Embedded System Development Process

Development Process

- In descriptive terms, the quality of product is reflected in its meeting all the customer requirement, functional requirement, performance requirement and reliability requirement.
- To deliver quality product a systematic approach to the development is must.
- This systematic approach is reflected in defining a process for the development. Process is essentially a detailed step by step procedure.

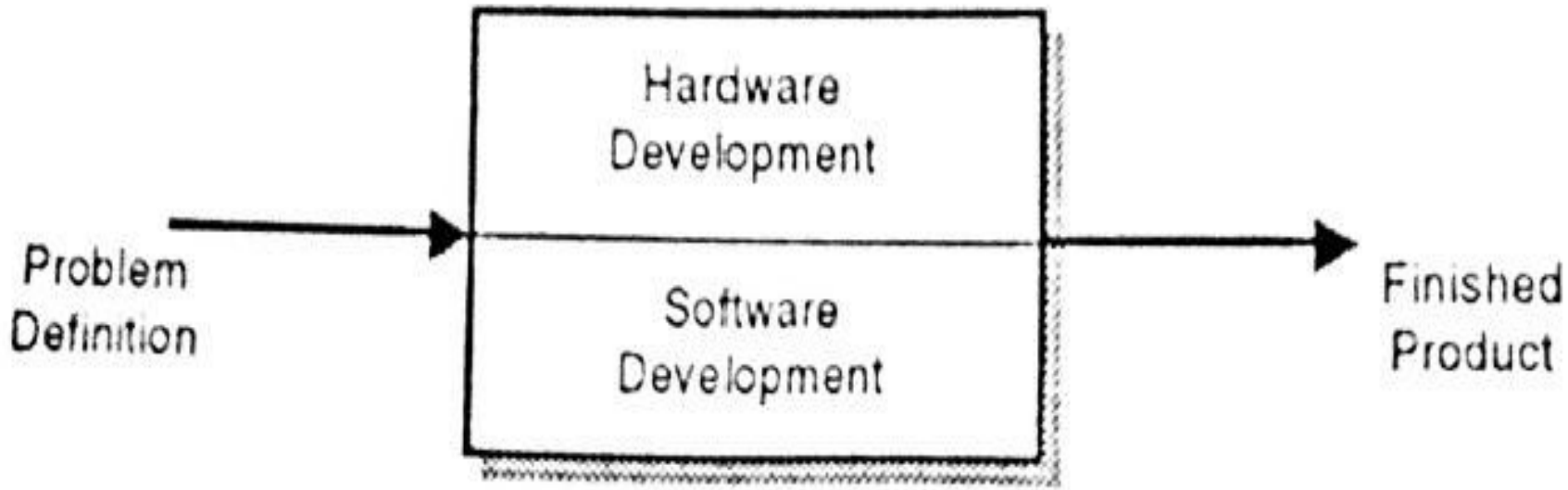


Fig. 4.2. The Embedded System Development Process

The development process defines the step by step procedure to convert the vague the problem definition into a working product. In embedded systems, we need to define detailed process for both hardware and software development.

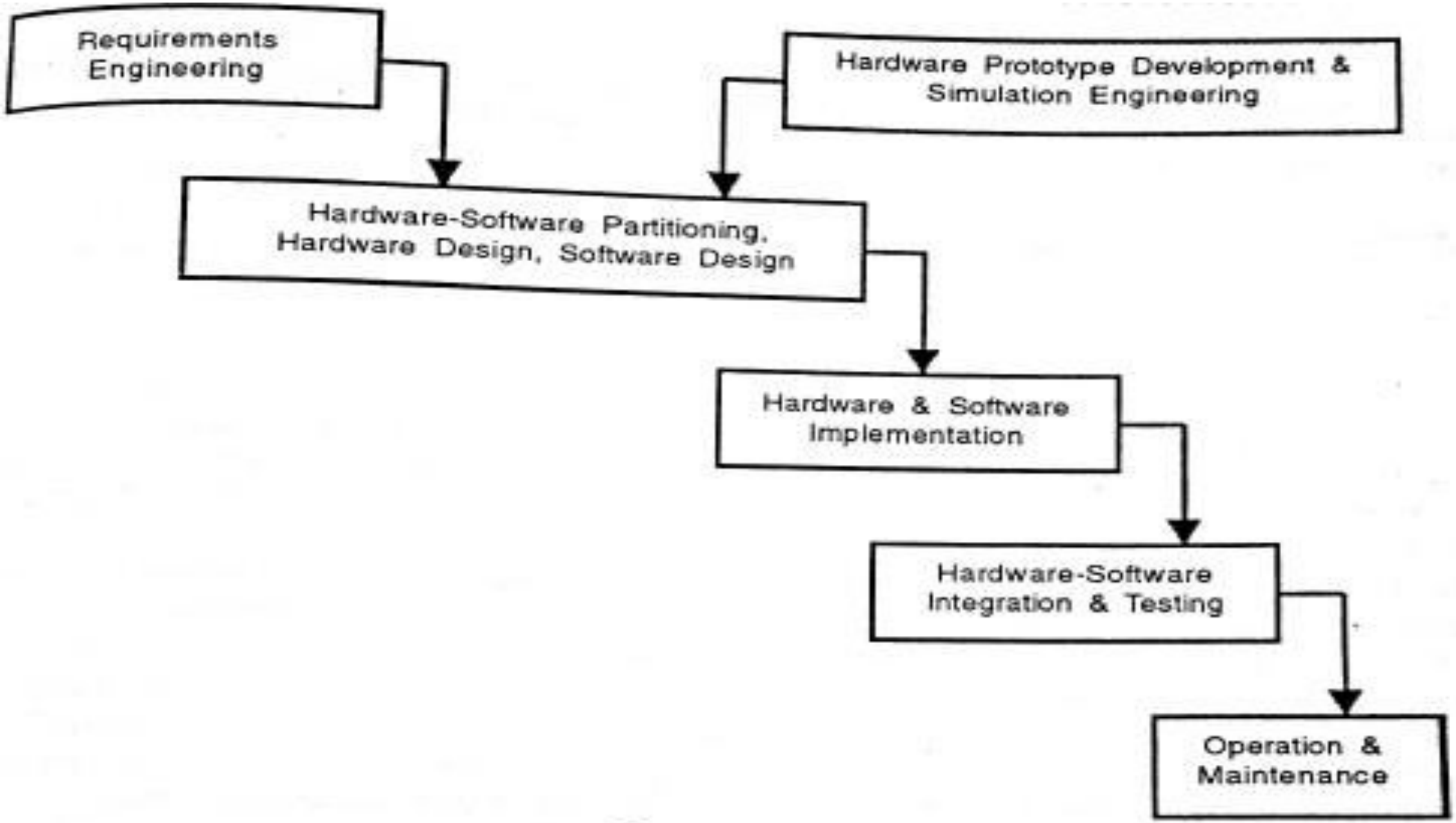


Fig. 4.3: Waterfall Model

- In commercial embedded system projects that do not involve very high end research, the waterfall model is used. The development process is divided into following 5stages.
    1. Requirement Engineering.
    2. Designing(Hardware/Software Partitioning, Hardware/Software Designing)
    3. Hardware/Software Implementation
    4. Hardware/ Software Integration & Testing
    5. Operation & Maintenance
- In addition to these stages, a hardware prototype is developed to prove that design concepts are practicable. And software simulation studies are carried out to test the algorithms used in embedded software.

Requirement Engineering

- Product Development: Based on the input of marketing department, we will envision new product. In such a case we need to study the features of the existing competing products to gather requirements.
- Turnkey Project: We need to develop an embedded system based on the requirements given by the client. Vague Problem Definition into Requirement Specifications.
- For both types of projects, we need to write a detailed requirements of the proposed embedded systems.

Requirement Engineering Process

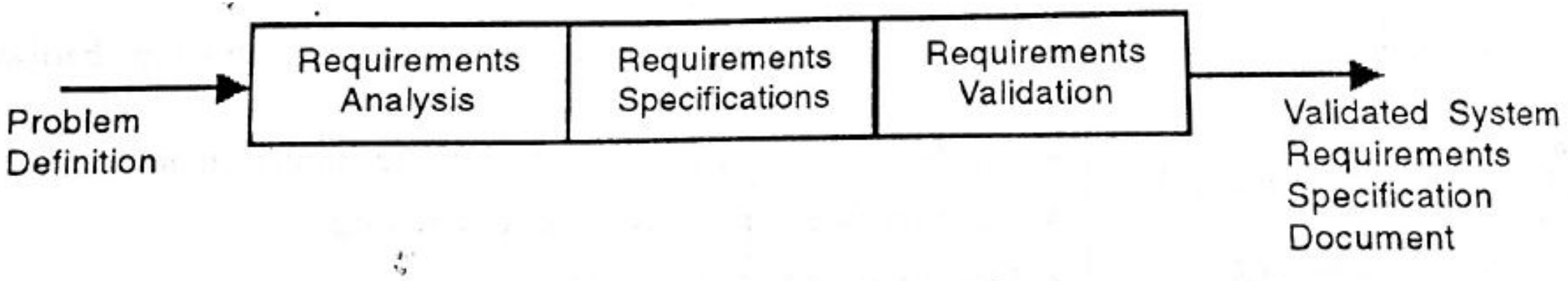


Fig. 4.4: Requirements Engineering Process

Requirement Engineering process can be divided into 3 phases:

1. Requirement Analysis
2. Requirement Specifications
3. Requirement Validations

Requirement Analysis

- Analysis on aspects such as
  - The inputs to the system
  - The outputs of the system
  - The processing to be done by the system along with timing restrictions, if any
  - Input supply voltage
  - The communication interfaces to be provided
  - The size of the embedded system (if there are any limitations on the size)
  - Operating environment (such as temperature and humidity)
  - Standards to be followed. Every industry segment specifies standards. These statutory standards need to be obtained from the client.

Requirement Specifications

Once these requirements are obtained, they need to be documented and a document called "System Requirements Specifications" has to be prepared. This document clearly spells out all the information obtained from the client. As this document will be the reference for carrying out the design and subsequently the testing, each and every specification needs to be documented. This document needs to be divided into two parts—one part covering all the functional requirements, i.e. what the system is supposed to do; and the second part covering all the non-functional requirements.

Requirement Specifications

- Non functional requirements are given below:
    1. Reliability(MTBF)
    2. Delivery Times
    3.Implementation Requirements
    4. Standards
    5. Safety Requirements
    6. Security

Requirement Validation

The next phase is requirements validation. This phase is to ensure that the requirements specifications document captures all the requirements of the user and also to ensure that the required embedded system can be designed and developed. You need to discuss with hardware engineers and software engineers to ascertain whether all the specifications could be met. Then you need to submit the document to the client, resolve any differences and obtain the client's approval. Validation ensures that there is no communication gap between the client and the development team.

Design

- The validated system specifications document has to be converted into design for both software and hardware.
- Firstly we will separate out hardware and software functionality.

Design Goals

operating ... various design alternatives keepin

The design goals are:

- To meet all the functional and performance requirements
- To reduce the size and cost of the system to the extent possible
- To reduce the power consumption of the system
- To reduce the development time and effort
- To reduce the maintenance effort and time
- To increase the reliability

Co-design

- Co-design involves partitioning the design into hardware and software. Sometimes it is difficult to decide whether functionality has to be implemented in hardware and software.
- Example: CRC Calculation[Which one is beneficial]

Co-design

- Decision on implementation in software or hardware needs to be taken keeping in view the following issues.
  - Speed of Execution
  - Flexibility for making changes
  - Size
  - Power Consumption
  - Memory
  - Cost

  [Moodle]

H/S Partitioning

- After Hardware and Software partitioning is done, the Hardware and Software design need to be carried out.

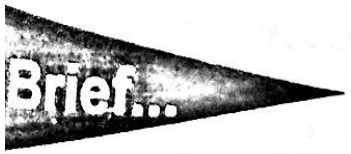
Hardware Design

- Hardware Design involves
  - Selection of the processor
  - Calculation of the memory requirements and the types of memory such as RAM (SRAM and DRAM), EPROM, Flash memory
  - Identification of input devices such as sensors, keyboard or keypad
  - Identification of output devices such as LEDs and LCD
  - Identification of communication interfaces such as RS232, Ethernet, USB
  - Identification of test points. To debug the hardware, you need test points and they have to be identified during design stage itself. If the processor supports JTAG (Joint Test Access Group) protocols for debugging, you need to design your board keeping in view these debug pins.
  - Identification of supply voltages and current requirements for designing the power supply unit.

Software Design

- Software design involves:

  - Working out the details of the processing to be done by the embedded system
  - Decomposition of the processing into different tasks
  - Calculation of the processing time and the resources required for each task
  - Deciding on the use of an embedded operating system. If the embedded system has strict deadlines to be met then a real-time operating system has to be chosen.
  - Studying the need for support for communication protocols stack. If the system has to be network-enabled, the TCP/IP protocol stack has to be ported onto the system. In addition, application layer protocols such as Hyper Text Transfer Protocol (HTTP), Trivial File Transfer Protocol (TFTP) etc. may need to be ported.



  - Study the need for field upgradation of the software.