UNIT-III
PART - A

Life Cycle Phases: Engineering and Production Stages, Inception, Elaboration, Construction, Transition Phases.

Introduction

- The most discriminating characteristic of a successful software development process is the well-defined separation between “research and development” activities and “production” activities.
- Most unsuccessful projects exhibit one of the following characteristics:

➢ **An overemphasis(overimportance) on research and development**

  – Too many analyses or paper studies are performed, or the construction of engineering baselines is postponed. This emphasis is typical of and promoted in the conventional software process.

➢ **An overemphasis on production**

  – Rush-to-judgment designs, premature work by overeager coders, and continuous hacking are typical.

Introduction

- Successful modern projects—and even successful projects developed under the conventional process—tend to have a very well-defined project milestone when there is a noticeable transition from a research attitude to a production attitude.
- Earlier phases focus on achieving functionality.
- Later phases revolve around achieving a product that can be shipped to a customer, with explicit attention to robustness, performance, fit, and finish.
- This life-cycle balance, which is somewhat subtle and still too intangible, is one of the underpinnings of successful software project management.

Introduction

- A modern software development process must be defined to support the following:

➢ Evolution of the plans, requirements, and architecture, together with well-defined synchronization points.

➢ Risk management and objective measures of progress and quality.

➢ Evolution of system capabilities through demonstrations of increasing functionality.

Engineering and Production Stages

- To achieve economies of scale and higher returns on investment, we must move toward a software manufacturing process driven by technological improvements in process automation and component-based development.
- At first order are the following two stages of the life cycle:

1. The engineering stage, driven by less predictable but smaller teams doing design and synthesis activities.
2. The production stage, driven by more predictable but larger teams doing construction, test, and deployment activities.

Engineering and Production Stages

Table: The two stages of the life cycle: engineering and production

LIFE-CYCLE ASPECT	ENGINEERING STAGE EMPHASIS	PRODUCTION STAGE EMPHASIS
Risk reduction	Schedule, technical feasibility	Cost
Products	Architecture baseline	Product release baselines
Activities	Analysis, design, planning	Implementation, testing
Assessment	Demonstration, inspection, analysis	Testing
Economics	Resolving diseconomies of scale	Exploiting economies of scale
Management	Planning	Operations

Engineering and Production Stages

- The transition between engineering and production is a crucial event for the various stakeholders.
- The production plan has been agreed upon, and there is a good enough understanding of the problem and the solution that all stakeholders can make a firm commitment to go ahead with production.
- The engineering stage is decomposed into two distinct phases, inception and elaboration, and the production stage into construction and transition.
- These four phases of the life-cycle process are loosely mapped to the conceptual framework of the spiral model as shown in below figure and are named to depict the state of the project.

Engineering and Production Stages

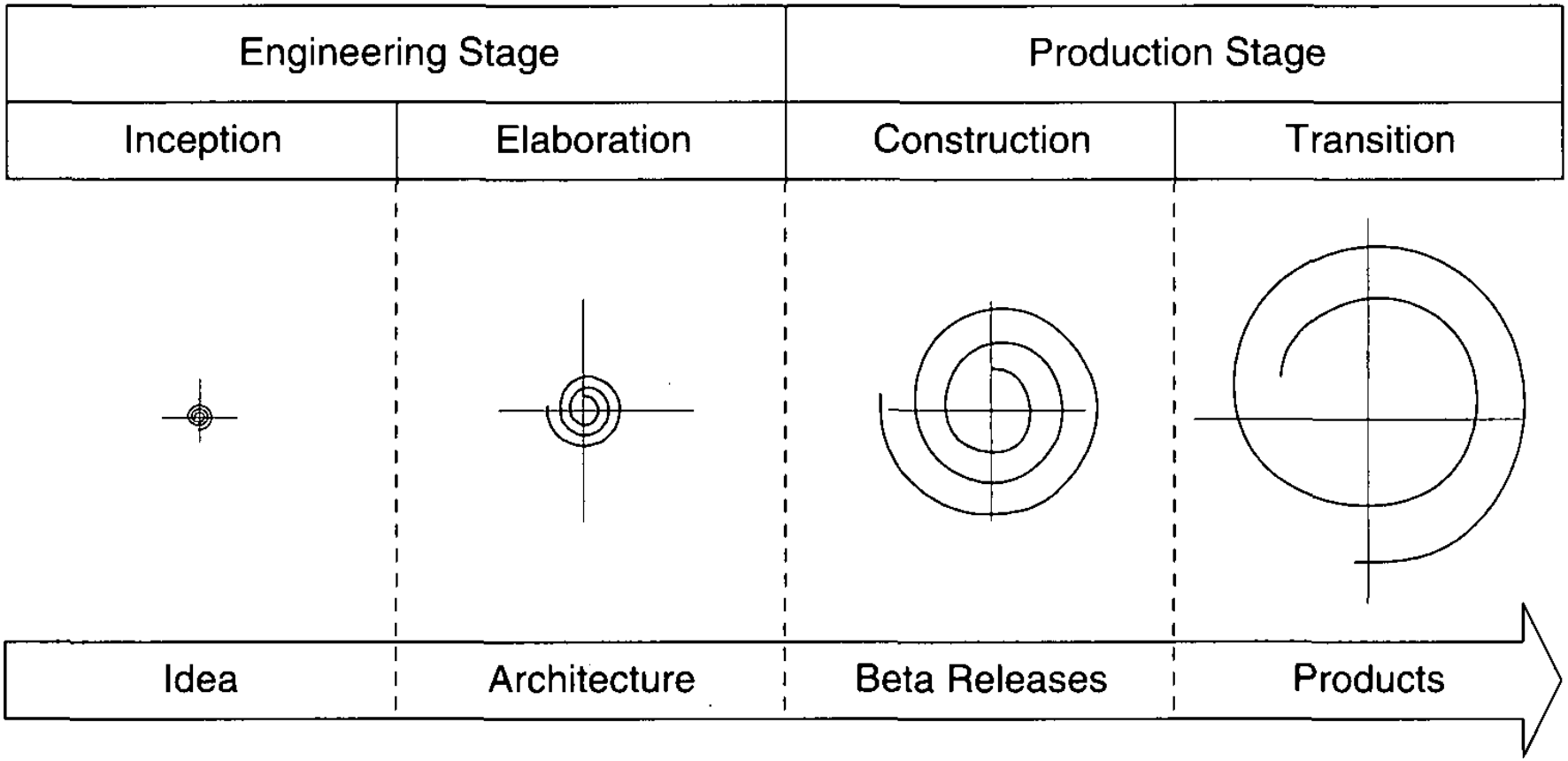

Figure: The phases of the life-cycle process

Engineering and Production Stages

- In the figure, the size of the spiral corresponds to the inertia of the project with respect to the breadth and depth of the artifacts that have been developed.
- This inertia manifests itself in maintaining artifact consistency, regression testing, documentation, quality analyses, and configuration control.
- Increased inertia may have little, or at least very straightforward, impact on changing any given discrete component or activity.
- However, the reaction time for accommodating major architectural changes, major requirements changes, major planning shifts, or major organizational perturbations clearly increases in subsequent phases.

Inception Phase

- The overriding goal of the inception phase is to achieve concurrence among stake-holders on the life-cycle objectives for the project.

  Primary Objectives:

  - Establishing the project's software scope and boundary conditions, including an operational concept, acceptance criteria, and a clear understanding of what is and is not intended to be in the product
  - Discriminating the critical use cases of the system and the primary scenarios of operation that will drive the major design trade-offs
  - Demonstrating at least one candidate architecture against some of the primary scenarios
  - Estimating the cost and schedule for the entire project (including detailed estimates for the elaboration phase)
  - Estimating potential risks (sources of unpredictability)

Inception Phase

Essential Activities:

- Formulating the scope of the project
  - This activity involves capturing the requirements and operational concept in an information repository that describes the user's view of the requirements. The information repository should be sufficient to define the problem space and derive the acceptance criteria for the end product.
- Synthesizing the architecture
  - Design trade-offs, problem space ambiguities, and available solution-space assets (technologies and existing components) are evaluated. An information repository is created that is sufficient to demonstrate the feasibility of at least one candidate architecture and an initial baseline of make/buy decisions so that the cost, schedule, and resource estimates can be derived.
- Planning and preparing a business case
  - Alternatives for risk management, staffing, iteration plans, and cost/schedule/profitability trade-offs are evaluated. The infrastructure (tools, processes, automation support) sufficient to support the life-cycle development task is determined.

Inception Phase

Primary Evaluation Criteria:

- Do all stakeholders concur on the scope definition and cost and schedule estimates?
- Are requirements understood, as evidenced by the fidelity of the critical usecases?
- Are the cost and schedule estimates, priorities, risks, and development processes credible?
- Do the depth and breadth of an architecture prototype demonstrate the preceding criteria?
- Are actual resource expenditures versus planned expenditures acceptable?

Elaboration Phase

- **It is easy to argue that the elaboration phase is the most critical of the four phases.**
- At the end of this phase, the “engineering” is considered complete and the project faces its reckoning: The decision is made whether or not to commit to the production phases.
- **During the elaboration phase, an executable architecture prototype is built in one or more iterations, depending on the scope, size, risk, and novelty of the project.**
- This effort addresses at least the critical use cases identified in the inception phase, which typically expose the top technical risks of the project.
- Although an evolutionary prototype of production-quality components is always a goal, it does not exclude the development of one or more exploratory, throw-away prototypes to mitigate specific risks such as design/requirements trade-offs, component feasibility analyses, or demonstrations to investors.

Elaboration Phase

Primary Objectives

- Baselining the architecture as rapidly as practical (establishing a configuration-managed snapshot in which all changes are rationalized, tracked, and maintained)
- Baselining the vision
- Baselining a high-fidelity plan for the construction phase
- Demonstrating that the baseline architecture will support the vision at a reasonable cost in a reasonable time

Elaboration Phase

Essential Activities

- **Elaborating the vision**
  - This activity involves establishing a high-fidelity understanding of the critical use cases that drive architectural or planning decisions.
- **Elaborating the process and infrastructure**
  - The construction process, the tools and process automation support, and the intermediate milestones and their respective evaluation criteria are established.
- **Elaborating the architecture and selecting components**
  - Potential components are evaluated and make/buy decisions are sufficiently understood so that construction phase cost and schedule can be determined with confidence. The selected architectural components are integrated and assessed against the primary scenarios. Lessons learned from these activities may well result in a redesign of the architecture as alternative designs are considered or the requirements are reconsidered.

Elaboration Phase

Primary Evaluation Criteria

- Is the vision stable?
- Is the architecture stable?
- Does the executable demonstration show that the major risk elements have been addressed and credibly resolved?
- Is the construction phase plan of sufficient fidelity, and is it backed up with a credible basis of estimate?
- Do all stakeholders agree that the current vision can be met if the current plan is executed to develop the complete system in the context of the current architecture?
- Are actual resource expenditures versus planned expenditures acceptable?

Construction Phase

- During the construction phase, all remaining components and application features are integrated into the application, and all features are thoroughly tested.
- Newly developed software is integrated where required.
- The construction phase represents a production process, in which emphasis is placed on managing resources and controlling operations to optimize costs, schedules, and quality.
- The management mindset undergoes a transition from the development of intellect property during inception and elaboration activities to the development of deployable products during construction and transition activities.

Construction Phase

Primary Objectives

- Minimizing development costs by optimizing resources and avoiding unnecessary scrap and rework
- Achieving adequate quality as rapidly as practical
- Achieving useful versions (alpha, beta, and other test releases) as rapidly as practical

Construction Phase

Essential Activities

- Resource management, control, and process optimization
- Complete component development and testing against evaluation criteria
- Assessment of product releases against acceptance criteria of the vision

Construction Phase

Primary Evaluation Criteria

- Is this product baseline mature enough to be deployed in the user community? (Existing defects are not obstacles to achieving the purpose of the next release.)
- Is this product baseline stable enough to be deployed in the user community? (Pending changes are not obstacles to achieving the purpose of the next release.)
- Are the stakeholders ready for transition to the user community?
- Are actual resource expenditures versus planned expenditures acceptable?

Transition Phase

- The transition phase is entered when a baseline is mature enough to be deployed in the end-user domain.
- This typically requires that a usable subset of the system has been achieved with acceptable quality levels and user documentation so that transition to the user will provide positive results.
- This phase could include any of the following activities:
  - Beta testing to validate the new system against user expectations
  - Beta testing and parallel operation relative to a legacy system it is replacing
  - Conversion of operational databases
  - Training of users and maintainers

Transition Phase

- The transition phase focuses on the activities required to place the software into the hands of the user.
- Typically, this phase includes several iterations, including beta releases, general availability releases, and bug-fix and enhancement releases.

Transition Phase

Primary Objectives

- Achieving user self-supportability
- Achieving stakeholder concurrence that deployment baselines are complete and consistent with the evaluation criteria of the vision
- Achieving final product baselines as rapidly and cost-effectively as practical

Transition Phase

Essential Activities

- Synchronization and integration of concurrent construction increments into consistent deployment baselines
- Deployment-specific engineering (cutover, commercial packaging and production, sales rollout kit development, field personnel training)
- Assessment of deployment baselines against the complete vision and acceptance criteria in the requirements set

Transition Phase

Evaluation Criteria

- Is the user satisfied?
- Are actual resource expenditures versus planned expenditures acceptable?