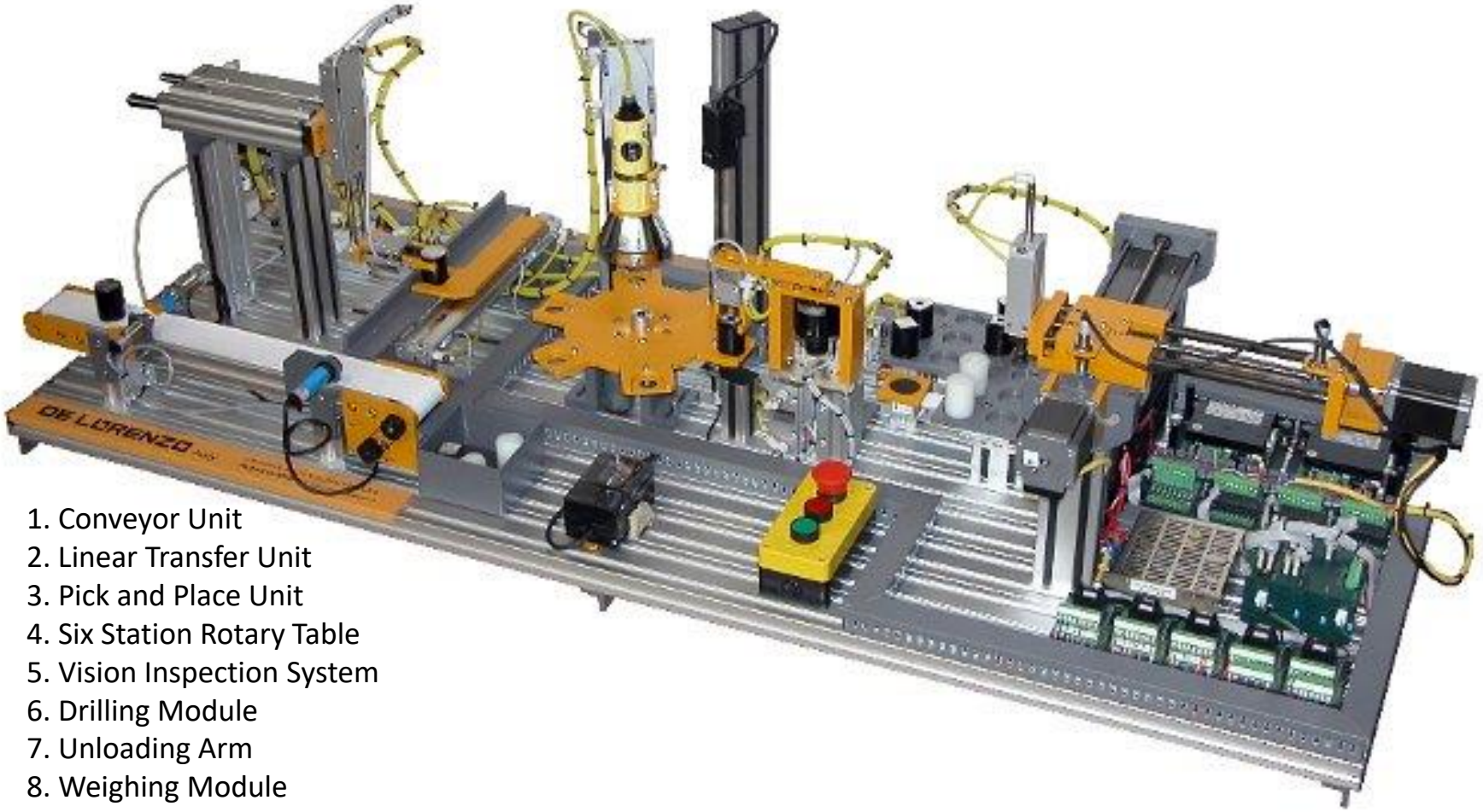
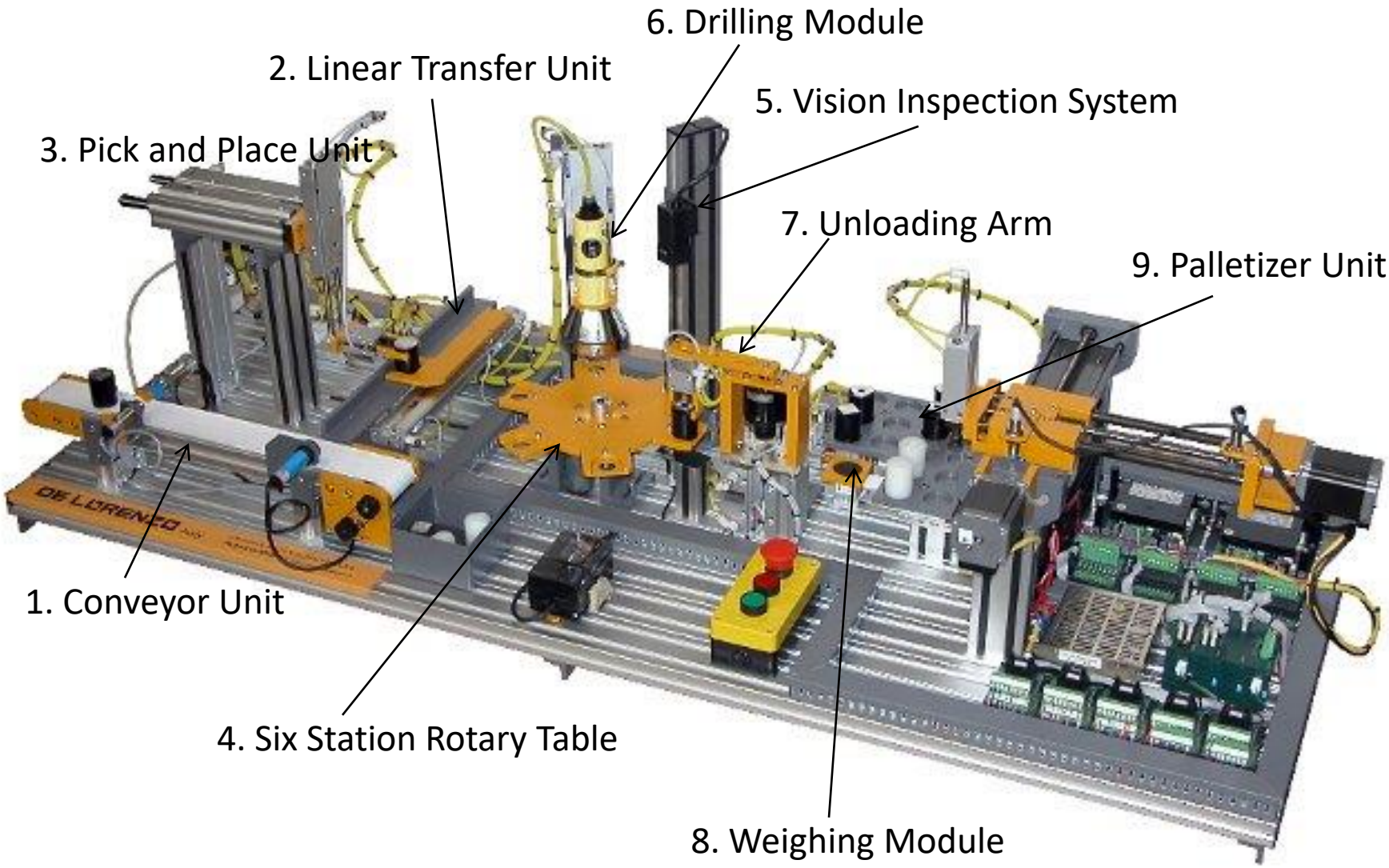
Introduction to CIM



1. Conveyor Unit
2. Linear Transfer Unit
3. Pick and Place Unit
4. Six Station Rotary Table
5. Vision Inspection System
6. Drilling Module
7. Unloading Arm
8. Weighing Module
9. Palletizer Unit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2. Linear Transfer Unit
5. Vision Inspection System
3. Pick and Place Unit
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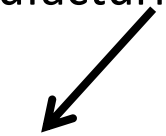
9. Palletizer Unit
1. Conveyor Unit
4. Six Station Rotary Table
8. Weighing Module

Outline

- Introduction to CIM
- Type of CIM
- Element of CIM
- Automation
- CAD/CAM
- Quality Function Deployment (QFD)

Overview

Application Area
(manufacturing companies)



C (Computer) I (Integrated) M (Manufacturing)

<u>Reasons</u>

They have more complex products, shorter product life cycle, shorter delivery time, more customized products and fewer skilled workers.

<u>Objective</u>

To avoid long design time, companies should develop tools and use new technologies, also improve their design and manufacturing process

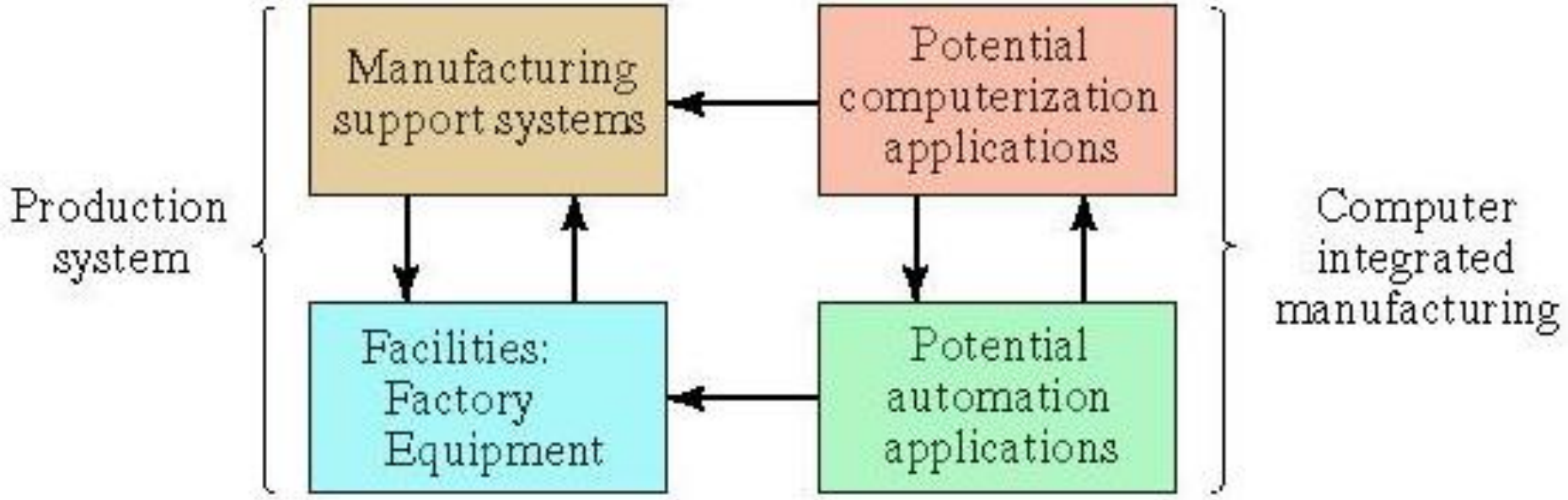
Definition1

- CIM is the application of **computer science technology** to the **enterprise of manufacturing** in order to provide the **right information** to the **right place** at the **right time**, which enable the achievement of its product, process and business goals (Ayres, 1991).

Definition2

- CIM is the integration of the total **manufacturing enterprise** through the use of integral systems and data **communications** coupled with new **managerial** philosophies that improve organizational and personnel efficiency (Singh, 1996).

CIM Structure



Types of Manufacturing System

1. **Continuous-flow processes**. Continuous dedicated production of large amount of bulk product. Continuous manufacturing is represented by **chemicals, plastics, petroleum, and food industries**.

Types of Manufacturing System

2. **Mass production of discrete products**. Dedicated production of large quantities of one product (with perhaps limited model variations). Examples include **automobiles, appliances and engine blocks**.

Types of Manufacturing System1

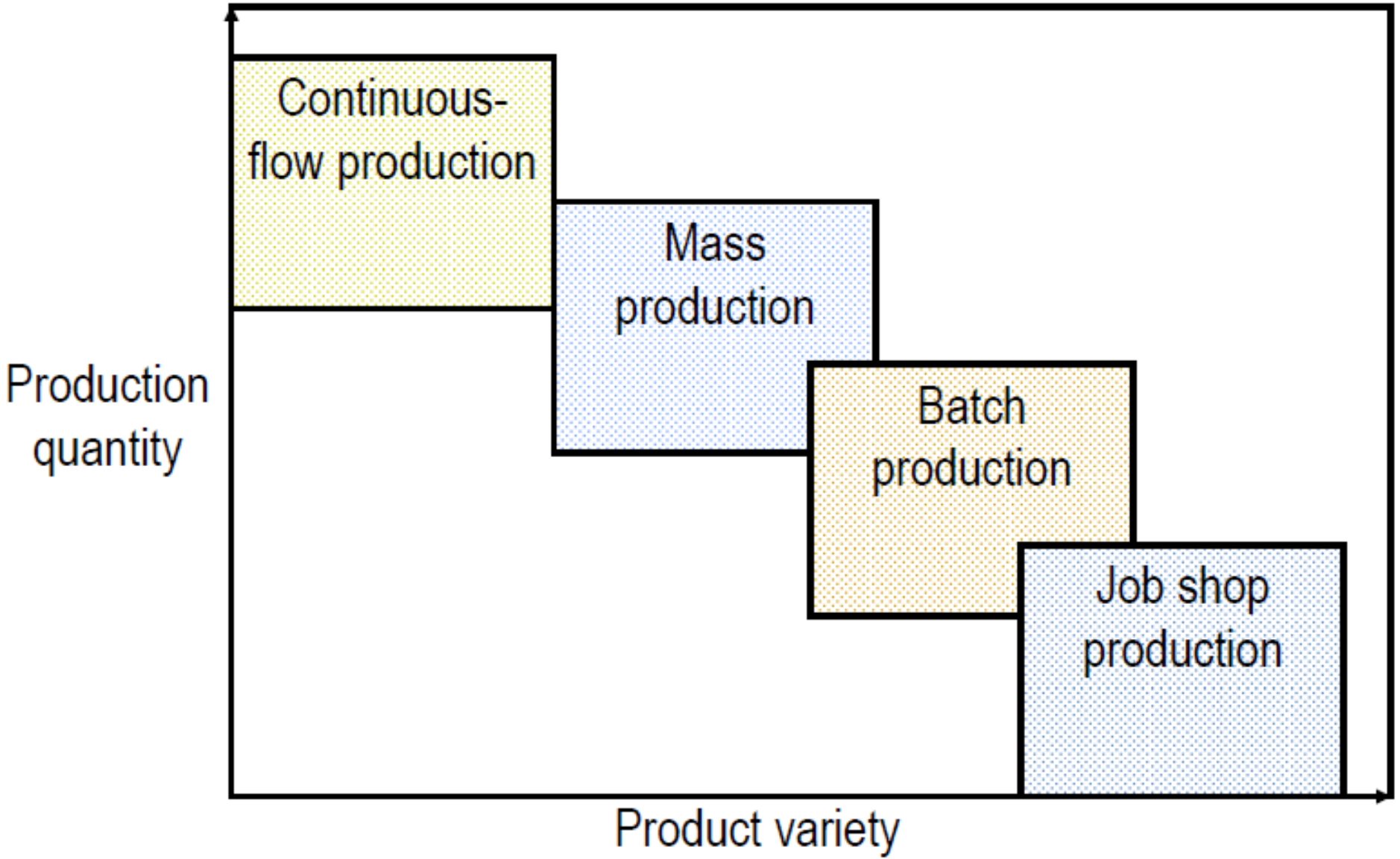
3. Batch production.

Production of medium lot sizes of the same product. The lot may be produced once or repeated periodically. Examples**: books, clothing and certain industrial machinery**.

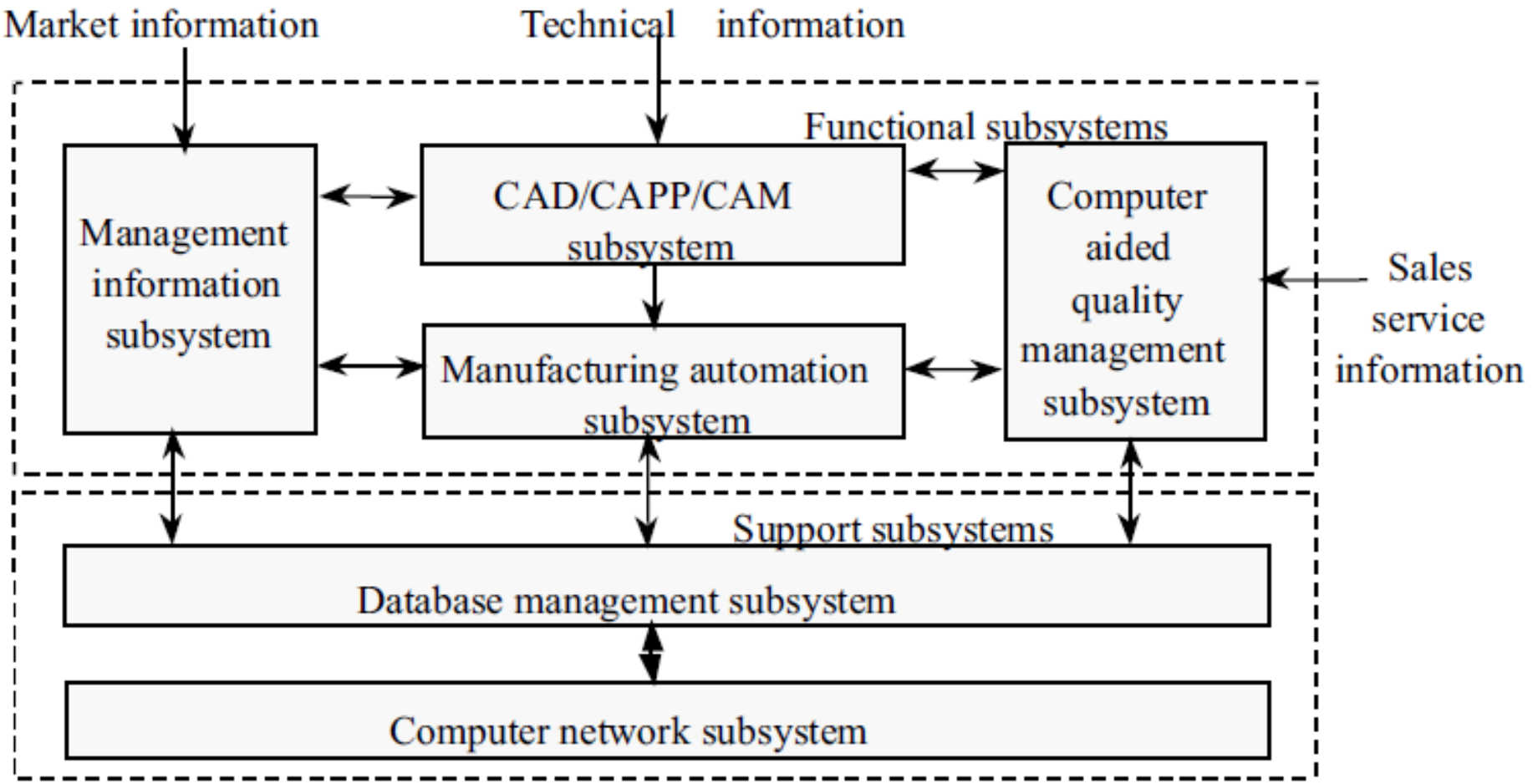
Types of Manufacturing System1

4. Job-shop production. Production of low quantities, often one of a kind, of specialized products. The products are often customized and technologically complex. Examples: **prototypes, aircraft, machine tools and other equipment**.

Types of Manufacturing System2

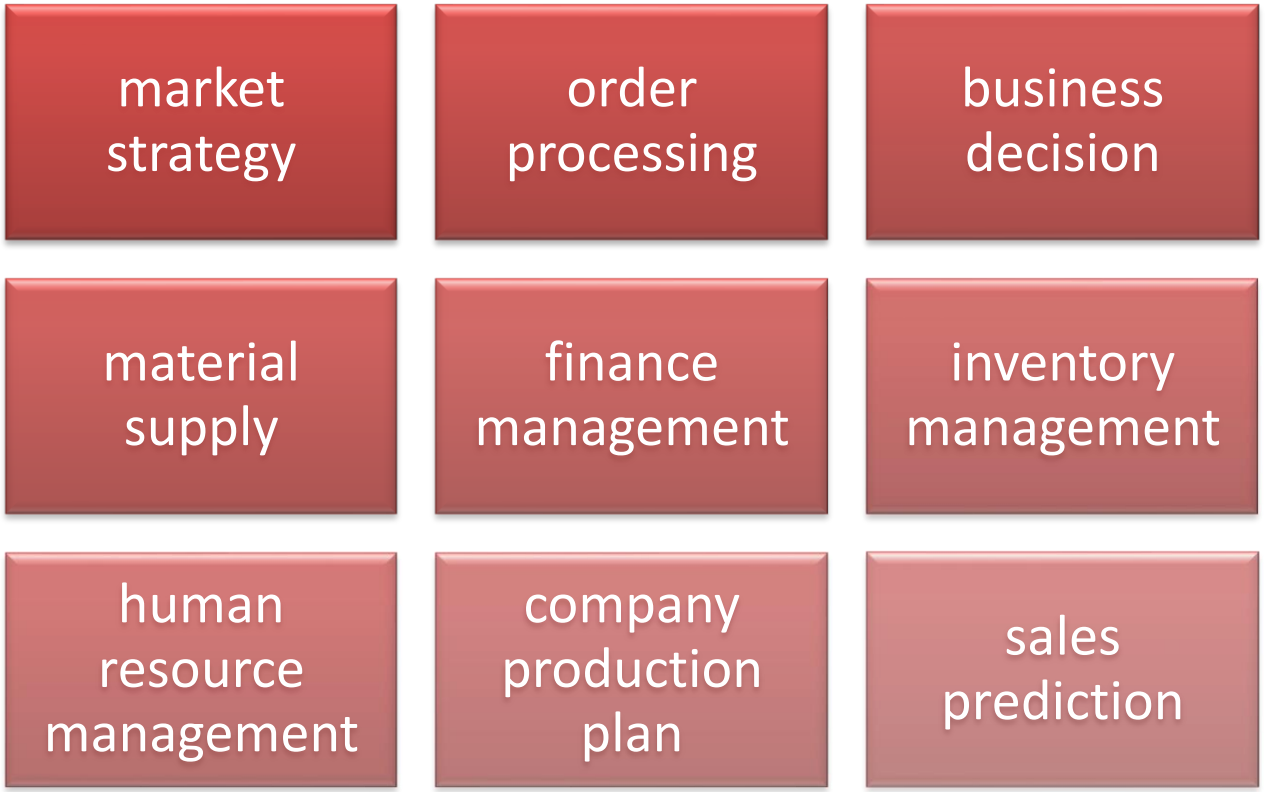


Elements of CIM



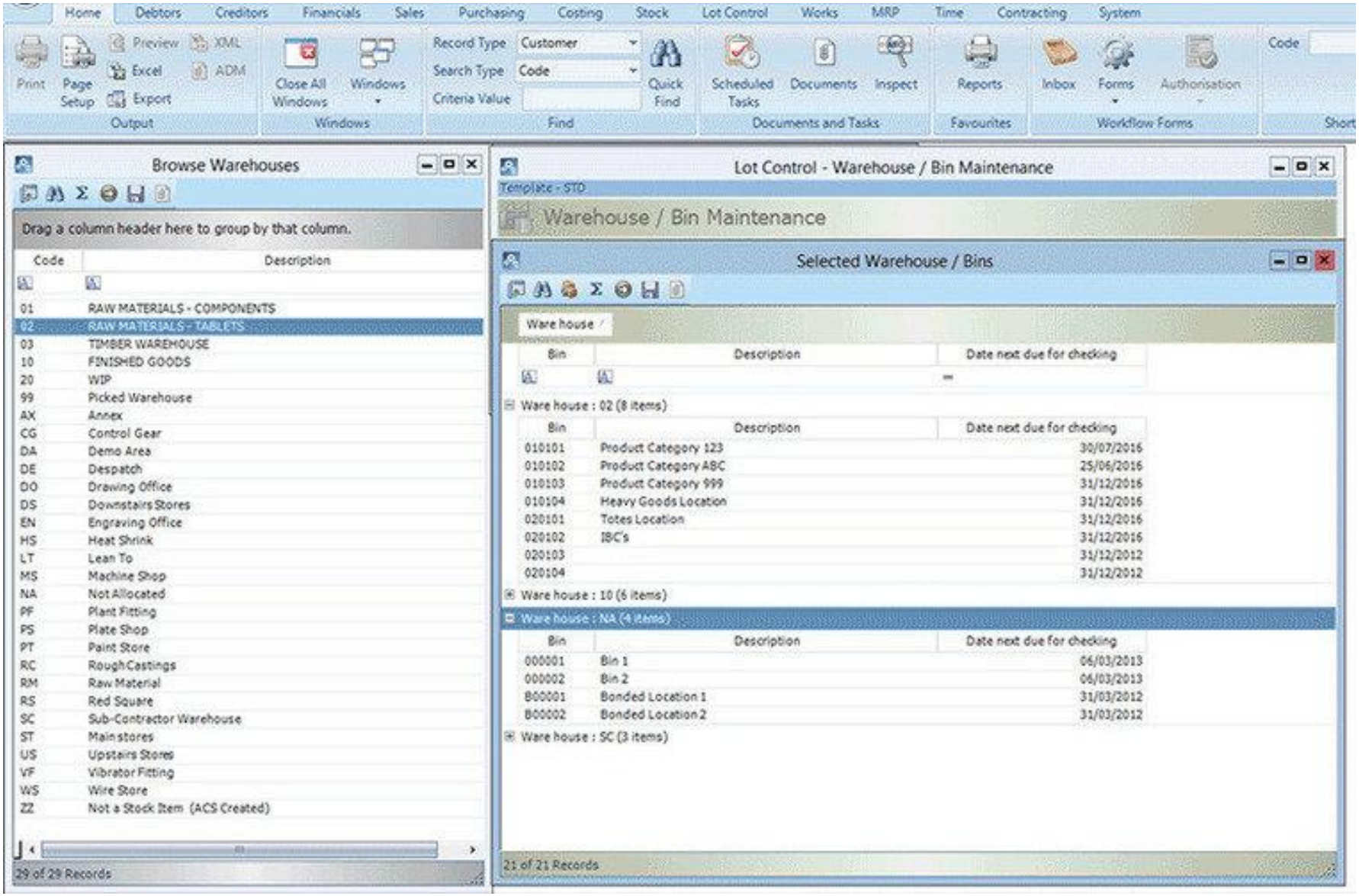
Management Information Subsystem

- To manage business process and information



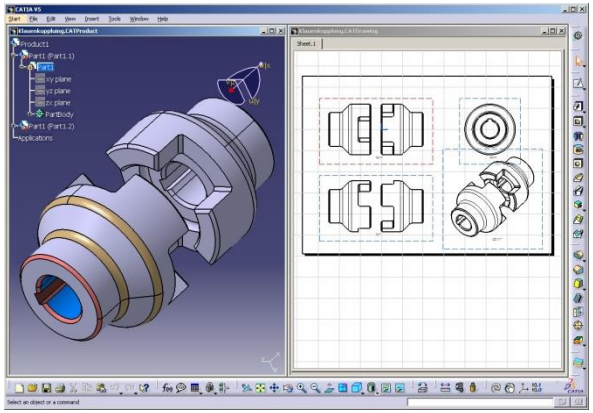
MIS 1

- The aims of MIS are to shorten delivery time, reduce cost, and help the company to make rapid decision to react to market change.
- Key application software uses in MIS is ERP (Enterprise Resource Planning).
- Find out any commercial ERP software products in market and give detail information on the basic concept of ERP.


Home
Debtors
Creditors
Financials
Sales
Purchasing
Costing
Stock
Lot Control
Works
MRP
Time
Contracting
System
Print
Page Setup
Preview
Excel
Export
XML
ADM
Output
Close All Windows
Windows
Windows
Record Type
Customer
Search Type
Code
Criteria Value
Quick Find
Find
Scheduled Tasks
Documents
Inspect
Documents and Tasks
Reports
Favourites
Inbox
Forms
Authorisation
Workflow Forms
Code
Browse Warehouses
Drag a column header here to group by that column.
Code
Description
01 RAW MATERIALS - COMPONENTS
02 RAW MATERIALS - TABLETS
03 TIMBER WAREHOUSE
10 FINISHED GOODS
20 WIP
99 Picked Warehouse
AX Annex
CG Control Gear
DA Demo Area
DE Despatch
DO Drawing Office
DS Downstairs Stores
EN Engraving Office
HS Heat Shrink
LT Lean To
MS Machine Shop
NA Not Allocated
PF Plant Fitting
PS Plate Shop
PT Paint Store
RC Rough Castings
RM Raw Material
RS Red Square
SC Sub-Contractor Warehouse
ST Main stores
US Upstairs Stores
VF Vibrator Fitting
WS Wire Store
ZZ Not a Stock Item (ACS Created)
29 of 29 Records
Lot Control - Warehouse / Bin Maintenance
Template - STD
Warehouse / Bin Maintenance
Selected Warehouse / Bins
Ware house
Bin
Description
Date next due for checking
Ware house : 02 (8 items)
010101 Product Category 123 30/07/2016
010102 Product Category ABC 25/06/2016
010103 Product Category 999 31/12/2016
010104 Heavy Goods Location 31/12/2016
020101 Totes Location 31/12/2016
020102 IBC's 31/12/2016
020103 31/12/2012
020104 31/12/2012
Ware house : 10 (6 items)
Ware house : NA (4 items)
000001 Bin 1 06/03/2013
000002 Bin 2 06/03/2013
B00001 Bonded Location 1 31/03/2012
B00002 Bonded Location 2 31/03/2012
Ware house : SC (3 items)
21 of 21 Records

CAD/CAPP/CAM Subsystem

- Computer Aided Design
- Computer Aided Process Planning
- Computer Aided Manufacturing
- Also called design automation subsystem, It used to promote the design automation standard and provide high quality product in faster design



CAD/CAPP/CAM Subsystem[1]

- CAD - to assist in the creation, modification, analysis, or optimization of a product design.
- CAPP - production of a part or an assembly. It act as a bridge between design and manufacturing by translating design specifications into manufacturing process details.
- CAM - preparing data for MAS, including producing NC code for NC machine, generating tool position, planning tool motion route, and simulating tool movement.

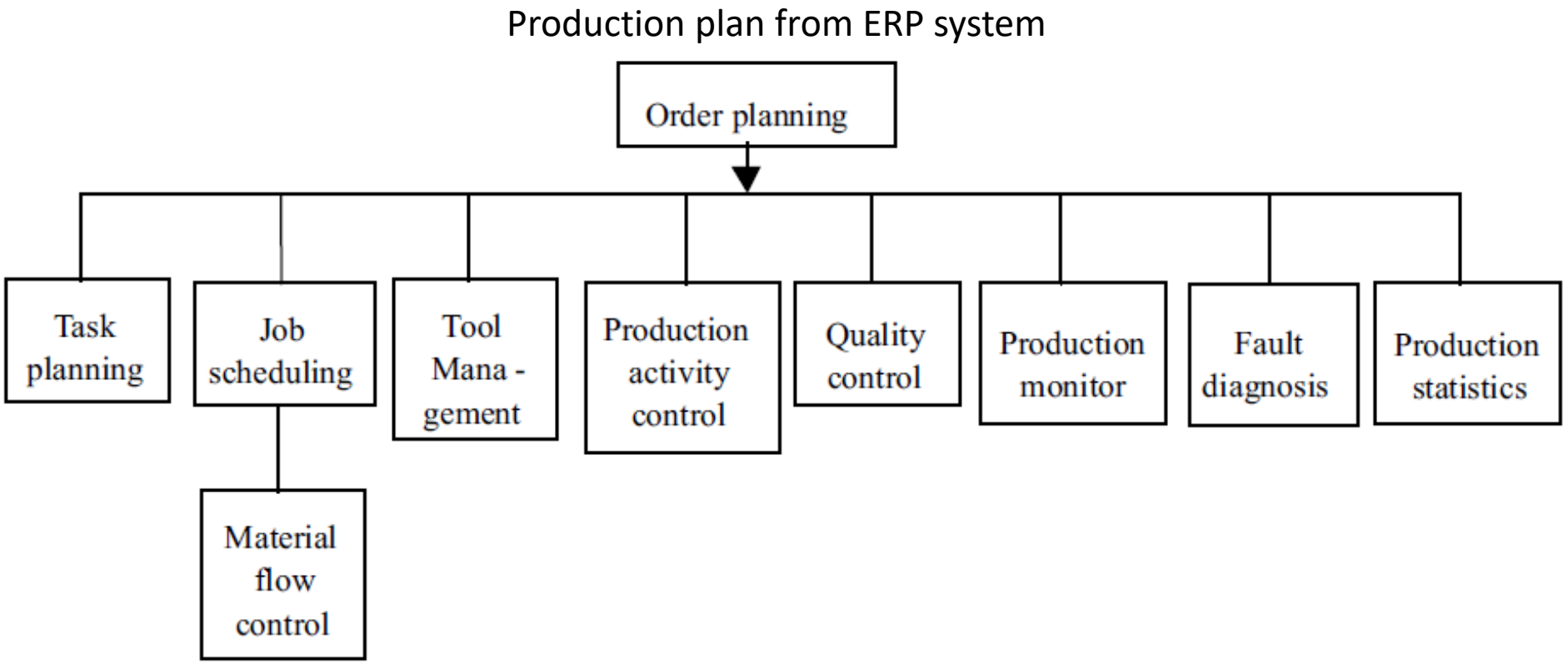
Manufacturing Automation Subsystem

- MAS can be described to structural, function and process.
- Structural description defines the hardware, software system associated with the production processes.
- Function description defines the MAS with a number of functions that combine together to finish the task of transforming raw material into product.
- Process description defines the MAS with a series of processes covering every activity in the manufacturing process.

Manufacturing Automation Subsystem[1]

- Objectives of MAS are **to increase the productivity, reduce cost, reduce work-in-progress, improve product quality and reduce production time**.
- Control methods are studied and MAS implemented shop-floor control and management system, it is a computer software system that is used to manage and control the operation of MAS.

Manufacturing Automation Subsystem2



Function modules of shop-floor control and management system

Computer Aided Quality Management Subsystem

- CIMS is a system used to guarantee the **product quality** and covers a wide range from product design, material supply, to production quality control.
- There are four components:
  - quality planning,
  - inspection and quality data collection,
  - quality assessment and control,
  - integrated quality management.

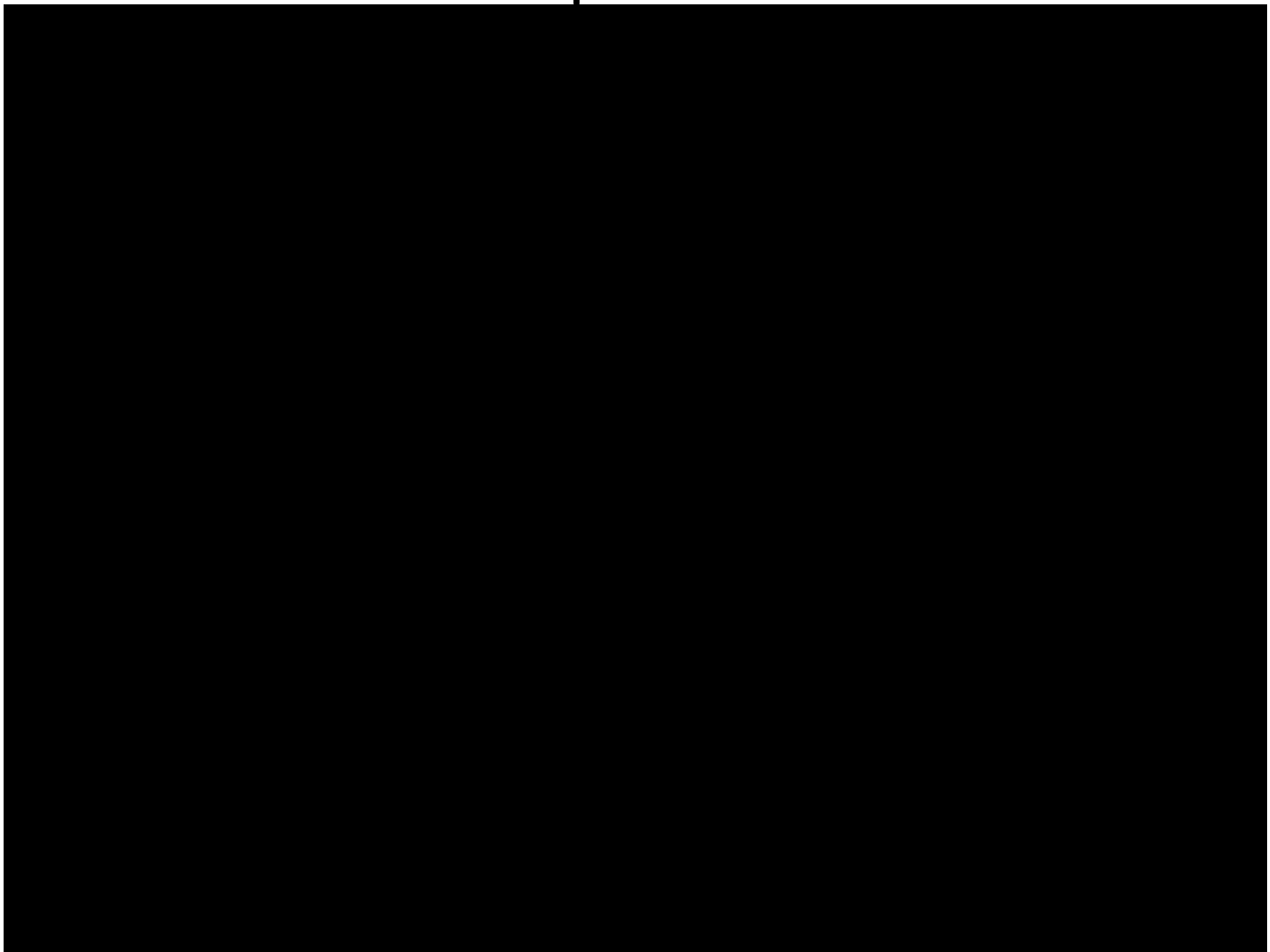
Database Management Subsystem

- DMS provides a basic support for the data store and information sharing of manufacturing company.

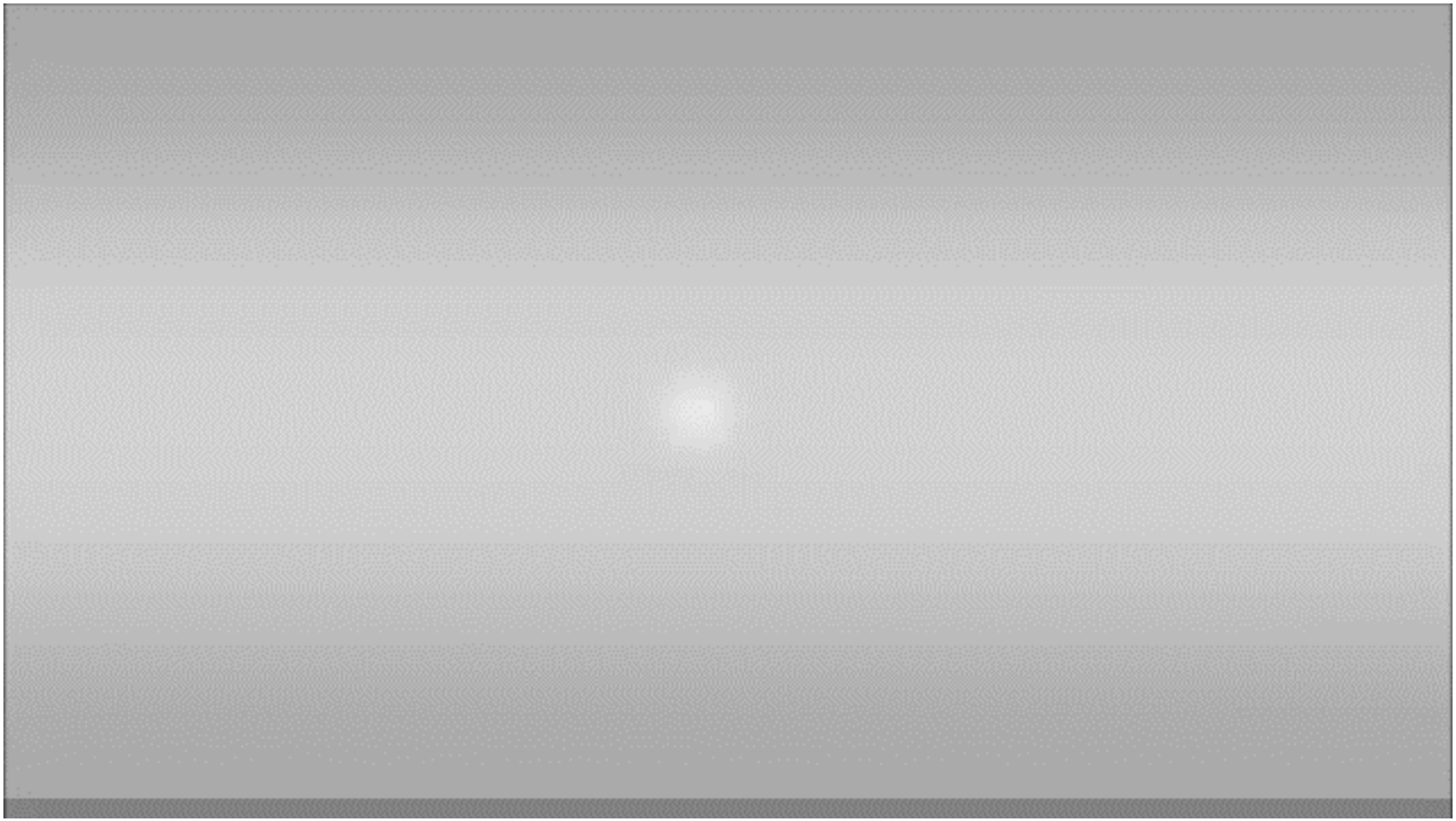
Computer Network Subsystem

- CNS consists of a number of computers (called nodes in the network), network devices and network software.
- CNS is used to connect different computers together so that enable the data communications between different computers.

Example of CIM



Example



AUTOMATION IN MANUFACTURING

Automation

- What is automation?
- Why automation is required?
- Which are the operations can be automated in production system?
- Can automation suddenly be implemented?

Automation[1]

- Automation can be defined as the **technology** concerned with the **application** of complex mechanical, electronic, and computer-based systems in the **operation and control** of **manufacturing systems**.

Automation2

- Automation is the use of **control systems**

(numerical control, programmable logic control, and other industrial control systems),

in concert with other **applications** of information **technology** (computer-aided technologies [CAD, CAM,]), to control **industrial machinery** and **processes**, reducing the need for **human intervention**.

Automation3

- In the scope of industrialization, automation is a step beyond mechanization.
- Where as mechanization provided human operators with machinery to assist them with the muscular requirements of work.
- Automation greatly reduces the need for human and mental requirements as well.
- Processes and systems can also be automated.

Reasons for Automation??

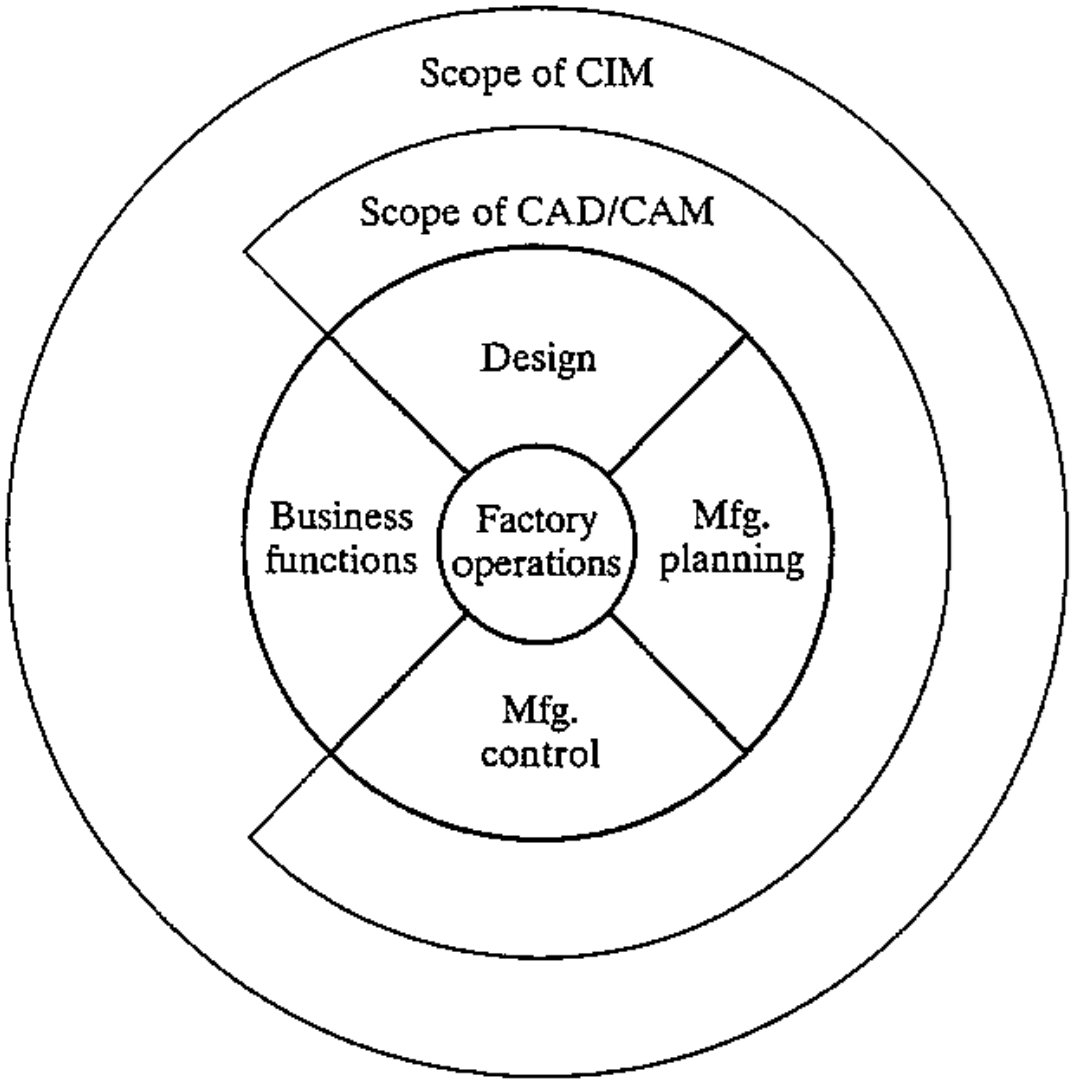
Reasons for Automation

1. To increase labor productivity
2. To reduce labor cost
3. To mitigate the effects of labor shortages
4. To reduce/remove routine manual & clerical tasks
5. To improve worker safety
6. To improve product quality
7. To reduce manufacturing lead time
8. To accomplish what cannot be done manual

CAD/CAM

- CAD/CAM involves the use of the digital computer to accomplish certain functions in product design and production (product manufacturing).
- Relationship between them is a conversion CAD data based into a process plan for making the product automatically.
- In CIM system, the system offers all of the engineering function as shown in next figure.

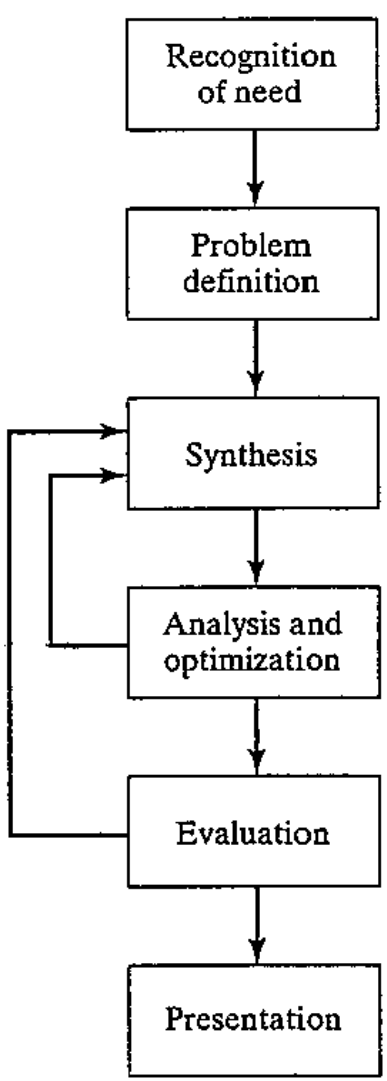
Scope of CAD/CAM and CIM

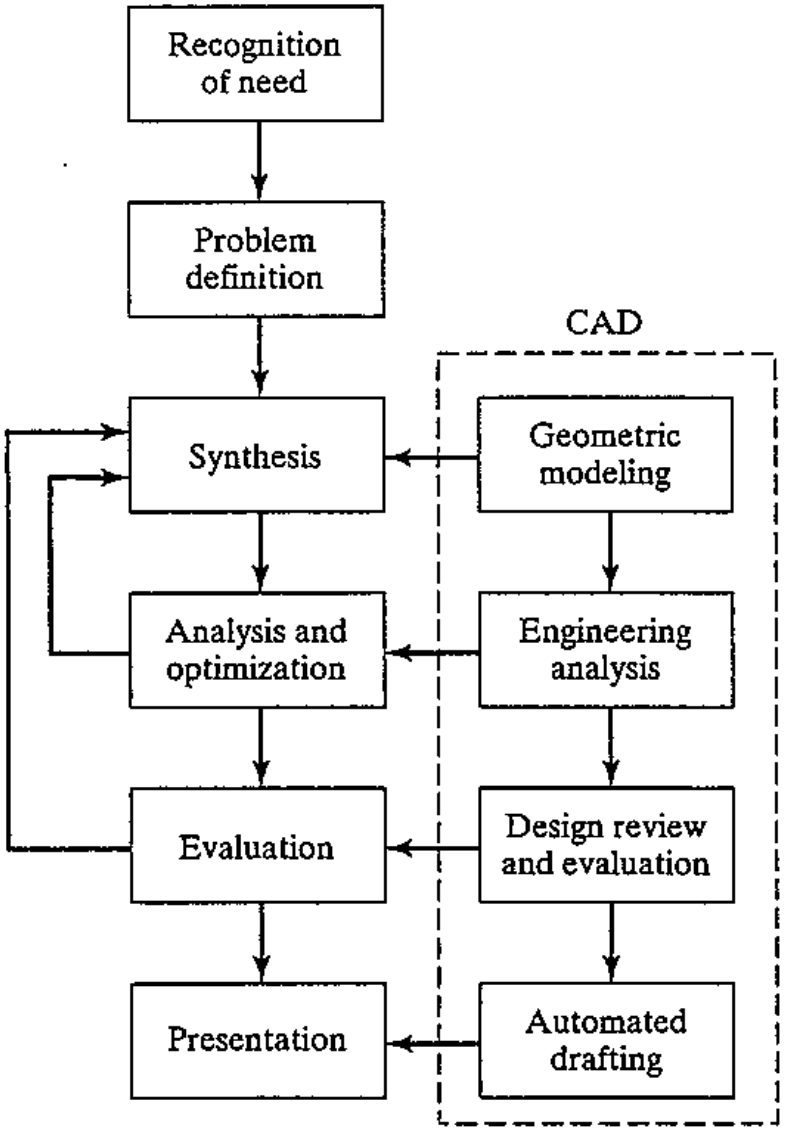


Product Design

- A part of critical function in production system. Thus, the general process of design should be discussed.
- Design process is an iterative process consisting of six phase: (1) recognition of need. (2) problem definition. (3) synthesis. (4) analysis and optimization. (5) evaluation and (6) presentation.

Design Process





Recognition Need

- Through identifying some deficiency in a current machine by an engineer or perceiving of some new product opportunity by a salesperson.
- It involves the realization by some one that a problem exists for which some corrective action can be taken in the form of a design solution.

Problem Definition

- It involves a through specification of the item to be designed. This specification includes the physical characteristics, function, cost, quality and operating performance.

Synthesis and Analysis

- Both are closely related and highly interactive in the design process.
- In considering a development of a certain product design, each of the subsystems of the product must be conceptualized by the designer, analyzed, improved through this analysis procedure, redesigned, analyzed again, and so on.

Evaluation

- It concerned with measuring the design against the specifications established in the problem definition phase.
- It often requires the fabrication and testing of a prototype model to assess operating performance, quality, reliability and other criteria.

Presentation

- It is concerned with documenting the design by means of drawings, material specifications, assembly lists and so on.

Design Process Using CAD

- Geometric Modeling – to develop a mathematical description of the geometry of an object.
- Engineering Analysis – to analyze in form of stress-strain calculations, heat transfer, or dynamic simulation.
- Design Evaluation and Review – to evaluate and review a proposed design includes dimensioning, error checking, animation of discrete-event simulation solutions.
- Plant Layout Design Scores – to design the floor layout and physical arrangement of equipment in a facility by software package.

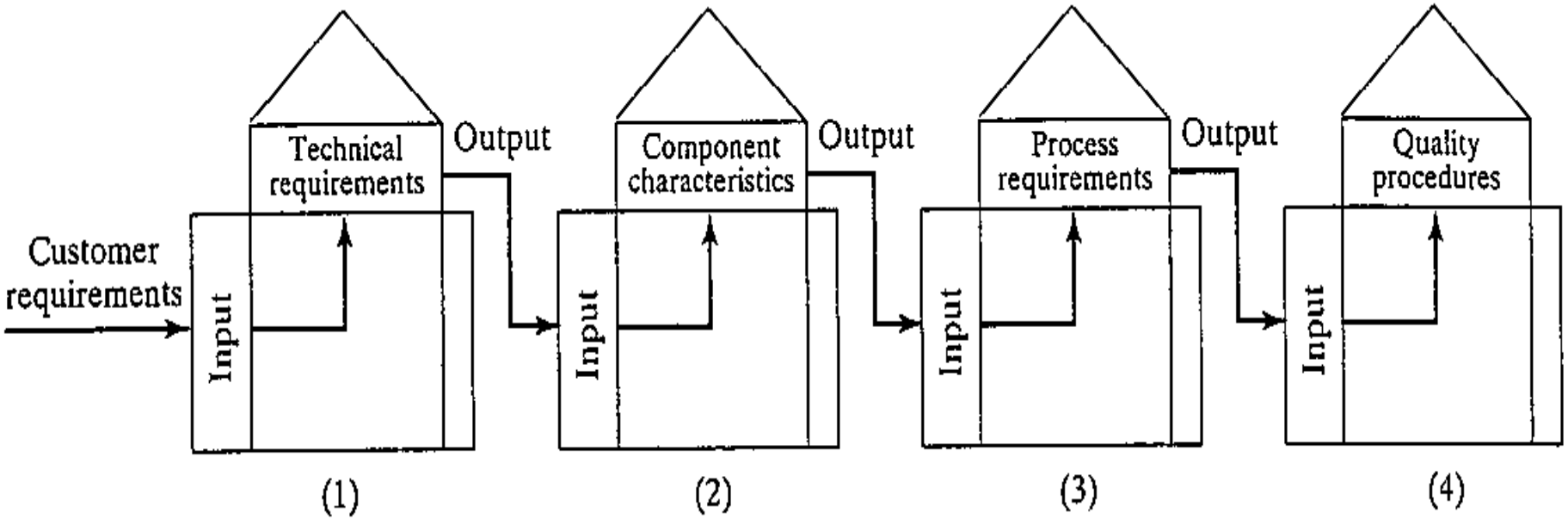
Quality Function Deployment (QFD)

- Quality-related technique.
- A systematic technique or method for organizing and managing any given product design problem.
- Other word, a systematic procedure for defining customer desires and requirements and interpreting them in term of product features and process characteristics.

QFD

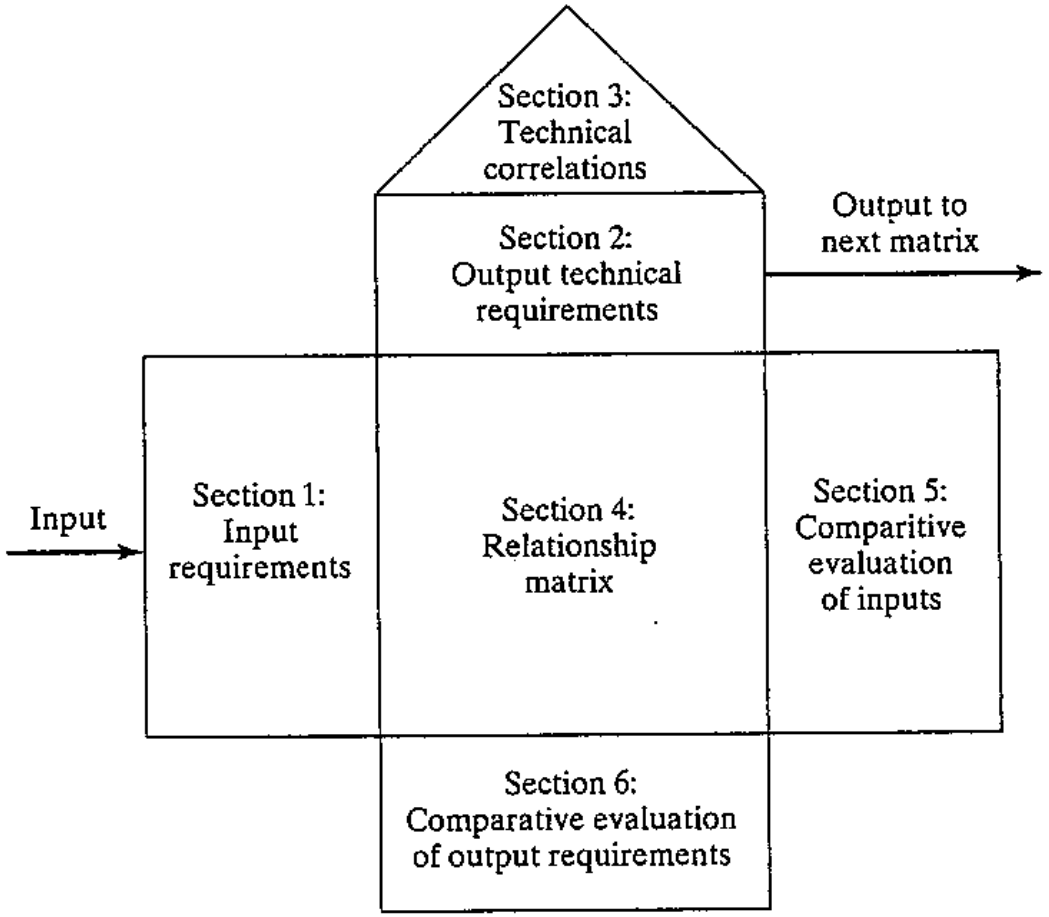
- A series of interconnected matrices are developed to establish the relationship between customer requirements and the technical features of a proposed new product.
- The matrices represent a progression of phases in the QFD analysis as shown in next figure.

QFD Matrices



QFD Matrix[1]

- Each matrix is similar format and consists of six sections as shown in the figure.



QFD Matrix$_2$

- Section 1- Identify **customer requirement**. By capturing the customer's needs, desires and requirements. Example of items/descriptions – interviews, comment cards, formal surveys, focus groups, study of complaint, customer returns, internet and field intelligence.

- Section 2 – Identify **product features** needed to meet customer requirement. By complying customer requirement and product features.

- Section 3 – Determine **technical correlations** among product features. By giving a score on relationship between a pairs of product features.

QFD Matrix[3]

Numerical Scores Used For Correlations and Evaluations in Sections 3, 4, 5, and 6 of the QFD Matrix

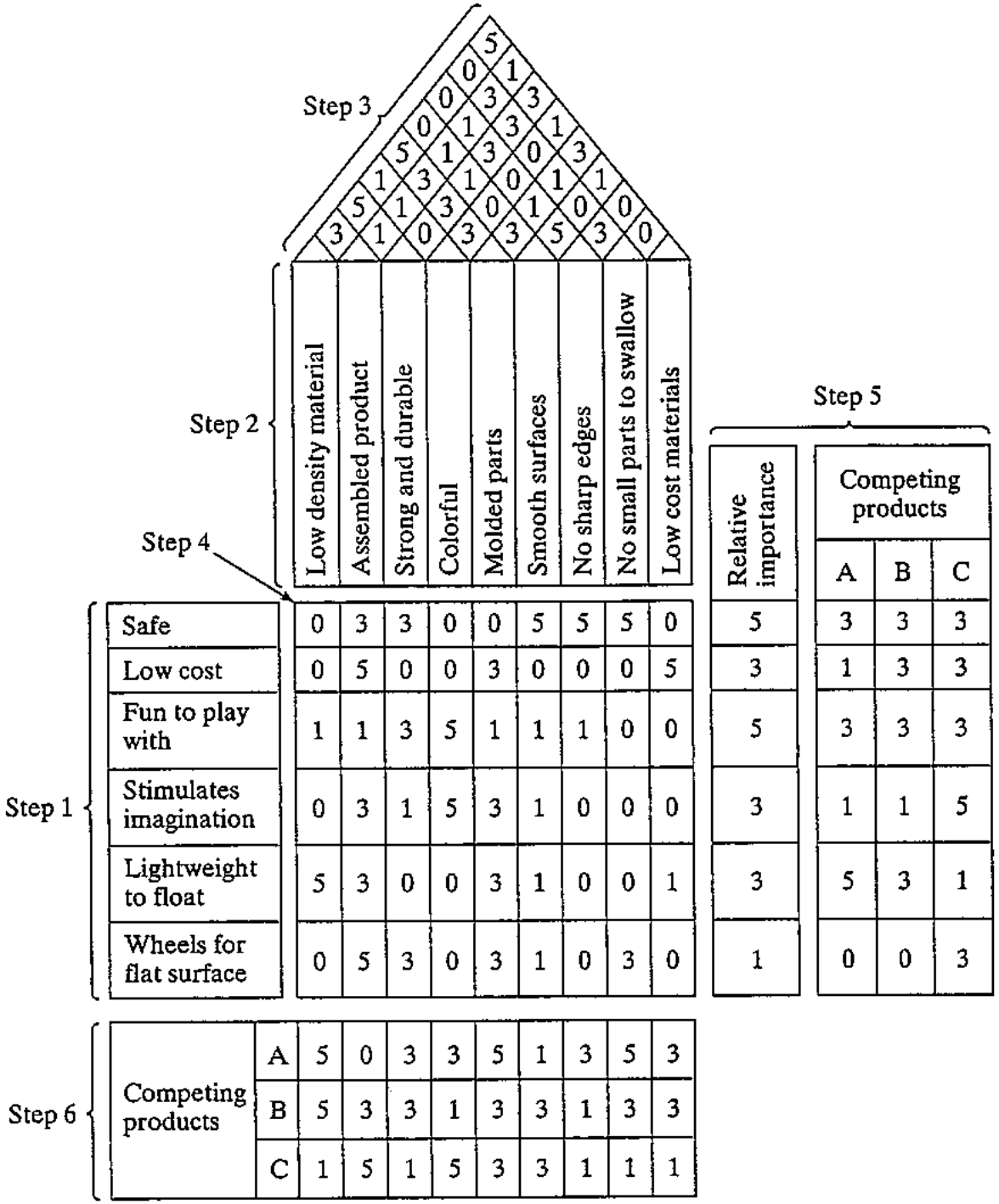
Numerical Score	*Strength of Relationship in Sections 3 and 4*	*Relative Importance in Section 5*	*Merits of Competing Product in Sections 5 and 6*
0	No relationship	No importance	Not applicable
1	Weak relationship	Little importance	Low score
3	Medium-to-strong relationship	Medium importance	Medium score
5	Very strong relationship	Very important	High score

- Section 4 – Develop relationship matrix between customer requirements and product features. By giving the score on relationship between them.
- Section 5 – Comparative evaluation of input customer requirements. There two comparisons; relative importance and existing competitive products
- Section 6 – Comparative evaluation of output technical requirements. By giving a score on relationship to the output technical for each competing product.

Example

We are engaged in a new product design project for the case of child's toy. The toy would be for children ages 3-9. it is a toy that could be used in a bathtub or on the floor. We want to construct the house of quality for such a toy (the initial matrix in QFD), first listing the customer requirements as might be obtained from one or more of the methods given in the table. We then want to identify the corresponding technical features of the product and develop the various correlations.

House of Quality



Exercise 1

- In retail industry, you require to identify a suitable camera for real-time shelf-monitoring and analytics platform that can reveals what's happening in the aisles.

- Retrofit, small and easy to use/mount on rack
- Camera control method (such as auto focus adjustment)
- Can connect using RTMP
- Determine method of output data linkage
- Low power consumption
- Wifi and Internet

Exercise 2

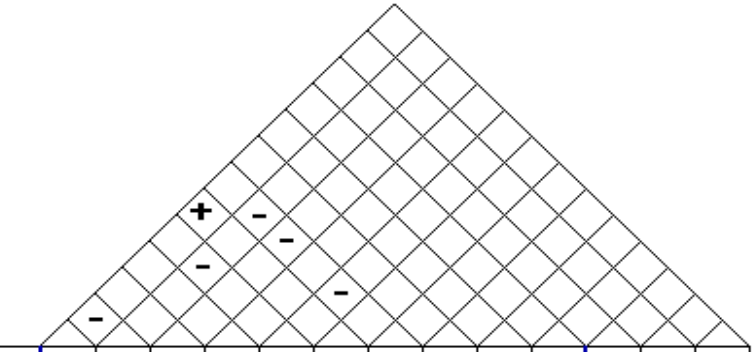
In warehouse management, you require to identify the QFD to performing the auto sorting of packages (range between 10- 80 cm). This is the basic requirements from logistic company:

自動で荷物の採寸・計量を行い、
物流の効率化を実現する画期的な計測器

SMART QBING

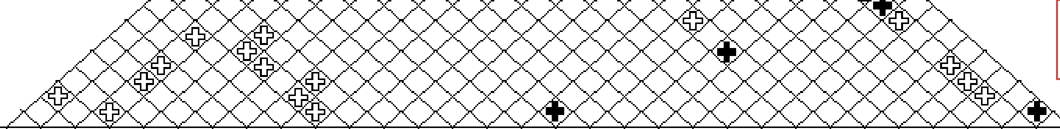
【processing shipping size】					
package number	height	width	length	adding 3 sides	size
1001	30	30	20	80	80
1002	25	15	30	70	80
1003	11	12	13	36	60

Windshield Wiper



	Mechanic	Sales	Driver	Visibility Percentage	Steps to attach	Time to attach (secs)	Steps to detach	Time to detach	Number of Parts	Weight (g)	Cars that fit it (%)	Smoothness of blade	Sales Price ($)	Design 1	Design 2	Design 3
Functional Performance																
removes water	5	9	1													
Fast attachment	3	1	9													
Fast detachment	3															
not release accidently	4		1													
Human Factors																
Easy to attach	2	9							1				3	5	4	
Easy to detach	4	9					9		1				3	5	5	
Interface with vehicle																
fits most cars	4		1			9						5	5	5	4	
Not mar window	5	1	1			9						1	5	3	5	
light weight	4	1	3			9	3		9			5	3	4	5	
not rattle	2		3				1		9			5	3	2	3	
Competitive sales price																
Design 1				92												
Design 2				100												
Design 3				89												
Target				100												

- ✚ Strong Negative
- ✜ Moderate Negative
- ● Strong Positive
- ○ Moderate Negative



Refrigerator

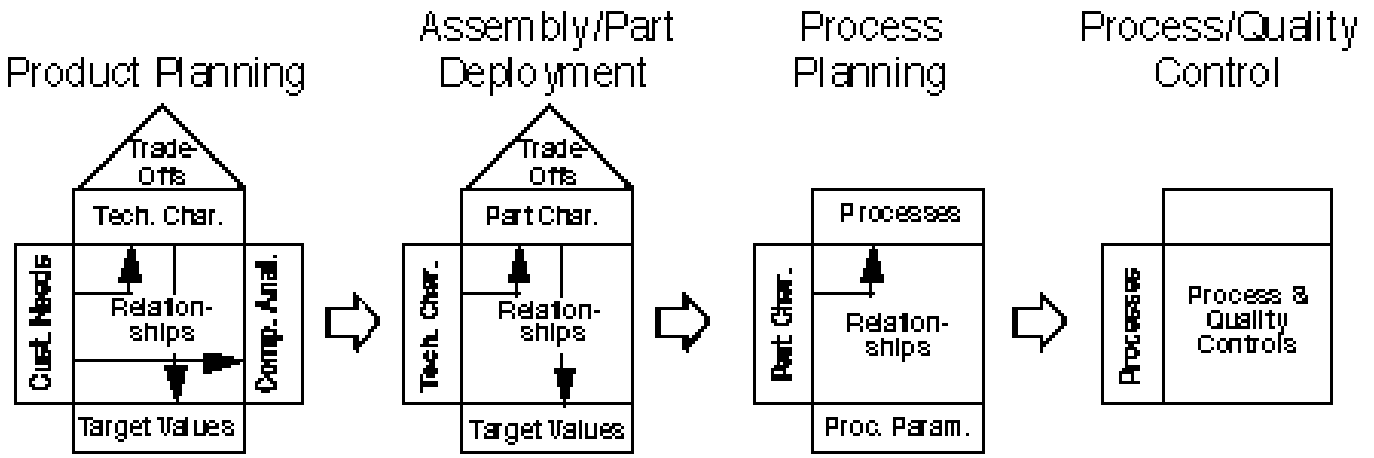
Category	Customer Needs	Priority	Compressor energy efficiency rating	Insulation efficiency	Noise measurement-front	Refrig. temp. range (on/off cycle)	Refrig. temperature variation	Refrig. cooling speed (from 30°C to 5°C)	Freezer temp. range (on/off cycle)	Freezer temperature variation	Freezer cooling speed (30°C to -15°C)	Volume efficiency (total/usable)	% Shelf & tray area adjustable	Drawer/shelf pull force	# of visibility features	Dis-assy & re-assy time for cleaning	% of features rated easy to clean	Freezer width	Refrigerator shelf depth & width	Freezer shelf height	Door tray depth	Warranty period (years)	Water filter replacement time & cost	10 year service contract cost	Time to disassb & reassb door	Refrigerator depth	Stainless & trim panel option prices	Focus group rating - appearance	Water temperature	Water filter indicator & life	Ice produced daily	Manufacturing cost	No. of adjustable temp. drawers	Competitive Evaluation (1-Low, 5-High): 1	2	3	4	5	Sales Points	Improvement Goal	Improvement Factor	Relative Development Effort
	Goal		↑	↓	↓	↓	↓	↓	↓	↓	↓	↑	↑	↓	↑	↓	↑	↑	↑	↑	O	↑	↓	↓	↓	O	↓	↑	↓	↑	↑	↓	↑									
Operation	Low energy consumption	4	5	5																															U	MGF	A	W	1.0	3	1.1	1
Operation	Quiet	1			5																															MFA	WG	U	1.0	5	1.0	0
Operation	Maintains temperature	3		1		3	3	3	3	3	3																								FA	MWG		U	1.0	5	1.0	0
Operation	Preserves food & freshness	3		1		5	5	5	5	5	5																						5			MFA	WG	U	1.2	5	1.0	0
Storage	Maximize storage space	5		3								5						3	3	3														U		MG	FA	W	1.1	5	1.4	5
Storage	Flexibility for changing storage needs	3										3	5	1		3																	3	A	U	WGF		M	1.0	3	1.1	1
Storage	Easy access & visibility	4											1	5	5	3		1	1	1														U		FA	WG	M	1.0	3	1.2	1
Storage	Easy to clean	2														5	5																			MWGFA		U	1.0	5	1.0	0
Storage	Handles large containers & items	4										3	3					5	5	5	5													U		WGA	MF		1.0	3	1.2	1
Reliab	Reliable, doesn't break	5																				5												M		WGA	F	U	1.0	5	1.0	0
Reliab	Easy & low cost to service	3																				5	5	5	1									U		MA	WG	F	1.0	4	1.3	1
Kitchen	Easy to deliver & install	1																							5	3									MWGFA			U	1.0	5	1.0	0
Kitchen	Fits in kitchen space	5		3								5														5								UMF			A	WG	1.1	5	1.4	5
Kitchen	Coordinates with kitchen décor	4																								3	5	5							U	MFA		WG	1.0	3	1.1	1
Disp.	Dispenses purified water	3				1																	3						5	5						UMFA	W	G	1.0	3	1.0	0
Disp.	Provides & dispenses purified ice	3							1														3						5	5	5					UMFA	G	W	1.0	3	1.0	0
$	Low price	3																														5			M	UWG		FA	1.2	5	1.2	5

Technical Evaluation (Italicized numbers represent subjective ratings)

	Compressor energy efficiency rating	Insulation efficiency	Noise measurement-front	Refrig. temp. range (on/off cycle)	Refrig. temperature variation	Refrig. cooling speed (from 30°C to 5°C)	Freezer temp. range (on/off cycle)	Freezer temperature variation	Freezer cooling speed (30°C to -15°C)	Volume efficiency (total/usable)	% Shelf & tray area adjustable	Drawer/shelf pull force	# of visibility features	Dis-assy & re-assy time for cleaning	% of features rated easy to clean	Freezer width	Refrigerator shelf depth & width	Freezer shelf height	Door tray depth	Warranty period (years)	Water filter replacement time & cost	10 year service contract cost	Time to disassb & reassb door	Refrigerator depth	Stainless & trim panel option prices	Focus group rating - appearance	Water temperature	Water filter indicator & life	Ice produced daily	Manufacturing cost	No. of adjustable temp. drawers
U	5.3	160	30	2.0	2.0	220	4.0	2.0	110	53%	2	3	2	4	4	300	450x475	4	3	5/2	2	1	5	29	2	4	5	2	2kg	486	3 drw
M	5.5	150	34	4.0	3.0	228	6.0	4.0	121	56%	5	4	4	2	2	316	464x475	3	5	5/1	3	4	2	28	1	4	4	5	5kg	513	3 drw
W	5.5	150	34	2.0	2.0	235	4.0	2.0	121	55%	4	4	5	5	5	320	422x413	5	5	5/1	5	4	2	28	4	5	4	5	2.3kg	471	3 drw
G	5.5	150	34	3.0	2.0	230	5.0	3.0	121	58%	3	4	4	3	3	320	440x460	3	5	5/1	3	4	2	28	5	4	4	3	2.3kg	487	3 drw
F	5.5	150	34	3.0	3.0	230	5.0	3.0	121	55%	4	3	3	3	3	310	418x446	3	5	5/1	4	4	2	28	3	3	4	5	2.3kg	511	3 drw
A	5.5	150	34	3.0	3.0	230	5.0	3.0	121	56%	3	3	4	3	3	310	430x465	2	5	5/1	3	4	2	29	2	3	4	3	2.3kg	511	3 drw

U - Us
M - Maytag
W - Whirlpool
G - GE
F - Frigidaire
A - Amana

FOUR-PHASE QFD APPROACH



- Define & prioritize customer needs
- Analyze competitive opportunities
- Plan a product to respond to needs & opportunities
- Establish critical characteristic target values

- Identify critical parts & assemblies
- Flowdown critical product characteristics
- Translate into critical part/assy characteristics & target values

- Determine critical processes & process flow
- Develop production equipment requirements
- Establish critical process parameters

- Determine critical part and process characteristics
- Establish process control methods & parameters
- Establish inspection & test methods & parameters