Lean and Six Sigma Tools that work!

### Dean Major September 24th, 2008

September 24<sup>th</sup>, 2008



### <u>Agenda</u>

- Introduction
- Location History/Company History
- Quality Horror Story!
- What didn't work/what is working
- Quality progress
- Lean progress



### Fun Fact:

• According to the book of lists, the fear of speaking in public is the #1 fear of all fears. The fear of dying is #7!



### Famous Quotation:

• "There are two types of speakers: those that are nervous and those that are liars"

• Mark Twain

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#### Introduction:

- Work
  - NNSY&DDCO- 17 years, Nuclear Quality, Nuclear Refueling (make believe nuclear engineer!), Process Innovation, Supply Chain management
  - Siemens/Continental- 9 years, Customer/Supplier
     Planner, Team Leader Customer Logistics, Six Sigma
     Black Belt, Manager of Logistics, Plans and Operations



#### Newport News plant is our Center of Expertise for Low Pressure Gasoline Injection

#### Location Description: Newport News





Industry Week's America's Best Plants

Deka VII

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Newport News has manufactured gasoline injectors for about 30 years

- LPI Headquarters
- LPI Center of Expertise
- Market Support for Americas
- Automotive activity started in 1971
- Injector manufacturing started in 1978
- Production:
  - -4 lines DEKA Multipoint injectors : (DEKA IV,DEKA V and DEKA VII)
  - -Fuel Rail Assemblies
  - -Pressure Regulators and Dampers
- Employees: 600
- Quality certification: ISO TS16949; ISO 14000
- •Surface: 310,000 ft<sup>2</sup>



## Gasoline Systems Subdivisions



### PGSCLPI has a global presence

• P GS C LPI Locations and customer application support

wewport News

1 11

Center of Expertise

Newport News

Monte

#### Customer Application Support

- Auburn Hills, MI-USA
  - Solihul, UK
  - Toulouse, France
  - Stuttgart, Germany
  - Munich, Germany
  - Regensburg, Germany
  - Shanghai, China
  - Seoul, South Korea
  - Kawasacki, Japan
  - Monterrey, Mexico

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Plants

Engineering

Head Office





#### SV P GS C LPI, 30 years experience in Fuel Injection SV P GS C LPI History



# LPI organization supplies engine mounted fuel delivery solutions

#### **SV P GS C LPI Port Folio**

Core Business : DEKA Multipoint Gasoline Injectors



Derivative Business : Fuel Rail Assemblies, Pressure Regulators & Dampers

Derivative Business : Alternative Fuels CNG & LPG Injectors



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# Since 1987, LPI has produced over 300 million injectors

• SV P GS C LPI Production, history and forecast

#### in million of units 55' 54' 49' 42' 42' 42' 43' 35' 32' 28' 18' '03 '04 '05 '06 '07 '08 '09 '10 '11 '87 '99' '91 '95 Newport News Pisa Changchun Monterrey (Fuel Rail)

**DEKA** injectors production



Fuel Rail Assemblies Production in million of units



Pressure Regulators Production in million of units

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#### Six Sigma History/Progress

- Master Black Belt selected fall 2001
- 3 Black Belts selected and trained spring 2003 (BMG)
- 6S Projects are a great success (\$9-10M saved, variability reduced)
- 67 Green Belts trained
- Internal Green Belt Training developed
- 10 Black Belts trained- 8 retained- Core of management team
- Lean Six Sigma in-house training developed
- Decisions based upon good data- root cause analysis



What dictates the customers belief of quality?

• Why do we believe that Toyota has superior quality to other car companies? Is it true?

• Do you know the secret to Toyota's quality?



#### **Quality Horror Story!!!**

- New Product Launch
  - High Cost Automation
  - New product design only built in sample lab
  - 4 months debugging before SOP
- Problems:
  - Oversold capacity
  - Product exhibits failure modes/design change/failures
  - Customer loses temper





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Quality Horror Story (it continues)!!!

- Lose customer quality certification
  - SQE assigned to Newport News
  - Customer de-sources supplier
  - Supplier learns from mistakes
- Customer re-certifies supplier
  - Allowed to bid on future business
  - Progress from Q, 6S, Lean (waste reductions)



## <u>Low historical point due to</u> <u>quality issues</u>

The greatest glory in living lies not in never falling, but in rising every time we fall.

<u>Nelson Mandela</u>



### Quality/Lean Progress

An organization's ability to learn, and translate that learning into action rapidly, is the ultimate competitive advantage.

Jack Welch



#### CUSTOMER FEEDBACK MOR #CF-2: Customer PPM



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#### Customer Quality Performance: 0 km ppm

FY 2008 Target:6 ppmReporting Month:Sept 20086-month average:1.3 ppm

#### Trend NPN Customer PPM 0 km 6-Month Rolling Average By Month of Incident



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## Quality Systems Tools:

#### Process Variability

• Plant wide tracking and recall system for Gage R&R and Capability Studies, includes escalation to top management.

• Established review of SPC as part of layered audits, up to Level 4 audit / Top Management.

 Detailed actions for weak gages and Cpk's

#### FMEA/CP

 Annual review of FMEA/CP via
 Procedures Launcher system.

• FMEA/CPs reviews are mandatory for every permanent change.

• Every 8D Corrective Action requires FMEA/CP review.

 Recurring RPN Reduction Reviews (top 5) Manage the Change

 All changes monitored by PQMs

• Every change requires approvals from PQM, ME, QE, PE and PM.

• Weekly notification sent regarding pending approvals and tasks for each change.

•Every change requires safe launch

#### Problem Solving/Corrective Action

 Status of Corrective Actions are tracked monthly via MOR meeting

• Corporate 8D format address standardizes 8D content (Especially systems and aids Lessons Learned with other facilities).

Frequent reviews with
 Pisa and Changchun

#### Management's Role

- Recurring "Managing the Change" meetings, facilitated by PQMs
- Inclusion of In-Process Metrics in Monthly MOR measures above elements
- Daily Fast Response on Emerging Issues

## Fast Response Meetings



Operations Team Leaders and Plant Manager (David Revill) shown during a daily Fast Response meeting.

#### Fast response is a system that:

- Is facilitated by the Quality Manager
- Standardizes reaction to significant external / internal quality and delivery risks
- Promotes communication and discipline, using daily meetings from 8:45 – 9:15 a.m.
- Utilizes a visual method of displaying important information. Tracks open actions.
- Determines when 8Ds and 5 Why's are needed.

In preparation for the fast response meeting, quality & operations identify significant quality and delivery concerns from the past 24 hours, which include:

- External concerns: customer concerns, supplier concerns
- Internal concerns: significant scrap issues, audit findings, raw material shortages, significant downtime causes, etc.
- First time quality data and delivery schedules



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													LW1. 11/19: Injector insertion problems into Rail: / Corsair. Clips not fully seating. 100% containment inspection hold. Clips in lab for-	LW1. open	
													measurements. Root cause: operator breaking light curtain. Part not properly seated. 11/20 - code updated. Read across to Eagle line?	CW49b. op	en
													CW49b. 6-N failures during TP483 build. Damaged upper coining tool. IC published. Red point established every hour. Need poke yoke-	B. open	
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	/ Rail	В	C	le	۶ĮØ	5		A	D	Ø	Ø		B. Missing o-ring on diagnostic caps on 4.7L. 30 skids pulled back, found clean point after 22 skids. Clean point found. MIR written -	D. open	
													need parts to SQA. Chargebacks accumulated.		
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-								_	_			<u> </u>	A. Reflowed 5000 Y failures. Complete 5 Why for next meeting. Need root cause, risk assessment and disposition.	A open	
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				Τ						ĺ		ľ	LW1. < 5% Fallout Crimp thickness - false rejects on low end - opportunities for improvement? JSturm: modify program needed. New-	LW1. Open	
													<u>gage to have reliable measurements. Target: 12/19 - need 2 hours downtime.</u> I W2. Syneriect complaint leakers, parts en route, 12/11: confirmed leakers. Need 8D to Syneriect, Bruce T.	LW2. Open	
													LW3. Parts coming back from Pisa - expected not to be defective, Bruce T. 11/9: Parts received. Awaiting analysis.	CW49a. op	en
													CW50a. 12/10: Housing issue - OC eyelet. Problem followed housings. Parts in lab - need hardness data also. 12/11: Crimp station	CW50a. op	en
	- I.	~						.		~	~		fallout - crimp thickness high. Problem follows housing lots again. Sorting for housings- qualifying housing lots prior to use. Out of spec narts samples returned to vendor. BOB and WOW are in the lab.	A. closed	en
	Regulator	Ø	۱ø	10				A	В	Ø	Ø		CW50b. Cracked covers after calibration, OC Eyelet is supplier. 5214-02. Parts in the lab. 100% sort of product and covers. Thinning	B. open	
													root cause? 12/13: As parts exit line, parts will be visually inspected. Automatic quality hold, release after inspection. Need to confirm in		
													isped or out of specification. Need parts to SQA. A. Mercedes micradamper shipment at risk due to motor down at station 6. Trying to overnight part.		
													B. Flex II is down, due to CW50a. Tietze: work with product engineering to review. Cracked covers - repeat of CW50b.		
9													C. Cracked filters found - will sort (sponge in box was damp)		
	CNC	a						~	a	a	a			1	
10	CNG	Ø	0	1º					Ø	Ø	Ø				
LW1. Euro regulator tube - leak issue identified at offline leak test. Raised material found on tube sealing surface? Need to measure parts. LW1. Monitoring							toring								
<b>   </b>   															



## Continental Newport News Quality Road Map



### **ZPL Process** Siemens VDO Corporate Initiative

- <u>Zero Tolerance for Defects, Production Systems, Lessons Learned</u>
- Fast Response
- Layered Process Audits / Error Proof Verification
- Line Side Review Process
- RPN Reduction
- Standard Work
- Standard Training
- Control of Non-conforming Material
- First Time Quality
- Read Across / Lessons Learned



### SiemensVDO Automotive 2007 Quality Award-Best world wide plant- Low PPM (1.5)

Why is this important?

The automotive customers demand high quality and award future business to the companies that provide that quality.



Why is this important?

When a large corporation looks at their assets and profitability, a high quality plant award can be the difference between leaving the plant operating, or moving the plant to a low cost producing country.

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#### What didn't work/What is working!

- Did not work:
  - Outside agency performing Lean projects
  - Six Sigma alone (only helps to reduce variability)
  - Management trying to solve everything
- Did work:
  - Top down lean approach and support
  - Culture change to Lean toolbox
  - Hourly interaction



#### Lean History/Progress

- Lean teams- come and go- so does Lean Progress!
- Outside agency performing Lean projects (isn't that nice!)
- Corporate Logistics Lean Supply Chain Analysis
- Corporate Production Systems Development with Lean Principles
- Lean Training- U of M, 36 Spring 2006, 25 Summer 2007
- Corporate Lean Team- strong culture shift
- Internal Lean initiatives successful
- 5S program administered by Hourly personnel



#### Continental P GS C M NPN Lean Enterprise – Goal



### Continental P GS C M NPN Lean Enterprise - Continuous Improvement



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## Continental P GS C M NPN Lean Enterprise – FPY and PPM



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### Continental P GS C M NPN Lean Enterprise – Manufacturing and Supply Chain Roadmap



#### Lean Mapping

EPE- Do you know this Lean term?

Every Product Every:
EPE expresses how frequently a process cycles through the range of variants it must produce.
We may have EPE every 3 weeks, every week, every day, etc.
The lower the time period of the EPE, the leaner the production system.



#### Continental P GS C M NPN Lean Enterprise – Product, Accounting and Six Sigma Roadmap



### Continental P GS C M NPN Lean Projects - Value Stream Mapping

VSM DEKA VII Injectors- Current State- December 2006 Classic EDI 18 Month Forecast SupplyO Production Planning Production 5 Day Detailed For AutoFax 30 Day Planning Suppliers 15 Supplier China, VW, Ford, Synerje onthiv Capacity Planning Monthly Capacity Planning Armature Tube Non-Mag Tube Ball Į¥, 5000 (4 hrs) Warehouse Post Wash Clean Room 3 36000 Components 10,000 (12 hrs) 10,000 (12 hrs) ∕ı∖, Yı Steel Consignment <u>۱</u> 60,000 117.000 22,000 10 000 2 types) VA-External Final F Narehou Steel Consignment 77 2 PA, 0.5 QC 2T: 5 sec **(**2 2PY; :09% 717 4\\_ 5000 (4 hrs) 2500 (2hrs) ∕ ı ∖, 1X Day 45 min 54,000 (2 types) 10.000  $\wedge$ 1.000 1X Day 48,000 152,000 40.00 KanBai KanBa Steel Consignment /+` 24,000 1X Day 45 min 67,000 Eliminatio 35,000 1X Day 45 min 83.000 60.900 36,000 Seats from Supple (1 box) Seat Guide Assy Coll Steel from Supplier (WHSE  $\overline{\Lambda}$ 75  $/ \downarrow_{\downarrow}$ / i \ 10,000 10,000 10,000 (12 hrs) 10,000 Orifices **SIEMENS VDO** Coll Steel from Supplier (WHSE  $\overline{\Lambda}$ 10,000 (12 hrs)

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#### Continental P GS C M NPN Lean Enterprise - VSM Example



#### Lean Mapping

#### **Rules of Future State Design**

First, Create FLOW
Then, flow at the rate of customer demand (achieve TAKT)
Finally, get the system responding only to customer PULL





#### Status: Green

%(	Project Timing	Project Lead	ler: Kevin Francis		
0	7/27/06	Goal:	Improve CNG Operations processing from spaghetti flow baseline level to defined U shaped cells by February 11, 2007.		
		Team members:	CNG Team		
olete		<u>Financial Impact</u> :	380k Euro FY07		
6 Comp		Process owner:	Kevin Francis		
0		Root Cause:	Current part flow has multiple movements from many areas and over long distances. It requires many inventory points and takes a part 2 days to complete the build process. This layout also requires 16 people to operate.		
100%	2/11/07	Results to date:	100% Complete.		
	2/13/06	Plan to closure:	Initial Phase Closed. Continuous implementation of Lean techniques required.		
	September 2	24 <sup>th</sup> , 2008 Co	ontinental Quality and Lean Progress		

Layout and material flow of complete line



- The present situation doesn't meet the Planned Cycle Time with staffing levels at 13 operators per shift.
- Operators wait during process time of machines (that means WASTE
- Because of the large batches inventory is high (more WASTE)
- Walking distances are excessive (more WASTE)



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#### Continental P GS C M NPN Lean Projects – CNG Line CNG Operation – Day Shift



#### $\rightarrow$ ONE PIECE FLOW (operator moving with the part and no waiting time)

- → This layout is based on the changes being made to welding (to eliminate change over time)
- → \*\*\* Supermarket before Cosmo Leak Test is needed to cool the parts (for 30 min approximately) 20 parts max.
- $\rightarrow$  1 PA to deliver supplied material at the beginning of the shift.

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## Continental P GS C M NPN Lean Projects - CNG Line Cells of Operation



Red Point/5S/Housekeeping Zones



### Continental P GS C M NPN Lean Projects – Lean SAW

Flow by Value Stream [Sub Assembly and Wash area]

distanting a



Lean Supply Chain Lean Product Lean Accounting/

hours

- year
- WIP REDUCTION
- ATB WIP reduced by 86%
- LTA WIP reduced by 45%
- Raw material reduced by over 50% (JIT philosophy)
- REDUCED TRAVEL
  DISTANCES
- By 54% inside Clean Rooms
- Single BU Supermarkets
- Delivery by material Train
- IMPROVED WASH PROCESS
- Improved part cleanliness
- "Green" solution: <50% environmental impact Total Annual

Savings: \$645k



Before

distanti pendi

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### Continental P GS C M NPN Lean Projects – Lean SAW Material Flow – Current Layout



### Continental P GS C M NPN Lean Projects – Lean SAW Material Flow – Current Layout



### Continental P GS C M NPN Lean Projects – Lean SAW Material Flow – Improved Layout



### Continental P GS C M NPN Lean Projects – Lean SAW Material Flow – Improved Layout





### Continental P GS C M NPN Lean Projects – ongoing

#### Material Delivery to Cell Operators "Water Spider"



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Lean Product Lean & Process Accounting/ Gevelopment Administration Six Sigme

Lean rufacturing



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## Continental P GS C M NPN Lean Projects – Fuel Rail Fuel Rail Assembly in the Cleanrooms







Lean Accounting/

avings of 6 240 Labor hours Main effect

- Savings: \$ 90.4k USD
- **REDUCED WIP**
- Reduced FR Injectors WIP
- by
  - over 83%
- OPTIMIZED FLOW
  - Injector movements
- reduced
  - bv 80%
  - Large dunnage movements reduced by 50%
- SUPPORT SYNERGIES
  - Supervisor and Technical support consolidated with **Injector Manufacturing**
- ADDITIONAL
- **OPPORTUNITIES**
- Evaluate automatic Test Line



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#### Continental P GS C M NPN Methodology Planned for Goals and Measurement System

## Measurement Linkage

