Improving Invoice Generation Process for Siemens

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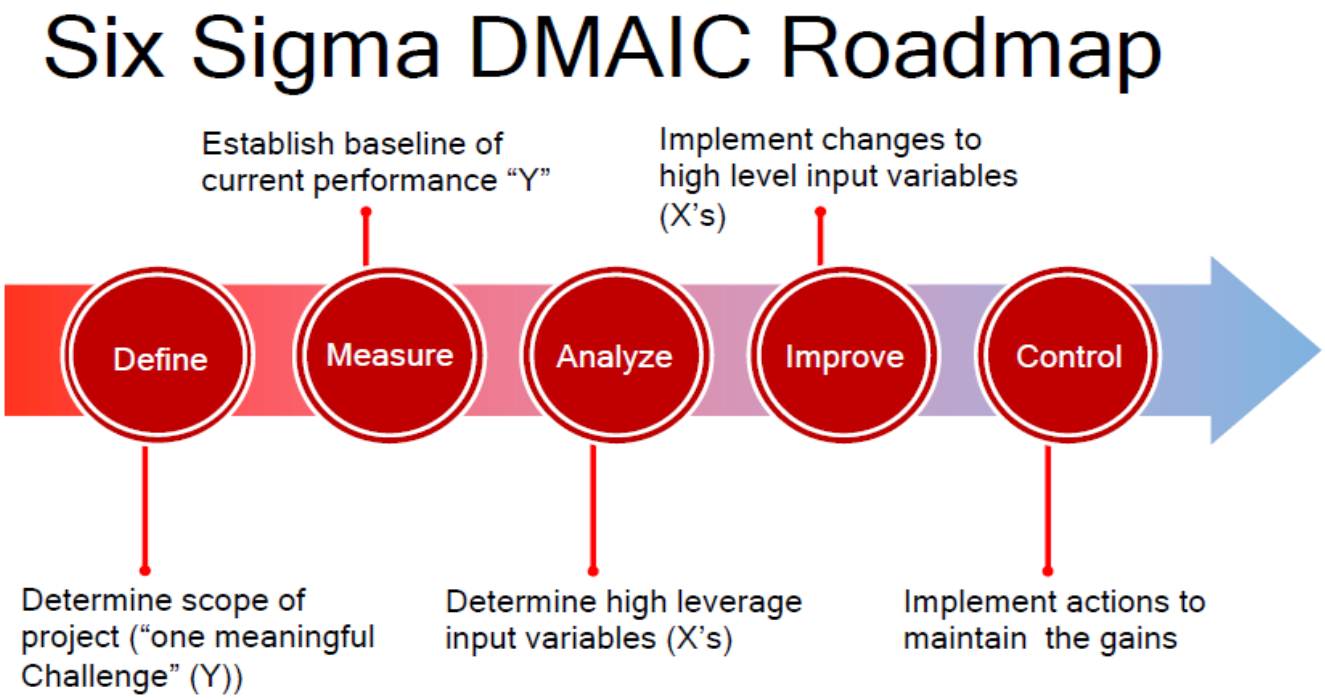
Lean Six-Sigma DMAIC

The process roadmap of this Siemens project implements the **DMAIC** process



DEFINE

Project Charter

Project Title

Problem Statement

The invoices are made for the purchasing department to initiate the rework process in the plant. The invoices are prepared by the system users from the quality inspection reports. Sometimes the invoices prepared have wrong entries listed than the processes mentioned on the inspection report. Moreover, the time required to make the invoice is high.

Executive Sponsor/Champion

Green Belt

Mission Statement

The goal of this project is to reduce the errors generated while creating invoices for different parts that are designated for rework by 9% as well as to reduce the time taken that it takes to generate these invoices.

Stakeholders

Siemens Energy

Process Owner: Siemens Energy

Team Members

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DMAIC	Plan Start	Operational Metric	Baseline	Target
Define		➢ Number of errors in invoices generated	10% error in generated invoice	0-1% error in generated invoice
Measure		➢ Time spent generating invoice	45 minutes	15 minutes
Analyze		➢ Satisfaction of procedure to generate invoice by employees using the system		
Improve		Defect Definition: A defect in this process is defined as an invoice generated with incorrect information entered in that is sent on to the next step in the process.		
Control		**Expected Benefits**		**Projected Savings**
End		Hard Benefits : Reduction in the number of invoice generating errors and cost miscalculations. Soft Benefits : Reduction in the total time required to generate an invoice. Strategic Benefits : Quick reconciliation and approval of invoice purchase orders.		

Project Scope

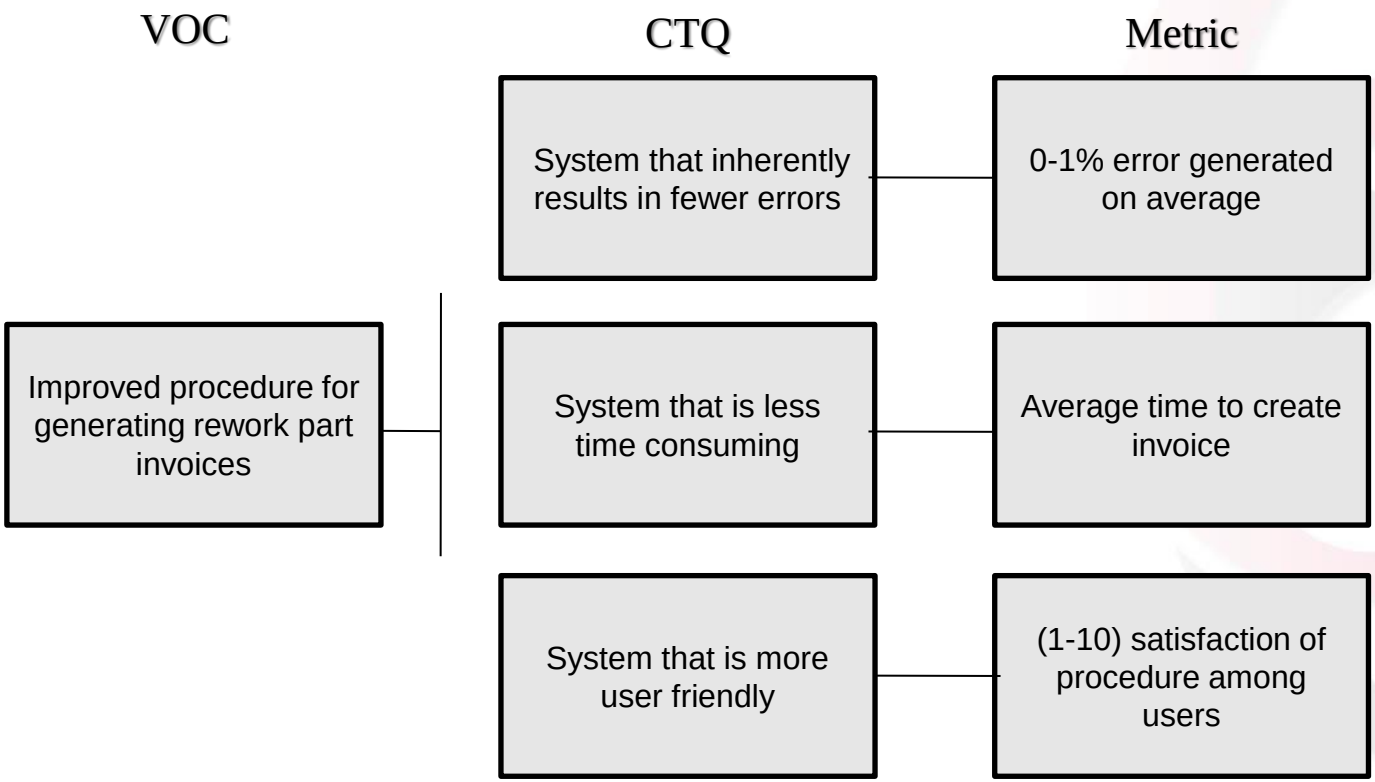
Out of Scope

- What parts are/are not routed through this system
- Who generates invoices
- Generation of inspection reports by quality engineers

In Scope

- The system in place where invoices are generated.
- The steps employees follow to generate the invoices.
- The system requires reduction in user error, time of invoice generation and costs

Project CTQs



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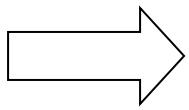
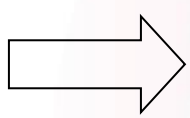




Supplier	**I**nput	**P**rocess	**O**utput	**C**ustomer
Department of Quality Control	Inspection report listing all rework activities necessary to the specific part	User manually enters information from inspection report to generate an invoice for the part	Invoice for specific part	Siemens Purchasing department

MEASURE

Measurement System Evaluation

- The problem faced by the customer is to improve the invoice generation process.
- The customer wants to generate error free invoices.
- The customer also wants to reduce the time required to prepare the invoice.
- Two types of data is measured.
- Sample invoices made by the users are compared with the actual invoice.
- Time required by different users to prepare the sample invoices is also measured.

Data Collection Plan

- 4 users from the Invoice making team are selected to measure the process.
- 4 sample invoices are made using existing process.
- Time required and errors generated during these invoice preparations are measured and analyzed.

Data Collection Sample

Project Title			Improving Invoice Generation Process for Siemens					
Project Leader			Team Siemens					
Frame	Component	Nomenclature	Proces	Actual Invoice Amount	Invoice Amount prepared by User 1	Invoice Amount prepared by User 2	Invoice Amount prepared by User 3	Invoice Amount prepared by User 4
501D5	Ring Segments	Row 1 GTR	Inspection	221	221	221	76	221
6-2000E	Blades	Row 1 Si3D	I&A	370	370	370	370	370
6-3000E	Ring Segments	Row 1 TLV	Light	410	410	410	410	410
6-5000F	Blades	Row 1 VGP	Light with 2464 coating	302	302	302	302	302
251B10-12	Blades	Row 2	I&A	75	75	75	75	75
5-4000F(2)	Blades	Row 2	I&A	80	80	80	80	80
6-8000H	Vanes	Row 2 (version 1.3 & 1.4)	Light	275	275	275	275	275
6-2000E	Vanes	Row 2 Si3D	I&A	124	124	124	124	124
5-2000E	Vanes	Row 2 Si3D	Medium incl Thermography	467	467	467	467	467
5-2000E	Vanes	Row 2 Si3D	I&A	427	392	427	427	427
6-3000E	Ring Segments	Row 2 TLV	Light	163	163	163	163	163
251B10-12	Blades	Row 3	Medium	412	412	322	412	412
6-2000E	Vanes	Row 3	I&A	403	403	403	403	403
6-8000H	Ring Segments	Row 3 (version 1.3)	Repair	300	300	300	300	300
6-6000G	Ring Segments	Row 3 TLV	Light	296	296	296	296	296
501B5	Vanes	Row 4	Scrap (See Cost Model Procedure Manual for Cost)	221	221	221	221	221
6-5000F	Vanes	Row 4	I&A	340	340	340	340	340
6-6000G	Blades	Row 4 (No Strip)	SEE FIXED COST MODEL FOR PRICING	441	441	441	441	441

Data Collection Plan

- 4 users from the Invoice making team are selected to measure the process.
- 4 sample invoices are made using existing process.
- Time required and errors generated during these invoice preparations are measured and analyzed.

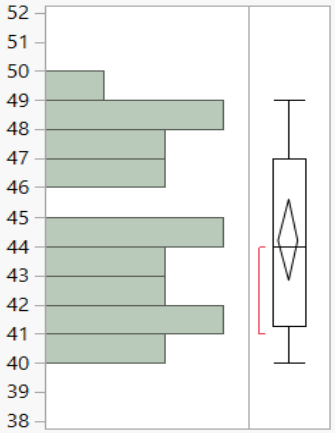
Project Title	Improving Invoice Generation Process for Siemens				
Project Leader	Team Siemens				
Invoice	Estimated Time taken in Invoice generation	Time taken for Invoice generation by User 1	Time taken for Invoice generation by User 2	Time taken for Invoice generation by User 3	Time taken for Invoice generation by User 4
Invoice 1	45	48	42	42	40
Invoice 2	45	42	43	42	46
Invoice 3	45	40	50	45	40
Invoice 4	45	42	43	50	41
Invoice 5	45	46	41	50	48
Invoice 6	45	43	48	43	47
Invoice 7	45	47	44	46	41
Invoice 8	45	47	46	49	46
Invoice 9	45	41	44	46	47
Invoice 10	45	48	46	44	43
Invoice 11	45	48	46	46	41
Invoice 12	45	44	47	40	47
Invoice 13	45	41	41	46	49
Invoice 14	45	44	40	43	41
Invoice 15	45	49	40	46	43
Invoice 16	45	43	50	50	49
Invoice 17	45	44	50	48	43
Invoice 18	45	41	42	44	47
Invoice 19	45	46	41	44	47
Invoice 20	45	40	40	40	41

ANALYZE

T-test Analysis on Time Taken by Users

Distributions

User 1



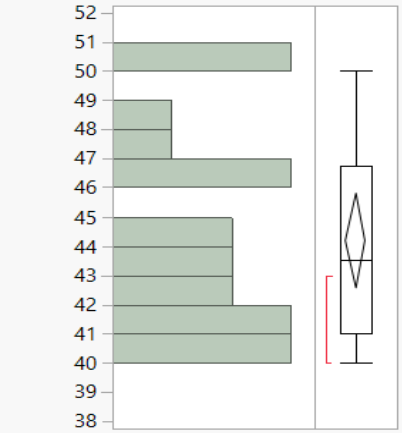
Quantiles

100.0%	maximum	49
99.5%		49
97.5%		49
90.0%		48
75.0%	quartile	47
50.0%	median	44
25.0%	quartile	41.25
10.0%		40.1
2.5%		40
0.5%		40
0.0%	minimum	40

Summary Statistics

Mean	44.2
Std Dev	2.9664794
Std Err Mean	0.663325
Upper 95% Mean	45.588355
Lower 95% Mean	42.811645
N	20

User 2



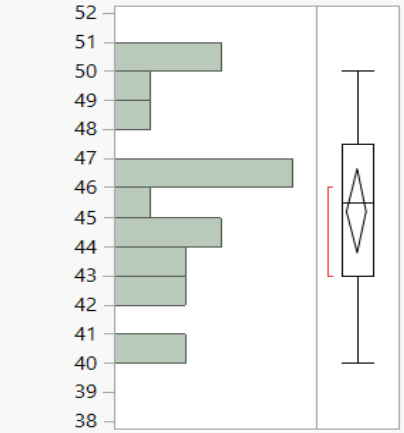
Quantiles

100.0%	maximum	50
99.5%		50
97.5%		50
90.0%		50
75.0%	quartile	46.75
50.0%	median	43.5
25.0%	quartile	41
10.0%		40
2.5%		40
0.5%		40
0.0%	minimum	40

Summary Statistics

Mean	44.2
Std Dev	3.4732057
Std Err Mean	0.7766324
Upper 95% Mean	45.82551
Lower 95% Mean	42.57449
N	20

User 3



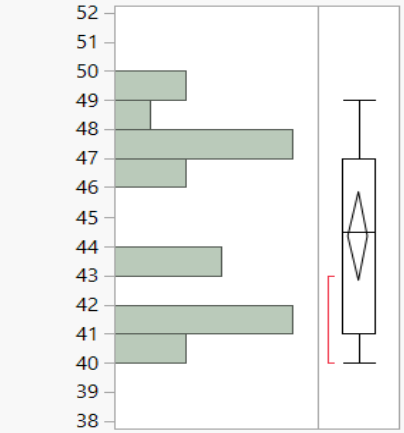
Quantiles

100.0%	maximum	50
99.5%		50
97.5%		50
90.0%		50
75.0%	quartile	47.5
50.0%	median	45.5
25.0%	quartile	43
10.0%		40.2
2.5%		40
0.5%		40
0.0%	minimum	40

Summary Statistics

Mean	45.2
Std Dev	3.105174
Std Err Mean	0.694338
Upper 95% Mean	46.653266
Lower 95% Mean	43.746734
N	20

User 4

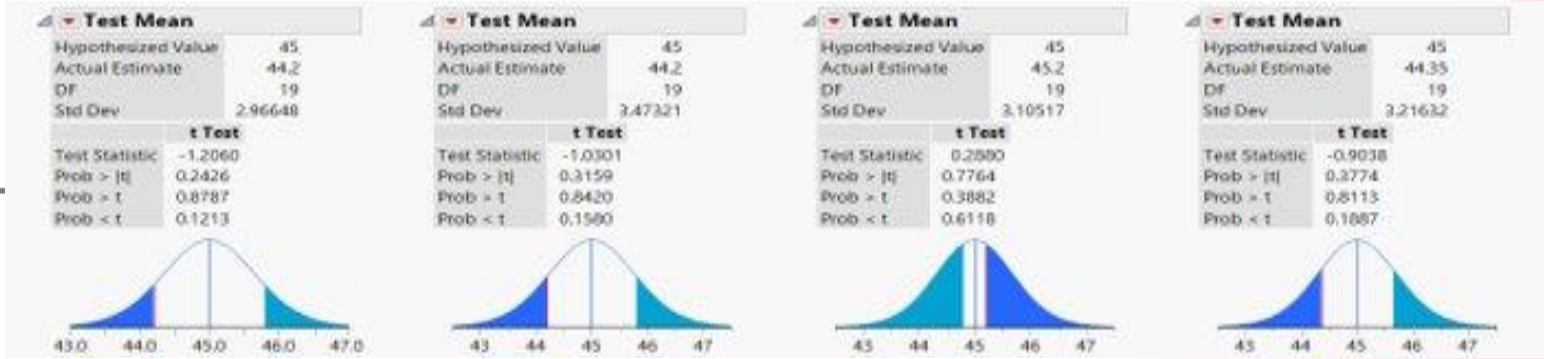


Quantiles

100.0%	maximum	49
99.5%		49
97.5%		49
90.0%		48.9
75.0%	quartile	47
50.0%	median	44.5
25.0%	quartile	41
10.0%		40.1
2.5%		40
0.5%		40
0.0%	minimum	40

Summary Statistics

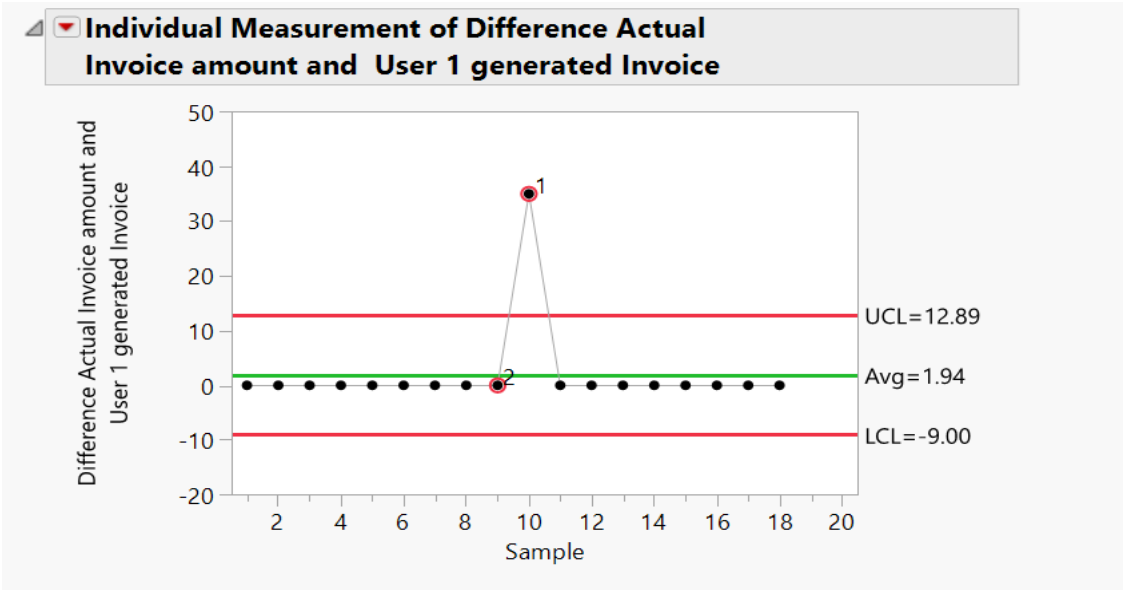
Mean	44.35
Std Dev	3.2163235
Std Err Mean	0.7191918
Upper 95% Mean	45.855286
Lower 95% Mean	42.844714
N	20

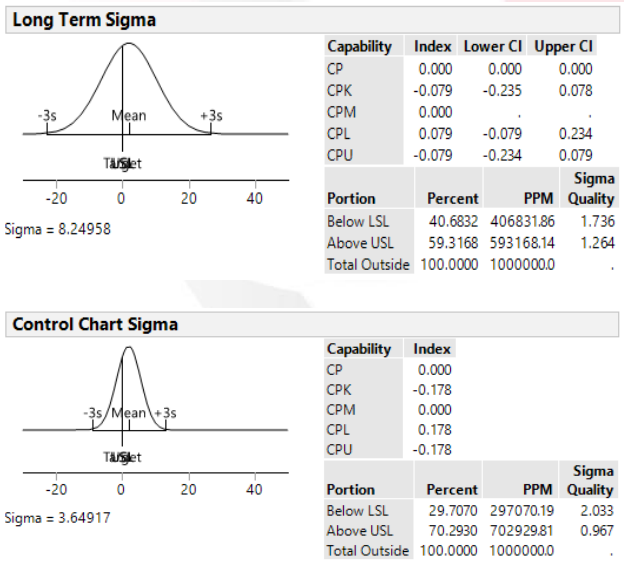


- From the above t-test analysis, all the four users take approximately 45 minutes to complete the invoice process which can be proved based on the hypothesis testing.
- We thus, fail to reject the null hypothesis (mean time taken by users is equal to 45 minutes) from the p-values which are greater than 0.05.
- From the analysis, User 3 is more statistically accurate and is much more optimal in invoice generation than other users.

Process Baseline – Control Charts

- The control chart for the errors occurred during sample invoice preparation is shown below.
- Target set is 0 for the capability analysis. The system should have 0 errors, the UCL and LCL does not exist.
- Cp value observed is 0 since the target, UCL and LCL are same.





Capability	Index	Lower CI	Upper CI
CP	0.000	0.000	0.000
CPK	-0.079	-0.235	0.078
CPM	0.000	.	.
CPL	0.079	-0.079	0.234
CPU	-0.079	-0.234	0.079

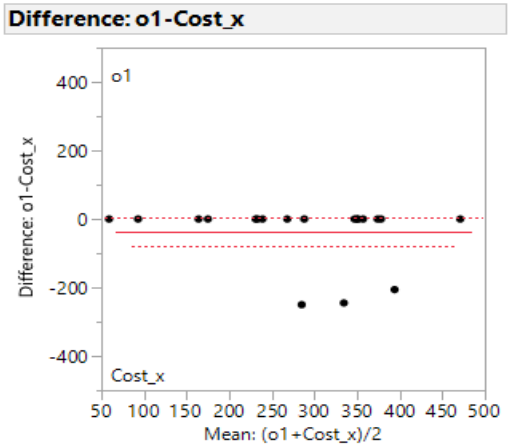
Portion	Percent	PPM	Sigma Quality
Below LSL	40.6832	406831.86	1.736
Above USL	59.3168	593168.14	1.264
Total Outside	100.0000	1000000.0	.

Capability	Index
CP	0.000
CPK	-0.178
CPM	0.000
CPL	0.178
CPU	-0.178

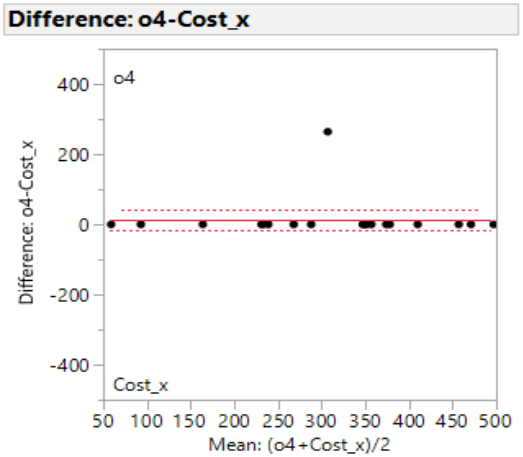
Portion	Percent	PPM	Sigma Quality
Below LSL	29.7070	297070.19	2.033
Above USL	70.2930	702929.81	0.967
Total Outside	100.0000	1000000.0	.

Data Analysis

- Matched pair test is used to compare the actual invoice amount and the invoice generated by the users.
- The p value is very close to 0.05, it can be concluded that that difference between means is not equal to zero.
- It means there is a possibility of generating the incorrect invoice using existing process

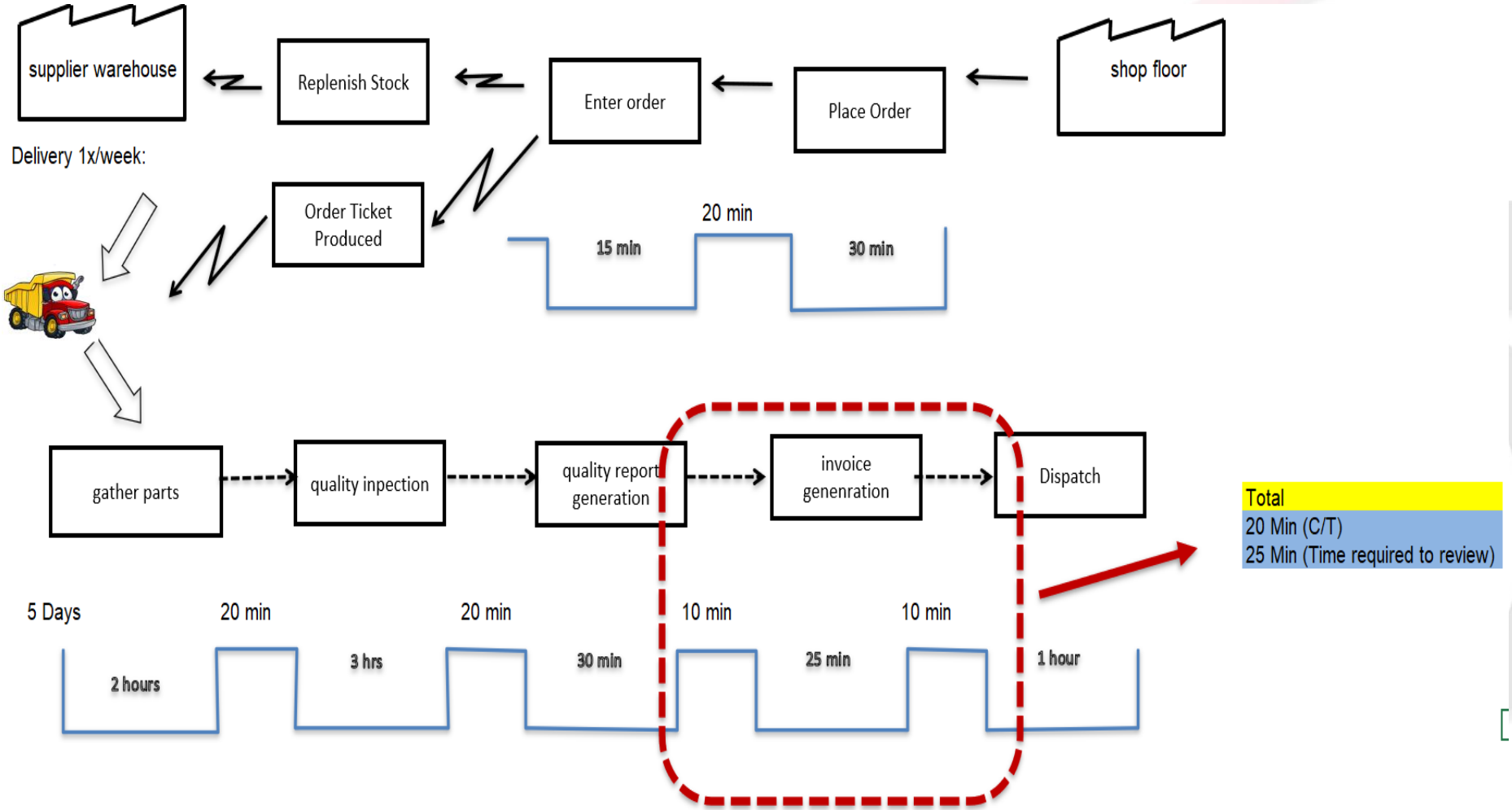


o1	265.316	t-Ratio	-1.82944
Cost_x	302.211	DF	18
Mean Difference	-36.895	Prob > |t|	0.0839
Std Error	20.1673	Prob > t	0.9580
Upper 95%	5.47512	Prob < t	0.0420*
Lower 95%	-79.265		
N	19		
Correlation	0.71874		

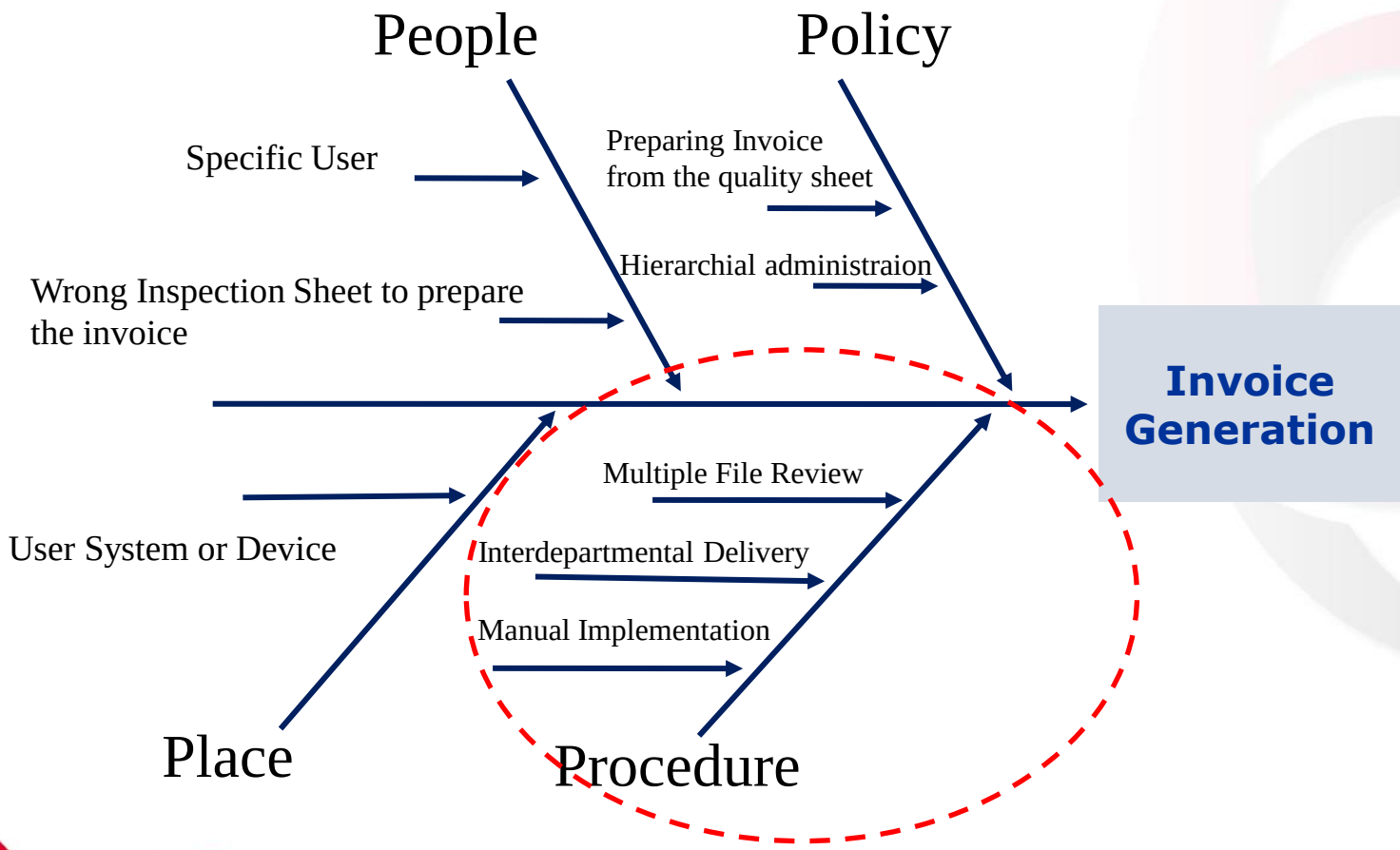


o4	316.105	t-Ratio	1
Cost_x	302.211	DF	18
Mean Difference	13.8947	Prob > |t|	0.3306
Std Error	13.8947	Prob > t	0.1653
Upper 95%	43.0865	Prob < t	0.8347
Lower 95%	-15.297		
N	19		
Correlation	0.88015		

Process Analysis



Ishikawa Diagram -Prioritized Root Causes



IMPROVE

Potential Solutions

- Automate the process of finding the cost of item included in invoice from bill of materials.
- Assigning the job of invoice generation to a single employee.
- Cross checking the item and its costs after invoice generation.

Solution Implementation Plan

- Prepare cost data of all rework parts
- Use this to make a Microsoft Access application which eases rework item selection.
- Generate PDF of these selected parts to make invoice

Effectiveness Of Solution

- The invoice generated from access database application has 0% error.
- On average it takes 7-10 minutes to generate an invoice using the access database application.
- Time saved compared to manual generation of invoice is 67%.

Invoice Generation Video

CONTROL

Summary of Solution Strategies

- Automated database system is created to prepare the invoice.
- Users need to be trained to understand the inspection sheet to operate the database system.
- It is recommended to cross check the invoice with the inspection sheet to ensure the correct entries.

New Process Baseline

- New process has fewer steps as compared to the previous process.
- The multiple comparison is eliminated due the computer application.
- The chances of errors are reduced to 1% and it can happen only due to wrong selection from the drop-down list.
- Time required is reduced from 45 minutes to 8 minutes.

Process Management Plan

- Train every new user on interpreting cost data which is used to make invoice.
- Give the user time to get used to the computer application they will be using.
- Document the reason why a user makes mistakes so that it can be reviewed by a new employee who will do this job.
- Keep record of error so that it can be analyzed to control the process

Cost/Benefit Analysis

Cost

- The cost required to design the system
- The cost required to train the users to operate the system
- Time required to adapt the new process and errors generated during the transition phase

Benefits

- Errors reduced from 10% to 1%.
- Time required to prepare the invoice reduced from 45 minutes to 8 minutes.