Software Project Management

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Project

- An individual or collaborative enterprise that is carefully planned to achieve a particular aim.
- A **project** is a series of tasks that need to be completed in order to reach a specific outcome.
- A **project** can also be defined as a set of inputs and outputs required to achieve a particular goal.
- **Projects** can range from simple to complex and can be managed by one person or a hundred.

Examples of **Project**:

- Planning a large reception or an event, that is a **project**.
- This is because, it was a specific reception for a specific reason and It was held on a specific date and time.
- That means reception was unique, temporary, and it had a defined beginning and end, and reception created a specific product or service to invited persons.

Classification of Projects.

- There are many ways to classify a project such as:
  - By size (cost, duration, team, business value, number of departments affected, and so on)
  - By type (new, maintenance, upgrade, **strategic**, tactical, operational)

Why Projects Fail?

- Not enough resources
- Not enough time
- Unclear specifications
- Changes in scope
- Disagreement among stakeholders
- Bad Plan
- Lack of project management

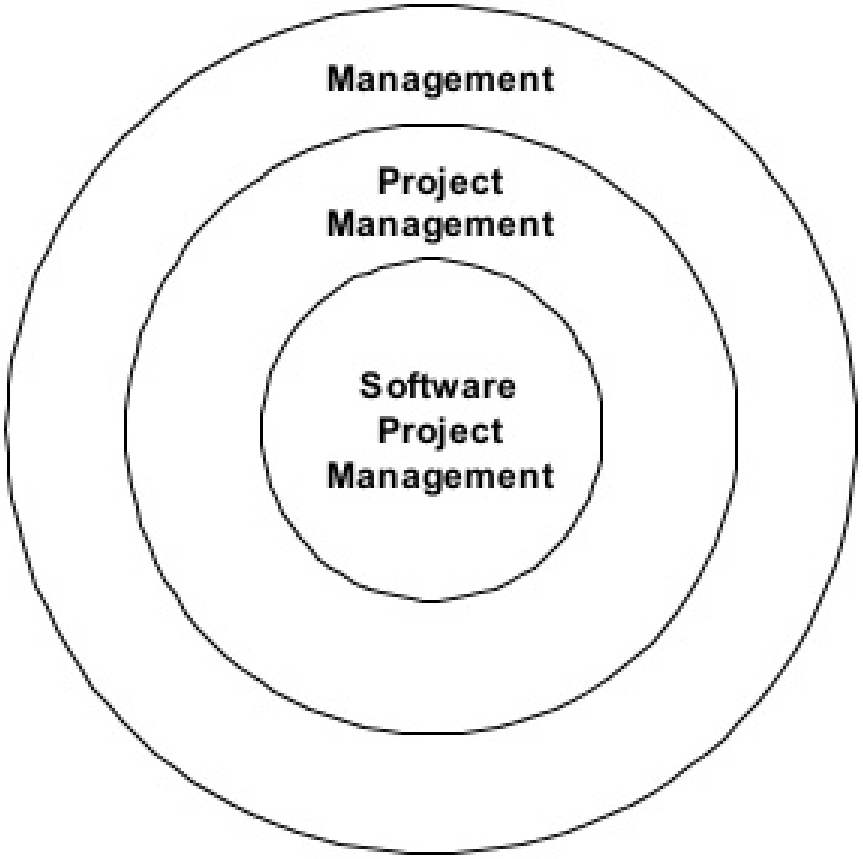
Software Project

- A Software Project is the complete procedure of software development from requirement gathering to testing and maintenance, carried out according to the execution methodologies, in a specified period of time to achieve intended software product.

Has four Ps:

- People – Organized and effective, highly motivated and coordinated team to do quality work & to achieve effective communication.
- Product – Product requirements from customer, portioned and position for work
- Process – Roadmap adopted to the people & problem
- Project – Organized to get succeed

Software Project **Management**



Factors affecting Software Projects

Table 1.2 Summary of Factor Rankings for Successful, Challenged, and Impaired Projects

Rank	*Factors for Successful Projects*	*Factors for Challenged Projects*	*Factors for Impaired Projects*
1	User involvement	Lack of user input	Incomplete requirements
2	Executive management support	Incomplete requirements	Lack of user involvement
3	Clear statement of requirements	Changing requirements & specifications	Lack of resources
4	Proper planning	Lack of executive support	Unrealistic expectations
5	Realistic expectations	Technology incompetence	Lack of executive support
6	Smaller project milestones	Lack of resources	Changing requirements specifications
7	Competent staff	Unrealistic expectations	Lack of planning
8	Ownership	Unclear objectives	Didn't need it any longer
9	Clear vision & objectives	Unrealistic time frames	Lack of IT management
10	Hard-working, focused team	New technology	Technology illiteracy

SOURCE: Adapted from The Standish Group, *CHAOS* (West Yarmouth, MA: 1995), http://www.standishgroup.com /visitor/chaos.htm.

Software Project Management

- It is a process of managing, allocating and timing resourrces to develope computer software that meets requirements.
- In Software Project Management, the end users and developers need to know the length, duration and cost of the project.
- SPM is a sub-discpline of project management in which software project are planned, implemented, monitored and controlled.

- It consists of eight tasks:
  - Problem Identification
  - Problem Defining
  - Project Planning
  - Project Organization
  - Resource Allocation
  - Project Scheduling
  - Tracking, Reporting and Controlling
  - Project Transmission
- Advantages of SPM: Easy manage a company's projects; Accessibility and Cost

- So, Software Project Management is the art and science of planning and leading SOFTWARE PROJECT.
- In problem ieentifiction and definition, the decisions are made while approving, declining or prioritizing projects.
- In problem identification, project is identified, defined and justified.
- In problem definition, the purpose of the project is clarified. The main product is project proposal.
- In project planning, it describes a series of actions or steps that are needed to for the development of work product.

- In project organization, the functions of the personnel are integrated. It is done in parallel with project planning.
- So that, Software Project Management is Software that has used for Project Planning, Schedulling, Resource allocation, and change management.
- The important of SPM – is a kinds of tools allow companies to become competitive in their environments, optimising time and effort and keeping project on track.
- The main objective of SPM is to deliver an information system that is acceptable to users and is developed on time and within budget.

- So, Software Project Managements is an umbrella activity within Software Engineering

- Project Management involves the Planning, Monitoring and Control of People, Process and Events that occur as Software evolves from preliminary concept to an operational implementation.

- Project Management begins before any technical activity and continues throughout the Definition, Development and Support of Computer Software.

Conventional Software Management Theory and Practice

1. The best thing about software is its flexibility:
   - It can be programmed to do almost anything.
2. The worst thing about software is its flexibility:
   - The “almost anything” characteristic has made it difficult to plan, monitor, and control software development.
3. In the mid-1990s, three important analyses were performed on the software engineering industry.

•All three analyses given the same general conclusion:- “The success rate for software projects is very low”.

Software management process framework:

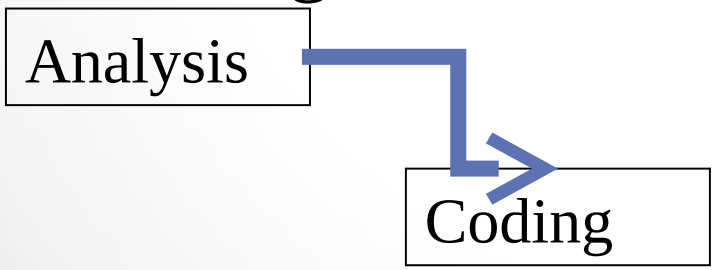
WATERFALLL MODEL

1. It is the baseline process for most conventional software projects have used.
2. We can examine this model in two ways:
    i. IN THEORY
    ii. IN PRACTICE

IN THEORY:

- In 1970, Winston Royce presented a paper called “Managing the Development of Large Scale Software Systems” at IEEE WESCON.
- Where he made three primary points:

1. There are two essential steps common to the development of computer programs:
   - analysis
   - coding



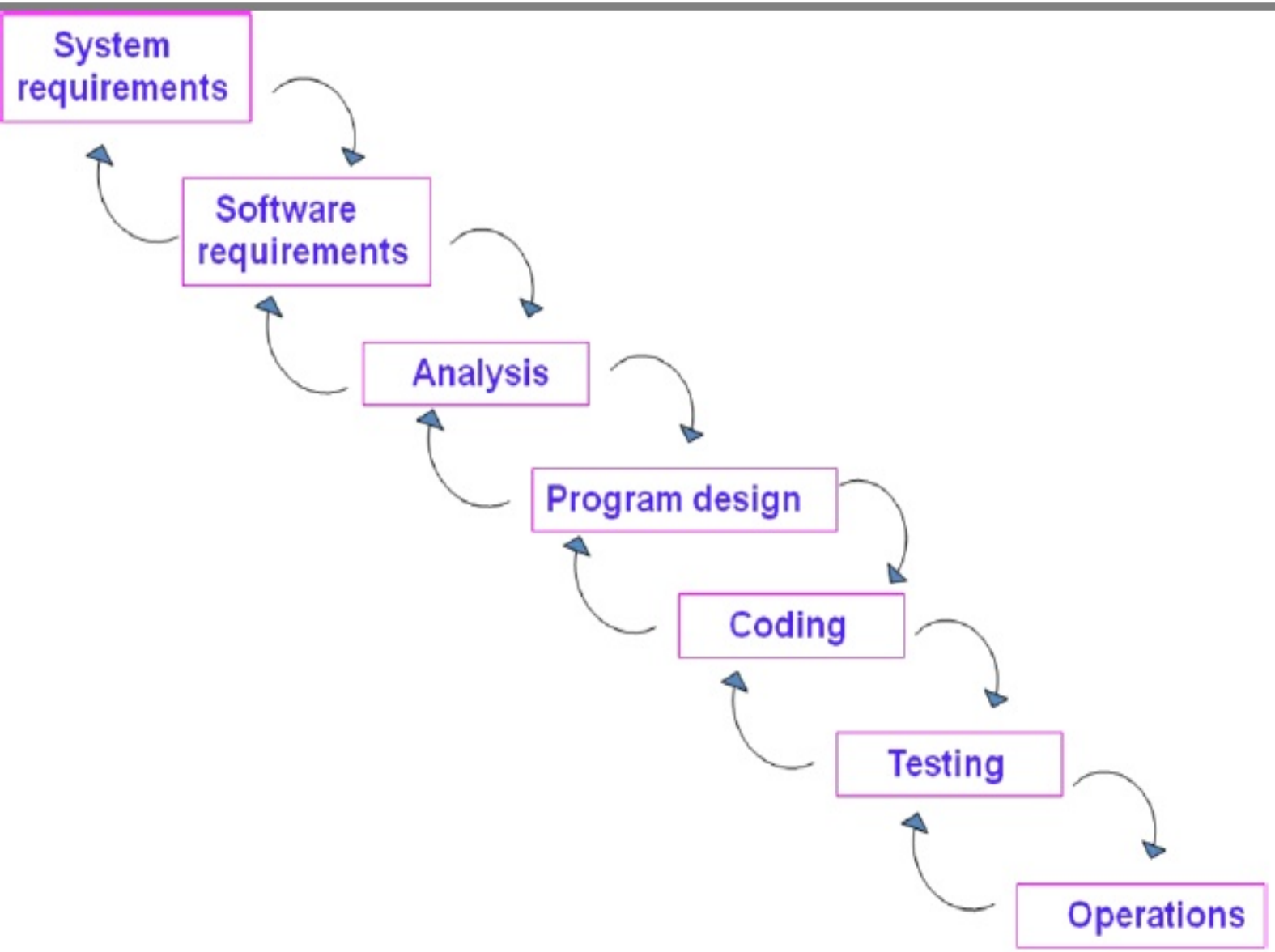
- Analysis and Coding both involve creative work that directly contributes to the usefulness of the end product.

Waterfall Model Part I: The two basic steps to build a program

2. In order to mange and control all of the intellectual freedom associated with software development one should follow the following steps:

- System requirements definition
- Software requirements definition
- Program design and testing

•These steps addition to the analysis and coding steps



Waterfall Model Part 2: The large – scale system approach

3. **Since the testing phase is at the end of the development cycle in the waterfall model, it may be risky and invites failure.**

- So we need to do either the requirements must be modified or a substantial design changes is warranted by breaking the software in to different pieces.

- There are five improvements to the basic waterfall model that would eliminate most of the development risks are as follows:

a) **Complete program design before analysis and coding begin (program design comes first):-**

- By this technique, the program designer give surety that the software will not fail because of storage, timing, and data fluctuations.
- Begin the design process with program designer, not the analyst or programmers.
- Write an overview document that is understandable, informative, and current so that every worker on the project can gain an elemental understanding of the system.

b) Maintain current and complete documentation (Document the design):-

- It is necessary to provide a lot of documentation on most software programs.
- Due to this, helps to support later modifications by a separate test team, a separate maintenance team, and operations personnel who are not software literate.

c) Do the job twice, if possible (Do it twice):

- If a computer program is developed for the first time, arrange matters so that the version finally delivered to the customer for operational deployment is actually the second version insofar as critical design/operations are concerned.

- “Do it N times” approach is the principle of modern-day iterative development.

d) Plan, control, and monitor testing:

- The biggest user of project resources is the test phase. This is the phase of greatest risk in terms of cost and schedule.
- In order to carryout proper testing the following things to be done:

i) Employ a team of test specialists who were not responsible for the original design.

ii) Employ visual inspections to spot the obvious errors like dropped minus signs, missing factors of two, jumps to wrong addresses.

iii) Test every logic phase.

iv) Employ the final checkout on the target computer.

e) Involve the customer:

- It is important to involve the customer in a formal way so that he has committed himself at earlier points before final delivery by conducting some reviews such as,

  i) Preliminary software review during preliminary program design step.

  ii) Critical software review during program design.

  iii) Final software acceptance review following testing.

IN PRACTICE

- Whatever the advices that are given by the software developers and the theory behind the waterfall model, some software projects still practice the conventional software management approach.
- Projects intended for trouble frequently exhibit the following symptoms:

  i) Protracted (delayed) integration
- In the conventional model, the entire system was designed on paper, then implemented all at once, then integrated.
- Only at the end of this process was it possible to perform system testing to verify that the fundamental architecture was sound.

- Here the testing activities consume 40% or more life-cycle resources.

ACTIVITY	COST
Management	5%
Requirements	5%
Design	10%
Code and unit testing	30%
Integration and test	40%
Deployment	5%
Environment	5%

Software Economics and Cost Estimation

- Software economics is the study of how scarce project resources are allocated for software projects.

- Software economics helps software managers allocate those resources in the most efficient manner.

- Software Economics includes many different disciplines which are shown below:


Social Psychology
Psychology
Organizational Behavior
Software Economics
Economics
Software Development
Statistics

- Software Economics examines the entire idea of software development and it includes many different disciplines such as:

- **Psychology** - focuses on the study of behavior and the reward/punishment model. "What get's rewarded gets done.“

- **Social Psychology** - focuses on how people behave in an organization, quality of work life, and peer pressures.

- **Organizational Behavior** - is the process of analyzing the structure of an organization to understand those structural issues impacting organizational productivity and quality.

- **Economics** - the study of prices (components), costs, and scarcity.

- **Statistics** - deals with quantitative and qualitative techniques for the collection of data, how data is analyzed, and how results are presented.

- **Increasing Marginal Cost**
  - As the size of a software project the unit cost (or average cost) rises.
  - In other words software has increasing marginal costs and there are few economies of scale when developing a software application.
  - Any large engineering or construction project follows this same economic model.
  - Hours per function point (average costs) go up as project and organizational size increase.

- **Diseconomies of Scale**
  - In all software projects there are some basic principles which cause diseconomies of scale. That is:
  - There are low fixed costs relative to variable costs
  - Communication becomes difficult as project becomes larger
  - Multiple logical paths grow in a nonlinear manner as size increases
  - Interrelationships of functions grow geometrically as project becomes large.

Software Economics Basic Factors:

- All kinds of software cost model can be abstracted into a function of five basic factors:

  1. Size

  2. process

  3.personnel

  4.environment and

  5. required quality.

1. **Size:** of end product, quantified in terms of the number of source instructions. No. of function points.
2. **Process:** used to produce the end product (rework, bureaucratic delays, communications overheads)
3. **Personnel:** capability of software engineering human resources.

4. **Environment:** tools & techniques availability to support of efficient software development and the process.
5. **Required Quality:** product quality including features, performance reliability etc.

   The relationships among these parameters and the estimated cost written as:

   Effort=(personnel)(environment)(quality) (sizeProcess)

- There are three generations of S/W development are:
  - Conventional, Transition and Modern practices.

- It can overview return on investment (ROI) by three way:
  - Achieving ROI across line of business (successive system) : cost per unit 1st, 2nd …… nth system.
  - Achieving ROI across a project with multiple iterations (successive iterations): 1st, 2nd, … nth iteration.
  - Achieving ROI across a life cycle of product releases (successive Releases): 1st, 2nd, … nth release.

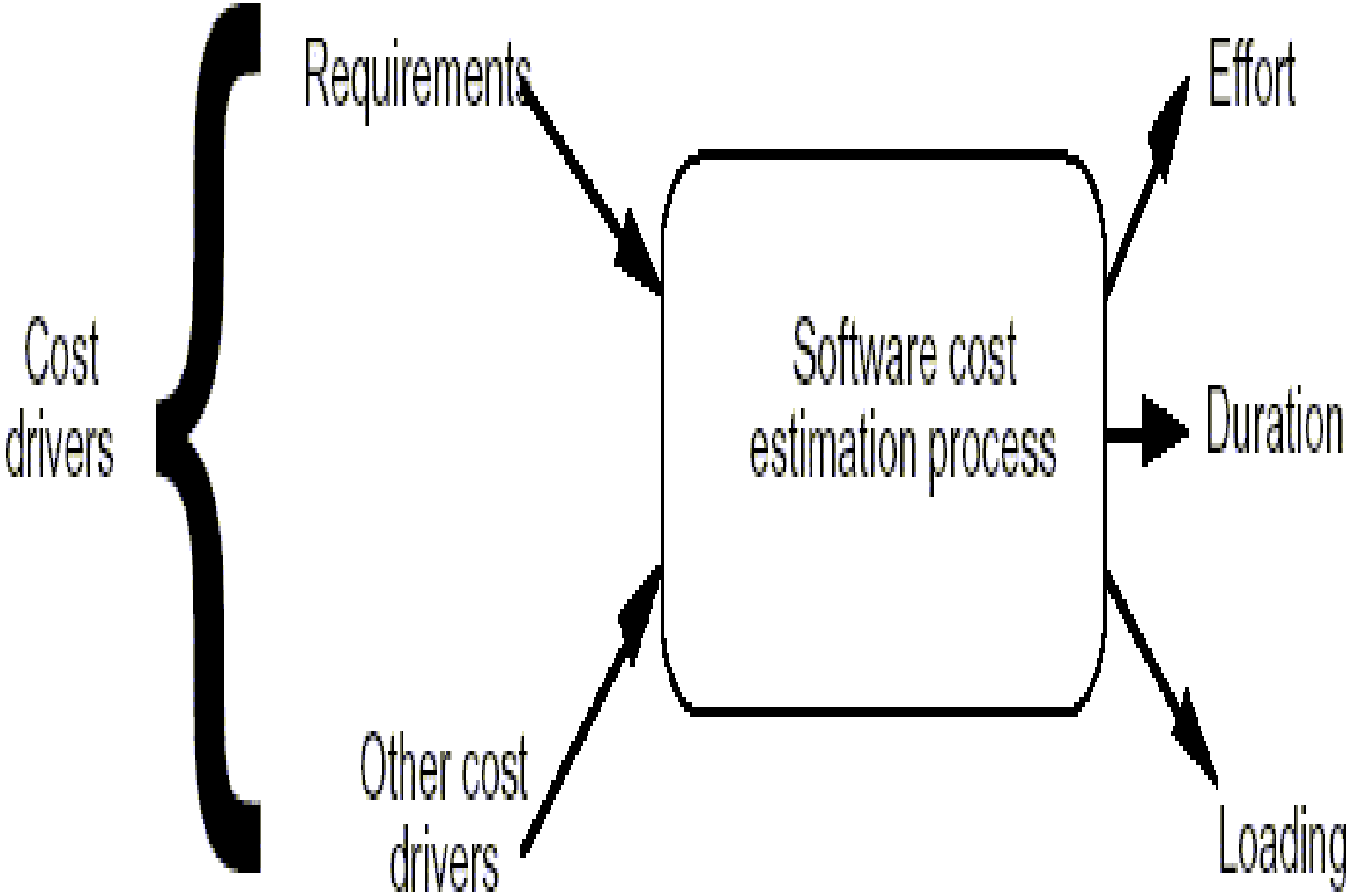
Cost Estimation

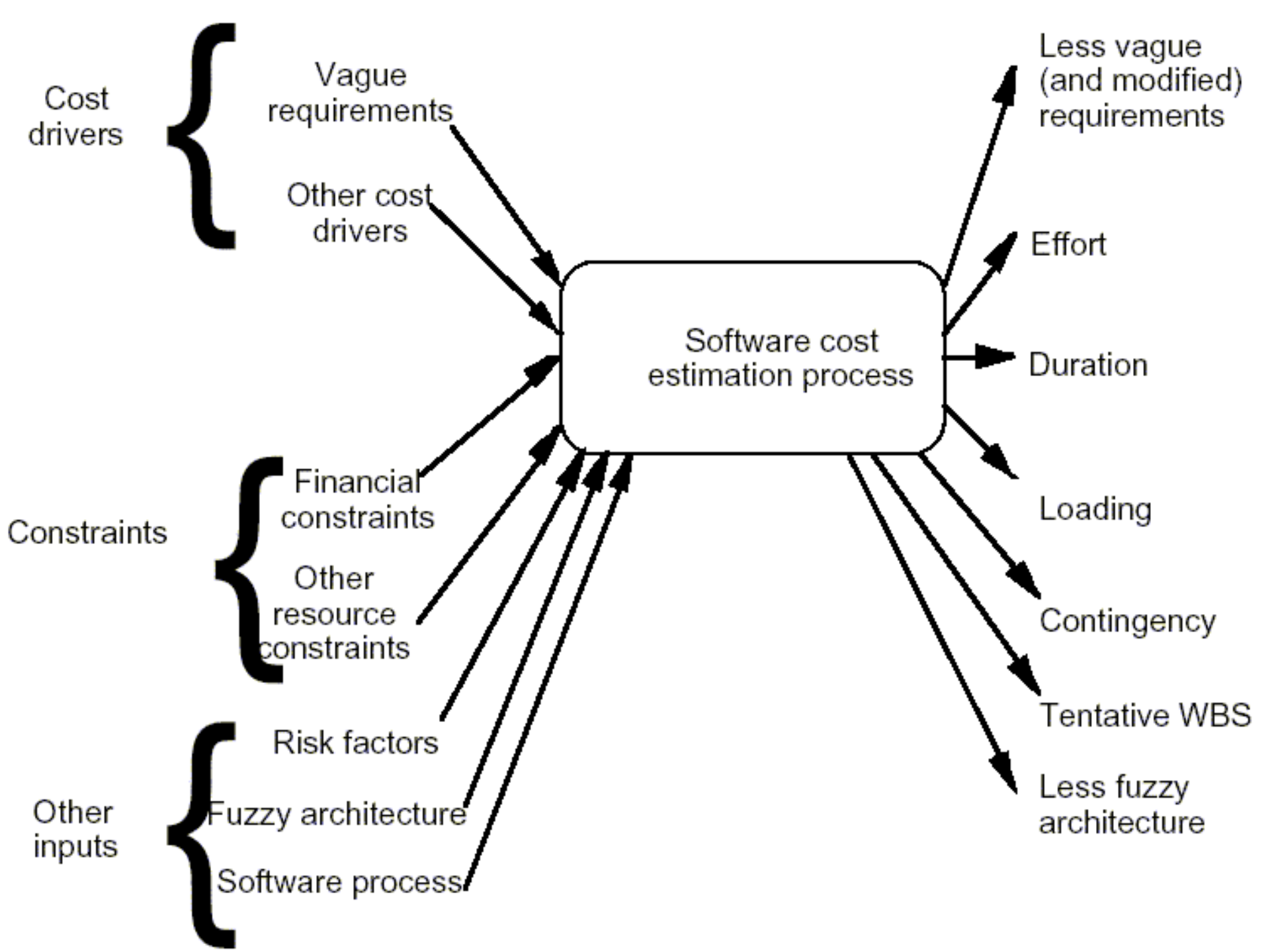
- The **costs** of development are primarily the **costs** of the effort involved, so the effort computation is used in both the **cost** and the schedule **estimate**.

- The initial **cost estimates** may be used to establish a budget for the **project** and to set a price for the **software** for a customer.

Software Cost Estimation Process

- Definition:
  - A set of techniques and procedures that is used to derive the software cost estimate.
  - Set of inputs to the process and then the process will use these inputs to generate the output.


Requirements
Effort
Cost drivers
Software cost estimation process
Duration
Other cost drivers
Loading


Cost drivers
Vague requirements
Other cost drivers
Constraints
Financial constraints
Other resource constraints
Other inputs
Risk factors
Fuzzy architecture
Software process
Software cost estimation process
Less vague (and modified) requirements
Effort
Duration
Loading
Contingency
Tentative WBS
Less fuzzy architecture

Costing and pricing

- Estimates are made to discover the cost, to the developer, of producing a software system
- There is not a simple relationship between the development cost and the price charged to the customer
- Broader organisational, economic, political and business considerations influence the price charged

Software pricing factors

Factor	Description
Market opportunity	A development organisation may quote a low price because it wishes to move into a new segment of the software market. Accepting a low profit on one project may give the opportunity of more profit later. The experience gained may allow new products to be developed.
Cost estimate uncertainty	If an organisation is unsure of its cost estimate, it may increase its price by some contingency over and above its normal profit.
Contractual terms	A customer may be willing to allow the developer to retain ownership of the source code and reuse it in other projects. The price charged may then be less than if the software source code is handed over to the customer.
Requirements volatility	If the requirements are likely to change, an organisation may lower its price to win a contract. After the contract is awarded, high prices may be charged for changes to the requirements.
Financial health	Developers in financial difficulty may lower their price to gain a contract. It is better to make a small profit or break even than to go out of business.

Productivity measures

- Size related measures based on some output from the software process. This may be lines of delivered source code, object code instructions, etc.

- Function-related measures based on an estimate of the functionality of the delivered software. Function-points are the best known of this type of measure.

Improving Software conomics

- **Improving Software Economics:**
  - Reducing Software product size,
  - improving software processes,
  - improving team effectiveness,
  - improving automation,
  - Achieving required quality, and
  - peer inspections.

- Most software cost models can be abstracted into a function of five basic parameters: size, process, personnel, environment, and required quality.

1. Reducing the **size** or complexity of what needs to be developed
2. Improving the development **process**
3. Using more-skilled **personnel** and better teams (not necessarily the same thing)
4. Using better **environments** (tools to automate the process)
5. Trading off or backing off on **quality** thresholds

- These parameters are given in priority order for most software domains.

- Below Table 3-1 lists some of the technology developments, process improvement efforts, and management approaches targeted at improving the economics of software development and integration.

TABLE 3-1. *Important trends in improving software economics*

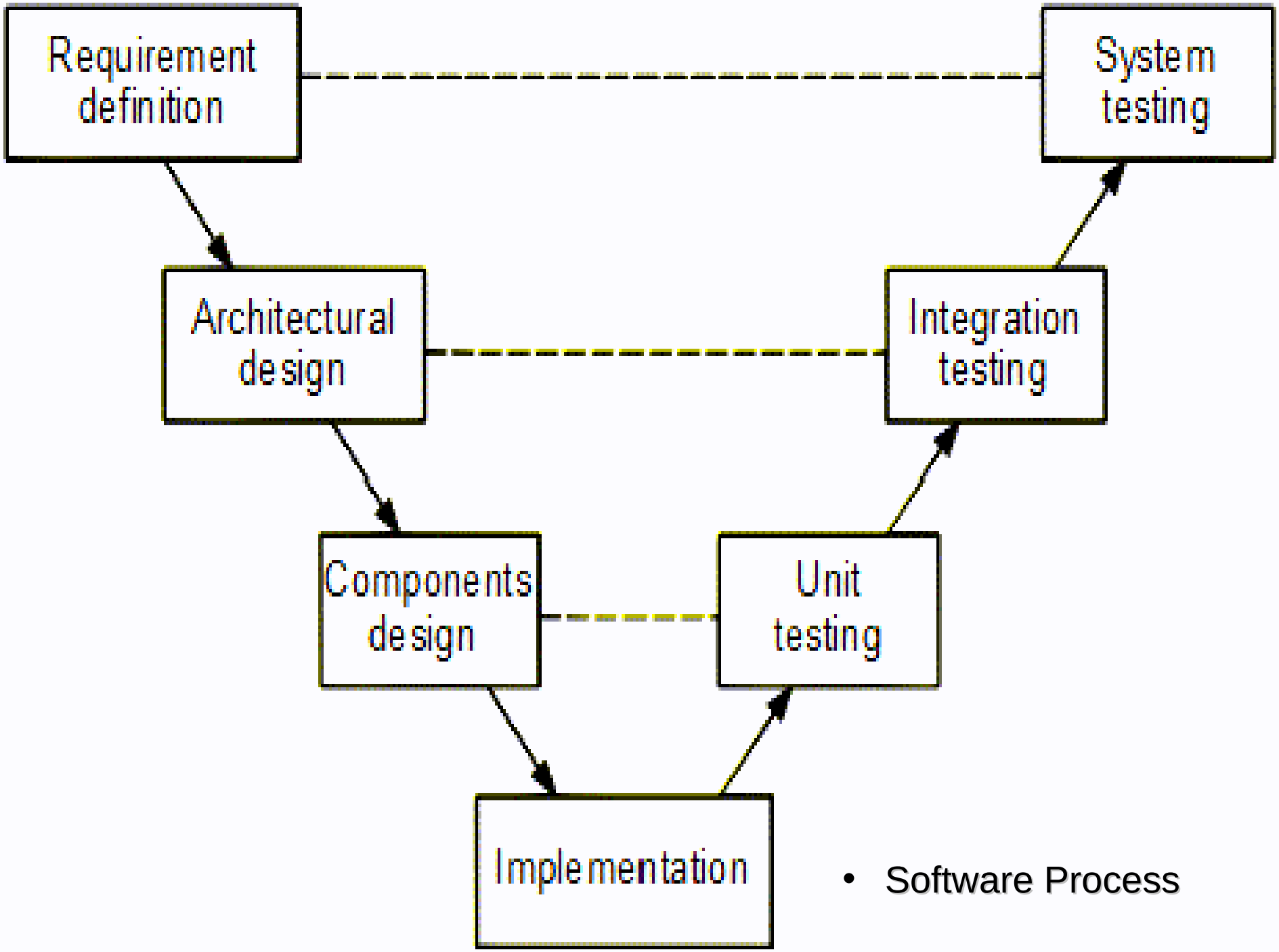
COST MODEL PARAMETERS	TRENDS
Size	Higher order languages (C++, Ada 95, Java, Visual Basic, etc.)
Abstraction and component-based development technologies	Object-oriented (analysis, design, programming)
	Reuse
	Commercial components
Process	Iterative development
Methods and techniques	Process maturity models
	Architecture-first development
	Acquisition reform
Personnel	Training and personnel skill development
People factors	Teamwork
	Win-win cultures
Environment	Integrated tools (visual modeling, compiler, editor, debugger, change management, etc.)
Automation technologies and tools	Open systems
	Hardware platform performance
	Automation of coding, documents, testing, analyses
Quality	Hardware platform performance
Performance, reliability, accuracy	Demonstration-based assessment
	Statistical quality control

4. Software Process

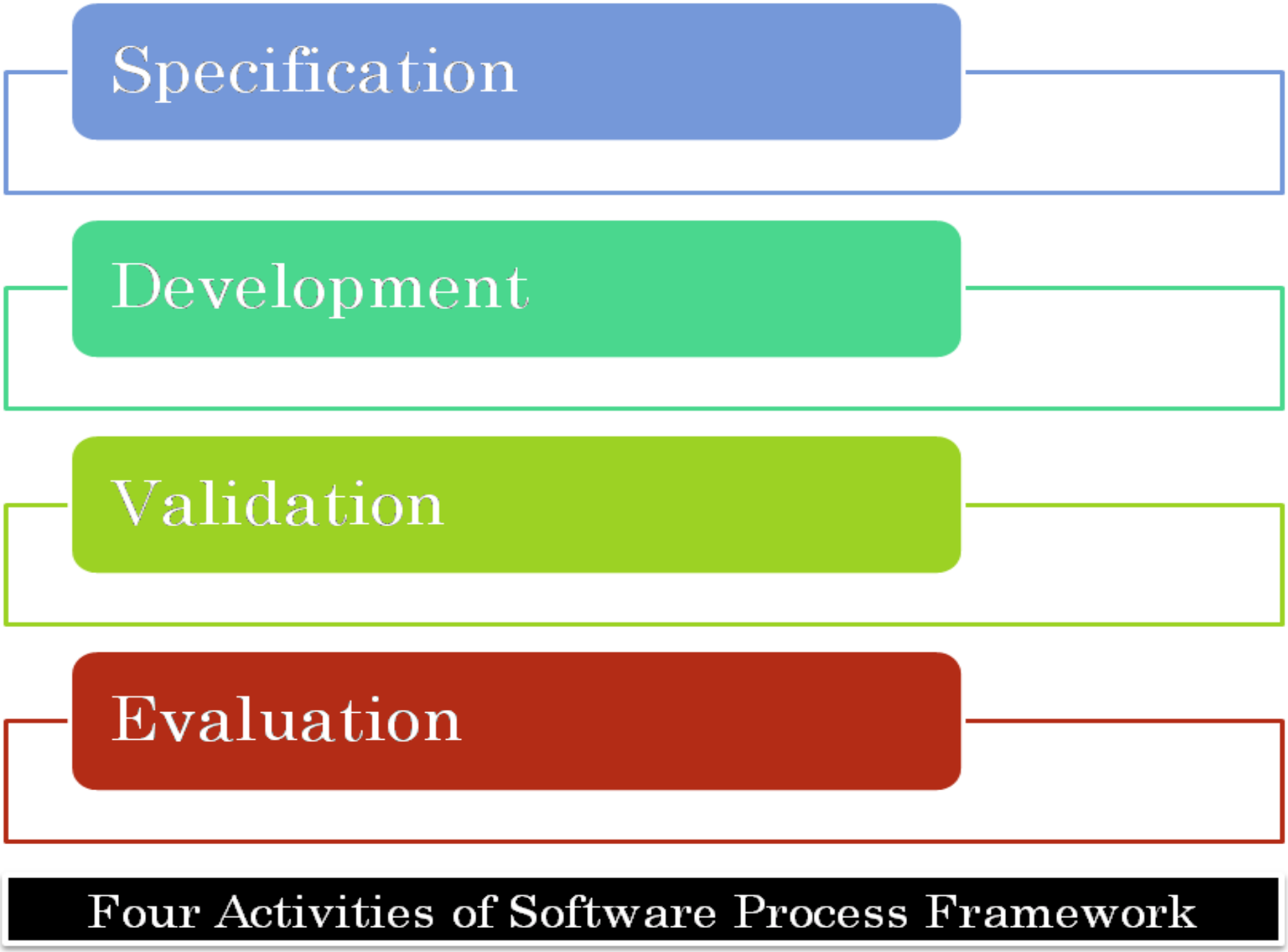
- A software process (also knows as software methodology) is a set of related activities that leads to the production of the software.
- These activities may involve the development of the software from the scratch, or, modifying an existing system.
- A **software development process**, also known as a **software development** lifecycle, is a structure imposed on the **development** of a **software** product.

- A **software process** is represented as a set of work phases that is applied to design and build a **software** product.

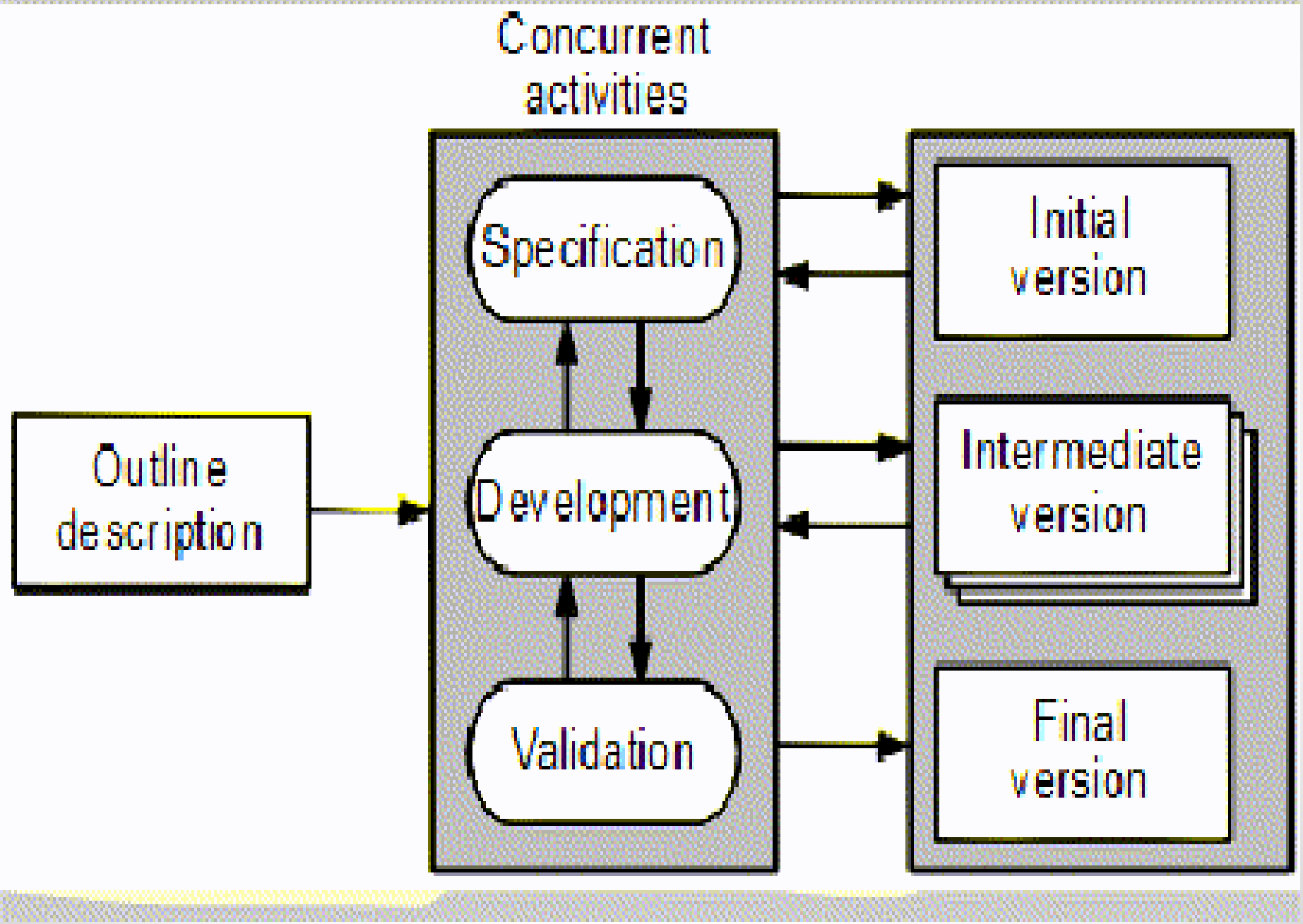
- The **software** that meets the specification is produced.



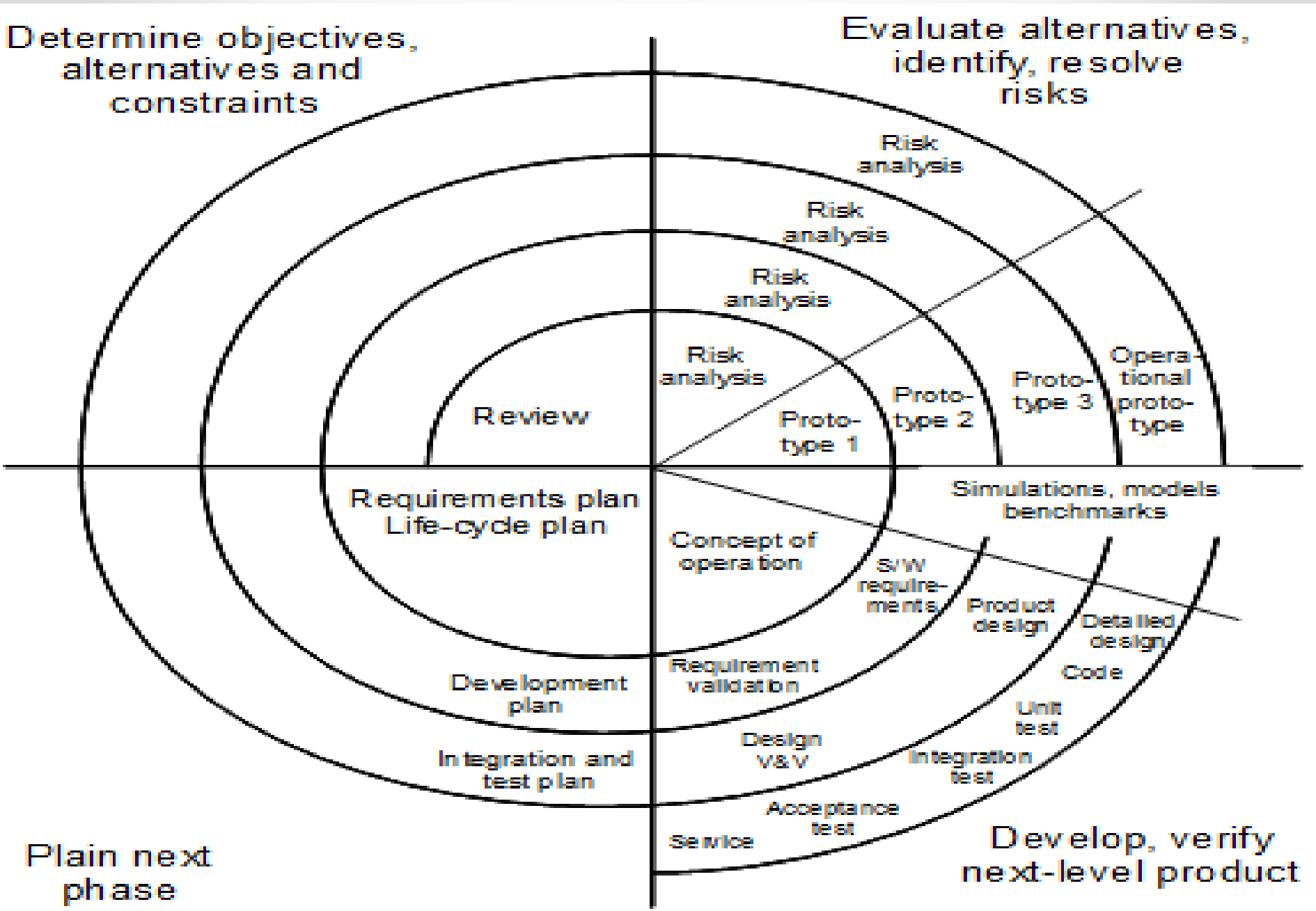
- Software Process



Four Activities of Software Process Framework



- Evolutionary Development



Spiral Development (Model)

There are four components includes in Software Process

- **Software Process Model:**The waterfall model, V-model of software process, Evolutionary development, Component based software engineering.
- **Process Iteration:** Incremental delivery, Spiral development,
- **Process activities:** Software Specification, software design and development, software validation and software evolution.
- The Rational Unified Process

- **Three level of Software Process:**

Three levels of process and their attributes

ATTRIBUTES	METAPROCESS	MACROPROCESS	MICROPROCESS
Subject	Line of business	Project	Iteration
Objectives	Line-of-business profitability Competitiveness	Project profitability Risk management Project budget, schedule, quality	Resource management Risk resolution Milestone budget, schedule, quality
Audience	Acquisition authorities, customers Organizational management	Software project managers Software engineers	Subproject managers Software engineers
Metrics	Project predictability Revenue, market share	On budget, on schedule Major milestone success Project scrap and rework	On budget, on schedule Major milestone progress Release/iteration scrap and rework
Concerns	Bureaucracy vs. standardization	Quality vs. financial performance	Content vs. schedule
Time scales	6 to 12 months	1 to many years	1 to 6 months

5. Team Effectiveness & Software Environment & Quality Target

- Teamwork is much more important than the sum of the individuals. With software teams, a project manager needs to configure a balance of solid talent with highly skilled people in the leverage positions. Some maxims of team management include the following:
  - A well-managed project can succeed with a nominal engineering team.
  - A mismanaged project will almost never succeed, even with an expert team of engineers.
  - A well-architected system can be built by a nominal team of software builders.
  - A poorly architected system will flounder even with an expert team of builders.

Boehm five staffing principles are -

- The principle of top talent: Use better and fewer people
- The principle of job matching: Fit the tasks to the skills and motivation of the people available.
- The principle of career progression: An organization does best in the long run by helping its people to self-actualize.
- The principle of team balance: Select people who will complement and harmonize with one another
- The principle of phase-out: Keeping a misfit on the team doesn't benefit anyone

- Software project managers need many leadership qualities in order to enhance team effectiveness.
- The following are some crucial attributes of successful software project managers that deserve much more attention:

1. **Hiring skills**. Few decisions are as important as hiring decisions. Placing the right person in the right job seems obvious but is surprisingly hard to achieve.
2. **Customer-interface skill**. Avoiding adversarial relationships among stake holders is a prerequisite for success.

3. **Decision-making skill.** The jillion books written about management have failed to provide a clear definition of this attribute. We all know a good leader when we run into one, and decision-making skill seems obvious despite its intangible definition.

4. **Team-building skill.** Teamwork requires that a manager establish trust, motivate progress, exploit eccentric prima donnas, transition average people into top performers, eliminate misfits, and consolidate diverse opinions into a team direction.

5. **Selling skill**. Successful project managers must sell all stakeholders (including themselves) on decisions and priorities, sell candidates on job positions, sell changes to the status quo in the face of resistance, and sell achievements against objectives. In practice, selling requires continuous negotiation, compromise, and empathy
6. **Software environment** is the term commonly used to refer to support an application.
7. A **software environment** for a particular application could include the operating system, the database system, specific development tools or compiler.

Quality Target

- Software best practices are derived from the development process and technologies.
- Key practices that improve overall software quality include the following:
  - Focusing on driving requirements and critical use cases early in the life cycle, focusing on requirements completeness and traceability late in the life cycle, and focusing throughout the life cycle on a balance between requirements evolution, design evolution, and plan evolution

- Using metrics and indicators to measure the progress and quality of an architecture as it evolves from a high-level prototype into a fully compliant product
- Providing integrated life-cycle environments that support early and continuous configuration control, change management, rigorous design methods, document automation, and regression test automation
- Using visual modeling and higher level languages that support architectural control, abstraction, reliable programming, reuse, and self-documentation
- Early and continuous insight into performance issues through demonstration-based evaluations

- Conventional development processes stressed early sizing and timing estimates of computer program resource utilization. However, the typical chronology of events in performance assessment was as follows
  - **Project inception**. The proposed design was asserted to be low risk with adequate performance margin.
  - **Initial design review**. Optimistic assessments of adequate design margin were based mostly on paper analysis or rough simulation of the critical threads. In most cases, the actual application algorithms and database sizes were fairly well understood.

- **Mid-life-cycle design review**. The assessments started whittling away at the margin, as early benchmarks and initial tests began exposing the optimism inherent in earlier estimates.
- **Integration and test**. Serious performance problems were uncovered, necessitating fundamental changes in the architecture. The underlying infrastructure was usually the scapegoat, but the real culprit was immature use of the infrastructure, immature architectural solutions, or poorly understood early design trade-offs.

6. Principles of Conventinal Software Engineering

1. Make quality
2. High-quality software is possible.
3. Give products to customers early.
4. Determine the problem before writing the requirements.
5. Evaluate design alternatives.
6. Use an appropriate process model.
7. Use different languages for different phases.
8. Minimize intellectual distance.
9. Put techniques before tools.
10. Get it right before you make it faster.
11. Inspect code.

12. Good management is more important than good technology.
13. People are the key to success.
14. Follow with care.
15. Take responsibility.
16. Understand the customer's priorities.
17. The more they see, the more they need.
18. Plan to throw one away.
19. Design for change.
20. Design without documentation is not design.
21. Use tools, but be realistic.
22. Avoid tricks.
23. Encapsulate.
24. Use coupling and cohesion.
25. Use the McCabe complexity measure.

26. Don't test your own software.
27. Analyze causes for errors.
28. Realize that software's entropy increases.
29. People and time are not interchangeable.
30. Expect excellence.

7. Principles of Modern Software Management

- Top 10 principles of modern software management are. (The first five, which are the main themes of my definition of an iterative process, are summarized here.

1. **Base the process on an architecture-first approach.** This requires that a demonstrable balance be achieved among the driving requirements, the architecturally significant design decisions, and the life-cycle plans before the resources are committed for full-scale development.

2. Establish an iterative life-cycle process that confronts risk early.

- With today's sophisticated software systems, it is not possible to define the entire problem, design the entire solution, build the software, and thentest the end product in sequence.
- Instead, an iterative process that refines the problem understanding, an effective solution, and an effective plan over several iterations encourages a balanced treatment of all stakeholder objectives.
- Major risks must be addressed early to increase predictability and avoid expensive downstream scrap and rework.

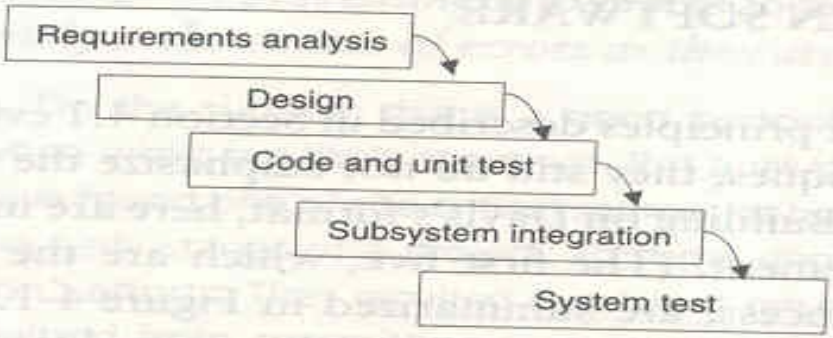
3. **Transition design methods to emphasize component-based development**. Moving from a line-of-code mentality to a component-based mentality is necessary to reduce the amount of human-generated source code and custom development.
4. **Establish a change management environment.** The dynamics of iterative development, including concurrent workflows by different teams working on shared artifacts, necessitates objectively controlled baselines

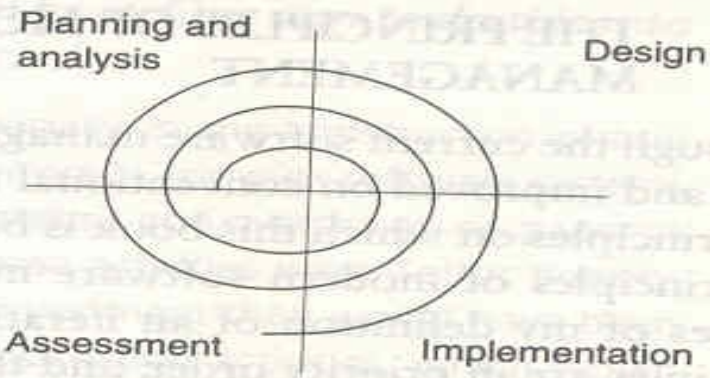
Waterfall Process

Requirements first
Custom development
Change avoidance
Ad hoc tools

Iterative Process

Architecture first
Component-based development
Change management
Round-trip engineering





Architecture-first approach → **The central design element**

Design and integration first, then production and test

Iterative life-cycle process → **The risk management element**

Risk control through ever-increasing function, performance, quality

Component-based development → **The technology element**

Object-oriented methods, rigorous notations, visual modeling

Change management environment → **The control element**

Metrics, trends, process instrumentation

Round-trip engineering → **The automation element**

Complementary tools, integrated environments

FIGURE 4-1. *The top five principles of a modern process*

5. **Enhance change freedom through tools that support *round-trip engineering*.** Round-trip engineering is the environment support necessary to automate and synchronize engineering information in different formats(such as requirements specifications, design models, source code, executable code, test cases).

6. **Capture design artifacts in rigorous, *model-based notation.*** A model based approach (such as UML) supports the evolution of semantically rich graphical and textual design notations.

7. **Instrument the process for *objective quality control* and progress assessment**. Life-cycle assessment of the progress and the quality of all intermediate products must be integrated into the process.

8. **Use a demonstration-based approach to assess intermediate artifacts.**

9. **Plan intermediate releases in groups of usage scenarios with evolving levels of detail.** It is essential that the software management process drive toward early and continuous demonstrations within the operational context of the system, namely its use cases.

10. **Establish a configurable process that is economically scalable.** No single process is suitable for all software developments.

- Below table maps top 10 risks of the conventional process to the key attributes and principles of a modern process

TABLE 4-1. *Modern process approaches for solving conventional problems*

CONVENTIONAL PROCESS: TOP 10 RISKS	IMPACT	MODERN PROCESS: INHERENT RISK RESOLUTION FEATURES
1. Late breakage and excessive scrap/rework	Quality, cost, schedule	Architecture-first approach Iterative development Automated change management Risk-confronting process
2. Attrition of key personnel	Quality, cost, schedule	Successful, early iterations Trustworthy management and planning
3. Inadequate development resources	Cost, schedule	Environments as first-class artifacts of the process Industrial-strength, integrated environments Model-based engineering artifacts Round-trip engineering
4. Adversarial stakeholders	Cost, schedule	Demonstration-based review Use-case-oriented requirements/testing
5. Necessary technology insertion	Cost, schedule	Architecture-first approach Component-based development
6. Requirements creep	Cost, schedule	Iterative development Use case modeling Demonstration-based review
7. Analysis paralysis	Schedule	Demonstration-based review Use-case-oriented requirements/testing
8. Inadequate performance	Quality	Demonstration-based performance assessment Early architecture performance feedback
9. Overemphasis on artifacts	Schedule	Demonstration-based assessment Objective quality control
10. Inadequate function	Quality	Iterative development Early prototypes, incremental releases

8. Iterative Process

- Modern software development processes have moved away from the conventional waterfall model, in which each stage of the development process is dependent on com pletion of the previous stage.

- The economic benefits inherent in transitioning from the conventional waterfall model to an iterative development process are significant but difficult to quantify.

- As one benchmark of the expected economic impact of process improvement, consider the process exponent parameters of the COCOMO II model. (Appendix B provides more detail on the COCOMO model) This exponent can range from 1.01 (virtually no diseconomy of scale) to 1.26 (significant diseconomy of scale).

- The parameters that govern the value of the process exponent are application precedentedness, process flexibility, architecture risk resolution, team cohesion, and software process maturity.

- The following paragraphs map the process exponent parameters of CO COMO II to top 10 principles of a modern process.
- **Application precedentedness**.
  - Domain experience is a critical factor in understanding how to plan and execute a software development project.
  - For unprecedented systems, one of the key goals is to confront risks and establish early precedents, even if they are incomplete or experimental.
  - This is one of the primary reasons that the software industry has moved to an ***iterative life-cycle process.***
  - Early iterations in the life cycle establish precedents from which the product, the process, and the plans can be elaborated in ***evolving levels*** **of** ***detail.***

- **Process flexibility**.
  - Development of modern software is characterized by such a broad solution space and so many interrelated concerns that there is a paramount need for continuous incorporation of changes.
  - These changes may be inherent in the problem understanding, the solution space, or the plans. Project artifacts must be supported by efficient ***change management*** commensurate with project needs.
  - A ***configurable process*** that allows a common framework to be adapted across a range of projects is necessary to achieve a software return on investment.

- **Architecture risk resolution**.
  - ***Architecture-first*** development is a crucial theme underlying a successful iterative development process.
  - A project team develops and stabilizes architecture before developing all the com ponents that make up the entire suite of applications components.
  - An ***architecture-first*** and ***component-based development approach*** forces the infrastructure, common mechanisms, and control mechanisms to be elaborated early in the life cycle and drives all component make/buy decisions into the architecture process.

- **Team cohesion**.
  - Successful teams are unified, and integrated teams are successful. Successful teams and unified or integrated teams share common objectives and priorities.
  - Advances in technology (such as programming languages, UML, and visual modeling) have enabled more rigorous and understandable notations for communicating software engineering information, particularly in the requirements and design artifacts that previously were ad hoc and based completely on paper exchange.
  - The ***model-based*** formats have also enabled the ***round-trip engineering*** support needed to establish change freedom sufficient for evolving design representations.

- **Software process maturity**.
  - The Software Engineering Institute's Capability Maturity Model (CMM) is a well-accepted benchmark for software process assessment.
  - One of key themes is that truly mature processes are enabled through an integrated environment that provides the appropriate level of automation to instrument the process for ***objective quality control.***

Unit – Important questions

1.	Explain briefly Waterfall model. Also explain Conventional s/w management performance?
2.	Define Software Economics. Also explain Pragmatic s/w cost estimation?
3.	Explain Important trends in improving Software economics?
4.	Explain five staffing principal offered by Boehm. Also explain Peer Inspections?
5..	Explain principles of conventional software engineering?
6.	Explain briefly principles of modern software management

Thank you