RTY: Rolled throughput yield

* Advantage of RTY over MDPO : RTY provides insight to within-process rework COPQ
* It is calculated based on the throughput yield or defects per opportunity at each step in the process.
* Yield metrics most accurately reflects quality throughout a process

Purpose of rolled throughput yield

* Spot significant differences in yield
* Provide baseline metric
* Analyze a process flow for improvements
* Revisit project scope

**Probability of success RTY = Y1 \* Y2 \* Y3 Rolled throughput yield / pass yield**

**Probability of a defect** = p = 1-Y = 1 - RTY

RTY = cumulative calculation of yield through multiple steps = 1 – probability of a defect = = 1- e –DPU

Total Defects per UNIT DPU = D **= - Ln ( RTY)**

**U**

Defects per unit OPPORTUNITY DPO = DPU = D **Defects per million MDPO = D / ( U \* O ) \* 1,000,000**

O U \* O

Determine the yield Y = e –DPU probability of defect free (yield) if DPU < 10%

The first pass yield for an operation is 95%

Probability of a defect 1 - 95% = 5% => Z = 1.645 (Z long term or Z equivalent)

Z short term = 1.645 + 1.5 = 3.145

Information of 100 units

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| DEFECTS | 0 | 1 | 2 | 3 | 4 | 5 |
| UNITS | 70 | 20 | 5 | 4 | 0 | 1 |

DPU = D = 0\*70 + 1\*20 + 2\*5 + 3\*4 + 4\*0 + 5\*1 = 47 = 0.47 We expect 0.47 **defects per unit**

U 100 100

If we have 6 opportunities for a defect DPO = 0.47 / 6 = 0.078 **MDPO = 78,333**

Throughput yield is determined by 1.00 –DPU = 1 – 0.47 => **RTY** = 53%

**RTY** = P ( X=0) = e – DPU = e – (0.47 ) = 62.5 % it is different from 53% because DPU is higher than 10%, the correct is 53%

1,000 units were examined for the possibility of 5 different defects. A total of 80 defects were found. How many defects would be expected in a million opportunities

**DPO = D**  = 80 = 0.016 DPMO = 16,000 Defects found = DPU .

**U x O** 1000 x 5 Units x Opportunities per unit Opportunities per unit

**In a sample of 5000 orders, 400 errors are found in 100 orders. DPMO is** *20,000*

O = No. Defects / Sample size



A process made 6 units, inspection found 8 defects in this process RTY? DPU = 8/6 = 1.33 ; **RTY = e-dpu = 0.264**

The p bar for a p chart is 0.00265, so DPMO = 2,650.

**Process is expected to be successful in 99.99966%. If the number of steps is 150,000 then,** Overall yield = (0.9999966)150,000 = 60.05%.

If a process is producing 80 defectives/million (**MDPO** = 80), what would be the 6 sigma quality level?



Using 6 sigma methodology, a company would have rate of: 5.3



DPU = D / U suppose DPU = 0.4495 then Z equiv (from Z table ) = 1.64

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Using Z table** | **ppm Using Table “S”** | **Close to** |
| Long term LT | Z LT = Z equiv = 1.64 | 440,000 | Close to Sigma 1.5 = 501,349 |
| Short term ST | Z ST = 1.5 + Z equiv = 2.14 | 274,412 | Close to Sigma 2 = 308,770 |



**Defects per normalized unit - Ln ( Y norm)**

Poisson P(x) = e – DPU DPU X DPU = D .

X ! U \* O

6 defects in 283 units, probability of units without any defect?

RTY = P ( X=0) = e – DPU = e – ( 6 / 283 ) = e – 0. 021 = 98% RTY = 1 – 0.021 = 98% (same number because DPU < 10%)

**Present value of $2,000.00 to be paid in 10 years interest rate of 7%?**

PV = FV/(1+I)n = $2,000/(1+0.07)10 = $1,017.00

**Select project if Benefit / (Invest + Cost) > 1**

**To reduce billing statements expenses use this metric:**

* **Return on investment ROI, or ROA**
* **Don’t use COPQ, because this metric is to measure defects**

Revenue factors:

* Income from additional sales from improved product cost, quality, features, availability to the customer
* Reduce losses for scrap, customer returns, warranty claims, COPQ, low throughput, porr time to market

ROA = Net revenue / Assess ROI= Net revenue / Invest

Period cost r = (1 + i ) 1 / m -1 m: No. of periods in a yearly basis

If the project internal rate of return is 11% we should take it if:

* The company cost of capital is lower
* Fund are unlimited for other better projects

Project requires 23,000 of initial investment and training cost of 6,000 spread over a 6 month. The project will save 3,000 per month starting the third month. Payback period? 1 year

- **Cost of Poor Quality**: cleanest measure of a long term success of an organization, ROI can be affected by accounting methods.

- **Cost Benefit Analysis**, Return on Invest (ROI): Better for evaluation of projects.

- **Cost benefit analysis** is not a direct measure of improvement, but to measure projects

**- Price/earning (P/E) ratio**: The amount a customer is willing to spend per dollar of profit is

**COPQ**: Cost of Poor quality: Units defects x cost per unit

**CODND**: Cost of doing nothing different