"The Importance of Attribute Recognition in the Quality Analysis and Control Process at Multinational Automotive Parts Suppliers in North America"

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Background

Educational

Eastern Kentucky University

- Bachelor of Art
- Master of Business Administration
- Master of Science-Manufacturing Technology
- Master of Science-Loss Prevention & Safety
- Indiana State University
 - Doctor of Philosophy-Technology Management with emphasis in Manufacturing Systems (Dissertation Target-2007)

Professional

- Twenty four years in manufacturing with eighteen of these in senior executive positions in Japanese-American automotive factories in North America.
- Most recently as General Manager of Production Planning for a parts supplier for Toyota Motor Manufacturing of North America

Why is study relevant?

- In 2003 Toyota Motor Corporation Surpassed Chrysler as the #3 producer of vehicles in North America. In 2007, they are expected to surpass General Motors as the #1 global supplier of automobiles.
- Since the late 1980's Toyota has opened or announced seven new automobile production facilities in North America with more additional facility announcements pending. Nissan opened new facilities in Mississippi, Honda & Hyundai in Alabama.
- German producers Mercedes & BMW operate manufacturing facilities in Alabama and South Carolina respectively
- With these assembly plants has come additional significant development in supplier networks generally locating close to the manufacturing sites.
- Global collaborative engineering and development activity has now become the norm
- Design and development activity is no longer geographically constrained thus creating new dimensions and new challenges that have not been encountered in traditional manufacturing settings (i.e.: language, location, style)

General Japanese Automotive Parts Development Structure



Japanese Parts Development

- Substantial investment in R&D facilities in Japan
- Original Equipment Manufacturing (OEM) design facilities located in Japan
- Substantial early development activity occurring in Japan
 - Generally local facilities not involved in preliminary design phases indicating a weaknesses in the global concurrent engineering process

Attempts at Global Standardization of Quality & Development

ISO-9000

- Interpretation of the standards
- Rigor of certification varies
- QS-9000
 - Only applicable to the North American traditional automotive producers
 - Not generally recognized by Japanese OEM producers

TS-16949

- The next attempt and global standardization of quality standards
 - Will it address issues of interpretation?



Japanese-American Supplier of Welded & Assembled Components in the Midwest
Facility has operated in North America in excess of five years

- Facility is a wholly owned subsidiary of an eighty year old automotive supplier in Japan
- Facility top management is characterized by Japanese expatriates with subordinate local staff
 - All engineering and development activity coordinated between Japanese parent and expatriated technical staff

Manufacturing Process



Welding Process

RESISTANCE WELDING PROCESS

Before Welding Process (Separate Material Structure) Steel Steel

Steel Piece "A" Steel Piece "B"



Development Structure (DFMEA & PFMEA)

PRIMARY FAILURE EVALUATION ANALYSIS

Process	PRIMARY METAL BLANKING	METAL FORMING	INITIAL COMPONENT RESISTANCE WELDING	FINAL ASSEMBLY RESISTANCE WELDING
Агеа	Material	Process	Process	Process
	Chemical Imbalance	Low spots in die	Improper ∨oltage	Improper ∨oltage
S	Wrong Width & Size	Scrap build up in die	No Water Flow to Tip	No Water Flow to Tip
BASI	Dimensional	Breakage of die	Welding Tip off center	Welding Tip off center
RE E		Poor Machine settings	Holding fixture contaminated	Holding fixture contaminated
ILU		Low points in the dies	Hold pressure	Hold pressure
FA		"Folding" of material	Cold Welds	Cold Welds
		Mis hits in die or double hits	Pin Holes	Pin Holes
		Folding	No Welds	No Welds
		Thinning		
		Splits		

Development Structure (Control Plan)

			CON	FROL PLAN A	ANALYSIS			
Process	PRIMARY METAL BLANKING	Control	METAL FORMING	Control	INITIAL COMPONENT RESISTANCE WELDING	Control	FINAL ASSEMBLY RESISTANCE WELDING	Control
Area	Material		Process		Process		Process	
	Chemical Imbalance	Material Certification and Mill Analysis	Low spots in die	Inspection	Improper Voltage	Check Sheet Machine Setting	Improper Voltage	Check Sheet Machine Setting
S	Wrong Width & Size	Inspection	Scrap build up in die	Inspection	No Water Flow to Tip	Check Sheet Machine Setting	No Water Flow to Tip	Check Sheet Machine Setting
BAS	Dimensional	Inspection	Breakage of die	Inspection	Welding Tip off center	Check Sheet Standard	Welding Tip off center	Check Sheet Standard
JRE			Poor Machine settings	Check Sheet	Holding fixture contaminated	Check Sheet Visual	Holding fixture contaminated	Check Sheet Visual
AILL			Low points in the dies	Inspection	Hold pressure	Check Sheet Machine Setting	Hold pressure	Check Sheet Machine Setting
Ţ			"Folding" of material	Inspection	Cold Welds	Destructive Test Specification	Cold Welds	Destructive Test Specification
			Mis hits in die or double hits	Inspection	Pin Holes	Visual	Pin Holes	Visual
			Folding	Inspection	No Welds	Visual	No Welds	Visual
			Thinning	Inspection				
			Splits	inspection				

Launch Performance

Statistics

SOP Initial Lanuch Performance









Investigation

Cold Weld Analysis MAN MACHINE Machines are not Operators Operators not Pins worn accurate (voltage don't have following flucuation time to do standard checks work **Tips** Coated Inadequate pressure Operators don't Training of Slag build up understand operators on jig nest defects Machines are insufficient wrong for the application Punch die Parts loaded offline wrong Cold Weld Condition Methods do not Not changing tips/pins Coating Material is include enough frequently thickness is incorrect for the defect prevention excessive application Manufacturing **Cleaning frequentcy** Sequence is wrong Material is not enough prone to defects Part alignment Weld setting Material is inaccurate out of spec METHOD MATERIAL Figure (G)

Key Variables Analysis

Current & Pressure Analysis



Number of runsaboul median:	+ 00000	Num berotruns up or down:	7 00000
Expected number of runs:	6.00000	Expecied number of runs:	6 33333
Longesi run aboul median :	+ 00000	Longestrun up or down:	2 00000
Approx P-Value for Clusiering:	0.08986	Approx P-Value for Trends:	0.7097Z
Approx P-Value for Mixtures:	09101+	Approx P-Value for Oscillation:	0.29028

Process Capability Analysis for Current



Short-Teim Capability

Cap	0.12	Targ		Mean	12071.0	%s>USL Exp	63.86	PPM>USL Exp 638573
CPU	-0.12	USL	115500	Mean+3s	16478.5	Obs	50.00	Ob\$ 50000
CPL	0.37	LSL	10450.0	Mean-3s	7663.5	%i⊲LSL Exp	13.49	PPM≂LSL Exp 134933
Cpk	-0.12	ĸ	19	\$	1469.2	Obs	0.00	Obs D
Cpm			30.0					



Expected number of runs:	6.00000	Expected number of runs:
Longesirun abouimedian:	2.00000	Longestrun up or down:
Approx P-Value for Clustering :	0.9101+	Approx P-Value for Trends:
Approx P-Value for Mixtures:	0.03986	Approx P-Value for Oscillation:

8.00000

6.33333

2.00000

0.916+3

0.02367

Process Capability Analysis for Pressure



Short-Term Capability

Ср	0.05	Taig		Mean	297.167	%s>USLExp	65.66	PPM>USLEXP 6	556641
CPU	-0.13	USL	263.000	Me an +3s	551,311	Obs	33,33	Obs 3	333333
CPL	0.23	LSL	238.000	Mean-3s	43 822	% «LSL Exp	24.25	PPM≂LSL Exp 2	242457
Срк	-0.13	к	3.733	\$	84.715	Obs	0.00	Obs	
Cpm			30.000						

Run Chart for Pressure

Post Improvement Analysis

Post Improvement Analysis



Longesliun sboul median. 50	10000 Lo	ongesiun up oldovn. 9	.00000
Appios P-Value foi Cluslering. 00	10985 Ac	pplos P-Value folfiends. 0	
lppics P-Value for Misluies. 0.5	19895 Ag	ppiox P-Value for Cacillation . 👘 🛛 🛛	.91945

Process Capability Analysis for After Im



Figure (I)

"True" Root Cause

Post Implementation Analysis



Conclusion

Japanese Design & Development

-Variables Identification Failure Potentials FAILURE POTENTIAL

North American Production

-Attribute Failure Contribution

Questions?