

Transformation–ECO TAT & OTD Improvement

KEYSIGHT LABS DESIGN SERVICES

ABSTRACT

“Unlocking Measurement Insights”- Keysight Technologies Inc. (NYSE: KEYS) is the world's leading electronic measurement company, transforming today's measurement experience through innovations in wireless, modular, and software solutions. With its Hewlett-Packard and Agilent legacy, Keysight delivers solutions in wireless communications, aerospace and defense and semiconductor markets with world-class platforms, software and consistent measurement science. The company's nearly 10,500 employees serve customers in more than 100 countries.

The Aim of Project “Transformation” is to improve Turnaround Time, On-time Delivery for Engineering Change Order Process to meet internal customers demand (those belongs to Design, Manufacturing, Procurement community across Keysight).

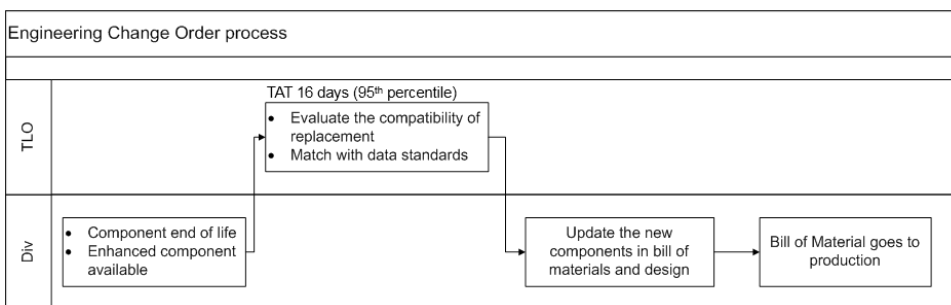
Keywords: Engineering Change Order (ECO), Turnaround Time (TAT) Improvement, Increased On-Time-Delivery (OTD), Business-Customer Requirement Collation using VOB-VOC, Problem Identification using Process & Data door approaches, 5Why Analysis.

Introduction

Keysight Labs Design Services Item Standardization Team manages (creates/ updates) Corporate Items and Manufacturer information in CSM database used across Keysight divisions worldwide.

Enovia is Enterprise web-based application used to raise Engineering Change Orders (ECO) request and Bill of Material management. An ECO is a unique change request number (e.g. ECO0XXXXXX) that is generated when customer submits the change request and once generated, routing, changes, tracking is done via ECO Number.

Like any other ticketing system TAT and OTD is measured for the ECO starting from request submission till closer. Typical lifecycle stages of an ECO is mentioned below where process begins at create stage where Customer raises ECO and then it passes through various stages and after doing the desired changes completes at Release stage.

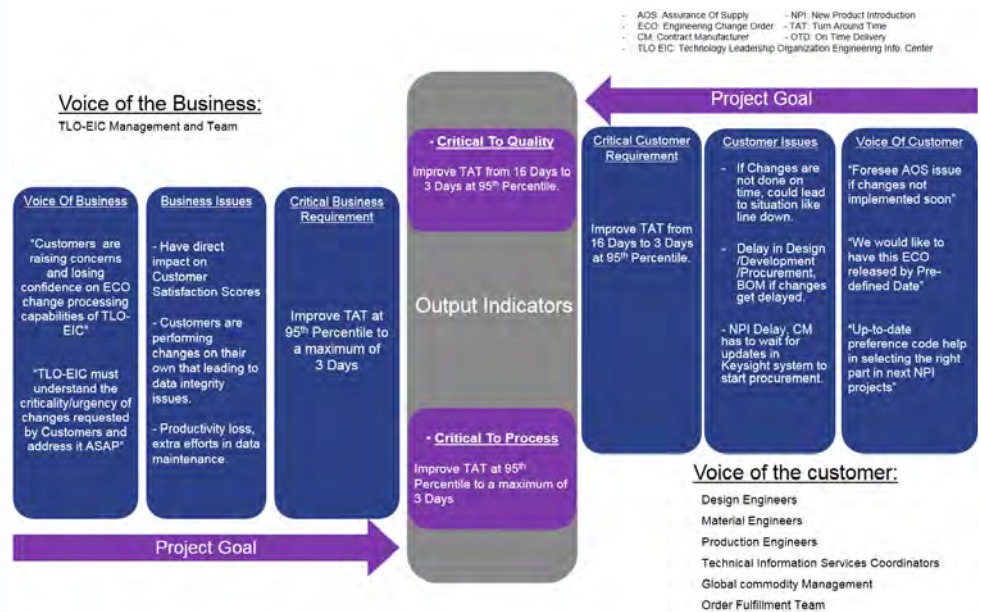


Problem Statement

Customers were unhappy with existing TAT & OTD and their demand was to improve both TAT and OTD for uninterrupted downstream process flow at their end. Business was also struggling with increasing trends in data integrity issues as customers were bypassing the standard ECO submission process and inclined to perform changes on their own.

Project Selection Criteria

Core team did VOC-VOB study to make sure that critical customer requirements are also in alignment with Business. When the things were put together it was realized that both Customer and Business are on the same page and have common area of interest that is to improve the existing TAT & OTD. Subsequently immediate approval from upper management was sought for this project. Below is the quick snap where Output Indicators clearly depicts the Customer-Business Convergence.



Project Timelines

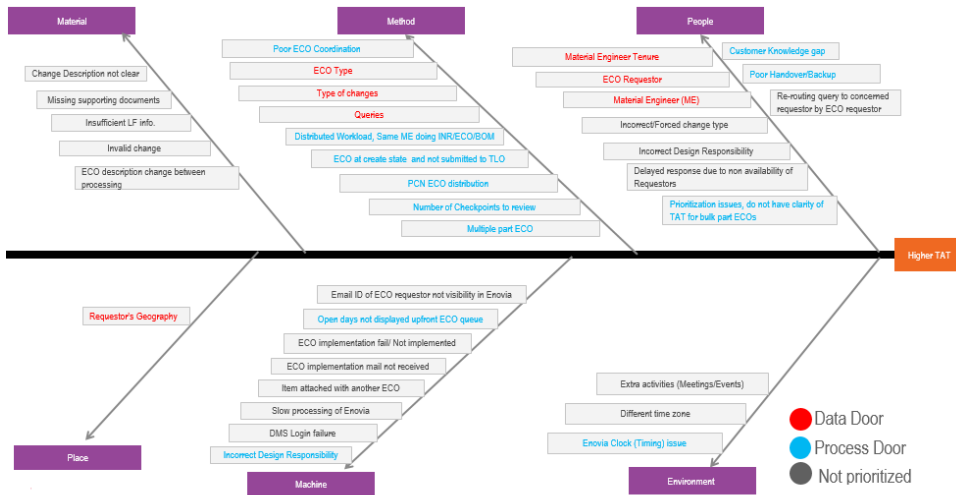
Data showed up increasing trends of unauthorized changes by customers and hence Business wants to bridge the gap in best possible time.

To ensure meeting every milestone on time and to keep good track of the same Gantt chart was prepared. Project was kicked-off on March '16 and completed by December '16 as per the plan.



Problem Identification

After defining the Project timeline next step was to find the issues in the process/system. Project team decided to go step by step and started with capturing all potential causes contributing in delay using Fish Bone method where High TAT was kept in the head and then conducted Brainstorming sessions with core team to find out Causes/issue in process/system and contributing towards High TAT.



After successfully placing potential causes in various areas (People, Place, Material, Method, Machine, Environment) then another round of brainstorming session was conducted with subject matter experts to sub categorized these issue in Data Door, Process Door, Not Prioritized bucket.

- **Data door:** Potential causes for which data can be collected for further Root cause analysis were categorized under data door bucket
- **Process door:** Potential causes for which data can't be collected but critical to the project were categorized under this bucket.
- **Not Prioritized:** These were the causes whose occurrence is low or these are least significant.

Data Collection Plan

By this point all potential causes were bucketized and hence data collection plan was plotted, that defines Measure Name, Data Type and since multiple folks were involved in this project to make sure everyone understands Project 'Y' and 'X's correctly and are on the same page clear operational definitions added here along with time bounded goal for completion.

Measure Name	TAT	ECO Requestor	Material Engineer (ME)	Material Engineer Tenure	ECO Type	Requestor's Geography	Type of changes	Query
Measure Type (Y or X)	Y	X	X	X	X	X	X	X
Data Type (Continuous or Discrete)	Continuous	Discrete	Discrete	Continuous	Discrete	Discrete	Discrete	Discrete
Operational Definition	Time from ECO submission till ECO Release	Customer who originates and submits the ECO to TLO	Materials Engineer who processes the ECO.	Tenure of ME in current process role	High-level categorization of ECO Type	Geographical location of ECO Requestor	Type of changes requested by the customer	Whether ECOs had a query while processing?
Who will collect the data?	Mahendar Singh	Mahendar Singh	Mahendar Singh	Manisha Makhijani	Mahendar Singh	Mahendar Singh	Mahendar Singh	Mahendar Singh
When will data be collected?	Apr 29, 2016	Apr 29, 2016	Apr 29, 2016	Apr 25, 2016	Apr 29, 2016	Apr 29, 2016	Apr 29, 2016	Apr 29, 2016

Statistical Analysis (Data Door Approach)

Various statistical tests were performed on Data Xs to check how many of these are significant and need to be addressed to achieve the project Y. Below is the summary of the and results of the Hypothesis testing done on various data Xs. Outcome of this analysis suggested out of 7 causes 5 were significant.

Y	Data Type	X's	Data Type	Hypothesis Test		Result
TAT	Continuous	ECO Requestor	Discrete	Homogeneity of Variance p value: 0.307	Mood's Median Test p value: 0.000	Significant
		Material Engineer (ME)	Discrete	Homogeneity of Variance p value: 0.767	Mood's Median Test p value: 0.000	Significant
		Materials Engineer (ME) Tenure	Continuous	Simple Linear Regression (Fitted Line Plot): R-Sq(adj): 0.6%		Not significant
		ECO Type	Discrete	Homogeneity of Variance p value: 0.371	Mood's Median Test p value: 0.000	Significant
		Requestor's Geography	Discrete	Homogeneity of Variance p value: 0.383	Mood's Median Test p value: 0.203	Not significant
		Type of Changes	Discrete	Homogeneity of Variance p value: 0.036	Mood's Median Test p value: 0.000	Significant
		Query	Discrete	Homogeneity of Variance p value: 0.000	Mood's Median Test p value: 0.000	Significant

p<0.05 implies that 'X' is significant, p>0.05 implies that 'X' is not significant

Subjective Analysis (Process Door Approach)

In parallel to data door analysis and result validation causes were looked into for which data can't be collected but these can be analyzed by looking into the existing process. NGT or Nominal Group Technique is one of the proven methodology commonly used in such situations. Below is the quick glance of NGT done in the group include Business Process analyst, Quality folks and Operations team.



Issue/Gaps to be addresses	Business	Quality	SME	Process	Priority Score
ECO at create state and not submitted to TLO	4	1	5	1	11
Enovia Clock (Timing) issue	4	6	1	1	12
Incorrect Design Responsibility	2	1	7	5	15
Customer Knowledge gap	1	2	6	1	10
Distributed Workload, Same ME doing INR/ECO/BOM	1	5	1	1	8
Multiple part ECO TAT	4	3	3	1	11
Number of Checkpoints to review	5	2	7	2	16
Poor ECO coordination	1	1	1	1	4
Open days not displayed upfront in Enovia ECO queue	3	3	7	1	14
PCN ECO distribution	1	3	1	1	6
Poor Handover/Backup	5	4	1	3	13

1-High Priority, 16-Least Priority

5-Why Analysis “Digging to Root of the Problem”

5-Why analysis done on various Xs identified by Hypotheses testing, NGT and FMEA, below is the table showing how the root cause was reached to and solutions devised for the same.

5 Why Analysis:					IMPROVE
X	Why 1	Why 2	Why 3	Solution	Solution Name
Material Engineer (ME)	Bandwidth issue: Due to other Priority work/Load ME is not able to process the changes immediately even after knowing that details provided in the ECO are OK to proceed	Since ME have band of 5 days, so completing the ECO changes is kept at low priority as long as it is not getting delayed in 5 Days	Due to other parallel routine activities Web/INR, BOM which have tighter TAT are consider as High priority leaving non-polling at medium/Low priority	Job specialization to have focused resources working on ECOs only.	
	Investigation/checking existing part history in multiple system (CDS, Gemini, Web/INR, Enovia, ATM, OHQ/PO History) takes longer time	Individual systems maintain records on its own.	No centralized system available where all records of parts are captured.	Deploy central Investigation Utility	Business Process Re-engineering Investigation Utility
Type of ECO	Requestor submitting multiple parts in one single ECO	Creating individual ECOs for individual parts is time consuming at customers end.	Time saving at customers end.	Review and make separate bucket of such ECOs and apply batch processing. All Win-Win!	Bulk Part Processing
Type of Changes	Finish information missing for new MEP addition.	Not mentioned in the datasheet/Not provided by requestor.		Expand Global Pass list, Quick query template(Lead Free, MPN query, RoHS Query in outlook itself)-Via Automation	Batch Processing
ECO Requestor	ECO Requestor are new to process or bypassing the standard process.	Process knowledge gap	Training specific to TLO process is not provided to new folks or Existing folks have outdated process knowledge	Customer Education required: Technical contact should be mentioned in ECO description by ECO creator or in 'Requester' field in the ECO	Customer Training Series
Query	Internal query/discussion that need to be carried out for certain ECOs with SMEs takes time	Most of the time SMEs are engaged in meetings other activity and hence physically not present on floor.	Practically it is not possible that SMEs available on floor all the time	Create some virtual common platform for addressing queries.	'RAPID' – Query Resolution Solution
Poor Coordination	Re-Routing of ECOs internally (from one ME to another) or out of scope ECOs assigned.	Unexperienced coordinator assigning ECOs in the team		Place experienced for Coordination	Experienced Coordinator
Work load and prioritization.	Not able to keep track of assignment, manual tracking.	Not able to prioritize work queues of ECO, BOM, INR.	Manual tracking, no visualization dashboard available.	Devise work Assignment Dashboard and some delay tracking mechanism.	INTELLITRACKER

● FMEA 'X'
● Data Door 'Xs'
● NGT 'X'

Solutions Implemented

Innovation-I “Work load balancing in operations team Intellitracker”– This is one of the In-house developed tool which helps operations Team lead in managing workload effectively.



Day	Date	Item No.	Description	Status	Total Assignments	PN	ECCO	Total
Monday	12/05/2016	IFR2012761	IFR2012766	IFR2012771	IFR2012776	0	0	4
Tuesday	12/06/2016	IFR2012779	IFR2012785	IFR2012790	IFR2012795	0	0	6
					31	14	0	45

Innovation-II “All in one Place” Part investigation utility is very effective in getting information from various system in one place without logging into different systems.

Part Investigation Tool

KEYSIGHT PART NUMBER	MANUFACTURER PART NUMBER	ITEM DESCRIPTION	ITEM STATUS	KEY	ITEM STATUS	ITEM RESPONSIBILITY TYPE	ITEM STATUS	ITEM RESPONSE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE	ITEM TYPE
08631024	08631024	Capacitor-Film Production	CAPACITOR-Film Approved	Manufacturer Equipment	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Innovation-III “Live query handling”: Cisco spark is introduced as a common platform for internal Query handling wherein group is created that includes operation team and SMEs. Any individual who is working on some ECO has any query can easily post his query on this platform and senior members of the team review the query and post answers, suggestions thus it became a kind of live query support system for the team.



Work allocation based on area of expertise: Operation team re-structured without adding any extra head count and dedicated resources placed for ECO processing.

ME Name	BIM/ NBM	Coordination	INR	ECO	BOM Analysis	QA	PDQ	Mailbox	Code Management	Others
	PM		Yes	Yes - AML (B) (B)	Yes		Yes			IDS-Unauthorised changes
	BIM		Yes (A)	Yes (P3) - AML (BIM)/ Grade (B)	Yes	INR (B)				Resistor/Capacitor Cleanup, Mass Updates
	BIM		Yes	Yes	Yes			Yes		SE-Parametric
	BIM		Yes	Yes						SE-PL Categorization
	BIM	Yes (INR Creation, INR/ECO/Route Assignment)	Yes							Data improvement
	BIM				INR/ECO	Yes	Yes (B)	Yes (B)	Yes (B)	DQ, Technical support
	NBM	ECO Assignment Monitor			Yes	INR/ECO			MAC-USP-PCI Yes	MIS/Delay reasons, Alignment
	NBM			Yes (P3) - Grade	Yes	INR/ECO	Yes	Yes		MIS/Delay reasons, Alignment
	NBM	Yes (INR Creation, INR/ECO/Route Assignment) (B)	Yes	Yes						
	NBM		Yes	Yes (P1) - AML (MIN/NBM)	Yes		Yes			IDS-538, Bulk Obsolescence
	NBM	Yes (INR Creation, INR/ECO/Route Assignment) (B)	Yes	Yes - AML (NBM) (B)						IDS-538, PCN-Parametric
		INR & BOM Assignment Monitor				BOM			Block number Assignment	Taxonomy Alignment, Technical support
Count of resources involved (Current) >>	12	2	7	8	6	5	4	2	2	11
Count of resources involved (New) >>	12	1+2 (B)	7	3+3 (B)	5	4+1 (B)	4	2+1 (B)	2+1 (B)	11

Result Monitoring and Control

Revised FMEA: To make sure that solution that were implemented are working fine, FMEA was done again and below are the results of the same.

Monitoring Results - FMEA (Failure Mode and Effect Analysis After Improvement)

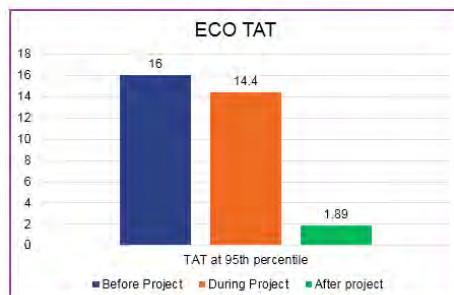
CONTROL

Potential Failure mode	Potential Effect of failure	Severity	Potential Cause of Failure	Occurrence	Current process control	Detection	RPN	Recommended actions	Responsibility & Target Date	Action	Severity	Occurrence	Detection	RPN
ECO is processed late	AOS Delay, NPI Delay, BOM Rework, Procurement delay	9	Workload Management and Prioritization. Multiple assignment affects prioritization	10	Individual Tracking & Daily Huddles	9	810	Work Assignment Dashboard, Delay Tracker for delay avoidance	Priya Kapoor	Deployed Intellitracker	9	2	5	90
ECO is processed late	AOS Delay, NPI Delay, BOM Rework, Procurement delay	8	Investigation Time	9	None	9	648	Single Tool for Investigation, History Tracking	Mahendar Singh	INVESTIGATION UTILITY	8	1	1	8
ECO is processed late	AOS Delay, NPI Delay, BOM Rework, Procurement delay	9	Obsolescence process	8	Individual tracking	7	504	Review and improve Obsolescence Process	Sachin Gupta, Twinkle Chirvi	Batch Processing	9	5	1	45
ECO is processed late	AOS Delay, NPI Delay, BOM Rework, Procurement delay	8	ECOs contain bulk parts for changes	9	Individual Tracking, Reviewer Comments, Daily Huddles	7	504	Streamline bulk changes requests	Mahendar Singh	Batch Processing	8	6	1	48
Delayed assignment	Changes implemented late	6	Extra-steps in ECO assignment	8	None	6	288	Ease ECO Assignment Process	Twinkle chirvi	New ECO assignment Process Implemented	9	1	1	9
ECO is processed late	AOS Delay, NPI Delay, BOM Rework, Procurement delay	9	Incomplete email communication for query	6	Individual Tracking, Daily Huddles	7	378	Requirement Checklist (paste on desk of MEs)	Manisha	Checklist Implemented	9	1	5	45
ECO is processed late	AOS Delay, NPI Delay, BOM Rework, Procurement delay	9	Processing Delay due to queries	9	Individual Tracking & Daily Huddles	7	567	Quicker query mechanism	Sachin Gupta, Twinkle Chirvi	Common Platform (Cisco Spark)	9	3	1	27
ECO is processed late	AOS Delay, NPI Delay, BOM Rework, Procurement delay	5	BIM/NBM assignment and spl. during high load situations	9	Coordinator reviews	8	360	Assign per ME expertise, Load sharing during high loads by Senior folks	Mahendar Singh	Experience Coordinator assigned	9	1	1	9
ECO is processed late	AOS Delay, NPI Delay, BOM Rework, Procurement delay	4	Insufficient information	5	None	6	120	Customer Education	Twinkle chirvi	Document for mandatory information shared with customer	9	1	5	45

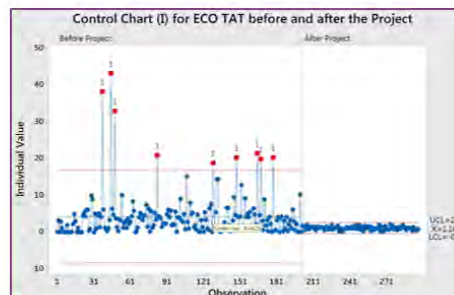
Showing only RPN>100. Complete FMEA is given in embedded excel sheet

Project Results

Project Result: Before and After improvement



ECO TAT reduced from 16 days (95th Percentile) to 1.89 days (95th Percentile)



ECO TAT reduced from 4.23 days (Average) to 1.1 days (Average)

Project Closure & Appreciation

The Project demonstrated effective application of Six Sigma Tools and Methodology in order to achieve a breakthrough in the ECO Process. The re-engineered process and respective improvement initiatives improved the Turn Around Time from 14 days to 3 days.

I would like to thank the Sponsors and Project Champion for their support, XXXXXXXX for his guidance. And Special Thanks to XXXX XXXX for pilot study.

-Project Lead

APPRECIATIONS:

" Great job done Mahendar. ECO TAT is now significantly improved"

- Project Sponsor

" Wonderful results!!! Excellent representation of strong customer focus and problem solving"

- Project Champion.

" Congratulations to each member of the Project team for the fantastic results! This project turned out to be a great success because of team work. Your sincere efforts and hard work is indeed highly appreciated.

Special thanks to:

1. XXXXXX for leading this project, for extensive data analysis & reporting.
2. XXXXXX & XXXXX for your guidance.
3. XXXXX for your contribution in Pilot run. And also all others who processed ECOs achieving 100% OTD/1 day TAT. Superb results!!
4. Entire ME team for support and suggestions during brainstorming sessions.

Congratulations to the entire ME team also for transitioning into the new process measurable.

Keep up the good work! And, best of luck for the future projects."

-Business Leader

