Unit-II
System Engineering

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Agenda

- System Engineering: Hierarchy,
- Business process engineering,
- Product engineering,
- System Modeling
- Requirement engineering: Analysis
- Analysis modeling approaches

- Outcome
- learn various System Modeling Approaches & apply them in real world scenario.
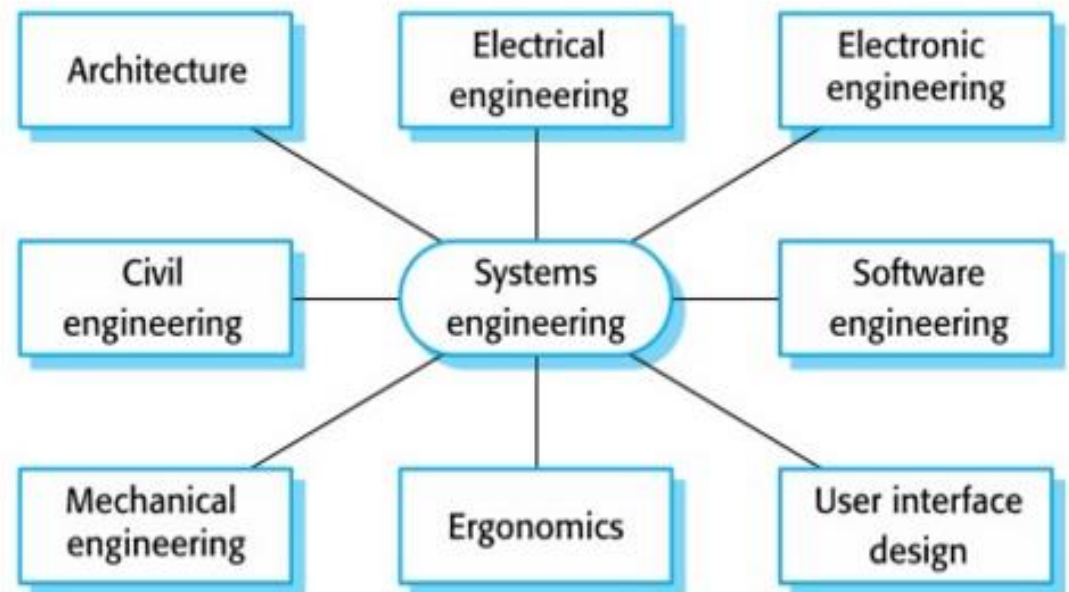
Systems engineering

- Systems engineering (SE) is an interdisciplinary area
- Focus - development of complex technological systems
- Software engineering encompasses the design, development and maintenance of complex systems
- with consideration to their software and hardware, their interconnections and the environments in which they operate over the course of their life cycle and ultimate decommissioning
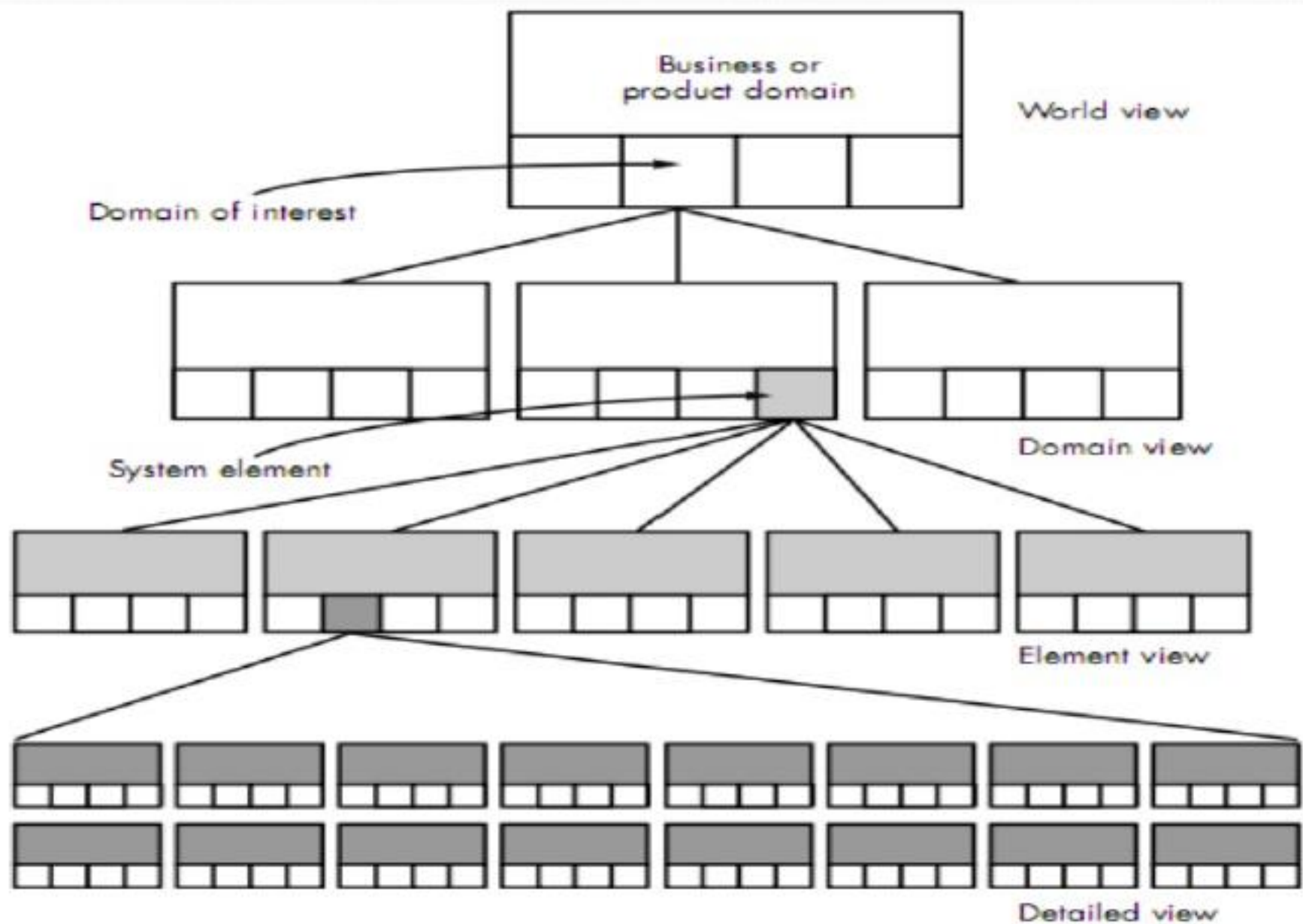
Systems engineering

- Systems thinking, in general, is a holistic approach that focuses on the way that a system's constituent parts interrelate and how systems work over time and within the context of larger systems.

- Current and developing trends of increasing automation and the Internet of Things are necessitating a more holistic view of the increasingly complex and interconnected systems operating throughout business and industry .
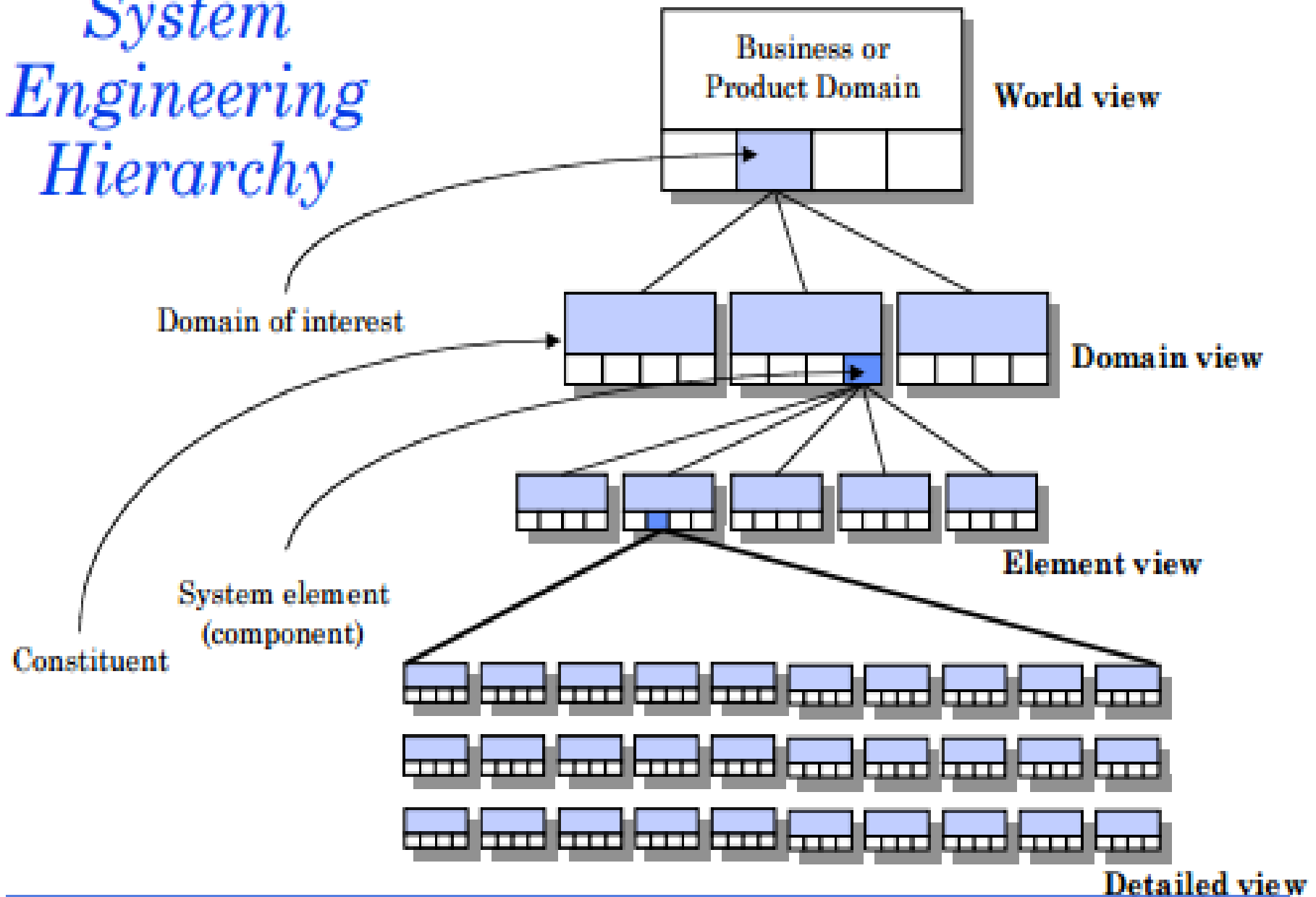
Systems engineering

- SE integrates knowledge and methods from multiple fields of science and technology to spark innovation in the development and implementation of new technologies.

- Disciplines informing SE include control engineering, cybernetics, electrical engineering, engineering management, industrial engineering, manufacturing engineering, mechanical engineering, organizational studies, project management and software engineering.

THE SYSTEM ENGINEERING HIERARCHY

Business or product domain

World view

Domain of interest

System element

Domain view

Element view

Detailed view

System Engineering Hierarchy

Business or Product Domain — World view

Domain of interest — Domain view

Constituent

System element (component) — Element view

Detailed view

The world view (WV) is composed of a set of domains (Di), which can each be a system or system of systems in its own right

$$WV = \{D_1\ D_2\ D_3 \ldots \ldots, Dn\}$$

Each domain is composed of specific elements (Ej) each of which serves some role in accomplishing the objective and goals of the domain and component:

$$Di = \{E_1\ E_2\ E_3 \ldots \ldots\ Em\}$$

Finally, each element is implemented by specifying the technical components (Ck) that achieve the necessary function for an element:
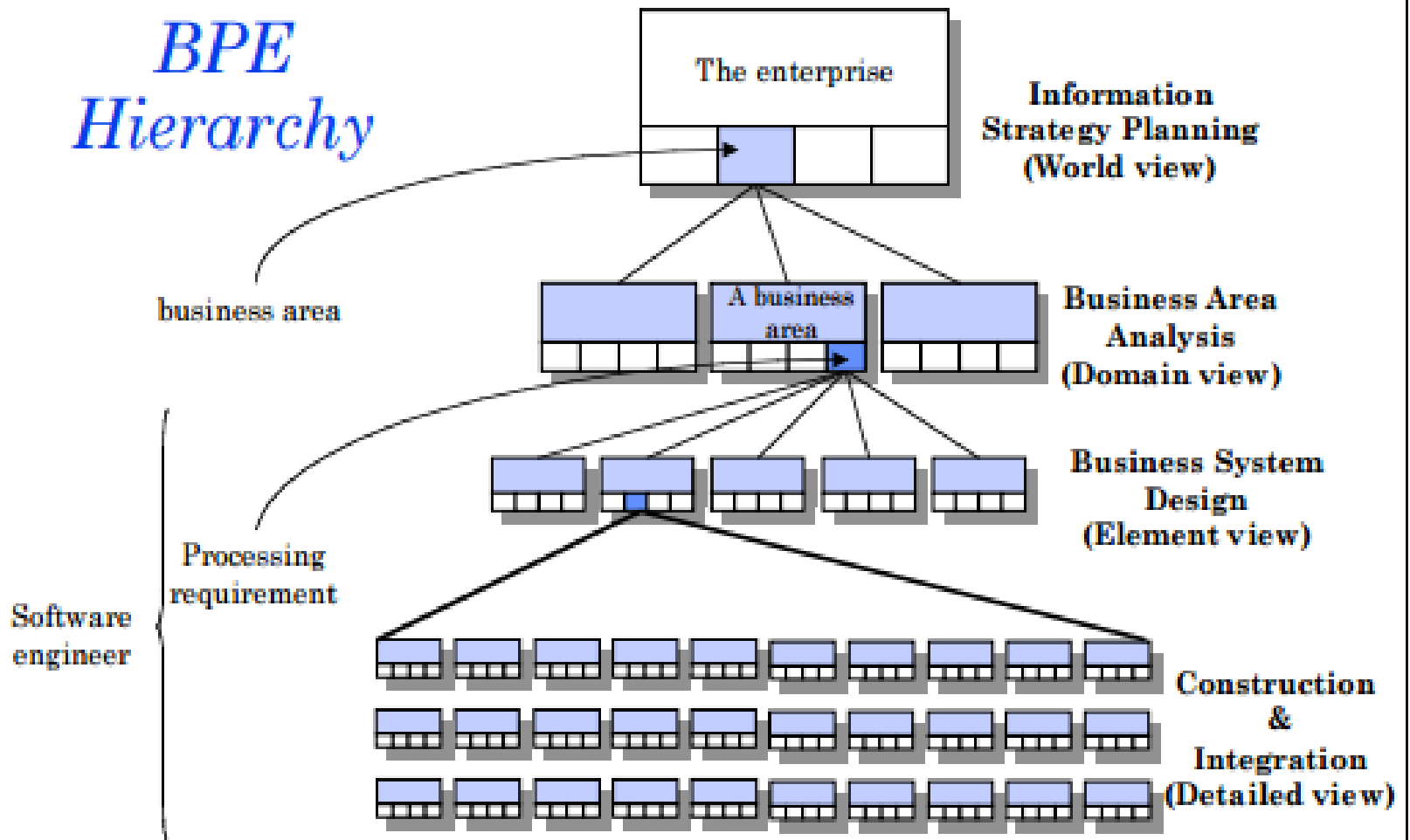
$$Ej = \{C_1,\ C_2\ C_3 \ldots \ldots\ C\ k\}$$

In the software context, a component could be a computer program, a reusable program component, a module, a class or object, or even a programming language statement.
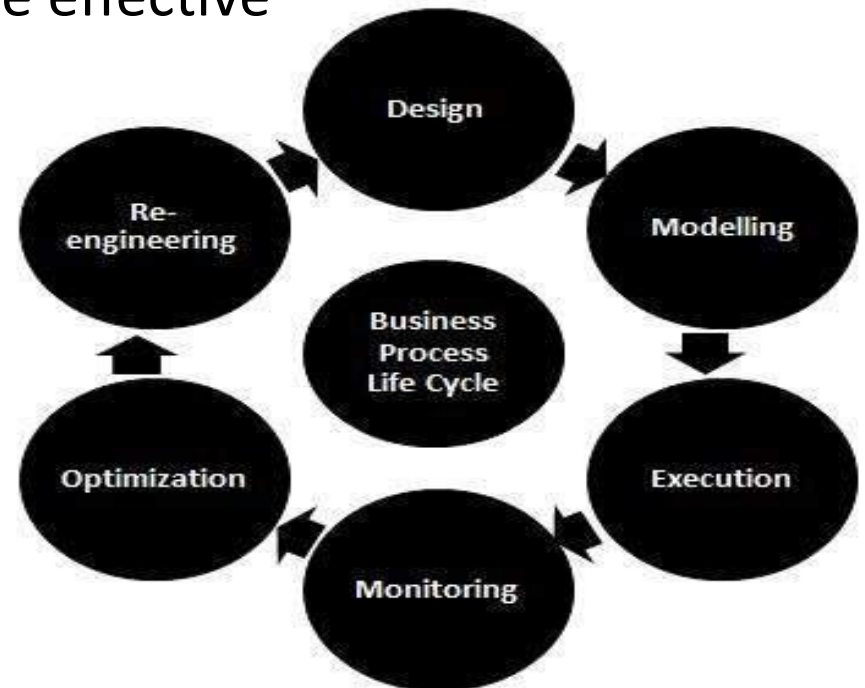
Business Process Engineering

➤A business process is a collection of activities or tasks that produce a specific service or product for end users.

➤It is usually represented as a flowchart as a sequence of activities that points to a Process Matrix.

➤Business process Modeling is carried out by Process owners or product owners to enable the test team to test efficiently.

➤It aims to improve business performance by optimizing the efficiency of the associated activities of a product or service.

- Uses an integrated set of procedures, methods, and tools to identify how information systems can best meet the strategic goals of an enterprise
- Focuses first on the enterprise and then on the business area
- Creates enterprise models, data models and process models
- Creates a framework for better information management distribution, and control

Business Process Hierarchy

BPE Hierarchy

The enterprise — Information Strategy Planning (World view)

business area

A business area — Business Area Analysis (Domain view)

Processing requirement — Business System Design (Element view)

Software engineer

Construction & Integration (Detailed view)

Business Process Life Cycle

✓Business process engineering is a way in which organizations study their current business processes and develop new methods to improve productivity, efficiency, and operational costs.
✓Business process engineering focuses on new business processes, how to diagnose problems with an organization's current methodology, and how to redesign, reconstruct, and monitor processes to ensure they are effective

Conceptual Framework for Business Process Engineering
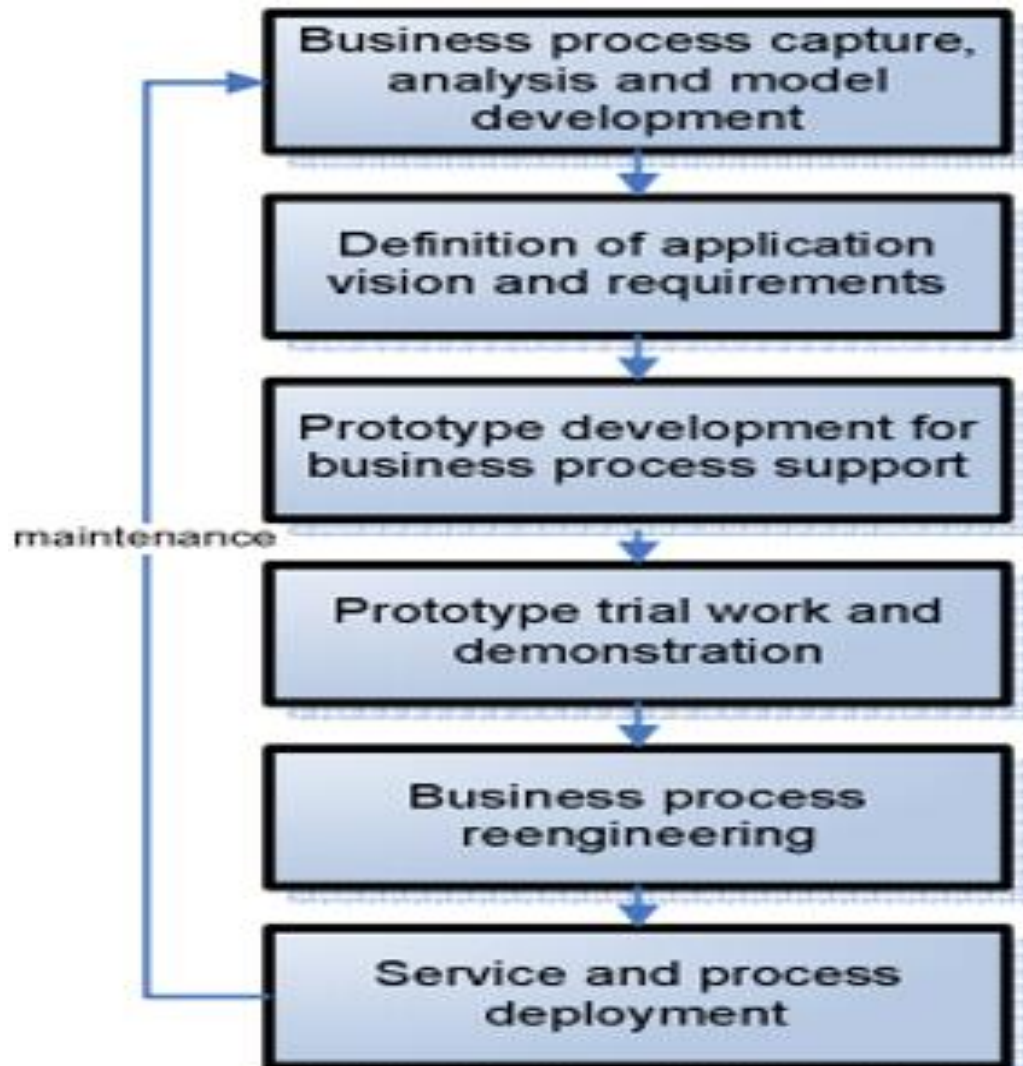
Business Process Testing [BPT]

- It is a tool used for an automated and manual testing for designing tests, maintaining tests and executing tests.

- The reusable tests are usually designed by Business Analysts for improving test efficiency.

Benefits and Features of BPT :

- Allows non-technical subject matter expertise to quickly build a reusable test workflow.

- It reduces the effort required for test maintenance.

- It converts the manual tests to manual test components.

- It provides a framework to build User Acceptance Tests to meet the requirements.

Product Engineering

- Software Products are nothing but software systems delivered to the customer with the documentation that describe how to install and use the system.

- certain cases, software products may be part of system products where hardware, as well as software, is delivered to a customer.

- Software products are produced with the help of the software process.

Types of software products

- Generic products:
  Generic products are the stand-alone systems that are developed by a production unit and sold on the open market to any customer who is able to buy them.

- Customized Products:
  Customized products are the systems that are commissioned by a particular customer. Some contractor develops the software for that customer.

# Essential characteristics of Well-Engineered Software Product

- Efficiency:The software should not make wasteful use of system resources such as memory and processor cycles.

- Maintainability: It should be possible to evolve the software to meet the changing requirements of customers.

- Dependability: It is the flexibility of the software that ought to not cause any physical or economic injury within the event of system failure. It includes a range of characteristics such as reliability, security and safety.

- In time: Software should be developed well in time.

- Within Budget: The software development costs should not overrun and it should be within the budgetary limit.

- Functionality: The software system should exhibit the proper functionality, i.e, it should perform all the functions it is supposed to perform.

- Adaptability:The software system should have the ability to get adapted to a reasonable extent with the changing requirements.

Product engineering

- refers to the process of designing and developing a device, assembly, or system such that it be produced as an item for sale through some production manufacturing process.

- Product engineering is an engineering discipline that deals with both design and manufacturing aspects of a product.

The product engineering hierarchy:
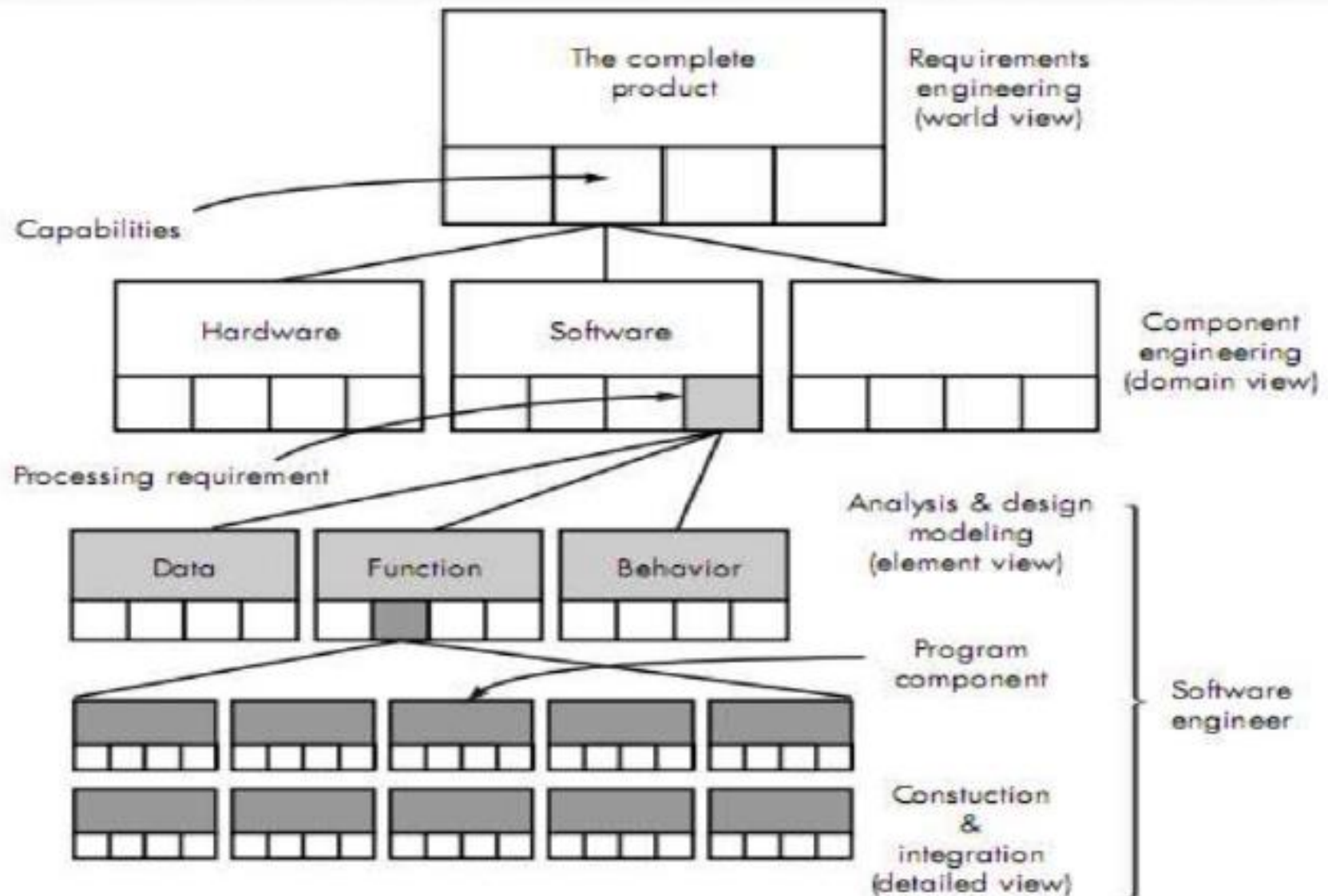
Roles & Responsibility

- Product engineers define the yield road map and drive the fulfillment during ramp-up and volume production,
- Identify and realize measures for yield improvement, test optimization and product cost-ability methods,
- Define qualification plan and perform feasibility analysis.
- Product engineers are the technical interface between the component development team and the production side (Front End and Back End), especially after the development phase and qualifications when the high volume production is running.
- Product engineers improve the product quality and secure the product reliability by balancing the cost of tests and tests coverage that could impact the production fall-off.
- They support failure analysis request from customers.

BPR Model
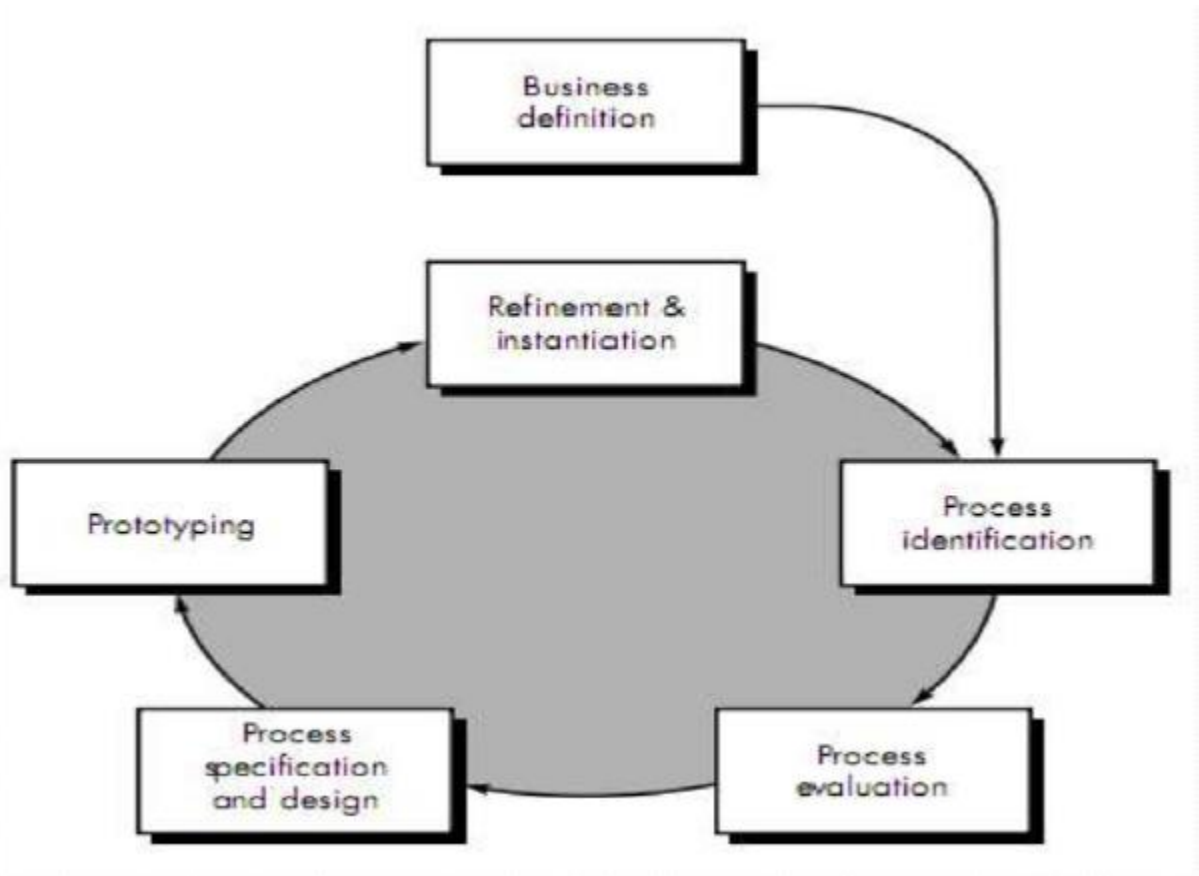
Activities of BPR model

The model defines six activities:

1. *Business definition:* Business goals are identified within the context of four key drivers: cost reduction, time reduction, quality improvement, and personnel development and empowerment.

2. *Process identification*: Processes that defined in the business definition are identified. They may then be ranked by importance that is ssfor the reengineering activity.

3. Process evaluation: The existing process is thoroughly analyzed and measured. Process tasks are identified; the costs and time consumed by process tasks are noted; and quality/performance problems are isolated.

4. Process specification and design: Based on information obtained during the first three BPR activities, use-cases that are prepared for each process that is to be redesigned.

5. Prototyping: A redesigned business process must be prototyped before it is fully integrated into the business. This activity "tests" the process so that refinements can be made.

6. Refinement and instantiation: Based on feedback from the prototype, the business process is refined and then instantiated within a business system.

MCQ

Q1. System engineering integrates _____ and _____ from multiple fields of science and technology to spark innovation in the development and implementation of new technologies   b

a)   Data , information
b)   knowledge , methods
c)   Methods, tools
d)   knowledge , tools

Q2. In the system hierarchy, for software context, system element such as computer program is present at – b

   a) element vies
   b) domain view
   c) world view
   d) detailed view

MCQ

Q3. Who is responsible to carry out business process engineering to enable the test team to test efficiently?

a) Manager
b) Process/ product owner
c) Test engineer
d) Programmer

Q4. In Business Process Hierarchy, business area analysis comes under –

a) World view
b) Element view
c) Domain view
d) Detailed view

MCQs

Q5. The product developed by a production unit and sold on the open market to any customer who is able to buy them is referred as –

a) customized product

b) Generic product

c) hybrid product

d) None of the mentioned

Q6. Which of the following is not a processing requirement of software at domain view

a) data

b) Function

c) Behavior

d) knowledge