Production Planning and Control
MG2029, 6.0

Production Engineering

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Course Crew

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Malin Pops Runsten	Lean production	08-790 94 27	mrunsten@kth.se

Course overview

Intended learning outcomes

After successfully completion of the course, students should be able to;

- explain fundamental principles and hierarchy embraced in the traditional production planning and control system,
- develop an aggregate plan for a multi component product manufacturing,
- suggest master production schedule and material requirement plan for a given aggregate plan,

Course overview

Intended learning outcomes

- Apply the proper inventory control method for a product with known demand,
- Describe the principles of push and pull control policies,
- Characterize the fundamental principles of lean philosophy and its tools,
- Apply value stream mapping for current and future cases to a given case study.

Teaching and learning activities

Lectures

- Theoretical aspects of the course will be presented and discussed in the lectures,

- Attendance to lectures is not a must

  however

  there will be some details given in lectures which might be beyond the coverage of the course literature. Since final exam will cover the content in lectures, your attendance is highly recommended.

- All lectures will be in classrooms unless otherwise stated.

Lecture Schedule

Week	Weekday	Begin date	Begin time	End time	Activity	Room	Info	Lecturer
w35	Tuesday	2023-08-29	08:00	10:00	Lecture	F2	Course introduction	HA, SB
w35	Thursday	2023-08-31	10:00	12:00	Lecture	M2	Aggregate planning	MW
w36	Monday	2023-09-04	08:00	10:00	Lecture	M2	Inventory Control	DS
w36	Tuesday	2023-09-05	08:00	10:00	Lecture	D1	Exercise lecture	MW, DS
w36	Thursday	2023-09-07	10:00	12:00	Lecture	M2	Lean Production -1	JS, MR
w37	Monday	2023-09-11	08:00	10:00	Lecture	M1	Lean Production -2	AB, MR
w37	Tuesday	2023-09-12	08:00	10:00	Lecture	M2	VSM - Value Stream Mapping	EB
w40	Tuesday	2023-10-03	08:00	10:00	Lecture	M2	Material Requirement Planning	SB
w40	Thursday	2023-10-05	10:00	12:00	Lecture	M2	Operations Scheduling	SB
w41	Monday	2023-10-09	08:00	10:00	Lecture	M1	Exercise lecture	SB
w41	Tuesday	2023-10-10	08:00	10:00	Lecture	M2	Todays challenges in planning	MW
w41	Friday	2023-10-13	09:00	12:00	Seminar	TBC	Toyotas 14 management principals	JS, AB, MR
w41	Friday	2023-10-13	13:00	16:00	Seminar	TBC	Toyotas 14 management principals	JS, AB, MR

This is the final schedule of lectures. Central schedule is updated accordingly at August 28th.

Teaching and learning activities

Production game

- Production game is a kind of board game emulating production and assembly environments illustrating the problems encountered in a traditional environment.
- It is composed of 3 rounds running at separate dates. For each run you need to book a time among a number of occasions. Find invitation in Canvas under calendar invites.
- The responsible instructor for the game is Eleonora Boffa, boffa@kth.se. Activity room is M231, Brinellvägen 68.
- Attendance is obligatory.
- Being there on time is important.

First session is on Monday, book your seats on time.

Teaching and learning activities

Lean Training Lab (by Atlas Copco)

- Concepts and tools of the lean philosophy given in lectures will be observed and implemented on a real assembly system operated by students. Book a time in Canvas!
- Location will be at Production Engineering department, Brinellvägen 68, (beside ping pong table).
- Labs will start at15:00.
- Attendance is obligatory and being there on time is very important.
- Eleonora Boffa, boffa@kth.se, is the responsible instructor.
- Video

Teaching and learning activities

A case study - Value Stream Mapping (VSM)

- You will have a group assignment about VSM.
- There will be 2 VSM tutorial/workshop sessions where you will have the opportunity to work as group on the case and ask your questions to VSM instructors.
- VSM assignment will be graded out of 5 points and the result will be added as bonus points to your final exam.
- Groups will be formed in Canvas under People - Groups. You will get further information in upcoming weeks.
- Eleonora Boffa, boffa@kth.se, is the responsible instructor.

Teaching and learning activities

Toyota 14 management principles discussion

- Each student will be assigned to a principle. He/she needs to study and present it to his/her own group mates.
- Each presentation will be max 10 mins. Presentation material is completely up to the student.
- Attendance is obligatory.
- You will get further information in upcoming weeks.
- There will be two sessions at October 13th.
- Further information will be posted on details.
- Johanna Strömgren, Andreas Bohlin and Malin Runsten are the responsible instructors.

Course overview

Attendance

- You cannot complete the course if you miss a compulsory activity.
- Missing a lab can only be compensated by attending it the following year !

Course Overview

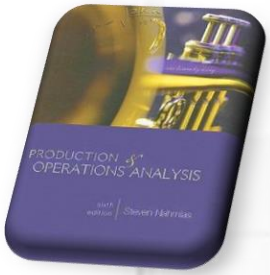
Assessment and examination

	Written Exam		Production Game	VSM Assignment	Lean Lab	Toyota Discussion
	Basic part (No VSM bonus)	Advanced part	P/F	(Bonus points)	P/F	P/F
E	70%		Pass	Create Current state map and populate it with the data provided in the project	Pass	Pass
D		50%				
C		60%		Analyze the operations, propose changes and create future state map & action plan accordingly		
B		70%				
A		85%		Conduct peer-review of another project group		

Course overview

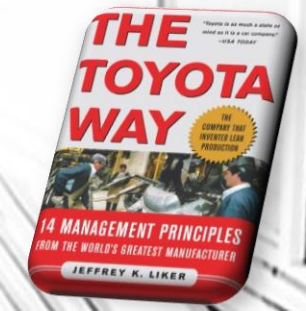
Literature

- Production and Operation Analysis,
  Steven Nahmias
  Related chapters are given in the Course PM in Canvas.



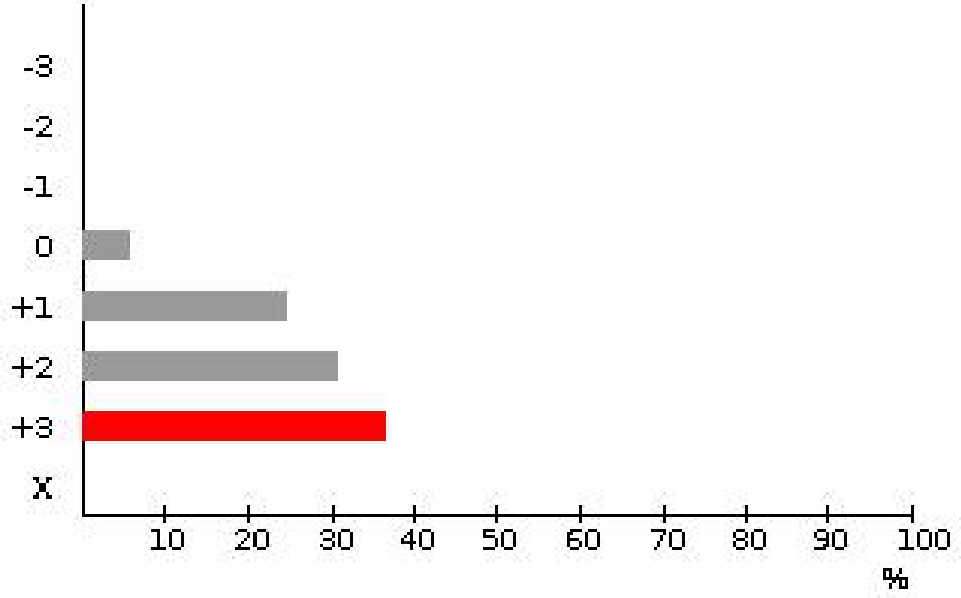
- Any lean book will be sufficient. Below book is an option.
  Lean – Turn Deviations to Success, (English)
  Peterson, Broman et al., ISBN 978-91-633-4587-6
  Lean– Gör avvikelser till framgång, (Swedish) Peterson, Broman et al., ISBN 978-91-633-2796-4
  Related chapters: All the chapters.

- The Toyota Way - 14 Management Principles from the World's Greatest Manufacturer,
  Jeffrey Liker, ISBN 0-07-139231-9
  (Related parts will be provided)



Feedback from past

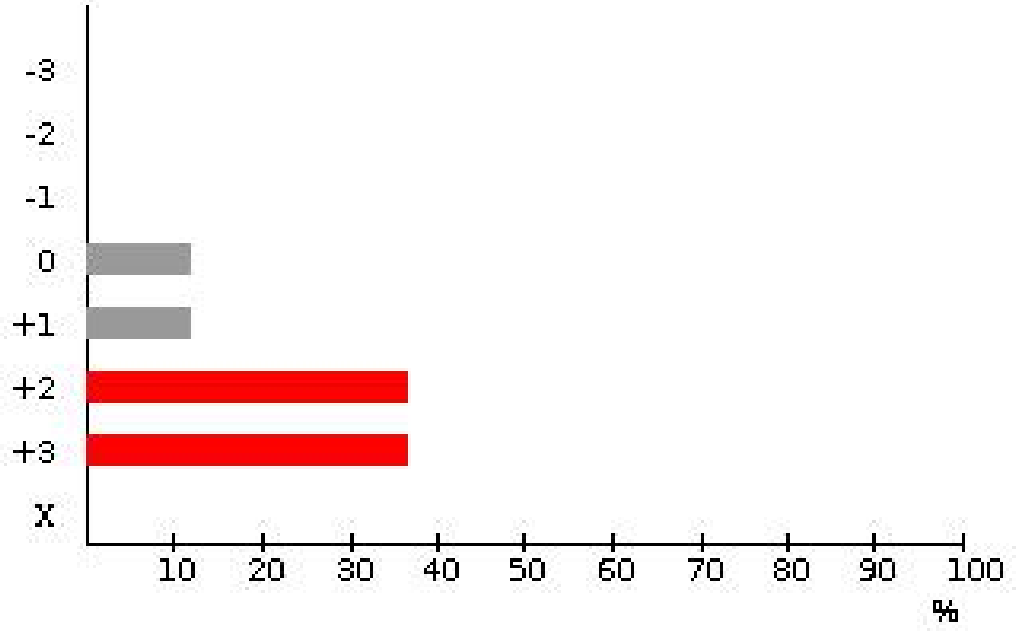
The course was challenging in a stimulating way
-3: strongly disagree with the statement...
0 : neutral to the statement...
+3: strongly agree with the statement



Feedback from past

I had the opportunity to try, and to learn from the experience

-3: strongly disagree with the statement...
0 : neutral to the statement...
+3: strongly agree with the statement



Feedback from past

What was the best aspect of the course?

-VSM project in combination with Lean training lab, the Production Game and all the rest interactive activities.

-The experiments or the simulations in famous companies. It gave you deep impression on what you learned in class.

-The open, informal and informative nature of the course.

-The course structure is very well thought through, mixing different exercises in order to give the student a holistic perspective. This structure should be a template for other courses at KTH. I feel that I will have great use of much of what I learned in the course.

-Lean lab. It was really interesting to see in practice how the LEAN tools can benefit a production line.

-That it was able to combine the theoretical aspect of learning with some visit to companies that you actually get to know things from the inside.

Feedback from past

What advice would you like to give to future course participants?

-Solve the book's problems and pay attention to theory as much as problems.

-Repeat the information after each 1-2 courses and take notes, otherwise is somehow complicated without having previous experience to connect the dots between the taught material and the one in the Production and Operations Analysis book.

-take it seriously, it is really helpful

-Try to follow teacher every class, it's really useful and helpful.

Production planning and control

Definition

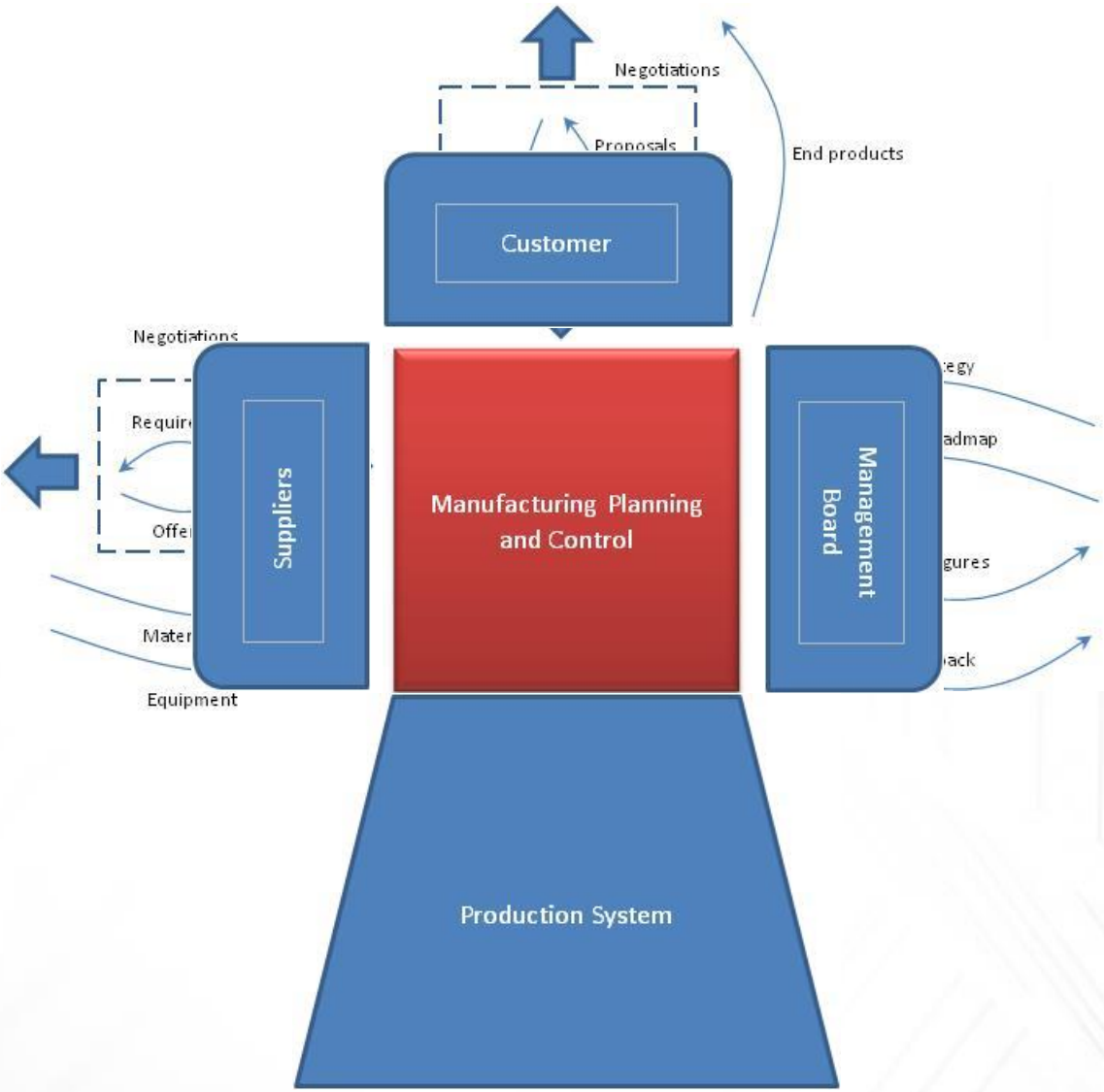
A production (or manufacturing) planning and control (PPC) system is concerned with planning, directing and controlling all aspects of manufacturing, including materials, scheduling machines and people, and coordinating suppliers and customers. *(Vollmann et al., 2011, p. 1)*

PPC systems nowadays

1. **Internationalization**: Growth in international markets has had a crucial impact on the PPC context. Global customer base and international suppliers have become a reality. The composition of supply chains change based on opportunities. This requires international, transparent and effective PPC systems.

2. **The role of the customer:** Meeting customer requirements and service demands are crucial. Both product and process flexibility is needed to produce customized products at variable volumes.

3. **Information technology:** Responding to global coordination and communication requirements calls for the deployment of information systems to link functionally disparate, geographically dispersed and culturally diverse organizational units.



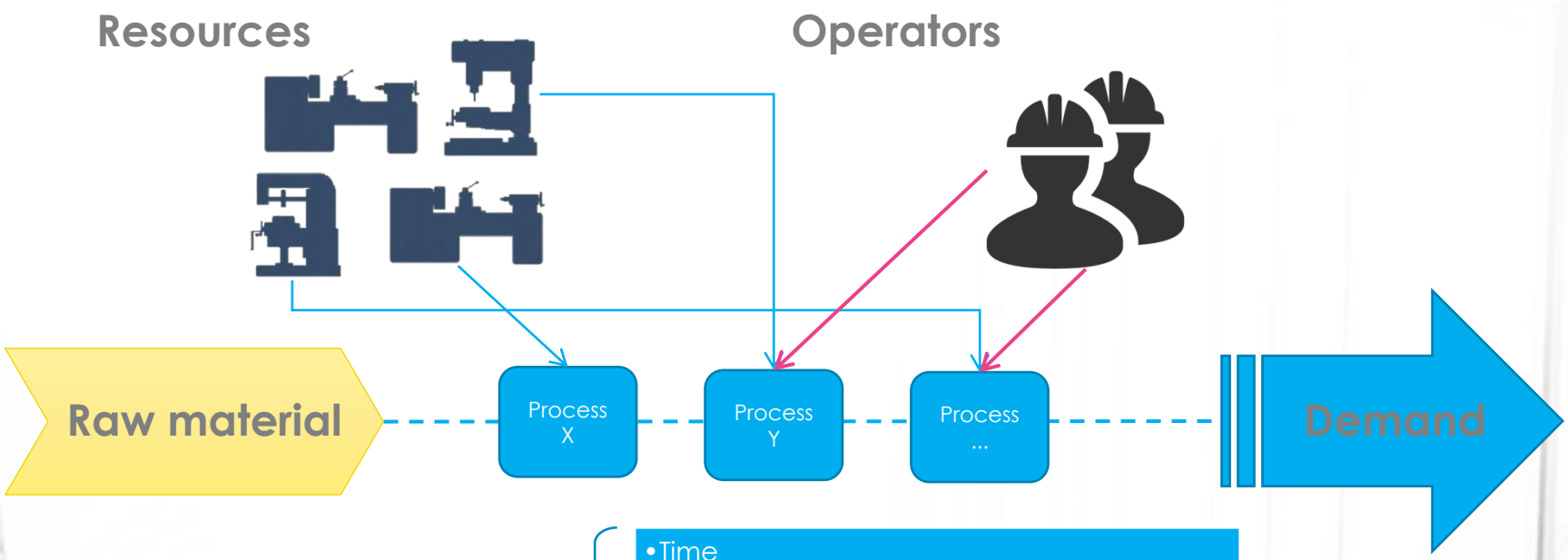
PPC Objectives

PPC system has to be adaptive !

A PPC system needs to continuously adapt and respond to changes in:

- Company environment
- Strategy
- Customer requirements
- New supply chain opportunities
- Particular shop floor problems
- …

PPC Objectives

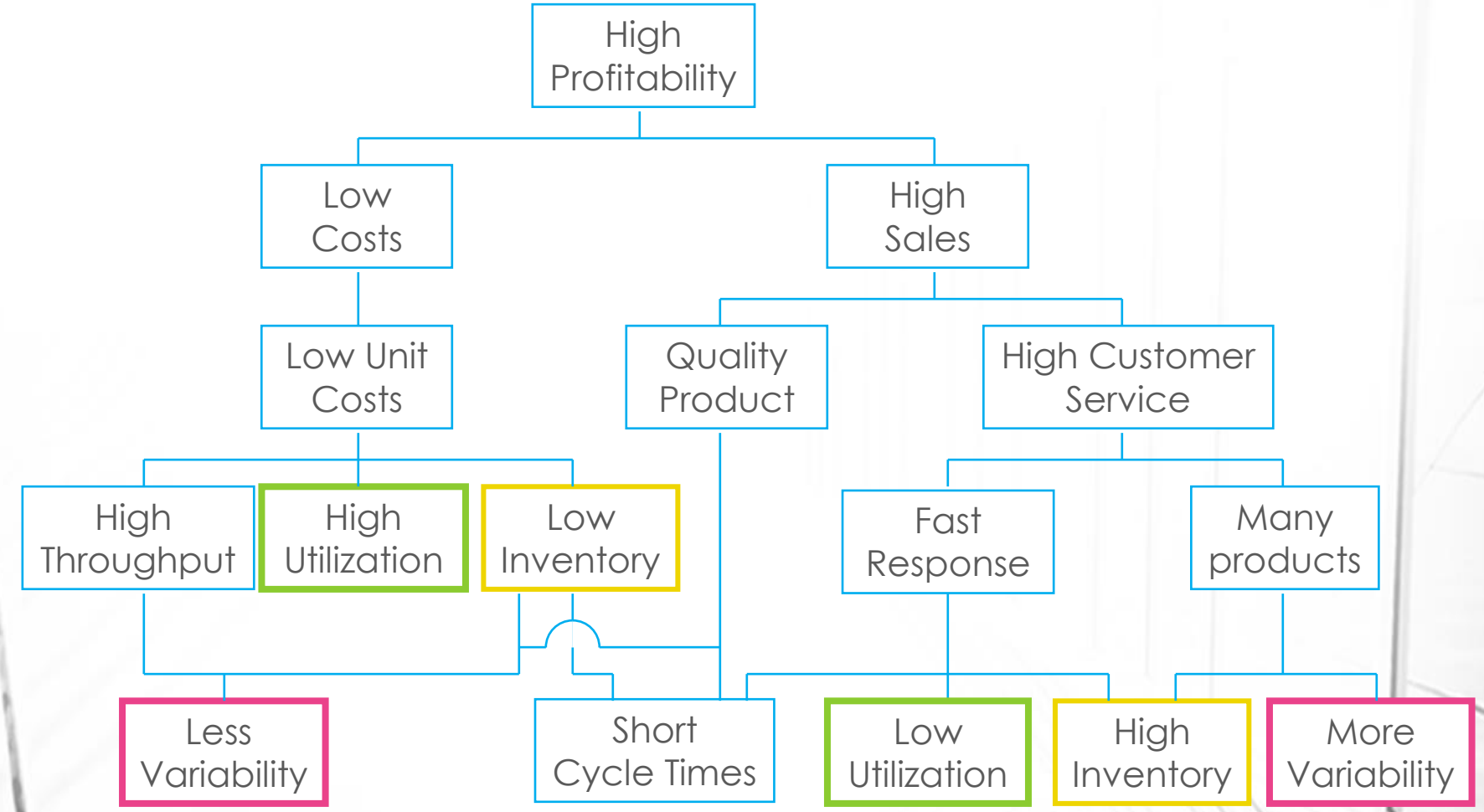


Constraints
- Time
- Money
- Resource
- ...

Uncertainties
- Machine breakdown
- Demand changes
- New technologies
- ...

Targets
- Economical
- Sales
- Timing

Conflicting objectives



Objectives in general

Production planning and control

- Effective utilization of resources.
- Steady flow of production.
- Estimate the resources.
- Ensures optimum inventory.
- Co-ordinates activities of departments.
- Minimize wastage of raw materials.
- Improves the labour productivity.
- Provides a better work environment.
- Facilitates quality improvement.
- Results in consumer satisfaction.
- Reduces the production costs.

Objectives

In short

To produce the product

of right quality

in right quantity

at right time

by optimum use of resources.

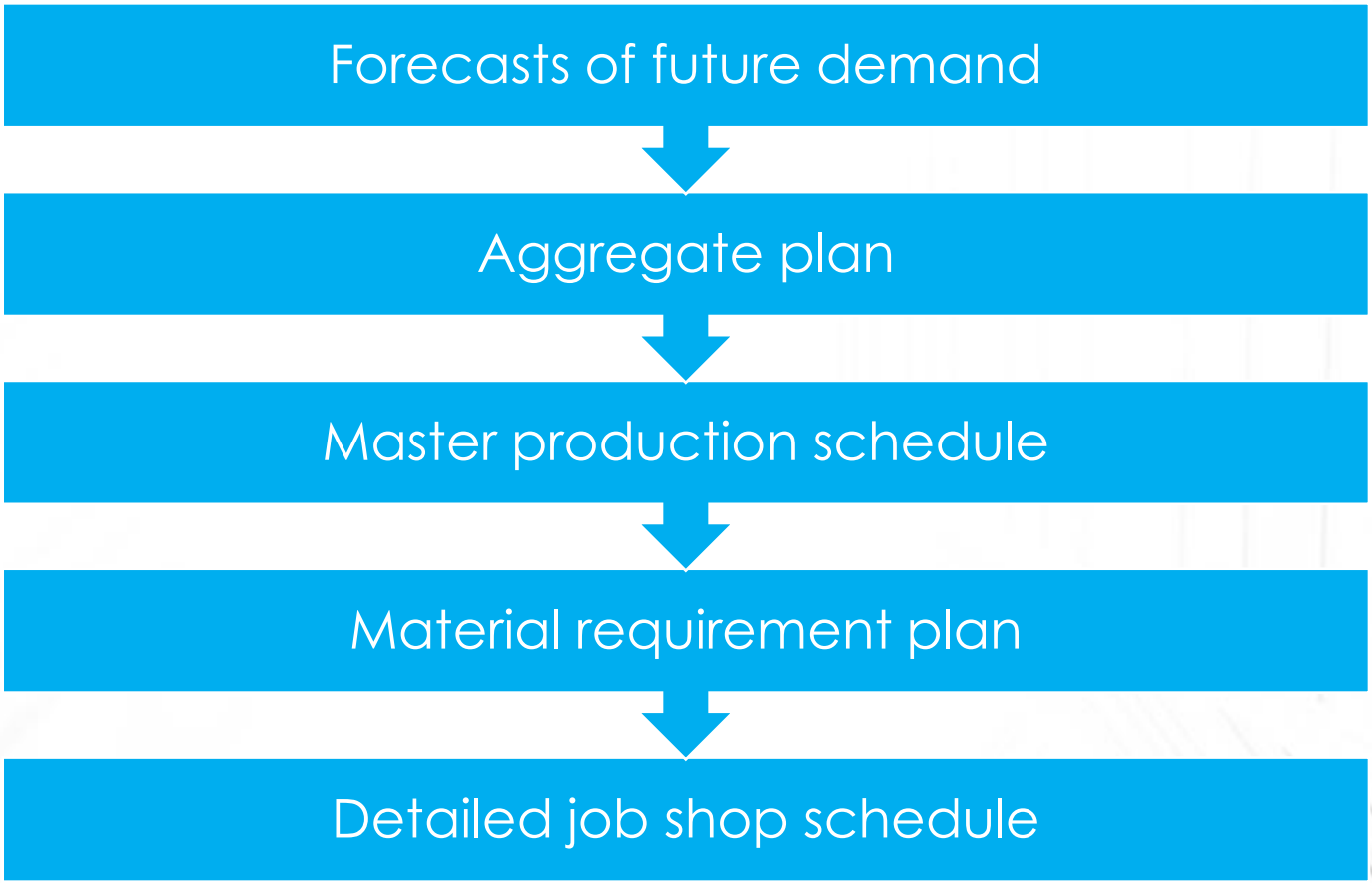
Levels of production planning

- Factory planning
  Planning of the facility location, decision of the number, responsibilities and relations of the departments.

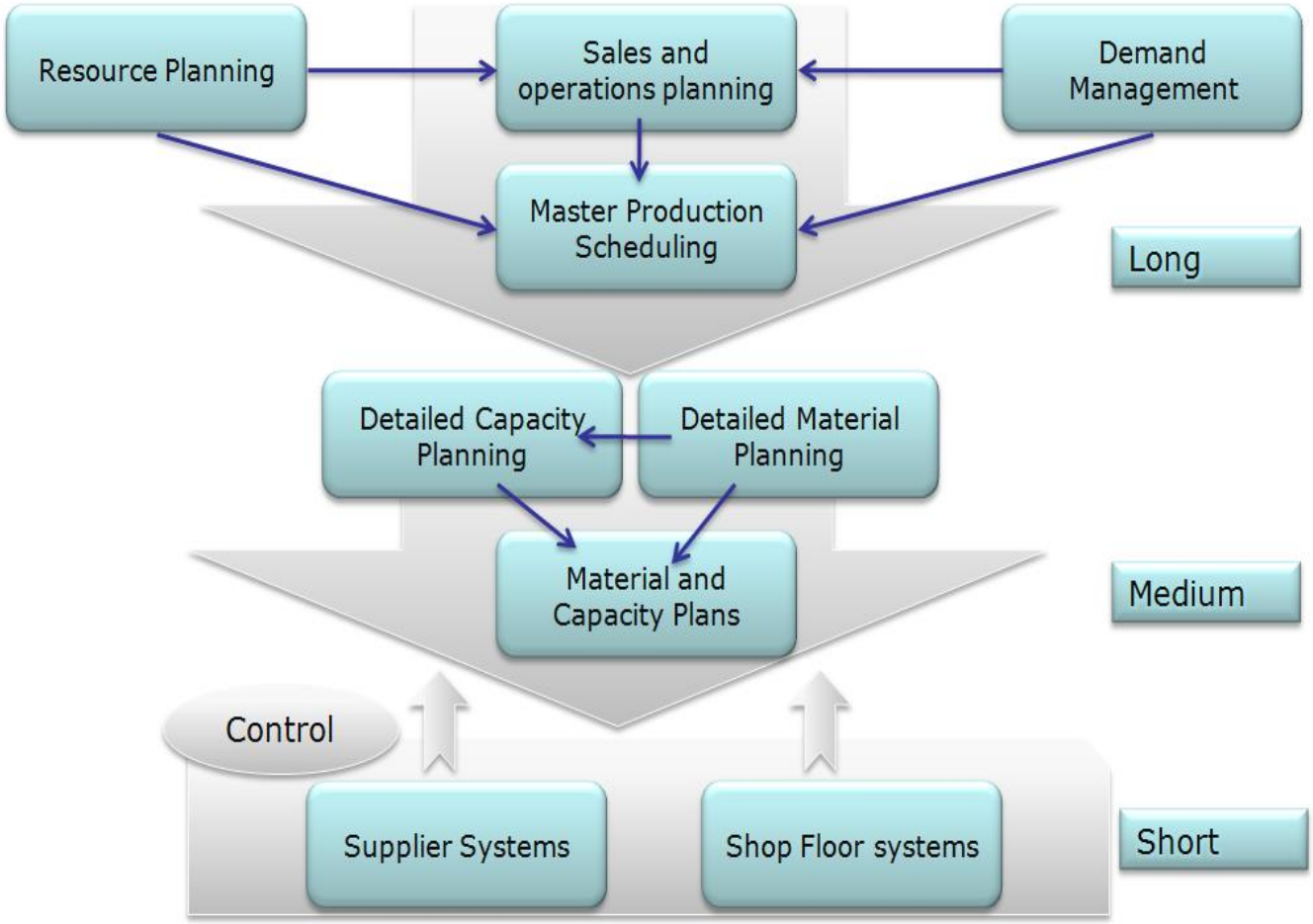
- Process planning
  Determination of required process in order to convert inputs into desired outputs, allocation of them to departments, sequencing inside the departments.

- Operations planning
  Planning the details of the methods required to perform each operation such as selection of work centers, designing of tools required for various operations. Then the sequences of work elements involved in each operation are planned. Specifications about each transfer, work centers, nature of tools required and the time necessary for the completion of each operation are prescribed.

Planning hierarchy



An PPC framework



Enterprise Resource Planning (ERP) System

PPC support activities

Under three time horizons: **long, intermediate and short term**

Long term objectives are achieving

- appropriate amount of capacity in terms of equipment, buildings, suppliers, manpower, machinery etc...
- optimum mix of human resource capabilities, technology and geographical location,
- proper capacity plan for key suppliers,

in order to meet the market demand of the future.

PPC support activities

Intermediate term objectives

- matching supply and demand in terms of both volume and product mix,
- providing exact material and production capacity needed to meet customer demand
- planning of capacity to determine employment levels, budgets, overtime and subcontracting needs, etc

PPC support activities

Short term objectives

- detailed scheduling of resources (people, material, equipment, facilities, time...)to meet demand,
- tracking the use of resources and execution to extract performance measures such as equipment and labor utilisation, completion of orders, material consumption etc.
- Incase of unexpected occurances provide problem solving support

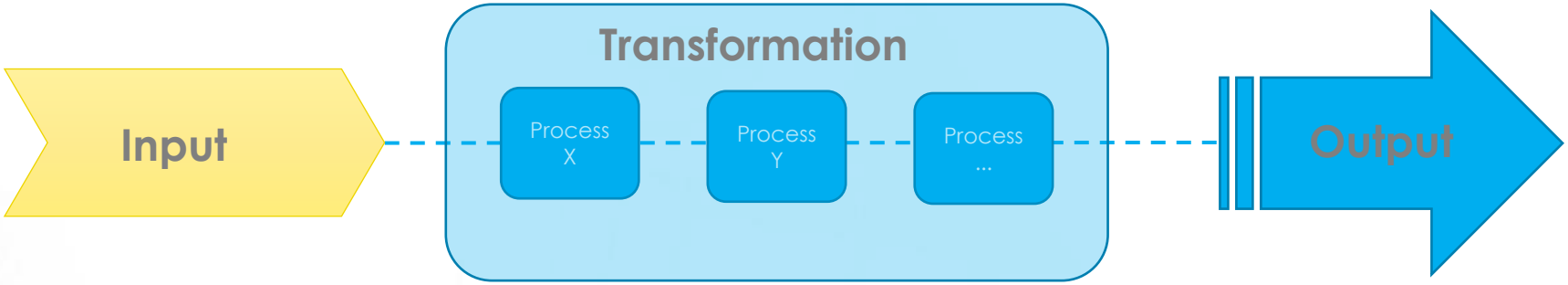
Production Control

Definition and objectives

- Production control is a mechanism to monitor the execution of the plans. It has several functions.
  - Making sure that production operations are started at planned places and planned times,
  - Observing progress of the operations and recording it properly,
  - Analyzing the recorded data with the plans and measuring the deviations
  - Taking immediate corrective actions to minimize negative impacts of deviations from the plan,
  - Feeding back the recorded information to the planning department to improve future plans

Production control

Open loop control system

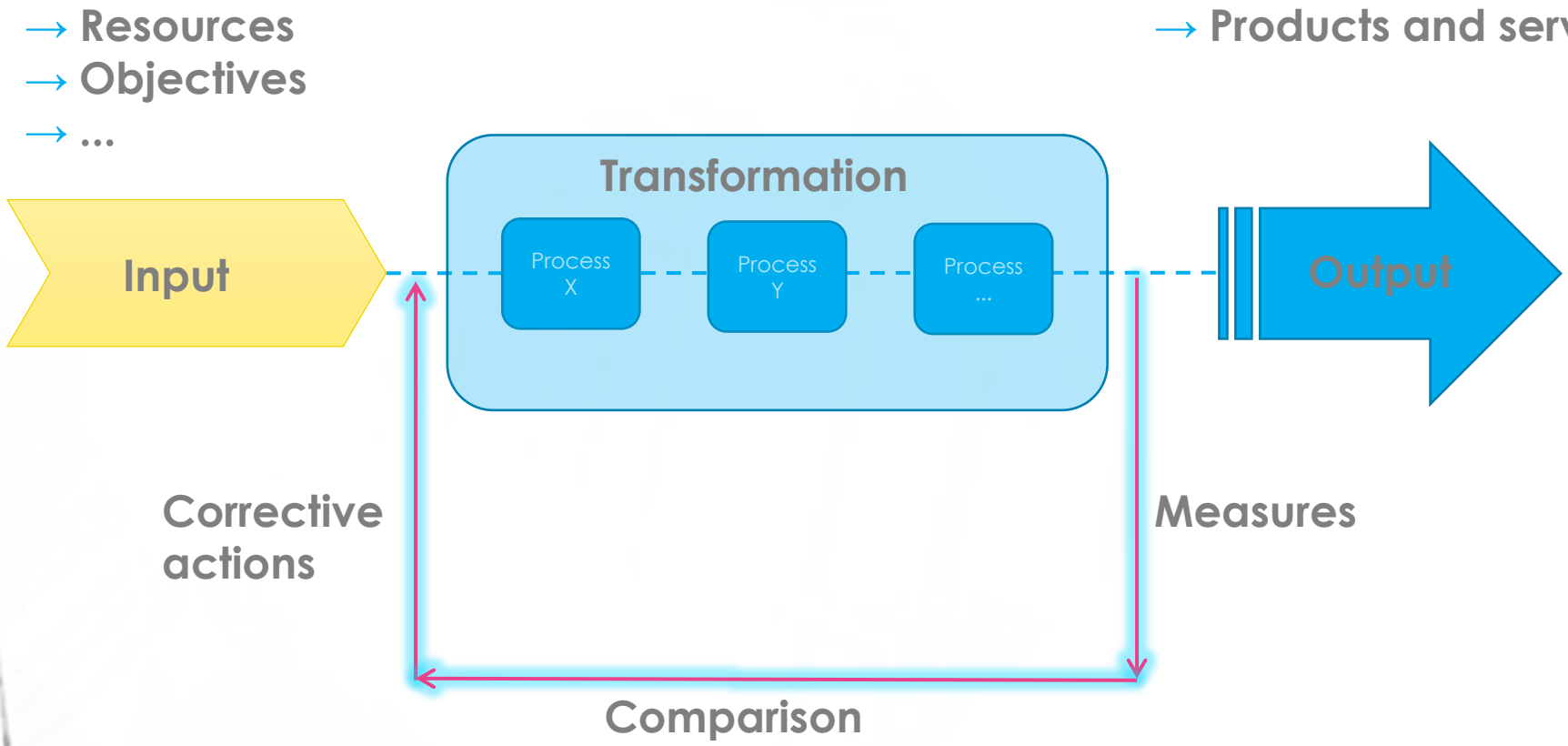


→ Resources
→ Objectives
→ ...

→ Products and services

Production control

Closed loop control system



Production control

What to control

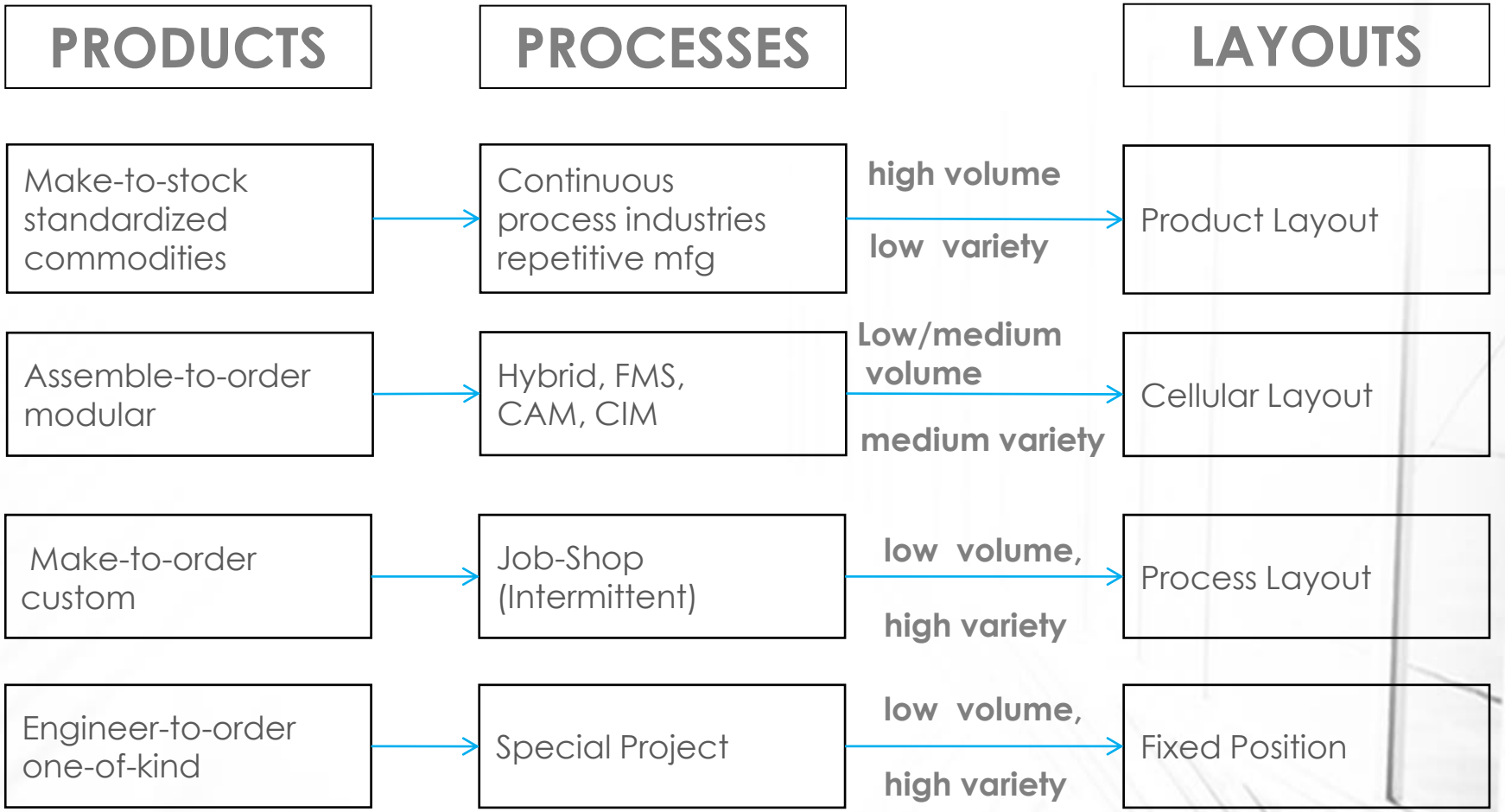
- Quality control
- Stock control
- Order processing/chasing against schedules
- Cost control (budgeting)
- People and labour productivity

Production system

Definition

A transformation system in which a saleable product or service is created by working upon a set of inputs. Inputs are in the form of men, machine, money, materials etc.

Production system



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Process flow structures

	Project	Job Shop	Batch Process	Assembly Line	Continuous flow
Flow	No flow				Continuous
Product variety	High				Low
Product volume	Low				High
Capital Invesment	Low				High
Resource Utilization	Low				High
Variable Cost	High				Low
Human Contribution	High				Low

Layout types

Fixed position layout

- The product or project remains stationary, and workers, materials, and equipment are moved as needed.
- Examples: Home building, ship and aircraft building, drilling for oil…

Layout types

Process layout

- Similar processes (or processes with similar needs) are located together
- By grouping similar processes utilization of resources is improved
- Customers, products, patients move through the processes according to their needs
- Different products = different needs = different routes
- Complex flow pattern in the operation

Examples: Supermarkets, job-shops, hospitals

Layout types

Cellular layout

- machines are grouped into a cell that can process items that have similar processing requirements
- Based on group technology which involves grouping items with similar design or manufacturing characteristics into part families
- Could be considered as mini product layouts
- Can improve and simplify a functional/process layout
- Flexible but it might duplicate some resources

Layout types

Product layout

- Also called line layout, flow line or assembly line
- Parts follow a specified route – the sequence of workstations matches with the sequence of required operations
- Work Flow is clear, predictable, easy to control

Examples: Car assembly, paper manufacture, self-service canteen