Six Sigma Project Complete Case Study

A Case Study on Improving Productivity by Reducing Operation Cost as Six Sigma Process Improvement

Keywords: **DMAIC, FMEA, KPI Dash Board, NVA, Pilot Verification, Root cause Analysis, Risk Analysis, Six sigma process improvement, VOC**

Abstract

This case study illustrates the application of six sigma process improvement to productivity improvement in manufacturing process.

Introduction

To ensure sustainable profitable growth in a highly price-sensitive appliance market **Cost reduction through operational excellence** is the key imperative. Elin Appliances upgrades can often be justified in terms of savings due to increased productivity. However, in a Six Sigma organization, the DMAIC Method & host of tools can be used to improve productivity through process improvements.

Six Sigma DMAIC

Six Sigma is a quality improvement program that looks at processes with a view to analyzing process steps, determining what process elements need improvement, developing alternatives for improvement, then selecting and implementing one. It relies on a variety of qualitative and quantitative tools, emphasizing the use of data and statistical analysis with in a method called DMAIC, an acronym for the names of its five phases (Define, Measure, Analyze, Improve, and Control) (Table 1). Six Sigma projects are typically selected for their potential savings in improving any process, whether it is in production, administration, engineering, or services. A Six Sigma project typically begins with a high level definition of a process, using a diagram to specify the process boundaries, inputs, outputs, customers, and requirement. In the measure phase, a process metric is selected and used to baseline the current performance of the process. In the analysis phase, the process is analyzed, usually with a process map and a failure modes and effects analysis (FMEA), but may include other types of analysis. The process map shows each process step with its inputs and outputs and provides the basis for either a FMEA or a quantitative, usually statistical, analysis. Areas for improvement are pinpointed and alternatives are generated and evaluated. Once an improvement option is selected and implemented, the project enters the control phase. In this phase, a plan is established for monitoring and controlling the process to ensure that gains are maintained.

The use of the DMAIC method may vary between projects. For example, the Measure and Analyze phases of this project ran concurrently rather than sequentially. Also, a proposed solution may emerge early in the Measure and Analysis phase, leading to an emphasis on planning and implementation in the Improve phase. Such was the case in the Productivity Improvement project. Consequently, this paper focuses on the Measure and Analyze phases in which a simulation based on a process map provided the justification for Productivity Improvement.

Table 1. DMAIC Method for Process Improvement

Phase Steps
Define - Identify an opportunity and define a project to address it.
Measure -Analyze the current process and specify the desired outcome.
Analyze - Identify root causes and proposed solutions.
Improve - Prioritize solutions; select, plan, validate, and implement a solution.
Control - Develop a plan for measuring progress and maintaining gains.

Define Phase

As per "Voice of the Customer(VOC)",customer products should have price stability & products should be competitive in pricing. To meet customer requirement cost reduction is the key driver for profitable growth.

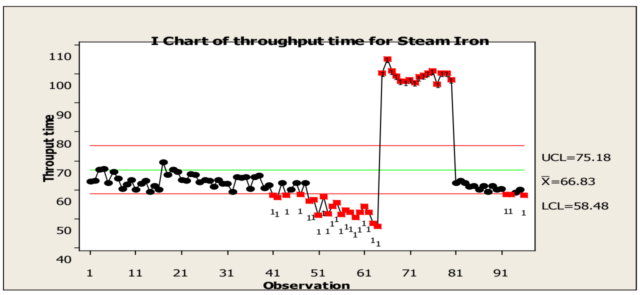
Problem / Opportunity statement

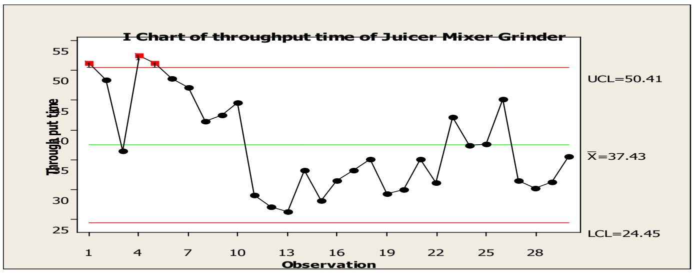
1. Estimated losses in factory due to poor productivity exceeded 100 K Euros in 2006-2007 financial year
2. Productivity improvement would generate hard and soft savings.

Measure Phase

1. The Flow through M-Phase-
2. Develop process measures
3. Collect Process data
4. Check data Quality
5. Understand Process behavior
6. Baseline Process Capability

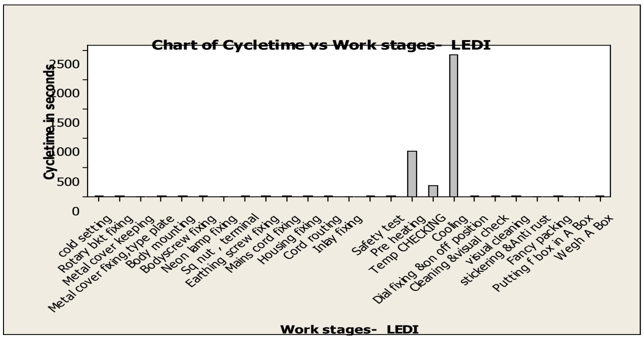
Process mapping data for Problem statement – Throughput time: Data collected for all assembly lines

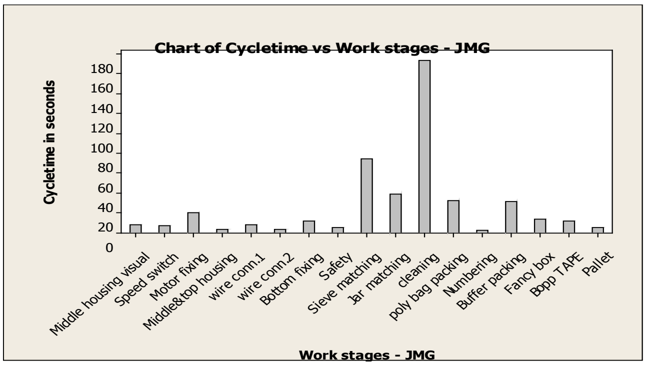




As per data, there is wide variation in process through put times

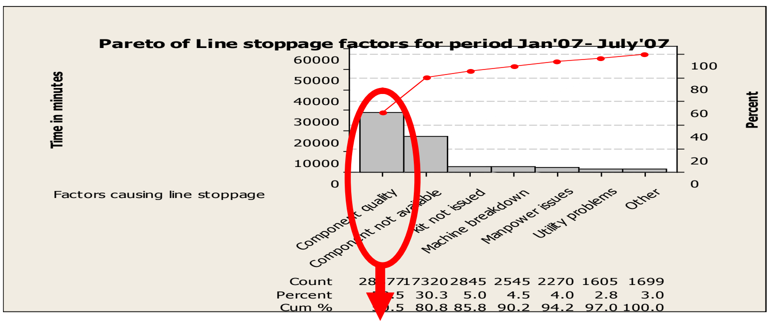
Cycle Time Study of Line





Assembly lines are highly unbalanced due to no value added content.

Root cause analysis of line stoppage



Component having high Quality issue

Why analysis of Non Value Added activity on line

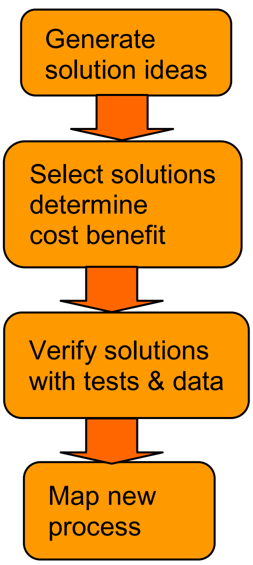
S. No.	Non valued added stage	WHY	WHY	WHY	WHY	WHY
1	Toaster cooling stage	time	Heat dissipation Is not properly controlled	Cooling equipment deficiency	Design of cooling equipment is not optimised	
2	Sieve matching and jar matching	Selective assay process	To check for noise and vibration	Unbalanclng of sieve	Interaction effect of components	specs of components not optimised
3	Iron cooling stage	Cooling time is high	Uniform cooling is not happening	Iron farthest from fan takes longer time to cool	Iron coding is influenced by ambient conditions also	cooling arrangement Is adequate
4	Preheating stage	Has to go through 3 heating cycles	This is a to ensure iron attains steady state	Requirement for 100% temp validation	Reliability of cold setting	Cold setting process Inadequate
5	Packaging and cleaning	line	Packaging stages are not balanced	Manual and too many offline activities	To many items in packaging design	Packaging design not simple
6	Pop up testing	time at the testing stage	Only four toasters can be tested at a time	Testing equipment capacity is a bottleneck	Equipment is not designed to line speed.	

Analyze Phase

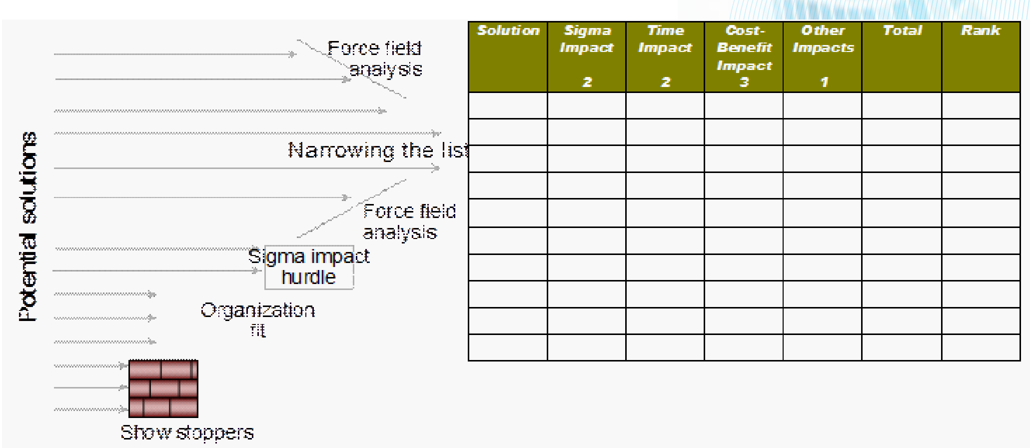
The flow through A-phase

1. Determine potential root cause to measure
2. Analyze data using process stratification
3. Verify root causes with test data

Solution selection process



Evaluating criterias



High impact solutions selected against each problem statement

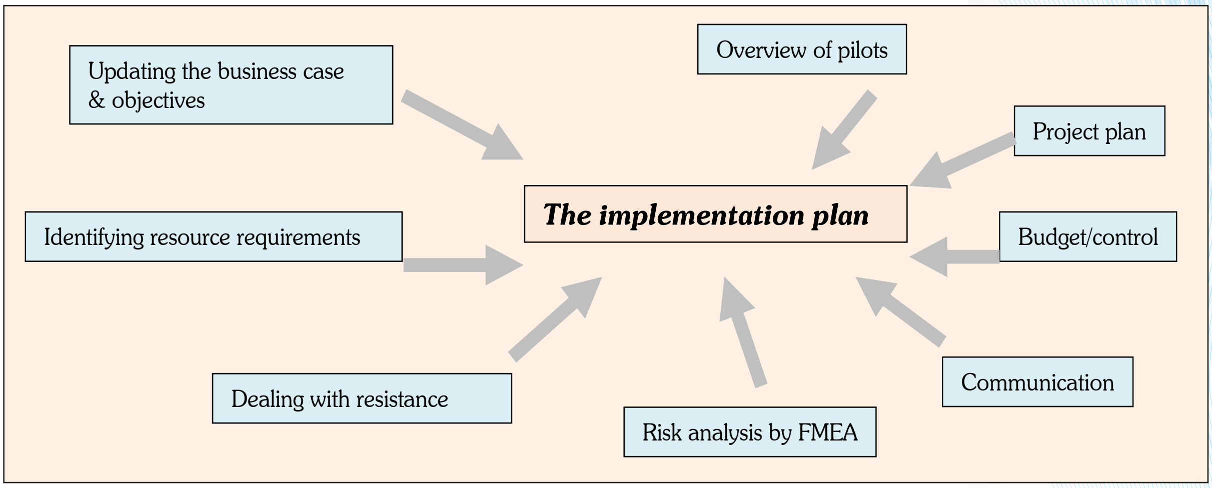
Problem statement **Line stoppage**	Problem statement **High NVA & TPT**	Problem statement **High TPT**
Remove hex screw	Replicate steam iron cooling jig	Introduce conveyor belt
Recalibrate standard	Automate cold setting process	Strengthen engineering function at comaker
Duplicate /repair moulds	Temperature checking on sampling basis	Standing working
Plastic JMG collar	Control Sieve unbalance <10 mg& motor coupler Within 0.1 mm run out	Streamline material feeding
Enclosed chamber for powder	Increase capacity of pop up testing jig	Automate RTV application
Jar assy relocation Near to comaker	Simplify packing and cleaning stages	
Source sieve from better supplier		

Implement phase

The Flow through implement phase-

- Assess risk using FMEA
- Design implementation plan
- Communicate to People
- Pilot solution and track improved performance

Elements of an implementation plan



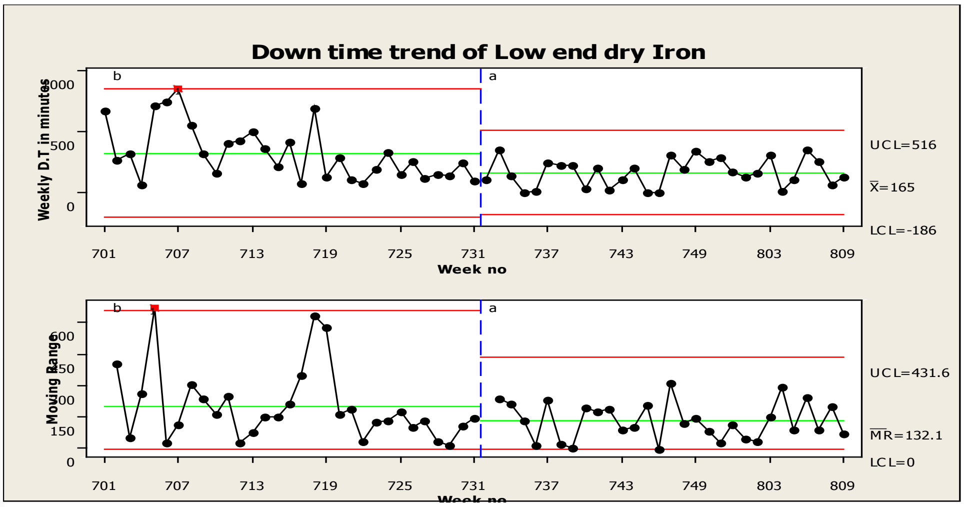
Some of the high risks for solutions that were addressed through FMEA

S.No.	Solution	Failure mode	Recommended actions
1	Conveyorisation	a. Breakdown b. Misalignment in speed	1. Proper design evaluation and release 2. Preventive maintenance plan 3. Proper pilot.
2	Standing working	a. High fatigue levels below morale in operators	1. reconfirm working ergonomics during pilot 2. have a proper communication plan to deal with resistance and change 3. show bench marks
3	Milkman feeder	Material not reaching on main line on time.	1. Proper routing plan 2. proper design of material transfer trolleys
4	Sampling checking of temperature at nine stage	Irons with high/ ow temp, passing Into market	1. Cold setting and nine stage in a con-trolled atmosphere 2. Control plan far cold setting process 3. Introduce automation in cold setting process
5	Automation In RTV application	a. Machine breakdown b. High cycle times c. High wastages	1. Preventive maintenance plan 2. SOP for Job setup validation and how to operate the machine.
6	Deletion of antirust in finished irons	Oxidation of soleplate in market	1. Proper evaluation and release 2. ControlonT1088 Aluminium composition

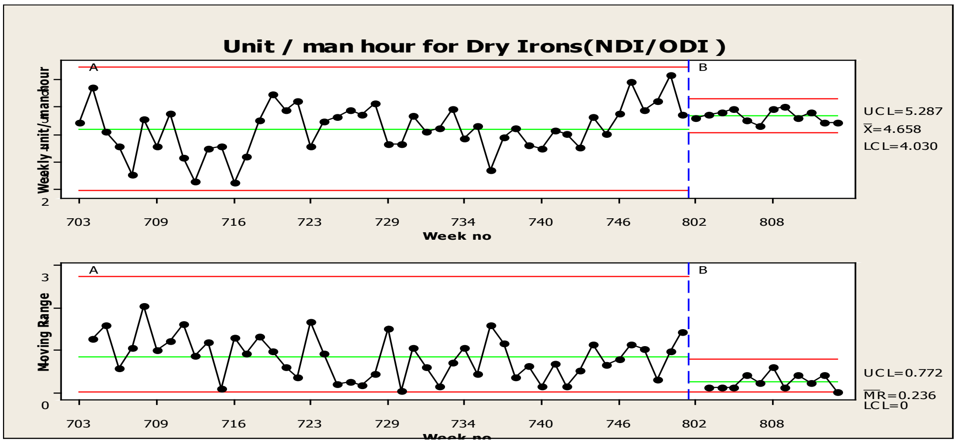
Pilot verification plan was used to modify the proposed solutions before implementation

S.No.	Pilot on Proposed solution	Pilot Verification	Modifications done on solutions
1	Automation on RTV application	1. High wastage of RTV 2. Misalignment of RTV dispenser with soleplate 3. new failure points identified	1. Reprogramming of m/c 2. reduce nozzle dia 3. make work instruction and training 4. revision of critical spares list
2	Oil shields in Jar pots	1 Paper caps not durable 2. Fitment Issues 3, Operator needs training.	1. change into plastic caps 2. modify dimensions 3.Training was provided.
S	Introduce cooling jigs	1 Metal cover not cooling in required time 2. Compressor not getting burnt	1. Addition of cooling fans on top 2. proper capacity of compressors were incorporated in the design.
4	Standing Working	1. Operator fatigue 2. mental bafflers 3. working ergonomics not proper	1. Gradual phasing in of standing working 2. one to one communication channels 3. Increase table height

The improved process-Primary metric unit/man hour



Process mean improved with reduced variation



Down Time Trend

Control Phase

Implement permanent control methods

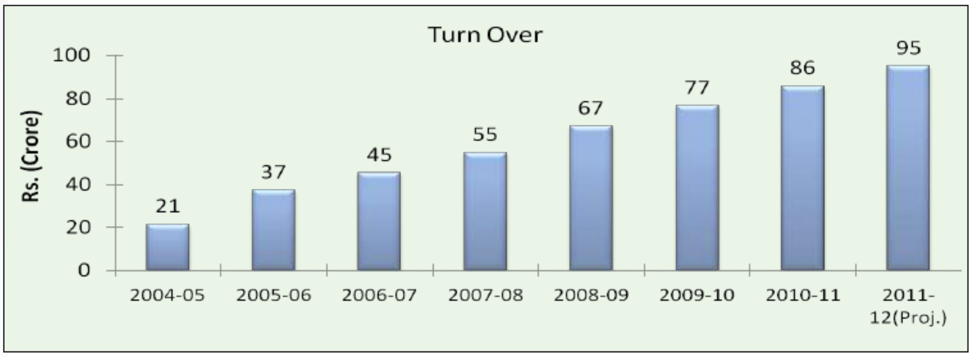
- Track and confirm improved long term process capability
- Standardize control plan
- Identify leverage opportunities
- Validate final financial results
- Project handout

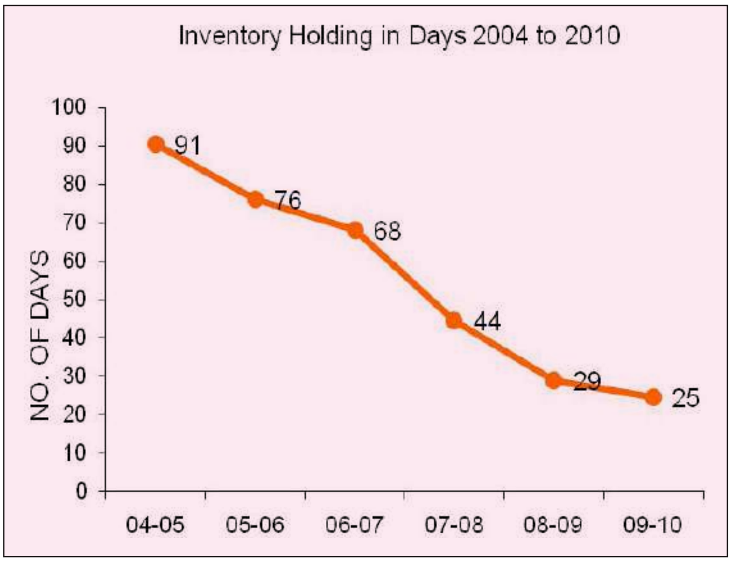
KPI Dash board–The Process outputs to be monitored

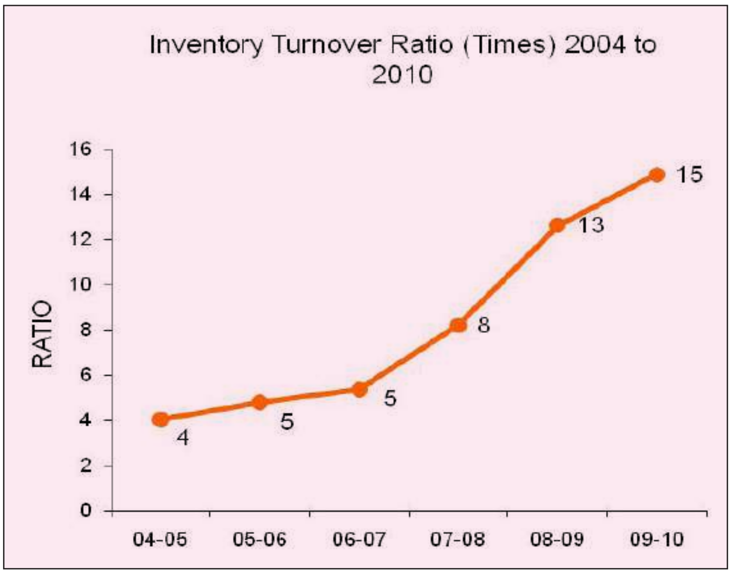
S. No.	What are the Y's to be monitored	Who will measure/ monitor	Control methods
1	Unit per man hour	Production manager	Control chart & OCAP
2	TPTof main assy process	Line supervisor	Control chart & OCAP
3	Hourly rate of production for main assy	PPC manager	Control chart & OCAP
4	Line stoppage time	Production manager	Control chart & OCAP
5	DPMO	Quality manager	Control chart

Results of Project

Financial Pulse







Productivity (Measured in Unit per Man hour)

Learnings from Project

- A rigorous base line is important to define the improved state of the process
- Never underestimate the power of Pilots for an effective implementation of solutions
- It is important to build a critical mass of people who will build the change in the organization
- An effective and consistent communication plan is the key for embedded change
- Behind every good product there is a good process