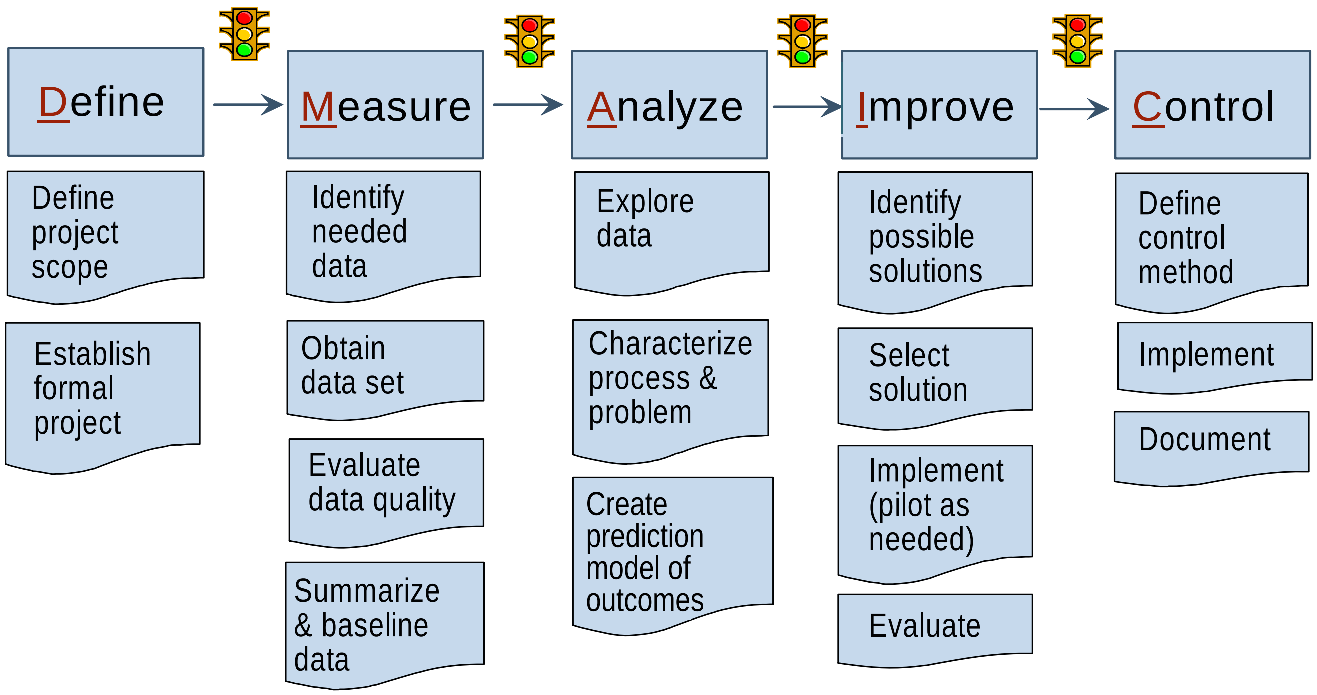
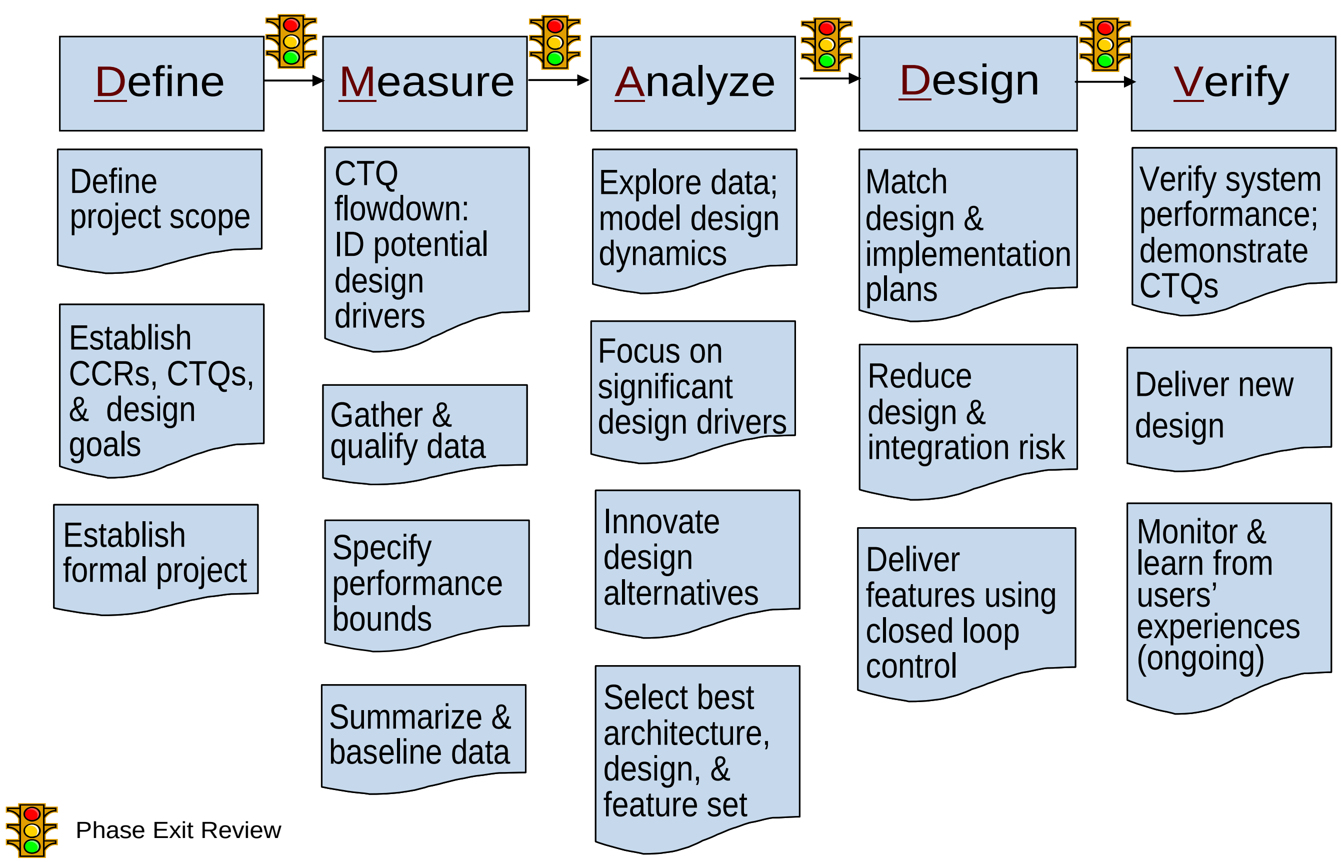
Software Engineering Institute | Carnegie Mellon

Advanced Statistics Reference – 1

DMAIC Roadmap



DMADV Roadmap



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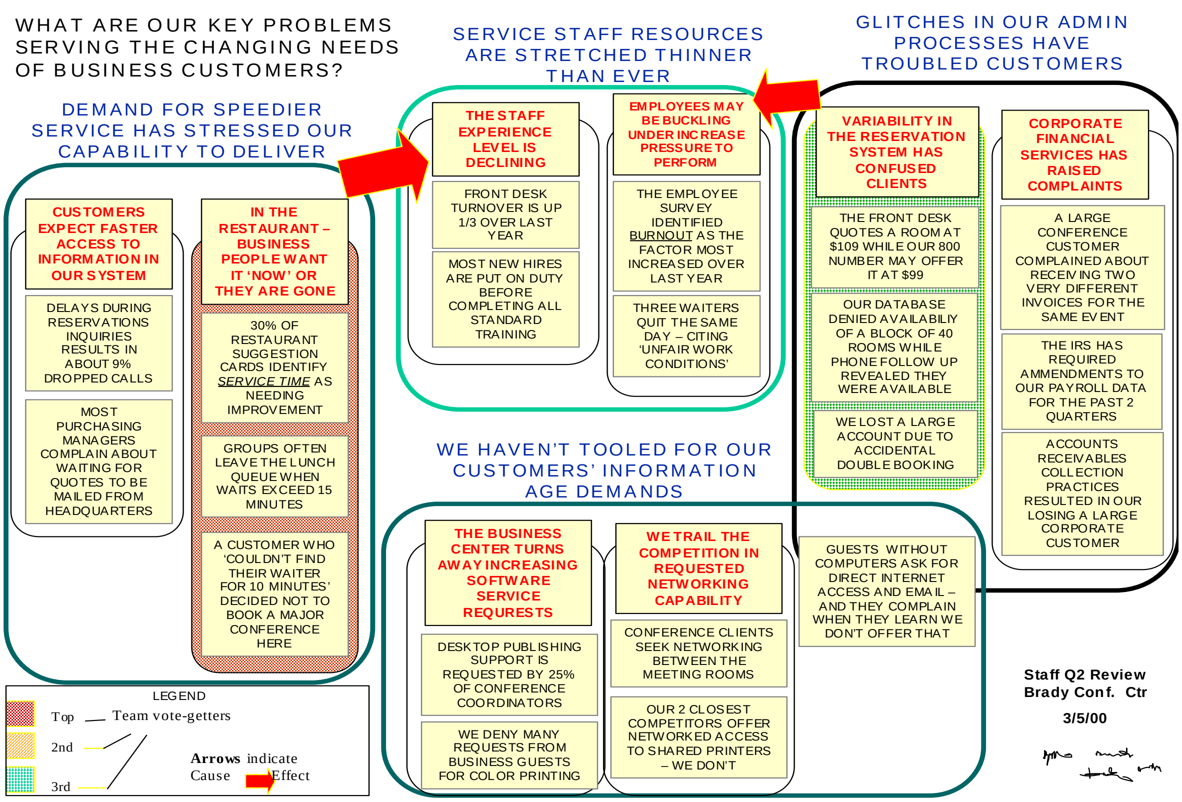
KJ Steps

1. State the theme as a question.
2. Gather facts that answer the theme question; write in **BLACK**.
3. Assemble the facts; reduce them to the key 20-30, if necessary.
4. *(Team)* Understand each fact and scrub its language for clarity.
5. Group the facts that really belong together, with a maximum of three in each group (lone wolves acceptable).
6. Title the groups in **RED**. Use complete sentences and follow abstraction “is-a” rules.
7. Encapsulate lower level facts under the **RED** titles.
8. Group the **RED** titles (maximum of three together) and any lone wolves that really belong together.
9. Title the groups in **BLUE**.
10. Encapsulate the **RED** groups under **BLUE** titles.
11. Arrange the **BLUE** titles and any remaining **RED** or lone wolf items to describe cause and effect relationships. Use arrow and opposition symbols.
12. *(Not always done on Context KJ)*
    a. Vote on the most important **RED**-level groups or lone wolves.
    b. Write a conclusion statement in **RED** in on the upper right side.
13. Sign and date the KJ.



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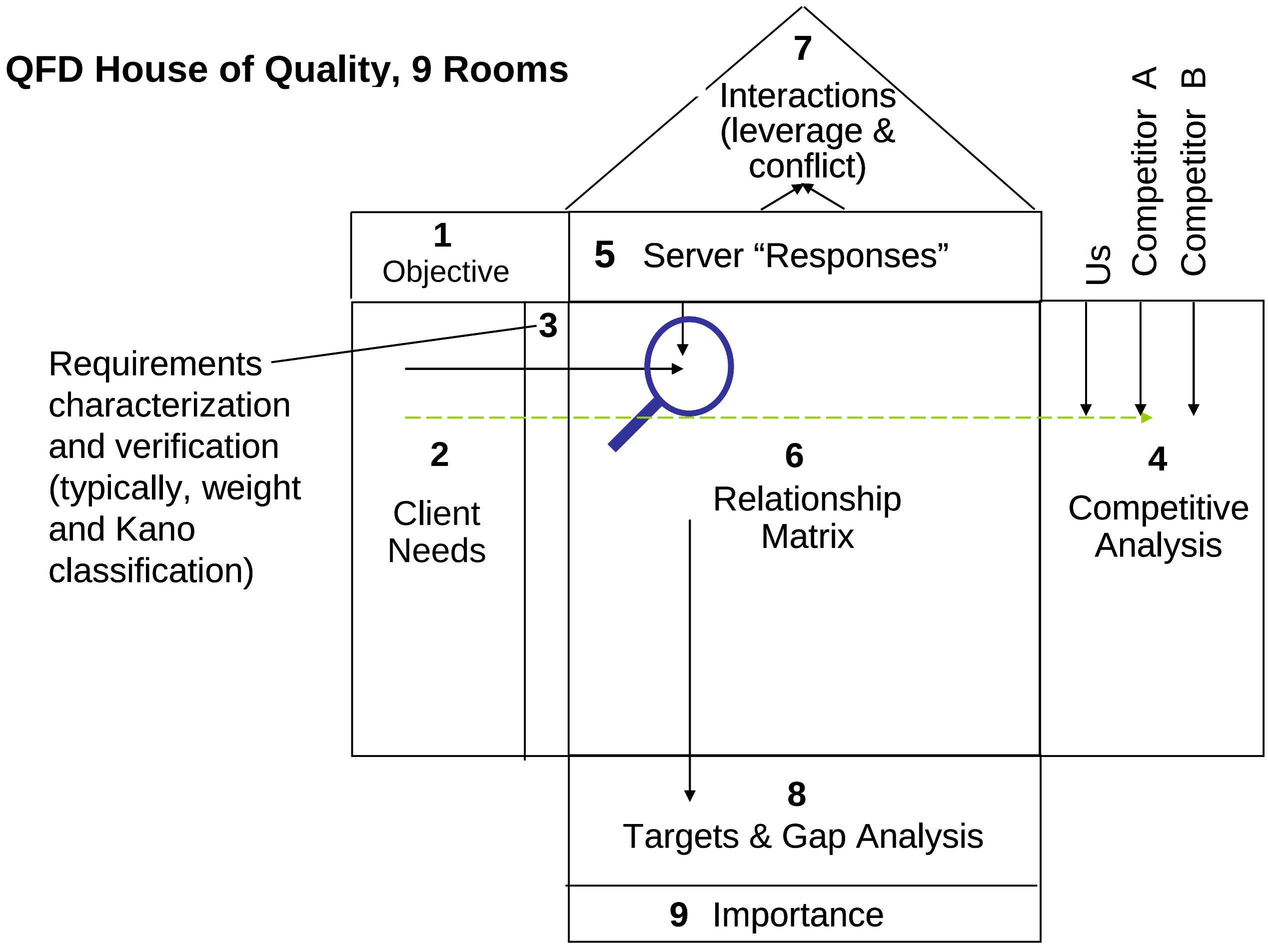
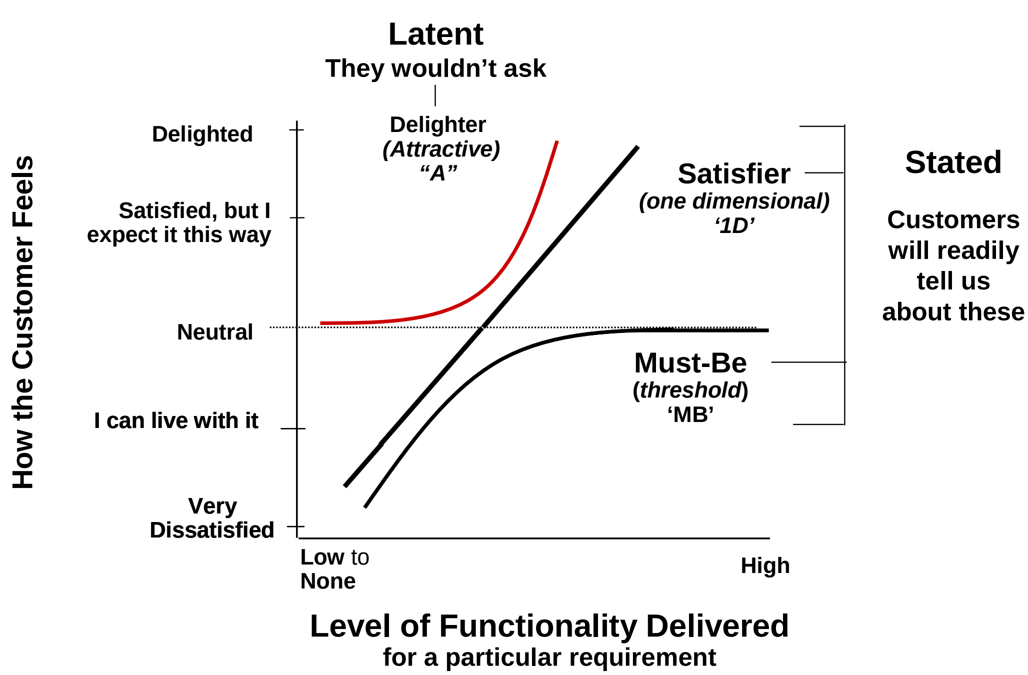
QFD House of Quality, 9 Rooms



Kano Model



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Steps for Creating a Monte Carlo Simulation Model with Crystal Ball

(1) Create a spreadsheet model of the problem.

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(2) Identify all uncertain cells to be “assumptions” with uncertain distributions.

↓

(3) Identify all outcome cells to be “forecasts”.

↓

(4) Set the options for the simulation including the number of trials to run.

↓

(5) Run the simulation.

↓

(6) Interpret the results by reviewing distributions of the “forecast” cells.

Steps for Optimization Using OptQuest

(1) Create a simulation model of the problem.

↓

(2) Define decision variables cells.

↓

(3) Select the objective for the optimization.

↓

(4) Identify additional requirements.

↓

(5) Confirm settings for decision variables.

↓

(6) Specify constraints for decision variables.

↓

(7) Identify optimization parameters.

↓

(8) Run the optimization.

↓

(9) Interpret the results.

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Objects Used to Build a Process Model

Entities – the items or people being processed (e.g., products, documents, customers)

Resources – the agents used to perform activities and move entities (e.g., service personnel, operators, or equipment)

Activities – the tasks performed on entities (e.g., assembly, document approval, customer checkout)

Connections – the lines connecting the graphic shapes

Storages – locations where entities can wait or be held until further processing (e.g., waiting areas, stock places)

Steps for Running a Simulation

1. Create ProcessModel scenario parameters and scenarios.
2. Set simulation options.
3. Run and observe the simulation.
4. Analyze the simulation output reports.

Steps for Running the ProcessModel Optimization

1. Define the optimization objectives.
2. Define the optimization inputs.
3. If needed, define the experiment to determine replication counts.
4. Set options for the optimization.
5. Initiate the optimization.
6. Review the optimization outputs (various outputs).

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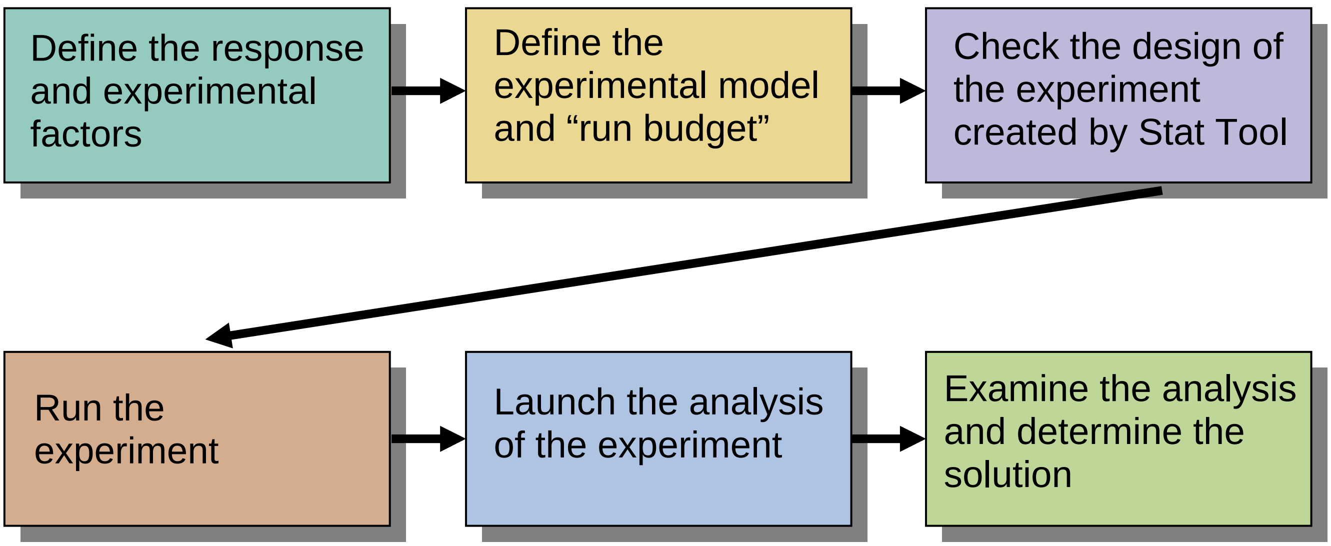
Design of Experiment Process



Replications

Each row of a DOE matrix can be evaluated more than once for a response or outcome value. Thus, a replication of one implies that the scenario or run will be evaluated twice for a response value. This allows the variability within a scenario to be evaluated and supports our analysis of deciding which factors are significant in the prediction model.

(Note that each simulator you will work with provides two response values to a given scenario in the experiment so that we will have one replication.)

Repetitions

This concept is slightly different from replication in that multiple measures are taken at the same settings without the need to reset any factors between the multiple measures. Replications presume that the activity of resetting the factors physically, including any equipment resetting, occurs between each of the multiple measures.

Runs

A row of a DOE matrix that depicts a scenario implementing the settings for the x factors (critical parameters) and the corresponding response or outcome value.

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Aliasing

When two or more factors can not be discerned from each other in a designed experiment because they each receive the same high-medium-low settings on each run of an experiment.

Interaction Terms

Additional factors that may be added to the designed experiment representing the multiplicative product of two or more of the primary factors. Interaction terms may be thought of as the interactions of two drugs. Individually, each drug may help, but when used together, they can cause an adverse effect!

Resolution of the Experiment

Designed experiments have different resolutions, which can be thought of as residing on a magnification scale. The four following resolutions are often encountered in practice.

- **Resolution II** – A designed experiment that is so weak in information that it has aliasing of primary factors with each other. (Weakest)
- **Resolution III** – A designed experiment that is slightly stronger. Primary factors are not aliased with each other, but are aliased with 2-way interactions.
- **Resolution IV** – A designed experiment that is even stronger. Primary factors are not aliased with each other or with the 2-way interactions, but allows 2-way interactions to be aliased with each other
- **Resolution V** – A designed experiment that is even stronger. There is no aliasing among primary factors or 2-way interactions.

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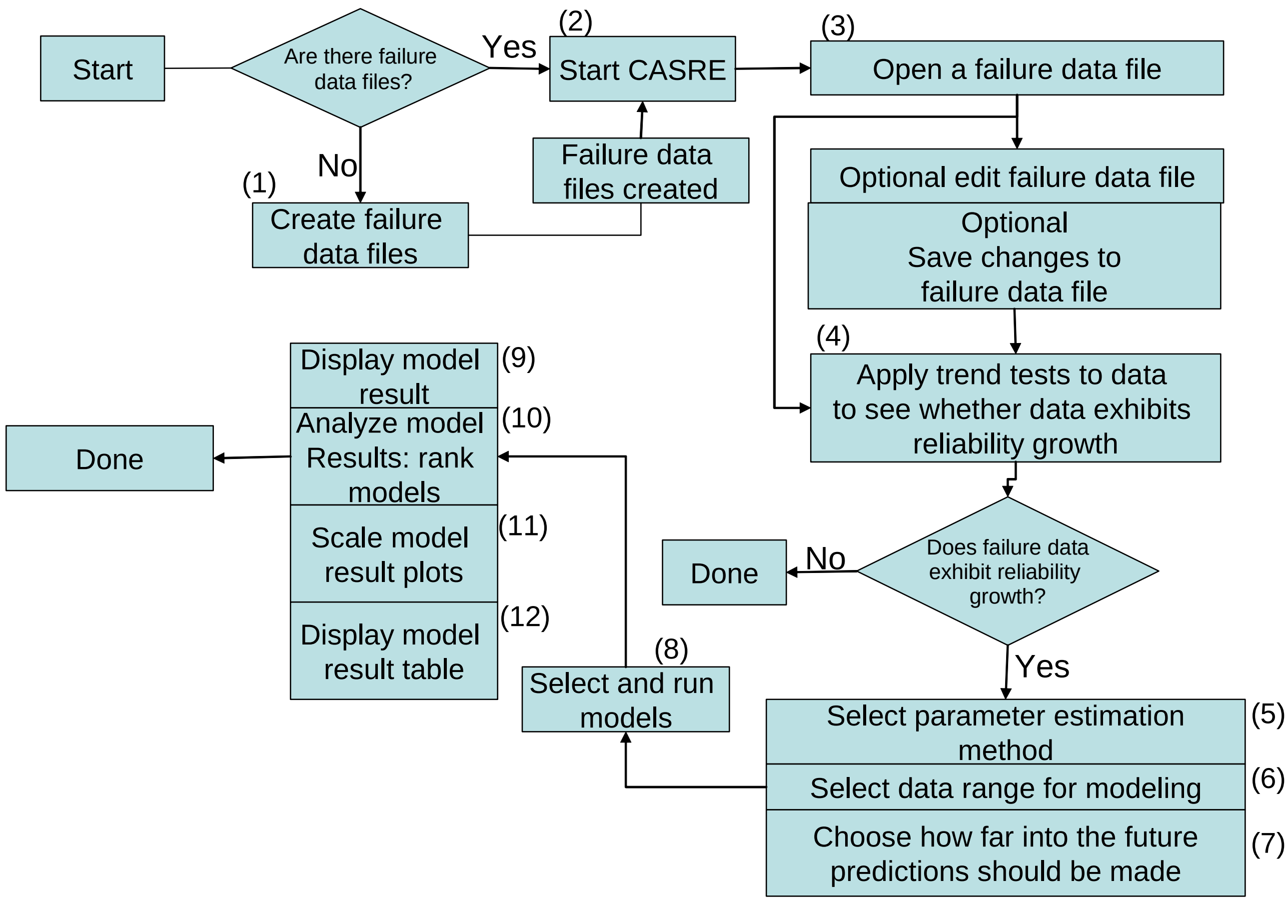
Flowchart of a Typical CASRE Session



Most Common Software Reliability Models

Time Between Failure Models

- **Geometric**
- **Jelinski-Monranda**
- **Littlewood-Verrall**
- **Musa Basic**
- **Musa-Okumoto**
- **NHPP**

Failure Count Models

- **Generalized Poisson Model**
- **Non-Homogeneous Poisson Process (intervals) Model (NHPP)**
- **Schick-Wolverton**
- **Schneidewind**
- **Yamada S-Shaped**

These models are explained in greater detail in the online textbook *Handbook of Software Reliability Engineering.* http://www.cse.cuhk.edu.hk/~lyu/book/reliability/