UNIT - IV

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.

Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.
Process Automation: Automation Building blocks, The Project Environment.

10. Iterative process planning

A good work breakdown structure and its synchronization with the process framework are critical factors in software project success. Development of a work breakdown structure dependent on the project management style, organizational culture, customer preference, financial constraints, and several other hard-to-define, project-specific parameters.
A WBS is simply a hierarchy of elements that decomposes the project plan into the discrete work tasks. A WBS provides the following information structure:

- A delineation of all significant work
- A clear task decomposition for assignment of responsibilities
- A framework for scheduling, budgeting, and expenditure tracking

Many parameters can drive the decomposition of work into discrete tasks: product subsystems, components, functions, organizational units, life-cycle phases, even geographies. Most systems have a first-level decomposition by subsystem. Subsystems are then decomposed into their components, one of which is typically the software.

10.1.1 CONVENTIONAL WBS ISSUES

Conventional work breakdown structures frequently suffer from three fundamental flaws.

1. They are prematurely structured around the product design.
2. They are prematurely decomposed, planned, and budgeted in either too much or too little detail.
3. They are project-specific, and cross-project comparisons are usually difficult or impossible.

Conventional work breakdown structures are prematurely structured around the product design. Figure 10-1 shows a typical conventional WBS that has been structured primarily around the subsystems of its product architecture, then further decomposed into the components of each subsystem. A WBS is the architecture for the financial plan.

Conventional work breakdown structures are prematurely decomposed, planned, and budgeted in either too little or too much detail. Large software projects tend to be over planned and small projects tend to be under planned. The basic problem with planning too much detail at the outset is that the detail does not evolve with the level of fidelity in the plan.

Conventional work breakdown structures are project-specific, and cross-project comparisons *are usually difficult or impossible.* With no standard WBS structure, it is extremely difficult to compare plans, financial data, schedule data, organizational efficiencies, cost trends, productivity trends, or quality trends across multiple projects.

Figure 10-1 Conventional work breakdown structure, following the product hierarchy

Management
System requirement and design
Subsystem 1
- **Component 11**
  - **Requirements**
  - **Design**
  - **Code**
  - **Test**
  - **Documentation**
- **…(similar structures for other components)**
- **Component 1N**
  - **Requirements**
  - **Design**
  - **Code**
  - **Test**

Documentation

…(similar structures for other subsystems)

Subsystem M

Component M1

Requirements

Design

Code

Test

Documentation

…(similar structures for other components)

Component MN

Requirements

Design

Code

Test

Documentation

Integration and test

Test planning

Test procedure preparation

Testing

Test reports

Other support areas

Configuration control

Quality assurance

System administration

10.1.2 EVOLUTIONARY WORK BREAKDOWN STRUCTURES

An evolutionary WBS should organize the planning elements around the process framework rather than the product framework. The basic recommendation for the WBS is to organize the hierarchy as follows:

- First-level WBS elements are the workflows (management, environment, requirements, design, implementation, assessment, and deployment).
- Second-level elements are defined for each phase of the life cycle (inception, elaboration, construction, and transition).
- Third-level elements are defined for the focus of activities that produce the artifacts of each phase.

A default WBS consistent with the process framework (phases, workflows, and artifacts) is shown in Figure 10-2. This recommended structure provides one example of how the elements of the process framework can be integrated into a plan. It provides a framework for estimating the costs and schedules of each element, allocating them across a project organization, and tracking expenditures.

The structure shown is intended to be merely a starting point. It needs to be tailored to the specifics of a project in many ways.

- Scale. Larger projects will have more levels and substructures.
- Organizational structure. Projects that include subcontractors or span multiple organizational entities may introduce constraints that necessitate different WBS allocations.
- Degree of custom development. Depending on the character of the project, there can be very different emphases in the requirements, design, and implementation workflows.
- Business context. Projects developing commercial products for delivery to a broad customer base may require much more elaborate substructures for the deployment element.
- Precedent experience. Very few projects start with a clean slate. Most of them are developed as new generations of a legacy system (with a mature WBS) or in the context of existing organizational standards (with preordained WBS expectations).

The WBS decomposes the character of the project and maps it to the life cycle, the budget, and the personnel. Reviewing a WBS provides insight into the important attributes, priorities, and structure of the project plan.

Another important attribute of a good WBS is that the planning fidelity inherent in each element is commensurate with the current life-cycle phase and project state. Figure 10-3 illustrates this idea. One of the primary reasons for organizing the default WBS the way I have is to allow for planning elements that range from planning packages (rough budgets that are maintained as an estimate for future elaboration rather than being decomposed into detail) through fully planned activity networks (with a well-defined budget and continuous assessment of actual versus planned expenditures).

Figure 10-2 Default work breakdown structure

A Management

- **AA Inception phase management**
  - **AAA Business case development**
  - **AAB Elaboration phase release specifications**
  - **AAC Elaboration phase WBS specifications**
  - **AAD Software development plan**
  - **AAE Inception phase project control and status assessments**
- **AB Elaboration phase management**
  - **ABA Construction phase release specifications**
  - **ABB Construction phase WBS baselining**
  - **ABC Elaboration phase project control and status assessments**

- **AC Construction phase management**
  - **ACA Deployment phase planning**
  - **ACB Deployment phase WBS baselining**
  - **ACC Construction phase project control and status assessments**
- **AD Transition phase management**
  - **ADA Next generation planning**
  - **ADB Transition phase project control and status assessments**

B Environment

- **BA Inception phase environment specification**
- **BB Elaboration phase environment baselining**
  - **BBA Development environment installation and administration**
  - **BBB Development environment integration and custom toolsmithing**
  - **BBC SCO database formulation**
- **BC Construction phase environment maintenance**
  - **BCA Development environment installation and administration**
  - **BCB SCO database maintenance**
- **BD Transition phase environment maintenance**
  - **BDA Development environment maintenance and administration**
  - **BDB SCO database maintenance**
  - **BDC Maintenance environment packaging and transition**

C Requirements

- **CA Inception phase requirements development**
  - **CCA Vision specification**
  - **CAB Use case modeling**
- **CB Elaboration phase requirements baselining**
  - **CBA Vision baselining**
  - **CBB Use case model baselining**
- **CC Construction phase requirements maintenance**
- **CD Transition phase requirements maintenance**

D Design

- **DA Inception phase architecture prototyping**
- **DB Elaboration phase architecture baselining**
  - **DBA Architecture design modeling**
  - **DBB Design demonstration planning and conduct**
  - **DBC Software architecture description**
- **DC Construction phase design modeling**
  - **DCA Architecture design model maintenance**
  - **DCB Component design modeling**
- **DD Transition phase design maintenance**

E Implementation

- **EA Inception phase component prototyping**
- **EB Elaboration phase component implementation**
  - **EBA Critical component coding demonstration integration**

- **EC Construction phase component implementation**
  - **ECA Initial release(s) component coding and stand-alone testing**
  - **ECB Alpha release component coding and stand-alone testing**
  - **ECC Beta release component coding and stand-alone testing**
  - **ECD Component maintenance**

F Assessment

- **FA Inception phase assessment**
- **FB Elaboration phase assessment**
  - **FBA Test modeling**
  - **FBB Architecture test scenario implementation**
  - **FBC Demonstration assessment and release descriptions**
- **FC Construction phase assessment**
  - **FCA Initial release assessment and release description**
  - **FCB Alpha release assessment and release description**
  - **FCC Beta release assessment and release description**
- **FD Transition phase assessment**
  - **FDA Product release assessment and release description**

G Deployment

- **GA Inception phase deployment planning**
- **GB Elaboration phase deployment planning**
- **GC Construction phase deployment**
  - **GCA User manual baselining**
- **GD Transition phase deployment**
  - **GDA Product transition to user**

Figure 10-3 Evolution of planning fidelity in the WBS over the life cycle

Inception

WBS Element	Fidelity
Management	**High**
Environment	Moderate
Requirement	**High**
Design	Moderate
Implementation	Low
Assessment	Low
Deployment	Low

Elaboration

WBS Element	Fidelity
Management	**High**
Environment	**High**
Requirement	**High**
Design	**High**
Implementation	Moderate
Assessment	Moderate
Deployment	Low

WBS Element	Fidelity
Management	**High**
Environment	**High**
Requirements	Low
Design	Low
Implementation	Moderate
Assessment	**High**
Deployment	**High**

Transition

WBS Element	Fidelity
Management	**High**
Environment	**High**
Requirements	Low
Design	Moderate
Implementation	**High**
Assessment	**High**
Deployment	Moderate

Construction

10.2 PLANNING GUIDELINES

Software projects span a broad range of application domains. It is valuable but risky to make specific planning recommendations independent of project context. Project-independent planning advice is also risky. There is the risk that the guidelines may pe adopted blindly without being adapted to specific project circumstances. Two simple planning guidelines should be considered when a project plan is being initiated or assessed. The first guideline, detailed in Table 10-1, prescribes a default allocation of costs among the first-level WBS elements. The second guideline, detailed in Table 10-2, prescribes the allocation of effort and schedule across the lifecycle phases.

10-1 Web budgeting defaults

First Level WBS Element	Default Budget
Management	10%
Environment	10%
Requirement	10%
Design	15%
Implementation	25%
Assessment	25%
Deployment	5%
Total	100%

Table 10-2 Default distributions of effort and schedule by phase

Domain	Inception	Elaboration	Construction	Transition

Effort	5%	20%	65%	10%
Schedule	10%	30%	50%	10%

10.3 THE COST AND SCHEDULE ESTIMATING PROCESS

Project plans need to be derived from two perspectives. The first is a forward-looking, top-down approach. It starts with an understanding of the general requirements and constraints, derives a macro-level budget and schedule, then decomposes these elements into lower level budgets and intermediate milestones. From this perspective, the following planning sequence would occur:

1. The software project manager (and others) develops a characterization of the overall size, process, environment, people, and quality required for the project.
2. A macro-level estimate of the total effort and schedule is developed using a software cost estimation model.
3. The software project manager partitions the estimate for the effort into a top-level WBS using guidelines such as those in Table 10-1.
4. At this point, subproject managers are given the responsibility for decomposing each of the WBS elements into lower levels using their top-level allocation, staffing profile, and major milestone dates as constraints.

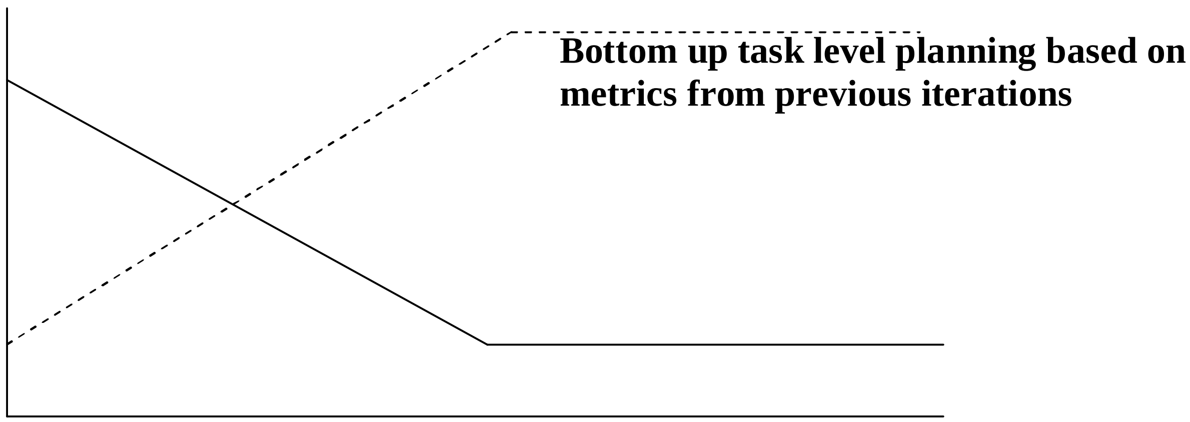
The second perspective is a backward-looking, bottom-up approach. We start with the end in mind, analyze the micro-level budgets and schedules, then sum all these elements into the higher level budgets and intermediate milestones. This approach tends to define and populate the WBS from the lowest levels upward. From this perspective, the following planning sequence would occur:

1. The lowest level WBS elements are elaborated into detailed tasks
2. Estimates are combined and integrated into higher level budgets and milestones.
3. Comparisons are made with the top-down budgets and schedule milestones.

Milestone scheduling or budget allocation through top-down estimating tends to exaggerate the project management biases and usually results in an overly optimistic plan. Bottom-up estimates usually exaggerate the performer biases and result in an overly pessimistic plan.

These two planning approaches should be used together, in balance, throughout the life cycle of the project. During the engineering stage, the top-down perspective will dominate because there is usually not enough depth of understanding nor stability in the detailed task sequences to perform credible bottom-up planning. During the production stage, there should be enough precedent experience and planning fidelity that the bottom-up planning perspective will dominate. Top-down approach should be well tuned to the project-specific parameters, so it should be used more as a global assessment technique. Figure 10-4 illustrates this life-cycle planning balance.

<u>Figure 10-4 Planning balance throughout the life cycle</u>



Top down project level planning based on microanalysis from previous projects

Engineering Stage		Production Stage	
Inception	**Elaboration**	**Construction**	**Transition**
Feasibility iteration	Architecture iteration	Usable iteration	Product Releases

Engineering stage planning emphasis	Production stage planning emphasis
Macro level task estimation for production stage artifacts	Micro level task estimation for production stage artifacts
Micro level task estimation for engineering artifacts	Macro level task estimation for maintenance of engineering artifacts
Stakeholder concurrence	Stakeholder concurrence
Coarse grained variance analysis of actual vs planned expenditures	Fine grained variance analysis of actual vs planned expenditures
Tuning the top down project independent planning guidelines into project specific planning guidelines	
WBS definition and elaboration	

10.4 THE ITERATION PLANNING PROCESS

Planning is concerned with defining the actual sequence of intermediate results. An evolutionary build plan is important because there are always adjustments in build content and schedule as early conjecture evolves into well-understood project circumstances. *Iteration* is used to mean a complete synchronization across the project, with a well-orchestrated global assessment of the entire project baseline.

- Inception iterations. The early prototyping activities integrate the foundation components of a candidate architecture and provide an executable framework for elaborating the critical use cases of the system. This framework includes existing components, commercial components, and custom prototypes sufficient to demonstrate a candidate architecture and sufficient requirements understanding to establish a credible business case, vision, and software development plan.
- Elaboration iterations. These iterations result in architecture, including a complete framework and infrastructure for execution. Upon completion of the architecture iteration, a few critical use cases should be demonstrable: (1) initializing the architecture, (2) injecting a scenario to drive the worst-case data processing flow through the system (for example, the peak transaction throughput or peak load scenario), and (3) injecting a scenario to drive the worst-case control flow through the system (for example, orchestrating the fault-tolerance use cases).
- Construction iterations. Most projects require at least two major construction iterations: an alpha release and a beta release.
- Transition iterations. Most projects use a single iteration to transition a beta release into the final product.

The general guideline is that most projects will use between four and nine iterations. The typical project would have the following six-iteration profile:

- One iteration in inception: an architecture prototype
- Two iterations in elaboration: architecture prototype and architecture baseline
- Two iterations in construction: alpha and beta releases
- One iteration in transition: product release

A very large or unprecedented project with many stakeholders may require additional inception iteration and two additional iterations in construction, for a total of nine iterations.

10.5 PRAGMATIC PLANNING

Even though good planning is more dynamic in an iterative process, doing it accurately is far easier. While executing iteration N of any phase, the software project manager must be monitoring and controlling against a plan that was initiated in iteration N - 1 and must be planning iteration N + 1. The art of good project· management is to make trade-offs in the current iteration plan and the next iteration plan based on objective results in the current iteration and previous iterations. Aside from bad architectures and misunderstood requirements, inadequate planning (and subsequent bad management) is one of the most common reasons for project failures. Conversely, the success of every successful project can be attributed in part to good planning.

A project's plan is a definition of how the project requirements will be transformed into' a product within the business constraints. It must be realistic, it must be current, it must be a team product, it must be understood by the stakeholders, and it must be used. Plans are not just for managers. The more open and visible the planning process and results, the more ownership there is among the team members who need to execute it. Bad, closely held plans cause attrition. Good, open plans can shape cultures and encourage teamwork.

Unit – Important Questions

1.	**Define Model-Based software architecture?**
2.	**Explain various process workflows?**
3.	**Define typical sequence of life cycle checkpoints?**
4.	**Explain general status of plans, requirements and product across the major milestones.**
5.	**Explain conventional and Evolutionary work break down structures?**
6.	**Explain briefly planning balance throughout the life cycle?**

Project Organizations and Responsibilities:

- **Organizations** engaged in software Line-of-Business need to support projects with the infrastructure necessary to use a common process.
- **Project** organizations need to allocate artifacts & responsibilities across project team to ensure a balance of global (architecture) & local (component) concerns.
- **The organization** must evolve with the WBS & Life cycle concerns.
- **Software lines of business & product teams have different motivation.**
- **Software lines of business** are motivated by return of investment (ROI), new business discriminators, market diversification & profitability.
- **Project teams** are motivated by the cost, Schedule & quality of specific

deliverables

1) Line-Of-Business Organizations:

The main features of default organization are as follows:

- Responsibility for process definition & maintenance is specific to a cohesive line of business.
- Responsibility for process automation is an organizational role & is equal in importance to the process definition role.
- Organizational role may be fulfilled by a single individual or several different teams.

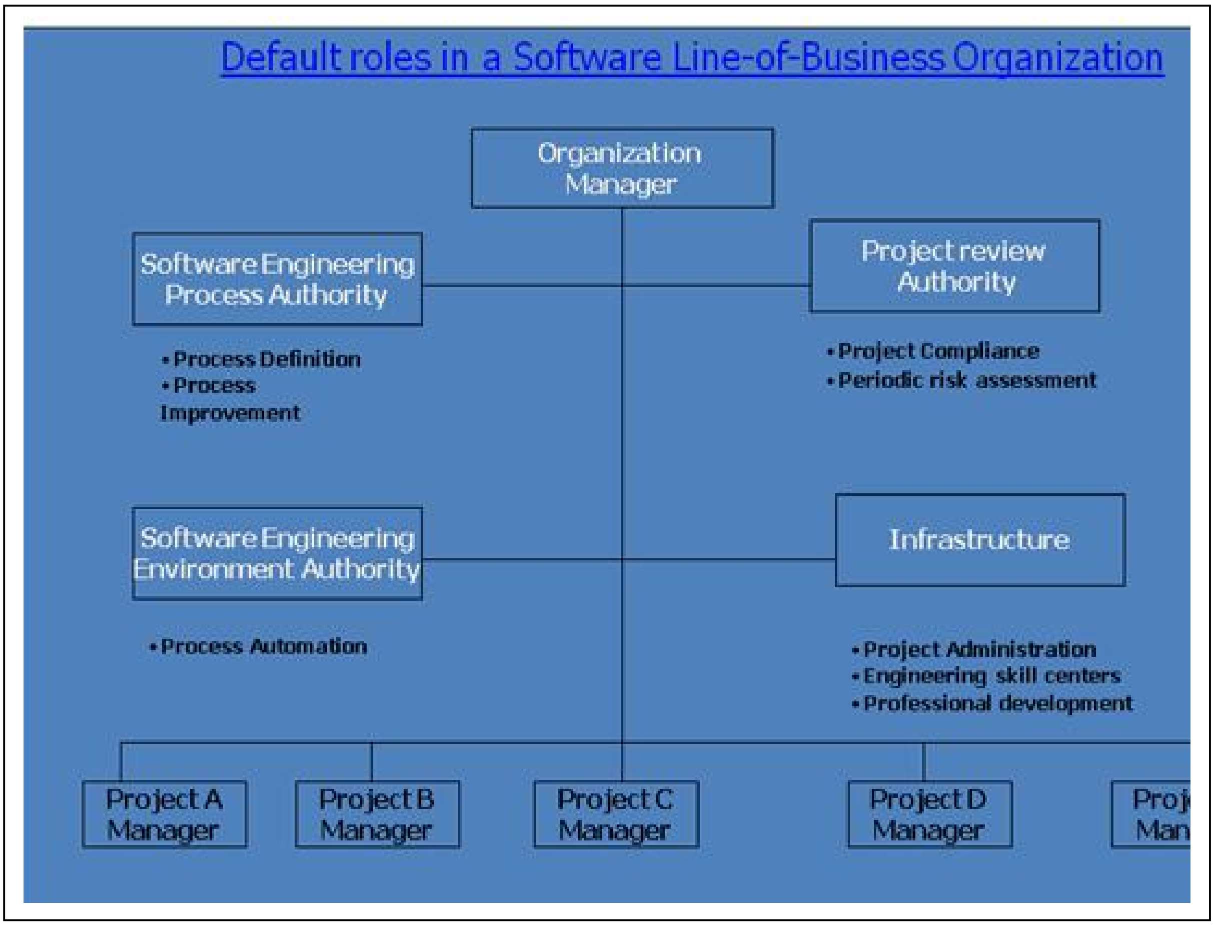


Fig: Default roles in a software Line-of-Business Organization.

Software Engineering Process Authority (SEPA)

The SEPA facilities the exchange of information & process guidance both to & from project practitioners

This role is accountable to General Manager for maintaining a current assessment of the organization's process maturity & its plan for future improvement

Project Review Authority (PRA)

The PRA is the single individual responsible for ensuring that a software project complies with all organizational & business unit software policies, practices & standards

A software Project Manager is responsible for meeting the requirements of a contract or some other project compliance standard

Software Engineering Environment Authority(SEEA)

The SEEA is responsible for automating the organization's process, maintaining the organization's standard environment, Training projects to use the environment & maintaining organization-wide reusable assets

The SEEA role is necessary to achieve a significant ROI for common process.

Infrastructure

An organization's infrastructure provides human resources support, project-independent research & development, & other capital software engineering assets.

2) Project organizations:

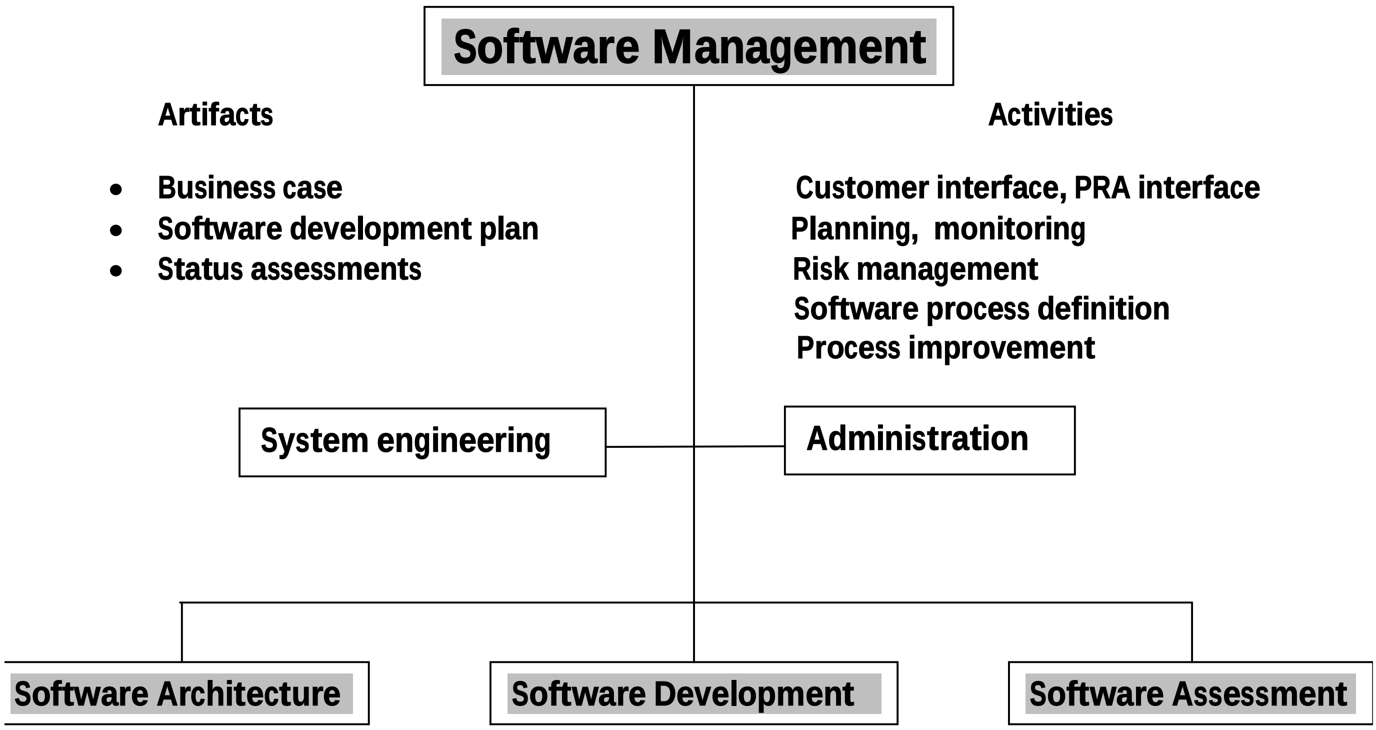
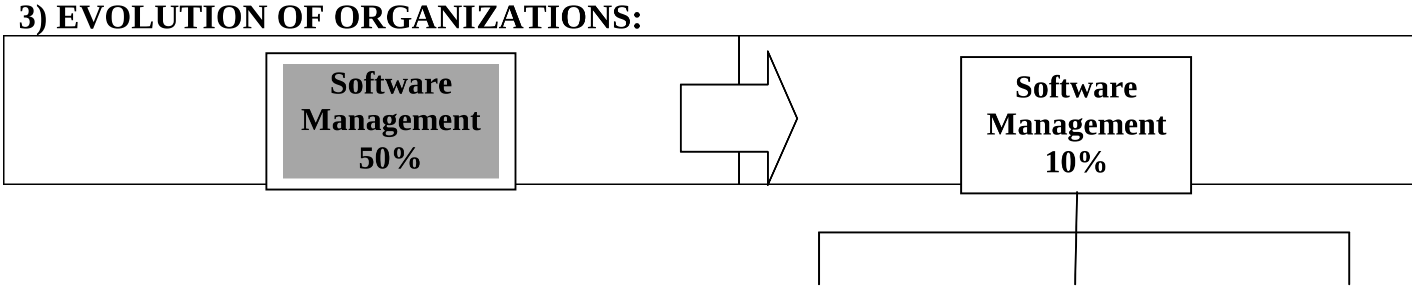
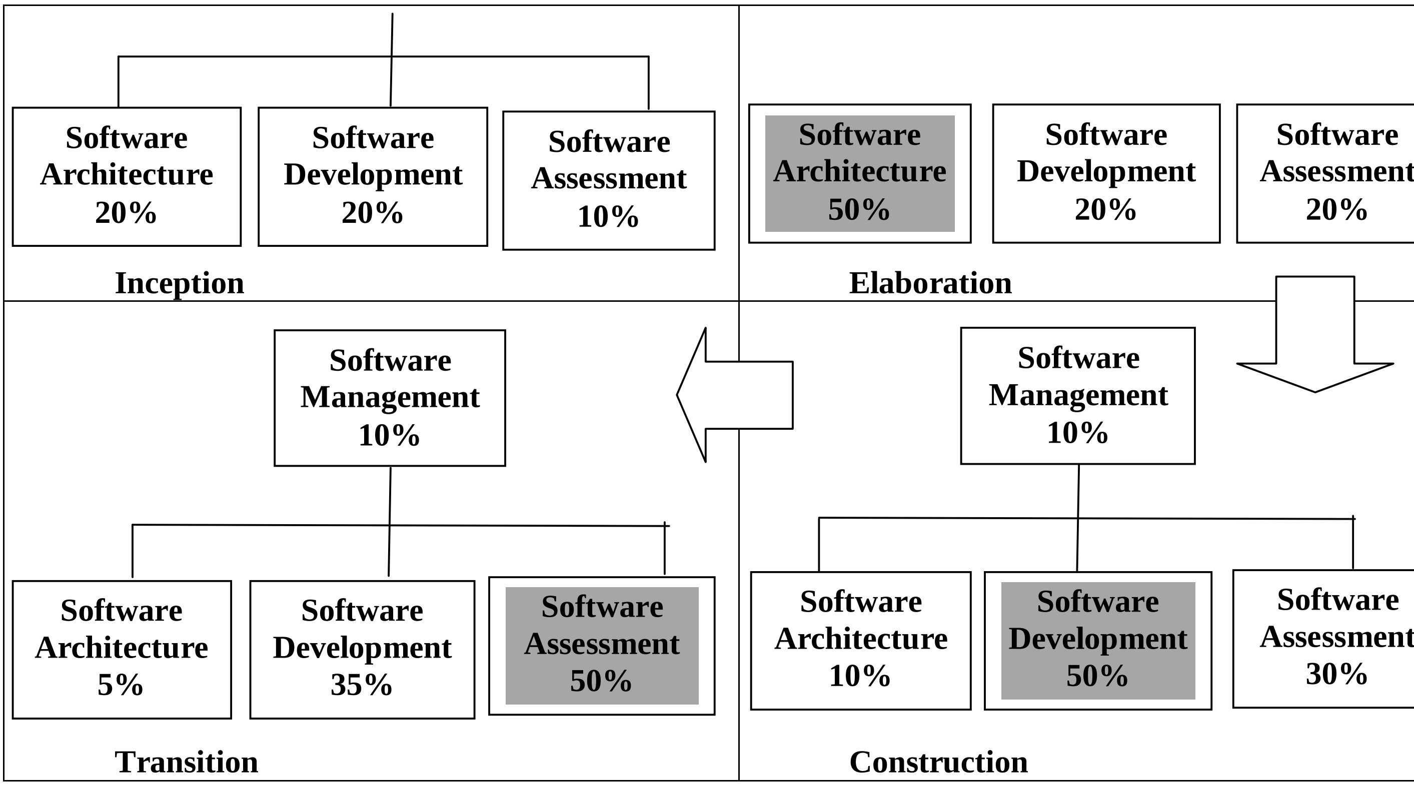


Figure 11-2. Default project organization and responsibilities

- The above figure shows a default project organization and maps project-level roles and responsibilities.
- The main features of the default organization are as follows:
- **The project management team** is an active participant, responsible for producing as well as managing.
- **The architecture team** is responsible for real artifacts and for the integration of components, not just for staff functions.
- **The development team** owns the component construction and maintenance activities.
- The assessment team is separate from development.
- **Quality** is everyone's into all activities and checkpoints.
- Each team takes responsibility for a different quality perspective.

3) EVOLUTION OF ORGANIZATIONS:





Inception: Software management: **50%** Software Architecture: 20% Software development: 20% Software Assessment (measurement/evaluation):10%	**Elaboration:** Software management: 10% Software Architecture: **50%** Software development: 20% Software Assessment (measurement/evaluation):20%
Construction: Software management: 10% Software Architecture: 10% Software development: **50%** Software Assessment (measurement/evaluation):30%	**Transition:** Software management: 10% Software Architecture: 5% Software development: 35% Software Assessment (measurement/evaluation):**50%**

The Process Automation:

Introductory Remarks:

The environment must be the first-class artifact of the process.

Process automation & change management is critical to an iterative process. If the change is expensive then the development organization will resist it.

Round-trip engineering & integrated environments promote change freedom & effective evolution of technical artifacts.

Metric automation is crucial to effective project control.

External stakeholders need access to environment resources to improve interaction with the development team & add value to the process.

The three levels of process which requires a certain degree of process automation for the corresponding process to be carried out efficiently.

Metaprocess (Line of business): The automation support for this level is called an infrastructure.

Macroproces (project): The automation support for a project's process is called an environment.
Microprocess (iteration): The automation support for generating artifacts is generally called a tool.

Tools: Automation Building blocks:
Many tools are available to automate the software development process. Most of the core software development tools map closely to one of the process workflows

Workflows	**Environment Tools & process Automation**
Management	**Workflow automation, Metrics automation**
Environment	**Change Management, Document Automation**
Requirements	**Requirement Management**
Design	**Visual Modeling**
Implementation	**-Editors, Compilers, Debugger, Linker, Runtime**
Assessment	**-Test automation, defect Tracking**
Deployment	**defect Tracking**

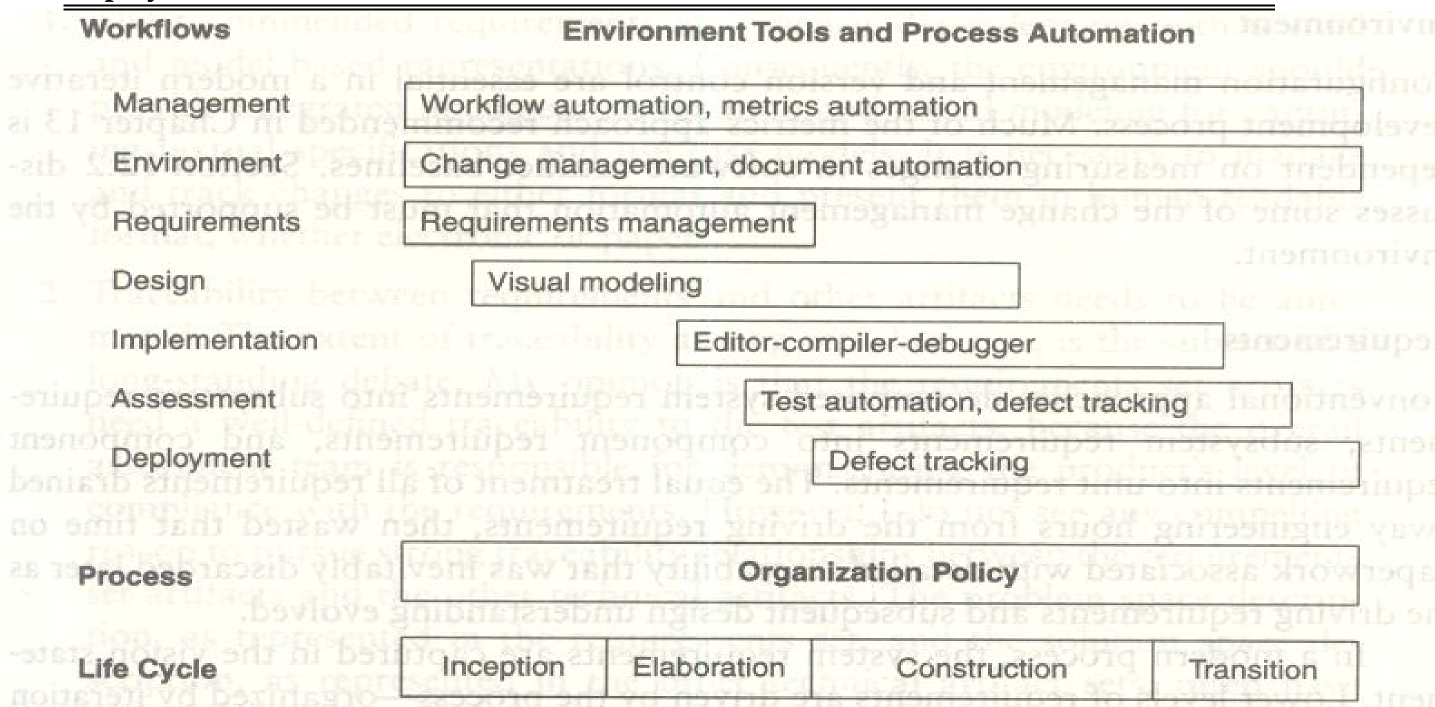


FIGURE 12-1. *Typical automation and tool components that support the process workflows*

PROCESS AUTOMATION

The Project Environment:

The project environment artifacts evolve through three discrete states.
(1)Prototyping Environment.(2)Development Environment.(3)Maintenance Environment.
The **Prototype Environment** includes an architecture test bed for prototyping project architecture to evaluate trade-offs during inception & elaboration phase of the life cycle.
The **Development environment** should include a full suite of development tools needed to support various Process workflows & round-trip engineering to the maximum extent possible.
The Maintenance Environment should typically coincide with the mature version of the development.
There are four important environment disciplines that are critical to management context & the success of a modern iterative development process.
Round-Trip engineering
Change Management
Software Change Orders (SCO)
Configuration baseline Configuration Control Board
Infrastructure
Organization Policy
Organization Environment
Stakeholder Environment.

Round Trip Environment
Tools must be integrated to maintain consistency & traceability.
Round-Trip engineering is the term used to describe this key requirement for environment that support iterative development.
As the software industry moves into maintaining different information sets for the engineering artifacts, more automation support is needed to ensure efficient & error free transition of data from one artifacts to another.
Round-trip engineering is the environment support necessary to maintain Consistency among the engineering artifacts.

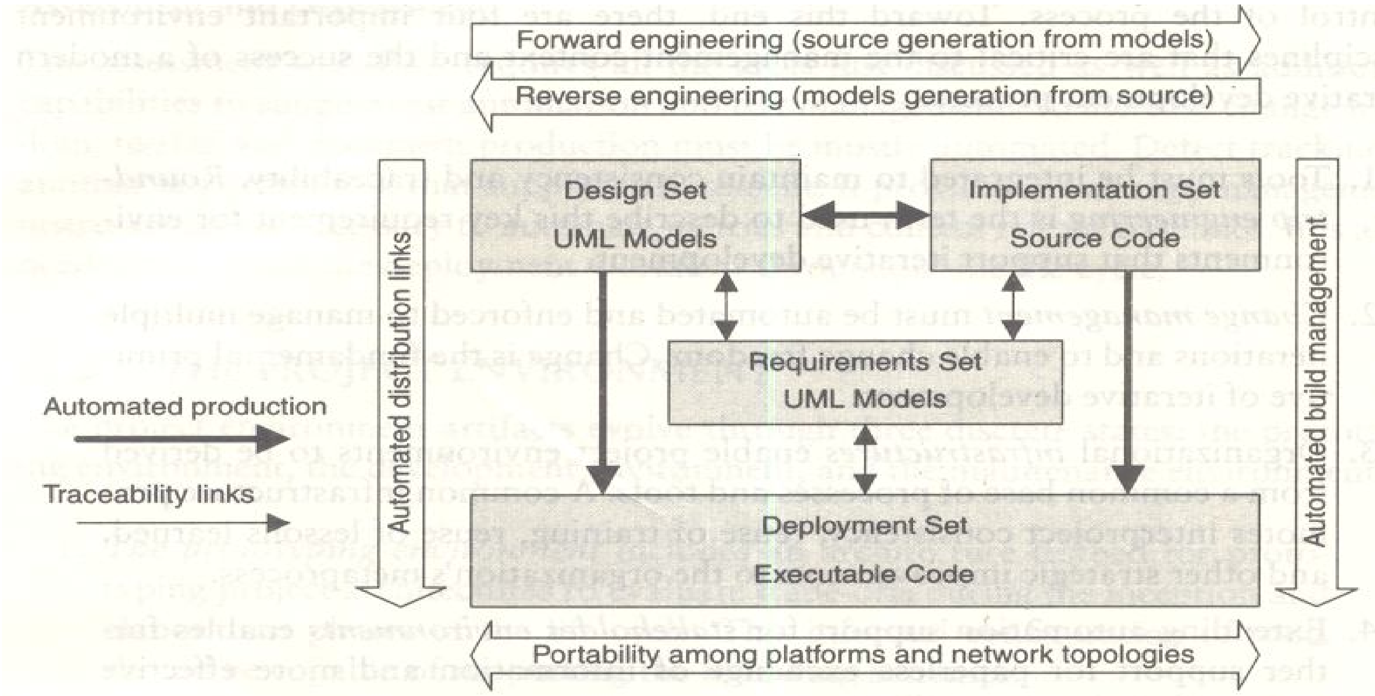


FIGURE 12-2. *Round-trip engineering*

Change Management

Change management must be automated & enforced to manage multiple iterations & to enable change freedom.

Change is the fundamental primitive of iterative Development.

I. **Software Change Orders**

The atomic unit of software work that is authorized to create, modify or obsolesce components within a configuration baseline is called a software change orders (SCO)

The basic fields of the SCO are Title, description, metrics, resolution, assessment & disposition

Title: ____________________

Description

Name: ____________________ Date: ____________

Project: ____________________

Metrics

Category: ________ (0/1 error, 2 enhancement, 3 new feature, 4 other)

Initial Estimate

Breakage: ________

Rework: ________

Actual Rework Expended

Analysis: ________ Test: ________

Implement: ________ Document: ________

Resolution

Analyst: ____________________

Software Component: ____________________

Assessment

Method: ____________ (inspection, analysis, demonstration, test)

Tester: ________ Platforms: ________ Date: ________

Disposition

State: ________ Release: ________ Priority ________

Acceptance: ____________________ Date: ________

Closure: ____________________ Date: ________

FIGURE 12-3. *The primitive components of a software change order*

<u>Change management</u>

II.Configuration Baseline

A configuration baseline is a named collection of software components &Supporting documentation that is subjected to change management & is upgraded, maintained, tested, statuses & obsolesced a unit

There are generally two classes of baselines

External Product Release

Internal testing Release

Three levels of baseline releases are required for most Systems

1. Major release (N)
2. Minor Release (M)
3. Interim (temporary) Release (X)

Major release represents a new generation of the product or project

A minor release represents the same basic product but with enhanced features, performance or quality.

Major & Minor releases are intended to be external product releases that are persistent & supported for a period of time.

An interim release corresponds to a developmental configuration that is intended to be transient.

Once software is placed in a controlled baseline all changes are tracked such that a distinction must be made for the cause of the change. Change categories are

Type 0: Critical Failures (must be fixed before release)

Type 1: A bug or defect either does not impair (Harm) the usefulness of the system or can be worked around

Type 2: A change that is an enhancement rather than a response to a defect

Type 3: A change that is necessitated by the update to the environment

Type 4: Changes that are not accommodated by the other categories.

Change Management

III Configuration Control Board (CCB)

A CCB is a team of people that functions as the decision Authority on the content of configuration baselines

A CCB includes:

1. Software managers
2. Software Architecture managers
3. Software Development managers
4. Software Assessment managers
5. Other Stakeholders who are integral to the maintenance of the controlled software delivery system?

Infrastructure

The organization infrastructure provides the organization's capital assets including two key artifacts **-** Policy & Environment

I Organization Policy:

A Policy captures the standards for project software development processes

The organization policy is usually packaged as a handbook that defines the life cycles & the process primitives such as

- Major milestones
- Intermediate Artifacts
- Engineering repositories
- Metrics
- Roles & Responsibilities

I. **Process-primitive definitions**
   A. Life-cycle phases (inception, elaboration, construction, transition)
   B. Checkpoints (major milestones, minor milestones, status assessments)
   C. Artifacts (requirements, design, implementation, deployment, management sets)
   D. Roles and responsibilities (PRA, SEPA, SEEA, project teams)

II. **Organizational software policies**
   A. Work breakdown structure
   B. Software development plan
   C. Baseline change management
   D. Software metrics
   E. Development environment
   F. Evaluation criteria and acceptance criteria
   G. Risk management
   H. Testing and assessment

III. **Waiver policy**

IV. **Appendixes**
   A. Current process assessment
   B. Software process improvement plan

FIGURE 12-5. *Organization policy outline*

Infrastructure

II Organization Environment

The Environment that captures an inventory of tools which are building blocks from which project environments can be configured efficiently & economically

Stakeholder Environment

Many large scale projects include people in external organizations that represent other stakeholders participating in the development process they might include

- Procurement agency contract monitors
- End-user engineering support personnel
- Third party maintenance contractors
- Independent verification & validation contractors
- Representatives of regulatory agencies & others.

These stakeholder representatives also need to access to development resources so that they can contribute value to overall effort. These stakeholders will be access through on-line

An on-line environment accessible by the external stakeholders allow them to participate in the process a follows

Accept & use executable increments for the hands-on evaluation.

Use the same on-line tools, data & reports that the development organization uses to manage & monitor the project

Avoid excessive travel, paper interchange delays, format translations, paper * shipping costs & other overhead cost

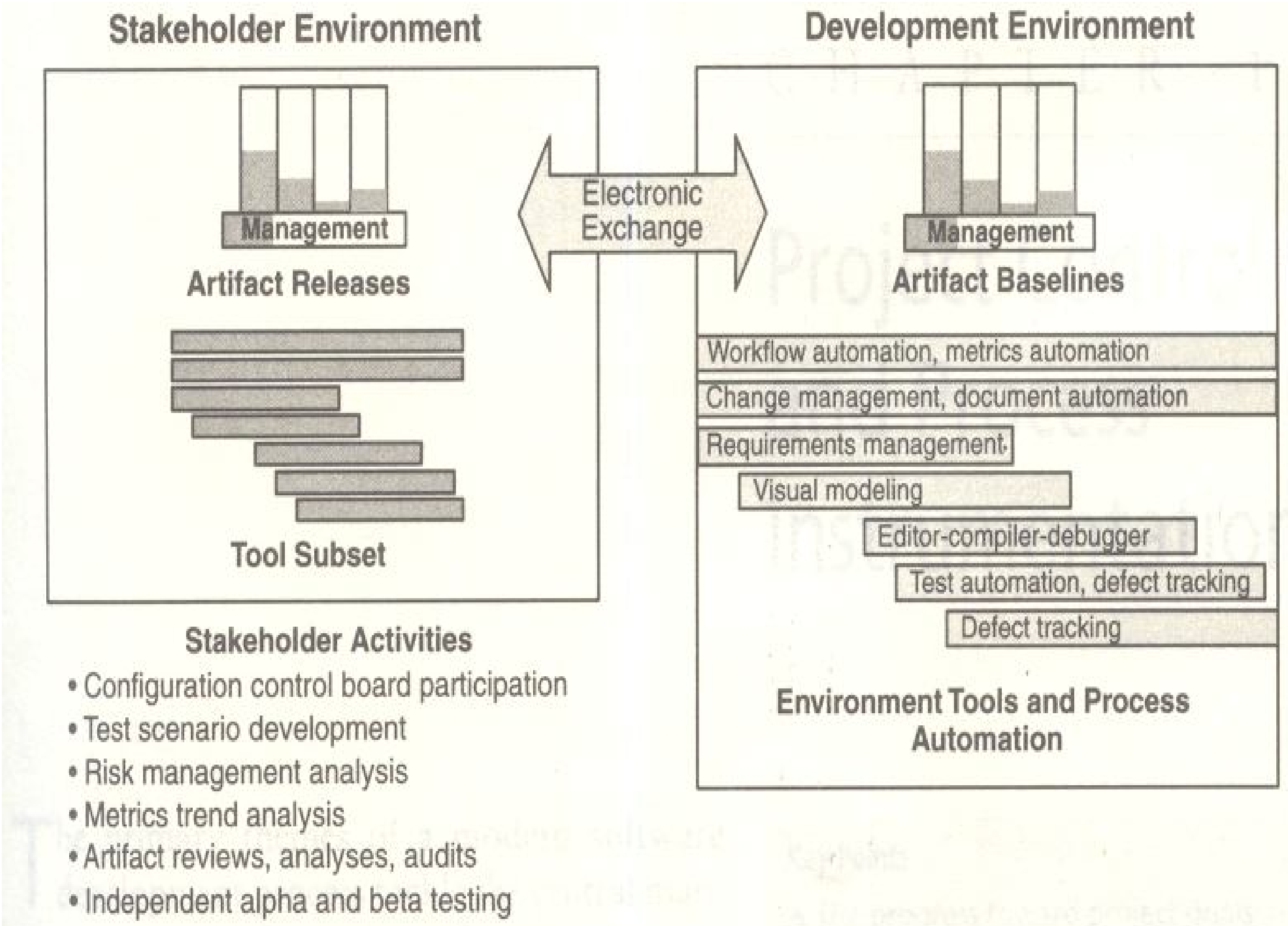


FIGURE 12-6. *Extending environments into stakeholder domains*