IEI6A2 Filsafat Teknik Industri

Perancangan Sistem Kerja

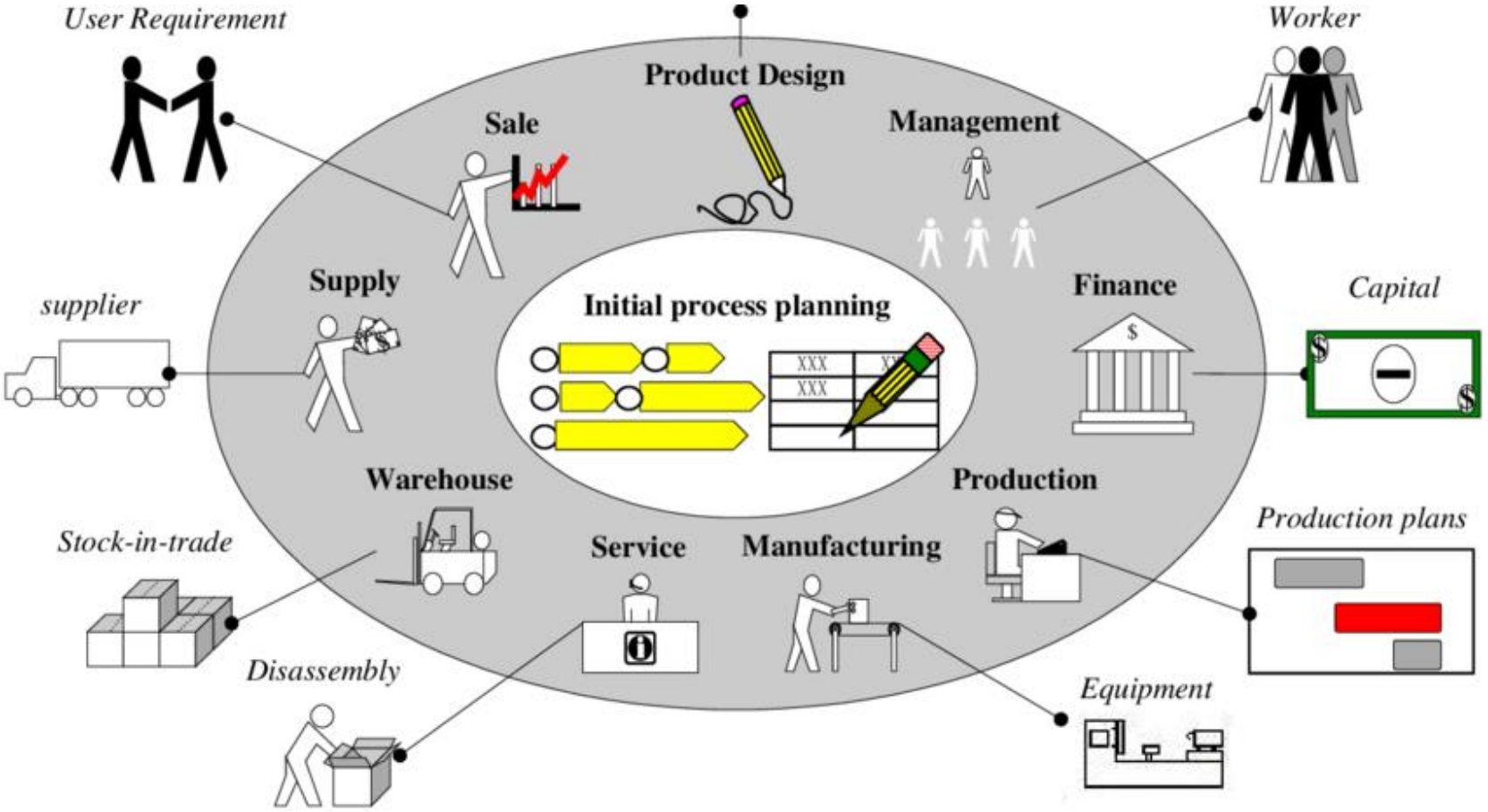
Prodi S2 Teknik Industri – Fakultas Rekayasa Industri

Course Learning Outcome (CLO)

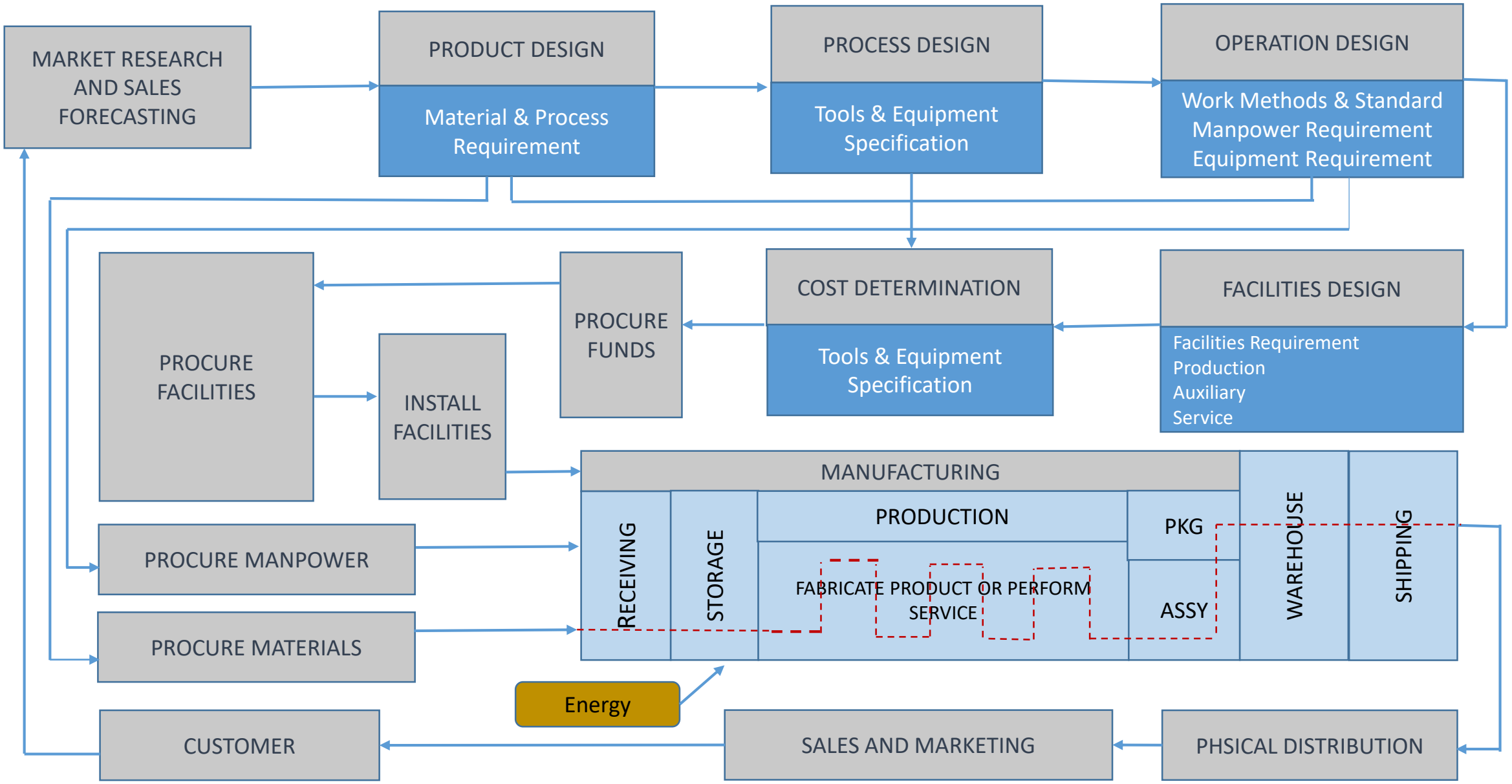
mampu menjelaskan perancangan sistem kerja

mampu menjelaskan perancangan fasiltas

Manufacturing Cycle

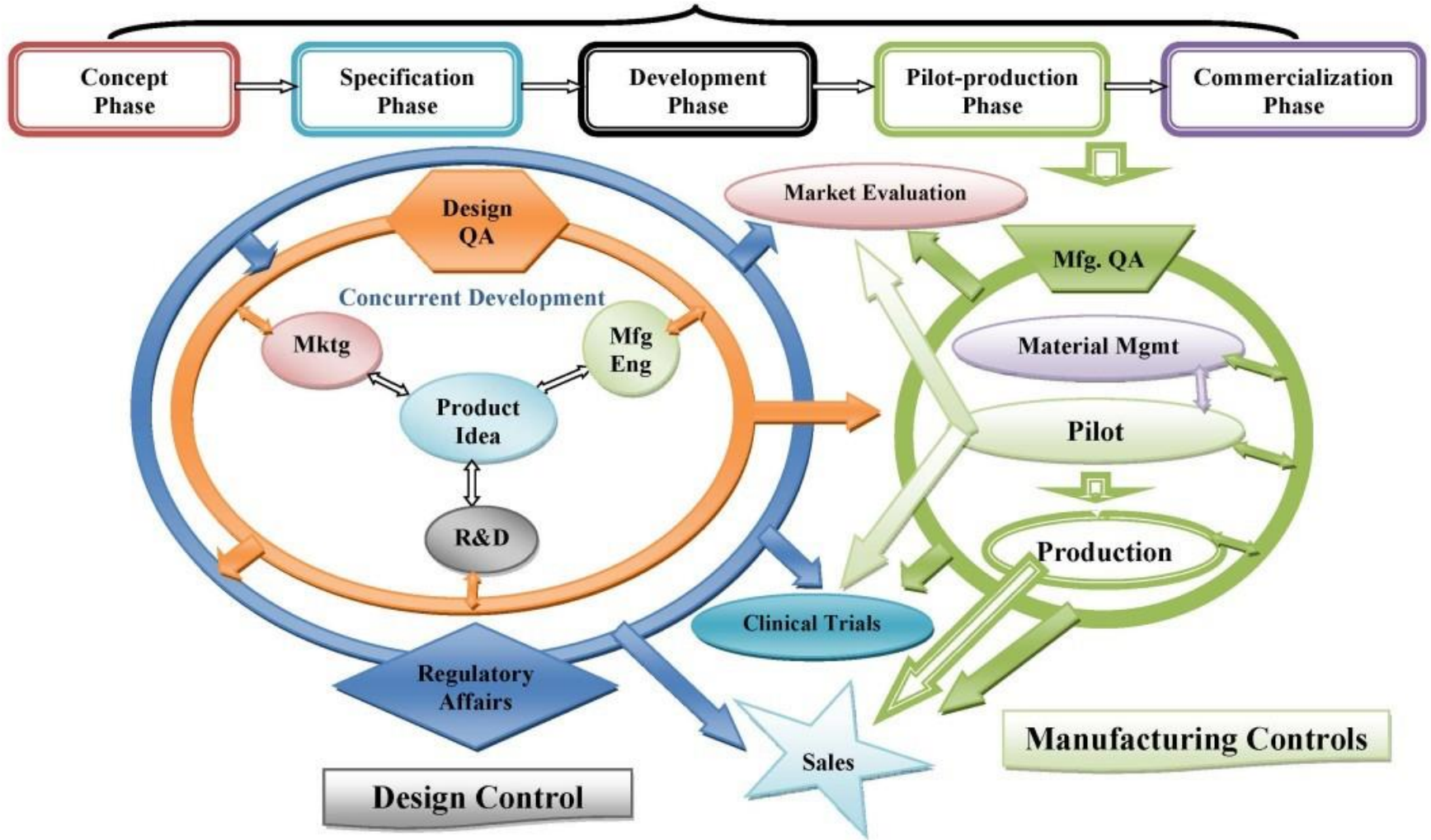


The Enterprise Design Process (Apple, 1995)

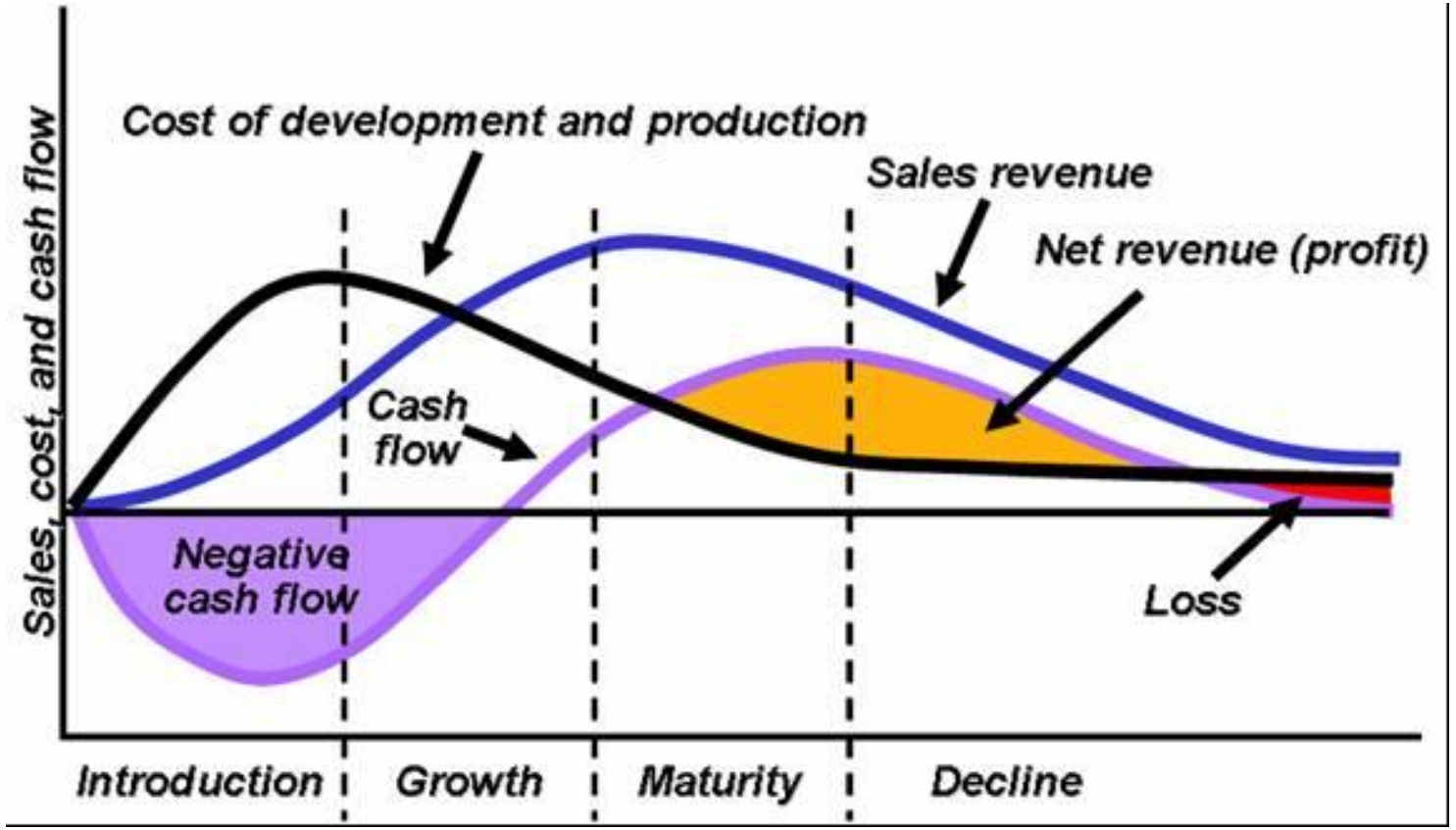


Product Design

PRODUCT DEVELOPMENT



Product Life Cycles



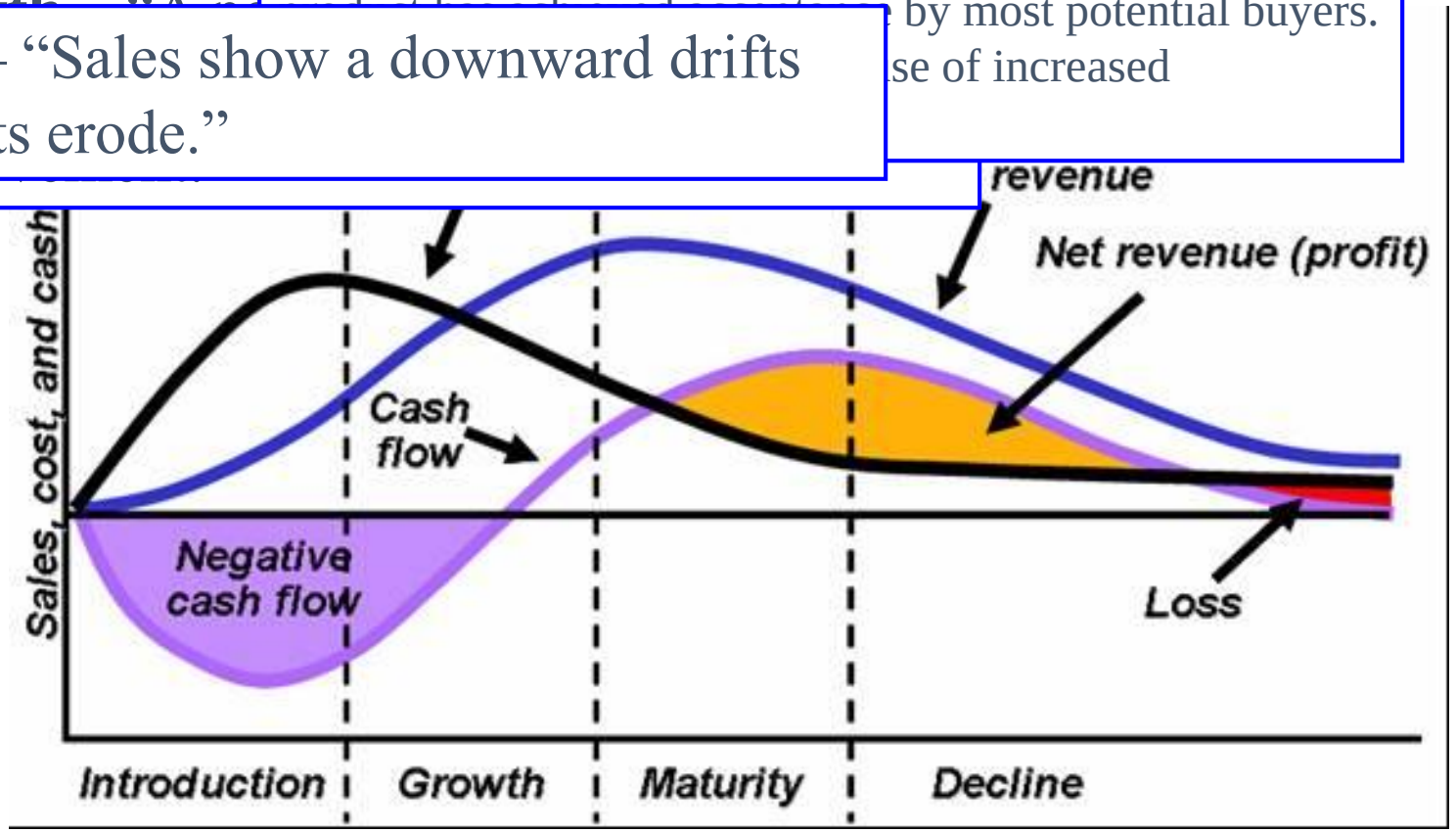
"Products are born. They live and die." *(Heizer and Render)*

Product Life Cycles

Introduction – "A p

Maturity – "A slowdown in sales growth because the
by most potential buyers.
se of increased

Decline – "Sales show a downward drifts and profits erode."



"Products are born. They live and die." *(Heizer and Render)*

Product Design

Product development tools → QFD, benchmarking

Production data :

- Component's Blue print
- Part list
- Production routing

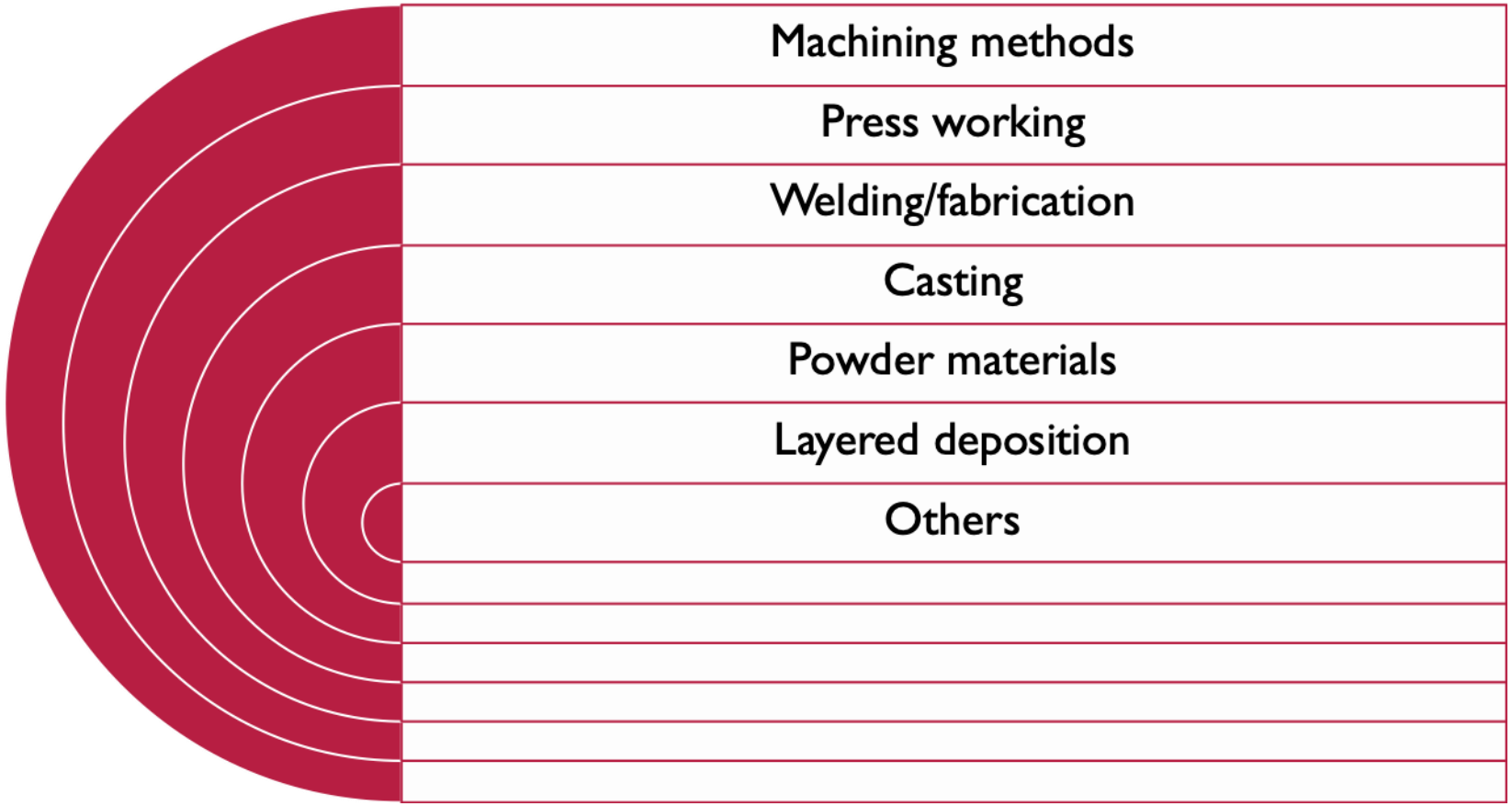
Output→ Product description, assembly drawing

Process Design

Process engineer

- How can we make it?
- How much does it cost?
- How long will it take us to complete it?
- How reliable will it be?
- How can we recycle it

What methods were used?



Process Design

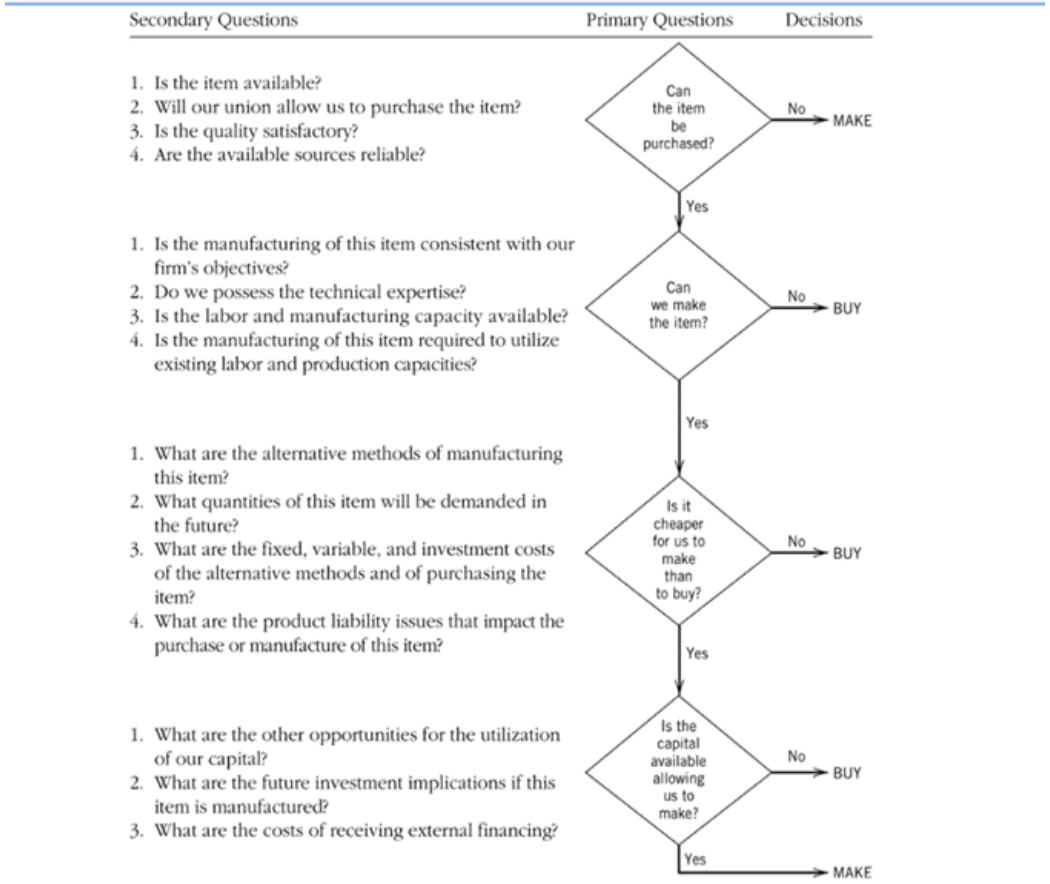
Identifying Requirement Process:

- Determining the scope of facility
- Make or buy decisions

Selecting Required Process

Sequencing the Required Processes

The make – or buy decision Process



Part List for an air flow regulator

PARTS LIST

Company: TW Inc.
Product: Air Flow Regulator

Prepared By: JSU
Date: 6/30/2003

Part No.	Name	Drwg. No.	Qty/unit	Material	Size	Make/Buy
1050	Pipe plug	4006	1	Steel	0.5" x 1.00"	Buy
2200	Body	1003	1	Aluminum	2.75" x 2.5" x 1.5"	Make
3250	Seat Ring	1005	1	Stainless Steel	2.97" x 0.87"	Make
3251	O-Ring	-	1	Rubber	0.75" diam.	Buy
3252	Plunger	1007	1	Brass	0.812" x 0.715"	Make
3253	Spring	-	1	Steel	1.4" x 0.225"	Buy
3254	Plunger Housing	1009	1	Aluminum	1.6" x 0.225"	Make
3255	O-Ring	-	1	Rubber	0.925" diam.	Buy
4150	Plunger Retainer	1011	1	Aluminum	0.42" x 1.2"	Make
4250	Lock Nut	4007	1	Aluminum	0.21" x 1.00"	Buy

The **part list provides a listing of the component parts of a product.** **In addition to** make-or-buy decisions, a part list includes at least the following:

1. Part numbers.
2. Part name.
3. Number of parts per product.
4. Drawing references

Part list Example

Model	Cat. No	Parts	Q'ty	Remarks
NPX-2	NX-010002	Plunger head	1	Plunger & plunger head
	NX-020002	First spring	1	-
	NX-040002	Nozzle cylinder	1	Nozzle cylinder & K bush
	NX-400002	O-ring & seal ring set	1	-
	NX-300002	O-ring retainer	1	-
	NX-090010	Ejector pipe	1	-
	NX-081000	Ejector setting screw	1	Screw, spring & washer

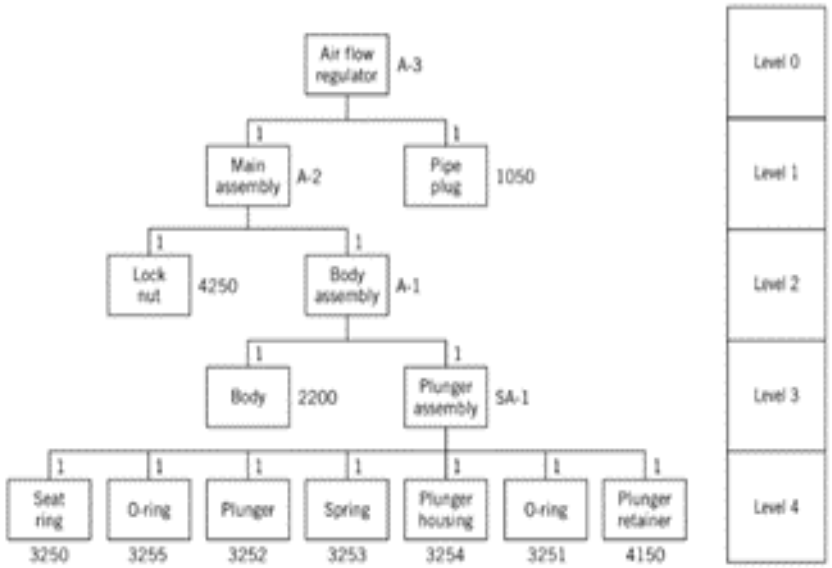
Bill Of materials for an air flow regulator

BILL OF MATERIALS

Company T.W., Inc. Prepared by J.A.
Product Air Flow Regulator Date

Level	Part No.	Part Name	Drwg. No.	Quant./ Unit	Make or Buy	Comments
0	0021	Air flow regulator	0999	1	Make	
1	1050	Pipe plug	4006	1	Buy	
1	6023	Main assembly	—	1	Make	
2	4250	Lock nut	4007	1	Buy	
2	6022	Body assembly	—	1	Make	
3	2200	Body	1003	1	Make	
3	6021	Plunger assembly	—	1	Make	
4	3250	Seat ring	1005	1	Make	
4	3251	O-ring	—	1	Buy	
4	3252	Plunger	1007	1	Make	
4	3253	Spring	—	1	Buy	
4	3254	Plunger housing	1009	1	Make	
4	3255	O-ring	—	1	Buy	
4	4150	Plunger retainer	1011	1	Make	

Bill Of materials for an air flow regulator



Proses selection procedure step

Identify alternative process for each operation

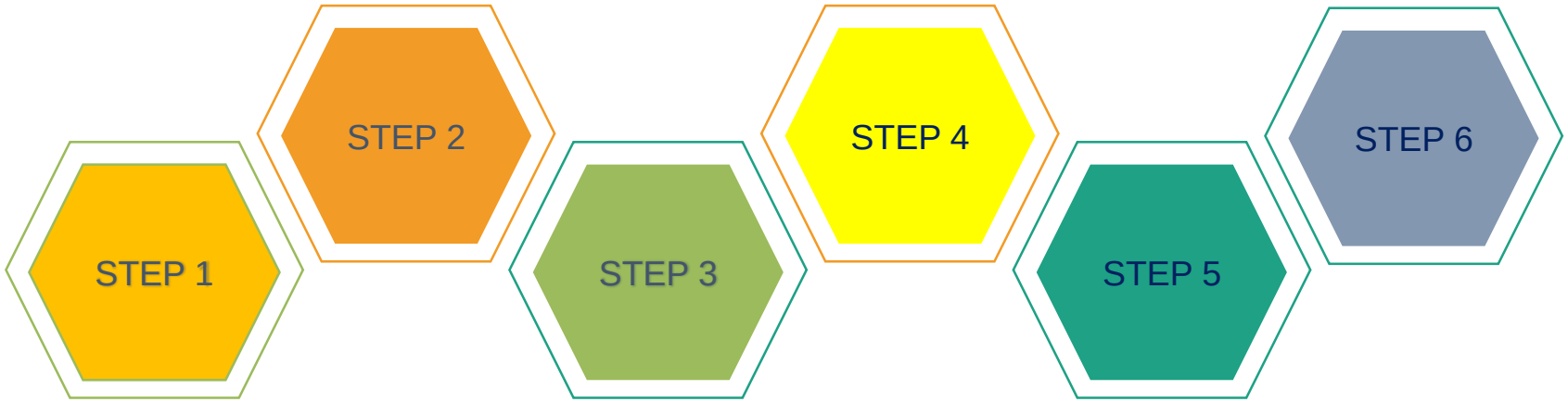
Identification of various equipment types: manual, mechanized, or automated

Standardize Process

Equipment utilization

Select Processes

The of the economic evaluation along with intangible f actors such as flexibility, versatility, reliability, maintainability, safety serve



Define elemental operations

Alternative forms of raw materials and types of elemental operations

Analyze alternative processes

Unit production times and equipment utilization, alternatives equipment type

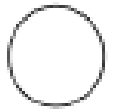
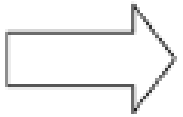
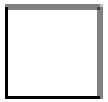
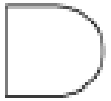
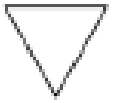
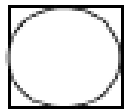
Evaluate Alternative Process

Economic evaluation of alternative equipment type

Design Process Tool

- *Operation Process Chart (OPC)*
  - *assembly chart*
  - *flow process chart*
  - *flow chart*
  - *from to chart*
  - *Multiple Product Process Chart (MPPC)*
- ***Route Sheet***
- *Activity Relationship Chart*

Operation Process Chart

Lambang	Keterangan
	Operasi
	Transportasi
	Inspeksi
	Menunggu
	Penyimpanan
	Aktivitas ganda

Operation Process Chart

- The operation process chart shows the chronological sequence of all operations, inspections, time allowances, and materials used in a manufacturing or business process, from the arrival of raw material to the packaging of the finished product.
- The chart depicts the entrance of all components and subassemblies to the main assembly.
- Two symbols are used in constructing the operation process Chart : an **operation** and an **inspection**.

Operation Process Chart

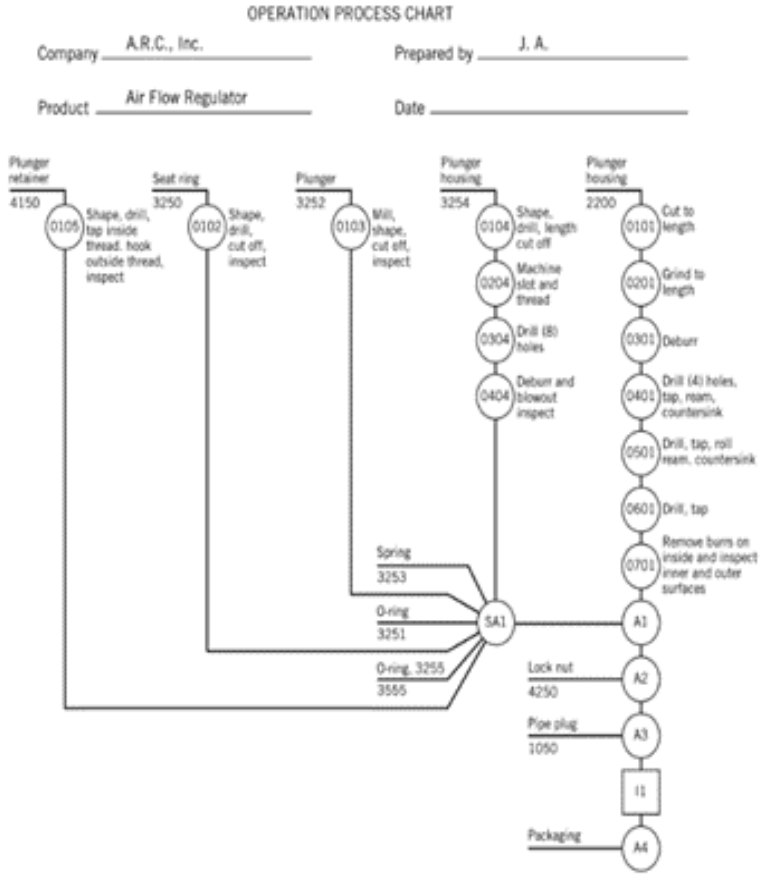
- Operations charts show the introduction of raw materials at the top of the chart on a horizontal line.

- Some parts require no fabrication steps. These parts are called buyouts. Buyouts are introduced above the operation

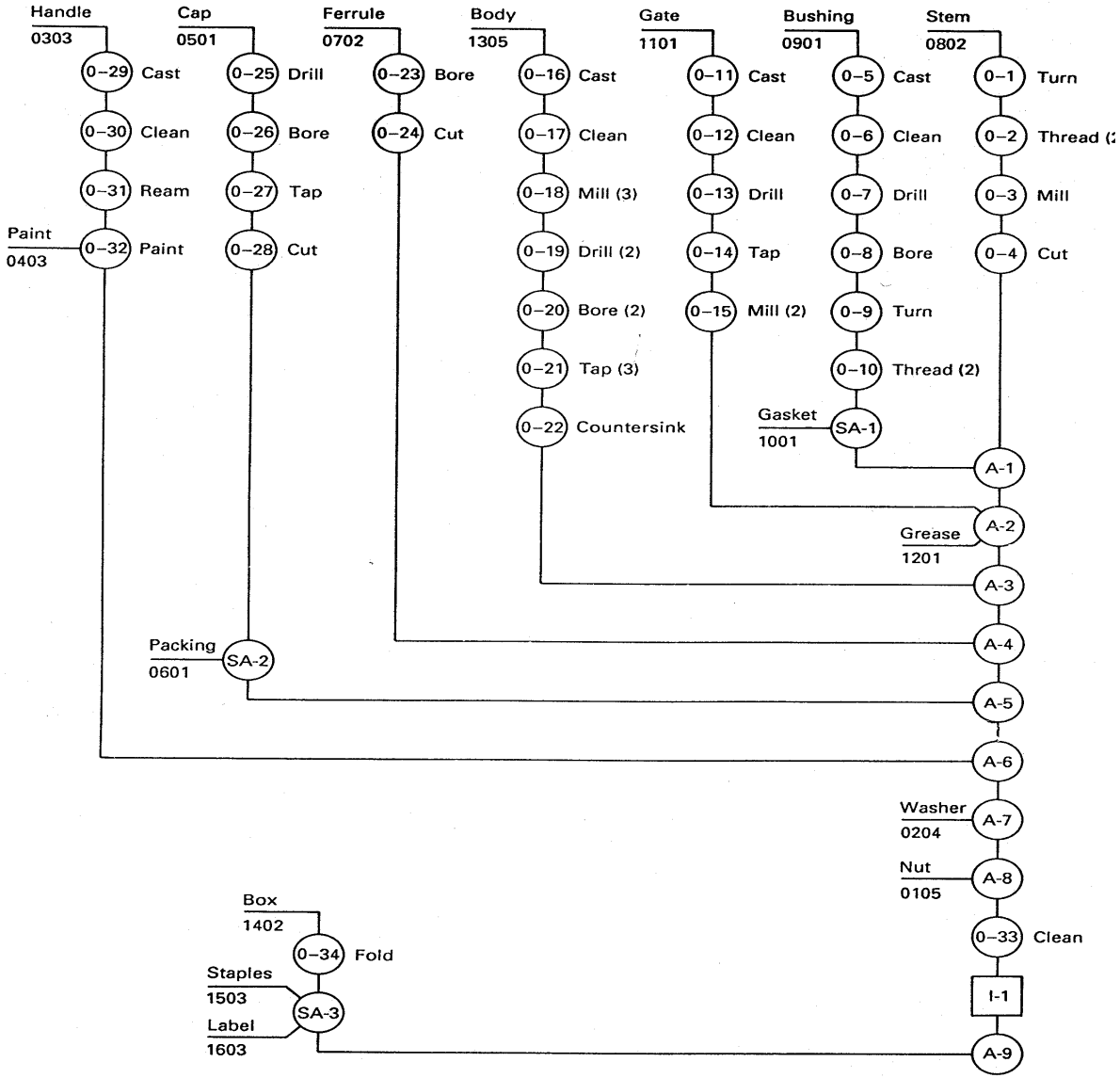
Operations Chart Steps

- Step by Step Procedures For Preparing an Operations Chart:
- Identify the parts to be manufactured and purchased
- Determine the operations required to fabricate each part and sequence them
- Determine the sequence or assembly for buyouts and fabricated parts
- Draw the operations chart as explained
- Put time standards, operation numbers and descriptions
- Calculate and write down the total hours required per 1,000 units

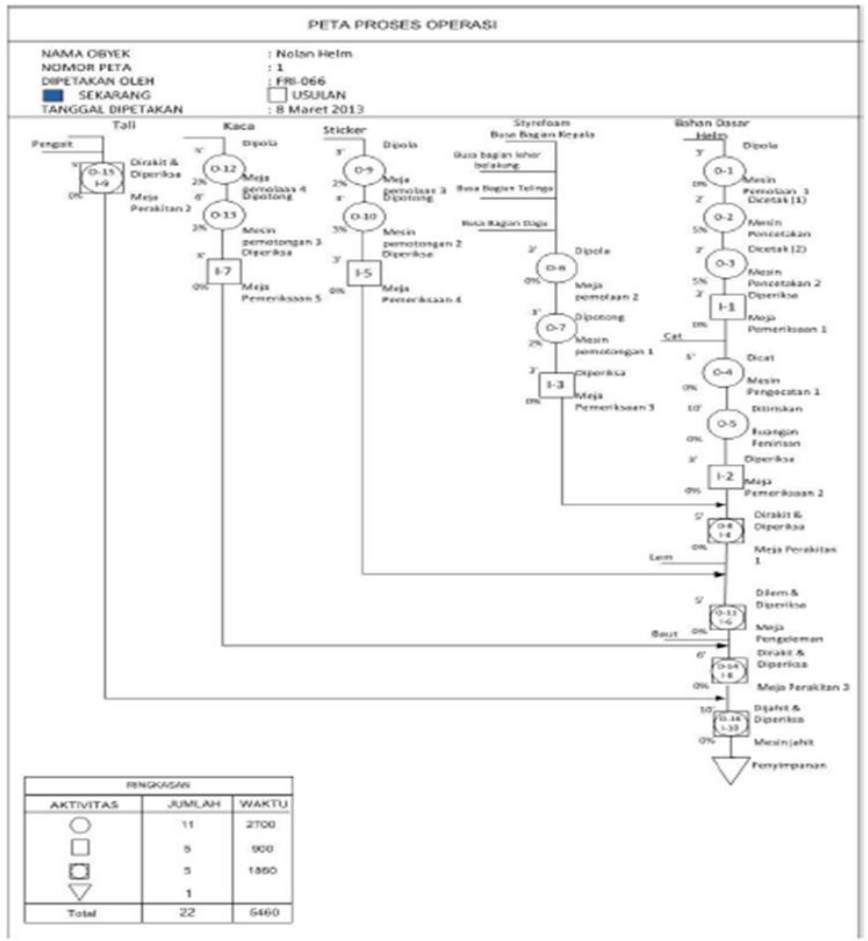
Operation Process Chart for the air flow regulator



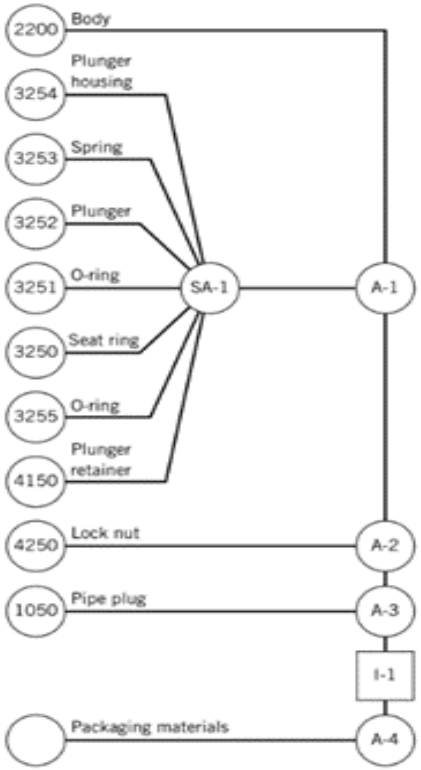
Operation Process Chart



Operation Process Chart

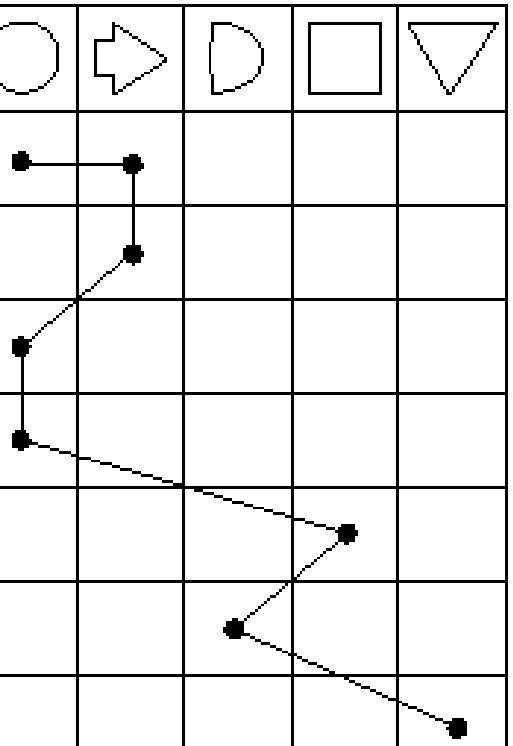


Assembly Chart for the air flow regulator



Flow Process Chart

Library selection	○	⇨	D	□	▽
Find book on shelves					
Take book to checkout					
Take book request form					
Complete request form					
Check form is completed correctly					
Wait for checkout completion					
Put book in briefcase					



Flow Process Chart

PETA ALIRAN PROSES

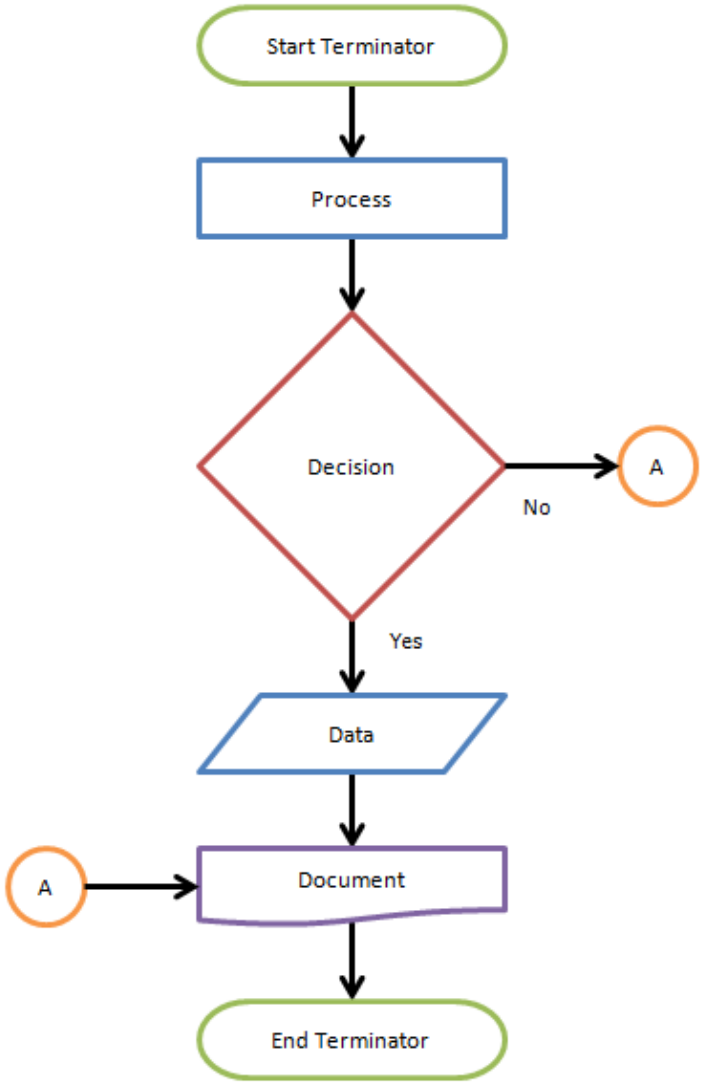
RINGKASAN

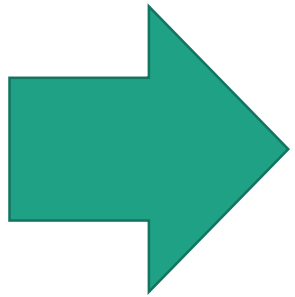
KEGIATAN	DISARANKAN JML	DISARANKAN WKT	USULAN JML	USULAN WKT	BEDA JML	BEDA WKT
OPERASI	6	6445				
PEMERIKSAAN	5	9				
TRANSPORTASI	5	65				
MENUNGGU	3	-				
PENYIMPANAN	1	-				
JARAK TOTAL	7					

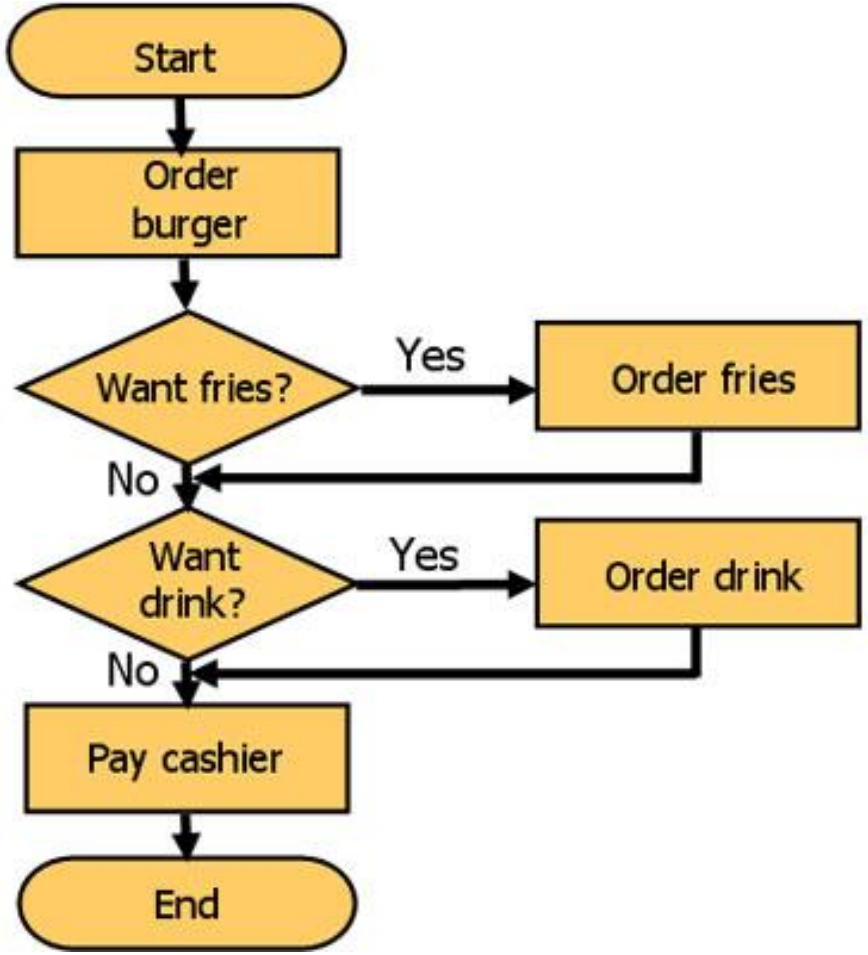
PEKERJAAN : Pembuatan Kopi
NOMOR PETA : 2
ORANG ☐ BAHAN ☑ KERTAS ☐
DISARANKAN ☑ USULAN ☐
DIPETAKAN OLEH : Cipto, Mandra, Cabuka
TANGGAL DIPETAKAN : 10 Juli 2009

URAIAN KEGIATAN	SEBARANG	JARAK (M)	WAKTU (M)	ANALISA	CATATAN	TINDAKAN
Bahan dipindahkan dibawa dari gudang ke meja persiapan	⇨	3	5			
Bahan dikeluarkan dari kotak	☐	-	11			
Bahan dibawa ke meja penimbangan	⇨	2	5			
Bahan ditunggu menunggu antrian	D	-	43			
Bahan dibawa ke meja proses	⇨	2	5			
Bahan menunggu untuk dicampurkan komposer dll	D	-	-			
Bahan diaduk	○	-	600			
Bahan diperiksa	☐	-	3			
Bahan menunggu untuk dicampurkan komposer dll	D	-	-			
Bahan diaduk	○	-	1400			
Bahan diperiksa	☐	-	3			
Bahan menunggu untuk dicampurkan komposer dll	D	-	-			
Bahan diaduk	○	-	2537			
Bahan diperiksa	☐	-	3			
Bahan dibawa ke gudang penyimpanan	⇨	-	-			

Flow Chart


Start Terminator
Process
Decision
No
A
Yes
Data
A
Document
End Terminator




Start
Order burger
Want fries?
Yes
Order fries
No
Want drink?
Yes
Order drink
No
Pay cashier
End

From to Chart

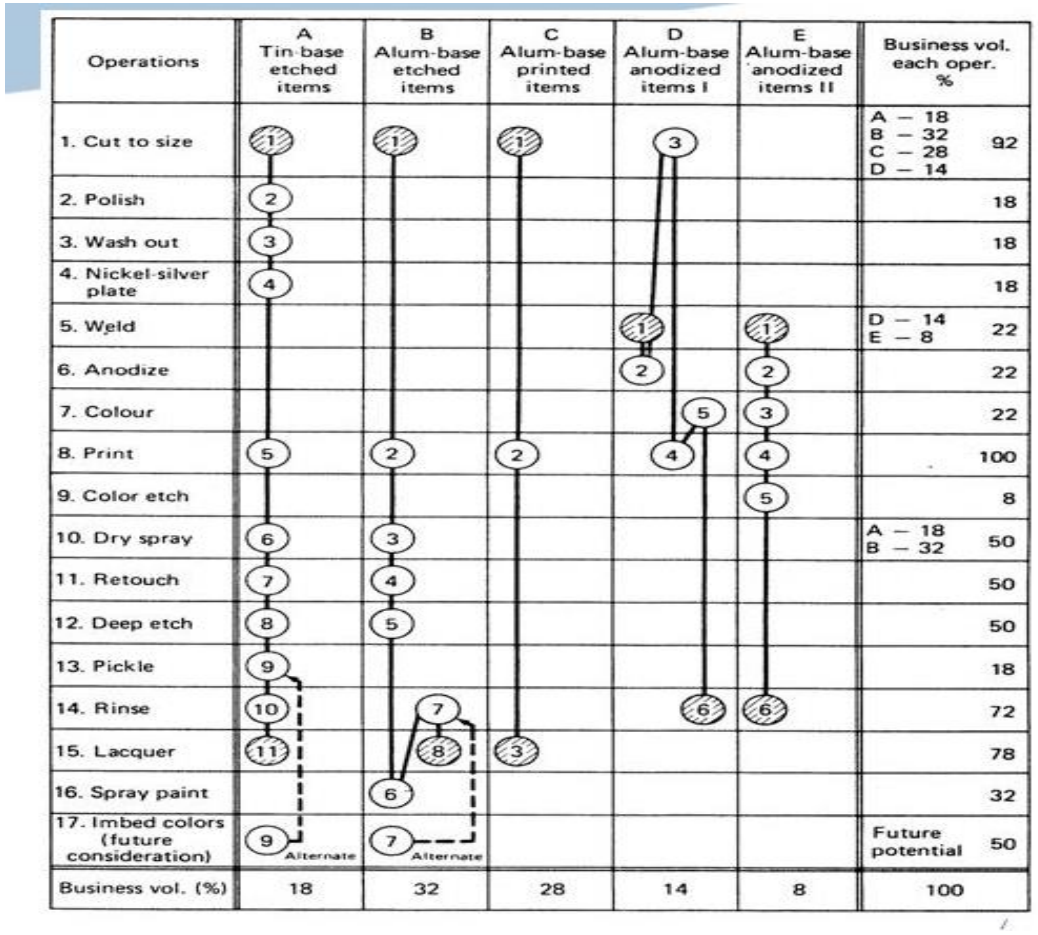
f: From-To Chart

This chart is a **matrix** that contains numbers representing a measure (units, unit loads, etc.) of the material flow between machines, departments, buildings, etc.

For example from stores to Saw 500

To / From	Stores	Saw	Grind	Weld	Lathe	Mill	Drill	Paint	Assemble	W'house	Total
Stores		500	100	200							800
Saw					300	200					500
Grind					200	100					300
Weld			200								200
Lathe						300	200				500
Mill							600				600
Drill								300	500		800
Paint									300		300
Assemble										800	800
W'house											-
Total	-	500	300	200	500	600	800	300	800	800	

Multiple Product Process Chart (MPPC)



Operations	A Tin-base etched items	B Alum-base etched items	C Alum-base printed items	D Alum-base anodized items I	E Alum-base anodized items II	Business vol. each oper. %	
1. Cut to size	1	1	1	3		A – 18 B – 32 C – 28 D – 14	92
2. Polish	2						18
3. Wash out	3						18
4. Nickel-silver plate	4						18
5. Weld				1	1	D – 14 E – 8	22
6. Anodize				2	2		22
7. Colour				5	3		22
8. Print	5	2	2	4	4		100
9. Color etch					5		8
10. Dry spray	6	3				A – 18 B – 32	50
11. Retouch	7	4					50
12. Deep etch	8	5					50
13. Pickle	9						18
14. Rinse	10	7		6	6		72
15. Lacquer	11	8	3				78
16. Spray paint		6					32
17. Imbed colors (future consideration)	9 Alternate	7 Alternate				Future potential	50
Business vol. (%)	18	32	28	14	8	100	

Route Sheet

Objective:

- To determine the number of material should be prepared in each process
- To determine the theoretical number of machine should be available

EXAMPLE PROCESS PLANS

Route Sheet by: T.C. Chang

Part No. S1243
Part Name: Mounting Bracket

workstation	Time(min)
1. Mtl Rm	
2. Mill02	5
3. Drl01	4
4. Insp	1

Oper. Routing Summary

Detailed Process Plan

PROCESS PLAN — ACE Inc.

Part No. S0125-F
Part Name: Housing
Original: S.D. Smart Date: 1/1/89
Checked: C.S. Good Date: 2/1/89

Material: steel 4340Si
Changes: _____ Date: _____
Approved: T.C. Chang Date: 2/14/89

No.	Operation Description	Workstation	Setup	Tool	Time (Min)
10	Mill bottom surface1	MILL01	see attach#1 for illustration	Face mill 6 teeth/4" dia	3 setup 5 machining
20	Mill top surface	MILL01	see attach#1	Face mill 6 teeth/4" dia	2 setup 6 machining
30	Drill 4 holes	DRL02	set on surface1	twist drill 1/2" dia 2" long	2 setup 3 machining

Operation Design

(Chapanis, 1985)

Discovers and applies information about human behavior, abilities, limitations, and other characteristics to the design of tools, machines, systems, tasks, jobs, environments for productive, safe, comfortable, and effective human use.

Human Performance Characteristics

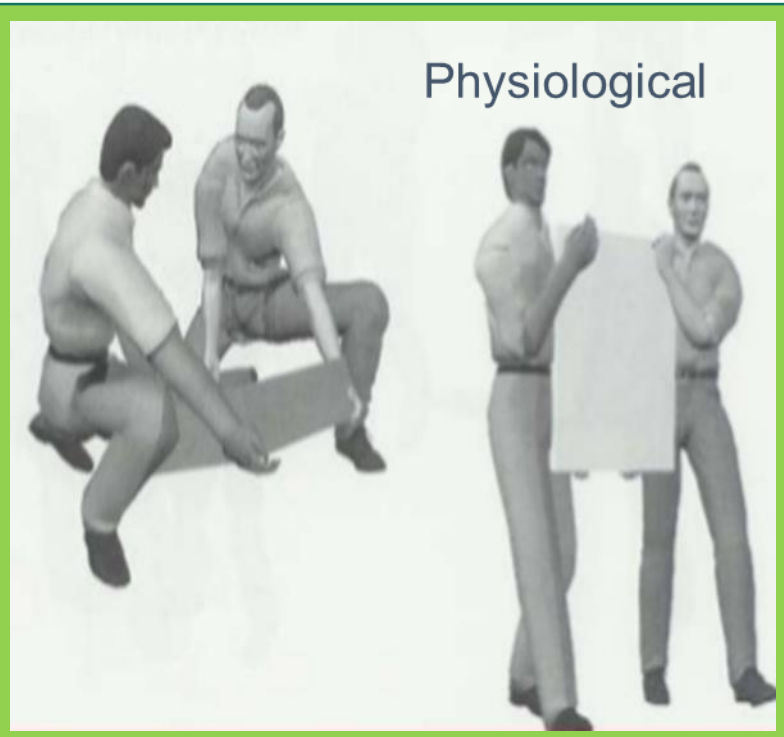
Fabrycky & Mize (1993)

Physiological performance characteristics

Psychological performance characteristics

Physiological performance characteristics

Physiological performance characteristics have to do with the physical aspects of human activities (we are concerned primarily with work activities) such lifting, reaching, carrying, hearing, seeing, and speaking.



Psychological performance characteristics

Psychological performance characteristics are those dealing with the mental aspects of human activities such as stress, boredom, and motivation

Psychological

Employee's Work Environment

Physical Aspect	Functional Aspect	Organizational Aspect	Compensation Aspect
Involve Science of anthropometry and ergonomics	Involve Industrial Engineering, work design, and work measurement	Require specialist in organizational structures, work analysis, and method design.	Require specialty in remuneration and incentive systems.

Human Interface With The Work Environment

1. Combination equipment
2. Workplace dimension
3. Light
4. Atmospheric contains
5. Temperature
6. Humidity
7. Air cleanliness
8. The work environment should be safe and attractive

Type of interface human with Machines

Manual man-machine system

Mechanical man-machine System

Automatic man-machine System

ERGONOMIC

Ergon
Kerja

+

Nomos
Hukum

=

Ergonomic

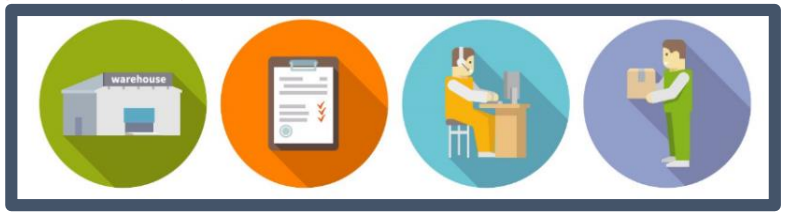
→

Disiplin ilmu yang mempelajari Manusia yang berkaitan dengan Pekerjaan

Ergonomic (NIOSH, 2007)

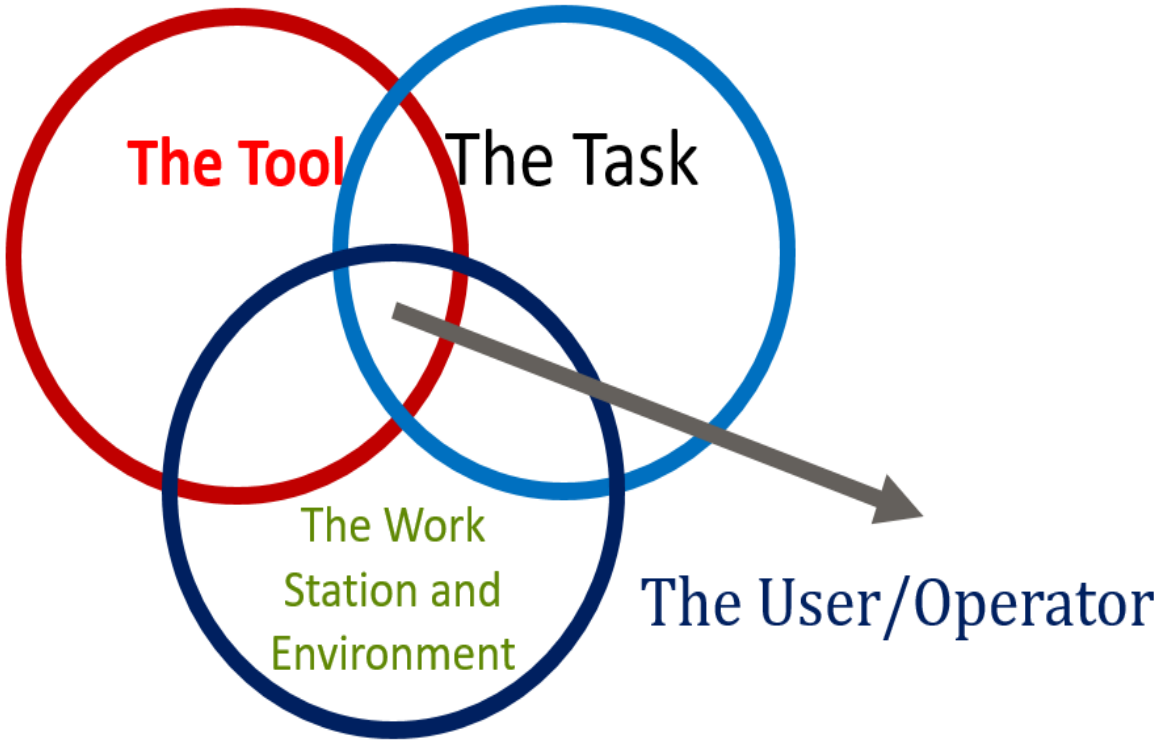
Suatu penerapan ilmu pengetahuan yang lebih menitik-beratkan rancangan fasilitas peralatan, dan perkakas sesuai dengan karakteristik anatomi, fisiologi, biomekanik, persepsi serta sikap kebiasaaan manusia.

Benefits of Ergonomics

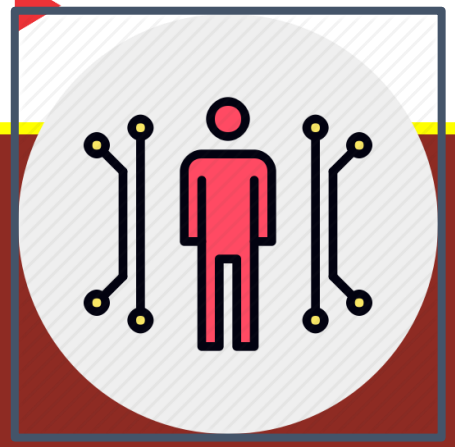


1. Productivity
2. Efficiency
3. Product Quality
4. Safety
5. Health
6. Reliability
7. Job Satisfaction
8. Personal Development

Ergonomic Scope



the context of ergonomics



Anthropometry:

A discipline that studies the human body's measurements and matches tools and work environments to these measurements.

Biomechanics:

A discipline that studies the exertion of forces by the human body.

Ergonomics deals with designing workstations, planning work methods, and designing work tools while taking the abilities and limitations of the human body into consideration. These abilities and limitations derive from the systems that comprise our body and from the processes that take place in our body.

Design Workstations

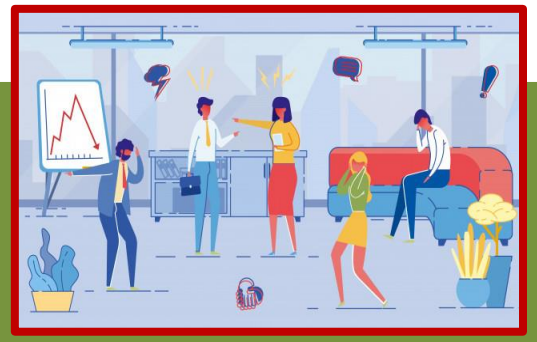
Planning Work Methods

Designing Work Tools

Aplikasi Ergonomi di Industri

Work Methods

Work Stations



Work Environment

Schedule Design

Schedule design

Schedule is designed to answer how much to produce and when will the product to be produced.

Production quantity decisions are referred to as lot size decisions; determining when to produce is referred to as production scheduling

In addition to how much and when, it is important to know how long production will continue; such a determination is obtained from market forecasts.

Need Market information

Schedule design

Has impacts in

- machine selection, number of machines
- number of shifts, number of employees
- space requirements
- storage equipment, material handling equipment, and personnel requirements
- storage policies
- building size, and so on.

Facilities Definition

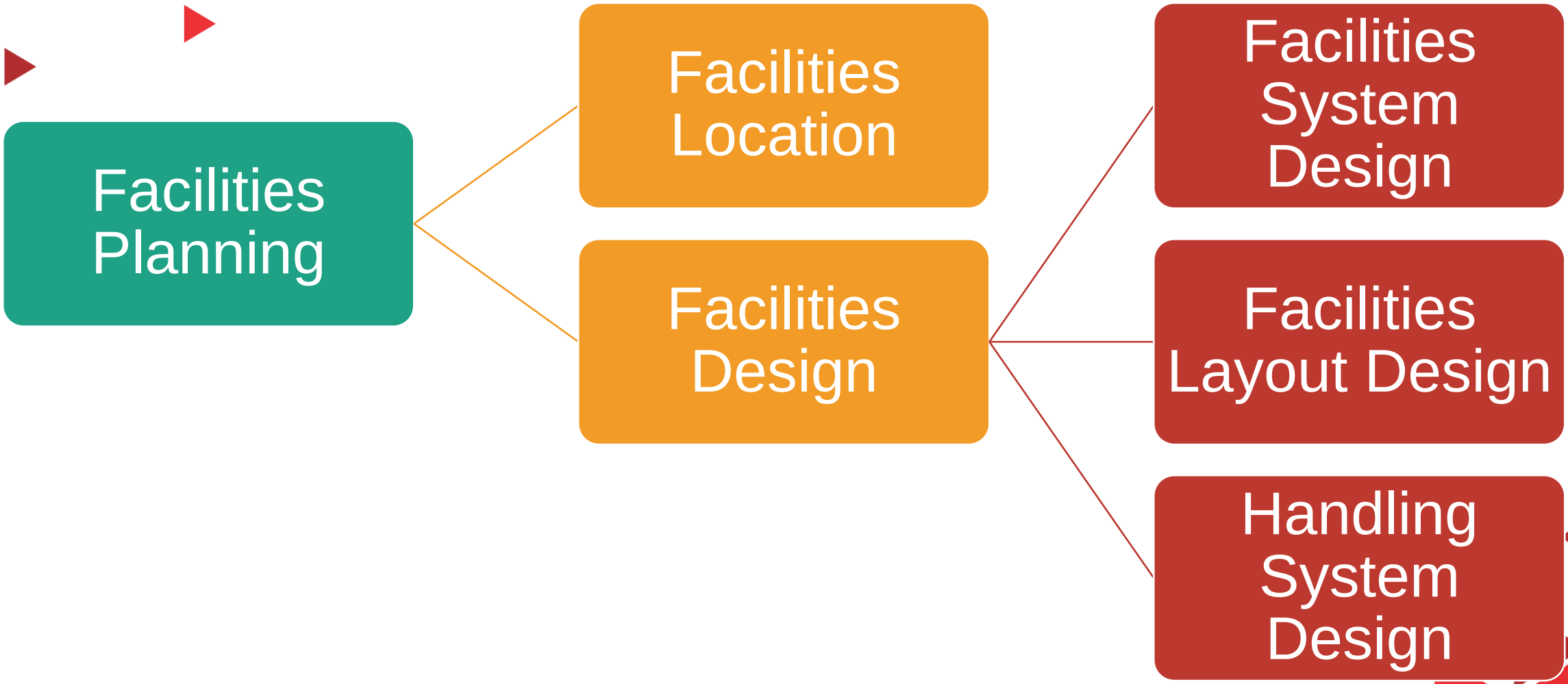
Buildings where **people, material, and machines** come together for a state of purpose (typically to make a tangible product or provide a service)

=

Jenis Sarana

Manufacturing and assembly center	Warehouse	Hospital	Bank
Airport Terminal	Office	School	Restaurant
Stadium	Health care	Distribution Center	etc

Facilities Planning Hierarchy



Facilities Location

Facilities Location

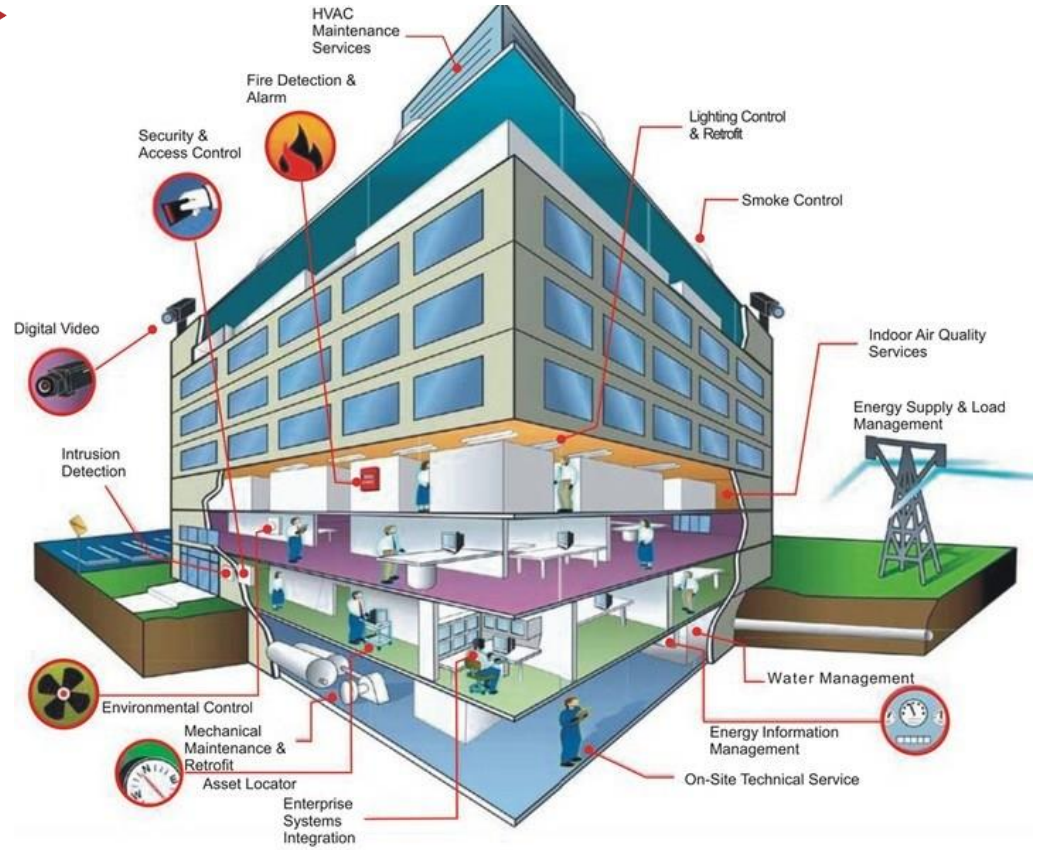
refers to its placement with respect to customers, suppliers, and other facilities with which it interfaces

The determination of Facilities location will consider

Source : Apple M. James

Facilities System Design

Facilities System Design



the determination of how the design component of a facility support achieving the facility's objective is referred to as facility design

Facilities System

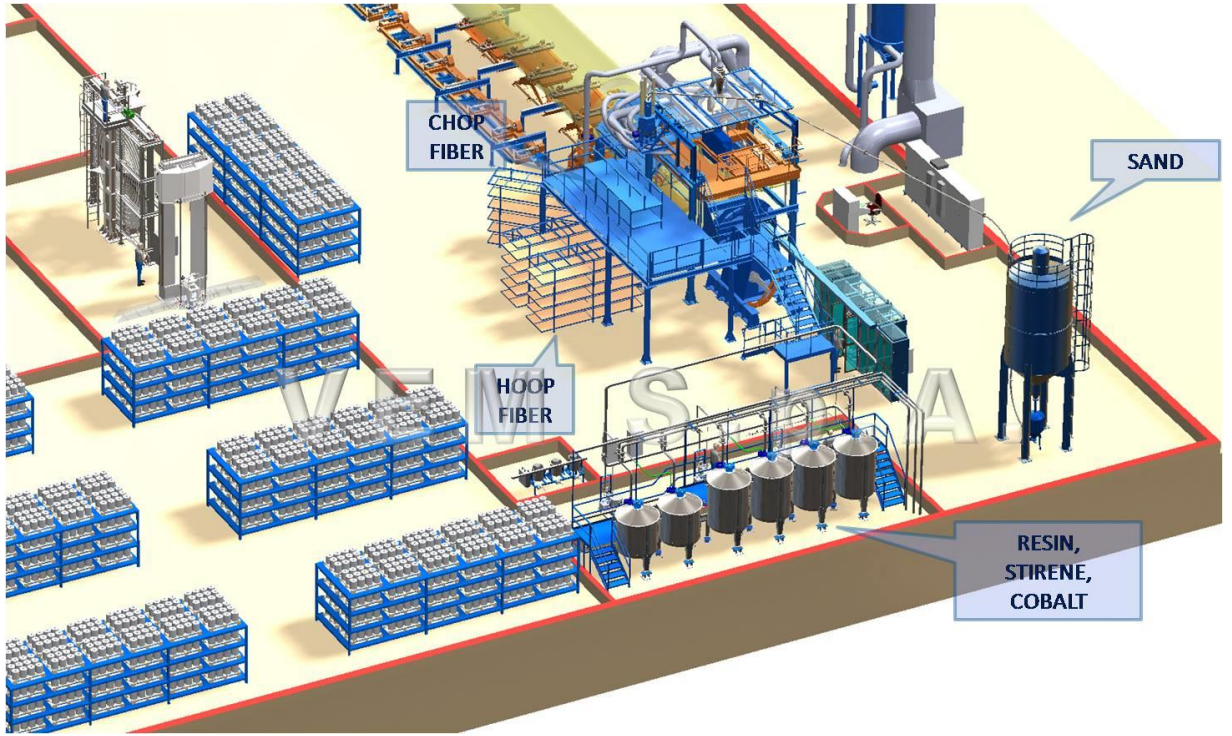
- Structural System
- Atmospheric System
- Enclosure System
- Lighting and Electrical System
- Life Safety System
- Sanitation System
- Building Automation System
- Computerized Maintenance Management System

Facilities Layout

Facilities Layout

Facilities Layout

Consists of all equipment, machinery and furnishings within the building/facilities.



Layout Type

- Product layout
- Process Layout
- Product Family Layout
- Fixed layout

Perencanaan Fasilitas yang Baik

Karakteristik Fasilitas yang Baik (Tompkins, et al 2016)

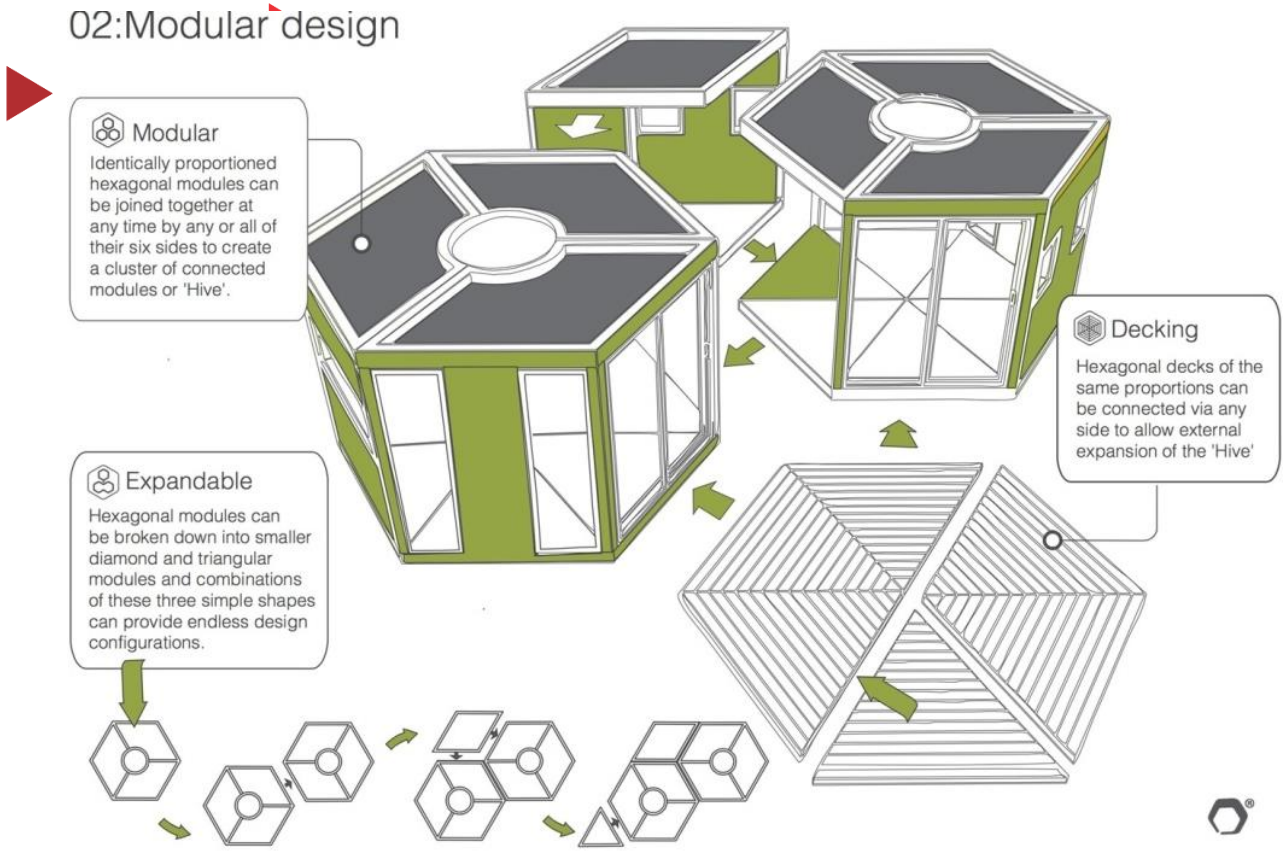
- Flexibility
- Modularity
- Upgradability
- Adaptability
- Selective Operability
- Environmental & Energy Friendliness

Flexibility

Fasilitas yang fleksibel akan dapat menangani **berbagai kebutuhan** tanpa diperlukan banyak **perubahan**

Fasilitas yang fleksibel memiliki kemampuan untuk **diubah atau disesuaikan** secara **cepat** untuk **mengikuti perubahan** kondisi

Modularity

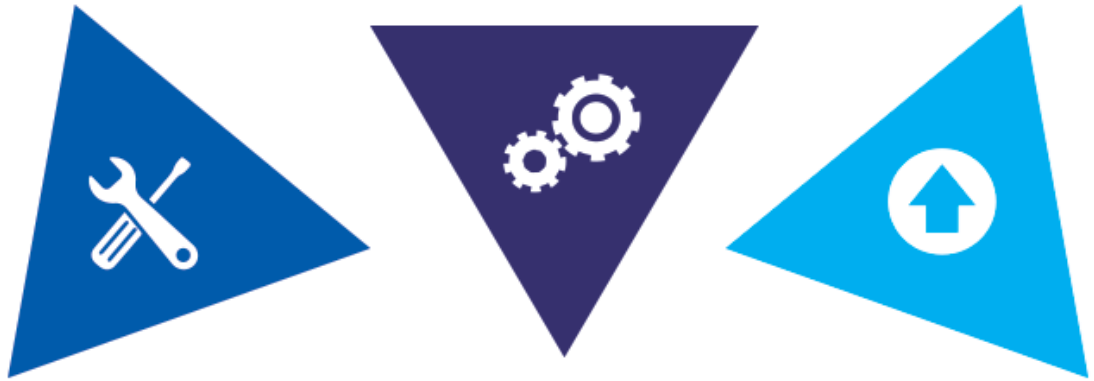


membagi sistem menjadi **bagian-bagian kecil (modul)** yang dapat mandiri dibuat dan kemudian digunakan dalam sistem yang berbeda untuk mengarahkan **beberapa fungsi**.

Modular facilities are those with systems that cooperate efficiently over a wide range of operating rates

Upgradability

Mampu mengintegrasikan kemajuan dalam sistem peralatan dan teknologi



Adaptability

Mempertimbangkan implikasi dari kalender, siklus, dan puncak dalam penggunaan fasilitas

Selective Operability

memahami **cara** setiap **segmen fasilitas beroperasi** dan memungkinkan rencana cadangan diterapkan.

rencana yang disusun untuk menghadapi situasi kritis yang diperkirakan akan terjadi

Environmental & Energy Friendliness

Menjalankan 5 kunci penting dalam menjaga kesehatan manusia dan lingkungan: **perkembangan lahan yang berkelanjutan**, **penghematan air, efisiensi energi, pemilihan material,** dan ***indoor environmental quality***

Holistic Approach to Create Such Facilities

Total Integration

- The integration of **material** and **information flow** in a true, top-down progression that begins with the **customer**.

Blurred boundaries

- the **elimination** of the traditional customer/supplier and manufacturing/warehousing relationships, as well as those among order entry, service, manufacturing, and distribution

Consolidation

- the **merging of similar and disparate business entities** that results in fewer and stronger competitors, customers, and suppliers. Consolidation also includes the **physical merging of sites, companies, and functions.**

Holistic Approach to Create Such Facilities

Reliability

- the implementation of robust systems, redundant systems, and fault-tolerant systems to create a very high levels of uptime.

Maintenance

- a combination of preventive and predictive maintenance.
- Preventive maintenance is a continuous process that minimize future maintenance problems.
- Predictive maintenance anticipates potential problems by sensing the operations of a machine or system

Economic progressiveness

- the adoption of innovative fiscal practices that integrate scattered information into a whole that may be used for decision making


THANK
YOU