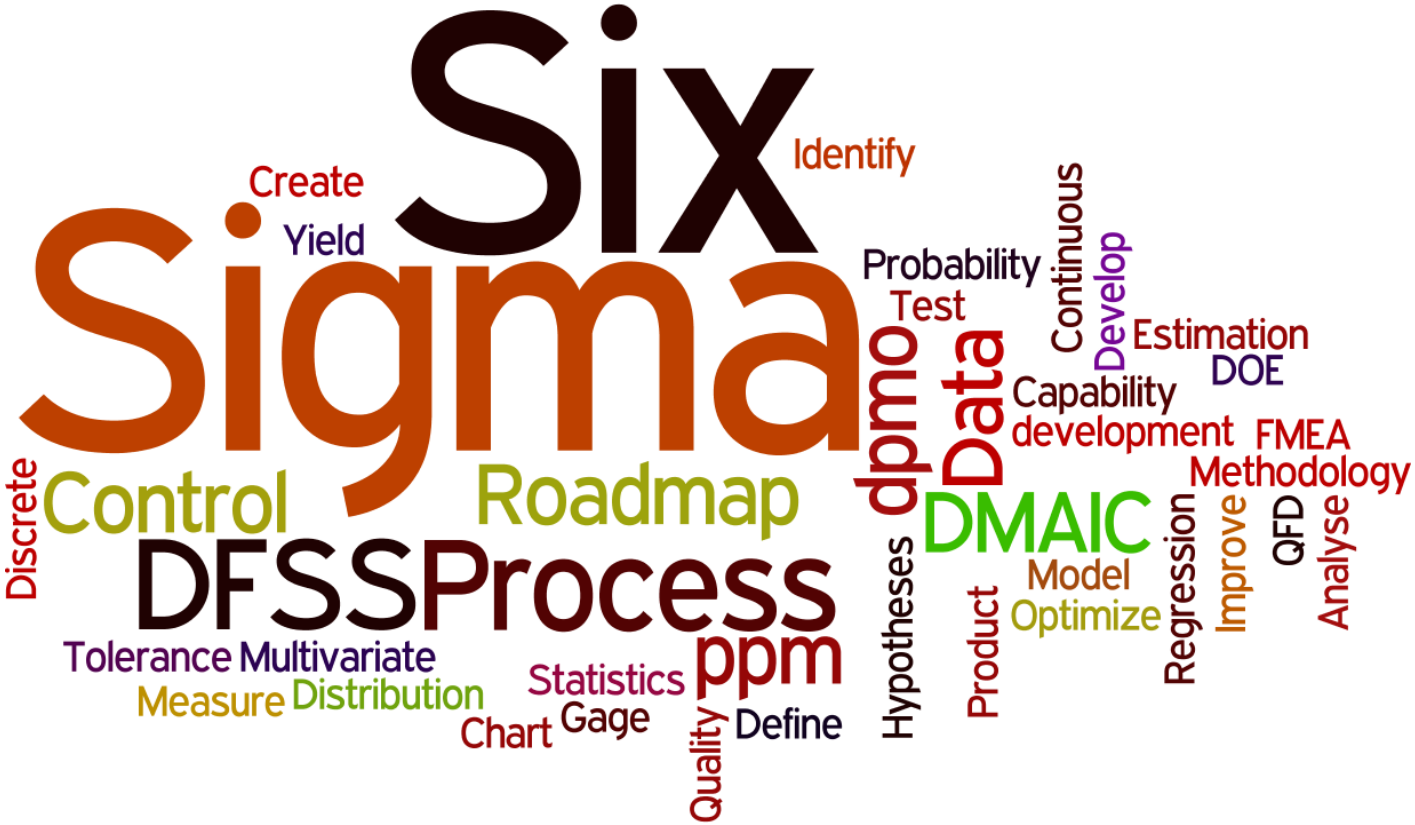
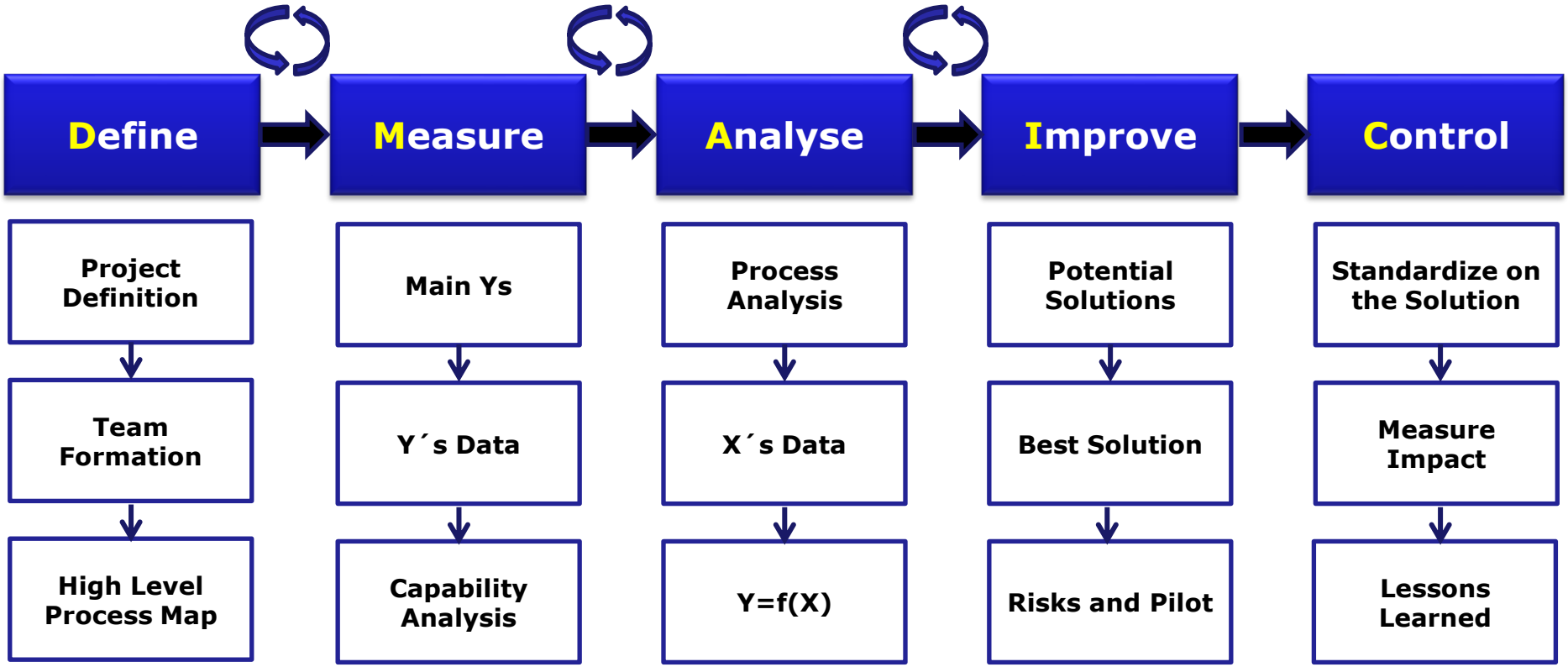


DMAIC- ANALYSE

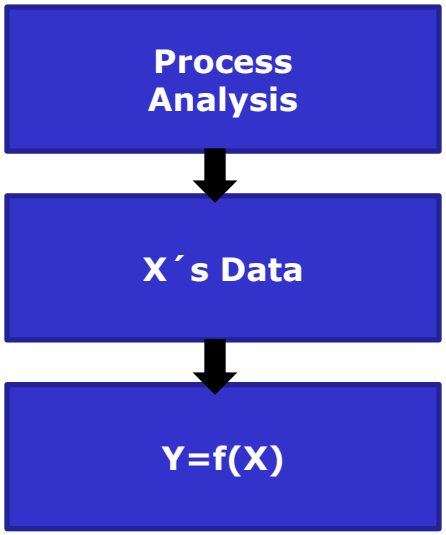
Process Analysis / X´s Data / Y=f(X)

Green Belts´s Training | Jun 2021

Roadmap Six Sigma – DMAIC
for improving products and processes



ANALYSE Y=f(X)



Try Answering:

What is the process really like?

What are the variables that potentially affect responses?

What do the input variables reveal?

How do causes affect responses?

Try to find a relationship between X and Y.
The first step is called **Process Door** and the others of **Data Door**.

Analyse: Main Deliverable

Fundamental Requirements:

1. **Process Characterization in terms of X, Y and Z**
2. **How were the data collected to characterize Y = f (X) + Z? Was it used DOE, Historical Data, Simulation, etc ...?**
3. **How was the analysis of Y = f (X) + Z done? DOE, Regression, Simulation, Matrix of Cause and Effect, 5Why's ...**

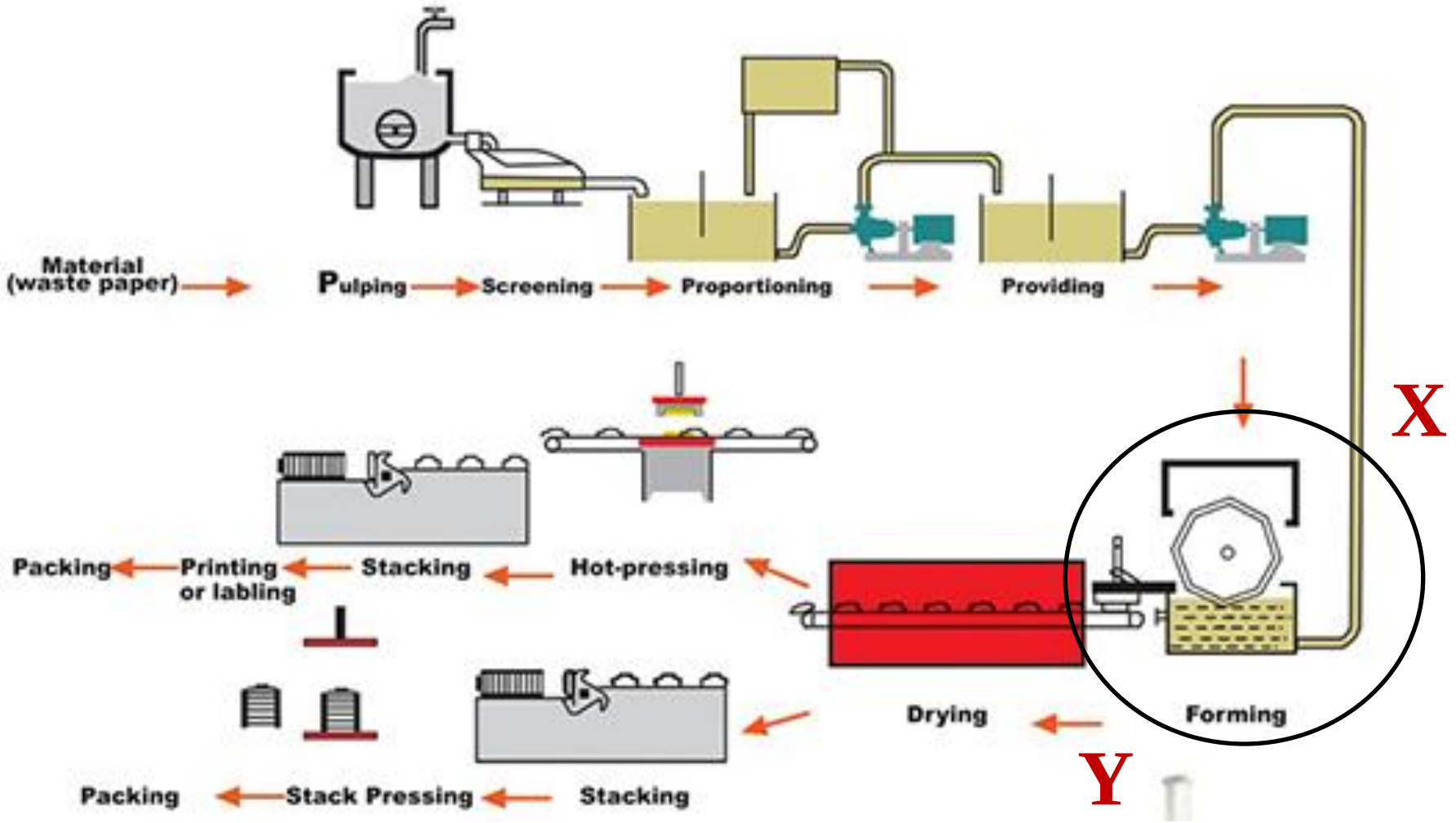
$$Y=f(X)+Z$$

Process Analysis

In this phase the metrics Y (and its units) need to be related do X variables. Here the practitioner needs to correct **characterize the process**, considering all the details.

The **Process Door** refers to a selection of tools and techniques that help you to understand and gain clues directly from the process itself.

X and Y by using Flowchart and Process mapping



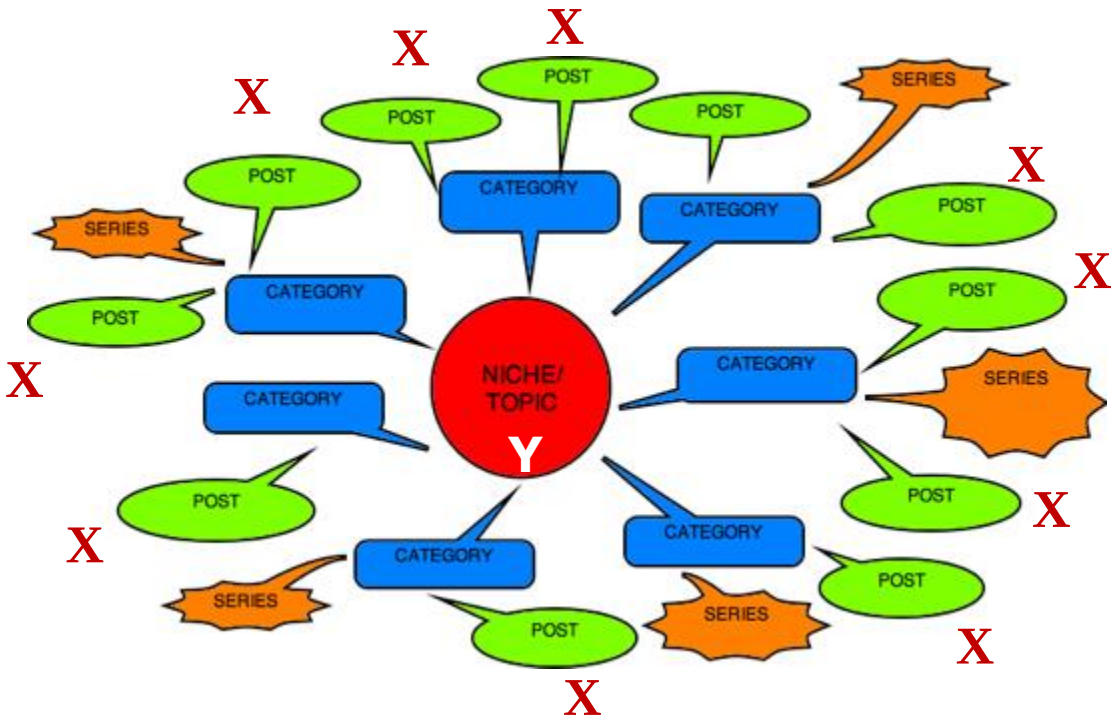
Ex.: Egg tray production

Map the Process as "it is"

Screening X´s by using Brainstorming / Focus Group /…

List of Xs

…… …… ……
…… …… ……
…… …… ……
…… …… ……
…… …… ……
…… …… ……
…… …… ……
…… …… ……

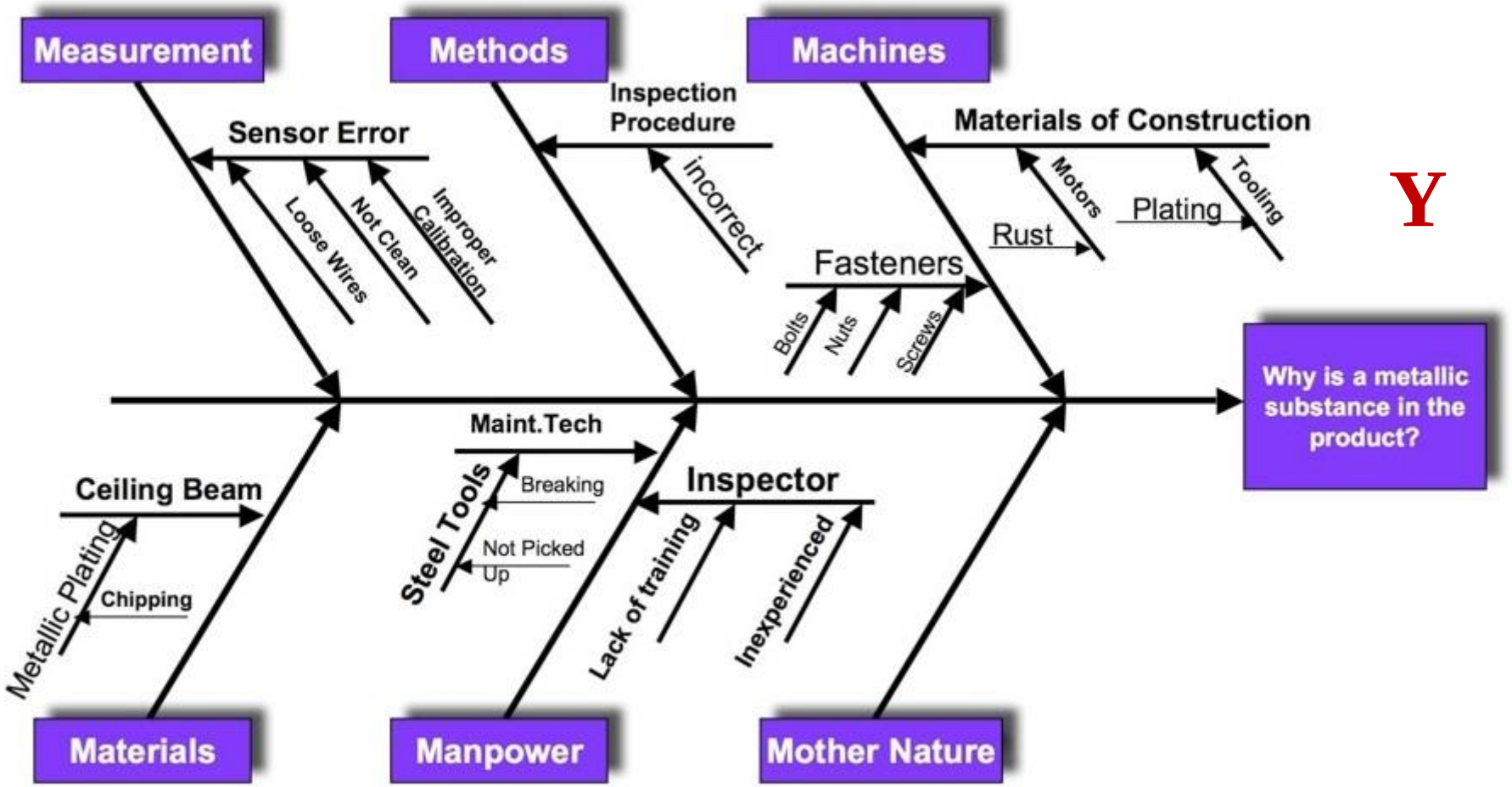


Use also tools to reach agreement:

- Agreement analysis,
- Cross-Tabulation.
- Pairwise
- AHP
- …

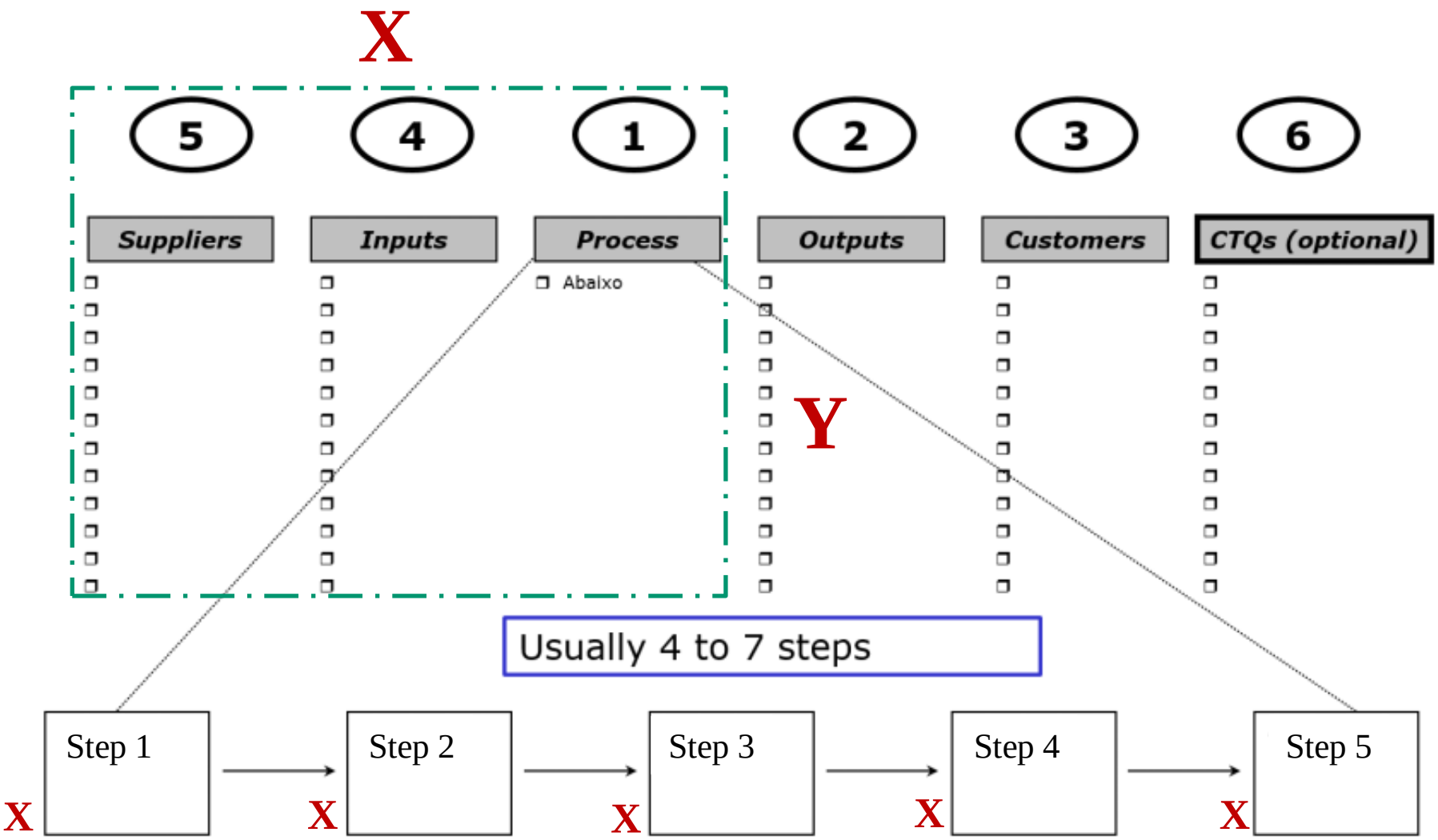
X and Y by using Cause and Effect diagram

X



Y

X and Y by using SIPOC



X´s data

In this phase (**similar to Measure Y´s data**) try to list all the variables that could impact the response(s).

y	x1	x2	x3	x4	x5	x6
60323	83	234289	2356	1590	107608	1947
61122	88.5	259426	2325	1456	108632	1948
60171	88.2	258054	3682	1616	109773	1949
61187	89.5	284599	3351	1650	110929	1950
63221	96.2	328975	2099	3099	112075	1951
63639	98.1	346999	1932	3594	113270	1952
64989	99	365385	1870	3547	115094	1953
63761	100	363112	3578	3350	116219	1954

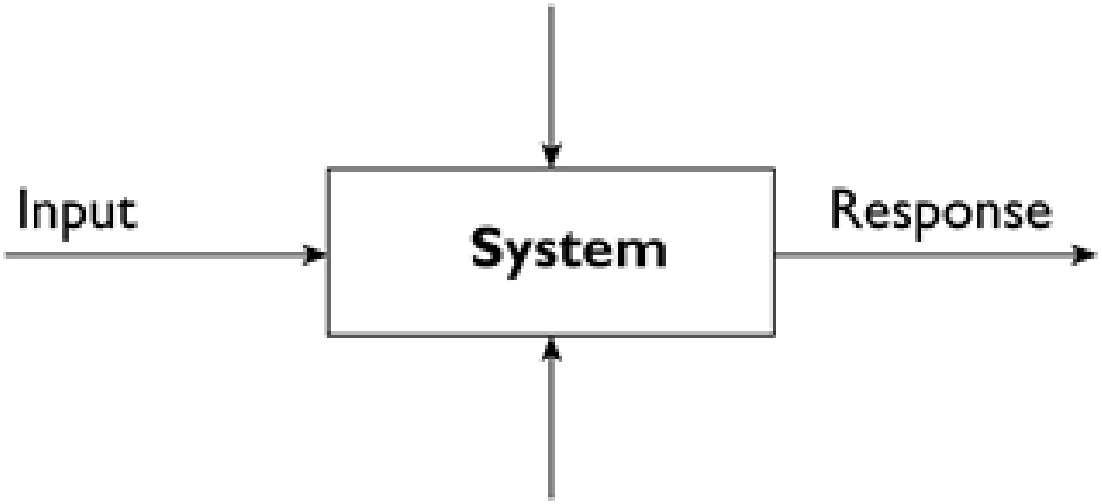
Define the variables as:

- Discrete or Continuous
- Control variables x Noise variables

If needed use Sampling/MSA/and operational definitions

Control x Noise variables

Control Factors: Parameters whose nominal values can be cost-effectively adjusted by the engineer.



Noise Factors: Parameters that influence system variability but are difficult, expensive, or impossible to control.

Y=f(X)

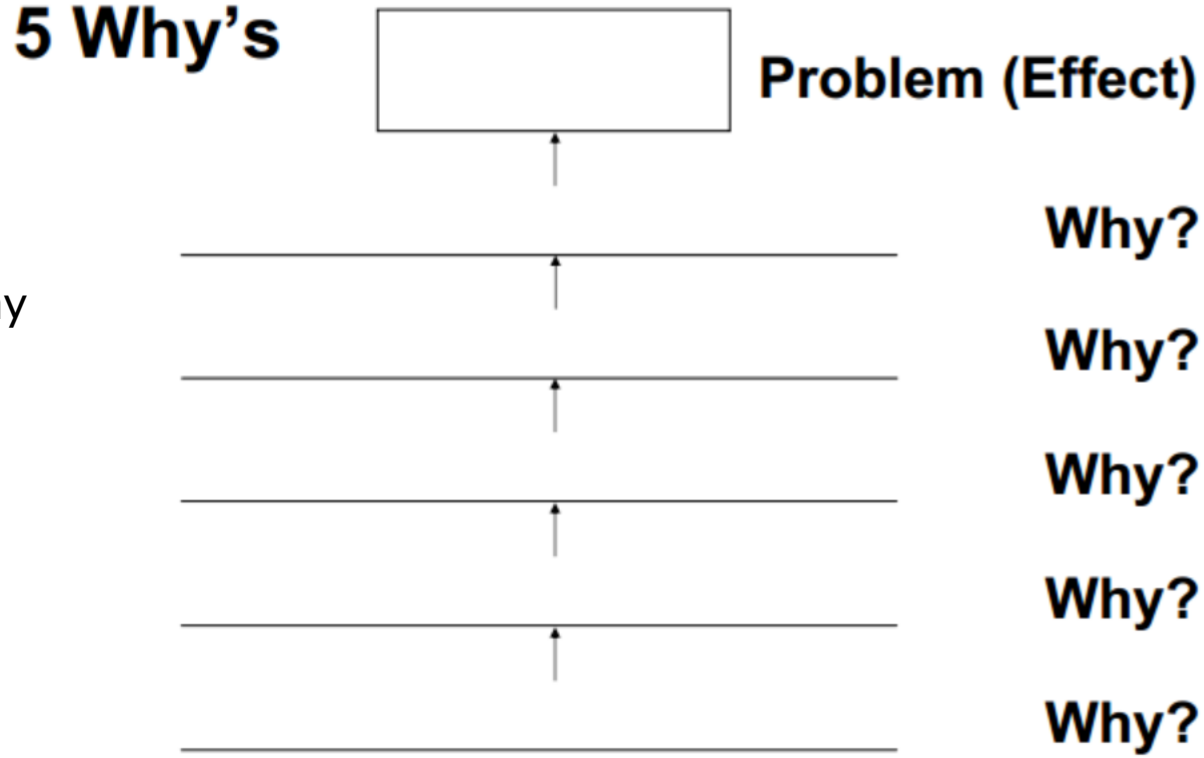
The transfer function could be established by using qualitative tools such as:

1) 5Why´s
2) Brainstorming / Brainwriting
3) Fishbone
4) SIPOC
5) Flowchart
6) Process mapping
7) …

Statistical tools are though **preferable**:

1) Regression
2) Design of Experiments
3) Simulation

5 Why's



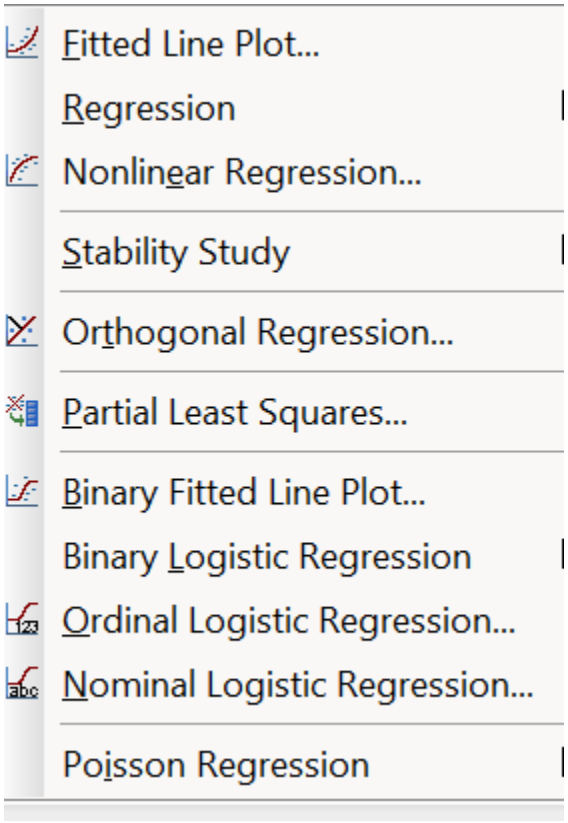
A simple qualitative way to propose Cause and Effect

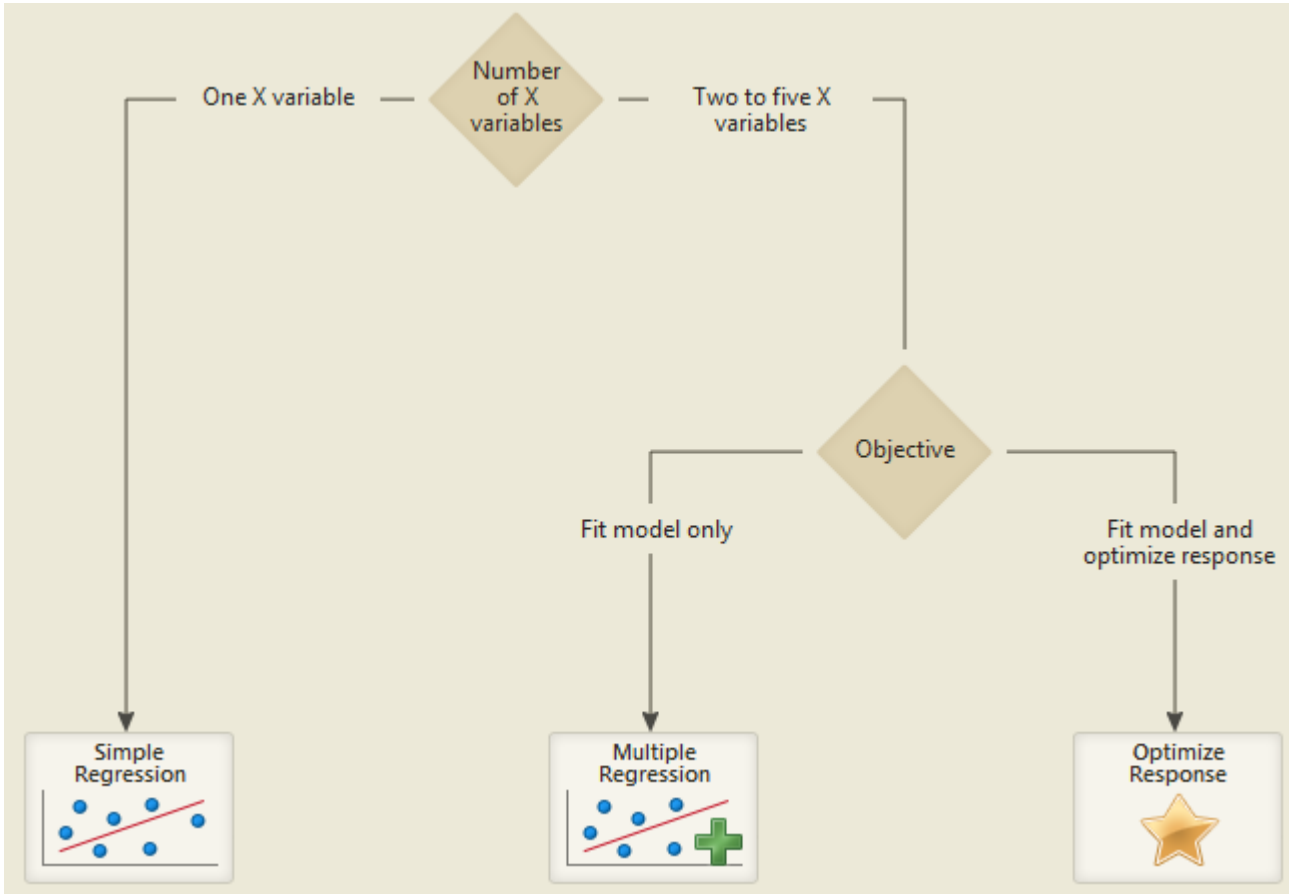
Exemplo:

1. **Why** is there a high reject rate of widgets? Because the plastic is stained.
2. **Why** is the plastic stained? Because there is excess oil in the cutting machine.
3. **Why** is there excess oil in the cutting machine? Because it is clogging as it is months since it was cleaned.
4. **Why** is it so long since it was cleaned? Because we only service machines when they break down, not on a preventative basis.
5. **Why** only service after breakdowns? Because maintenance says it is cheaper (but what about the cost of rejects and rework?).

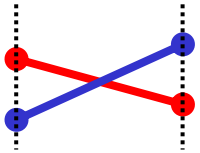
Y=f(X) by using Regression

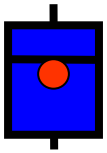
Use Regression when historical data is available



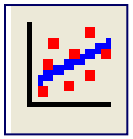


Y=f(X) by using Design of Experiments

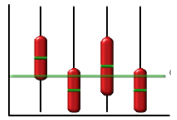




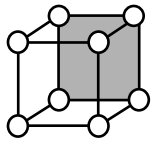
Use Regression when historical data is not available but experiments are possible

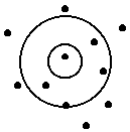


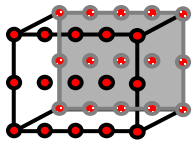
Summary

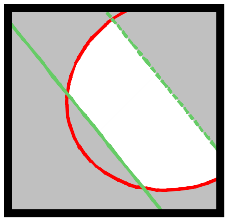


- Efficient Experimentation
- Factorial Designs
- Fractional Factorial Designs
- Screening Designs
- Taguchi Designs
- Response Surface Methodology
- Desirability
- Mixtures









Y=f(X) by using Simulation

Use Simulation when historical data is not available and experiments are not possible