

PETER CHHIM

Process Improvement & Management: *Elusive Cost Savings for an Automotive Supplier*

On a warmer than usual midsummer day, EXTRIM Corporation's newly minted Quality Manager, Tami Tran, sat at her desk and began sipping away at her ice cold cola as she contemplated what process improvement project she would begin working on next. Tami had just concluded a project that yielded the company significant savings, and the clout that accompanied her success invigorated her. As her train of thought was beginning to gain momentum, the phone unexpectedly rang.

On the other line was Michael Woods, EXTRIM Corporation's OEM¹ plant representative². Michael represented EXTRIM at an OEM facility in Louisville, Kentucky. The plant assembled Sport Utility Vehicles, which prominently featured EXTRIM's roof rack assemblies (See Exhibit 1). Michael was calling to inform her that the assemblers at the plant were complaining of having difficulty in attaching EXTRIM's roof rails to their vehicles.

Michael indicated that the details were sketchy at the moment and that he did not have a chance to visit the plant to see the issue himself. He had received a call earlier in the day from the plant's Incoming Quality (IQ) department, and, being the diligent plant representative that he was, he was simply keeping her abreast of the situation.

Before becoming a plant representative, Michael had worked for the plant as a supervisor for a number of years and felt that he had a good pulse for the plant's culture. He said that he would meet with the assemblers within the next few days and contact her if he needed her assistance. He was confident that he would be able to resolve the issue without any incident.

Tami, being relatively new to the company, and consequently not having much experience working with Michael, was eased by his assuredness. Still, she had enough experience working with OEM customers that she knew that if this issue were to escalate; neither of them would have very much time to react.

BACKGROUND

EXTRIM Corporation is a privately owned U.S. supplier of automotive *exterior trim*³, focusing primarily on luggage racks and truck bed accessories. The company's core business centers on products for SUVs⁴, Trucks, and Minivans. It has been in business for over 50 years and has a

¹ OEM – Original Equipment Manufacturer

² Many OEM suppliers hire OEM plant representatives. These individuals work directly at the plant and give their clients immediate feedback on plant activities and issues.

³ Automotive exterior trim – functional or styling components such as side mirrors, door handles, roof racks, grilles, bumpers, etc., located on the exterior of an automobile.

⁴ SUV – Sport Utility Vehicle

global customer base that consists of nearly all prominent OEM automobile manufacturers. In recent years, it has expanded its customer base to include clients outside of the automotive industry; however, its primary business still remains with the domestic automobile OEMs.

As sales for SUVs and Trucks grew to record numbers in the 1980s and 1990s, EXTRIM Corporation did exceptionally well as its products were making their way onto more and more vehicles. Unfortunately though, the recent economic and political climate of the 21st century caused a consumer shift from SUVs and trucks to smaller, more fuel efficient, passenger cars. This meant that EXTRIM Corporation was selling fewer of its products, and consequently, its overall revenue and profits were shrinking.

To exacerbate the problem, more and more of the OEMs were considering *de-contenting*⁵ luggage racks from their vehicles in an effort to reduce overall costs. These items would then become available only through *dealer options*⁶. This meant that the revenue for EXTRIM Corporation would be significantly reduced as dealer options limited the *take rate*⁷ for its products.

As overall sales figures in the industry continued to decline, competition from abroad fiercely increased. To make matters worse, domestic OEMs were becoming more and more interested in low price suppliers. This made the task of winning *product bids*⁸ more challenging, especially for a supply base that was already having difficulty surviving in a world with considerably lower demand.

Some suppliers undertook a strategy to try and win these bids by quoting products at a *piece price*⁹ loss. If the supplier ended up winning the contract, they would then try to implement process improvements in order to reduce the cost of producing the part(s), thereby increasing their margins in the hopes of turning a profit.

While this was certainly a risky strategy, at times it was absolutely necessary, especially in the case of distressed companies. However, this approach came with a caveat. Since the company was already producing and selling each item at a loss, it needed to quickly implement process improvements in order to reverse the negative margins before the financial strain would become too unbearable for the already distressed company.

Another strategy that suppliers often use to recoup costs and increase profits is to charge premium fees for customer design changes. When these changes occur, they often require compressed timing, or additional resources. Since the changes are often necessary, and the timing is usually compressed, suppliers can charge premium fees to their customers – a large percentage of which is absorbed by the supplier who coordinates the change.

⁵ De-contenting – A term used to describe the elimination of certain product as standard vehicle items, and instead making them available through option packages.

⁶ Dealer options – Vehicle accessories that an automobile customer can choose to purchase from and be installed by a dealer when buying a vehicle (instead of it coming already installed on the vehicle by the OEM)

⁷ Take rate - percentage of vehicles that a component is used on

⁸ Product bid – A quotation submitted from a potential supplier in order to obtain a sales contract

⁹ Piece price – The quoted price of each product sold to the customer

During these turbulent times, EXTRIM Corporation acquired several contracts where they were willing to absorb a loss on piece price in order to remain operational. The strategy was deemed necessary in order to remain solvent in such a difficult market environment. When EXTRIM was awarded these programs, the leadership explicitly communicated to the management teams at its various facilities that significant process improvements were necessary in order for the company to make a profit. At the corporate level, the company even developed the so called ‘value added / value engineering’ team to work with the plants on identifying improvements that could be used to reduce costs.

PROCESS IMPROVEMENT AND MANAGEMENT

As suppliers to the OEMs, a risky strategy that companies sometimes undertake is underbidding on piece price cost in order to win contracts. The rationale being that the company can strive for operational improvements that would decrease production costs, and in turn allow the company to make profit. An effective method of doing so is to assign resources to process improvement activities. Some common examples are shown in the table below.

Table 1: Process Improvement Methods and Objective

Method and Objective	Definition
Benchmarking	Benchmarking is the process of comparing one's business processes and performance metrics to industry leaders and/or best practices from other industries.
Just-in-Time	Just-in-Time is an inventory and quality management practice that reduces a business's in-process inventory and the accompanying costs for carrying it.
Lean Manufacturing	Lean Manufacturing is a construct which consists of practices that reduce the expenditure of resources for any goal other than the creation of value for the end customer.
Six Sigma	Six Sigma is a process improvement methodology that improves process outputs by identifying and controlling sources of variation.
Theory of Constraints	Theory of constraints is a management practice that seeks to improve system outputs by identifying and managing constraints within the system.
Kaizen	Kaizen is a Japanese term that refers to activities which are geared towards continuous improvement of processes.

PDCA	Plan Do Check Act (PDCA) is a four step problem solving process.
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In order to identify whether a process has improved, it must first be measured. Inherently then, any process improvement must be exposed to some form of control or management. The management of process changes has different requirements based on governance. For example, all OEMs have unique formal process management systems that their suppliers must adhere to when considering and conducting a process change. In addition, Tier-2¹⁰ suppliers who are certified to an Inter-, or Intra-national quality standard such as ISO¹¹, have specific requirements for managing process changes as well. EXTRIM Corporation is ISO certified, and both a Tier-2 and Tier-1 supplier.

Typically, if an element in a production process is changed, for example, outsourcing a stamping operation, or changing a parameter of a manufacturing process, a member of the plant wishing to outsource the operation would contact their customer's process management representative and initiate the request to change the process. The supplier and customer would then complete certain requirements pertaining to the change, and, if approved by the customer, the supplier could then implement the change. Typical change notifications are provided in Exhibit 2. The purpose of this notification process is to serve as a change management process that ensures the proposed change is viable, robust, and does not negatively affect the current state for both parties involved.

EXTRIM CORPORATION – FOWLerville ROLL FORM & ASSEMBLY PLANT

EXTRIM Corporation's roll forming and assembly facility is the site of this case study. These manufacturing processes constitute EXTRIM's oldest division; however, the current plant was recently erected at a new location in Fowlerville Township, Michigan in early 2000. The plant runs two 10-hour shifts per day, 4 days a week and employs between 75-100 employees. Its organizational structure is provided in Exhibit 3.

The plant provides product as both a Tier-1 and Tier-2 supplier. As a Tier-1, some of its customers include Ford, Toyota and Honda. As a Tier-2, the company provides component products to its sister facilities for final assembly.

The Roll Form and Assembly plant is EXTRIM Corporation's smallest facility. The plant consists of a dozen roll mills, a few small stamping dies, and various assembly cells. To ensure a quality product, critical-to-customer part characteristics are checked at the startup and during the run of each of its manufacturing processes. These product audits are used to verify whether the manufacturing processes are producing product within desired product specifications. The findings of these audits are captured on the corresponding inspection forms (Exhibit 4).

¹⁰ Tier-1 refers to a direct shipping supplier to the OEM's, while Tier-2 refers to a direct shipping supplier to Tier-1's

¹¹ ISO refers to the International Organization for Standardization, an international body that develops various industrial and commercial standards for industry.

Fowlerville's strategy for confirming that its manufacturing processes are producing products within specifications varies based on process capability and risk. If a process has been identified as being volatile, i.e., it cannot consistently produce product within desired product specifications, then it requires constant monitoring. Consequently, its inspection frequency is enhanced to minimize the risk of producing defective product.

Generally, once a manufacturing process has been setup and is ready to begin running production, five consecutive parts are run and checked for conformance to specifications. The setup operator performs the initial checks and then notifies the team leader for review and concurrence. After the team leader has approved the checks, a member of the quality department is notified for final concurrence and approval. If all three parties agree that the checks are acceptable, then the process is authorized to begin production. If not, the process must be reviewed for adequacy, adjustments made accordingly, and the approval process re-initiated.

Data on part characteristics is typically used as a point of reference to inform decision making at the local level. For example, once a roll mill has been setup to run a job, and the initial approval is completed, the mill may run an hour's worth of production before an *in-process*¹² check is performed. This check is typically completed by the operator running the mill. If it is discovered that a part characteristic is outside of specification, the process is stopped and the entire run of product produced since the last approval is checked for conformance.

Operators record data on in-process inspection sheets. Once these are completed, they are turned into the quality department. At this point, a member of the quality department provides a blank inspection form back to the operators so they can continue recording data at the work area. Completed forms are scanned into the company's network drive so that anyone connected to it can review and analyze the data. Typically, this data is used as one of the bases for process improvement initiatives.

THE BRIGHT NEW HIRE

Tami remembered the day that she received the mandate from EXTRIM's executive management team regarding process improvements and the tenuous position the company currently held. She was just hired as Fowlerville's Quality Manager a day earlier, and while she acknowledged the risk that the company faced, she was also galvanized by the challenge that lay ahead. She knew that she had the skill set to help the company get through these hard times, and she wanted to quickly demonstrate to her management team that she was worthy of her recent promotion.

Tami was hired by the company roughly six months earlier as a process engineer. She was brought on board to help make operational improvements within the facility, and in a short period of time her analytical skills became readily apparent to management. Tami was able to shed light on various factors impeding the effectiveness and efficiencies of several of the plant's manufacturing processes. Although she felt a measure of satisfaction knowing that her work was appreciated, she felt hindered by management's inability to implement rapid change, and she questioned why such obvious improvement activities weren't immediately put into practice.

¹² In-process check – a check of product or process characteristics during a production run

When the plant's Quality Manager decided to pursue another opportunity with a different company, EXTRIM's management team wasted little time in offering her the position. In turn, Tami wasted even littler time accepting it. Armed with a greater scope of responsibility, and now the authority to wield it, Tami felt she had the resources in hand to realize the potential of her ideas with the expediency she felt they deserved.

PROCESS IMPROVEMENT AT FOWLerville

Tami decided to begin her process improvement efforts by focusing on a high volume, roll formed black textured painted roof rail assembly. After roll forming and cold saw cutting the parts to length, the Fowlerville plant would ship the rails to a supplier for black textured painting. The supplier would paint the rails and ship them back to the Fowlerville plant for final assembly and shipment to the customer (Exhibit 5).

The roof rail program was launched a year before Tami was hired into EXTRIM Corporation. Consequently, Tami was not intimately involved with its launch and did not have very much knowledge of the product. However, she did hear that there were numerous difficulties encountered during the launch, and that the part design had gone through several iterations of change before it finally settled into its current state. She remembered hearing that the primary motivator for the re-design was difficulty in attaching the roof rails to the customers' vehicles. However, the part had now been in production for a more than a year now and there had been no further complaints from the customer.

Tami, having past experience with product launches as a Tier-1 supplier, didn't think much of the various issues because based on her experience; these were typical of any product launch. Somehow these things had a way of working themselves out just before launch.

To begin her analysis, Tami decided to focus on the first step of the rail assembly process, the roll forming. Off the roll mill, the only part characteristics requiring to be checked were the crown¹³, sweep¹⁴, and attachment hole locations of the rail. Tami obtained check sheets from the past month (choosing not to go back any further because she reasoned that product produced before this time had already been processed and sent to the customer), and began inputting this data into Mini-Tab¹⁵. She was looking for opportunities to minimize scrap and related costs by identifying processes that were operating near their upper or lower control limits.

Through her experience, Tami developed a methodology she liked to employ when analyzing variable data (see Exhibit 6). First, she obtained descriptive statistics of each of the part characteristics. These statistics included the mean, standard deviation, range, etc. Next, she generated an *Individual Moving Range (I-MR) chart*¹⁶ of each part characteristic variable to

¹³ Crown – Vertical distance measured from the theoretical chord of a part to its center point.

¹⁴ Sweep – A measure of horizontal curvature

¹⁵ Mini-Tab – A commercial statistical software package for analyzing data

¹⁶ I-MR Chart – A type of control chart used to monitor continuous variables (e.g., Dimensions). The chart has so called, "control limits" that help to visually determine whether a process is in-control, i.e., its data points are between the control limits. The chart assumes that the underlying data follows a normal distribution.

check to see whether the process generating the data was in control. Afterwards, she generated a *normal probability plot*¹⁷ to check to see whether the data from each part characteristic followed the required normal distribution. Finally, she generated a histogram for each variable and used them to check *process capability*¹⁸.

After completing her analysis (Exhibit 7), Tami did not detect any significant anomalies with the part characteristics, although something did catch her eye. She noticed that the mean of the crown dimension was running towards the lower end of its specification limit. None of the data points were outside of the limits, but Tami knew that theoretically a normal distribution with a mean that was shifted considerably away from its target would yield product outside of specifications. If this occurred, it could lead to both scrap and customer concerns. This was just the type of opportunity she was looking for!

Tami checked data from previous inspection forms and discovered that the dimension had been consistently run towards the lower specification limit. To avoid any future issue, Tami felt she should have the process mean shifted closer towards the specification target (center of the specification limits). She showed her findings to the production manager who in turn instructed his operator to make the necessary adjustment to move the rail's crown height closer to its nominal print dimension.

Once this was completed, Tami re-collected data and re-analyzed it (using the methodology described above) to verify that the characteristic was now centered within its specification limits. Any potential issues pertaining to this specification should be averted. Satisfied that there was nothing left of significant value, she decided to move on to other process improvement initiatives.

THE ROOF RAIL ATTACHMENT ISSUE

After getting off the phone with Michael Woods, Tami decided to investigate the various manufacturing processes that produced the roof rack assemblies. Tami recalled that this roof rail assembly was the one she had investigated about a month earlier. If the plant was having difficulty attaching the rails to the roof, she knew that it had to be tied to one of its three significant part characteristics:

- (1) Location of attachment holes
- (2) Rail crown
- (3) Rail sweep.

She recalled that she identified an issue with the crown of these rails, and that she had this characteristic shifted closer to its target value. She was unsure how this could be contributing to the issue as it should have provided a better assembly, but nonetheless, she had the most recent

¹⁷ Probability plot – Certain types of variables exhibit a normal distribution (also known as the Gaussian distribution), ex., height of men for US population. A normal probability plot is a way to assess whether this is the case.

¹⁸ Process capability – A measure of the process's ability to consistently produce a product characteristic within specifications.

data collected (Exhibit 8) for analysis. Relieved, she confirmed that all the part characteristics were running near their respective nominal targets with process capability, C_{pk}^{19} values greater than 1.33. Consequently, this indicated that no data points were outside of print specifications. This convinced her that the issue wasn't related to the Fowlerville plant.

A week had passed when Tami received another phone call. This time it was not from Michael, but instead, Tom Spaw, the IQ Manager from the OEM plant that Fowlerville shipped their rail assemblies to. Tom was noticeably upset. He indicated that it had been a week since he notified Michael Woods of the attachment issue and that no one, including Michael, had contacted him regarding assistance or a resolution to the plant's problem. The issue had now escalated as assembly operators were getting injured trying to attach Fowlerville's roof racks to their vehicles. For some reason the rails were now too bowed about their center and the operators had to apply significant force to attach the center support to the roof (see Exhibit 9). Tom wanted Tami and Michael at his plant and in his office first thing tomorrow morning.

Tami tried to defend her position by indicating that she had performed studies on the part characteristics of the assembly, and that the Fowlerville plant was producing parts within print specifications. She even mentioned that she had the crown parameter of the rails shifted closer towards nominal in an effort to ensure parts were being produced within specification. This should be helping the attachment of the roof rails, not hindering it!

Upon hearing this, Tom quickly engaged her. She should have notified him of her activities and findings earlier, and at this point the data needed to be reviewed so that the root cause could be established and a countermeasure implemented quickly. Tami reluctantly agreed, buoyed by her belief that the Fowlerville plant was not complicit to the issue, and hung up with Tom. She heaved a sigh and sat perplexed; the roof rails were within print specifications, so what could be wrong?

¹⁹ C_{pk} – A process capability index that estimates whether the process is capable of producing product if the process target is centered between the specifications limits. Recommended minimum process capability for two-sided specifications for existing processes is 1.33.

Exhibit 1: Fowlerville's roof rail assembly



Exhibit 2: Examples of process changes requiring customer notification

1	Use of other construction or material than was used in the previously approved part or product.
2	Production from new or modified tools (except perishable tools), dies, molds patterns, etc. including additional or replacement tooling.
3	Production following upgrade (increasing capacity, performance or changing an existing function) or rearrangement of existing tooling or equipment.
4	Production from tooling and equipment transferred to a different plant site or from an additional plant site
5	Change of supplier for parts, non-equivalent materials, or services (e.g., heat-treating, plating).
6	Product produced after the tooling has been inactive for volume production for twelve months or more
7	Product and process changes related to components of the production product manufactured internally or manufactured by suppliers
8	Change in test/inspection method – new technique (no effect on acceptance criteria). In these cases, supplier must demonstrate that the new method is measurement capability equivalent to the previously approved method
9	New source of raw material from new or existing supplier
10	For bulk material - change in product appearance attributes

Exhibit 3: Locations of EXTRIM Corporations various facilities.Within North America:

Roll Form & Assembly Facility located in Fowlerville Township, MI

Number of Employees: 75 – 100

Work Schedule: 2, 10 hour shifts per day, 4 days a week

Molding & Assembly Facility located in Saline, MI

Number of Employees: 300 – 400

Work Schedule: 3, 8 hour shifts per day, 5 days a week

Aluminum Extrusion & Assembly Facility located in Franklin, GA

Number of Employees: 200 – 300

Work Schedule: 3, 8 hour shifts per day, 5 days a week

Commercial & Engineering Offices:

Number of Employees: 20 – 30

Exhibit 4: In-Process Inspection Form for Roll Form Rail

Fowlerville In -Process									Every Coil Change				
Inspection Form		Crown Target 0.0mm (USL +1.0mm, LSL -1.00mm)	Attachment Holes Locations (2 at each end)	Sweep (3mm pin gage)	No Scratches, Roll Marks, Creases, Ripples (Per CAS)	Date, Rev. Level, Part #, Shift # Stamp Must be deep enough to be visible & legible after paint & chrome	Steel Thickness (0.026 + 0.004 - 0.00)	Steel Width (9.105 +/- 0.005)	Steel Tag # (Write in remarks column)	Approve [A] or Reject [R]	Approved by:	Remarks:	
Mill Department													
Customer:													
Part No:													
Part Name: Roof Rails													
Section #:													
Matl: 900007 (Galvanize Steel)													
Matl: 900008 (Stainless Steel)													
Check Frequency: <input checked="" type="checkbox"/> 1pc / per hour													
<input type="checkbox"/> 2 / Shift													
Acceptance Criteria: Zero Defects													
All repairs and rework shall be reinspected as per Control Plan.													
Rev: A													
Reason: First revision													
Form Approved by: Tami Tran													
Form Approved Date: 9/2/2008													
Date:	Lot Size Time	Fix	Fix	Fix	Vis	Vis	Mic	C	Vis	Approve [A] or Reject [R]	Approved by:	Remarks:	
9/12/2009	7:00am	-0.70	Ok	Ok	Ok	Ok	0.026	9.106	9003	A	Sheila M	5 Piece setup approved	
9/12/2009	8:10am	-0.81	Ok	Ok	Ok	Ok				A	Tim J		
9/12/2009	9:15am	-0.65	Ok	Ok	Ok	Ok				A	Tim J		
9/12/2009	10:20am	-0.67	Ok	Ok	Ok	Ok				A	Tim J		
9/12/2009	11:00am	-0.71	Ok	Ok	Ok	Ok				A	Tim J		
9/12/2009	12:05pm	-0.75	Ok	Ok	Ok	Ok				A	Tim J		
9/12/2009	1:10pm	-0.79	Ok	Ok	Ok	Ok				A	Tim J		
9/12/2009	2:00pm	-0.70	Ok	Ok	Ok	Ok				A	Tim J		
9/12/2009	3:05pm	-0.69	Ok	Ok	Ok	Ok				A	Tim J		
9/12/2009	4:00pm	-0.76	Ok	Ok	Ok	Ok				A	Anthony T	Shift Change	
9/12/2009	5:30pm	-0.82	Ok	Ok	Ok	Ok	0.027	9.106	9004	A	Janice M	Coil Changeover	
9/12/2009	6:15pm	-0.71	Ok	Ok	Ok	Ok				A	Anthony T		
9/12/2009	7:20pm	-0.79	Ok	Ok	Ok	Ok				A	Anthony T		
9/12/2009	8:15pm	-0.76	Ok	Ok	Ok	Ok				A	Anthony T		
9/12/2009	9:10pm	-0.80	Ok	Ok	Ok	Ok				A	Anthony T		
9/12/2009	10:11pm	-0.86	Ok	Ok	Ok	Ok				A	Anthony T		
9/12/2009	11:00pm	-0.76	Ok	Ok	Ok	Ok				A	Anthony T		

Exhibit 5: Supply Chain for Roof Rail Assemblies

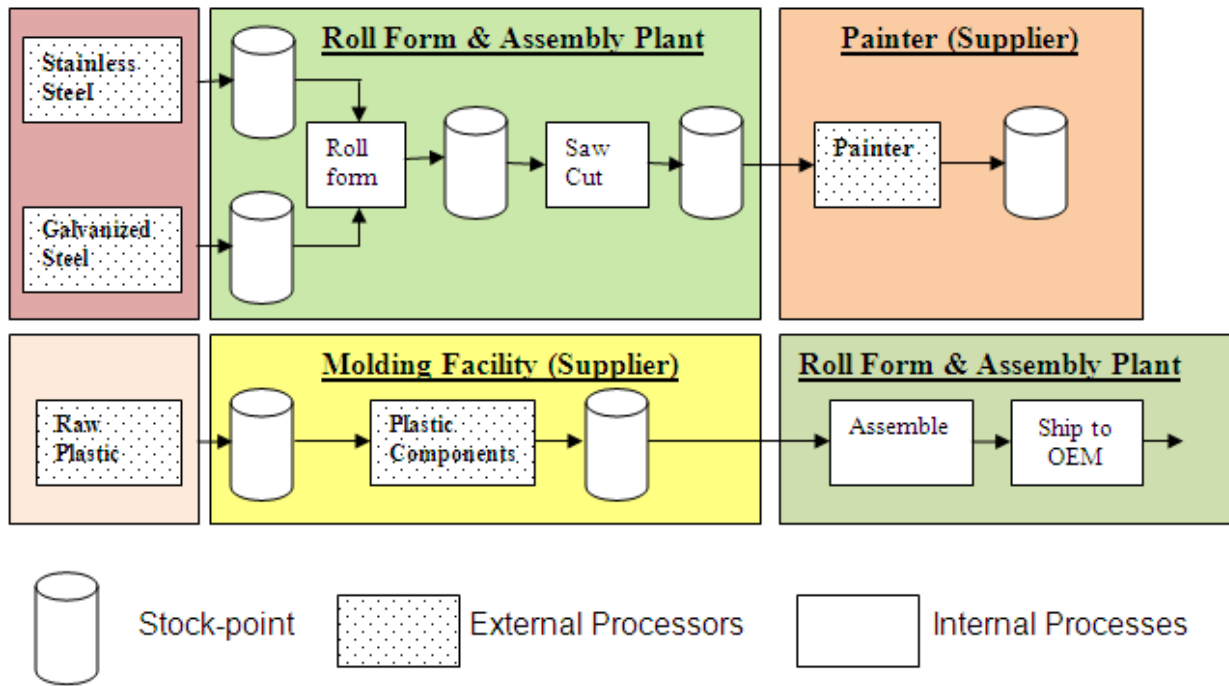


Exhibit 6: Tami's methodology for analyzing variable data points.

Step 1: Gather data

Step 2: Enter data into Mini-Tab Software

Step 3: Generate Descriptive Statistics

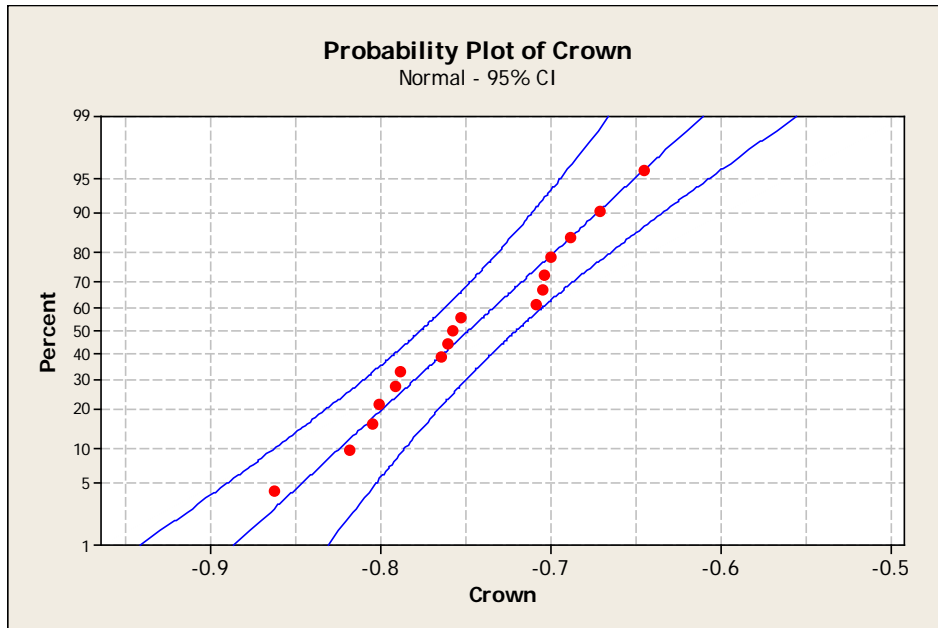
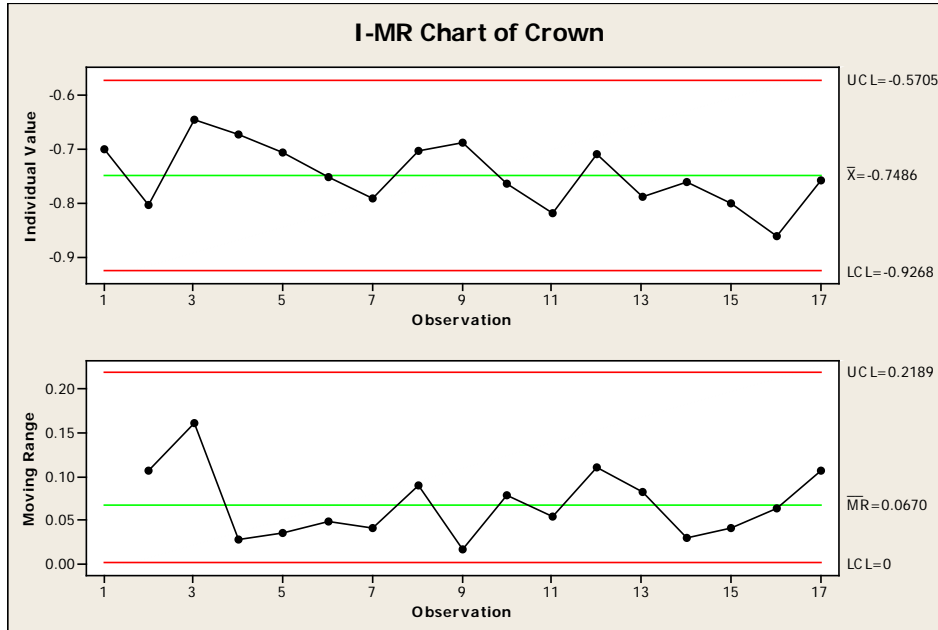
Step 4: Check for process control with Individual Moving Range (I-MR) Chart

Step 5: Check for normality of data with normal probability plot

Step 6: Check process capability of data by generating indexes (Pp, Ppk, Cp, Cpk)

Exhibit 7: Printout of crown data (Descriptive statistics, I-MR Chart, Normal Probability Plot, Capability Analysis)

Variable	Count	Mean	StDev	Min	Q1	Median	Q3	Max	Range	Skewness	Kurtosis
Crown	17	-0.749	0.059	-0.86	-0.796	-0.757	-0.702	-0.645	0.218	-0.06	-0.71



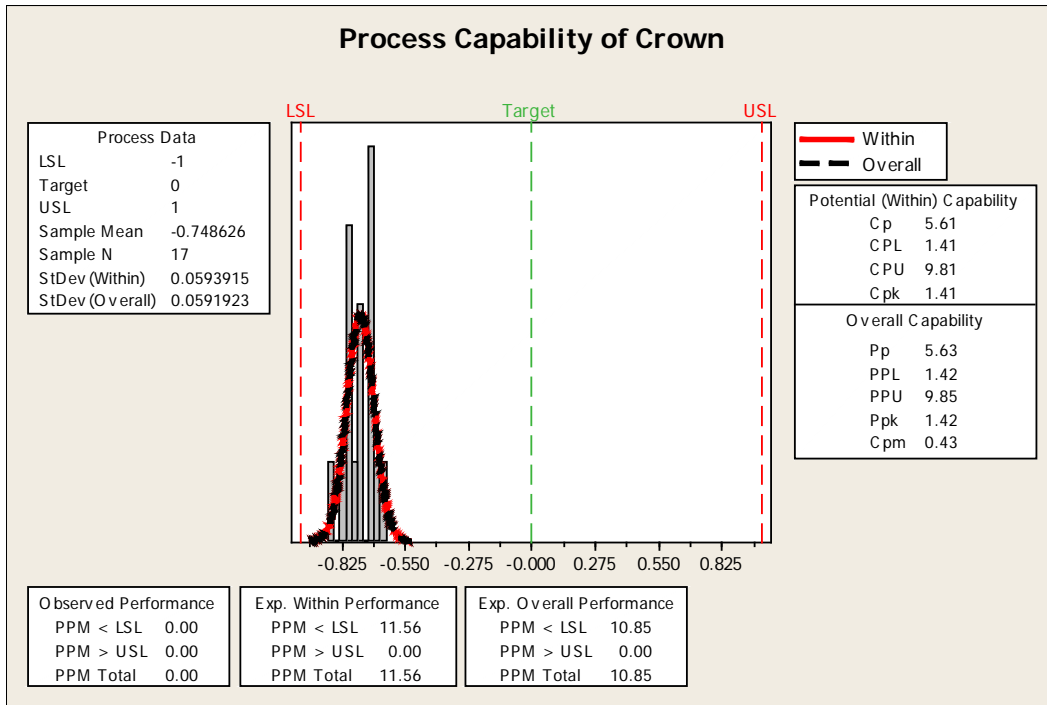


Exhibit 8: In-Process Inspection Form for Roll Form Rail

Fowlerville In -Process Inspection Form
Mill Department
 Customer: _____
 Part No: _____
 Part Name: Roof Rails
 Section #: _____
 Matl: 900007 (Galvanize Steel)
 Matl: 900008 (Stainless Steel)
 Check Frequency: 1pc / per hour
 2 / Shift
Acceptance Criteria: Zero Defects
All repairs and rework shall be reinspected as per Control Plan.

Date:	Lot Size Time	Crown Target 0.0mm (USL +1.0mm, LSL -1.00mm)	Attachment Holes Locations (2 at each end)	Sweep (3mm pin gage)	No Scratches, Roll Marks, Creases, Ripples (Per CAS)	Date, Rev, Level, Part #, Shift # Stamp Must be deep enough to be visible & legible after paint & chrome	Every Coil Change			Approve [A] or Reject [R]	Approved by:	Remarks:
							Steel Thickness (0.026 + 0.004 - 0.00)	Steel Width (9.105 +/- 0.005)	Steel Tag # (Write in remarks column)			
		Fix	Fix	Fix	Vis	Vis	Mic	C	Vis			
9/14/2009	7:05am	0.20	Ok	Ok	Ok	Ok				A	Tim J	
9/14/2009	8:10am	-0.04	Ok	Ok	Ok	Ok				A	Tim J	
9/14/2009	9:13am	0.10	Ok	Ok	Ok	Ok				A	Tim J	
9/14/2009	10:20am	-0.22	Ok	Ok	Ok	Ok	0.026	9.107	9010	A	Sheila M	
9/14/2009	11:10am	0.04	Ok	Ok	Ok	Ok				A	Tim J	
9/14/2009	12:05pm	0.19	Ok	Ok	Ok	Ok				A	Tim J	
9/14/2009	1:10pm	0.05	Ok	Ok	Ok	Ok				A	Tim J	
9/14/2009	2:10pm	0.16	Ok	Ok	Ok	Ok				A	Tim J	
9/14/2009	3:05pm	0.02	Ok	Ok	Ok	Ok				A	Tim J	
9/14/2009	4:00pm	0.07	Ok	Ok	Ok	Ok				A	Anthony T	Shift Change
9/14/2009	5:30pm	-0.30	Ok	Ok	Ok	Ok				A	Anthony T	
9/14/2009	6:20pm	0.27	Ok	Ok	Ok	Ok				A	Anthony T	
9/14/2009	7:20pm	0.08	Ok	Ok	Ok	Ok				A	Anthony T	
9/14/2009	8:20pm	-0.09	Ok	Ok	Ok	Ok	0.027	9.106	8007	A	Janice M	Coil Changeover
9/14/2009	9:10pm	0.23	Ok	Ok	Ok	Ok				A	Anthony T	
9/14/2009	10:10pm	-0.27	Ok	Ok	Ok	Ok				A	Anthony T	
9/14/2009	11:00pm	-0.07	Ok	Ok	Ok	Ok				A	Anthony T	

Notes: _____

- C - Caliper
- D - Destructive
- Fix - Fixture
- HG - Hand Gauge
- Mic - Micrometer
- S - Scale
- Vis - Visual

Rev: A
 Reason: First revision
 Form Approved by: Tami Tran
 Form Approved Date: 9/2/2008

Exhibit 9: Assembly Sequence of Roof Rails to Vehicle

Step 1:



Align center support to attaching bolts of roof.

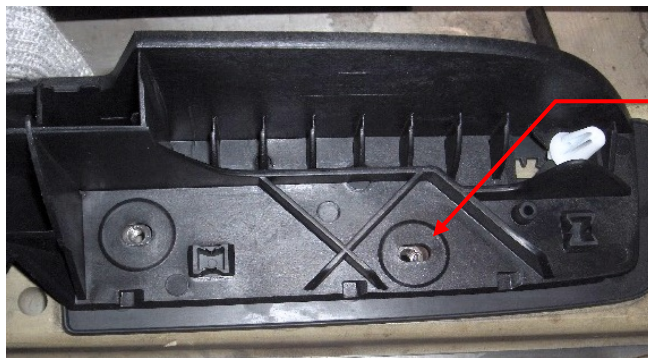


Step 2:



Shift rail until netted against attaching bolts.

Step 3:



Use bolts and attach supports to roof through attaching holes.