Quality function deployment in RAMS engineering

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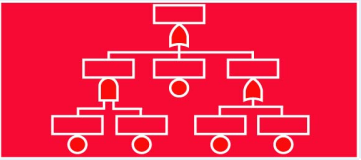
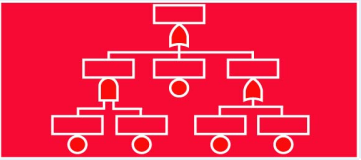


QFD history and definition

- QFD was originally developed by Dr. Yoji Akao for the Kobe Shipyard, Mitsubishi Heavy Industries, in Japan in 1966

Akao (1990) defined QFD as "a method for developing a design quality aimed at satisfying the customer and then translating the customer's demand into design targets and major quality assurance points to be used throughout the production phase . . . [QFD] is a way to assure the design quality while the product is still in the design stage."

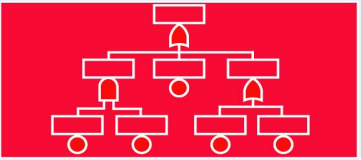


What is QFD?

QFD is a planning tool that:

- Translates customer needs, expectations, and requirements into detailed product and process specifications

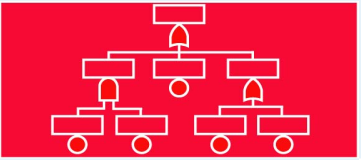
- Identifies the significant items on which to focus time, product improvement efforts, and other resources
- Good tool for comparing existing solutions
- Good for reference during redesign



QFD objectives

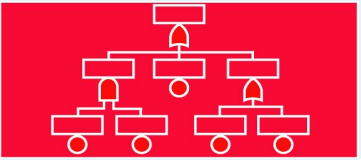
The main questions to be answered by a QFD are:

- What are the *qualities* the customer desires?
- What *functions* must the product serve, and what functions must we use to provide the product or service?
- Based on our available resources, how can we *best provide* what our customer wants?



Benefits of QFD

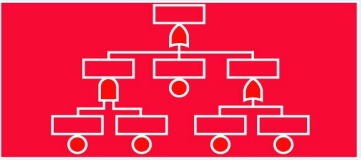
- Shorter development cycles
- Trade-offs are made in design, strategically, rather than in the market, tactically
- Lower costs, increased productivity
- Documentation oriented
- Team involvement and commitment at the design stage



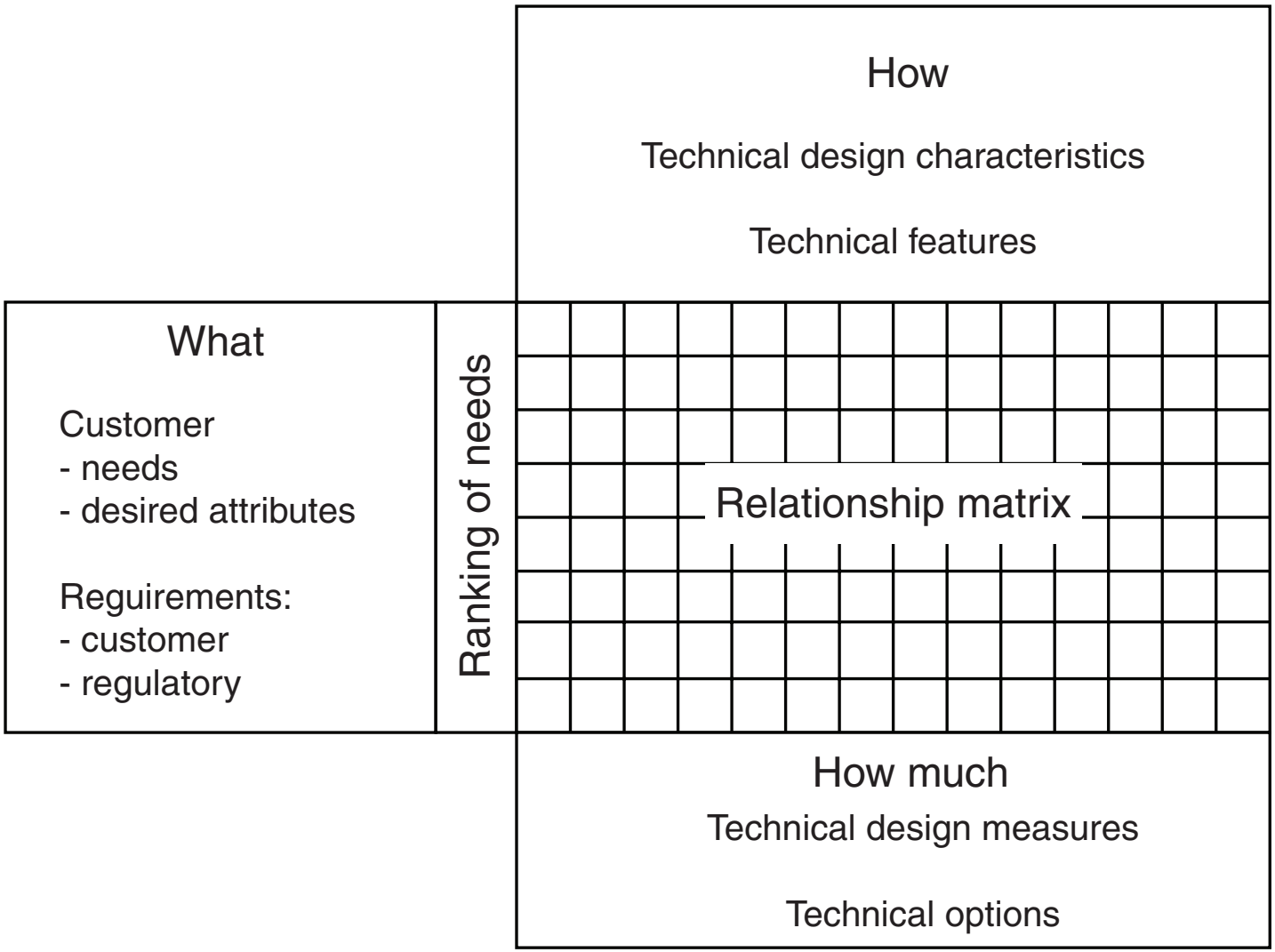
What do the customer(s) want/need?

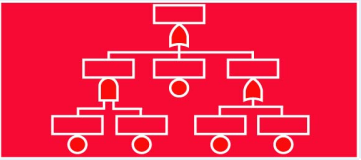
- Design/functional requirements
- How do you find out?
  - Ask them
  - Surveys
  - Focus groups
  - Warranty forms
  - Service reports

(Ref. Lisa Catana 2006)



Basic structure of QFD

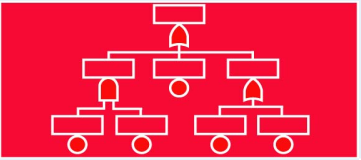




Customer needs - Examples

The following are possible needs/requirements for a safety valve:

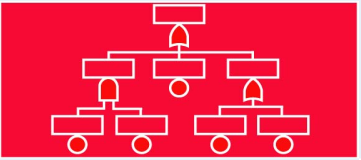
- High reliability (e.g., SIL 3)
- Short maintenance time
- High durability
- Easy and fast to function test
- Possible to partial stroke test
- Possible to replace actuator in line
- Short closing time (e.g., ≤ 5 seconds)
- Moderate cost



Technical features - Examples

The following are possible technical features for a safety valve:

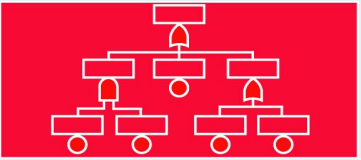
- Material selection
- Valve type
- Actuator type
- Failsafe principle
- Seal geometry
- Balancing stem
- Stem to valve connection
- Position indication



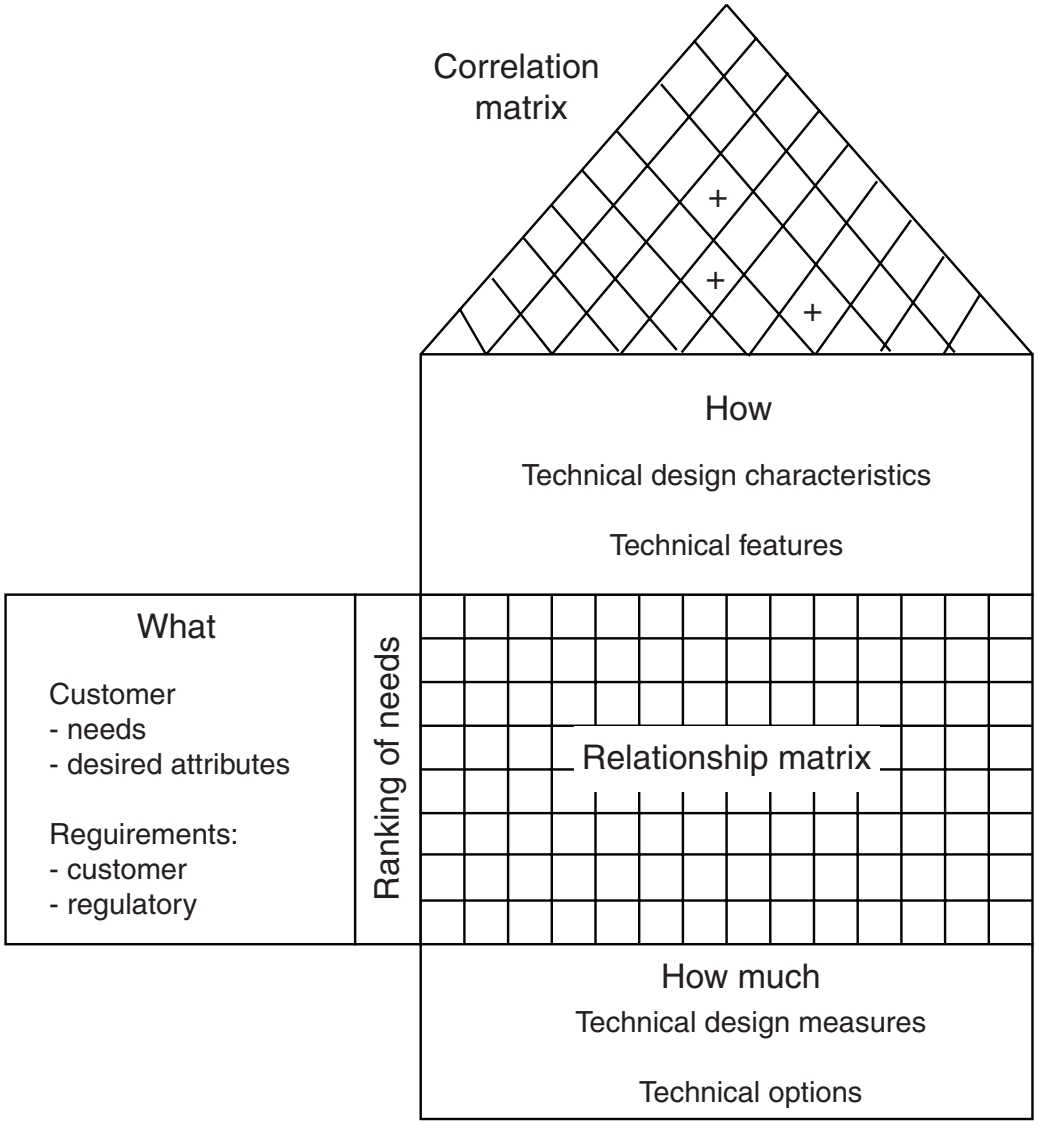
Technical options - Examples

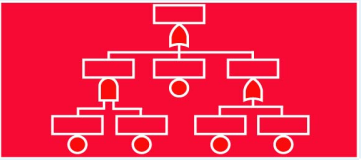
The following are possible technical options for a safety valve. Several options may be relevant for each technical feature.

- Valve type: gate, ball, flapper, ...
- Failsafe principle: spring-loaded, hydraulic/pneumatic accumulator, explosives, ...
- Seal geometry: Chevron, Chevron + metal, metal + elastomeric, ...
- and so on



Correlation matrix

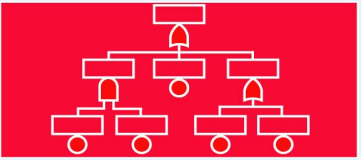




Correlation matrix

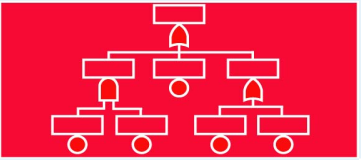
- Consider impact of technical features/requirements on each other
- Feature to feature comparison
- Augment or impede

- Does improving one requirement cause a deterioration or improvement in another requirement?



QFD: An stepwise process

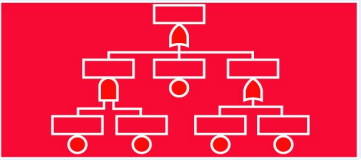
1. Identify and define (potential) customers
2. Customer requirements ("Voice of the customer")
3. Regulatory requirements
4. Customer importance ranking (e.g., scale 1–5)
5. Customer rating of the competition("competition benchmarking")
6. Technical features ("Voice of the engineer")
7. Direction of improvement (for each feature)
8. Relationship matrix (e.g., scale 1–3–9)
9. Technical analysis of competitor products
10. Target values for technical features
11. Correlation matrix
12. Absolute importance (product of cell value and customer importance ranking)



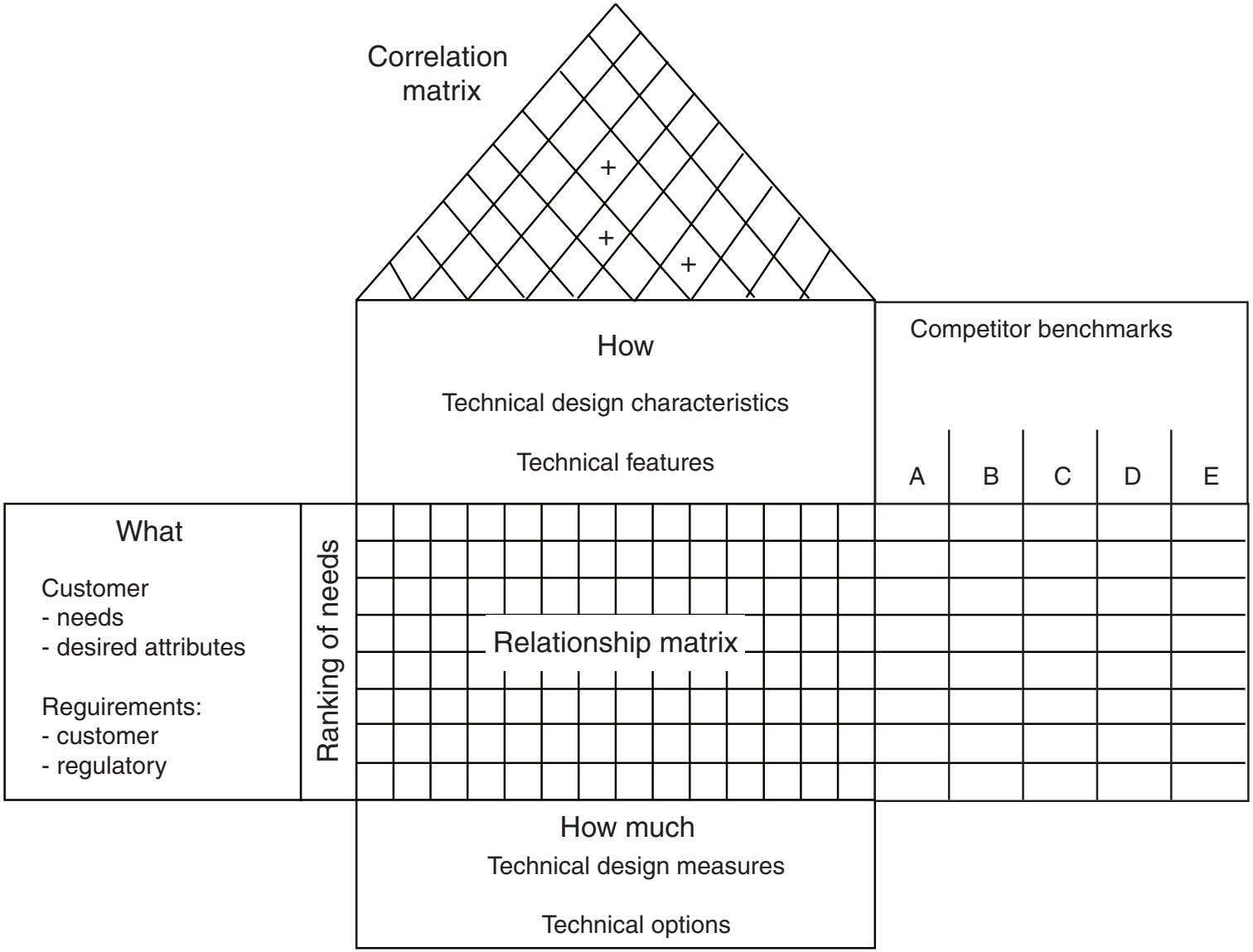
Competition benchmarks

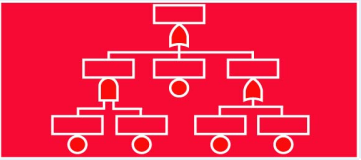
- Find out what the competitors are doing
- Find out what they are doing right and wrong – and copy the good stuff
- Rate the competition against functional requirements

(Ref. Lisa Catana 2006)



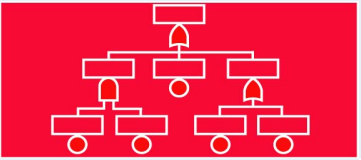
Competitor benchmarking



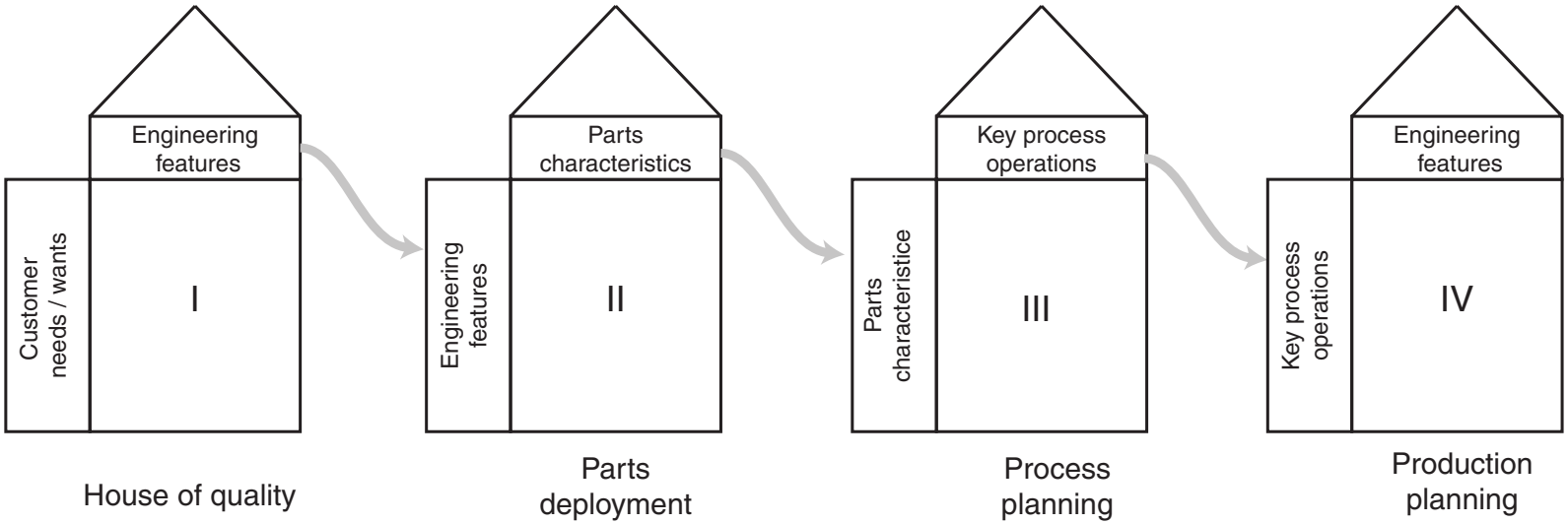


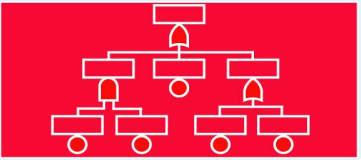
QFD phases

1. Product planning
   (a) Identify and define the (potential) customers
   (b) Identify the customers' needs, expectations, and requirements related to your product idea
   (c) Transform customer needs into a product concept
2. Product design
3. Process planning
4. Process control



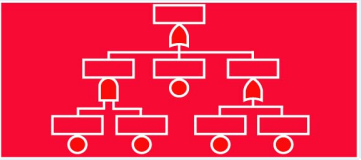
QFD phases





QFD tools

- *Affinity diagram*:
  – creative tool used to organize a lot of qualitative data
- *Interrelationship digraph*:
  – establishes relationships between and among causes
- *Tree diagram*:
  – classification tree of the ideas in the affinity diagram
- *Matrix diagram*:
  – maps the voice of the customer against the company capabilities required to meet the customer's needs.



Affinity diagram

An *Affinity Diagram* is a tool that gathers large amounts of language data (ideas, opinions, issues) and organizes them into groupings based on their natural relationships.

1. State the issue to be examined in broad terms, such as an open ended question or statement.
2. Generate and record ideas using Post-it notes. Begin sticking them on a wall or large sheet of chart paper, in no particular order, and where everyone can see them
3. Arrange the notes in related or similar groupings
4. Choose a word or phrase that captures the intent of each group and place it at the top as a category name or title