Process Improvement Project – Improve turn-around time & time-to-resolution for customer found defects

Process Owner: Sharat Sripada

Define – 9/25 → Measure – 10/10 → Analyze – 11/1 → Improve – 12/1 → Control (ongoing)

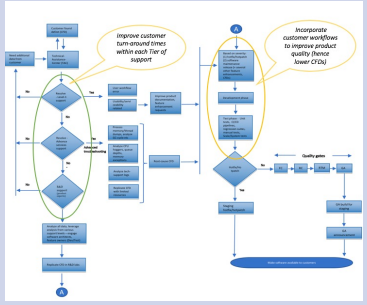
Problem Statement:

Improve support, Engineering turn-around time for customer found defects(CFDs) + improve overall quality of the product to lower incoming rate of defects

Goals:

- ~10% reduction in turn-around time/mean time to defect resolution (in terms of hours)
- ~5% lower incoming CFD rate – bracing some customer practices into our existing

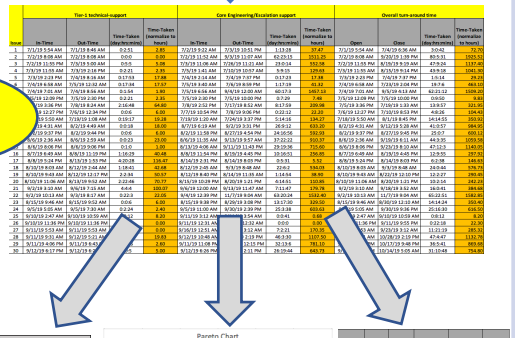
Phased approach



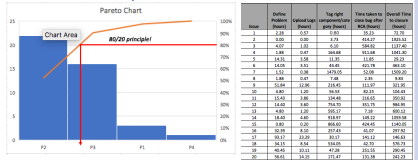
Process–chart explaining a typical flow for a CFD

Performance Measure	Data Source and Location	How Will Data Be Collected	Who will Collect Data	When will Data be Collected	Target Sample Size
• Monitor incoming defects	• Bug tracking tool	• Manual + Download bug list as csv/import to Excel	• Sharat Sripada	• 10/31, 11/30, 12/8	• All that is available
• Overall time(in hours) a CFD spends in each Tier of support	• Bug tracking tool	• Ingest data in excel (derived from raw data)	• Sharat Sripada	• N/A	• 10 CFDs
• Time consumed in support to define problem	• Bug tracking tool	• Not readily available – needs to derived reading through the defect lifecycle	• Sharat Sripada	• 10/31, 11/30, 12/8	• 10 CFDs
• Time consumed to upload logs & make data available	• Bug tracking tool	• Not readily available – needs to derived reading through the defect lifecycle	• Sharat Sripada	• 10/31, 11/30, 12/8	• 10 CFDs
• Time consumed for the defect to go to the right category	• Bug tracking tool	• Not readily available – needs to derived reading through the defect lifecycle	• Sharat Sripada	• 10/31, 11/30, 12/8	• 10 CFDs
• Time to identify a workaround (if applicable)	• Bug tracking tool	• Not readily available – needs to derived reading through the defect lifecycle	• Sharat Sripada	• 10/31, 11/30, 12/8	• 10 CFDs
• Normalizing data from day:hour:min to hours to have a single	• CSV/Excel data	• NA	• Sharat Sripada	• N/A	• 10 CFDs

Data collection



Jul-Sept(2019)			
Descriptive Stats	Tier-1 technical-support (hrs)	Core Engineering/Escalation support (hrs)	Overall turn-around time (hrs)
Average	22.51	442.25	610.39
Median	7.10	233.42	423.89
Variance	917.3095495	224814.7216	270014.5897
SD	30.28711854	474.1463082	519.629281
Min	0.00	0.00	8.20
Max	116.47	1532.40	1925.52



Sigma Quality Level (SQL)	
d time	Defect incoming rate
hat can cause the overall ncrease = 5 ul-Sept 2019) = 30 defect opportunities = 5 * 30 = 150 al defects = 46 Defect per opportunity rate = 46/150 * 100 = 30.67 Defects per million opportunities = 306667 SQL = 2.0	• Defect opportunities = 1 • Actual defect threshold = 5 • Total possible defects per day = 5 • Total actual defects (averaging data = 148/92 days) = 1.608 • Defect per opportunity rate = 1.608/5 * 100 = 32.16 • Defects per million opportunities = 32173.91 SQL = 2.0

SQL2.0

Correlation co-efficient calculations b/n X's & Overall Time to closure		
X's	Overall Time to closure (R)	Overall Time to closure (R^2)
Define problem	-0.275883463	0.076111685
Upload logs	-0.275883463	0.076111685
Tag right component/category	0.649959013	0.422446719
Time taken to close bug after RCA	0.409240798	0.167478031

- High correlation co-efficient between 'Tag right component/category' and 'Overall Time to closure of defects' among all known inputs/Xs.
- Scatter plot below shows the correlation between the variables the corresponding equation from linear regression is shown:

Sigma Quality Level (SQL)	
ause the overall = 5 2019) = 25 = 5 * 25 = 125 = 37 er opportunity rate = 37/125 * 100 = 29.6 Defects per million opportunities = 296000 SQL = 2.0 *No change from baseline ®*	Did not have a software GA release in the last couple of months. SQL remained at 2.0 as well

SQL2.0

- SQL remained at 2.0 after the process change which proves no significant benefits were gained

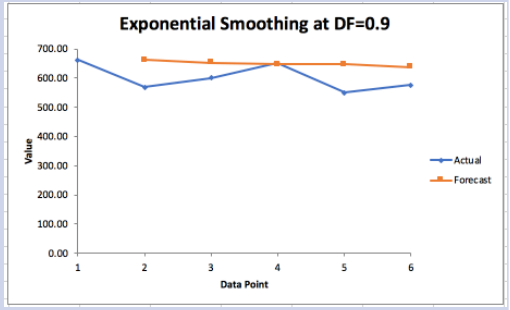
Marginal gain in Mean

Overall Time to closure of defects		
	Before	After
Mean	610.39	596.28
Sample	30	25
SD	519.63	549.56
Zvalue	0.097	
Pvalue	0.922582939	
Alpha	0.1	

$H_0: \mu_1 \leq \mu_2$

$H_a: \mu_1 > \mu_2$

Unable to accept the null–hypotheses since p >> alpha!



- Pilot for Phase-1 of the project (lowering overall CFD turn-around time) shows lower forecast for Jan-2020 which is encouraging.
- In pipeline for Q1 FY 2020, pilot for Phase-2 which also aims to reduce the overall count of CFDs.

Define – Problem Statement, Impact & Goals

Improve turn-around time & time-to-resolution for customer found defects (CFDs).

- **Impact**
  - Impact to Customers (Consumers) – Critical services and applications can be impacted depending on the severity of a CFD. Severity is categorized P1-P4 (P1 being most severe) and correspondingly have a spiraling effects on their growth and revenue.
  - Impact to R&D (Producers) - Engaging multi-tier support/R&D escalation groups, development and test teams investigating, root-causing and fixing CFDs impacts productivity & delivery of critical milestones.

- **Goals**
  - ~10% reduction in turn-around time/mean time to defect resolution (in terms of hours)
  - ~5% lower incoming CFD rate – bracing some customer practices into our existing

- **Team**

Vice-President - Quality Engineering, Customer Advocacy Specialist & Sharat Sripada

NOTE – Cannot callout a dollar value in Impact/Savings/Goals since it is protected by NDA.

Define – Operational Definitions

Defects

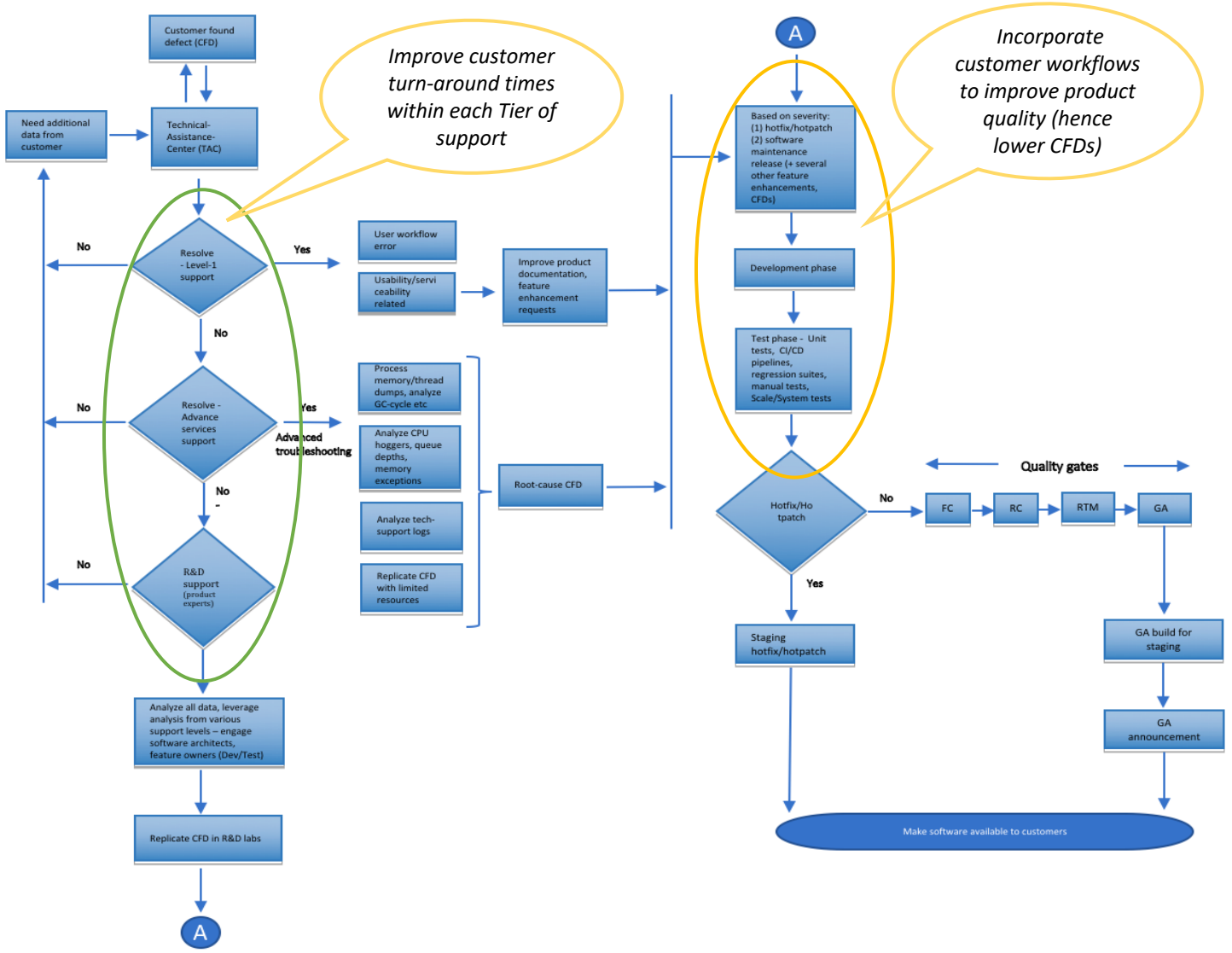
Based on the goals, we were able to identify the following indices and determine some pilot values for each of the categories:

- Turn-around time top contributors:
  - Define problem > 24 hours
  - Upload logs > 8 hours
  - Tag the right category/component > 120 hours
  - To close defect after RCA > 400 hours
  - Overall time to closure > 600 hours
- CFD incoming rate > 5 per day

Definitions

- Define problem: Time a support Engineer takes to understand and define/create a defect in the Bug Tracking Tool (also explains steps he did to triage or remediate a problem)
- Upload logs: Time a support Engineer takes to collect diagnostic information/logs from customer production & upload it to the defect in the Bug Tracking Tool
- Tag the right category/component: Time a defect is un-attended to since it landed in a wrong component
- To close defect after RCA: Time a defect is left open after an RCA for completion of other book-keeping processes

Define Phase – Process Map



Identified broadly two areas of process improvement:

1. Improve turn-around times within various Tiers of support

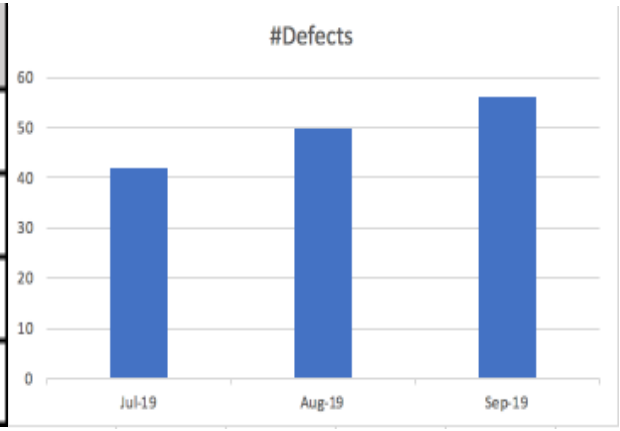
2. Enhance certain R&D practices to improve overall product quality (reviews, incorporating customer workflows, automation etc).

NOTE – Pilot for (2) of the process improvement is planned in Phase-2, Q1 FY-2020. We will merely, plot/use some meaningful data but do not strive to prove any benefits.

Measure Phase – Data collection

Issue	Tier-1 technical-support				Core Engineering/Escalation support				Overall turn-around time			
	In-Time	Out-Time	Time-Taken (day:hrs:mins)	Time-Taken (normalize to hours)	In-Time	Out-Time	Time-Taken (day:hrs:mins)	Time-Taken (normalize to hours)	Open	Close	Time-Taken (day:hrs:mins)	Time-Taken (normalize to hours)
1	7/1/19 5:54 AM	7/1/19 8:46 AM	0:2:51	2.85	7/2/19 9:22 AM	7/3/19 10:51 PM	1:13:28	37.47	7/1/19 5:54 AM	7/4/19 6:36 AM	3:0:42	72.70
2	7/2/19 8:08 AM	7/2/19 8:08 AM	0:0:0	0.00	7/2/19 11:52 AM	9/3/19 11:07 AM	62:23:15	1511.25	7/2/19 8:08 AM	9/20/19 1:39 PM	80:5:31	1925.52
3	7/2/19 11:55 PM	7/3/19 5:00 AM	0:5:5	5.08	7/3/19 11:06 AM	7/26/19 11:21 AM	23:0:14	552.58	7/2/19 11:55 PM	8/19/19 9:19 AM	47:9:24	1137.40
4	7/3/19 11:55 AM	7/3/19 2:16 PM	0:2:21	2.35	7/5/19 1:41 AM	7/10/19 10:57 AM	5:9:15	129.63	7/3/19 11:55 AM	8/15/19 9:14 PM	43:9:18	1041.30
5	7/3/19 2:23 PM	7/4/19 8:16 AM	0:17:53	17.88	7/4/19 2:14 AM	7/4/19 7:37 PM	0:17:23	17.38	7/3/19 2:23 PM	7/4/19 7:37 PM	1:5:14	29.23
6	7/4/19 6:58 AM	7/5/19 12:32 AM	0:17:34	17.57	7/5/19 3:40 AM	7/6/19 8:59 PM	1:17:19	41.32	7/4/19 6:58 AM	7/23/19 2:04 PM	19:7:6	463.10
7	7/4/19 7:01 AM	7/4/19 8:56 AM	0:1:54	1.90	7/5/19 6:56 AM	9/4/19 12:00 AM	60:17:3	1457.13	7/4/19 7:01 AM	9/5/19 4:13 AM	62:21:12	1509.20
8	7/5/19 12:09 PM	7/5/19 2:30 PM	0:2:21	2.35	7/5/19 2:30 PM	7/5/19 10:00 PM	0:7:29	7.48	7/5/19 12:09 PM	7/5/19 10:00 PM	0:9:50	9.83
9	7/5/19 3:36 PM	7/8/19 8:24 AM	2:16:48	64.80	7/8/19 2:52 PM	7/17/19 8:52 AM	8:17:59	209.98	7/5/19 3:36 PM	7/19/19 1:33 AM	13:9:57	321.95
10	7/6/19 12:27 PM	7/6/19 12:34 PM	0:0:6	6.00	7/7/19 10:54 PM	7/8/19 9:06 PM	0:22:12	22.20	7/6/19 12:27 PM	7/10/19 8:53 PM	4:8:26	104.43
11	7/18/19 5:50 AM	7/19/19 1:08 AM	0:19:17	19.28	7/19/19 1:20 AM	7/24/19 3:37 PM	5:14:16	134.27	7/18/19 5:50 AM	8/1/19 8:45 PM	14:14:55	350.92
12	8/2/19 4:31 AM	8/2/19 4:49 AM	0:0:18	18.00	8/7/19 6:19 AM	9/2/19 3:31 PM	26:9:12	633.20	8/2/19 4:31 AM	9/12/19 5:28 AM	41:0:57	984.95
13	8/2/19 9:37 PM	8/2/19 9:44 PM	0:0:6	6.00	8/2/19 11:58 PM	8/27/19 4:54 PM	24:16:56	592.93	8/2/19 9:37 PM	8/27/19 9:45 PM	25:0:7	600.12
14	8/6/19 2:36 AM	8/6/19 2:59 AM	0:0:23	23.00	8/6/19 11:35 AM	9/13/19 9:57 AM	37:22:22	910.37	8/6/19 2:36 AM	9/19/19 6:11 AM	44:3:35	1059.58
15	8/6/19 8:06 PM	8/6/19 9:06 PM	0:1:0	1.00	8/13/19 4:06 AM	9/11/19 11:43 PM	29:19:36	715.60	8/6/19 8:06 PM	9/23/19 8:10 AM	47:12:3	1140.05
16	8/7/19 6:49 AM	8/8/19 11:19 PM	1:16:29	40.48	8/8/19 11:54 PM	8/19/19 4:45 PM	10:16:51	256.85	8/7/19 6:49 AM	8/19/19 4:45 PM	12:9:55	297.92
17	8/8/19 5:24 PM	8/13/19 1:53 PM	4:20:28	116.47	8/14/19 2:31 PM	8/14/19 8:03 PM	0:5:31	5.52	8/8/19 5:24 PM	8/14/19 8:03 PM	6:2:38	146.63
18	8/10/19 8:03 AM	8/12/19 2:44 AM	1:18:41	42.68	8/12/19 2:45 AM	9/3/19 8:48 AM	22:6:2	534.03	8/10/19 8:03 AM	9/3/19 8:48 AM	24:0:44	576.73
19	8/10/19 9:43 AM	8/12/19 12:17 PM	2:2:34	50.57	8/12/19 8:40 PM	8/14/19 11:35 AM	1:14:54	38.90	8/10/19 9:43 AM	8/22/19 12:10 PM	12:2:27	290.45
20	8/10/19 11:06 AM	8/13/19 9:52 AM	2:22:46	70.77	8/15/19 10:29 PM	8/20/19 1:21 PM	4:14:51	110.85	8/10/19 11:06 AM	8/20/19 1:21 PM	10:2:14	242.23
21	9/2/19 3:10 AM	9/6/19 7:15 AM	4:4:4	100.07	9/6/19 12:00 AM	9/13/19 11:47 AM	7:11:47	179.78	9/2/19 3:10 AM	9/18/19 3:52 AM	16:0:41	384.68
22	9/2/19 10:13 AM	9/3/19 8:17 AM	0:22:3	22.05	9/4/19 12:39 PM	11/7/19 9:04 AM	63:20:24	1532.40	9/2/19 10:13 AM	11/7/19 9:04 AM	65:22:51	1582.85
23	8/15/19 9:46 AM	8/15/19 9:52 AM	0:0:6	6.00	8/15/19 9:38 PM	8/29/19 3:08 PM	13:17:30	329.50	8/15/19 9:46 AM	8/30/19 12:10 AM	14:14:24	350.40
24	9/5/19 5:05 AM	9/5/19 7:30 AM	0:2:24	2.40	9/5/19 11:00 AM	9/30/19 2:39 PM	25:3:38	603.63	9/5/19 5:05 AM	9/30/19 9:36 PM	25:16:30	616.50
25	9/10/19 2:47 AM	9/10/19 10:59 AM	0:8:12	8.20	9/11/19 3:12 AM	9/11/19 3:54 AM	0:0:41	0.68	9/10/19 2:47 AM	9/10/19 10:59 AM	0:8:12	8.20
26	9/10/19 11:36 PM	9/10/19 11:36 PM	0:0:0	0.00	9/11/19 12:31 AM	9/11/19 12:32 AM	0:0:0	0.00	9/10/19 11:36 PM	9/11/19 9:55 PM	0:22:18	22.30
27	9/11/19 5:53 AM	9/11/19 5:53 AM	0:0:0	0.00	9/16/19 12:51 AM	9/23/19 3:12 AM	7:2:21	170.35	9/11/19 5:53 AM	9/23/19 3:12 AM	11:21:19	285.32
28	9/11/19 9:31 AM	9/12/19 5:21 AM	0:19:50	19.83	9/12/19 10:48 AM	10/28/19 2:19 PM	46:3:30	1107.50	9/11/19 9:31 AM	10/28/19 2:19 PM	47:4:47	1132.78
29	9/11/19 4:06 PM	9/11/19 6:43 PM	0:2:36	2.60	9/11/19 11:08 PM	10/14/19 12:15 PM	32:13:6	781.10	9/11/19 4:06 PM	10/17/19 9:48 PM	36:5:41	869.68
30	9/12/19 6:17 PM	9/12/19 6:23 PM	0:0:5	5.00	9/12/19 6:26 PM	10/9/19 2:11 PM	26:19:44	643.73	9/12/19 6:17 PM	10/14/19 5:05 AM	31:10:48	754.80

Time	#Defects	Avg	Median	SD	Range
Jul-19	42	661.47	392.53	693.07	1915.68
Aug-19	50	568.96	463.83	368.88	993.42
Sep-19	56	600.75	500.59	498.72	1574.65
Overall	148	610.39	423.89	519.63	1917.31



- In an attempt to study trends we sampled data of incoming defects during the period of Jul-Sept 19 and plotted a baseline (10x defects from each month)
- We broadly measured time-taken for defects across Tier-1 technical-support, Core Engineering/Escalation support & the Overall turn-around times* for defects (which includes an RCA & release)
- Since all measurements are in terms of 'hours' this data will be classified as ***CONTINUOS***

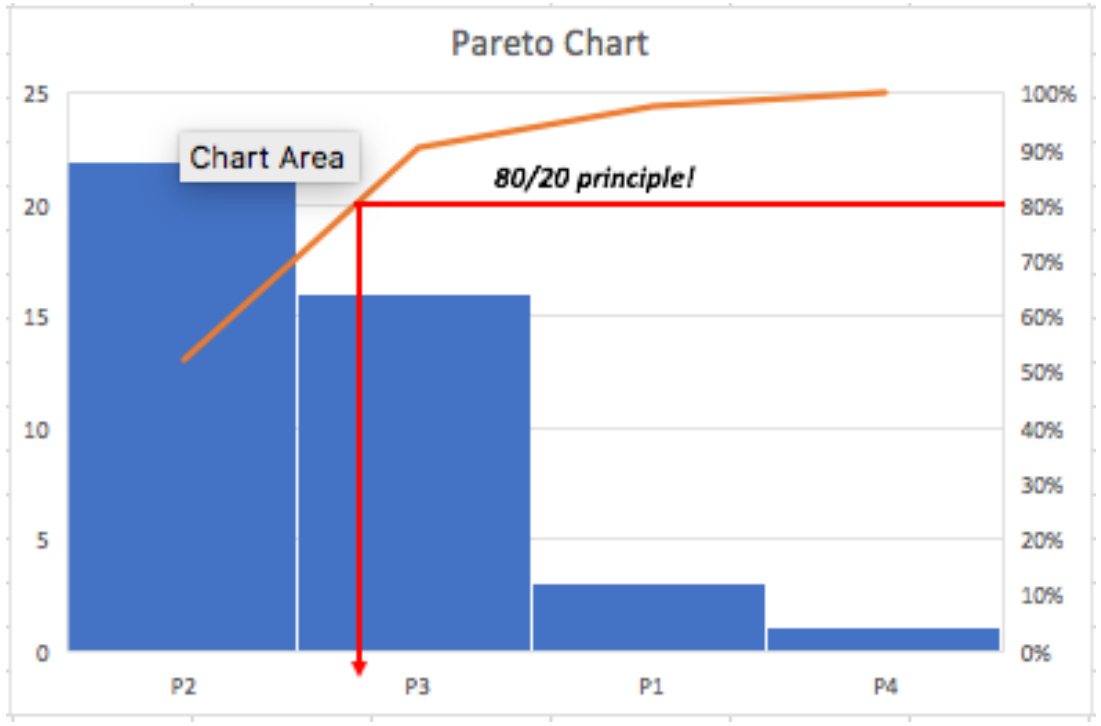
* Overall turn-around time is not additive of the time defects spend in Tier-1/Escalation support (it involves additional R&D practices).

Measure Phase – Data collection (cont.)

Issue	Define Problem (hours)	Upload Logs (hours)	Tag right component/category (hours)	Time taken to close bug after RCA (hours)	Overall Time to closure (hours)
1	2.28	0.57	0.60	35.23	72.70
2	0.00	0.00	3.73	414.27	1925.52
3	4.07	1.02	6.10	584.82	1137.40
4	1.88	0.47	164.68	911.68	1041.30
5	14.31	3.58	11.35	11.85	29.23
6	14.05	3.51	44.45	421.78	463.10
7	1.52	0.38	1479.05	52.08	1509.20
8	1.88	0.47	7.48	2.35	9.83
9	51.84	12.96	216.45	111.97	321.95
10	4.80	1.20	56.53	82.23	104.43
11	15.43	3.86	134.48	216.65	350.92
12	14.40	3.60	754.70	351.75	984.95
13	4.80	1.20	595.17	7.18	600.12
14	18.40	4.60	918.97	149.22	1059.58
15	0.80	0.20	866.60	424.45	1140.05
16	32.39	8.10	257.43	41.07	297.92
17	93.17	23.29	30.17	141.12	146.63
18	34.15	8.54	534.05	42.70	576.73
19	40.45	10.11	47.28	251.55	290.45
20	56.61	14.15	171.47	131.38	242.23
21	80.05	20.01	172.53	204.90	384.68
22	17.64	4.41	1560.78	50.45	1582.85
23	4.80	1.20	341.25	20.90	350.40
24	1.92	0.48	607.13	12.87	616.50
25	6.56	1.64	16.90	7.52	8.20
26	0.00	0.00	0.92	22.30	22.30
27	0.00	0.00	285.32	114.97	285.32
28	15.87	3.97	1112.95	25.28	1132.78
29	2.08	0.52	785.52	88.58	869.68
30	4.00	1.00	643.80	111.07	754.80

- In this table are presented some top contributors which have been defined earlier under Define Phase – ‘Operational Definitions’
- The data is specific to the time-line Jul-Sept 2019 & will collect a similar data for Oct-Dec 2019 where we will drive some process improvements.

Measure phase – Pareto Chart



- To further examine the nature of the defects we classified them based on their severity: P1, P2, P3, P4 (P1 being most severe)
- From the Pareto Chart: Applying the 80/20 principle – 80% of the problems are due to P3 category (20%) of bugs in the system
- This is an important data-point we are trying to mine, to understand if there are any patterns to certain components of the software falling in this category.

Measure Phase – Data collection

Performance Measure	Data Source and Location	How Will Data Be Collected	Who will Collect Data	When will Data be Collected	Target Sample Size
• Monitor incoming defects	• Bug tracking tool	• Manual + Download bug-list as csv/import to Excel	• Sharat Sripada	• 10/31, 11/30, 12/8	• All that is available
• Overall time(in hours) a CFD spends in each Tier of support	• Bug tracking tool	• Ingest data in excel (derived from raw data)	• Sharat Sripada	• N/A	• 10 CFDs
• Time consumed in support to define problem	• Bug tracking tool	• Not readily available – needs to derived reading through the defect lifecycle	• Sharat Sripada	• 10/31, 11/30, 12/8	• 10 CFDs
• Time consumed to upload logs & make data available	• Bug tracking tool	• Not readily available – needs to derived reading through the defect lifecycle	• Sharat Sripada	• 10/31, 11/30, 12/8	• 10 CFDs
• Time consumed for the defect to go to the right category	• Bug tracking tool	• Not readily available – needs to derived reading through the defect lifecycle	• Sharat Sripada	• 10/31, 11/30, 12/8	• 10 CFDs
• Time to identify a workaround (if applicable)	• Bug tracking tool	• Not readily available – needs to derived reading through the defect lifecycle	• Sharat Sripada	• 10/31, 11/30, 12/8	• 10 CFDs
• Normalizing data from day:hour:min to hours to have a single	• CSV/Excel data	• N/A	• Sharat Sripada	• N/A	• 10 CFDs

Measure phase – SQL & Measurement Error

Sigma Quality Level (SQL)	
Overall turn-around time	Defect incoming rate
• Defect opportunities that can cause the overall turn-around time to increase = 5 • Defects sample set (Jul-Sept 2019) = 30 • Overall defect opportunities = 5 * 30 = 150 • Actual defects = 46 • Defect per opportunity rate = 46/150 * 100 = 30.67 • Defects per million opportunities = 306667 **SQL = 2.0**	• Defect opportunities = 1 • Actual defect threshold = 5 • Total possible defects per day = 5 • Total actual defects (averaging data = 148/92 days) = 1.608 • Defect per opportunity rate = 1.608/5 * 100 = 32.16 • Defects per million opportunities = 32173.91 **SQL = 2.0**

Issue	1st	2nd	Did you agree
1	good	good	yes
2	good	good	yes
3	good	good	yes
4	good	good	yes
5	good	good	yes
12	good	bad	no
13	good	good	yes
14	good	good	yes
15	good	good	yes
16	good	good	yes
21	bad	good	no
22	good	good	yes
23	good	good	yes
24	good	good	yes
25	good	good	yes
Totals			
Percent good	93.33333333	93.33333333	
Percent bad	6.666666667	6.666666667	
Percent agreed			0.866666667
P observed	0.866666667		
P chance	0.124444444		
K (repeatability)	0.847715736		

- **Measurement Error**: There are potential measurement errors since this involves reading through several updates on defects & using discretion (based on certain deterministic criteria) to tabulate data.

I randomly picked some defects between two separate dates & calculated the Kappa index for repeatability as 0.8477 -> 0.85 (which meets the criteria for measurement of >= 0.85)

NOTE – The sample set was 50% of the original set (this is a manual laborious process & hence the smaller comparison set)

Measure Phase – Estimate sample size

Using the formula:

$$n = \left(\frac{(Z_{\alpha/2})\sigma}{E} \right)^2$$

Referencing data from the Measure phase:

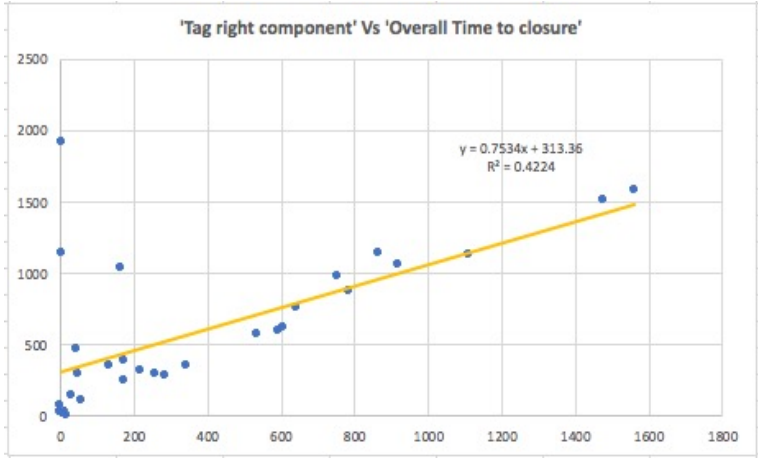
- Z(alpha/2) at 95% confidence level = 1.96
- SD for data (overall turn-around time) = 519.62 hours (not accounting for weekends/holidays which we will use in the Error estimate)
- Acceptable error = 40 hours

n = (1.96 * 519.62) / 40 = **25.46**

Analyze phase – Scatter-plots and Correlation

Issue	Define Problem (hours)	Upload Logs (hours)	Tag right component/category (hours)	Time taken to close bug after RCA (hours)	Overall Time to closure (hours)
1	2.28	0.57	0.60	35.23	72.70
2	0.00	0.00	3.73	414.27	1925.52
3	4.07	1.02	6.10	584.82	1137.40
4	1.88	0.47	164.68	911.68	1041.30
5	14.31	3.58	11.35	11.85	29.23
6	14.05	3.51	44.45	421.78	463.10
7	1.52	0.38	1479.05	52.08	1509.20
8	1.88	0.47	7.48	2.35	9.83
9	51.84	12.96	216.45	111.97	321.95
10	4.80	1.20	56.53	82.23	104.43
11	15.43	3.86	134.48	216.65	350.92
12	14.40	3.60	754.70	351.75	984.95
13	4.80	1.20	595.17	7.18	600.12
14	18.40	4.60	918.97	149.22	1059.58
15	0.80	0.20	866.60	424.45	1140.05
16	32.39	8.10	257.43	41.07	297.92
17	93.17	23.29	30.17	141.12	146.63
18	34.15	8.54	534.05	42.70	576.73
19	40.45	10.11	47.28	251.55	290.45
20	56.61	14.15	171.47	131.38	242.23
21	80.05	20.01	172.53	204.90	384.68
22	17.64	4.41	1560.78	50.45	1582.85
23	4.80	1.20	341.25	20.90	350.40
24	1.92	0.48	607.13	12.87	616.50
25	6.56	1.64	16.90	7.52	8.20
26	0.00	0.00	0.92	22.30	22.30
27	0.00	0.00	285.32	114.97	285.32
28	15.87	3.97	1112.95	25.28	1132.78
29	2.08	0.52	785.52	88.58	869.68
30	4.00	1.00	643.80	111.07	754.80

Correlation co-efficient calculations b/n X's & Overall Time to closure		
X's	Overall Time to closure (R)	Overall Time to closure (R^2)
Define problem	-0.275883463	0.076111685
Upload logs	-0.275883463	0.076111685
Tag right component/category	0.649959013	0.422446719
Time taken to close bug after RCA	0.409240798	0.167478031



When gathering data & tabulating top contributors adding delay to the overall resolution of a defect, I wanted to understand their correlation.

Plotting the correlation co-efficient:

1. The data beside indicates the r-value highest for 'Tag right component/category' (vs 'Overall Time to closure')

2. Hence we plot the corresponding scatter plot & derive the equation from Linear Regression:

$$y = 0.7534x + 313.3$$

3. Also of significance was 'Time taken to close bug after RCA'

NOTE - Extreme corner table from Slide-6/Define Phase – Data collection

Improve phase – What we did!

Based on the data that came out of the Analyze Phase, we did the following:

For ‘Tag the right component/category’:

- Support Engineers were informed during TOIs, trainings or New-Product-Intro sessions about what components they should tag to defects
- Trainings also captured specific diagnostics to collect when the component was selected in the Bug tracking tool (it also pointed them in the direction to dive deeper with triaging defects so it could to go to the right component)

For ‘Time taken to close the bug after an RCA’:

- We went after the Teams responsible to book-keeping giving them some guide-lines

NOTE – These are loaded process changes & it possibly takes several releases to see these items become lesser contributors before we get our next bunch of parameters.

I repeated the data collection process post these changes during the week of 12/2 – 12/8

Improve phase - SQL & Hypothesis Test

Sigma Quality Level (SQL)	
Overall turn-around time	Defect incoming rate
• Defect opportunities that can cause the overall turn-around time to increase = 5 • Defects sample set (Oct-Dec 2019) = 25 • Overall defect opportunities = 5 * 25 = 125 • Actual defects = 37 • Defect per opportunity rate = 37/125 * 100 = 29.6 • Defects per million opportunities = 296000 **SQL = 2.0** *No change from baseline* ☹	Did not have a software GA release in the last couple of months. SQL remained at 2.0 as well

Overall Time to closure of defects		
	Before	After
Mean	610.39	596.28
Sample	30	25
SD	519.63	549.56
Zvalue	0.097	
Pvalue	0.922582939	
Alpha	0.1	

Hypothesis Test: Since there was marginal improvement in the mean across data-sets before & after the process improvement, I ran the following test:

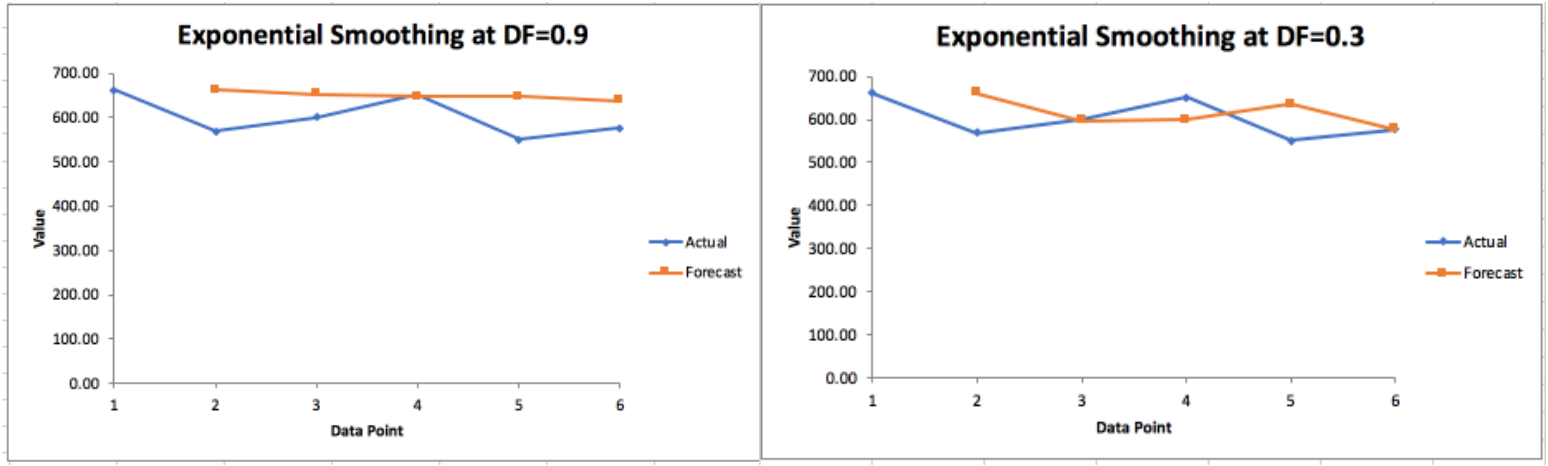
- Continuous -> Two-Sample -> Upper/Right-tail test

$H_0: \mu_1 \leq \mu_2$

$H_a: \mu_1 > \mu_2$

- Since p-value >> alpha at 0.1, 0.05 or 0.01 we fail to Reject the Null hypothesis & therefore state the new mean is not statistically different from the previous!

Control phase – Time series, Next-steps & conclusion



Time series analysis:

- As a final step, we predict the mean time for CFD resolution in Jan-2020 using an exponential smoothing time series method shown alongside.
- The forecast itself is encouraging, showing the mean time to resolution of a CFD:
  - DF=0.3 -> 576
  - DF=0.9 -> 637

Initial Goal of 10% reduction in time to resolution of defects is met!

Next steps & conclusion

- This is a pilot but just the sheer volume of data & all the variables associated with a complex eco-system are overwhelming – hence we would spend some effort in automating the data-collection process itself
- Continue driving process improvements & make necessary changes to get meaningful results

Goal - Streaming an efficient pipeline for flow of defects with the aim itself being to bring the rate of defects down.