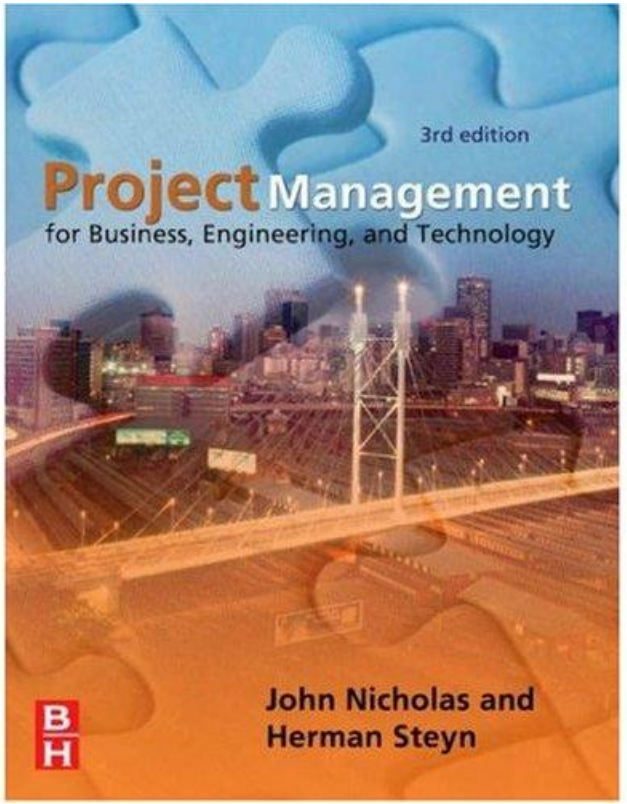
Chapter 11
Project Execution and Control

Project Management for Business, Engineering, and Technology

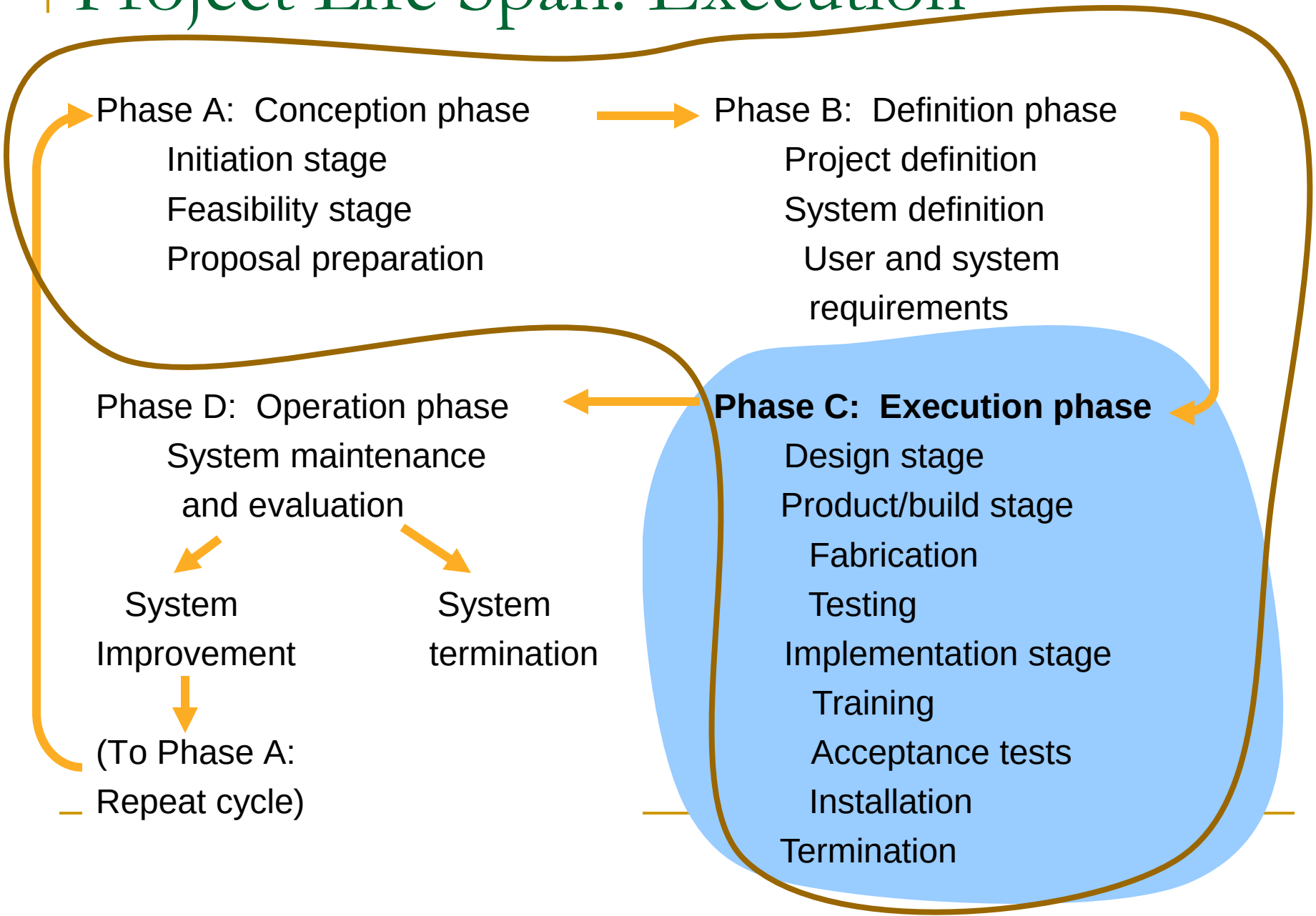


Prepared by
John Nicholas, Ph.D.
Loyola University Chicago

Phase C: Project Execution

- Most projects move through some or all of the stages of Phase C in the Project Cycle Span model

Project Life Span: Execution



Phase C: Project Execution

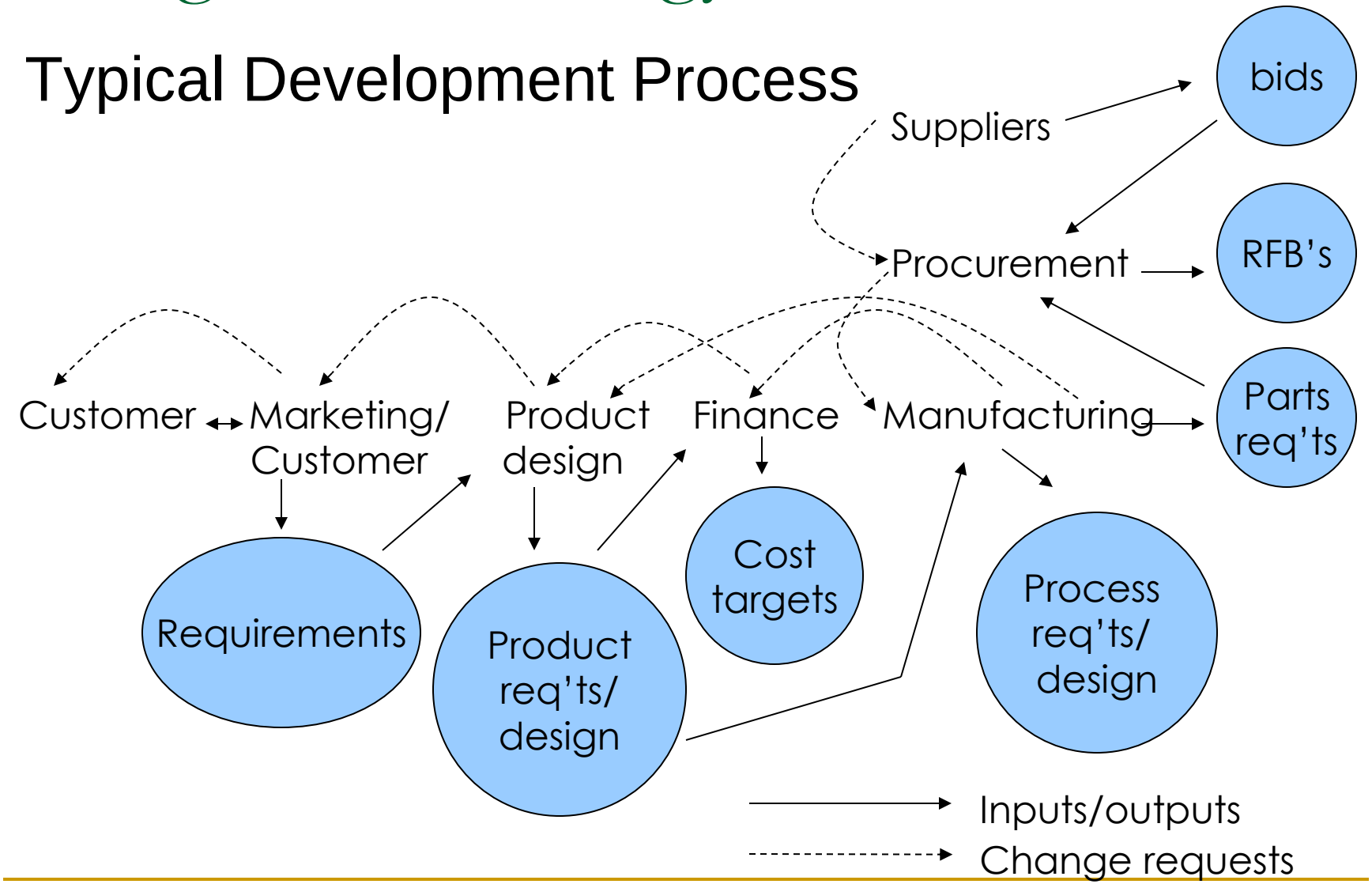
- In addition to planning, scheduling, budgeting, and risk and quality management responsibilities already discussed, during Execution the PM is responsible for
  - Expanding the project team
  - Assigning responsibilities
  - Task integration
  - Documentation
  - Change control
  - Quality control
  - Production coordination
  - Inventory control
- When PM is not directly responsible for these, she appoints people who are

Design Stage

- Design methodology
- Technical Review process
- Planning for production/build and later stages

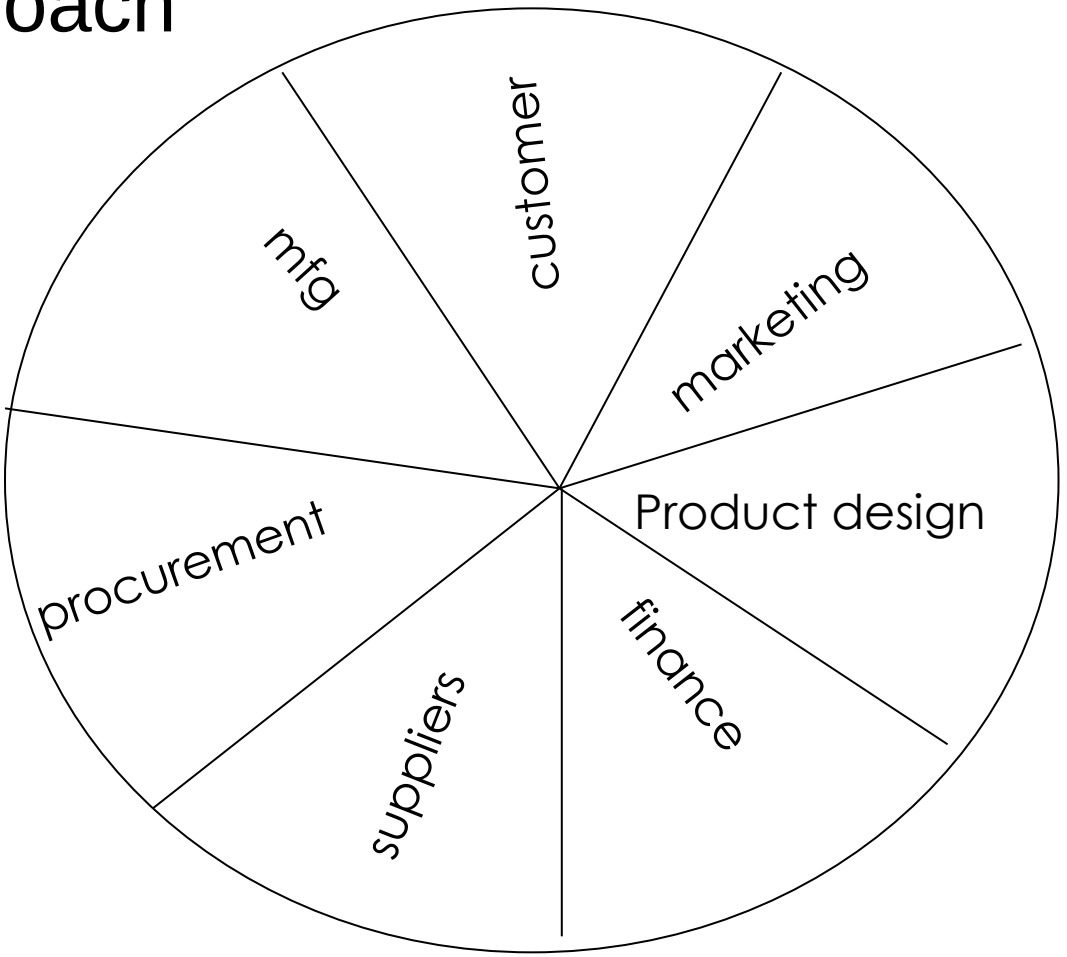
Design methodology

- Typical Development Process

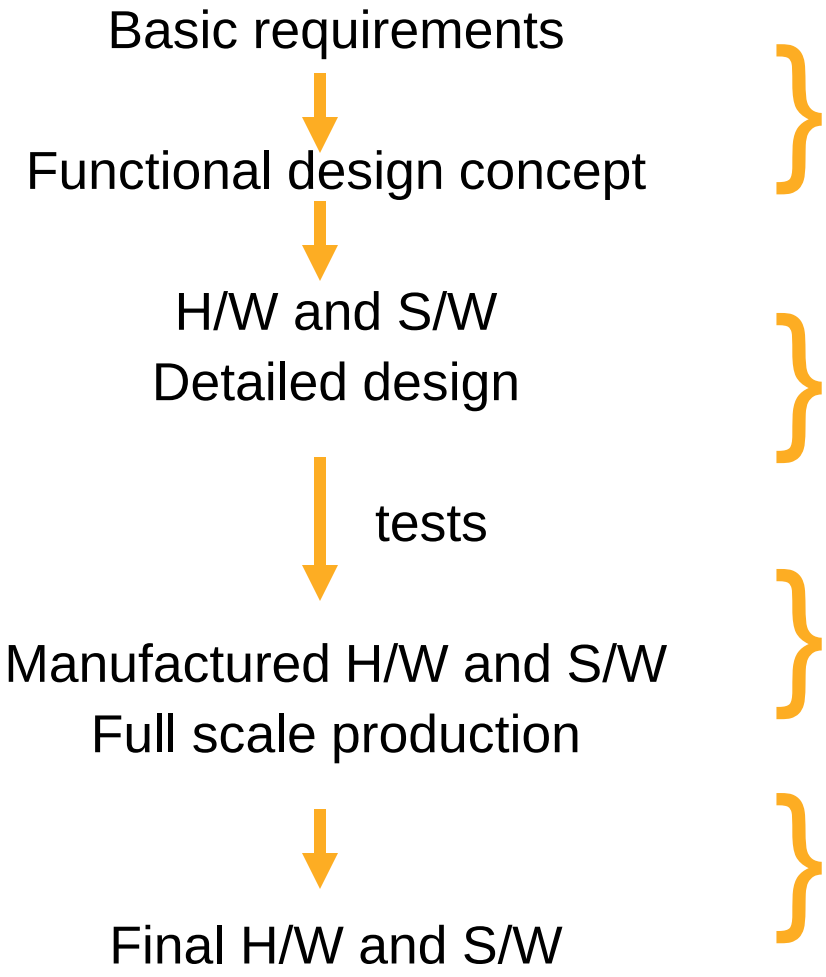


Design methodology

- Team approach



Technical Review Process



1. **Preliminary review** : does concept fit basic requirements?
2. **Critical Review:** does detailed design reflect functional design?
3. **Functional readiness review:** Do manufactured items conform to detailed design?
4. **Product readiness**: Do production documents conform to design documents?

Production/Build Stage

- System fabrication/ construction/ assembly
- Testing: design vs. requirement/ vs. implementation
  - logical, stress, failure

Production/Build

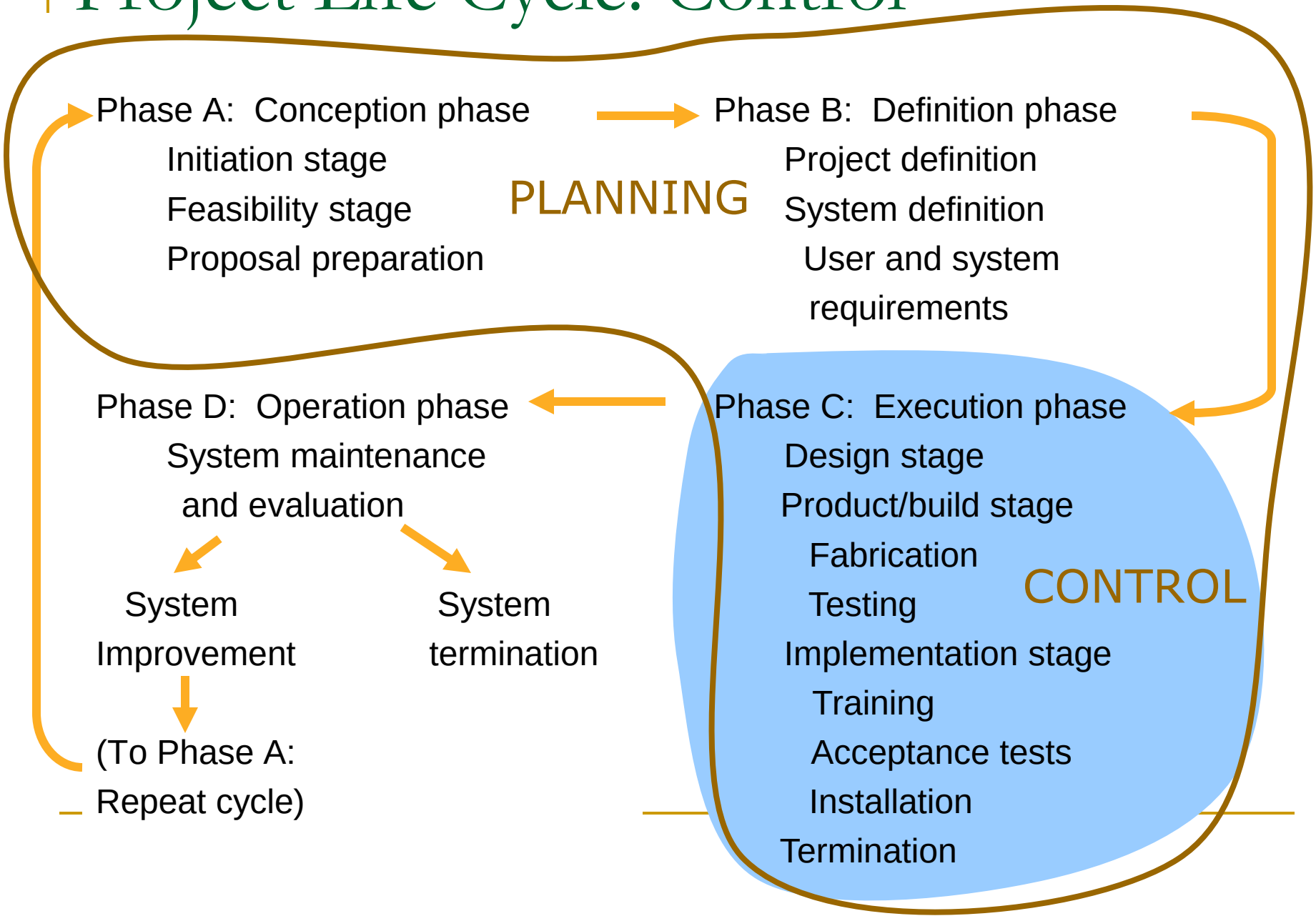
- Side-items vs. end-items
  - Manuals
  - Tools/peripherals
  - User training

- Detailed planning for the implementation stage

Project Control

- PM Role Throughout Phase C
  - Guide project to meet performance requirements, scheduled due dates, and budgeted expenses.
  - Track project performance vs. plan
  - Take corrective action
    - Make project conform with plan
    - Make plan conform to new realities/expectations

Project Life Cycle: Control



Internal vs. External Control

- Internal vs. External Control
  - Internal

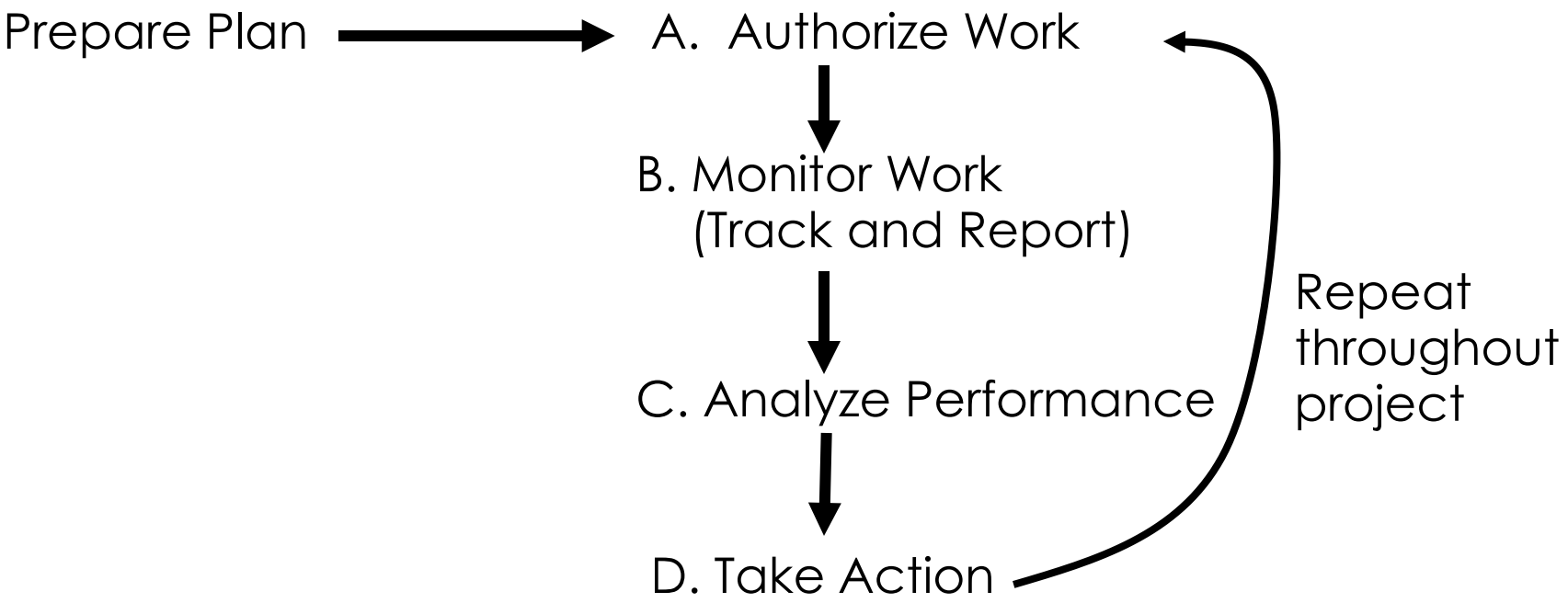
    Exercised by contractor
  - External

    Exercised by customer
    - Audit of books and records
    - Work inspection
    - Periodic reports of costs, schedule, and performance
    - Incentive contracts
    - Customer's own project manager

Control Process

Control Process

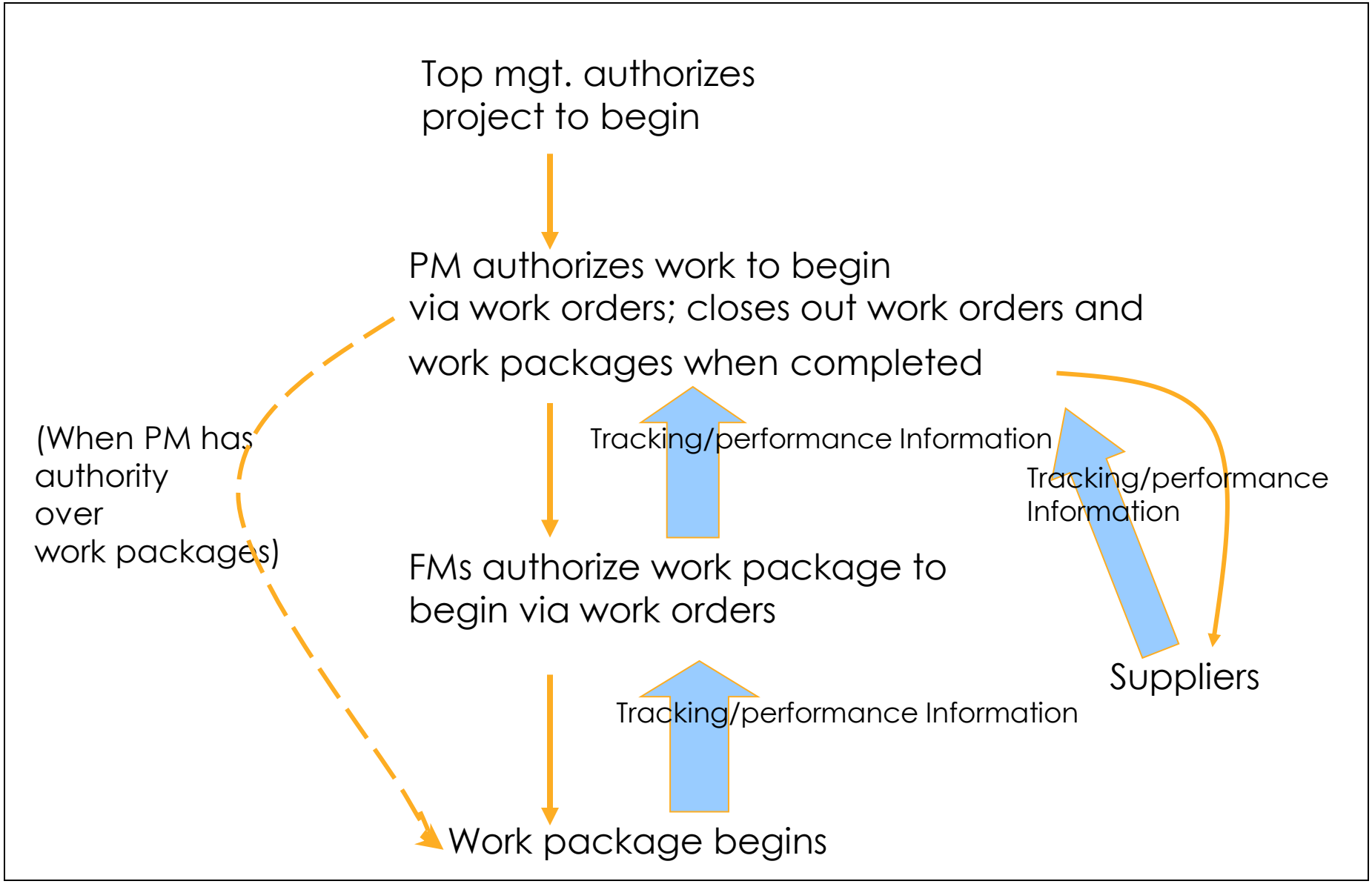
- Starts with the Project Plan



Work Authorization

- Authorize Work/Closeout Work (start/stop control)
  - No work begins without authorization.
  - All work ends with formal closeout.

Work Authorization (start/stop control)



Monitoring Performance

- Project plan specifies methods/procedures for tracking and assessment
- Defines specific measures and metrics to be used for terms like “ review”, “verify”, or “assess”
- Monitoring includes status meetings and reviews and specified in the communication plan

Example project communication plan, next slide

Meetings/ Reports / Role/type	Status Meeting	Status Meeting Minutes	Business Feasibility	EDARB Request	Technical Feasibility	Business Brief	Project Plan	Problems and Issues	Business Study	Use Case Analysis	System Architecture	Detailed Technical Design	Other
Client	X	X	X			X	X	X	X	X			
Relationship Manager		X	X	X	X	X	X	X	X	X	X		
Business Analyst	X	X	X			X	X	X	X	X	X		
Project Manager	X	X	X	X	X	X	X	X	X	X	X		X
Client Project Team	X	X	X			X	X	X	X	X			
IT Project Team	X	X					X	X	X	X	X		X
Client Director		X	X			X		X	X				X
IT Director		X	X	X	X	X	X	X	X	X	X		
Project Sponsor		X	X			X			X				
IT VP		X	X						X				
Architect	X	X	X	X	X	X	X	X	X	X	X		X
Security/Audit	X	X	X		X			X	X	X	X		
Internet Operations	X	X	X		X		X	X	X	X	X		X
Intranet Operations	X	X	X		X		X	X	X				
Legal/Corp. Comm.		X	X		X			X	X				
Other													

Monitoring Performance

Use a variety of measures, qualitative and quantitative

- Invoices
- Time cards
- Managers and supervisors assess progress by observation, asking questions, and reviewing reports
- Achievement of milestones.
- Test and demonstration results.
- Design reviews—meetings with managers and technical personnel to review progress
- Opinions of outside experts.

Monitoring Performance

- Do not only measures cost and time, which are measures of *input*.
- Need measures of *output* from each task and work package
  - Output measures address the deliverables or results defined for each work package.

Project Control Emphasis

- *Scope Change Control*
  - identify where changes have occurred
  - ensure the changes are necessary or beneficial
  - contain or delimit the changes wherever possible
  - the implementation of changes.

- *Quality Control*
  - manage work to achieve requirements and specifications
  - take preventive measures to eliminate errors and mistakes
  - identify and eliminate sources of errors and mistakes
  - includes technical performance measurement, TPM

Project Control Emphasis

- *Schedule Control*
  - keep the project on schedule and minimize schedule overruns
  - *Use Time Buffers*
  - *Fight Tendency to Multitask*
  - *Frequently Report Activity Status*
  - *Publicize Consequences of Delays and Benefits of Early Finish*

Project Control Emphasis

- Procurement Control
  - Monitor quality, schedule, and cost of all procured items
  - Visit and inspect the facilities of subcontractors and suppliers
  - Track subcontractors' and suppliers' progress and expenses,
  - Prepare contingency for all major procured material, equipment, components, and services

Performance Analysis with Earned Value

Percent Complete Concept

- Subjective assessment of performance vs. schedule
- Assessed regularly for every work package
- Requires competency, candor, and trust

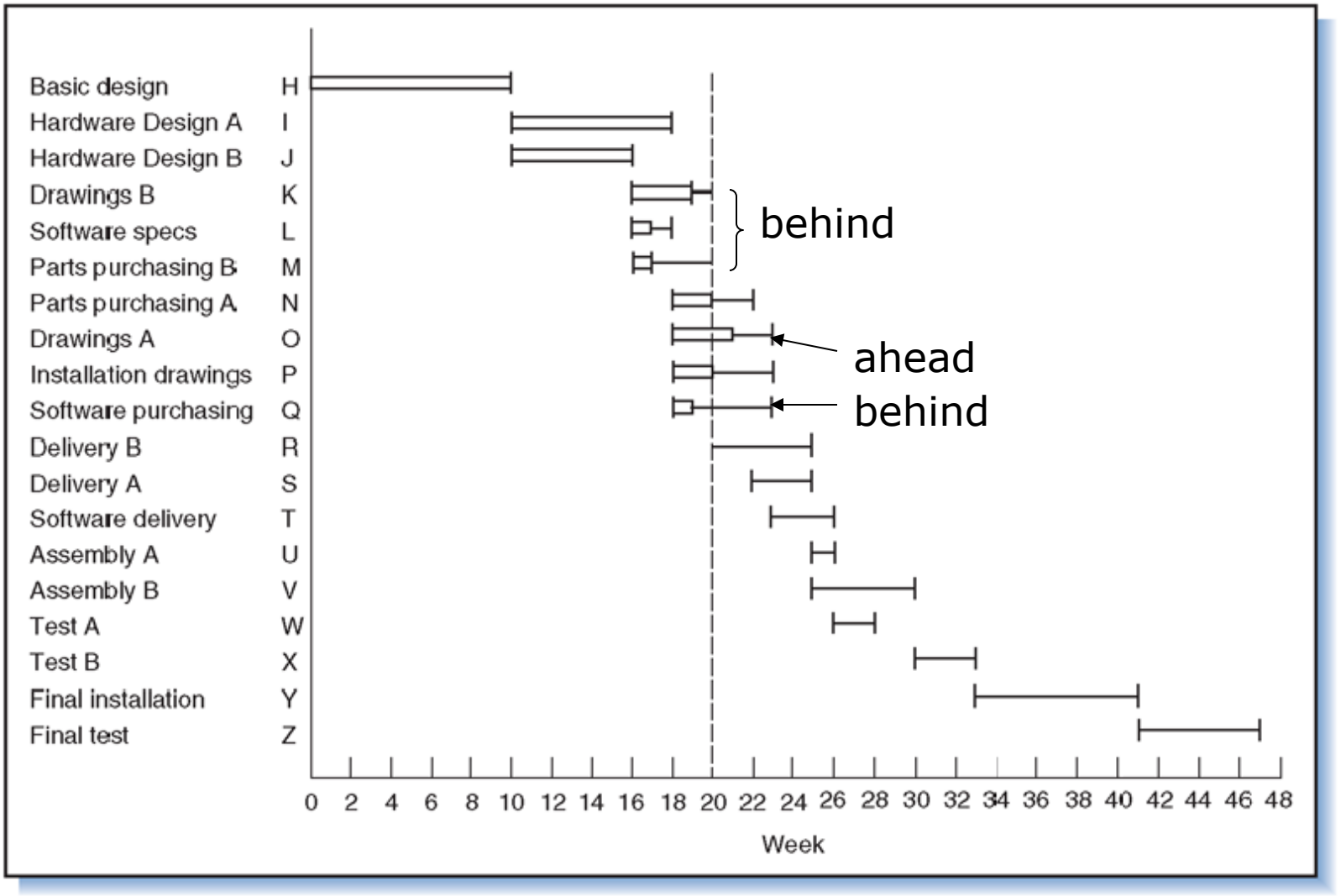


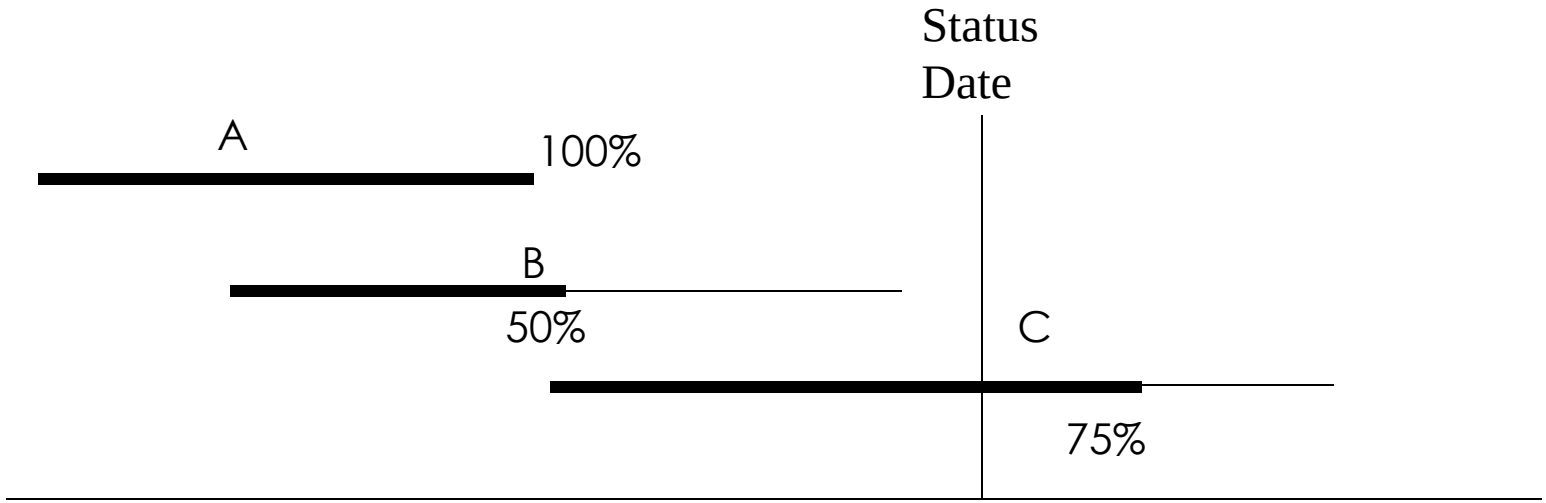
Figure 11-4
Gantt chart showing work status as of week 20.

Earned Value

- Performance Assessment
  - Purpose: determine current status of project with respect to schedule and budget

- Earned value method
  - Combine % complete, schedule, and cost information to assess current status of project

Earned Value Concept (EV)



How well is this project doing?

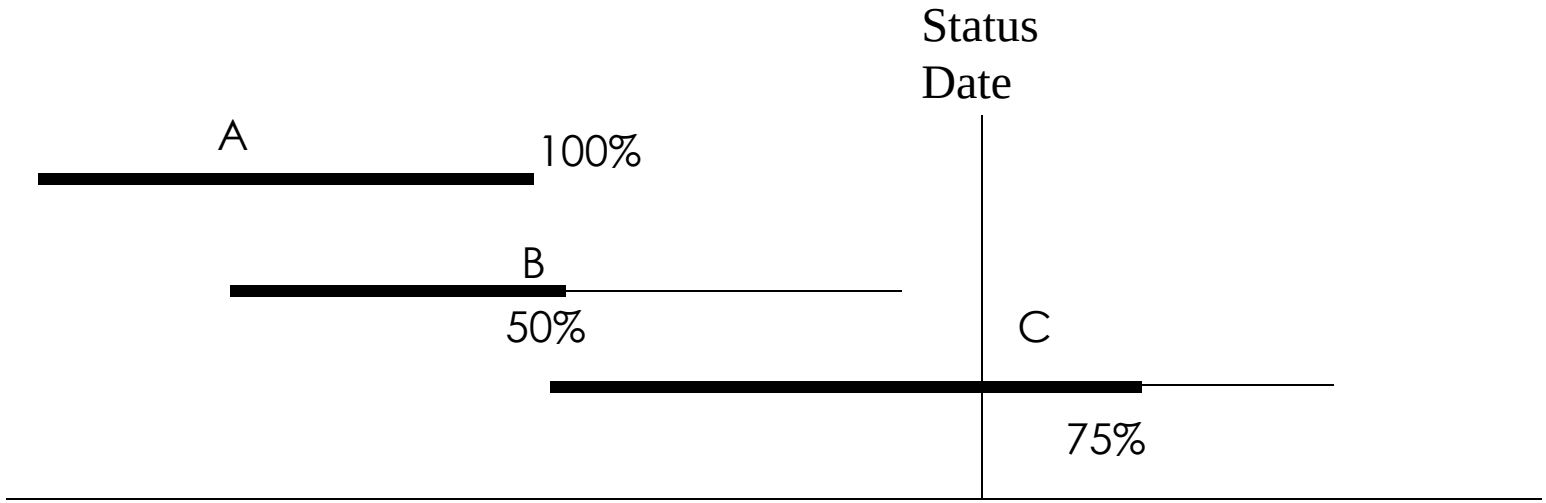
	Total Budget	Expenditure to date
A	1000	1000
B	2000	2050
C	1000	250
	4000	3300

Earned Value Example

- Example, project with three tasks, A, B, and C
  - Task A is on schedule, on budget
  - Task B is behind schedule, under budget
  - Task C is ahead of schedule, under budget

- How well is the project doing?

Earned Value Concept (EV)

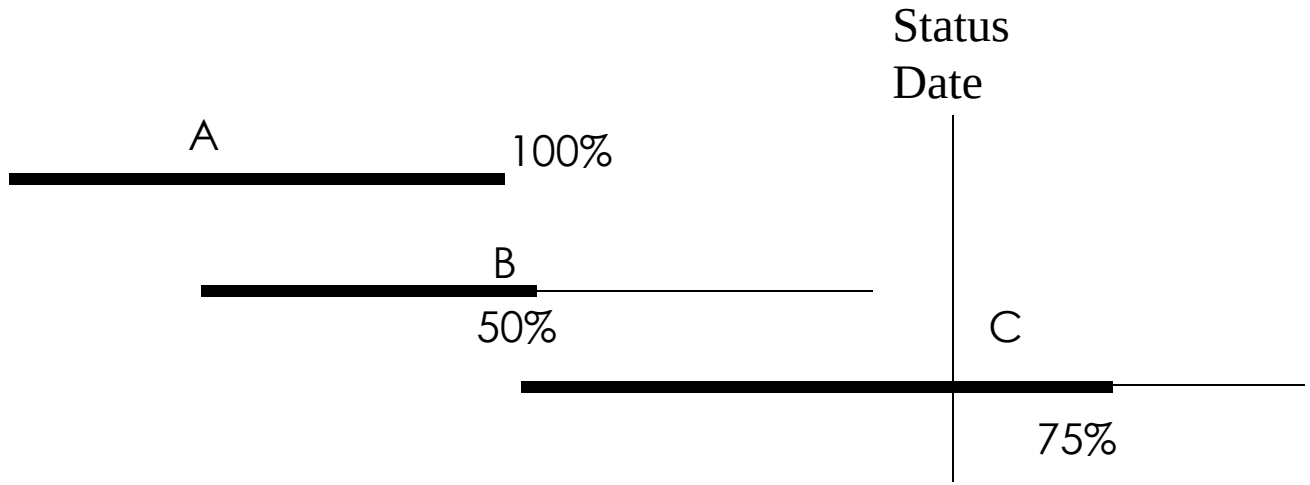


	(a) Total Budget	(b) AC	(c) Percent Scheduled	(a) x (c)= PV	(d) Percent Completed	(a) x (d)= EV
A	1000	1000	100	1000	100	1000
B	2000	2050	100	2000	50	1000
C	1000	250	50	500	75	750
	4000	3300		3500		2750

Earned Value Example

- Definitions
  - PV = planned value (also called BCWS: budgeted cost of work scheduled)
  - AC = actual cost (or ACWP: actual cost of work performed)
  - EV= earned value (or BCWP: budgeted cost of work performed)

Earned Value Concept (EV)



Budget	AC	PV	EV
4000	3300	3500	2750

- Since EV < PV, project is **behind schedule** in terms of value of work (ignores critical path)
- Since AC > EV project is **over budget** in terms of value of work completed

Earned Value Example

- Second example
  - Assess not only current state of the project but also the project's likely completion cost.

Earned Value Example

Definitions

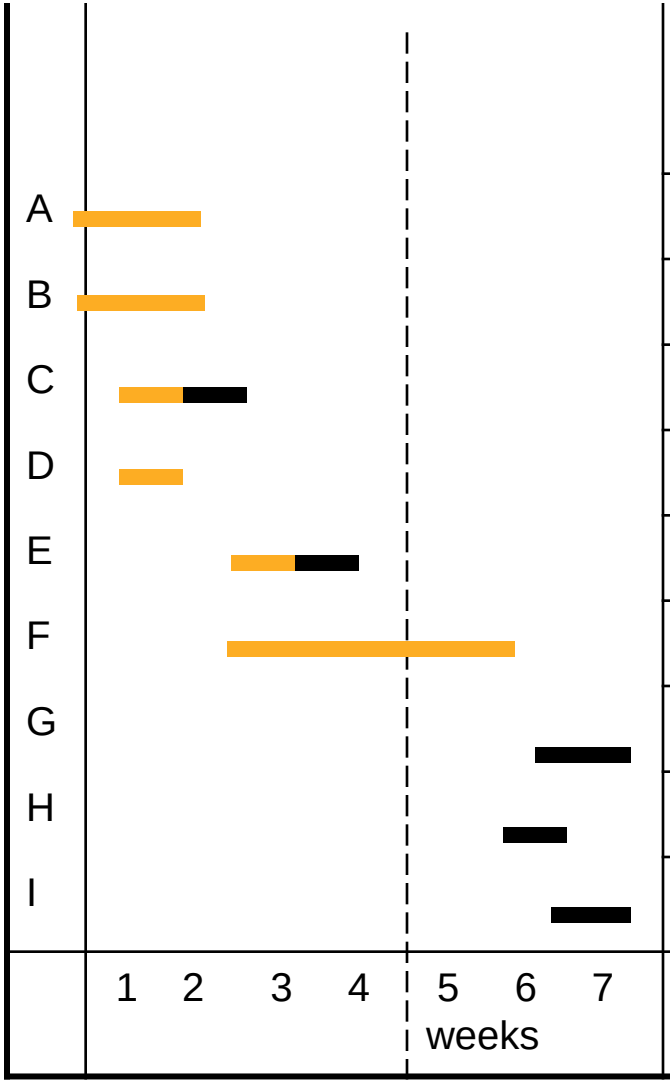
- CPI= cost performance index= EV/AC
- ETC= estimated cost to complete project

  = (BAC - EV)/CPI

  BAC = *budgeted* cost at completion
- EAC= estimated cost of project at completion

  = AC + ETC

Earned Value Example



	Budget	% Scheduled	PV	% Complete	EV	AC
A	220	100	220	100	220	240
B	190	100	190	100	190	180
C	250	100	250	50	125	150
D	90	100	90	100	90	110
E	350	100	350	50	175	190
F	400	50	200	100	400	380
G	250	0	0	0	0	0
H	140	0	0	0	0	0
I	240	0	0	0	0	0
	2,130		1,300		1,200	1,250

Earned Value Example

Status summary analysis, end of week 4:

1. Project Cost to date $1,250
2. Value of work completed, EV = $1,200
3. Value of work remaining,

   $2,130 – $ 1,200 = $930
3. CPI = 1,200/1,250 = 0.96
4. Likely cost to complete project

   930/0.96 = $969

Earned Value Example

Second Example (cont'd)

- Likely project cost at completion
  - $1,250 + $969 = $2,219

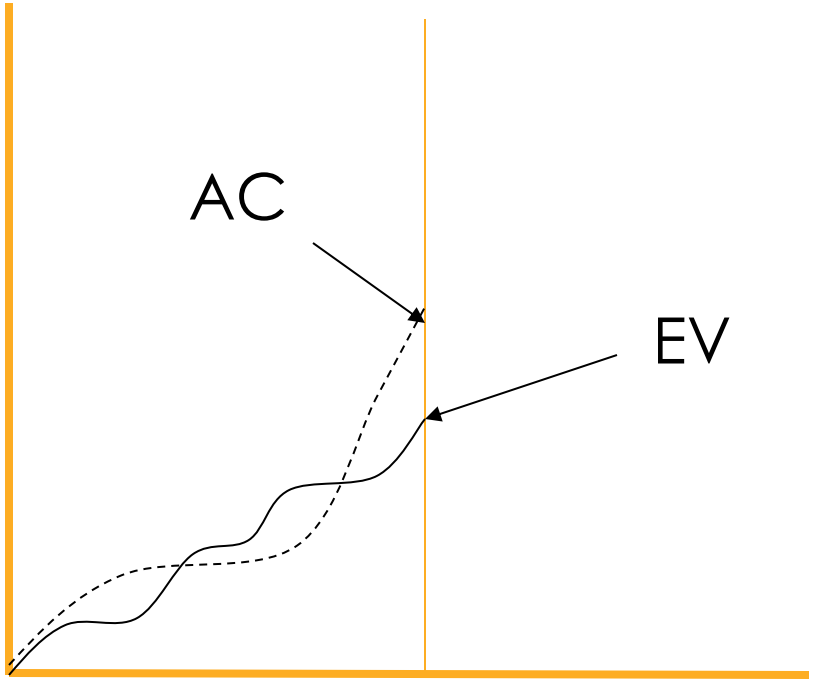
- Project cost variance
  - $2,130 – $2,219 = -$89 (4.2% overrun)

Earned Value Tracking

- Earned value is assessed continually
- Actual expenditures (AC) and actual work completed (EV) are assessed vs. budget and schedule (PV)

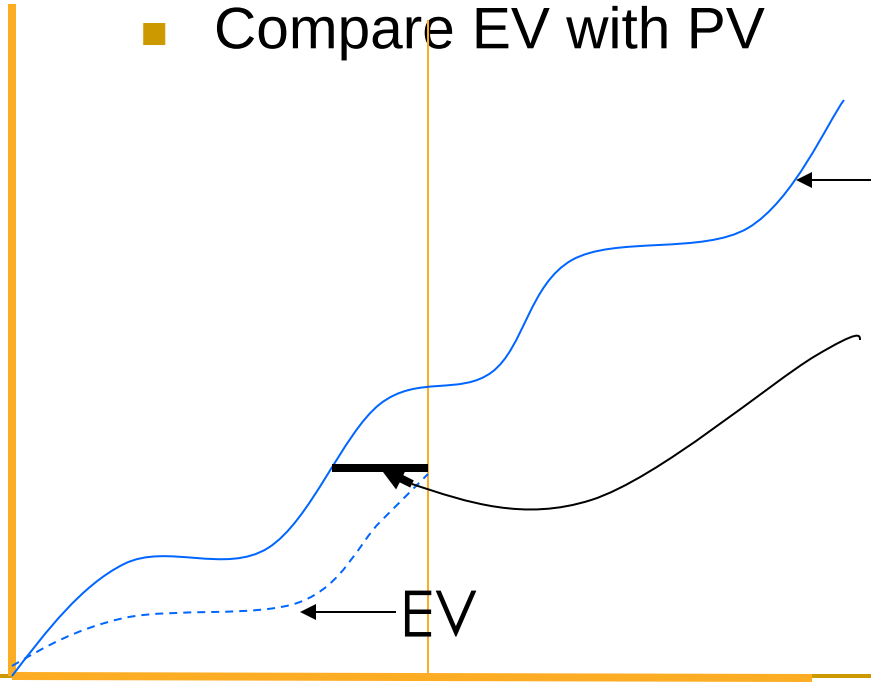
Earned Value Tracking

- If AC line is *above* EV line, project is over budget



Earned Value Tracking

- If EV line is *below* PV line, project is behind schedule
  - How much behind schedule?
    - Identify progress on the critical path, or
    - Compare EV with PV



Measure on the graph **horizontal** distance between PV and EV.

This represents amount of time project is behind, ahead of schedule

Earned Value Tracking

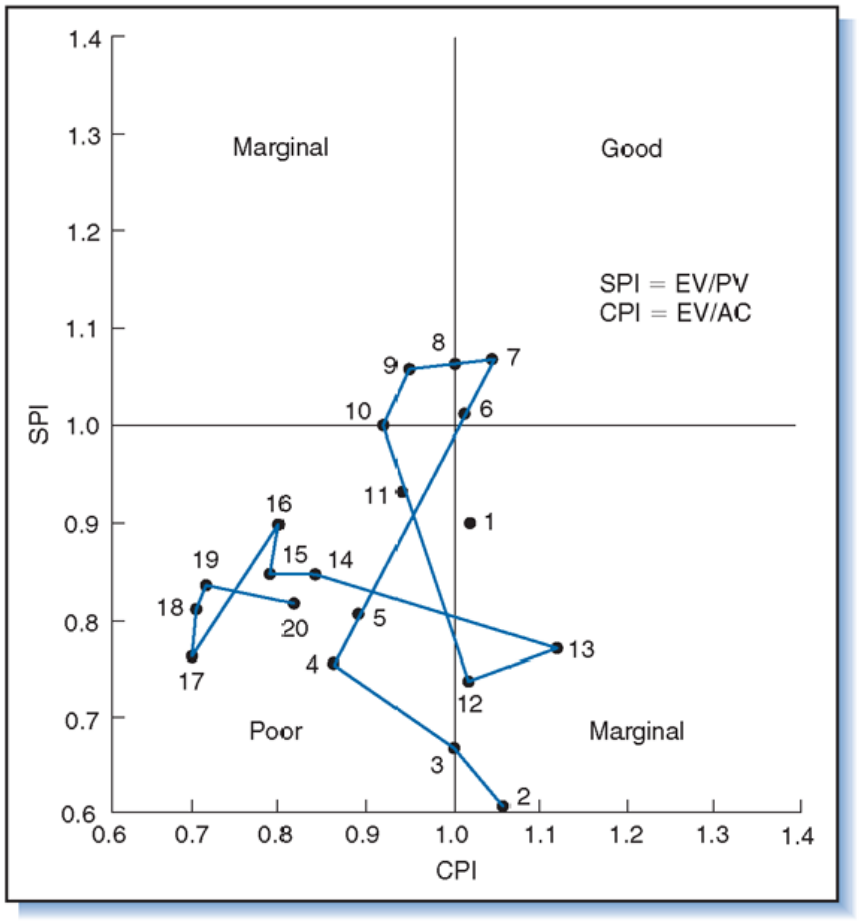


Figure 11-16
LOGON project cost/schedule performance plotted for months 1–20.

Value of Earned Value ?

- Enables
  - simultaneous assessment of % completion, schedule, and cost performance
  - information about work packages to be rolled up to provide a project –wide assessment
  - forecasts of cost and date at completion

- Assumes
  - valid estimates of % complete
  - actual expenditures coincide with work performed (no delayed or advance payment)

Controlling Changes in Projects

- “Change”
  - any deviation in the project plan
  - happens *defacto* or by *discretion*
  - tends to increase project cost and schedule
- Role of the PM is to control changes, not let changes control the project!

Reasons for Change in Projects

- Incomplete Requirements
  - Unknowns or omissions in the original plan or requirements
- User change of mind
  - Because of changing conditions or needs, the original requirements are no longer what user wants

Reasons for Change in Projects

- Insurmountable Obstacles
  - Unavoidable difficulties render original plan difficult or impossible to follow.
  - Original requirements difficult or impossible to achieve
- Pursuit of perfection
  - User or designer perceives “desirable” improvements in the original plan or requirements

Reasons for Change in Projects

- Opportunities
  - User or designer sees benefits not recognized or unavailable when plans or requirements were first established

Effects of Changes

- Uncontrolled changes lead to “scope creep”
- The effects of the change on the project must be assessed
  - Effects of defacto changes must be *reflected* in revised work plans, schedules, and budgets
  - Estimated effects of discretionary (requested) changes must be *assessed before* the changes are approved or denied.

Change Control System and Configuration Management

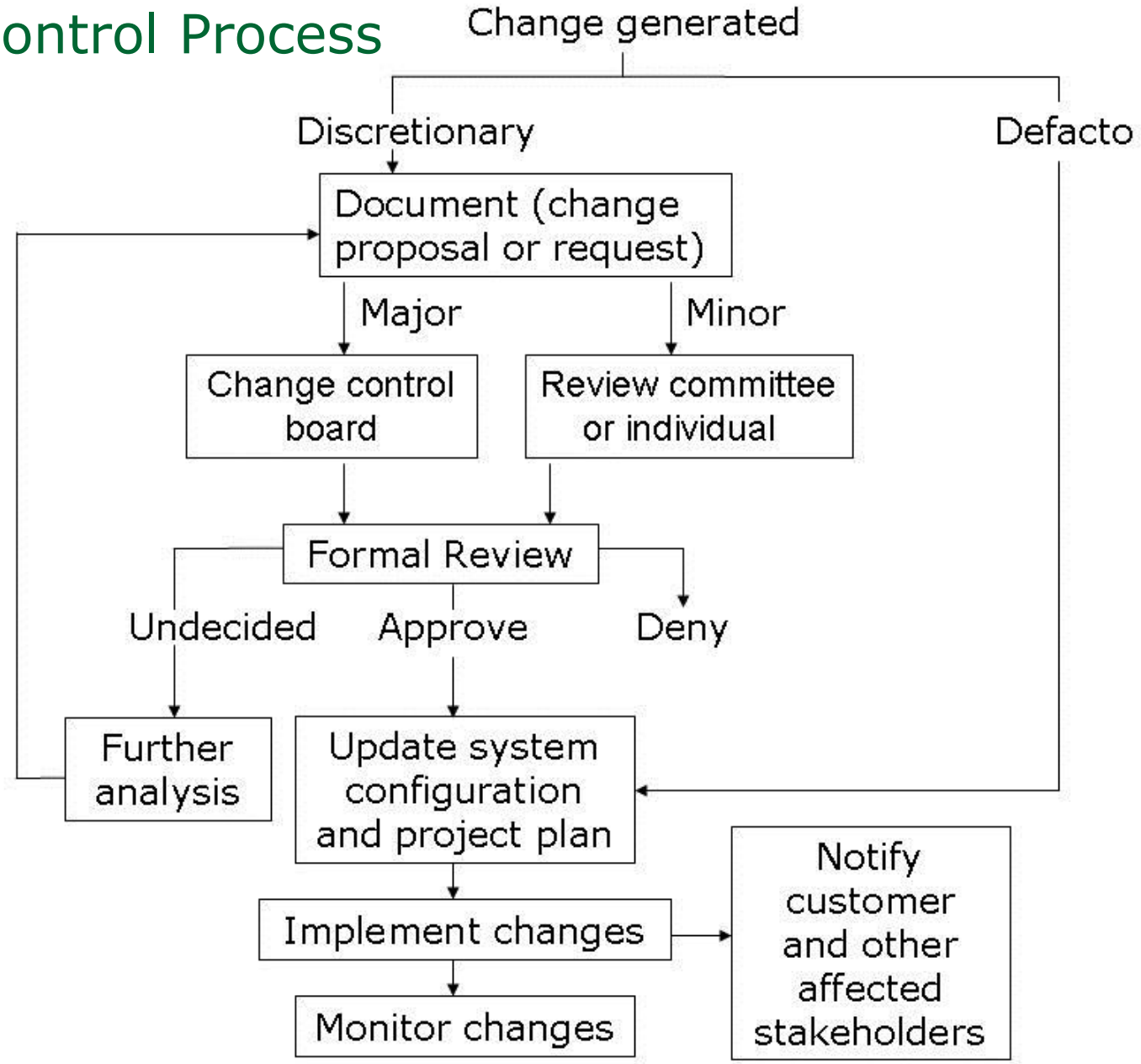
- Project plan should include polices and procedures for *change control* and *configuration management*

- These policies and procedures are communicated to customers, contractors, suppliers, and everyone in the core project team

Functions of Change Control

- Continuously identify changes as they occur
- Reveal consequences of changes (impacts on the other tasks, project costs, and duration)
- Analyze alternative courses of action and make acceptance or rejection decisions
- Minimize changes
- Communicate changes to all concerned
- Ensure changes are implemented
- Report summaries of all changes and their impact on the project

Change Control Process



Change Control Procedures

- Require that the original *work requirements* and work orders are *clearly stated* and *agreed upon* by persons responsible
- Closely *monitor work* to ensure it is meeting (not exceeding) specifications.
- *Be alert* for signs of cost or schedule overruns; take quick action to correct problems

Change Control Procedures

- Require all engineering and work changes to be
  1. *documented* for their effect on work orders , budgets, schedules, and contractual prices
  2. reviewed, and
  3. *authorized* by sign- off

- Example

IRON *Butterfly Corp*			
Change Request			Page … of …
Title:			
Project no.	Task no.	Revision no.	Date issued
Description of change			
Reason for change			
Documentation attached			
Originated by: Date:			
Request logged by: Date:			
Cost implications			
Schedule implications			
Implications on performance of deliverable(s)			
Other implications (risks & issues)			
Proposed plan for implementation			
Implications evaluated by: Date:			
Recommendation Recommended by: Date:			
Documentation attached			
Approved by: Date:		Approved by: Date:	

CHANGE ORDER

Owner ☐ X
Architect ☐ X
Contractor ☐ X
Field ☐
Other ☐

AIA Document G701, adapted

Project: Ernst & Young - One Cambridge Center
Owner: Ernst & Young LLP
Contractor: Beacon Skanska Construction Company

Change Order Number: 3
Date: June 6, 1997
Architect's Project No.: 6045-00
Contractor's Project No.: 6113
Contract Date: March, 1997

Contract for: 2nd & 3rd floor demo and build-out

The Contract is changed as follows:

See Page Two

$45,221.00

The original Contract Sum was	$1,738,526.00
Net change by previously authorized Change Orders	$67,200.00
The Contract Sum prior to this Change Order was	$1,805,726.00
The Contract Sum will be increased by this Change Order in the amount of	$45,221.00
The new Contract Sum including this Change Order will be	$1,850,947.00
The Contract Time will be unchanged by	0 Day(s)
The date of Substantial Completion as of the date of this Change Order therefore is _____	

Note: This summary does not reflect changes in the Contract Sum or Contract Time that have been authorized by Construction Change Directive.

Not valid until signed by the Owner, Architect, and Contractor.

Architect	Contractor	Owner
The Environments Group	Beacon Skanska Construction Co.	Ernst & Young LLP
303 East Wacker Drive	270 Congress Street	260 Congress Street
Chicago, IL 60601	Boston, MA 02210	Boston, MA 02210
By: _____	By: _____	By: _____
Date: _____	Date: _____	Date: _____

Change Control Procedures

- Require similar control procedures of all subcontractors, purchase orders, test requests, etc.
  - Examples:

http://www.retisoft.com/CRTrakFeatures.html

http://www.ittoolkit.com/workbooks/qt_pmchange.pdf

Change Control Procedures (cont'd)

- *Change control board*
- *Freeze date*: At a predefined phase, *freeze* project against all nonessential changes (freeze point must be agreed to by management)
  - The sooner the project can be frozen, the less that changes will adversely affect project schedule and cost

Boeing 777

Change Requests

Time

Freeze Date

Configuration Management

- “Configuration”
  - The relative arrangement, location or disposition of a subsystem or component within the system. Configuration refers to both functional and physical items.
- Problem:
  - Complex, large systems are designed, developed, and produced over a period of many months years
  - During this time, changes to configuration will occur

Configuration Management

- “Configuration management”
  - Managing changes to system design, and maintaining records of the current configuration
- Configuration management in large complex systems is costly and time-consuming,
  - hence must be planned early and incorporated into the project plan and budget

Configuration Management

- Configuration management continues after the system becomes operational, hence the process moves from the contractor to the customer.

Apollo spacecraft

- During peak design period, 1000 change orders per week!

Main Functions of CM

1. Identify the items to be placed under CM
   - Functional and physical characteristics
   - Selected subsystems and components
2. Establish baseline configuration
3. Document the items to define functional performance requirements and physical specifications
4. Manage changes to the configuration

Scope creep example: Bradley Fighting Vehicle

- Scope creep run amuck!

Video segment from the movie *The Pentagon Wars**

Bradley fighting vehicle development project

- Changes made at whim of generals
- No effective change control or CM
- Results
  - 17 YEARS over schedule
  - $14 BILLION over budget
  - Ineffective armor

* HBO Home Video,1998, 104 minutes; visit http://hbohomevideo.com/