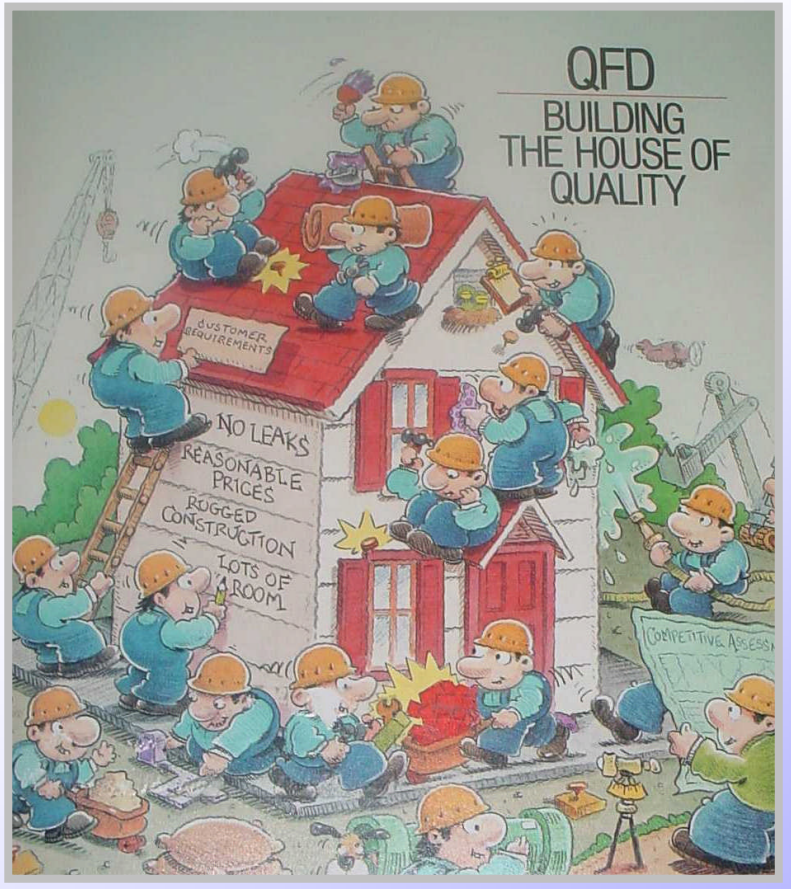
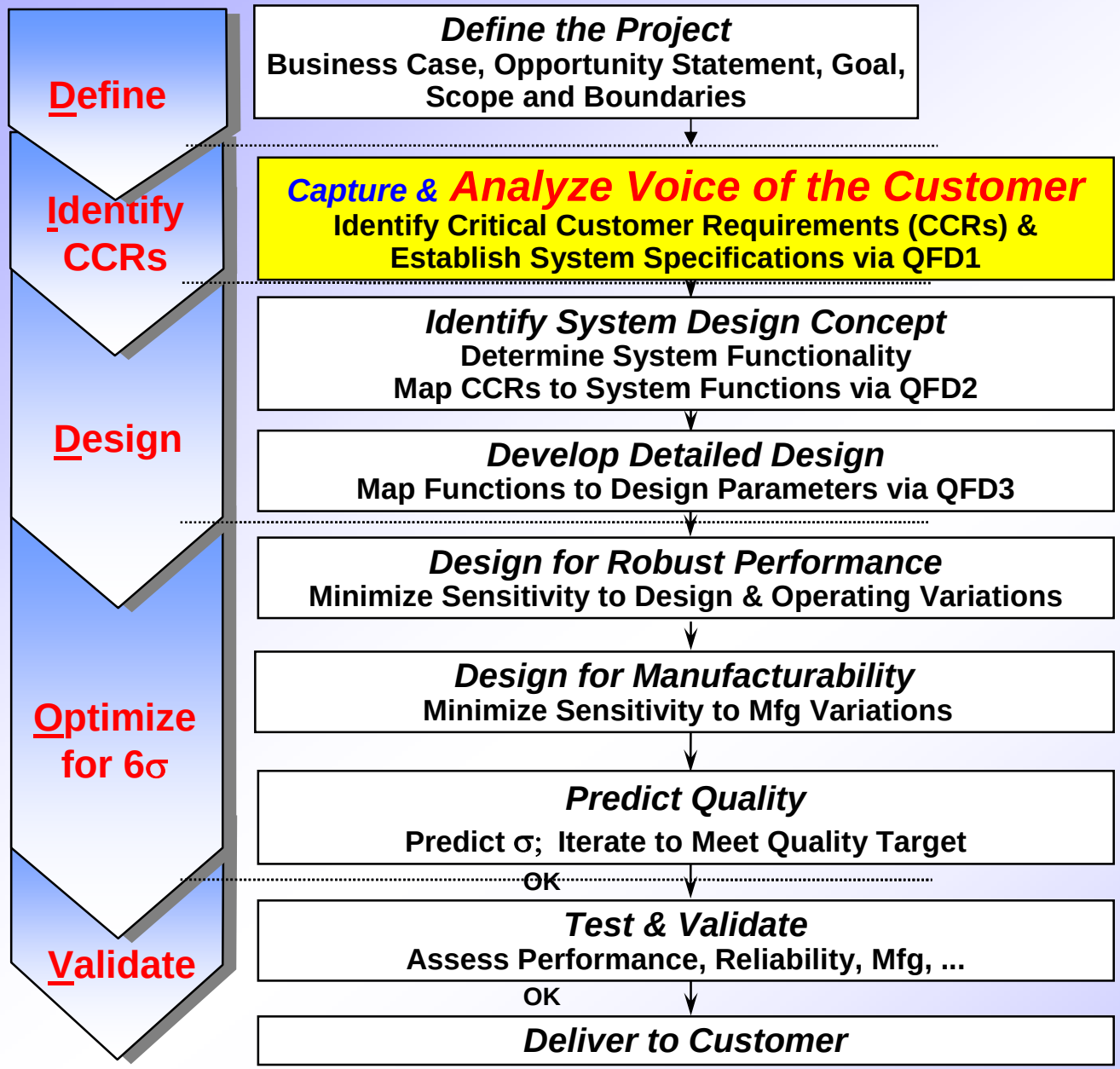
Quality Function Deployment and Selection Matrices

Customer
Driven Product
Development

Illustrated by Examples





Typical DFSS Process

Source: Design for Six Sigma, K. Yang

House of Quality & Selection Matrix Discussion Objectives

- Understand purpose of each “Room” in the Matrix
- Illustrate 7-step approach to HOQ, via example
- Identify Critical Customer Requirements (CCRs)
- Establish System Engineering Design Specifications
- Explain Solution Selection Matrix

What are Quality Function Deployment and Solution Selection Matrices?

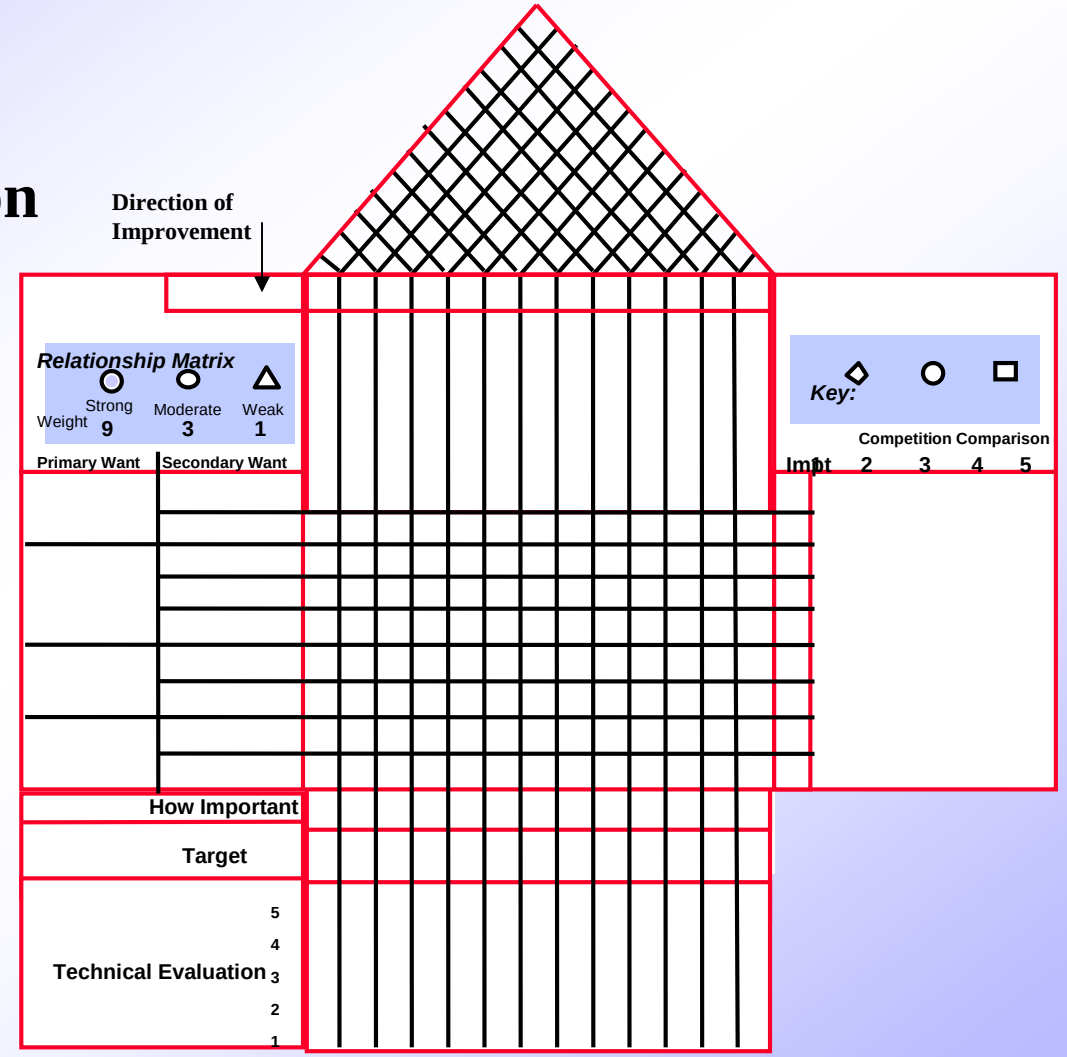
- **Tools to assist in <u>data based</u> decision making**
- **System of matrices translating Customer Needs into Engineering Specifications**
- **Tools to reduce design uncertainty**
- **Applied to Product, Service, Process, IT, or Software Designs**

What is a House of Quality?

Graphical representation of the logic flow . . .

Customer Needs

Engineering Design Specifications



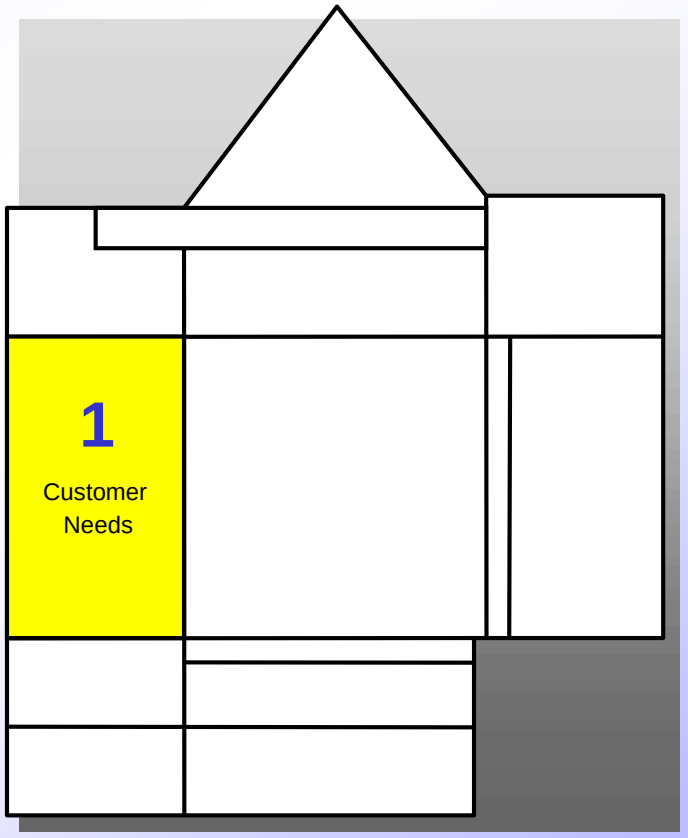
Customer Needs (Room 1)

Objective:

Orderly summation of Customer's Needs . . .

from Voice of Customer . . .

Collected early in the Identify Phase of DFSS



Example: Bank Loan Customer Needs

Primary	Secondary
Friendly staff	Willing to answer questions
	Treat me nicely
Knowledgeable staff	Knows loan procedure
	Knows market
	Understands my situation
Speed	Money when I need it
	Application quickly filled out
Accurate	Don't make mistakes
	Give me the right rate

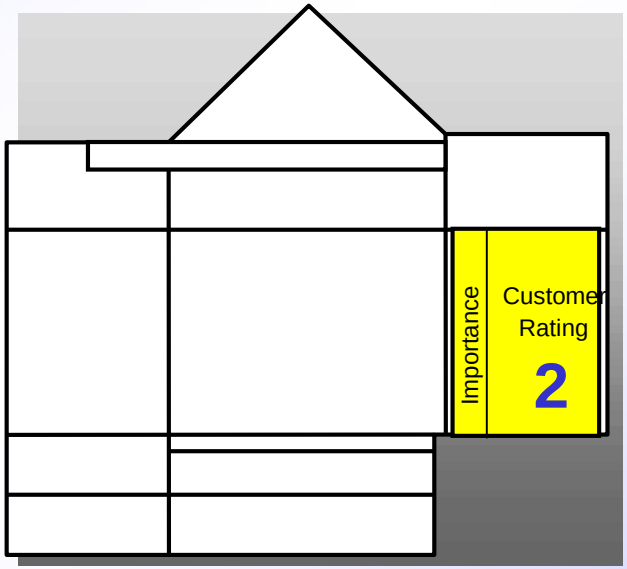
Tip: List of needs should be less than 20

Source: Design and Management of Service Processes, R. Ramaswamy

Customer Rating (Room 2)

Objectives:

1. **Document Customer Needs Importance with a 1-5 rating**
2. **Document Perception (opinion) of our offering and competitors' offering**



Information comes from Quantitative Voice of Customer

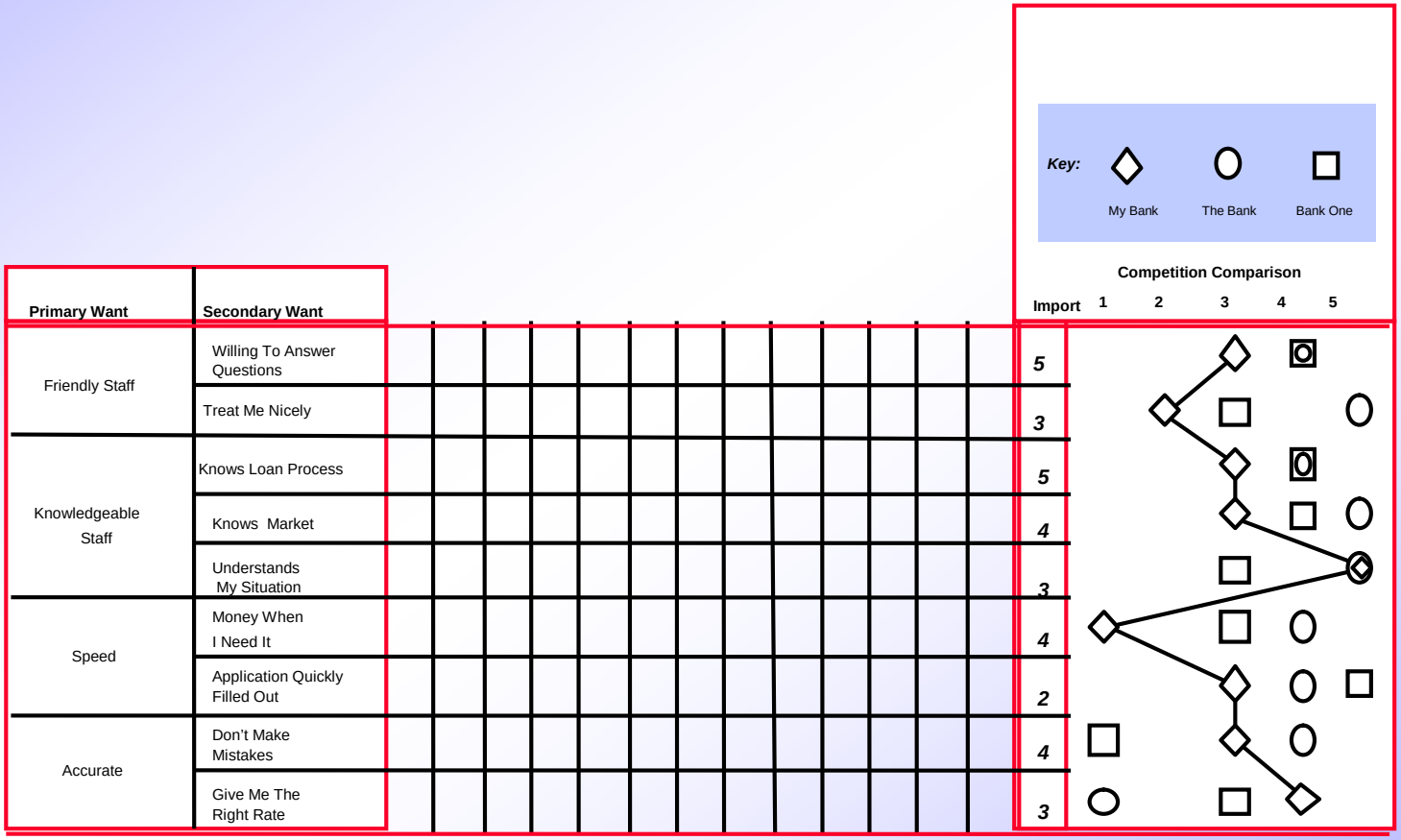
Customer Rating (Room 2)

Document Importance of each Customer Need

- **Rating scale (1 – 5, with 5 as highest rating)**
- **Frequency of response in Qualitative VOC does not automatically indicate importance**

Plot Customer's Perception (opinion) of our performance and that of our competition

Example: Customer Rating

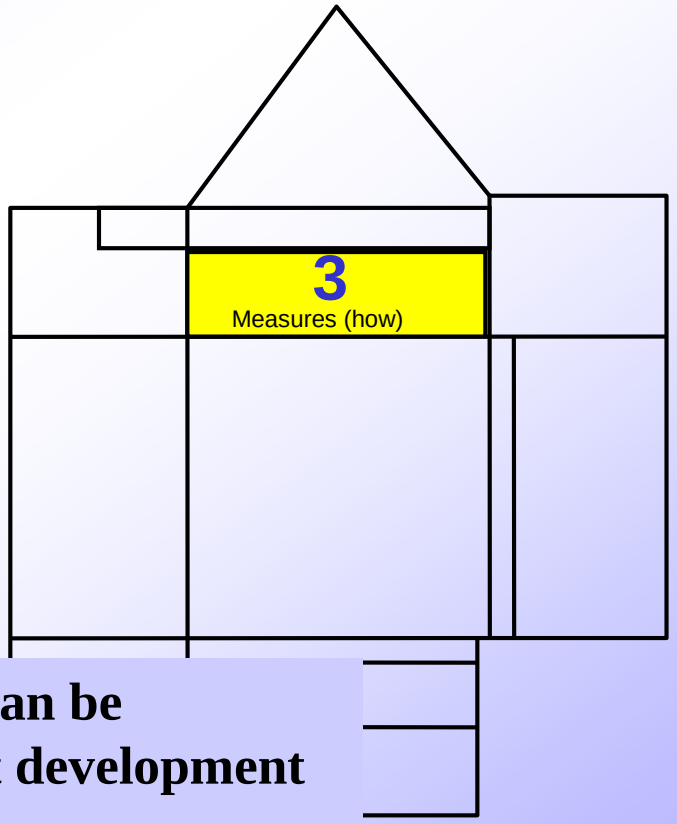


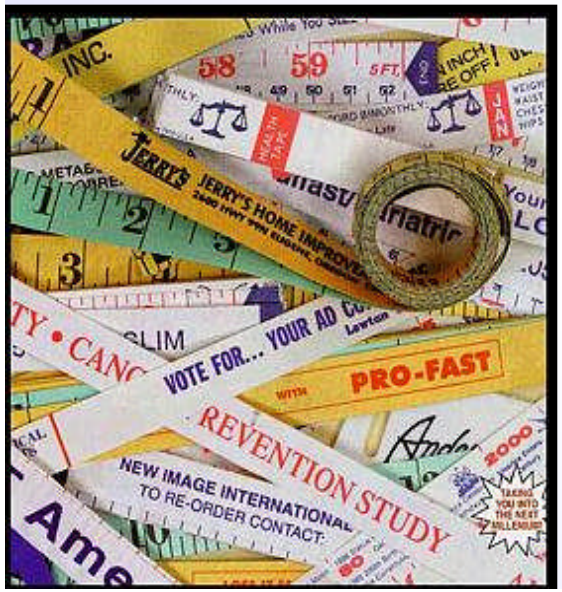
Source: Design and Management of Service Processes, R. Ramaswamy

Design Measures (Room 3)

Objectives:

Translate from “Customer Speak” to “Engineering Design Speak”





- **Objective Measures that can be conducted during product development**
- **Ensure Customer Satisfaction**

Example: Measures (Room 3)

Target Goals

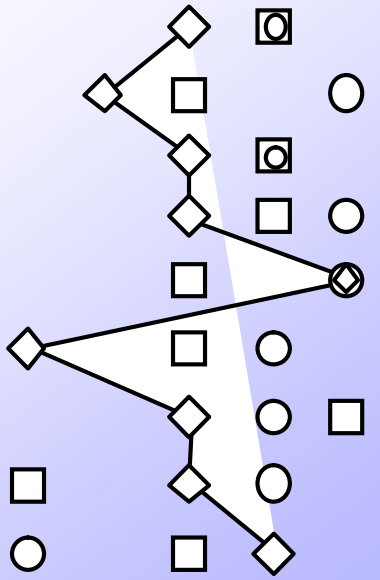
Relationship Matrix

	Strong	Moderate	Weak
Weight	9	3	1

Key: My Bank, The Bank, Bank One

Primary Want	Secondary Want	Time To Answer Phone	# Of Calls Answered/Hr	# Of Customer Complaints	Time Allocated To Customer	# Errors In Entry Process	# Callbacks To Customer	# Of Return Visits	% Callbacks	Time To Complete Loan Process	Time To Complete Application Form	# Of Errors/Customer	Variance From Actual Rate	# Of Errors In Application	Import
Friendly Staff	Willing To Answer Questions														5
	Treat Me Nicely														3
Knowledgeable Staff	Knows Loan Process														5
	Knows Market														4
	Understands My Situation														3
Speed	Money When I Need It														4
	Application quickly filled out														2
Accurate	Don't Make Mistakes														4
	Give Me The Right Rate														3

Competition Comparison 1 2 3 4 5

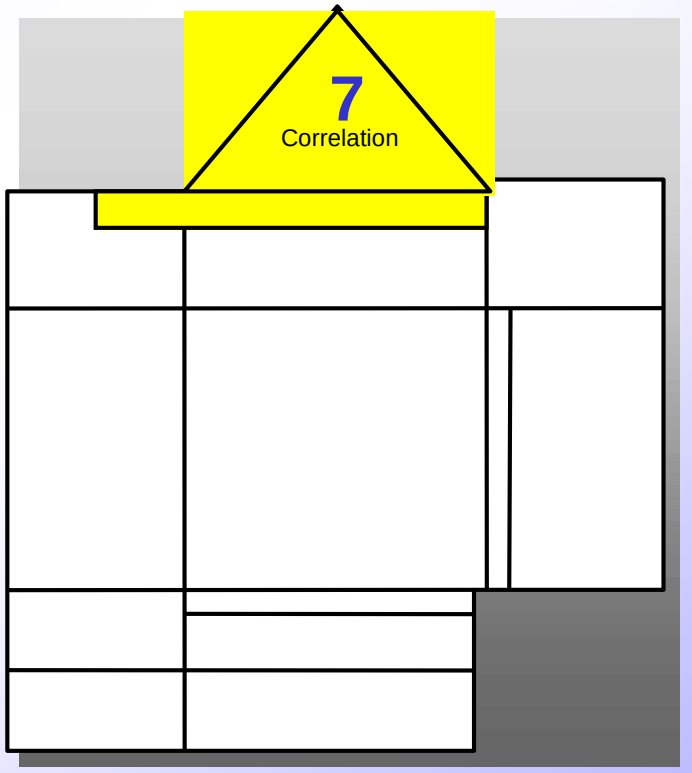


Source: Design and Management of Service Processes, R. Ramaswamyn

Measures Correlation (Room 7)

Objectives:

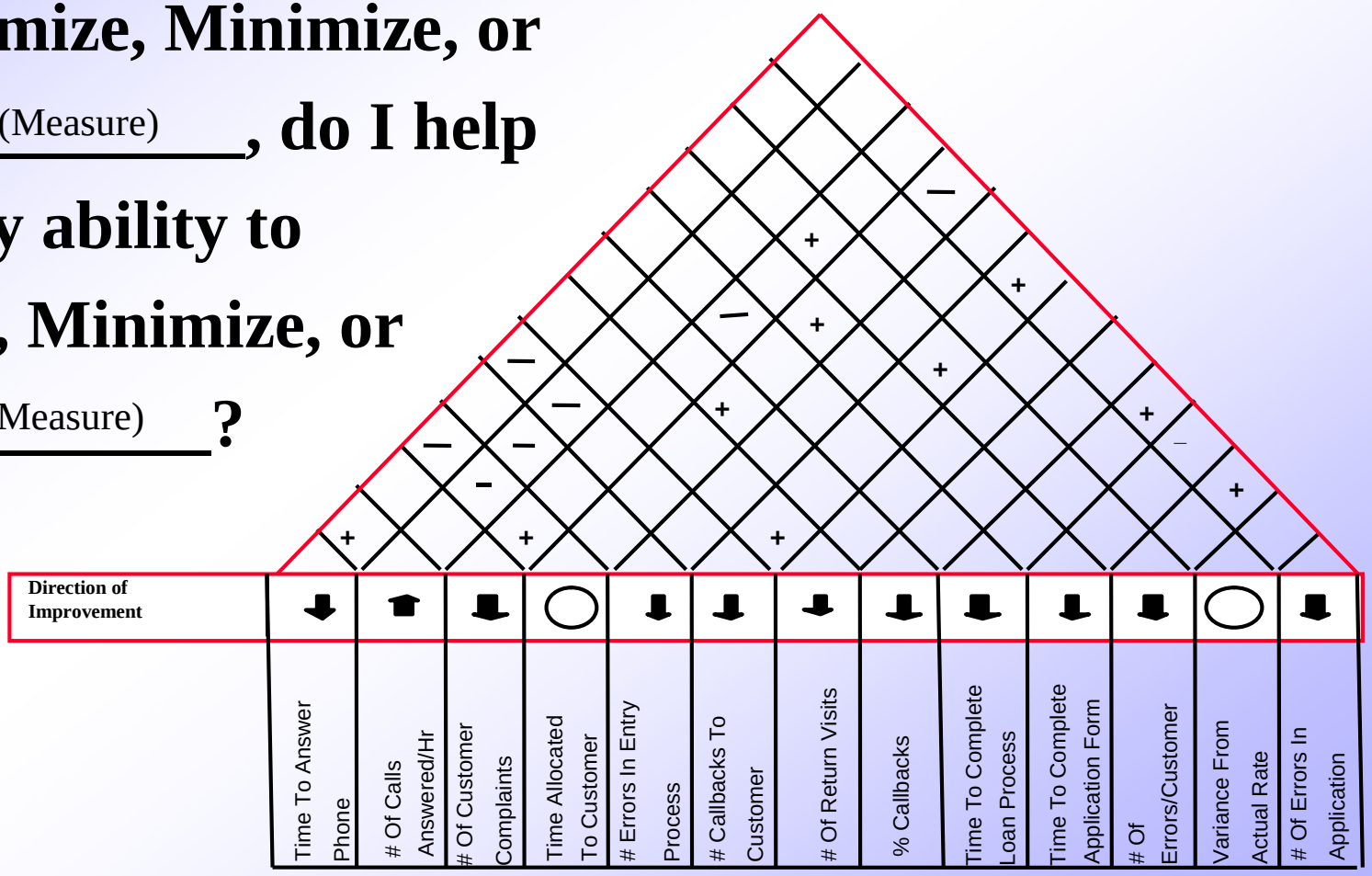
- **Establish direction of improvement for each Design Measure**
  - **Maximize** ⇧
  - **Minimize** ⇩
  - **Target a Specification** ○
- **Determine which Measures are related, and extent of Relationship**
- **Identify Design Conflicts that lead to compromise or Trade-off**



Example: Measures Correlation

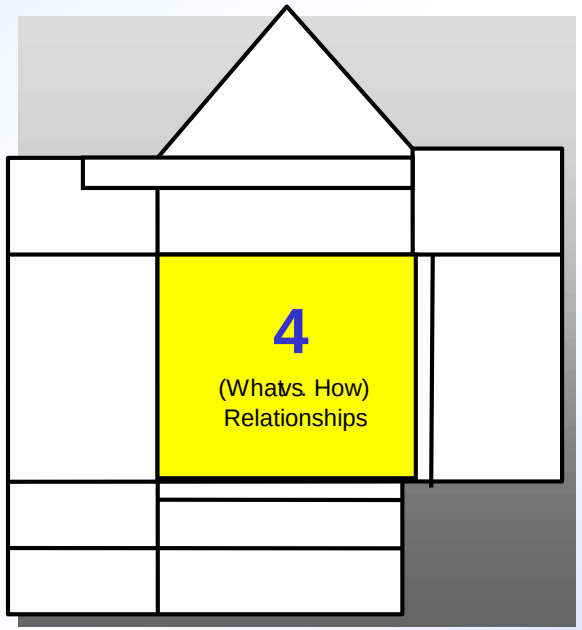
Facilitation Question:

As I Maximize, Minimize, or Target_____(Measure)_____, do I help or hurt my ability to Maximize, Minimize, or Target_____(Measure)_____?



Source: Design and Management of Service Processes, R. Ramaswamy

Relationships (Room 4)



Objective:

Establish relationships between

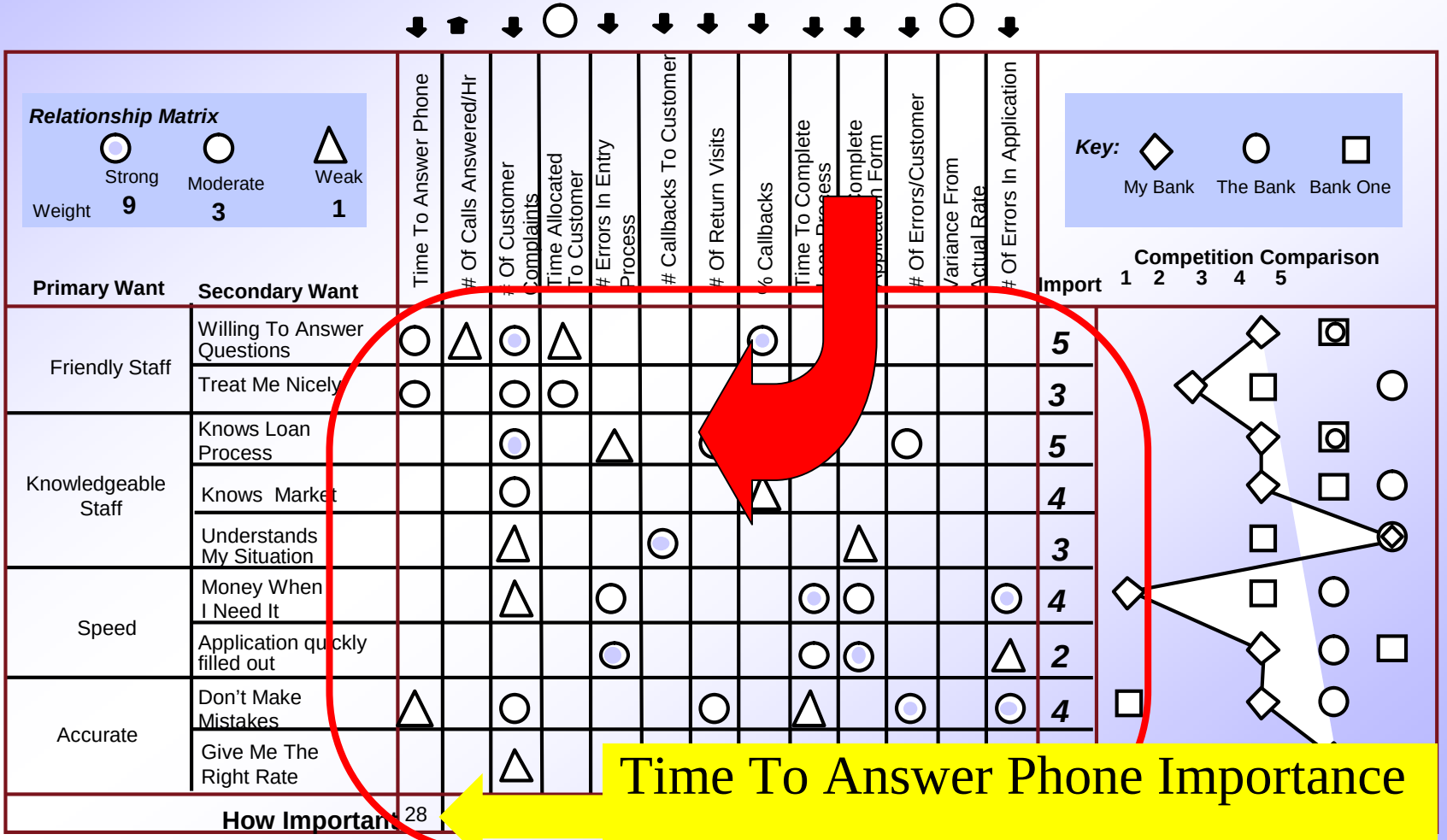
Design Measures and Customer Needs

Process:

- **Use 9 (strong), 3 (moderate) and 1 (weak) . . . rate Relationship between each Measure and Customer Need**
- **Use Relationship Matrix symbols: ● ○ △**
- **Calculate score for each cell by multiplying Importance Rating (Room 2) by Relationship Rating**
- **Add up individual scores for each Measure to determine the "How Important" value**

Example: Relationships (Room 4)

Facilitation Question: **As I Maximize, Minimize, or Target** (Measure), **what direct positive impact does it have on satisfying** (Customer Need)**?**

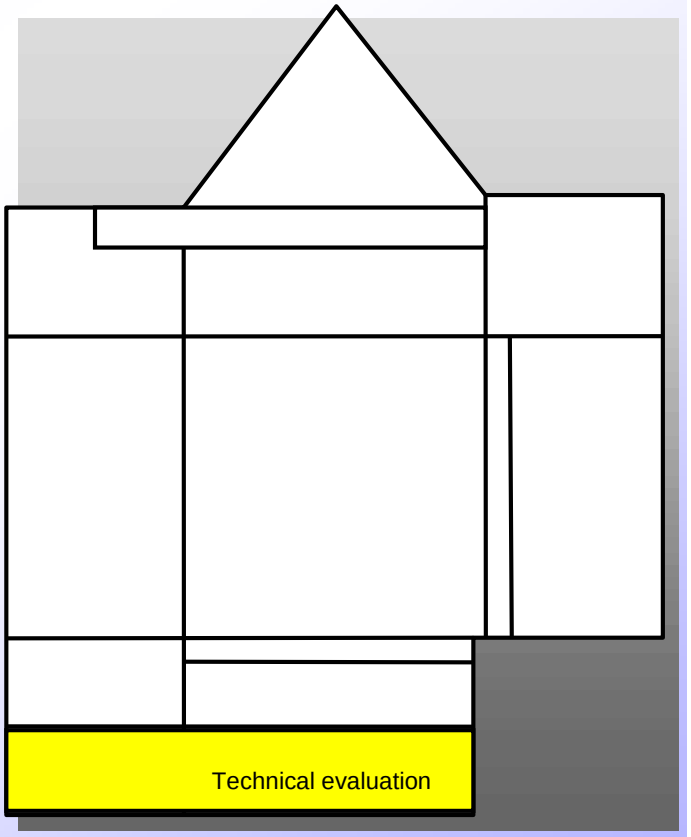


Technical Evaluation (Room 5)

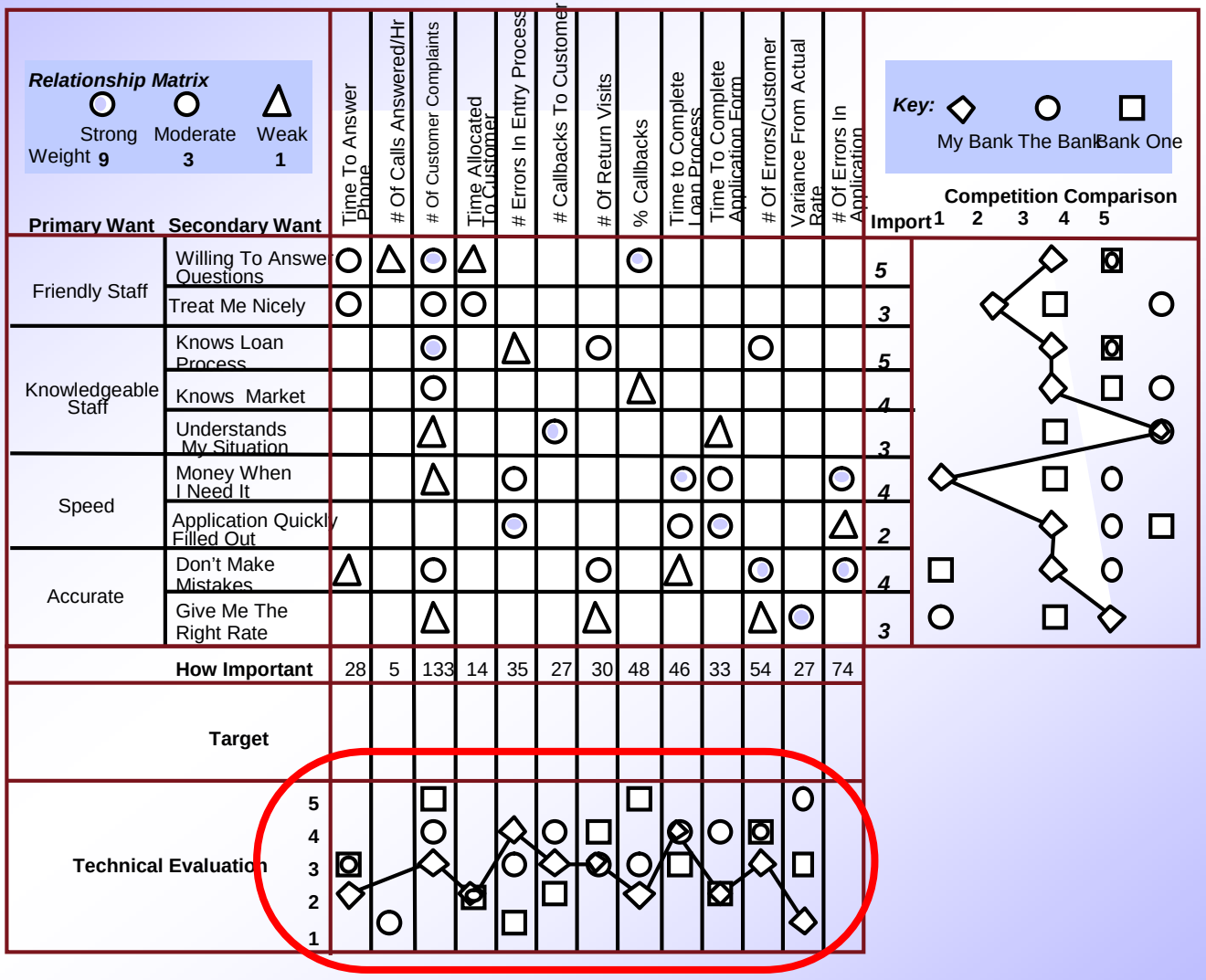
Objective:

Factual picture of how we technically compare to competition:

- **Best in class Technology**
- **Innovative technology**

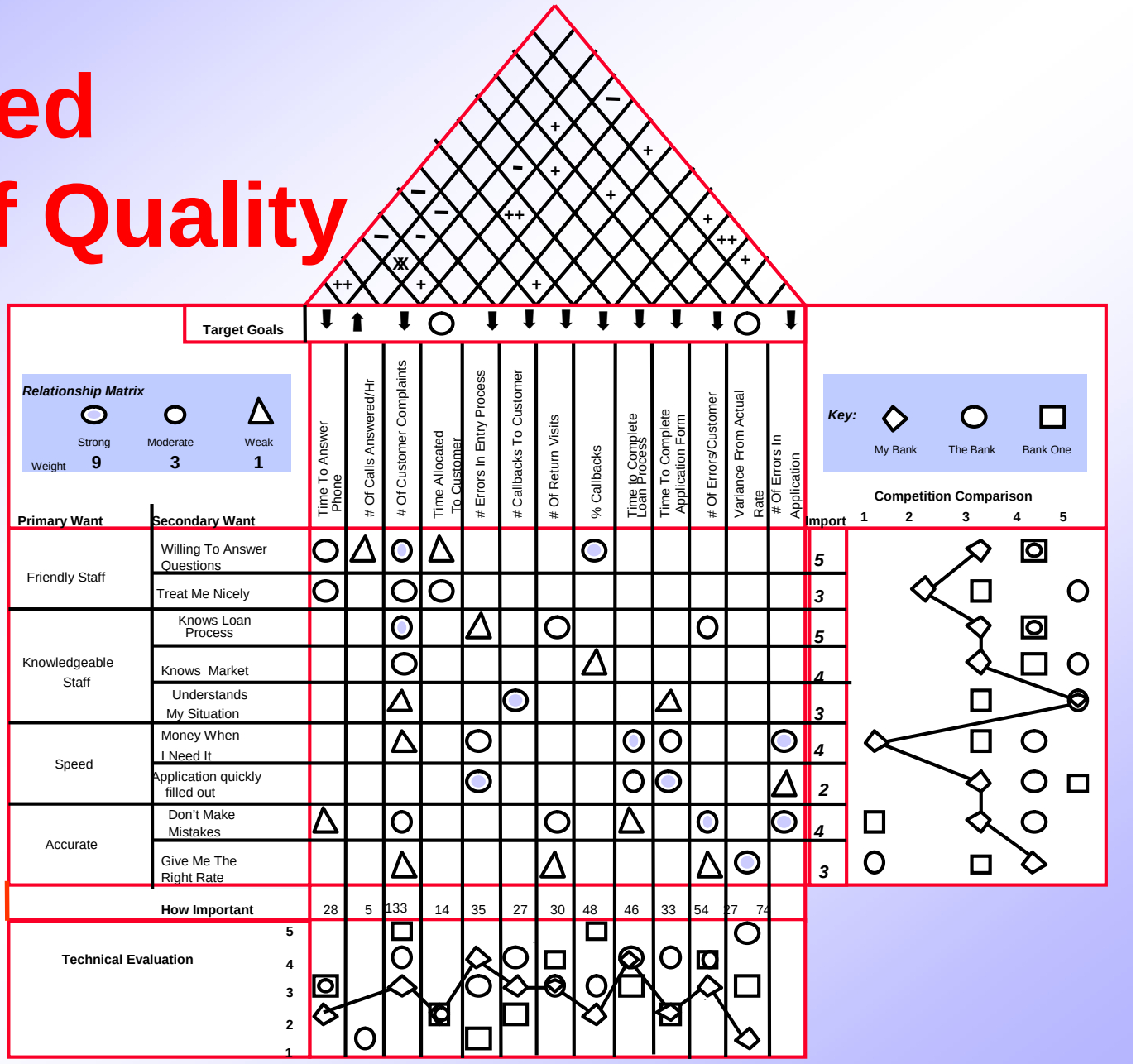


Example: Technical Evaluation (Room 5)



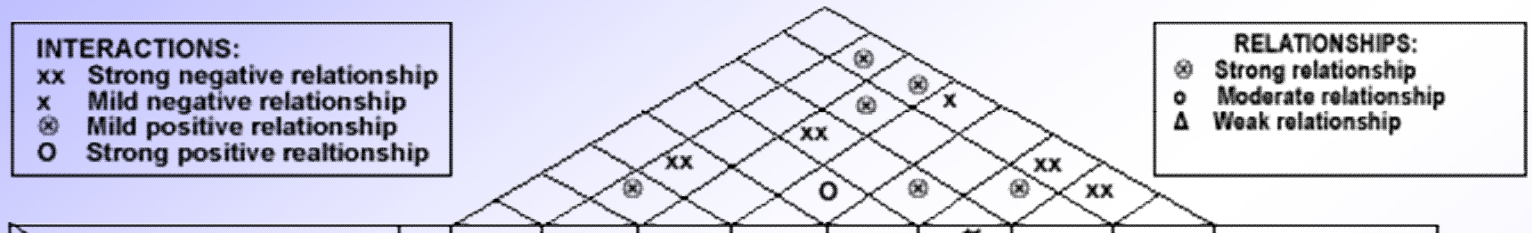
Source: Design and Management of Service Processes, R. Ramaswamyb

Completed House of Quality Example



Source: Design and Management of Service Processes, R. Ramaswamyn

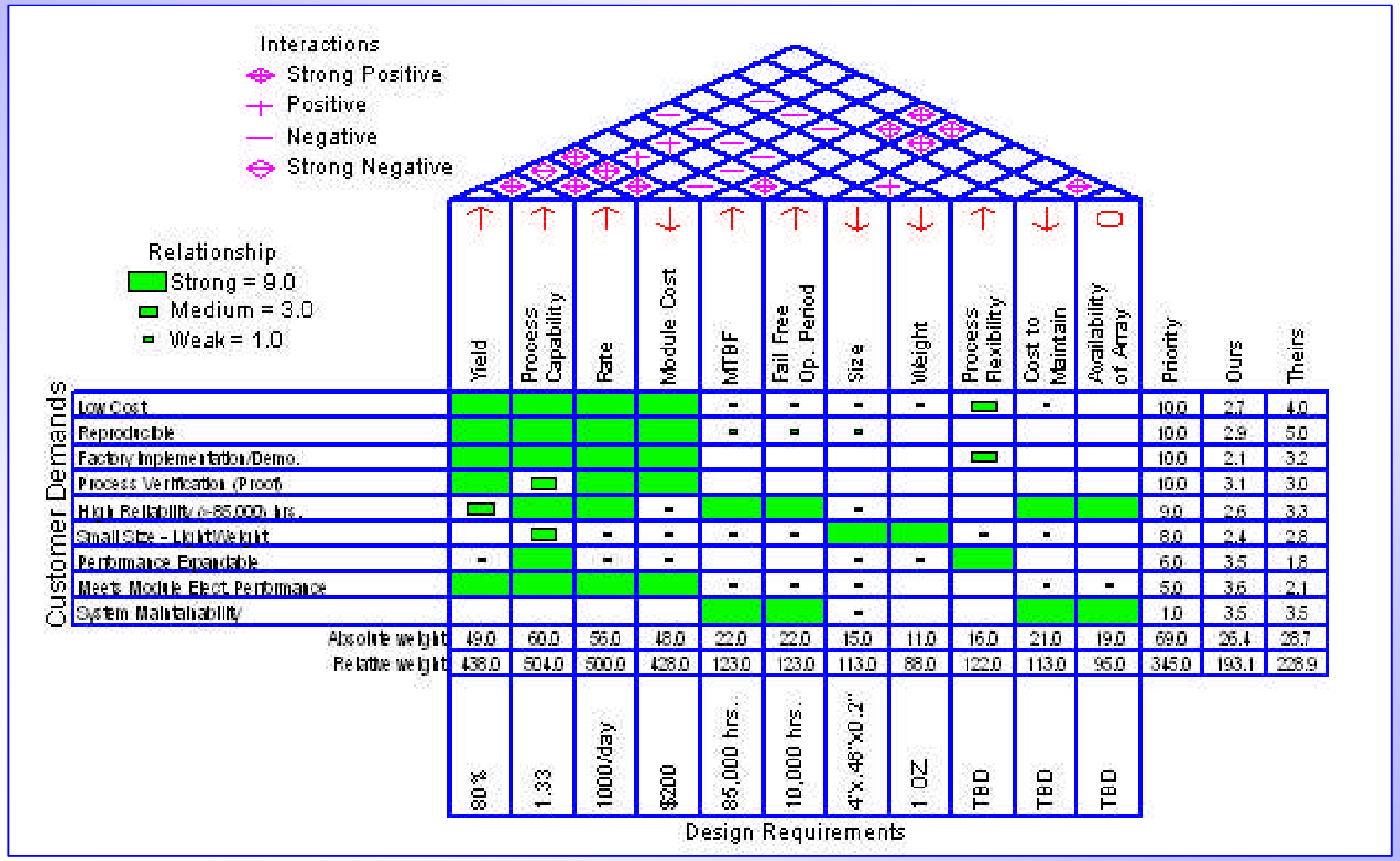
Example – Aircraft APU



Customer Reqmts \ Product Design Reqmts	Priority	Bleed air ducting to interface P1.A	Low APU weight	Low turbine wheel weight	High equivalent shaft horsepower	Controlled turbine inlet temperature	Turbine assy. tri-hub containment	Strong internal containment ring	Lightweight containment ring	Competitive Evaluations 1 5
Cust. envelope/interface	3	⊗						⊗		x o
Max.Weight 160lbs.	4	o	⊗	o			o		⊗	o x
Bleed air 75 lbs/min	4	o			⊗	⊗				o x
Turbine containment	5			o		o	⊗	⊗		ox
Elect pwr. 40KVA	3				⊗					x o
Reliable	5			o		⊗				xo
Support oil-cooled gen.	5		o							o x
* * *										
Technical Evaluations	5 / 1	x o	x o	x o	x o	o x	o x	x o	x o	
Target Value		Target Loc.	158lb	<6 lb	350hp	1850°	2.5 lb @Pwr	3 lb @Pwr	<6 lb	
Technical Difficulty		1	4	3	5	3	4	2	4	
Importance Rating		39	35	42	35	60	52	40	20	

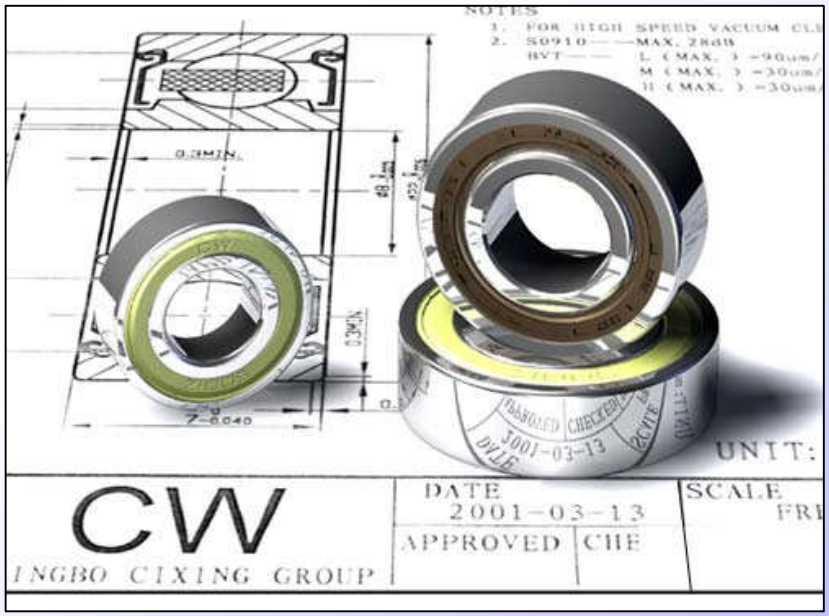
Evaluations:
x We
o XYZ Co.

Example – Manufactured Module



Establish Design Specifications

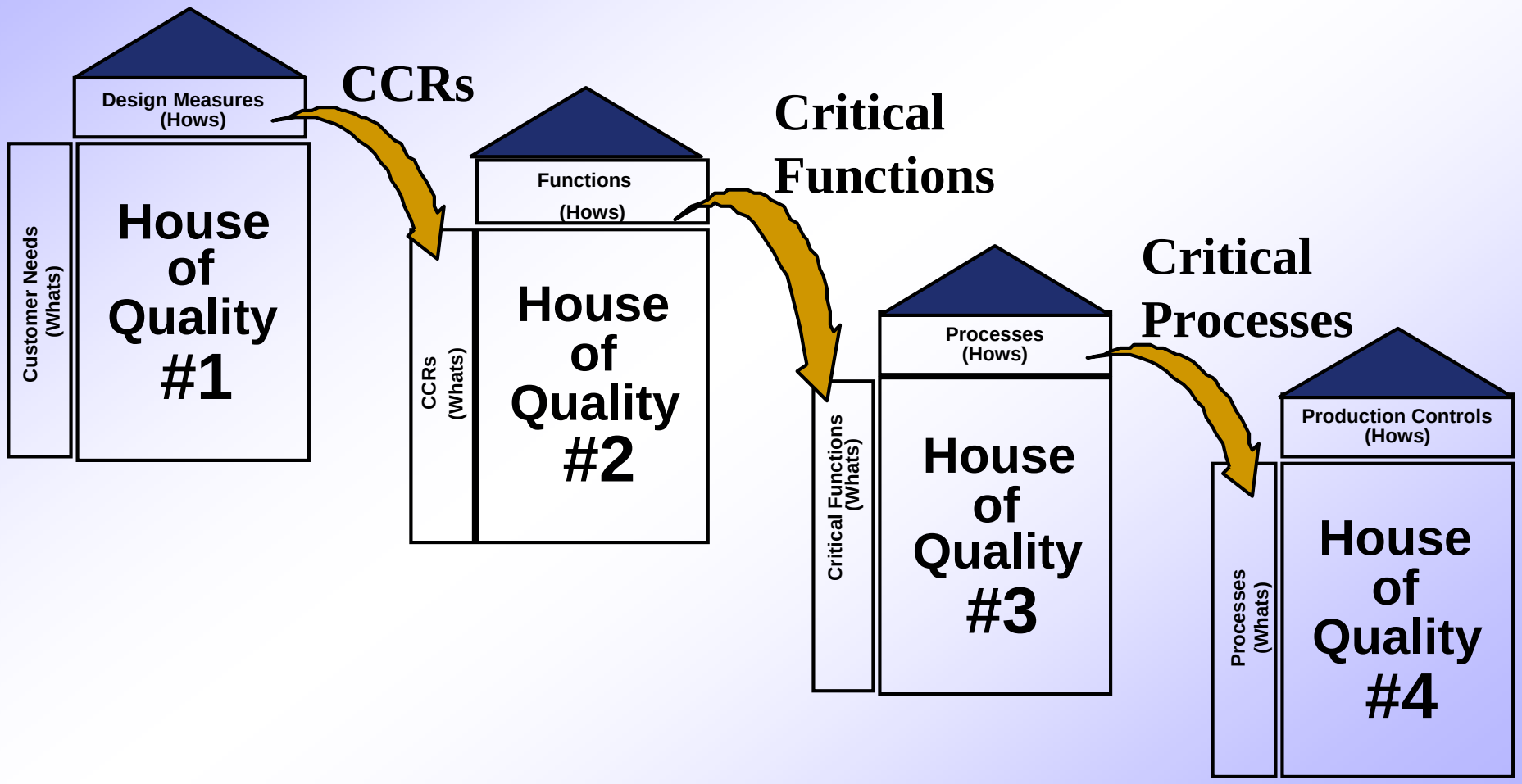
- **Establish Targets, Upper Specification Limit (USL), and Lower Specification Limit (LSL) for each Measure in the HOQ**



- **Set Target Values to:**
  - **Ensure Customer Satisfaction**
  - **Gain Competitive advantage**

Be sure to document Design Specs in bottom row of HOQ

Developing Further Houses



Source: The Roadmap to Repeatable Success, B. Bicknell

Solution Selection Matrix

Engineering Criteria	Importance	Possible Solutions					
		S_1	S_2	S_3	S_4		
Criteria $_1$							
Criteria $_2$							
Criteria $_3$							
Criteria $_4$							
Totals							

Solution Selection Matrix

Engineering Criteria	Importance	Possible Solutions					
		S_1	S_2	S_3	S_4		
Criteria $_1$							
Criteria $_2$							
Criteria							
Criteria							
Totals							

List 8 - 10 possible solutions to your design challenge

- Features of finished design that cut across many full designs

or . . .

- Specific full designs

Solution Selection Matrix

Engineering Criteria	Importance	Possible Solutions					
		S_1	S_2	S_3	S_4		
Criteria $_1$							
Criteria $_2$							
Criteria $_3$							
Criteria $_4$							
Totals							

List 6 – 12 Engineering Criteria

- Criteria utilized to select solution
- Examples:
  - User friendly
  - Maturity of technology
  - Power requirements
  - Space
  - Weight
  - Speed of response
  - Hardware Platform – microprocessor, PC
  - Software – C, Assembly Language

Solution Selection Matrix

Engineering Criteria	Importance	Possible Solutions					
		S_1	S_2	S_3	S_4		
Criteria $_1$							
Criteria $_2$							
Criteria $_3$							
Criteria $_4$							
Totals							

Importance Rating of each Criteria

- 1 – 5 scale

Solution Selection Matrix

Engineering Criteria	Importance	Possible Solutions					
		S_1	S_2	S_3	S_4		
Criteria $_1$							
Criteria $_2$							

Specific Cell Rating . . .

Rate each cell on how well the Possible Solution meets the Design Criteria

Strong = 9 points, Moderate = 3 points, Weak = 1 point

Use symbols for ease of understanding

Solution Selection Matrix

Engineering Criteria	Importance	Possible Solutions					
		S_1	S_2	S_3	S_4		
Criteria $_1$							
Criteria $_2$							
Criteria $_3$							
Criteria $_4$							
Totals							

S_2 Total Calculation =

$(S_2)(ImpC_1) + (S_2)(ImpC_2) + \ldots (S_2)(ImpC_N)$

House of Quality & Selection Matrix Discussion Summary

- Defined the purpose of each "Room" in the House of Quality (HOQ)
  - Illustrated, via an example
- Provided algorithm to determine Critical Customer Requirements (CCRs)
- Illustrated establishment of System Level Engineering Design Specifications
- Defined Solution Selection Matrix
- Provided Examples

Questions?