Process Improvement for Repair Department at Inficon, Syracuse

SCM 755 – Lean Six Sigma

Meet the Team!
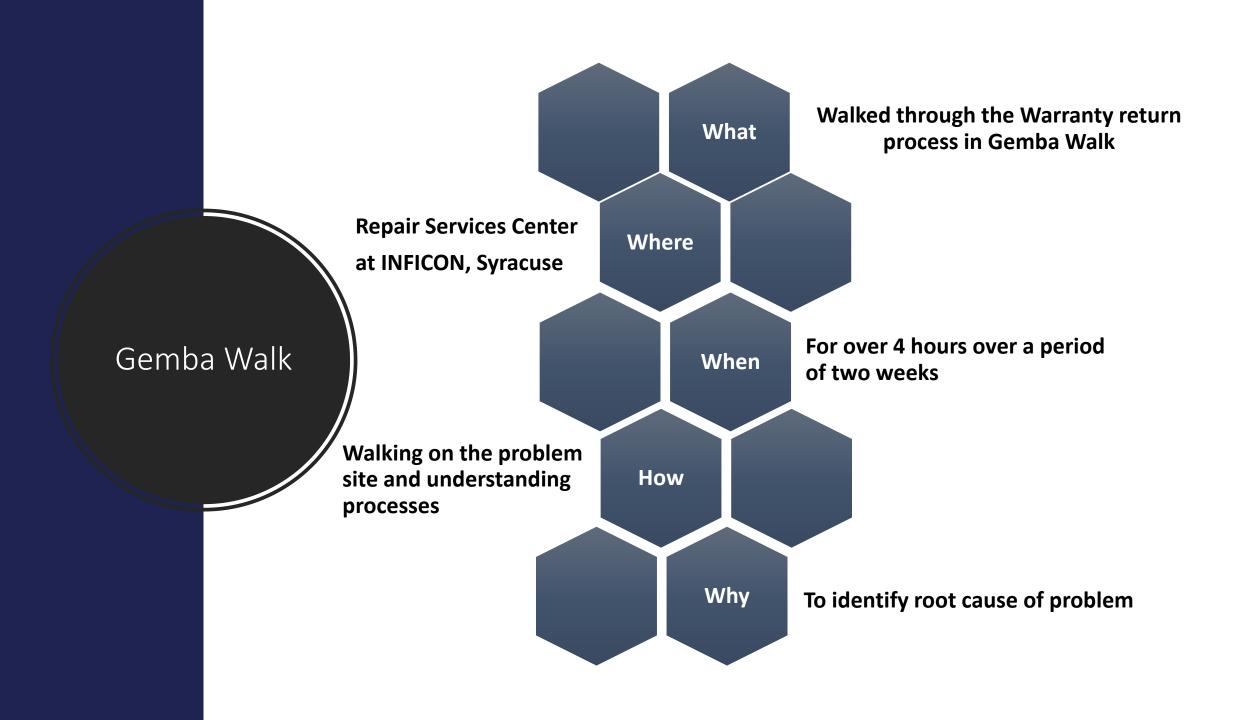
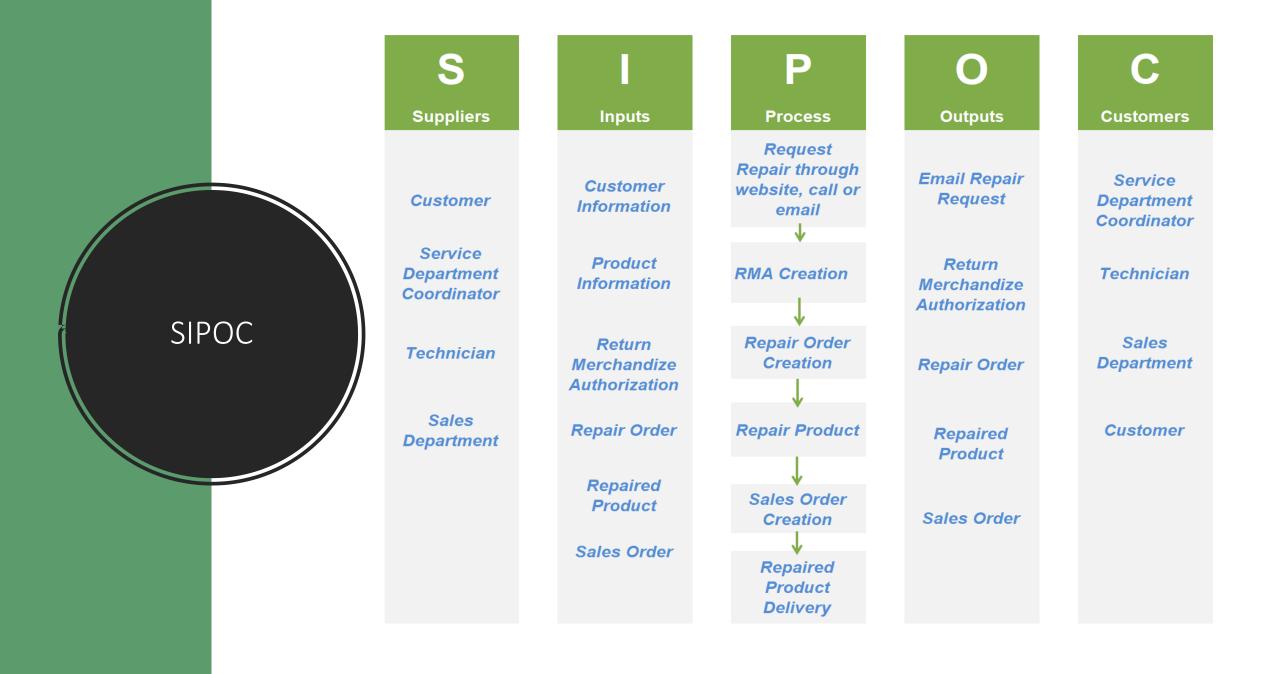Akshata Naronakar

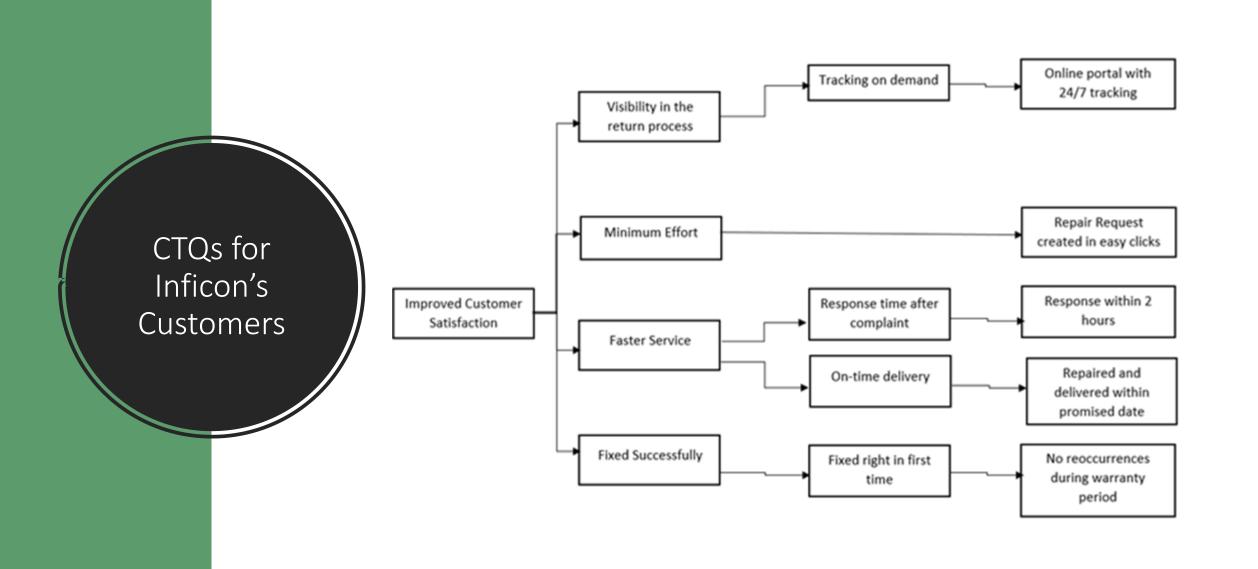Shambhavi Godbole

Raghav Raheja

Define

Problem Statement

1. Inficon's warranty expense has increased by 25.81% from 2016 to 2017
2. Discrepancy in the warranty reporting across departments
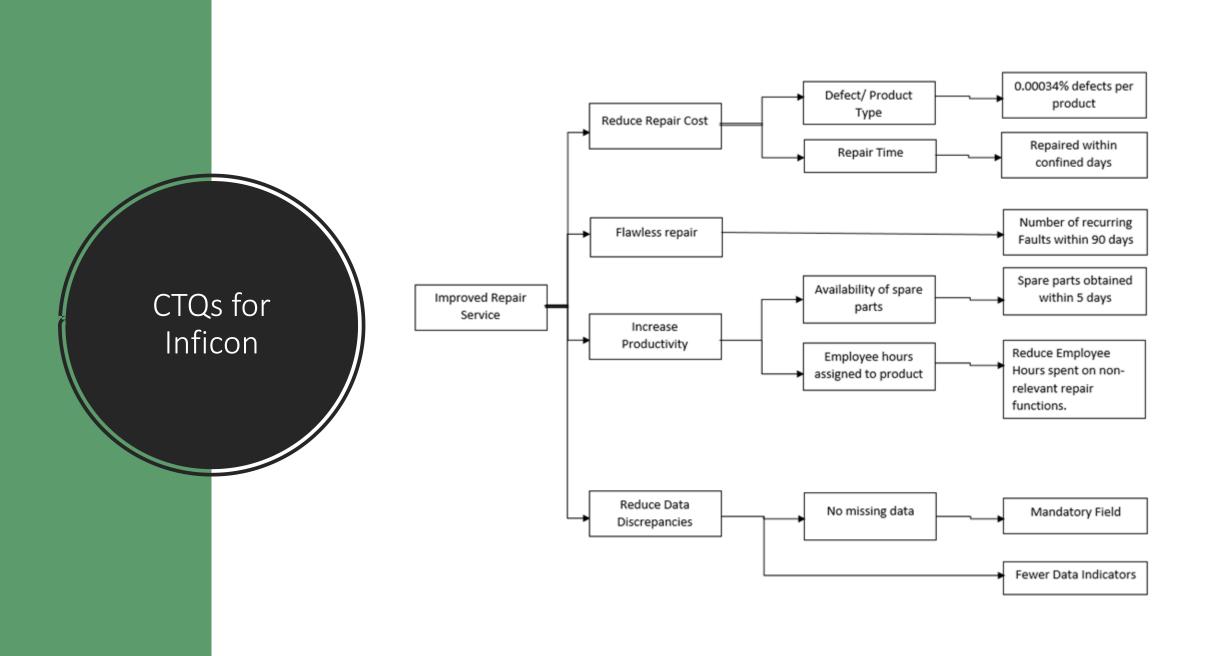3. Excessive workload on a customer while requesting a repair

Business Case

1. Finding the root cause for 246,309$ of the increased warranty expense from 2016 to 2017
2. Accountability for 606,211$ in data discrepancy between accounting and service repair departments
3. Increased customer satisfaction, data Integrity and improved employee productivity

Gemba Walk

What — Walked through the Warranty return process in Gemba Walk

Where — Repair Services Center at INFICON, Syracuse

When — For over 4 hours over a period of two weeks

How — Walking on the problem site and understanding processes

Why — To identify root cause of problem

CTQs for Inficon

Improved Repair Service

- Reduce Repair Cost
  - Defect/ Product Type → 0.00034% defects per product
  - Repair Time → Repaired within confined days
- Flawless repair → Number of recurring Faults within 90 days
- Increase Productivity
  - Availability of spare parts → Spare parts obtained within 5 days
  - Employee hours assigned to product → Reduce Employee Hours spent on non-relevant repair functions.
- Reduce Data Discrepancies
  - No missing data → Mandatory Field
  - Fewer Data Indicators

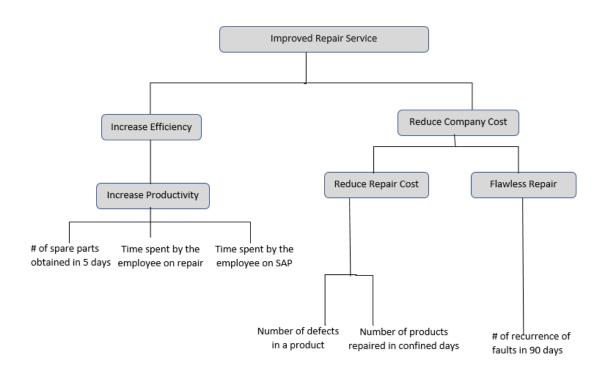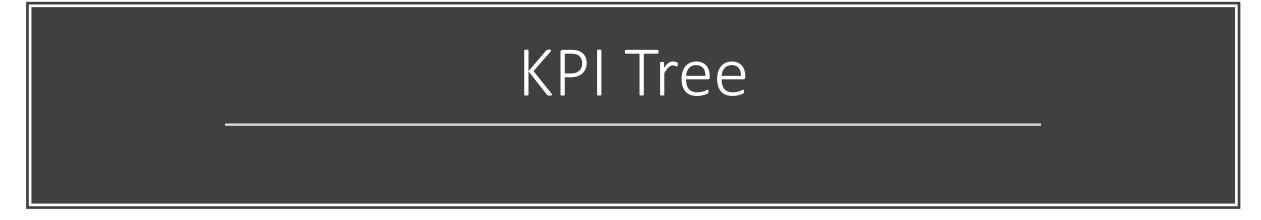# Measure

Customer Metrics
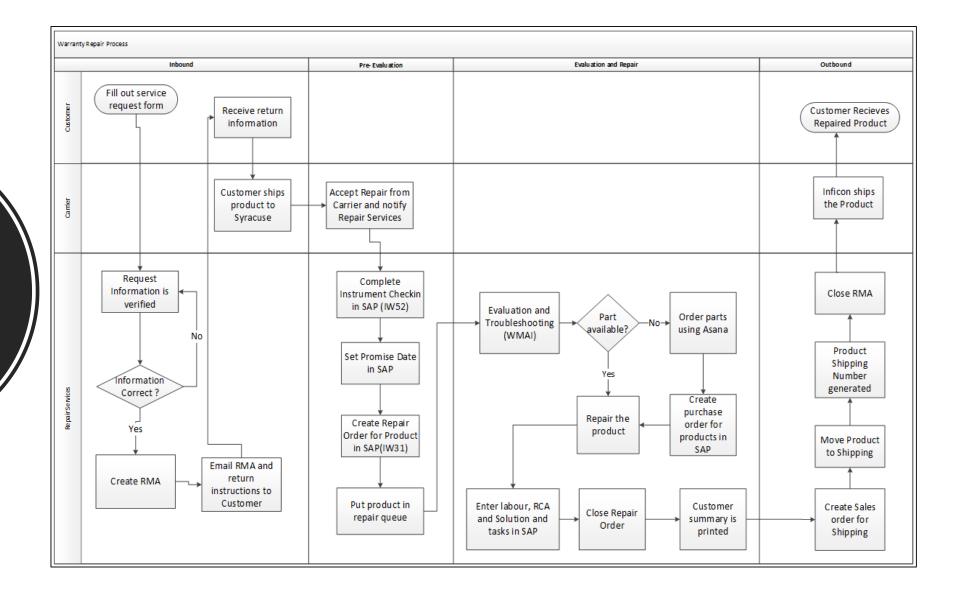
- Repair Return Frequency
- RMA Response Time
- Repair Turnaround time
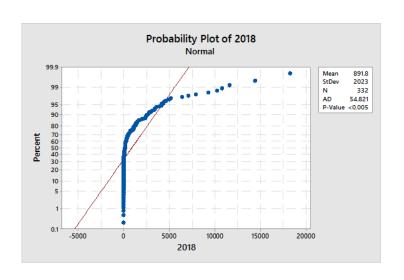- Repair Request Clicks

Inficon Metrics

- Parts Delay Time
- Employee Hours spent in SAP
- Employee Hours spent in Repair
- Total Repair turnaround Time
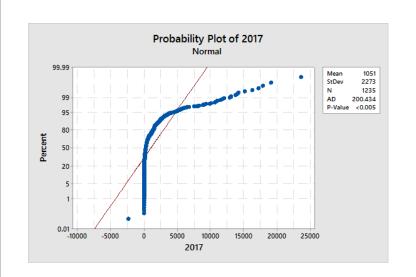- Number of Defects per product

KPI Tree
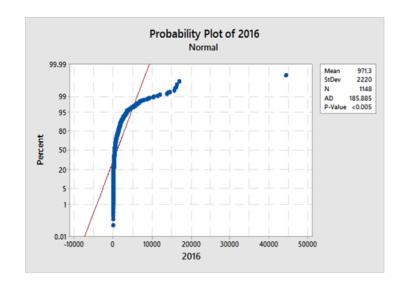
Warranty Process Flow Diagram

Data Distribution of Warranty Expense for Year 2016, 2017,2018
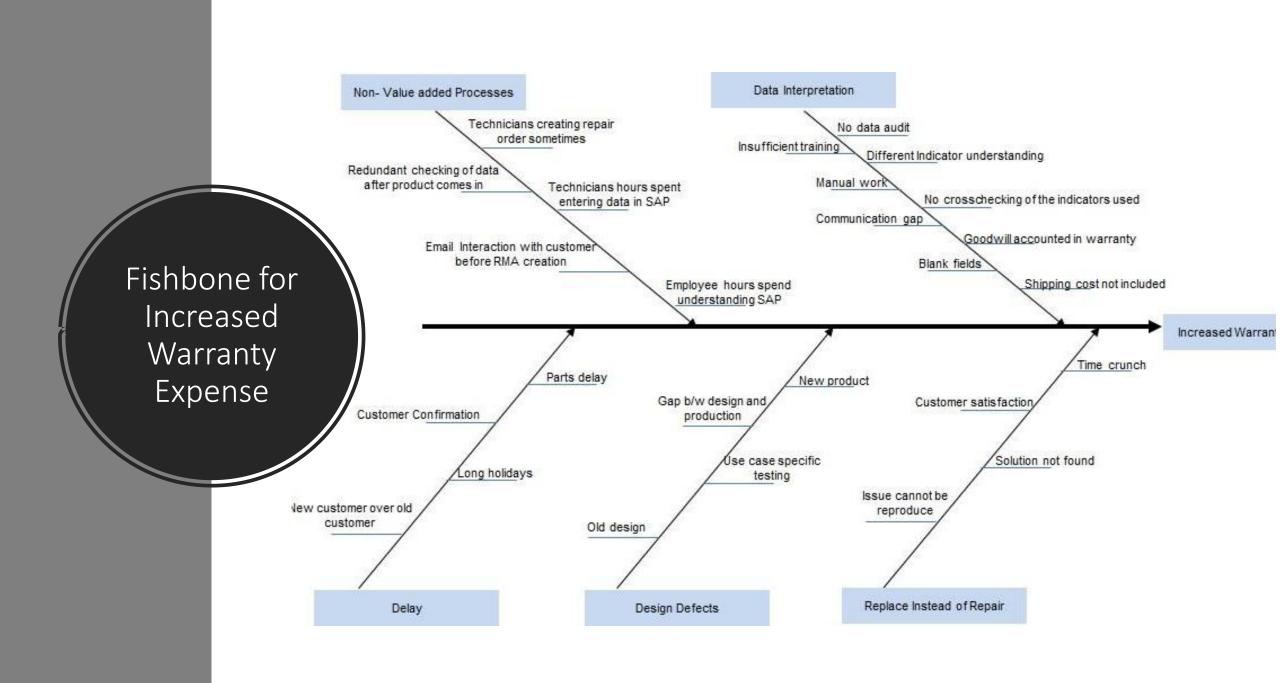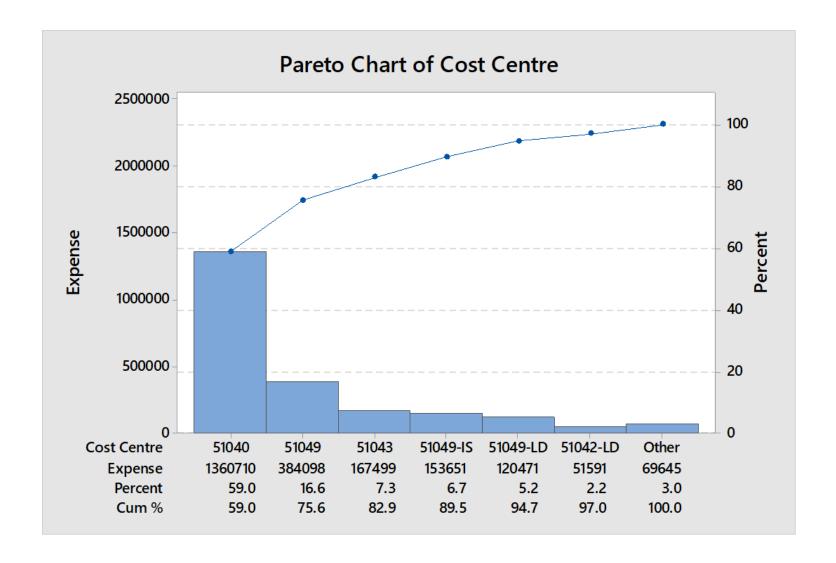
P-value less than 0.05 indicates non-normal distribution

Analyze

Fishbone for Increased Warranty Expense

Non- Value added Processes
- Technicians creating repair order sometimes
- Redundant checking of data after product comes in
- Technicians hours spent entering data in SAP
- Email Interaction with customer before RMA creation
- Employee hours spend understanding SAP

Data Interpretation
- No data audit
- Insufficient training
- Different Indicator understanding
- Manual work
- No crosschecking of the indicators used
- Communication gap
- Goodwill accounted in warranty
- Blank fields
- Shipping cost not included

Increased Warranty
- Time crunch

Delay
- Parts delay
- Customer Confirmation
- Long holidays
- New customer over old customer

Design Defects
- New product
- Gap b/w design and production
- Use case specific testing
- Old design

Replace Instead of Repair
- Customer satisfaction
- Solution not found
- Issue cannot be reproduce

Pareto Chart for Cost Centre

Pareto Chart of Cost Centre

Cost Centre	51040	51049	51043	51049-IS	51049-LD	51042-LD	Other
Expense	1360710	384098	167499	153651	120471	51591	69645
Percent	59.0	16.6	7.3	6.7	5.2	2.2	3.0
Cum %	59.0	75.6	82.9	89.5	94.7	97.0	100.0

Pareto Chart for 51040

Pareto Chart of Product From 51040

Product	Fusion	HAPSITE	3000 MGC	CMS	Thermal Desorber	Other
Expense	852318	190535	174559	50262	46801	46235
Percent	62.6	14.0	12.8	3.7	3.4	3.4
Cum %	62.6	76.6	89.5	93.2	96.6	100.0

Pareto Chart for 51049

Pareto Chart of Product From 51049
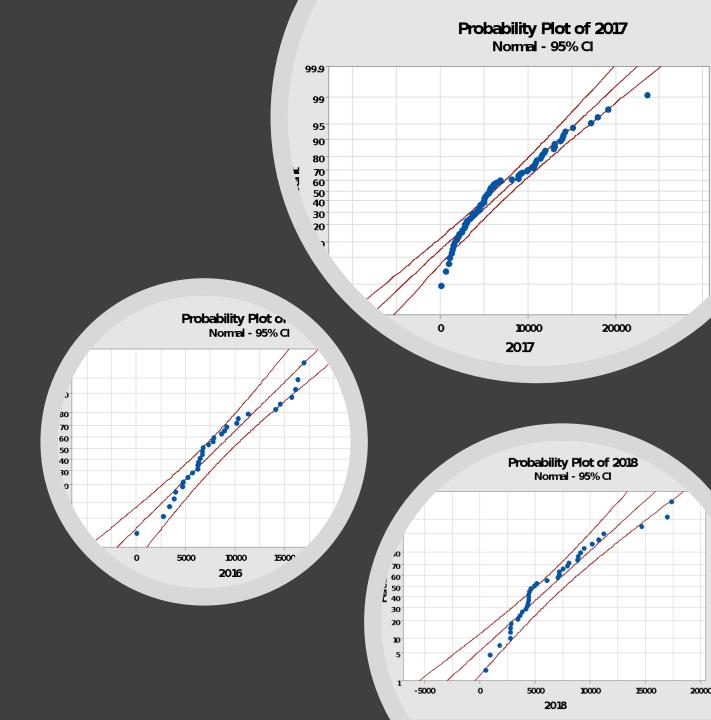
Sub-Part Issue in Fusion

| Fusion 2016			
BF 1.0uL , TCD2, M5A 10m/Q-BOND 3m, LL	1	10338.07	4.04%
HEATER ON ISC FAILED	1	0	0.00%
Micro GC Fusion 2 Mod System	20	129667.78	50.67%
MicroGC Fusion 2 Mod System	12	115885.84	45.29%
Grand Total	**34**	**255891.69**	
Fusion 2017			
BF 1.0uL , TCD2, M5A 10m/Q-BOND 3m, LL	5	8555.77	1.51%
LV, TCD, RTx-1, 10m	1	1854.88	0.33%
LV, TCD, Rxi-1ms 20m, LL	1	4756.71	0.84%
LV, TCD2, Rt-Q-BOND 12m x2, LL	2	18598.65	3.29%
Micro GC Fusion 2 Mod System	64	506789.16	89.73%
Micro GC Fusion 3 Mod System	1	1661.04	0.29%
Micro GC Fusion 4 Mod System	2	5820.35	1.03%
Valve SF, 10 Way, 21 Port, 1/16 Tube, SS	2	1340.5	0.24%
VV, TCD2, Rt-Q-BOND 12m x2, LL	2	8827.09	1.56%
VV, TCD2, Rxi-1ms 20m, LL	1	5051.26	0.89%
VV, TCD2, Stabilwax 10m, LL	1	1527.79	0.27%
Grand Total	**82**	**564783.2**	
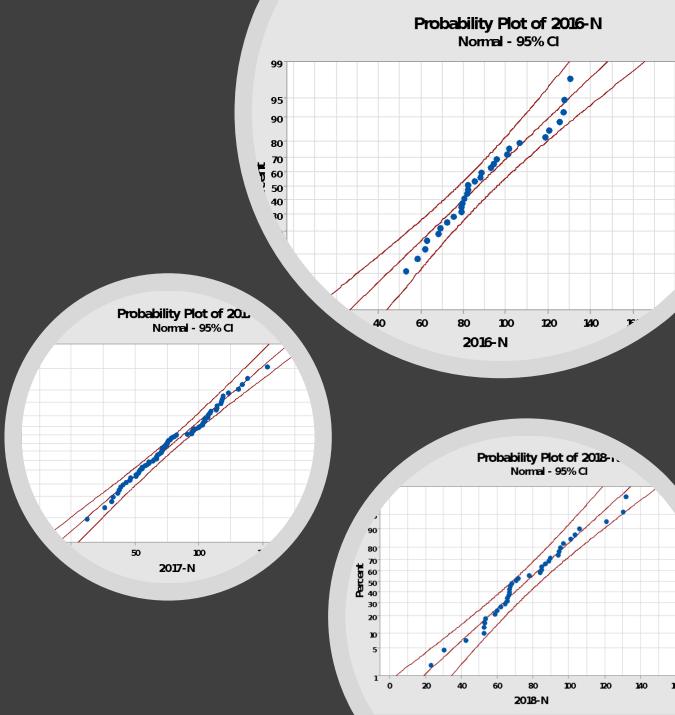
Boxplot for Fusion Warranty Expense since 2016

Probability Plot
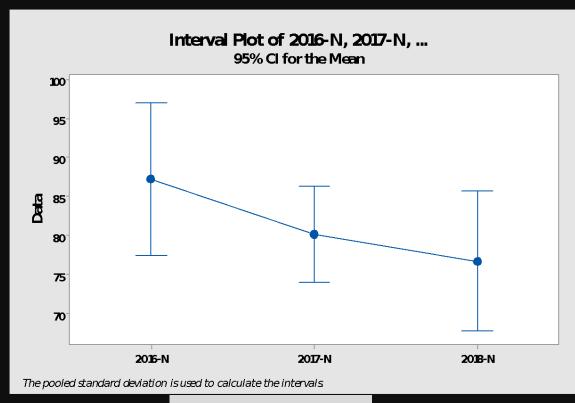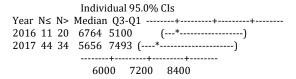
Probability Plots After Box-Cox

Mood Median Vs ANOVA

Interval Plot of 2016-N, 2017-N, ...
95% CI for the Mean

The pooled standard deviation is used to calculate the intervals.

P-Value = 0.288

Mood Median Test: Expense versus Year

Mood median test for Expense
Chi-Square = 6.95   DF = 2   P = **0.031**

```
                Individual 95.0% CIs
Year  N≤  N>  Median  Q3-Q1   -+---------+---------+---------+-----
2016   9  22   6764   5100           (--*--------------)
2017  43  35   5656   7493      (----*---------------)
2018  21  16   4974   5163   (---*---------------)
                             -+---------+---------+---------+-----
                            4500    6000    7500    9000
Overall median = 6093
```

Mood Median Test: Expense versus Year
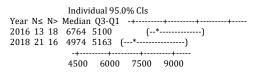
Mood median test for Expense
Chi-Square = 3.89   DF = 1   P = **0.049**

```
                Individual 95.0% CIs
Year  N≤  N>  Median  Q3-Q1  --------+---------+---------+--------
2016  11  20   6764   5100         (---*------------------)
2017  44  34   5656   7493   (----*---------------------)
                            --------+---------+---------+--------
                             6000    7200    8400
```

Mood Median Test: Expense versus Year

Mood median test for Expense
Chi-Square = 1.48   DF = 1   P = **0.223**

```
                Individual 95.0% CIs
Year  N≤  N>  Median  Q3-Q1   -+---------+---------+---------+-----
2016  13  18   6764   5100           (--*-------------)
2018  21  16   4974   5163   (---*---------------)
                             -+---------+---------+---------+-----
                            4500    6000    7500    9000

Overall median = 6609
```
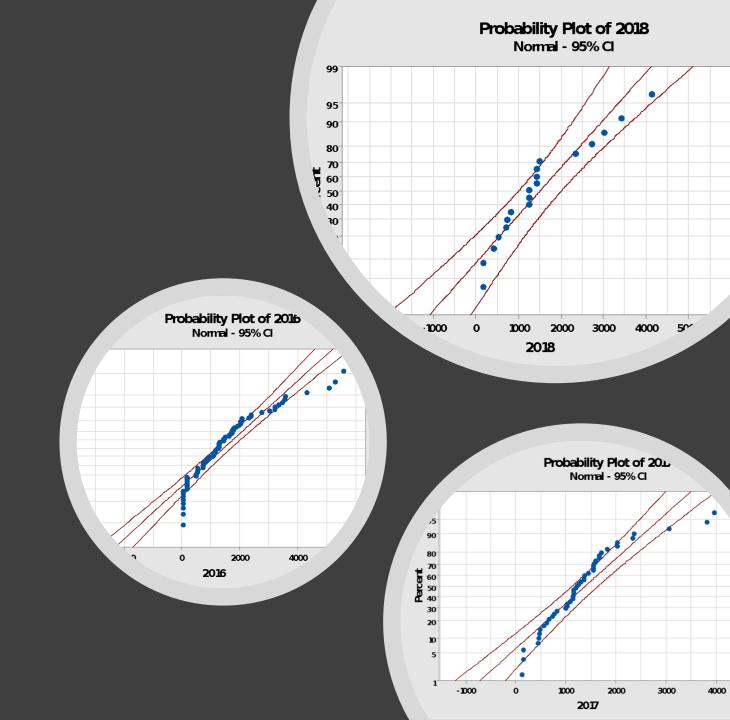
Mood Median Test: Exp versus Ye

Mood median test for Exp
Chi-Square = 0.29   DF = 1   P = **0.593**

```
                Individual 95.0% CIs
Ye    N≤  N>  Median  Q3-Q1  ----+---------+---------+---------+--
2017  38  40   5656   7493       (----*--------------------)
2018  20  17   4974   5163   (----*---------------------)
                            ----+---------+---------+---------+--
                            4800    6000    7200    8400

Overall median = 5573
```

Sub-Part Issue in Hapsite
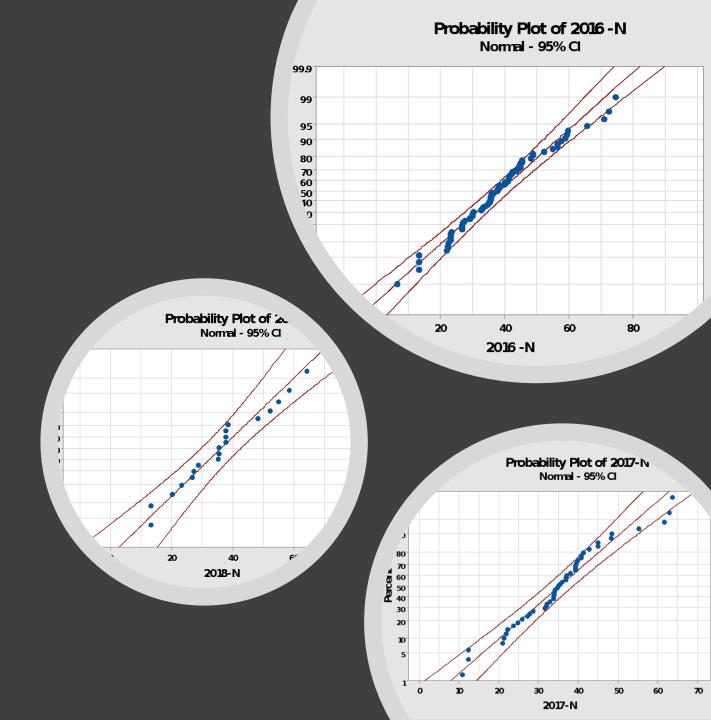
Hapsite 2016			
Row Labels	**Count of Order**	**Sum of Total act.costs**	
Dynamic Sample Collector	2	984.26	1%
Flash Drive, ER	2	1988.61	2%
GC Controller Board, HAPSITE ER, Tested	2	1546.54	1%
HAPSITE ER WITHOUT NEG	2	9158.88	8%
HAPSITE ER, USB/Wireless, w/NEG	48	85304.78	70%
HAPSITE Smart Plus, w/NEG	1	1620	1%
HAPSITE Smart to Plus Upgrade	1	1080	1%
Hapsite Smart Upgrade	1	1210.61	1%
Headspace Sampling System, ER HAPSITE	1	719.57	1%
Headspace Sampling System, HAPSITE	1	858.5	1%
Load Lock and Motor Assembly	1	1785.81	1%
Spare Non Evaporable Getter (NEG) Pump	1	1768.75	1%
SPME Accessory, HAPSITE ER	1	1219.86	1%
Thermal Desorber Accessory, HAPSITE ER	32	12125.67	10%
Grand Total	**113**	**122091.84**	

Hapsite 2017			
Row Labels	**Count of Order**	**Sum of Total act.costs**	
110V(ac) Power Supply, United States	1	1153.12	1%
230V(ac) Power Supply, Australia / China	1	1153.11	1%
Concentrator, Tri-Bed Kit	1	564.05	1%
ETX Board, Tested	1	1566.23	2%
Hapsite Battery	2	1920.54	2%
HAPSITE ER WITHOUT NEG	1	997.05	1%
HAPSITE ER, Blue, w/NEG	2	3261.61	3%
HAPSITE ER, USB/Wireless, w/NEG	29	49106.67	49%
HAPSITE Smart to Plus Upgrade	2	1757.16	2%
HAPSITE VIPER GREEN w NEG	1	771.45	1%
High Voltage Module PCB,Tested	2	1265.19	1%
Thermal Desorber Accessory, HAPSITE ER	45	34313.09	34%
Grand Total	**97**	**99953.9**	

Probability Plot

Probability Plot of 2018
Normal - 95% CI

Probability Plot of 2016
Normal - 95% CI

Probability Plot of 2017
Normal - 95% CI
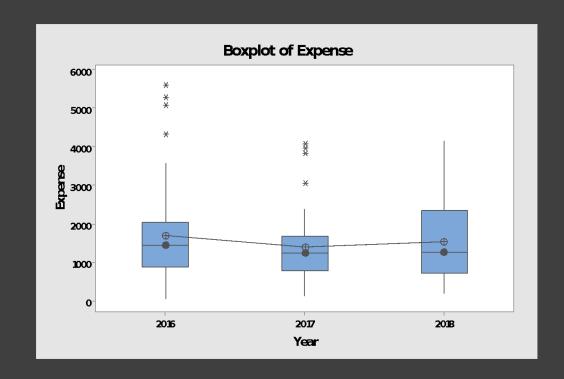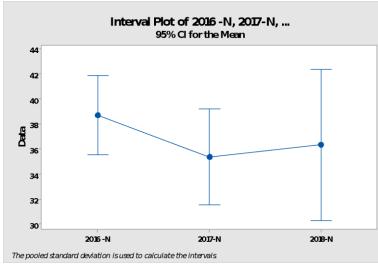
Probability plot after Box-Cox

Mood Median Vs ANOVA

Interval Plot of 2016 -N, 2017-N, ...
95% CI for the Mean

P-Value = 0.399

Boxplot of Expense

Mood Median Test: Expense versus Year
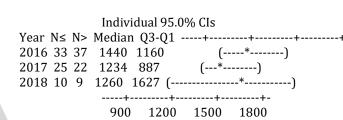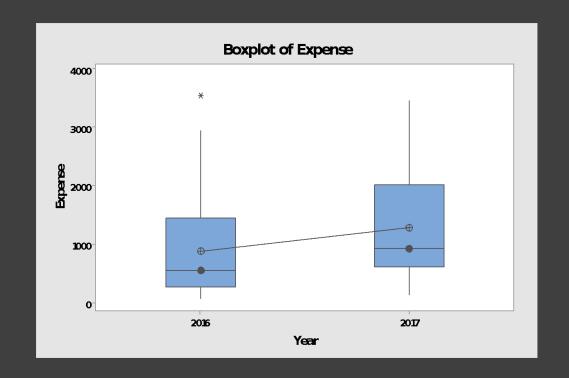
Mood median test for Expense
Chi-Square = 0.47   DF = 2   P = 0.790

```
                  Individual 95.0% CIs
Year  N≤  N>  Median  Q3-Q1  -----+---------+---------+---------+
2016  33  37  1440    1160              (-----*--------)
2017  25  22  1234    887          (---*--------)
2018  10  9   1260    1627  (----------------*-----------)
                            -----+---------+---------+---------+-
                             900    1200    1500    1800
```
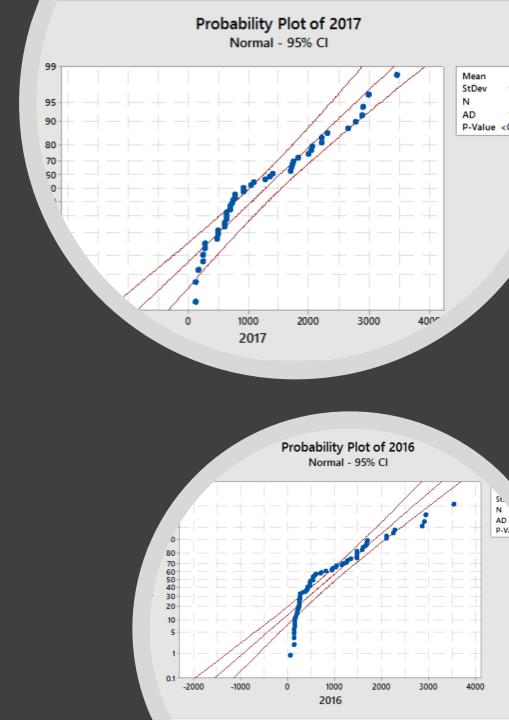
Sub-part issue in Transpector MPH/MPS

2017			
MPH100 Electronics Box w/ Ethernet Comm	3	3389.28	9%
MPH200 Electronics Box w/ Ethernet Comm	3	823.2	2%
MPH300 Electronics Box w/ Ethernet Comm	2	1248	3%
MPS200 Electronics Box w/ Ethernet Comm	1	504	1%
Transpector MPH100M	4	5654.28	14%
Transpector MPH200M	2	1950	5%
Transpector MPH200P	4	8554.66	21%
Transpector MPH300H	6	14570.45	37%
Transpector MPS100M	2	2224.37	6%
Transpector MPS200M	1	924	2%
Grand Total	**28**	**39842.24**	
2016			
MPH100 Electronics Box w/ Ethernet Comm	46	15468.66	22%
MPH200 Electronics Box w/ Ethernet Comm	2	660	1%
MPS100 Electronics Box w/ Ethernet Comm	1	721.39	1%
Transpector MPH100H	4	4266.94	6%
Transpector MPH100M	7	10046.17	14%
Transpector MPH100P	9	13331.93	19%
Transpector MPH200M	7	12845.41	18%
Transpector MPH200P	4	6211.91	9%
Transpector MPS100F	1	821.16	1%
Transpector MPS100M	4	5855.02	8%
Grand Total	**85**	**70228.59**	

Data Distribution

Sign Test for Median: 2016

Sign test of median = 924.0 versus < 924.0

	N	Below	Equal	Above	P	Median
2016	80	49	0	31	0.0287	540.7

Hypothesis Testing

Mood Median Test: Expense versus Year

Mood median test for Expense
Chi-Square = 4.48   DF = 1   P = 0.034

```
                  Individual 95.0% CIs
Year N≤ N> Median  Q3-Q1 --------+---------+---------+--------
2016 46 34   541   1198  (--*--------)
2017 17 28   924   1403       (-----*--------------------)
                         --------+---------+---------+--------
                            700     1050     1400
```

Overall median = 695

A 95.0% CI for median(2016) - median(2017): (-974,-110)

Confusion Matrix for Data Discrepency

Expense in $:

Confusion Matrix	Finance Indicator 2	Finance Indicator Not 2
KGW and RGW	1679784	1073573
Not KGW and RGW	104764	0

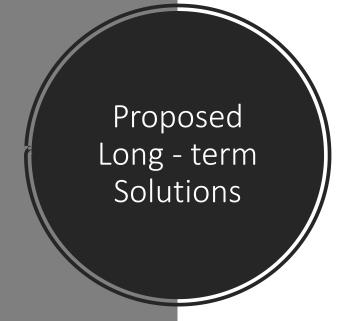Accuracy = 1679784+0 / (1679784+1073573+104764+0) = **58.77%**

Improve
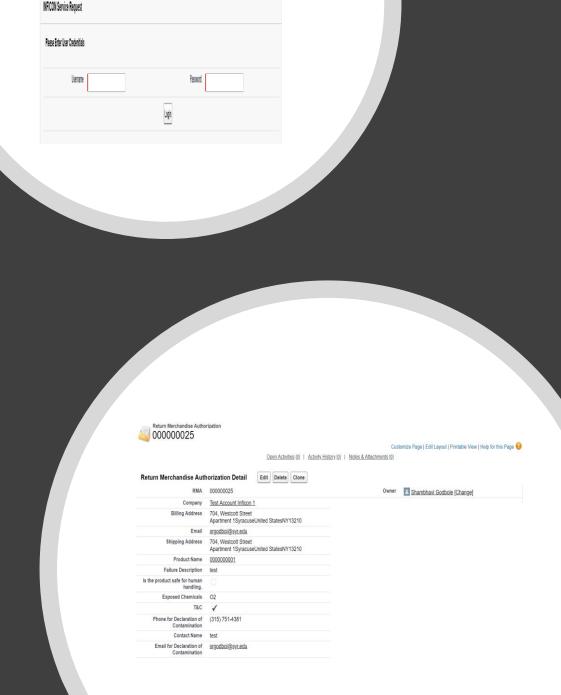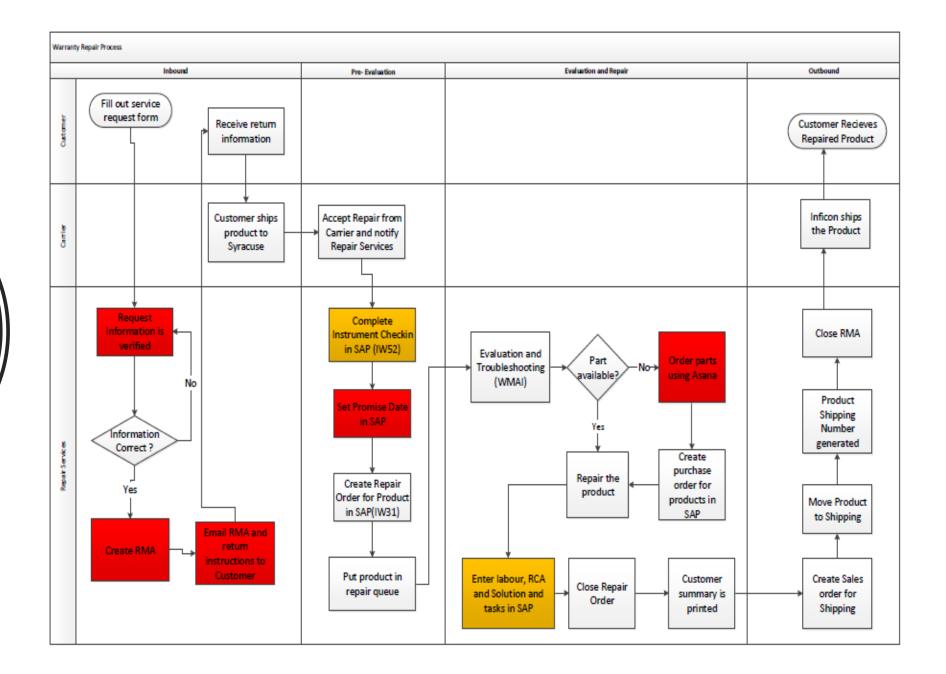
Pilot Testing

- Login portal for Customers to request repairs on their products only for orders that they have already purchased. This will facilitate data validation and integrity.

- Auto-create RMA for straightforward cases and automate the process of sending return instructions for the same. This will save time of the customers and service department.

- Tracking would be possible for customer on returns portal for each step of the repair process as well as shipping. This will facilitate immediate visibility.

Value Added Process Map

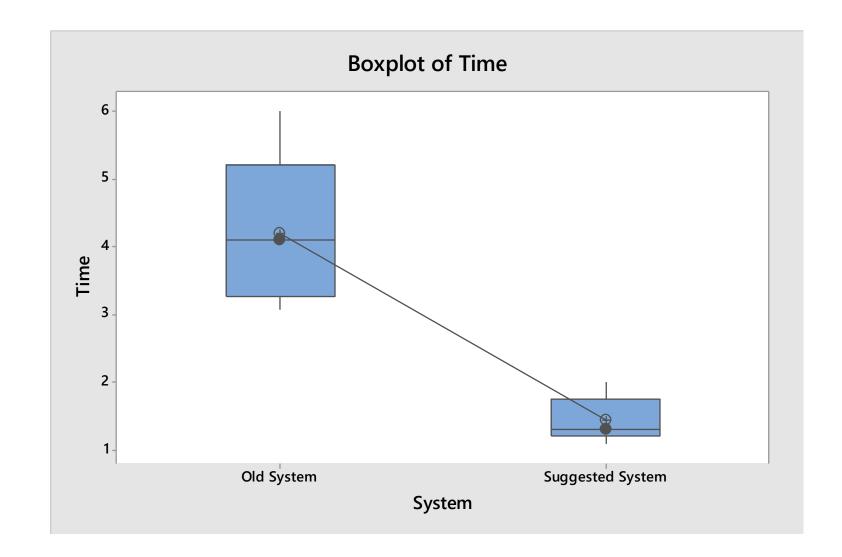**Warranty Repair Process**

| Inbound | Pre-Evaluation | Evaluation and Repair | Outbound |

Customer
- Fill out service request form
- Receive return information
- Customer Recieves Repaired Product

Carrier
- Customer ships product to Syracuse
- Accept Repair from Carrier and notify Repair Services
- Inficon ships the Product

Repair Services
- Request Information is verified
- Information Correct? — No / Yes
- Create RMA
- Email RMA and return instructions to Customer
- Complete Instrument Checkin in SAP (IW52)
- Set Promise Date in SAP
- Create Repair Order for Product in SAP(IW31)
- Put product in repair queue
- Evaluation and Troubleshooting (WMAI)
- Part available? — No / Yes
- Order parts using Asana
- Create purchase order for products in SAP
- Repair the product
- Enter labour, RCA and Solution and tasks in SAP
- Close Repair Order
- Customer summary is printed
- Close RMA
- Product Shipping Number generated
- Move Product to Shipping
- Create Sales order for Shipping

Control

Type of Communication	Audience	Purpose of Communication/Tasks (Pain Points)	Frequency	Facilitator	Time
Repair Team Meeting	Technician/Coordinators/Service Engineers/Supervisor	Communicate any changes in the process and report on Work in Progress (WIP)	Once in a week	Technical Services Manager	TBD
Department Team	Department Heads	Communicate any changes in the department. Interrelated Field/Indicators discussion. Comparison of numbers from different departments.	Once in 2 weeks	Division Head	TBD
Quality Control Meeting	Quality Assurance Team and Product Managers	Product Managers observation in terms of Issues in the product and Number of defects coming in each product.	Once in a month	Quality Assurance Head	TBD
Question and Answer Meeting for SAP	Whoever uses SAP and have questions on it	Understand the working of SAP	Once in a month	SAP Expert	TBD

Communication Plan

Sample Checklist

Role	Service Coordinator	
Process	RMA Creation	
Task Finished		
Task Not Finished		
Checklist	Tips	Is Completed
Opened Transaction IW51		
Notification Type	Z7 for field service, S2 for internal RMAs	
Set Acctg. Indicator	2 for Warranty	
Added Description		
Input Customer Information		
Input Serial Number		
Input Material		
Input Failure Description		
Input Priority	billable or non billable	
Input Main WorkCtr	Product Department	
Input Required End date	Check Estimated turnaround time	
Task IFBT		
Task IFBT Text : DOC	Copy Paste Service Request form	
Task Responsible	Author	
Save		
Partner Name	Author	
Green Check		

Someone is filling in for the coordinator

Minimize missing data and reduce data discrepancy

Effective Analysis into customer returns data

Standardize the existing processes

Thank you!