QUALITY MANAGEMENT
(MSL 71500)
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HANDOUT IV

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What is it?

-A methodology to help achieve simultaneously a competitive advantage in quality, cost and delivery (QCD).

- Initiated by Shigeru Mizuno and Yogi Akao, of the Tokyo Institute of Technology in the 1960's.

- Applied first at the Mitsubishi Heavy Industries Limited in the Kobe Shipyard, Japan in 1972, it has been successfully used in product and service design by many organizations.

The original Japanese name was *hin shitsu ki no ten kai*, which may be translated as,

¨ *Hin shitsu* means quality or feature / attributes,

¨ *ki no* means function or mechanization,

¨ *ten kai* means deployment, diffusion, or development / evolution.

QFD has been defined as "a system for translating consumer requirements into appropriate company requirements at each stage from research and product development to engineering and manufacturing to marketing/sales and distribution"

(American Supplier Institute, 1989).

Elements of QFD:

-QFD consists of two components which are deployed into the design process: quality and function.

-The "quality deployment" component brings the customer's voice into the design process.

-It ensures design and production quality by identifying design targets, and product and part specifications, that arc consistent with customer requirements.

-A method to systematically and structurally convert customer's wishes in an early stage into critical aspects of your product, service and/or process.

-It may be defined as, “a system for designing a product or a service based on customer demands and involving all members of the organization.”

-It presents a structured approach to integrate the customer requirements with products and service design specifications, to finally identify the set of design characteristics to best satisfy the customer requirements.

-Primarily a planning tool to fulfill customer expectations and requirements; thus often referred to as the Voice of the Customer.

The traditional QFD Technique is based on the premise:
- A set of items, "the Whats" (Customer Requirements), is assigned to the rows.

-Similarly, a set of related items, "the Hows" (Design Characteristics), is assigned to the columns.

-The row items carry a numeric relative importance score.

-The relation between the row items and the column items are expressed in numeric values

- The relative importance for the column items is calculated.

- Priorities are set so as to enable one to focus on those quality components and design characteristics that are most important to meet customer requirements.

The structure of the QFD is similar to a framework of a house and thus also referred to as the House of Quality.

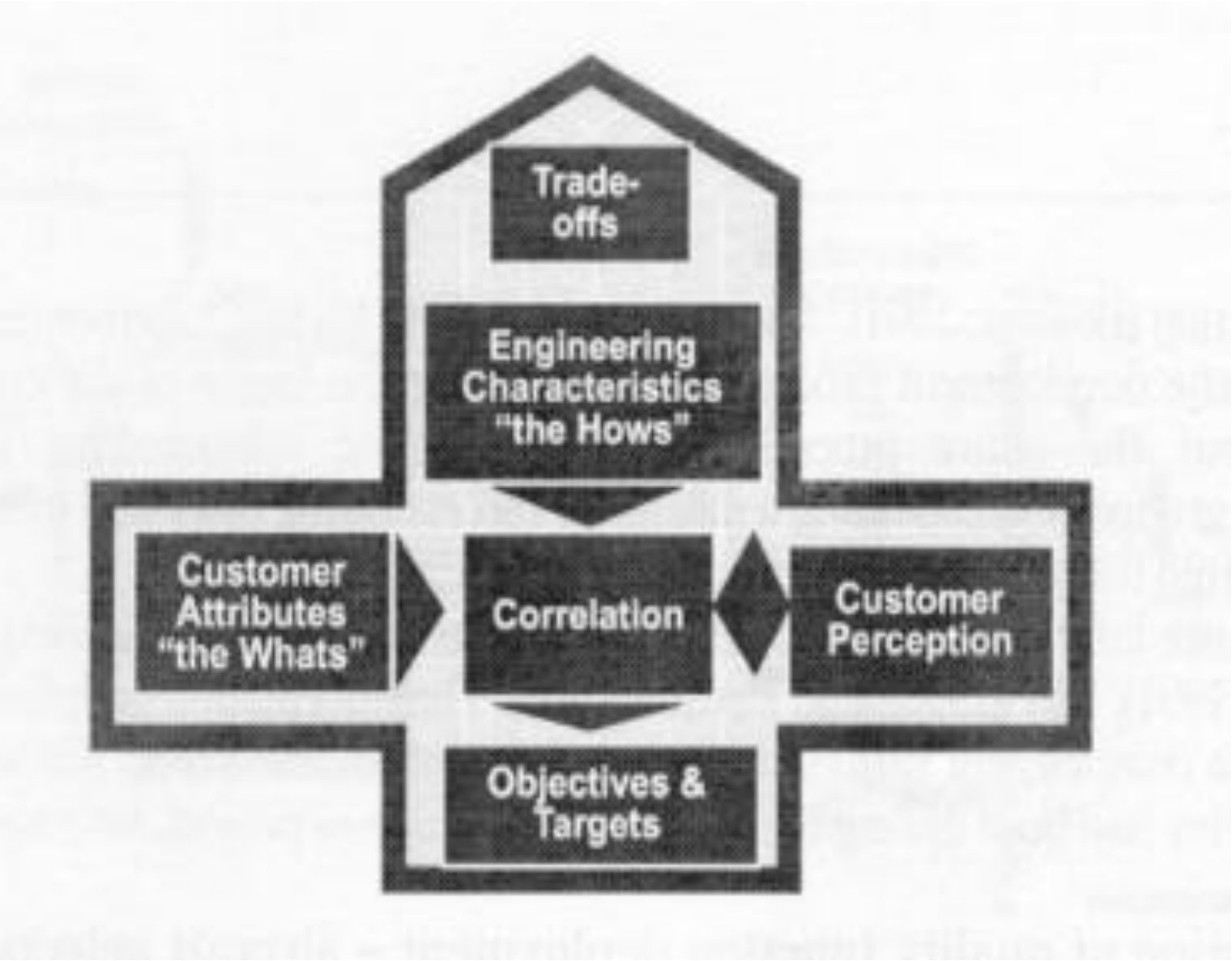
1 The exterior walls on the left of the house are the customer requirements / expectations.

2.The ceiling of the house contains the technical descriptors / design characteristics.

3.The interior walls of the house reflect the relationship between the customer requirements and the design characteristics.

4.The roof of the house portrays the interrelationship between the various technical descriptors / design characteristics.

5.The foundation of the house is the prioritized technical descriptors / design characteristics.


Trade-
offs
Engineering
Characteristics
"the Hows"
Customer
Attributes
"the Whats"
Correlation
Customer
Perception
Objectives &
Targets

The House of Quality always contains four basic parts to it : “the hows”, “the whats”, “the relationships” , and “how much”.

-Starts with identifying and ranking the relative importance of the customer requirements;
- Then goes on to identify the design characteristics / parameters that contribute to the meeting of the customer requirements;
-Then estimates the relationship between the customer requirements and the design characteristics; the relationship among the design characteristics; to finally identify the set of design characteristics to best satisfy the customer requirements

So, the QFD presents a structured approach to integrate the customer requirements with products and service design specifications.

-The relative importance scores for the customer requirement is measured on a scale of 1-5 (moving from least important to the most important).

-The results are presented in the right-hand side of the QFD matrix. Next, the interrelationship between row attributes and column attributes is evaluated.

-A correlation scale of strong (5), medium (3) and weak (1), is used to describe the relationship between each design characteristic element as it intersects with each customer requirement.

-The scores for each column are obtained by multiplying the relative score with the interrelationship score.

-This is done for all the ‘what’ items, vis-a-vis the ‘how’ items, in a column and the scores are added to obtain the scores for that particular each column.

-Thus, the absolute values are determined, by multiplying the importance value for each customer requirement by the correlation value assigned.

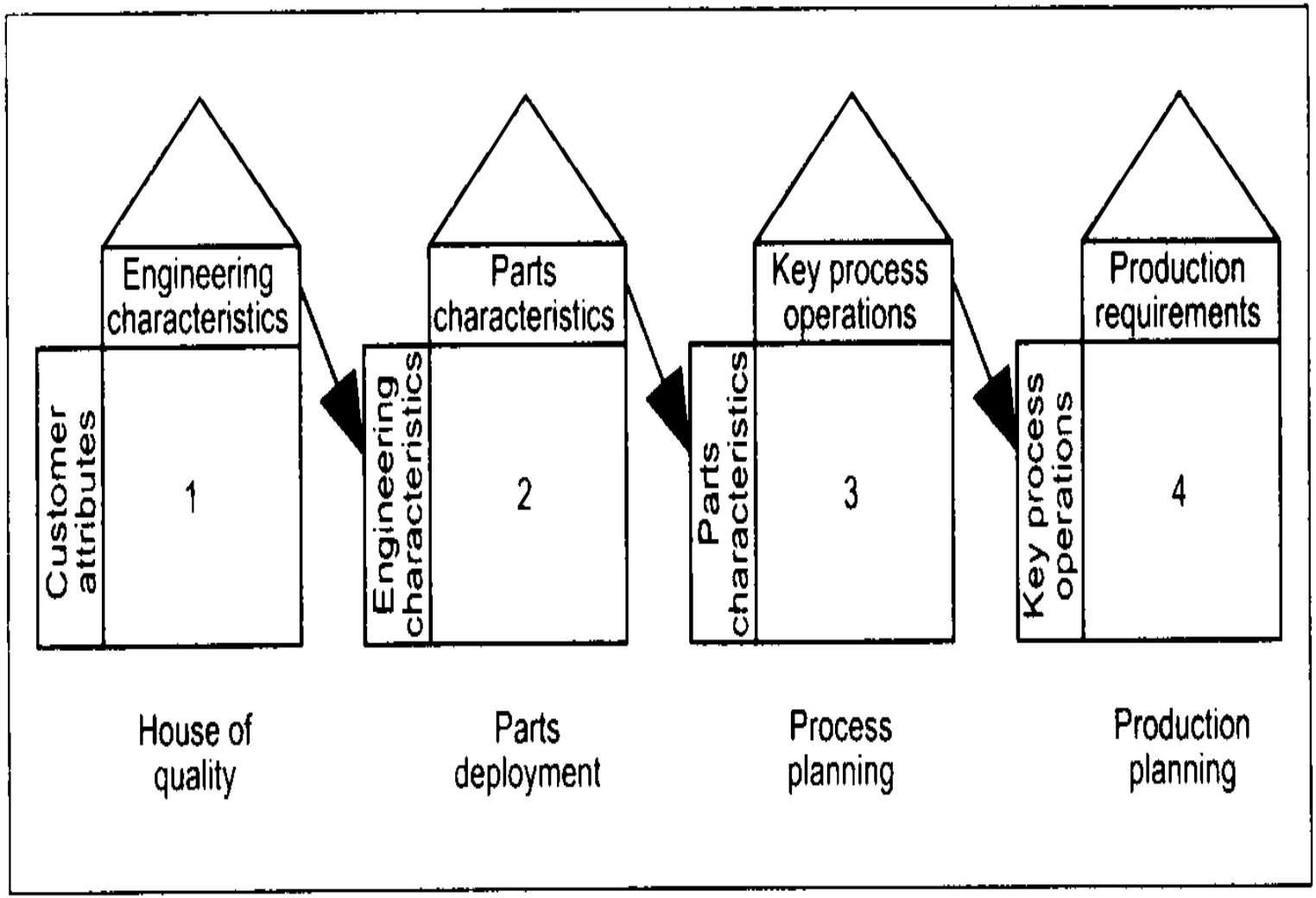
-The absolute values are converted to the relative rankings.

-This enables one to focus on those quality components and design characteristics that are most important to meet customer requirements.

-The critical product specifications (technical parameters) are translated in detail, by means of three further sequel houses, into the manner in which the process is to be controllably executed, to achieve stable and acceptable product quality.

-In the first house, the link is made between customer wishes and product specifications.

-In the second house, the relationship between these product specifications and the characteristics of the product parts is central.


Engineering characteristics
Customer attributes
1
House of quality
Parts characteristics
Engineering characteristics
2
Parts deployment
Key process operations
Parts characteristics
3
Process planning
Production requirements
Key process operations
4
Production planning

-In the third house, the link is laid between product parts and process characteristics.

-As a result, the performance indicators of critical processes are established.

-Finally, the process characteristics are translated in the fourth house into the controlled way manufacturing process operations are to be executed.

When do you use it?

-QFD is used to better understand the customer and to develop products, services and processes in a more customer-oriented way. The objective of QFD is to allow the "voice of the customer" to be heard more clearly in the product development process and related operational processes, but also to comply with the "do it right the first time" principle.

How do you use it?

-Put together a multidisciplinary expert team, which is coached by a team leader and supported by a QFD-facilitator. The team leader should preferably be a product manager or product engineer. In this preparatory phase, also formulate the objectives and the scope of the QFD-project.

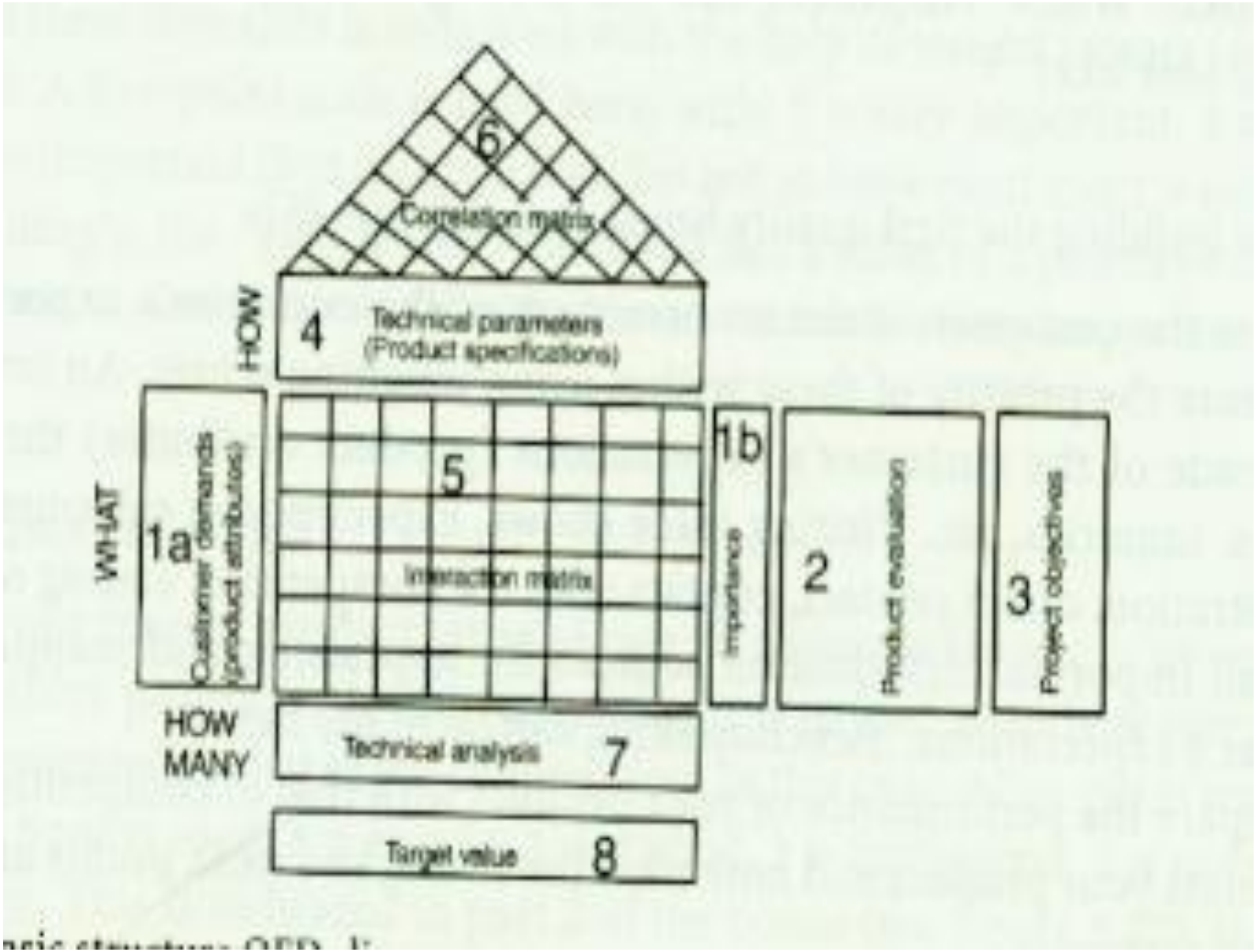
Steps for building the first quality house:

1. Define the customer, make an inventory of the customer's expectations and measure the priority of these wishes using weighing scores.

2. Compare the performance of your product with that of competitive products. Evaluate your product and note what the strong and weak points are according to the customer.

-Identify and quantify the improvement objectives. Note which expectations of the customer need to be improved in relationship to the competitive product and indicate this in a score.

-Translate the customer's expectations into quantifiable technical parameters or product specifications.


6
Correlation matrix
HOW
4
Technical parameters
(Product specifications)
WHAT
1a
Customer demands
(product attributes)
5
Interaction matrix
1b
Importance
2
Product evaluation
3
Project objectives
HOW
MANY
Technical analysis
7
Target value
8

-Investigate the relationships between the customer's expectations and the technical parameters. Note in a matrix up to what level the customer's expectations are influenced by the technical parameters and indicate this relationship through a score.

-Identify the interactions between the technical parameters.

-Make the relationships between these parameters explicit in the roof of the quality house.

Record the measure unit of all technical parameters. Express these parameters in measurable data.

Determine the target values of the new product design; note the proposed improvements of the technical parameters.

Example

This example entails the design improvement of an attache case. Figure on the next page shows the filled in quality house for the improved design of the attache case based on the customer's expectations.

Step 1: Establishing the customer's expectations:

-The customer's expectations are established by means of brainstorming and are classified in the part named 1a of the quality house.

-This step deals with what is important to the customer. These demands aren't all of equal importance.

-The importance of these demands is indicated with the help of weight factors (part I b).

-A five-point scale is used here, with: 5 = very important, 4 = important, 3 = less important (but nice to have), 2 = not so important and 1 == not important.

Step 2: Product evaluation:

-In this step, our current product (attache case) is compared to one or more important competitive products.

-An insight is gained as to how our product performs compared to that of the competitor.

-In this case, a five-point scale from excellent to poor is used: 5 = excellent, 4 = good, 3 = fairly good, 2 = not so good and 1 = poor.

-This is indicated in part 2 of the house.

Step 3: Project objectives:

-In this step, the customer's expectations we want to improve in relation to the competitor are indicated.

-In other words, the target value for each product attribute is indicated through a score (in part 3 of the house).

-Once again, a five-point scale is used.

-For the attributes that need no improvement, the target value is put on a par with the current score of the product evaluation.

-For others where we need improvement, an improvement rate is established.

The improvement rate = target value / evaluation score

-Next, the weight (importance) of each customer's expectation or product attribute is established as a project objective.

The weight =
improvement rate x the relevant importance-weight factor

-All weights were then added after which the total in the last column was used to calculate the weight in % of each attribute.

Step 4: Technical parameters/product specifications:

- After the activities to visualize the importance of the customer's expectations were finished, it was decided on HOW to handle these expectations.

-Through brain-storming, it was decided which technical parameters or characteristics are influenced by the different customer expectations.

-The product design is determined by these parameters.

Step 5: Interaction matrix:

-The level in which the technical parameters influence the customer's expectations is studied.

-This is done in the interaction matrix (see part 5 in figure).

-In this matrix, the relationships between the customer's expectations or product attributes and technical parameters is studied.

-This involves a coupling between WHAT and HOW.

-For each cell of the matrix, it is determined whether there is a relationship between the attributes and parameters, and if so, how strong this relationship is.

-An empty row in the matrix means that there is no relationship between the technical product characteristics and the related customer's expectation (the product does not satisfy this need).

The following applies:
-a red dot relates to a strong relationship (9),
-a green triangle is a medium relationship (3),
-a black dot is a weak relationship (1), and,
-an empty cell means that there is no interaction between

customer's expectations and product specifications.

-Next, the project importance is indicated for each cell in a score.
Cell score = relationship's strength x the weight (%)

-The sum of the cell scores per column indicates the priority of the technical parameters for the project.

-Next, the priority per technical parameter is indicated, i.e. which product specifications deserve special attention in

order to meet the demands of the customers?

Step 7: Technical analysis:

-In this part of the House of Quality (part 7 in figure) the measure unit of all technical parameters is indicated (HOW MANY).

-Next, our product and the competitive product are

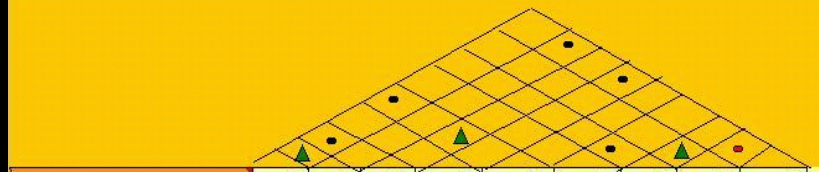
technically evaluated on these parameters.

Step 8: Target value:

-Target values are determined based on the technical data and the priorities of the parameters.

-Target values regard the improvements of technical parameters, which the management pursues.

-Design teams execute these improvements.



Technical parameters / Product attributes	Volume	Safety Lock	Empty weight	Opening steps	Segments	Material	Angle of opening	Closing force	Wear of lock	Importance	1	2	3	4	5	Target value	Improved rate	Weight	Weight %
Easy to carry	54		6			6				2						4	1	2	6
Easy to open		60		180	20				60	4						5	1.7	6.8	20
Easy to find contents	30				270		90			4						5	2.5	10	30
Adjustable capacity	27		9		9		9			1						4	1	1	3
Easy to close		36						108	36	3						4	1.3	3.9	12
Durable			15	135		135		45	135	5						4	1	5	15
Stable when standing	27		27			9				3						4	1	3	9
Privately accessible		54		18	6					2						3	1	2	6
Absolute weight	138	150	57	333	305	150	99	153	231	1616								33.7	100
Related weight	9	9	4	21	19	9	6	9	14	100									
Measurement unit	cm3	Type	Kg	#	#	Type	Degree	N	#										
Our product	394	x	2.4	6	5	k	80	0,45	5000										
Competitive product	416	y	2.2	4	6	l	85	0,32	3500										
Target value	394	z	2.4	2	8	k	80	0,45	5500										

KEY

Relationship scores

9- Strong 3-Medium 1-Weak

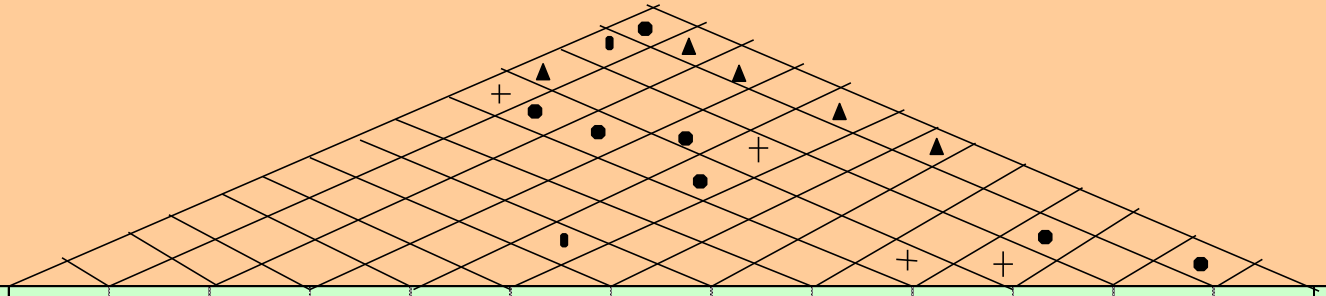
Correlations

Strong Medium Weak

Our product

Competitor

QFD : HOUSE OF QUALTY: PATHALOGICAL CLINIC



Technical Features →		Qualified Doctors		Water		Electricity		Chemist		Ambulance		Other Staff		Parking		Lounge		Beds		O.T		Timings		No. of doctors		Location		Priority	1	2	3	4	5	TV	IR	WT	WT(%)
Customer Preferences	Fees	+	45	▲	9	▲	9					●	27			▲	9	▲	9	●	27	●	27	+	81	●	27	4			★ □			3	1	4	9
	Basic Facilities			+	126	+	126							●	42			+	126			●	42	●	42	▲	14	5				★	□	5	1	6	14
	Advanced Facilities							●	27	+	81							●	27	+	81	●	27	▲	9	▲	9	3			★	□		4	1	4	9
	Ambience/ Comfort			●	27	●	27							▲	9	+	81	●	27									3				★ □		5	1	4	9
	Courtsey	+	135					●	45			+	135											▲	15			4			★	□		5	2	7	15
	Accessability																									+	99	3		□	★			3	2	5	11
	Emergency	+	54	+	54	+	54	●	27	+	54	●	27	▲	9	▲	9	+	54	+	54	+	54	●	27	●	27	2			★ □			4	1	3	6
	Reputation	+	81					●	27	●	27	+	81	▲	9	▲	9	▲	9	+	81	●	27					3			★ □			4	1	4	9
	Layout of the hospital	●	15	●	15			●	15					●	15					●	15					●	15	2				★	□	5	1	3	5
	Timeliness	●	36							●	36	▲	12									+	108	+	108	▲	12	4			★ □			4	1	5	12
	SUM SCORES	366		231		216		141		198		282		84		108		252		258		285		282		203		2906								42.5	100
	PRIORITY (%)	13		8		7		5		7		10		3		4		9		9		10		10		7		100									

+: 9: strong relationship, ● : 3: medium relationship, ▲ : 1: weak relationship

QFD benefits:

QFD enhances both the design process, and the underlying organization.

(A) Design benefits

(B) Organizational benefits

(A) Design benefits:

- Fewer and early design changes:
- Less time in development;
- Fewer start-up problems;
- Lower start-up cost;
- Fewer field problems;
- More satisfied customers;
- Identifies comparative strengths and weaknesses of products with respect to competition.

(B) Organizational benefits:

- Encourages teamwork and participation.

- Encourages documentation of marketing, design, engineering, and manufacturing product knowledge in a consistent and objective manner.

-We propose four stages.

-We call these phases:

a) functional strategies,

b) manufacturing priorities,

c) action plans and,

d) detail tasks.

a) In the first stage all functional level strategies are realized and they become the *whats* for the next stage.

b) In the second stage, all parallel functional level strategies are their potential customers.

c) In the third stage, broad manufacturing priorities are translated into detailed action plans for implementation.

d) The last stage is identifying specific tasks to realize the plans.

Methodology for manufacturing strategic planning as follows:

Step I: ***Define the business environment.***

-Identify the market segments, order winning criteria, competitors' status and then determine corporate and business strategy.

-This is probably the most important step in the QFD process, because good results will not occur with incorrect input.

Step II: F*unctional strategies formulation stage.*

-At this stage business strategy will be translated into all functional strategies including manufacturing, marketing, R&D, HR & Finance.

-Interactions among all functional strategies to avoid potential conflicts between functional strategies or due to financial constraints.

-A QFD matrix will be used in this stage to identify the most appropriate functional strategies, and these strategies will be *whats* at the next stage.

Step III: *Manufacturing priorities formulation stage.*

-After all functional levels have formulated their own strategies, these strategies are placed in rows of the matrix.

-Manufacturing initiatives (or attributes) are listed in columns to identify those that best fulfill the established strategies of all functional levels.

Step IV: *Action plans formulation stage:*

- The manufacturing attributes identified in the previous stage are decomposed into more detailed programmes for implementation.

-It is also necessary for all other functional levels to develop their own plans for implementation through the same process.

-Again, the full structure of the QFD matrix should be used: consider the interactions among the activities, rate the importance of each, and finally identify the most significant projects to achieve the goals.

Step V: *Detailed tasks formulation stage.*

-The action plans should be further decomposed to specific tasks.

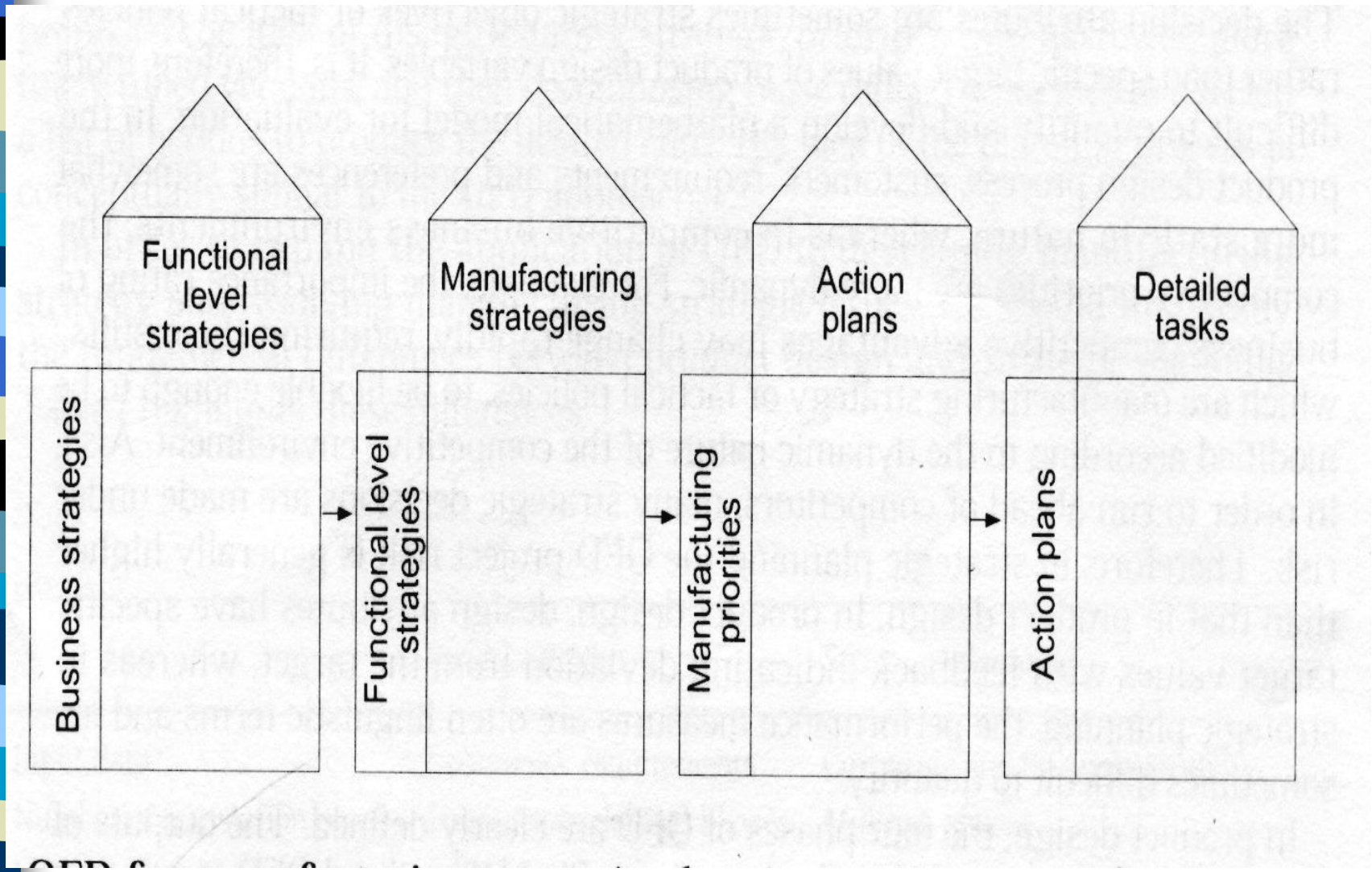
-A QFD matrix is used to identify the essential tasks for the action plans;

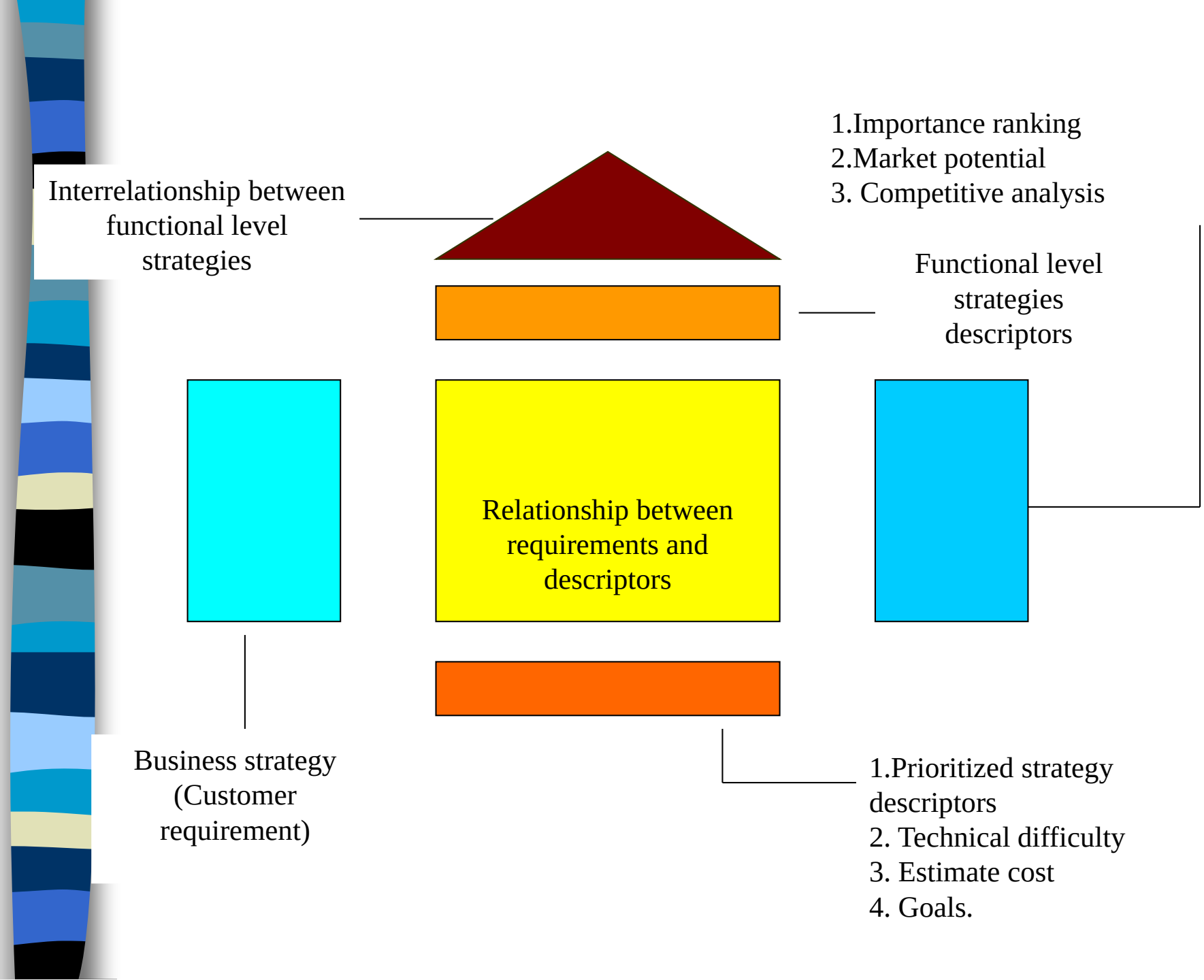
-At this stage, manufacturing engineers and the operators and workers should be involved in the QFD sessions.

Step VI: *Feedback and revision stage:*

- It is critical to obtain feedback from the lowest levels of the organization in order to track progress and evaluate performance.

-Also, depending on the business environment, some modifications may have to be made as time progresses to keep going in the right direction.


Business strategies
Functional level strategies
Functional level strategies
Manufacturing strategies
Manufacturing priorities
Action plans
Action plans
Detailed tasks


Interrelationship between functional level strategies
1.Importance ranking
2.Market potential
3. Competitive analysis
Functional level strategies descriptors
Relationship between requirements and descriptors
Business strategy (Customer requirement)
1.Prioritized strategy descriptors
2. Technical difficulty
3. Estimate cost
4. Goals.