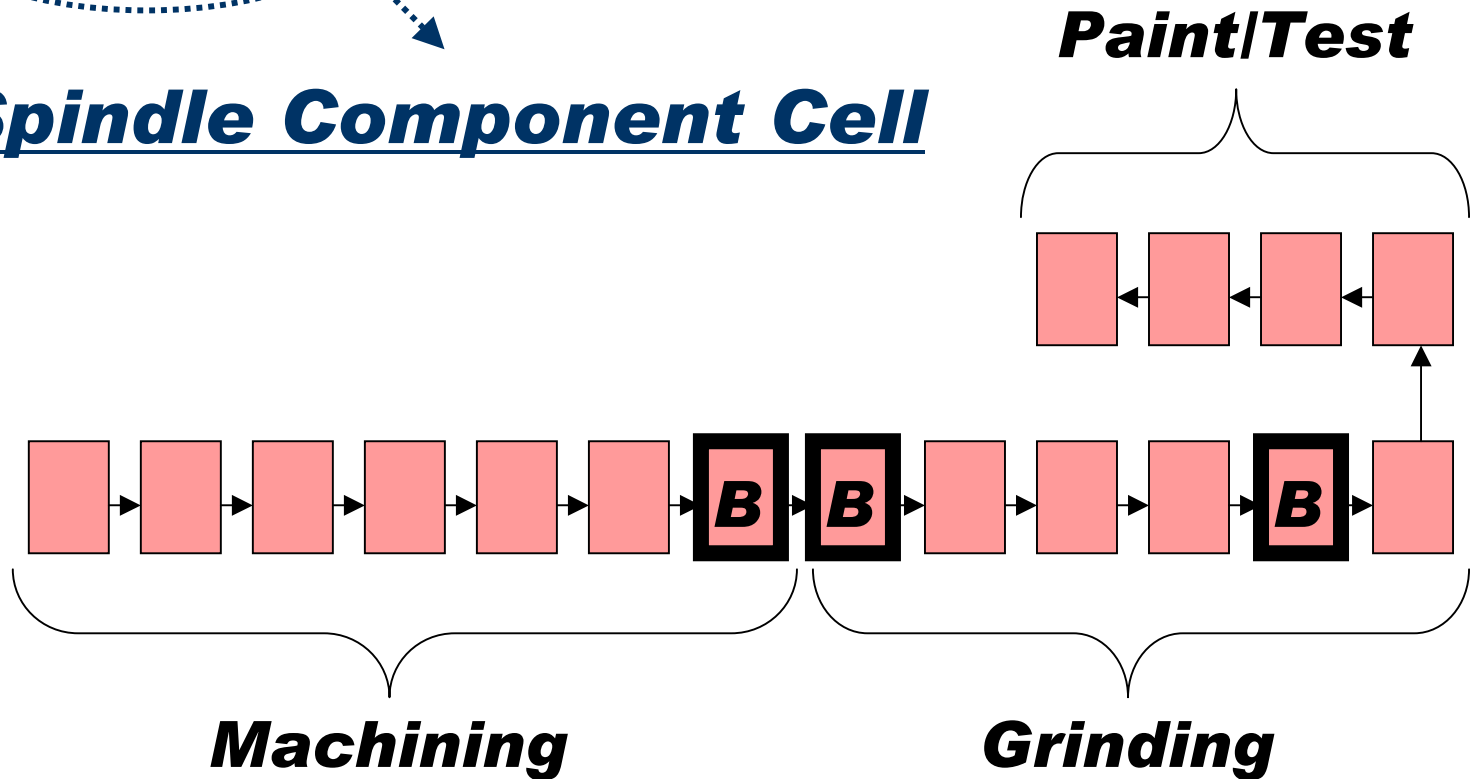
Manufacturer of Spindle and Roller Clutch Bearings

- ***Long established plant 1948.***
- ***Plant area is 1.3 million square feet.***
- ***Workforce of 1150 hourly employees.***
- ***Strong traditional UAW environment.***
- ***Systems consist of old traditional mass manufacturing and new cells.***

Spindle Bearing Cell



Spindle Component Cell



B = Bottleneck Processes at 27 seconds



Spindle Component Cell

Initial Performance

- **Daily requirements were 2,000 per day**
- **Actual average daily output was 1,500 (55% utilization)**
- **7 day/3 shift operation**
- **Ongoing daily struggle to meet deliveries**
- **Frequent premium transportation**

Where did we go wrong?

- **Too many sequentially coupled operations**
- **Optimistic uptime assumptions**
- **Too many processes at or near the same cycle time (no clear constraint)**



Spindle Component Cell

Let's look at the first two issues together:

- A **4** process sequence at **98% Uptime**

$$.98 \times .98 \times .98 \times .98$$

Or

$$.98^4$$

- **End Result: 92%**

If we take this a little further:

- A **17** process sequence at **98% Uptime**

$$.98^{17} = 79\%$$

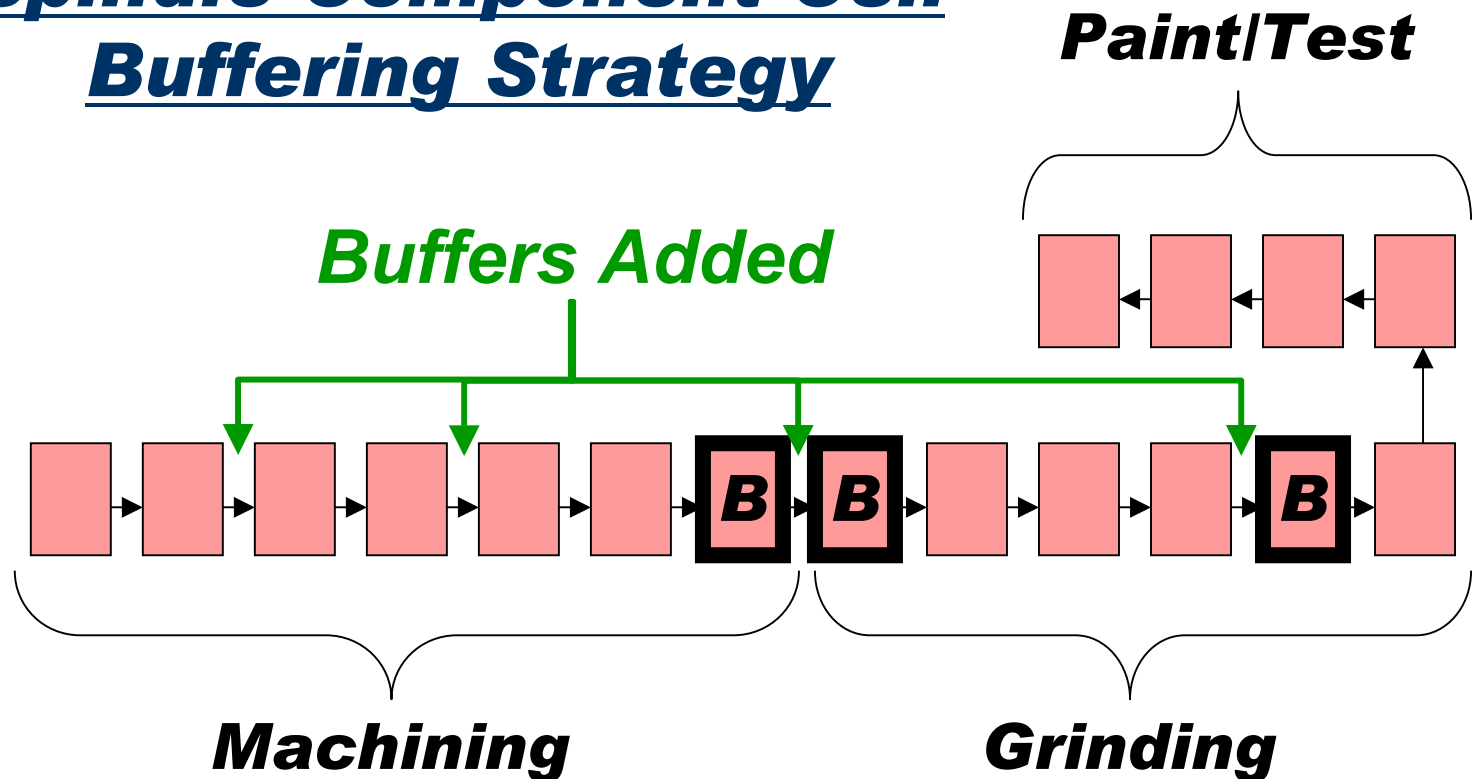
- A **17** process sequence at **97% Uptime**

$$.97^{17} = 60\%$$

Variation in combination with **Dependency**

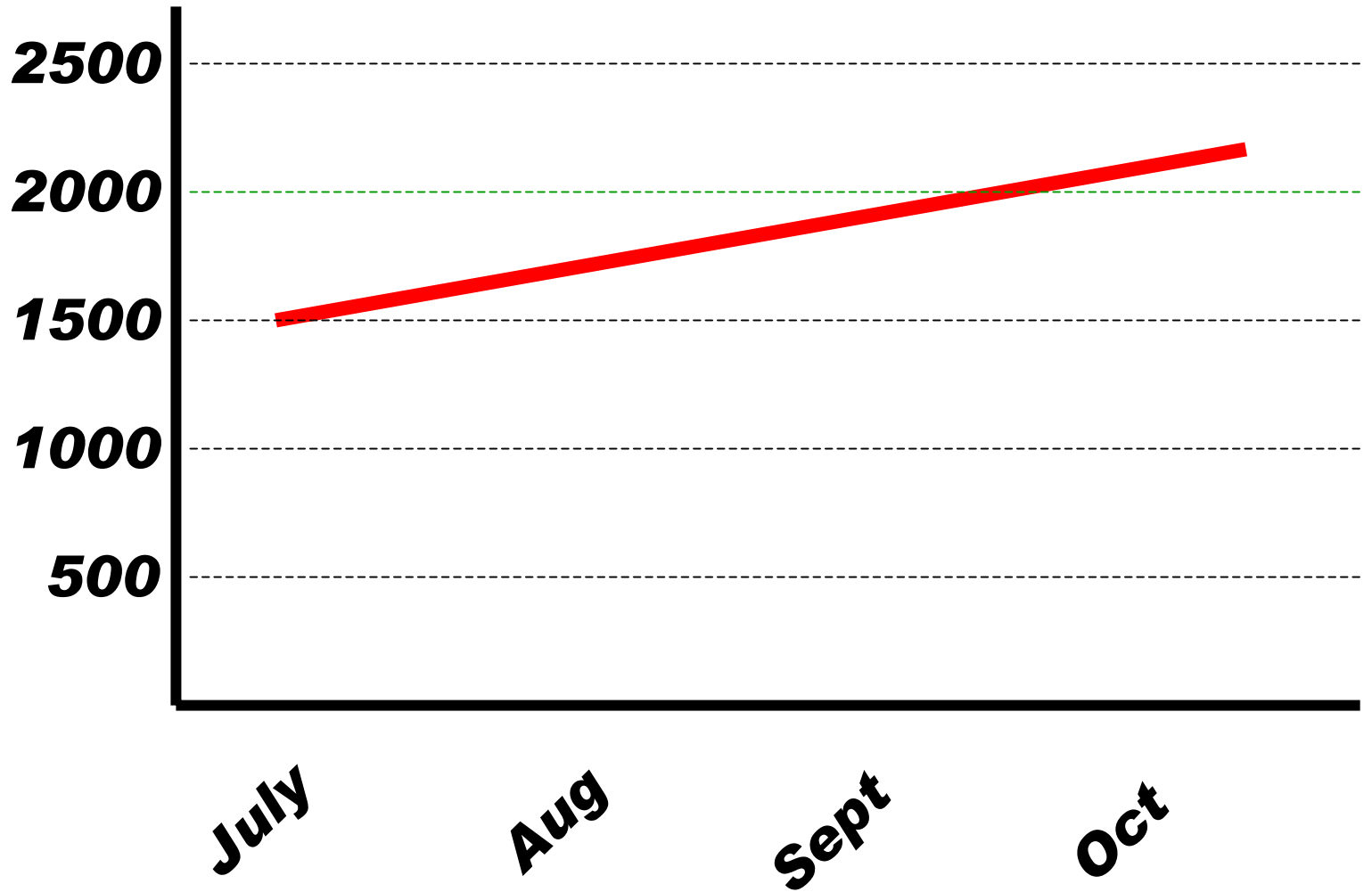
The throughput of the system is highly sensitive to even the smallest of changes in individual process uptime and increases in sensitivity as the number of coupled operations increase.

Spindle Component Cell **Buffering Strategy**



B = Bottleneck Processes at 27 seconds

Results
46% Improvement





Lean Manufacturing

“Constraint Management” is still thought to be a contradictory concept.

Constraint Management



GM is changing...

- Current Experience**
- ISO TS 16949**
- Growing Business Objectives**

- Supplier Relations, - Smooth Launches,*
- Optimal Investment in capital and tooling,*
- Profitability*



Summary...

- ***GENERAL MOTORS WWP continues to embrace TOC (Constraints Management) and incorporating the theory into its business processes.***
- ***TOC will continue to play an even greater role as we expand our efforts globally.***
- ***Broadening the knowledge on Constraints Management to our business partners through education and joint initiatives remains an increasingly important strategic initiative.***