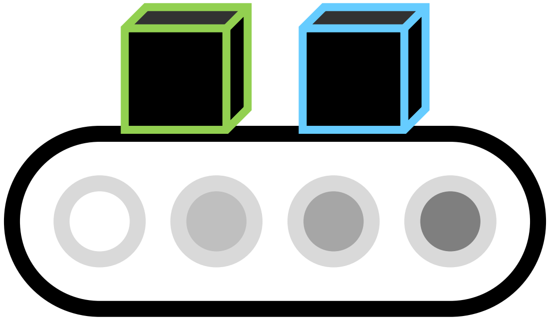
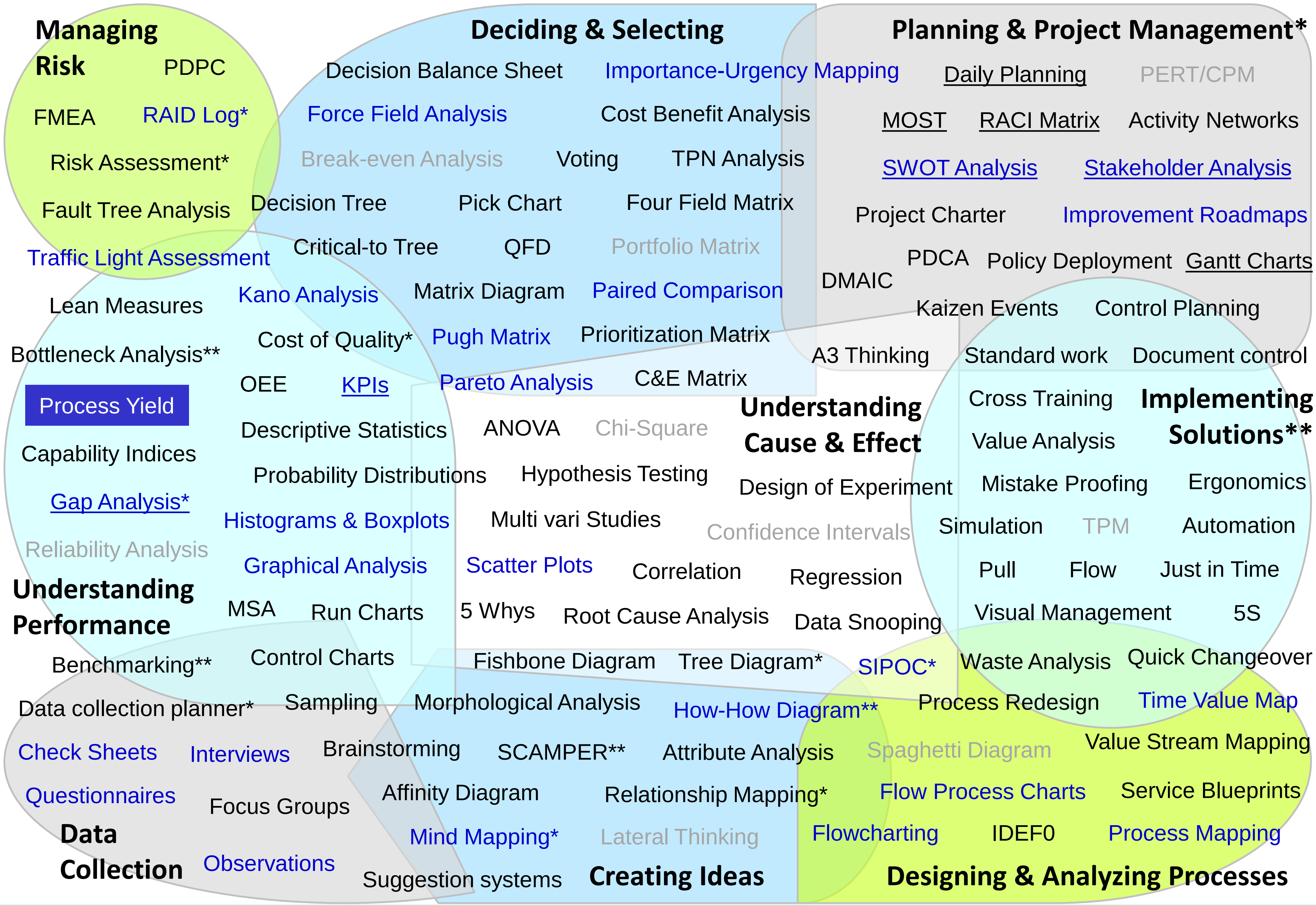
Continuous Improvement Toolkit

Process Yield Measures

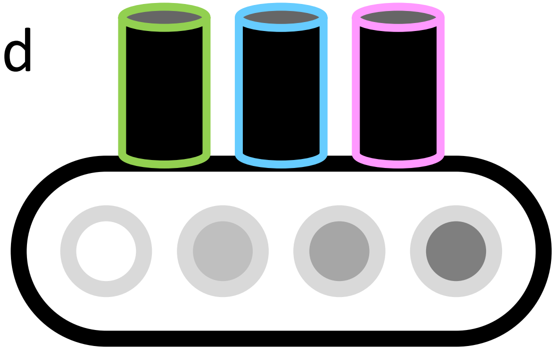


The Continuous Improvement Map



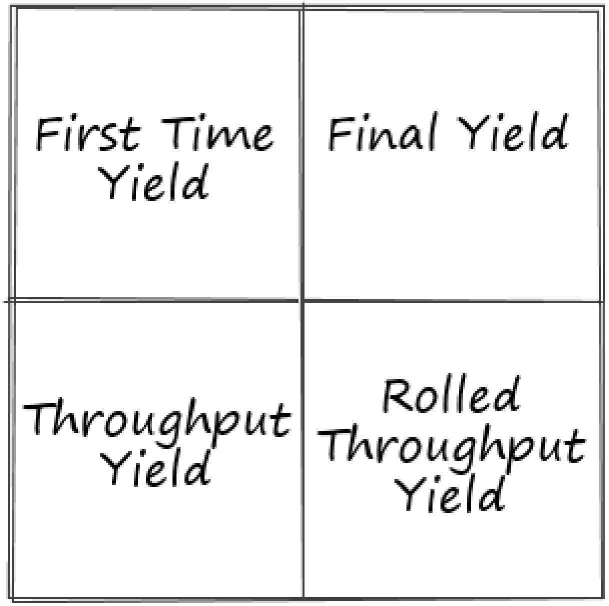
- Process Yield Measures

- An ideal process must produce without defects or rework.
- You should have the appropriate performance metrics to measure the process yield.
- These metrics should be able to expose even the smallest inefficiencies in a process.
- They should enable operations to understand their true process yield in order to set realistic improvement targets.



- Process Yield Measures

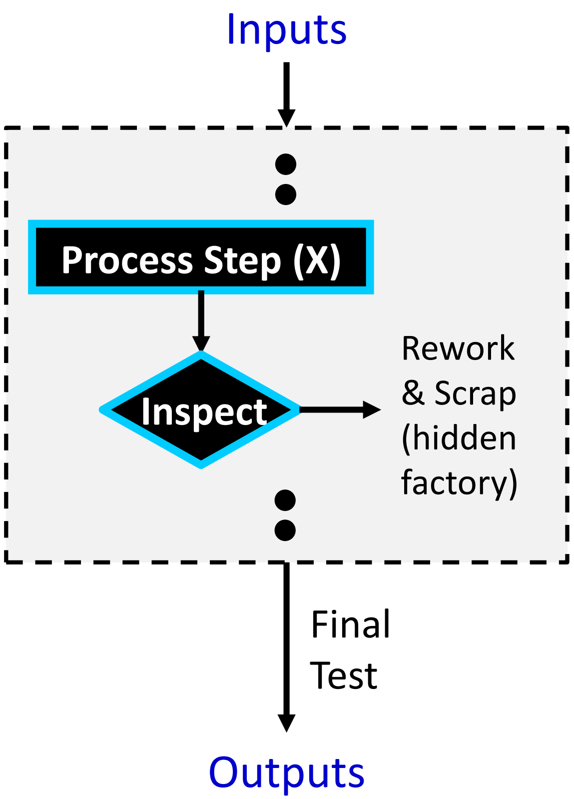
- Many companies utilize two measures of process yield:
  - ***First time yield.***
  - ***Final yield.***
- They represent the classic approach for calculating process yield.
- They don't account for the hidden factory.



- Process Yield Measures

First Time Yield (FTY):

- Obtained by dividing the good product or service units (including reworked units) by the number of total units that entered the sub-process.



- **Example:**
  - FTY of an individual sub-process that processed **100** units and produced **90** good units would be **90%**.

- Process Yield Measures

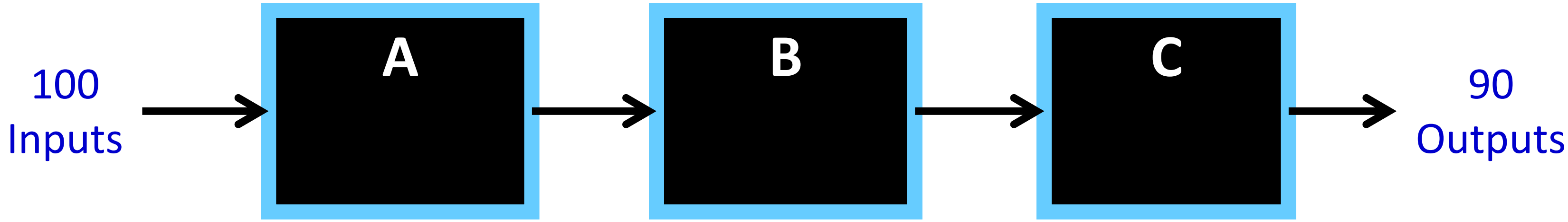
Final Yield (FY):

- The probability that a unit will successfully pass all steps assessed at the end of the process.
- Obtained by counting the good units that made it through until the last process step divided by the total number of units that entered the process.
- If there are the same amount of units at the end of the process as there were at the beginning, then the final yield would be 100%.

- Process Yield Measures

Final Yield (FY):

- Consider the following 3-step process:



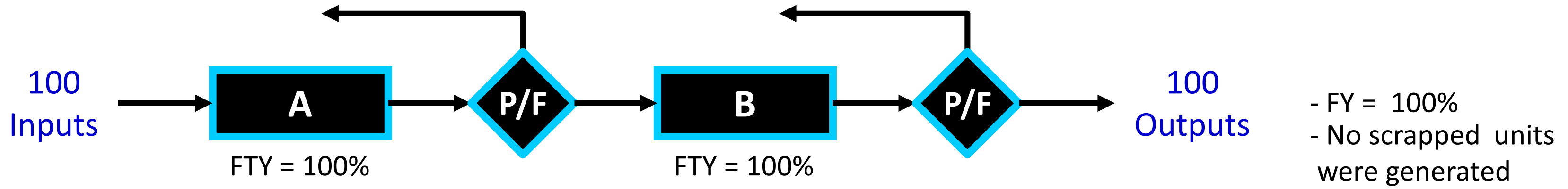
Final Yield = 90%

Is this the whole story?

- Process Yield Measures

First Time Yield and Final Yield:

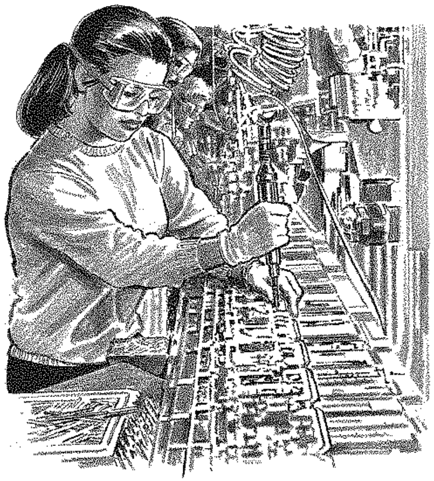
- They don't reflect the actual defect rates and ignore the hidden factory.
- They are not sensitive to product complexity.
- They only look at the volume of the produced units.
- Corrective actions are often taken on spot when mistakes are discovered and rework are not recorded in quality logs.
- Process yield rates look better than what they really are.



- Process Yield Measures

Throughput Yield (TPY):

- The probability that all defect opportunities produced at a particular step will conform to their respective performance standards.
- Only considers the good units that passed through a process step right the first time and error-free.



- A reworked unit that passed the test is not added to the throughput yield but to the first time yield.
- The difference between the two metrics should highlight the quality risk due to rework.
- This should lead to the pursuit of process improvement.

- Process Yield Measures

Rolled Throughput Yield (RTY):

- Represents the probability of passing all performance standards through the entire process defect-free.
- It is calculated by multiplying the individual throughput yield values of each process step:

RTY = Throughput Yield of process step 1 * Throughput Yield of process step 2 * … * Throughput Yield of process N.

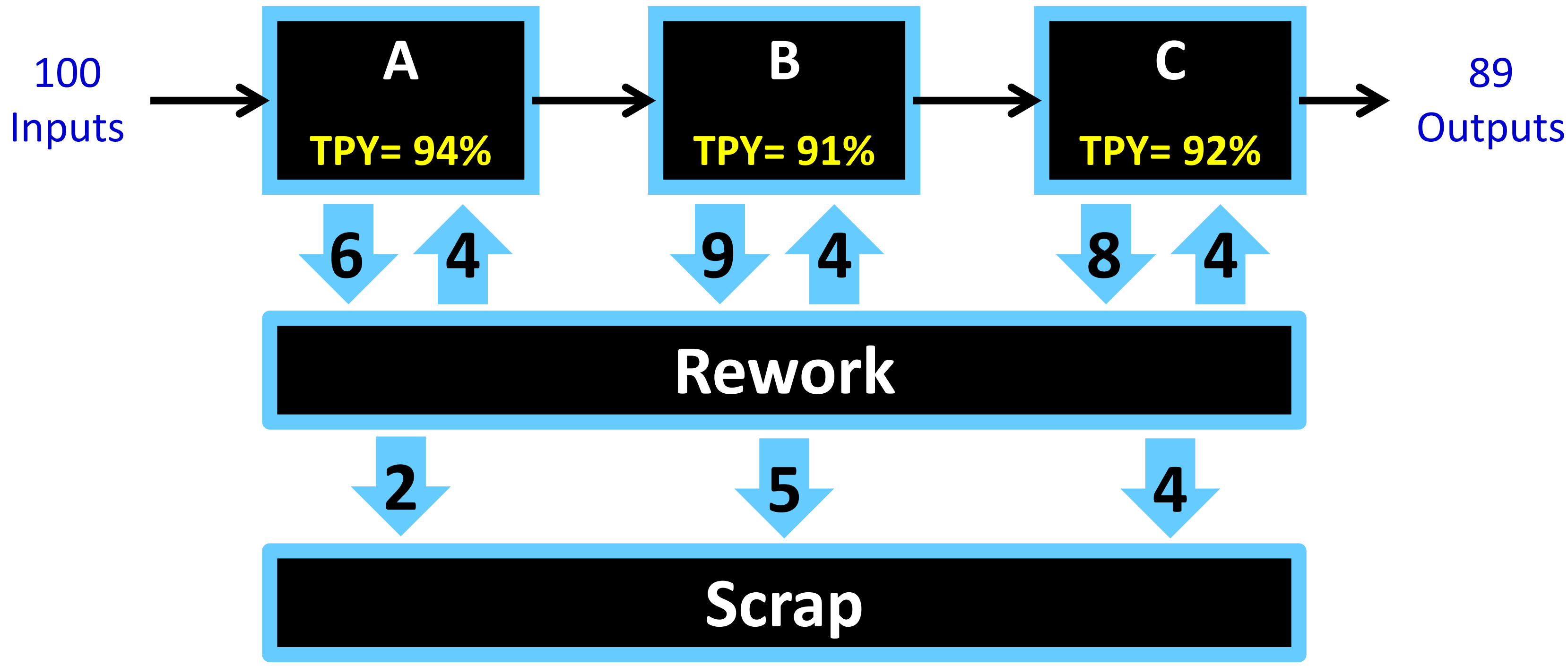
- Process Yield Measures

Rolled Throughput Yield:

- Quantifies the cumulative effects of inefficiencies found throughout the process.
- Provides a better insight of the rates of errors and rework.
- Allows companies to be much more accurate when assessing the performance of their industrial or commercial processes.
- Calculations are done at each process step.
- Substantially less than final yield.

- Process Yield Measures

Example – Low Complexity Process:

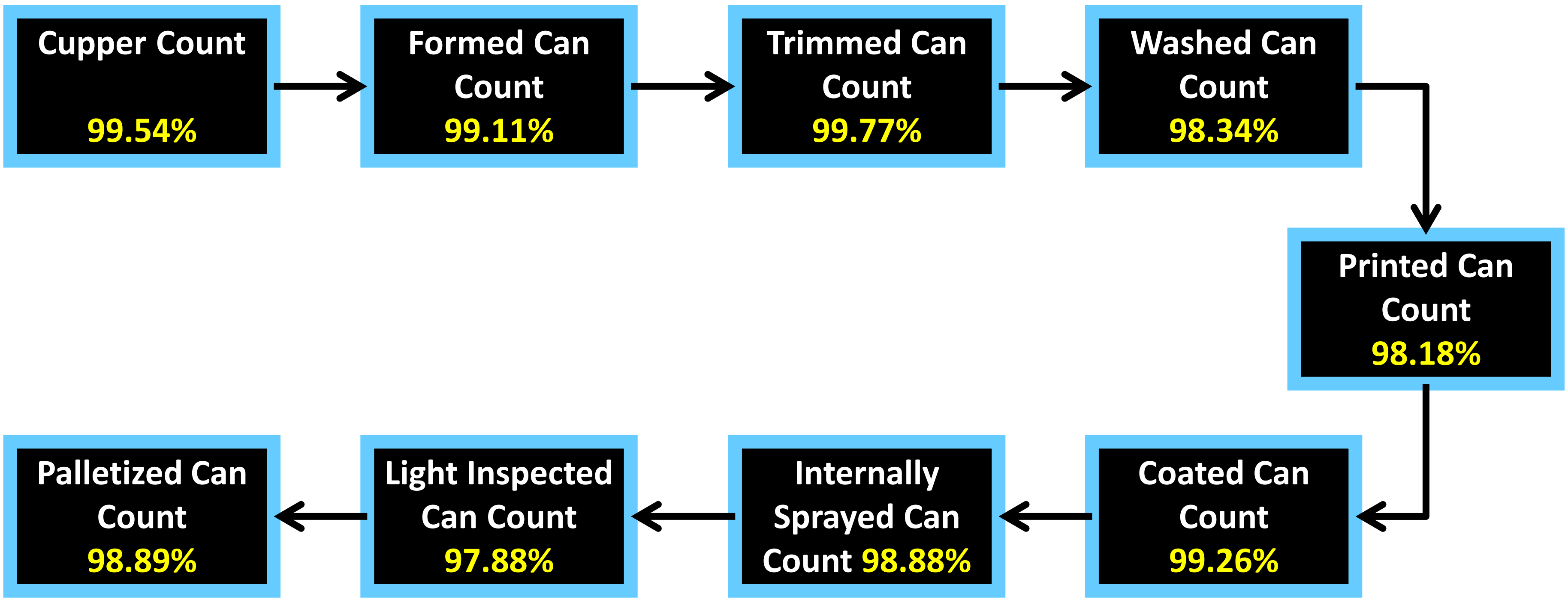


RTY = TPY(A) * TPY(B) * TPY(C) = 94% * 91% * 92% = 78.7%

RTY is a true reflection of the process performance

- Process Yield Measures

Example – High Volume Process (High Volume Process):



RTY = 90.28%

The probability of manufacturing a can that meets all specs is 90.28%

- Process Yield Measures

Example – High Volume and Low Complexity:

- What is the RTY of a process that involve **5** steps and produces **30,000** units per hour, knowing that the throughput yield for each process step is **95%**?

- RTY = $(0.95)^5$ = 77.4%.
- Throughput Yield per hour = 0.7738 * 30,000 = 23,213 TPY per hour.
- i.e. 6787 non-conforming units per hour (22.6%).

- Process Yield Measures

Example – Low Volume and High Complexity:

- What is the RTY of a process that involves **30** steps and produces **10** units per hour, knowing that the throughput yield for each process step is **95%**?

- RTY = $(0.95)^{30}$ = 22.5%.
- Throughput Yield per hour = 0.2146 * 10 = 2.15 TPY per hour.
- i.e. 8 non-conforming units per hour (77.4%) and only 21.5% will be shipped without rework.

- Process Yield Measures

Further Information

- Using of a process map as a guide in the process yield evaluation is a good practice and can be very helpful.
- Throughput yield is sensitive to the number of critical-to-quality characteristics (CTQs) in a product (product complexity).
- Rolled throughput yield is sensitive to the number of CTQs, the effectiveness of the process, and the number of process steps (process complexity).
- Simplification of the process needs to be considered to improve the process yield rate.