Product Design and CAD/CAM in the Production System

L-31

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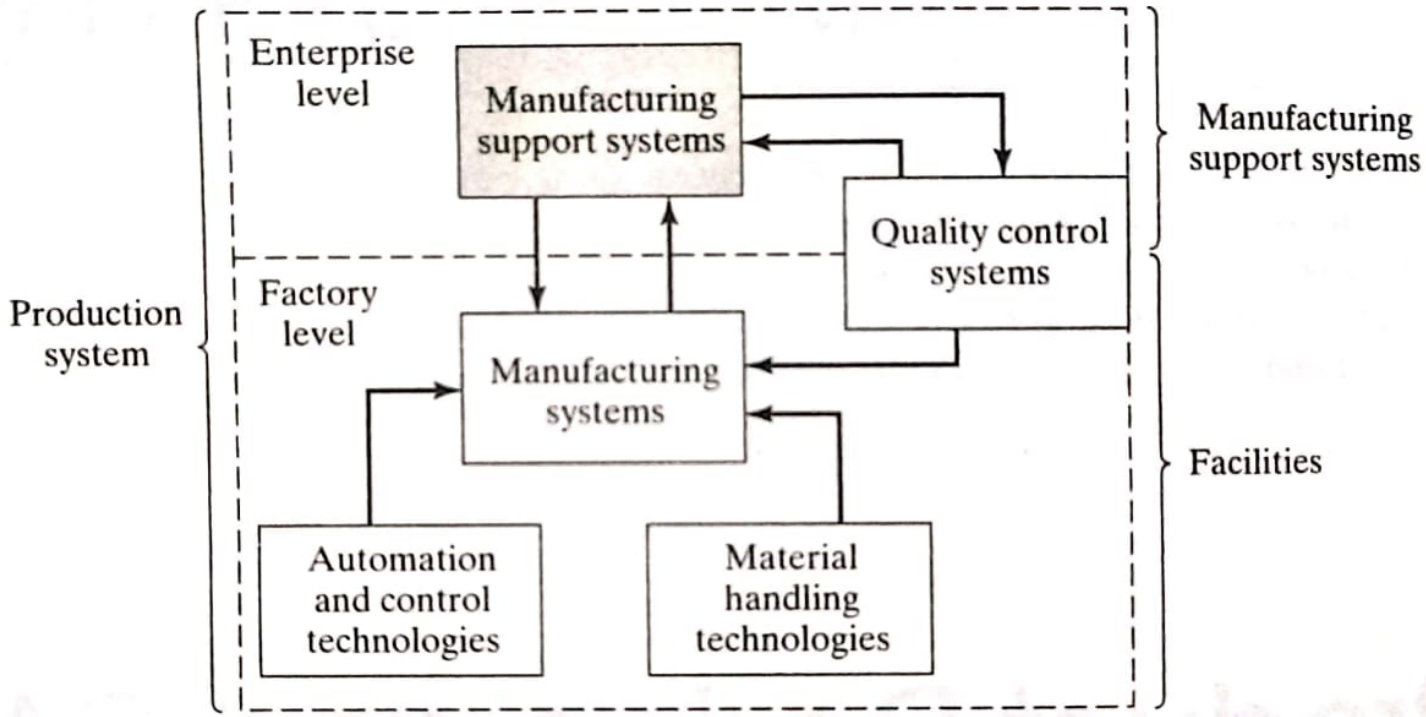

Figure 24.1 The position of the manufacturing support systems in the larger production system.

1) Product Design and CAD

- Product design is a critical function in the production system. The quality of product design is probably the single most important factor in determining the commercial success and societal value of product.

a) Design Process:

The general process of design is characterized by shigley as an iterative process consisting of six phases:

(1) recognition of need
(2) Problem Definition
(3) Synthesis
(4) Analysis and optimization
(5) Evaluation
(6) Presentation

b) Application of Computers in Design

- CAD is defined as any design activity that involves the effective use of the computer to create, modify, analyze or document an engineering design.

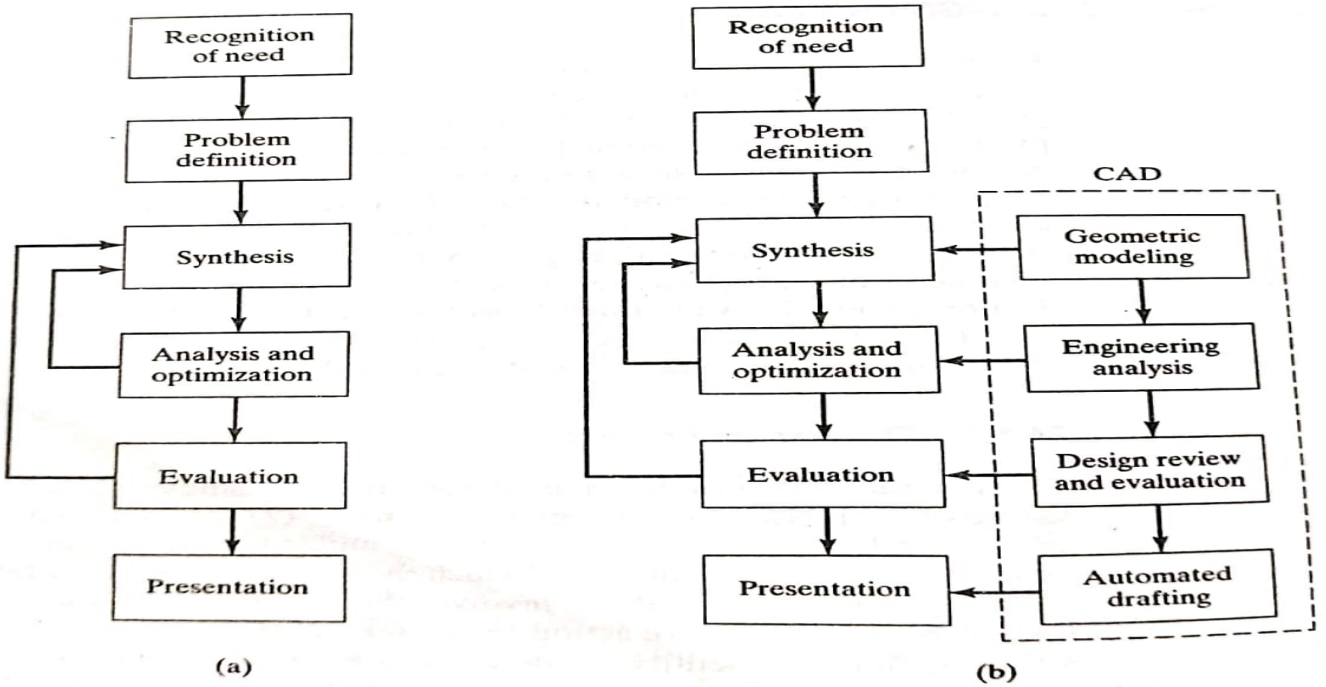

Figure 24.2 (a) Design process as defined by Shigley [15]. (b) The design process using computer-aided design (CAD).

Contd.

 There are several good reasons for using a CAD system to support the engineering design function.

(i) To increase the productivity of the designer

(ii) To improve the quality of the design

(iii) To improve design documentation

(iv) To create a manufacturing data base

TABLE 24.1 Computer-Aided Design Applied to Four of the Shigley Design Phases

Design Phase	*CAD Function*
1. Synthesis	Geometric modeling
2. Analysis and optimization	Engineering analysis
3. Evaluation	Design review and evaluation
4. Presentation	Automated drafting

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- Geometric Modeling

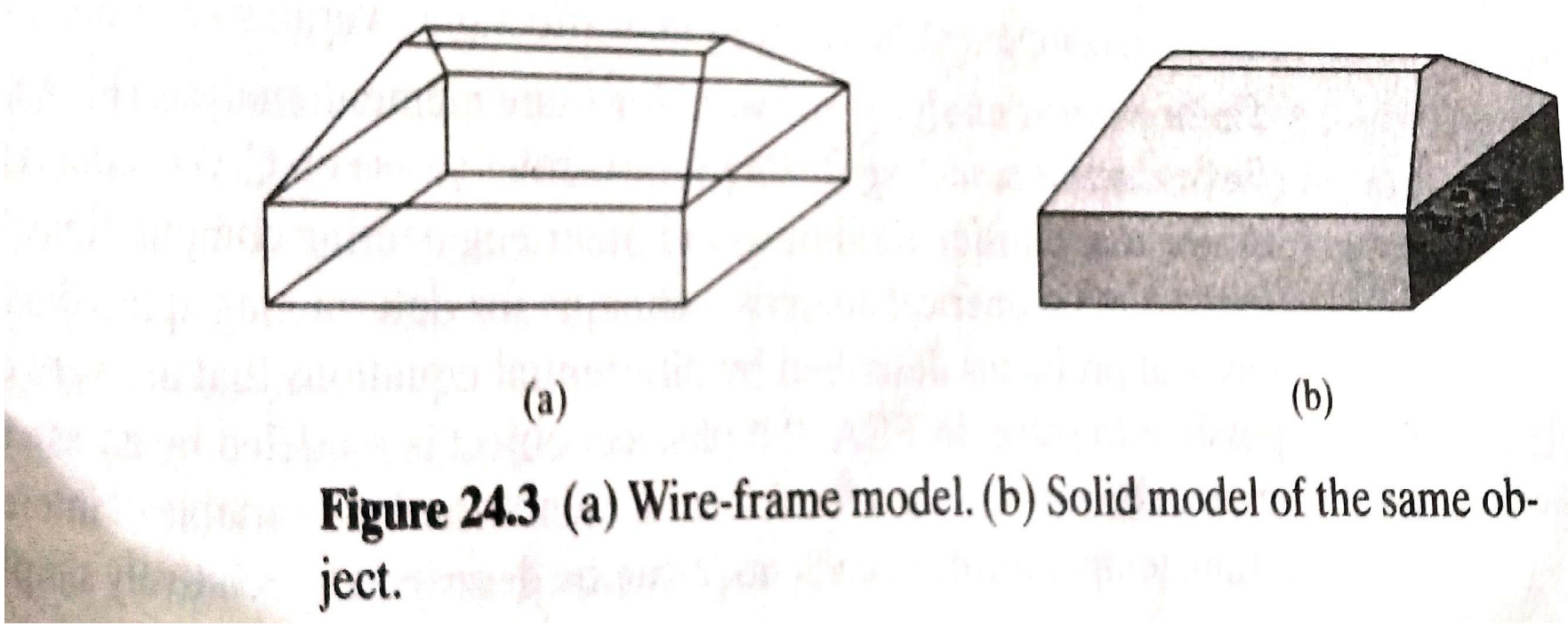

Figure 24.3 (a) Wire-frame model. (b) Solid model of the same object.

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 Engineering Analysis:

The term computer-aided engineering (CAE) is often used for engineering analyses performed by computer. Examples of engineering analysis software in common use on CAD system include:

a) Mass properties analysis
b) Interference checking
c) Tolerance analysis
d) Finite element analysis
e) Kinematic and dynamic analysis
f) Discrete- event simulation

Contd.

 Design Evaluation and Review:

(i) Automatic dimensioning

(ii) Error checking

(iii) Animation of discrete-event simulation solutions

(iv) Plant layout design scores

We rely on the use of geometric model of the product residing in the CAD data file. The two of these approaches used here

(i) Rapid Prototyping

(ii) Virtual prototyping

 Automated Drafting

2) CAD system hardware

The hardware for a typical CAD system consists of the following components

(i)Design Workstations:

It functions are the following

a) Communicate with the CPU
b) Continously generate a graphic image
c) Provide digital descriptions of the image
d) Translate user commands into operating functions
e) Facilitate interaction between user and the system

Contd.

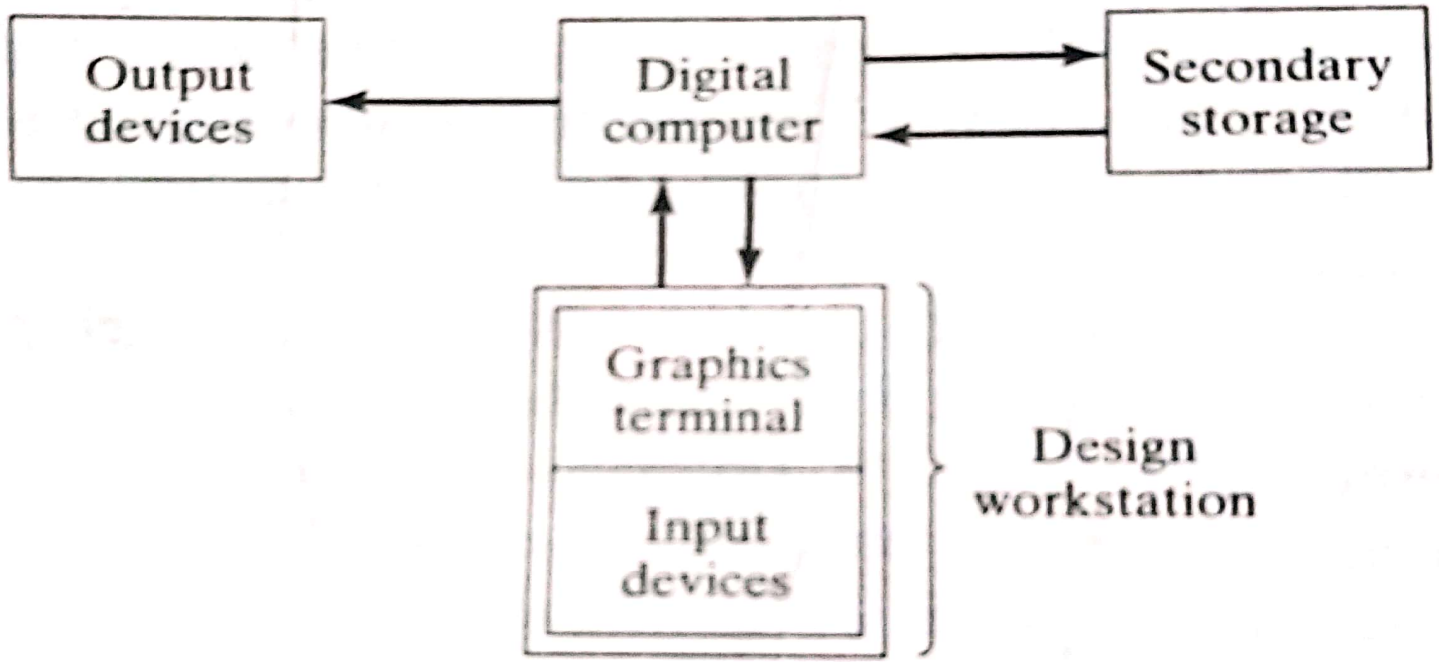

Figure 24.5 Configuration of a typical CAD system.

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(ii) Digital computer:

The three principal configurations

(a) Host and terminal

(b) Engineering workstation

(c) CAD system based on personal computer

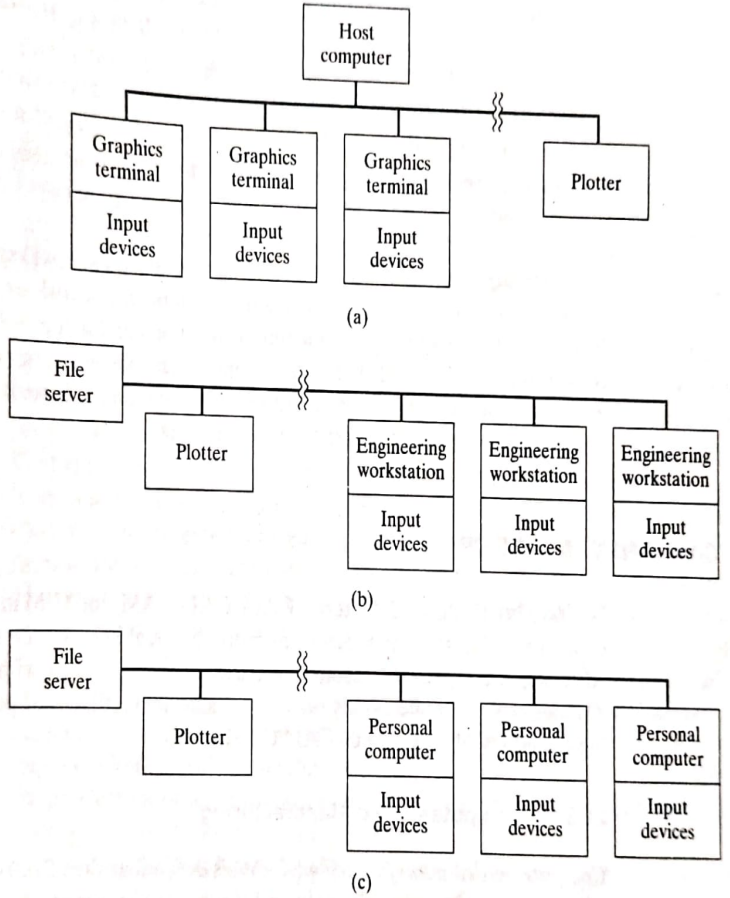

Figure 24.6 Three CAD system configurations: (a) host and terminal, (b) engineering workstation, and (c) CAD system based on a PC.

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(iii) Plotters and Printers

Following are the devices used

a) Pen plotters
b) Electrostatic plotters
c) Dot-matrix printers
d) Ink jet printers

(iv) Storage Devices

3) CAM, CAD/CAM and CIM

The term computer integrated manufacturing (CIM) is sometimes used interchangeably with CAM and CAD/CAM.

(a) Computer Aided manufacturing: It is defined as the effective use of computer technology in manufacturing planning and control. It is divided into two broad categories

(i) manufacturing planning :

The following list surveys the important applications of CAM in this category

- Computer-aided process planning (CAPP)
- Computer-assisted NC part programming
- Computerized machinability data system
- Development of work standards
- Cost estimating
- Production and inventory planning
- Computer-aided line balancing

Contd.

(ii) manufacturing control

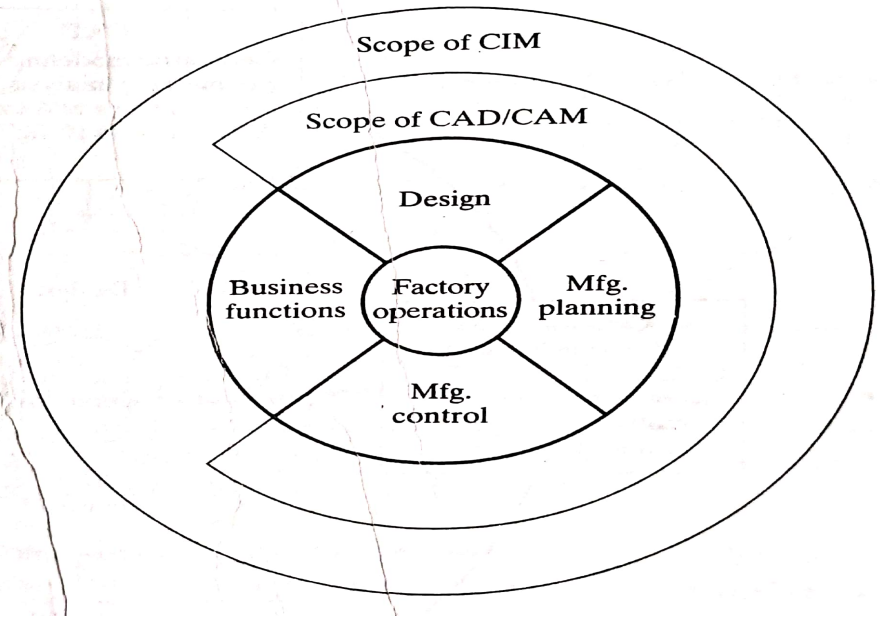
These management and control areas include:

a) Process monitoring and control
b) Quality control
c) Shop floor control
d) Inventory control
e) Just-in-time production control

b) CAD/CAM

The CAD/CAM is concerned with the engineering functions in both design and manufacturing.Product design, engineering analysis and documentation of the design represent engineering activities in design.

C) Computer Integrated Manufacturing



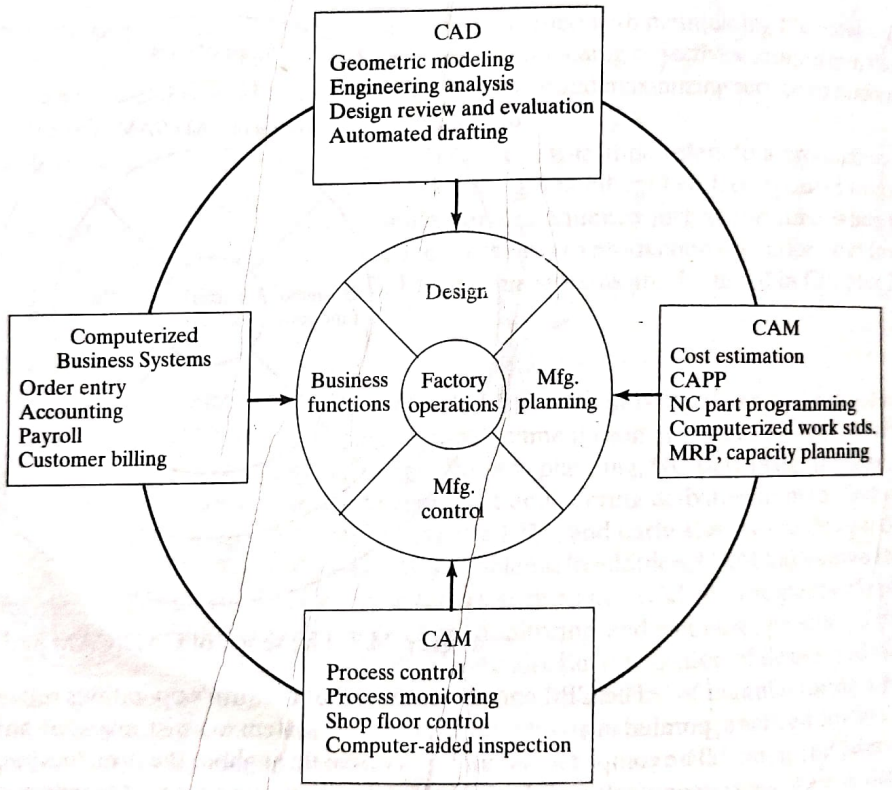


Figure 24.8 Computerized elements of a CIM system.

4) Quality Function Deployment

Quality function deployment is a systematic procedure for defining customer desires and requirements and interpreting them in terms of product features and process characteristics

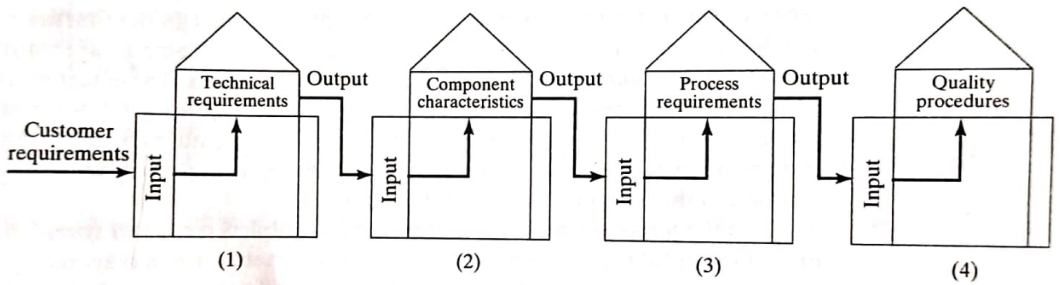


Figure 24.9 Quality function deployment, shown here as a series of matrices that relate customer requirements to successive technical requirements. Shown here is a typical progression: (1) customer requirements to technical requirements of the product, (2) technical requirements of the product to component characteristics, (3) component characteristics to process requirements, and (4) process requirements to quality procedures.

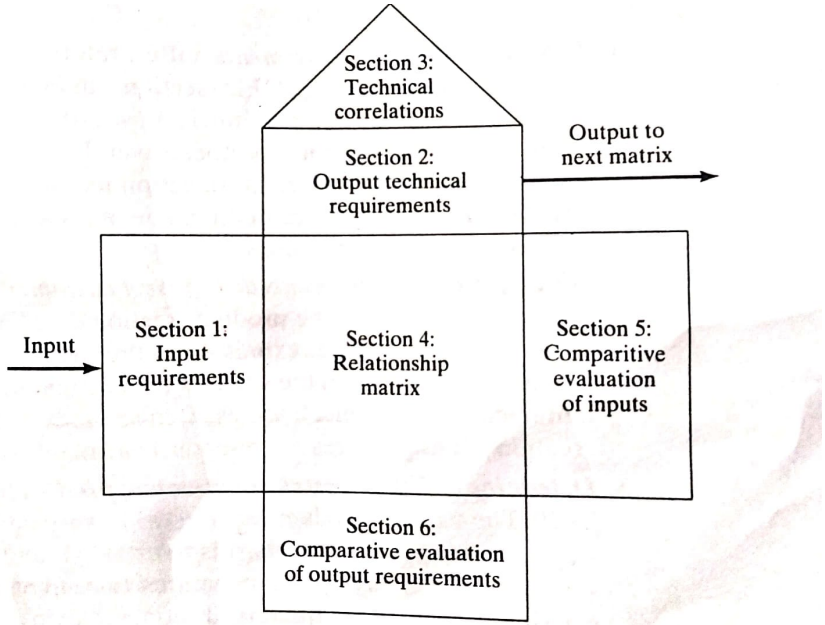


Figure 24.10 General form of each matrix in QFD, known as the ***house of quality*** in the starting matrix because of its shape.

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The procedure can be outlined in the following steps:

(i) Identify customer requirements

(ii) Identify product features needed to meet customer requirements

(iii) Determine technical correlations among product features

(iv) Develop relationship matrix between customer requirements and product features

(v) Comparative evaluation of input customer requirements.

(vi) Comparative evaluation of output technical requirements

Example: Quality Function Deployment: House of Quality

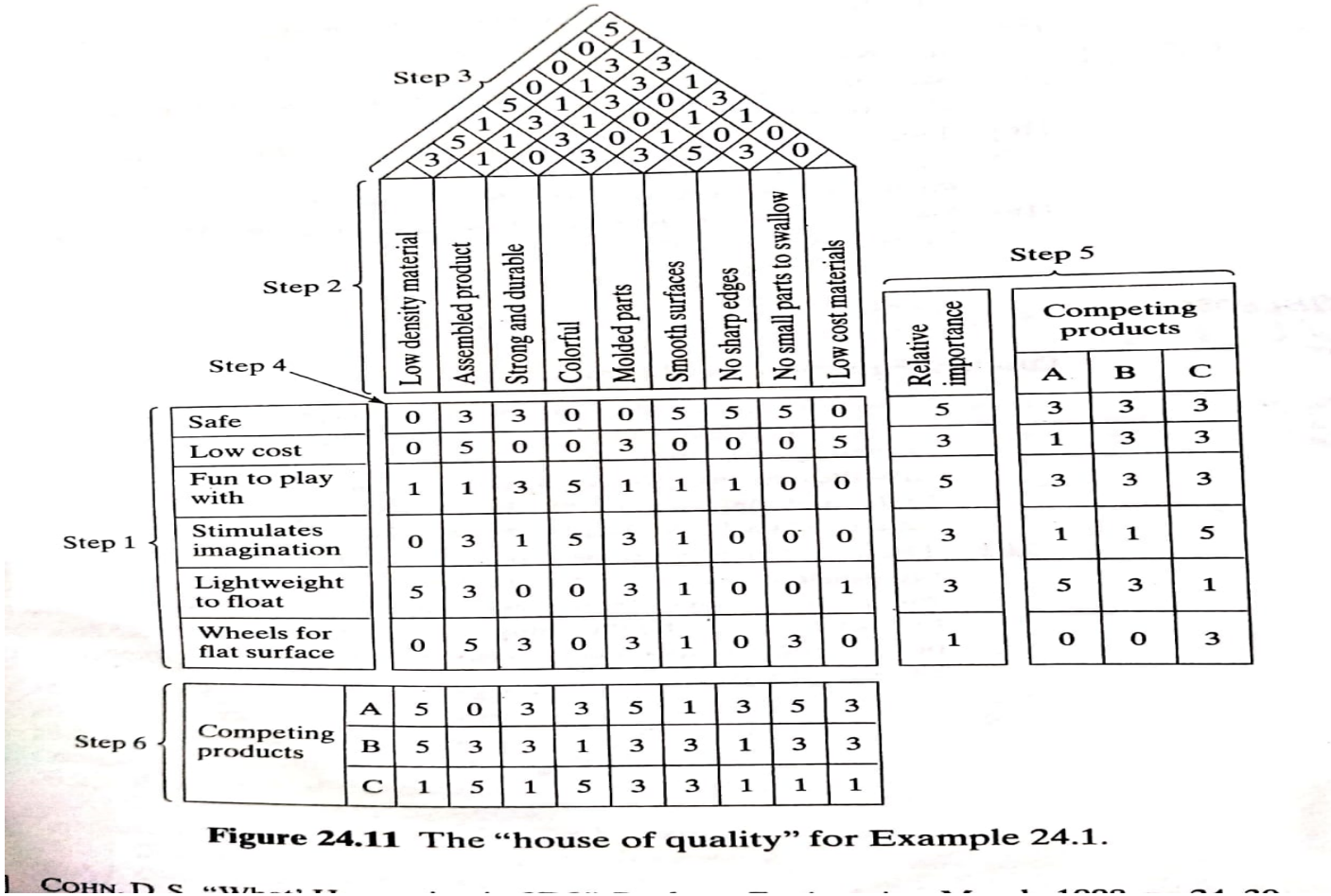

Figure 24.11 The "house of quality" for Example 24.1.

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d) Quality Function Deployment