



CSSE 372 Software Project Management: Critical Path Method

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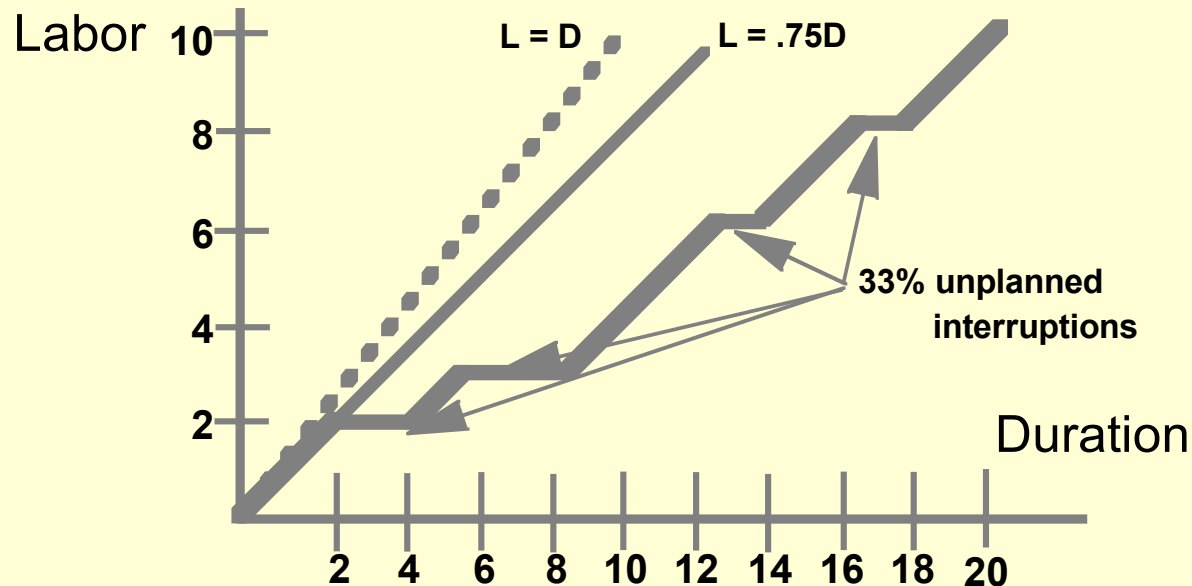
ROSE-HULMAN
INSTITUTE OF TECHNOLOGY



**The moment you realize
It's only Tuesday**



Elapsed Time (duration) versus Work (effort)



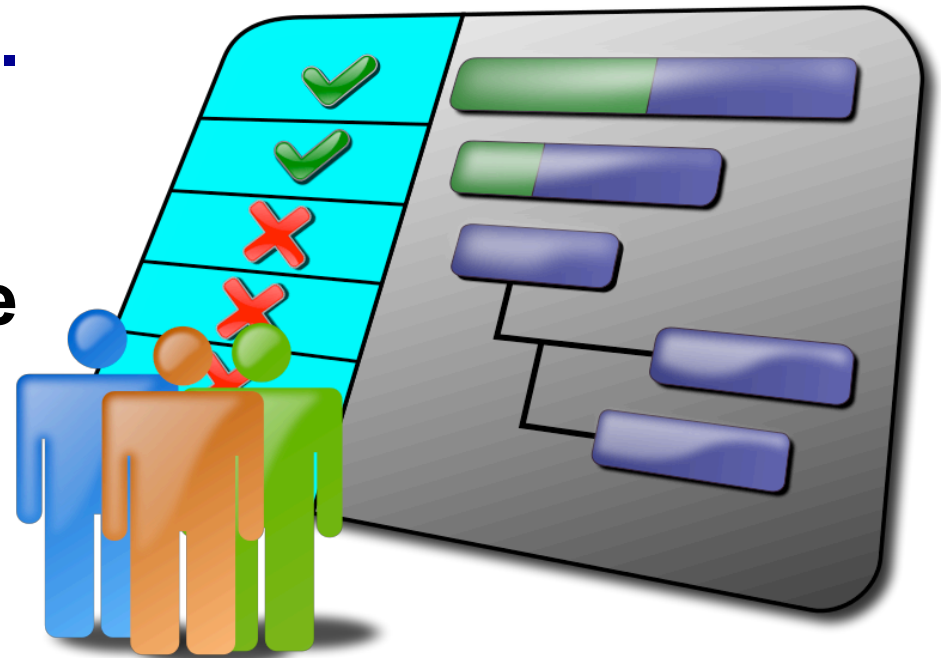
MODEL ASSUMPTIONS

- * Individuals work at 75 percent efficiency rate.
- * Unplanned interruptions account for 33 percent of clock time.

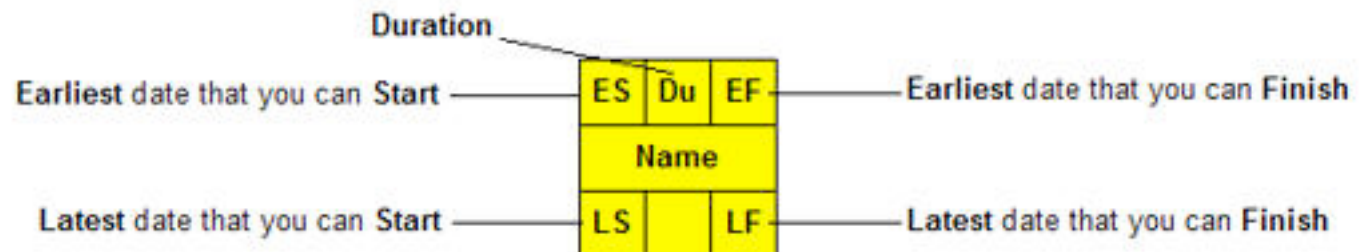
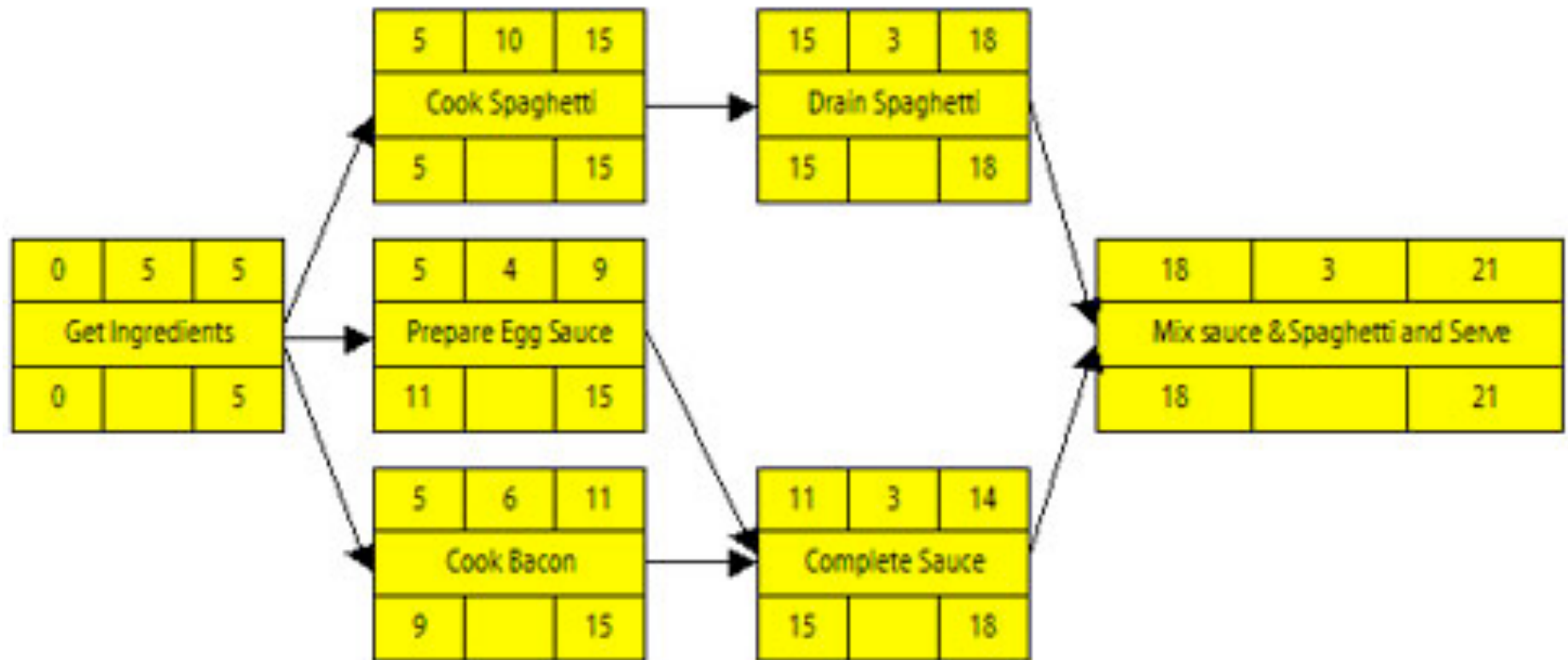
Learning Outcomes: Schedule

Create and maintain a software project schedule.

- Examine tasks from a dependency perspective
- Explore the shortest path using Critical Path Method



A Simple Task Network Example



Why would you want to know the critical path in a project task network?

- Think for 15.2 seconds...
- Turn to a neighbor and discuss it for a minute

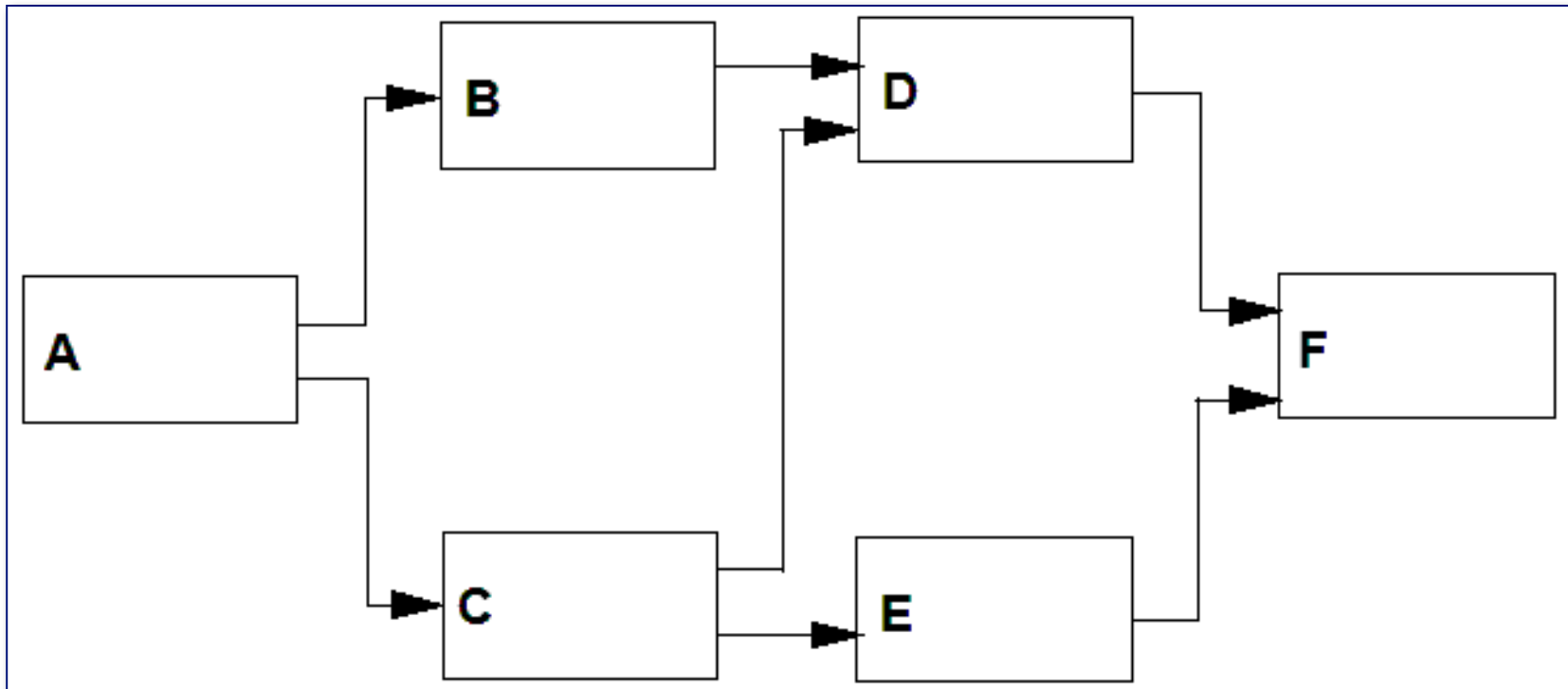




Critical Path Method (CPM)

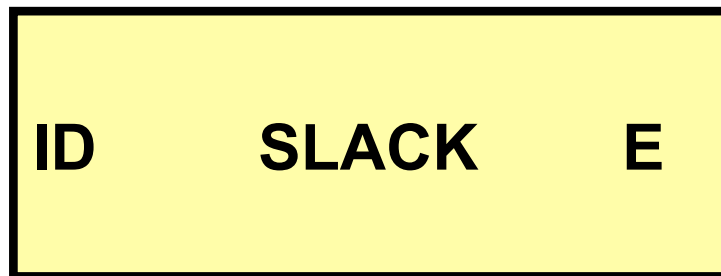
- 1. List of all activities required to complete the project (from WBS),**
- 2. Determine time (duration) each activity takes to complete**
- 3. Identify dependencies between the activities**
- 4. Calculate the Forward Pass**
- 5. Calculate the Backward Pass**
- 6. Determine Critical Path (longest path)**

Recall: Scheduling-Task Information



ES

EF



LS

LF

ES = earliest start, EF = earliest finish time

LS = latest start, LF = latest finish time

Slack = $(LS - ES)$ or $(LF - EF)$

E = Effort (duration)



Paths Through the Network

■ The Forward Pass → **Early Schedule**

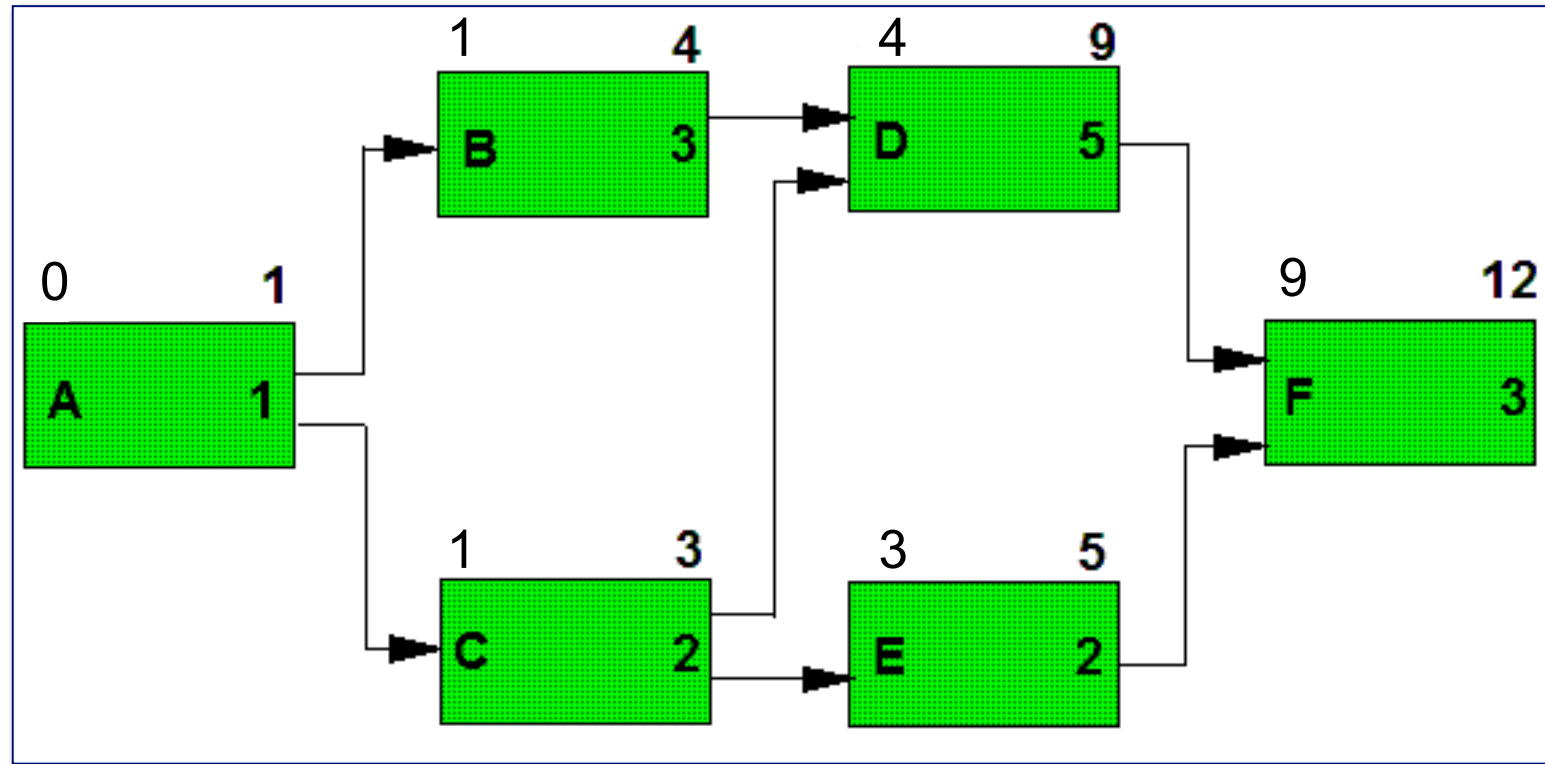
- Left to right (start to finish)
- Determines Early Start (ES) and Early Finish (EF)
- $ES + \text{duration} = EF$



■ Backward Pass ← **Late Schedule**

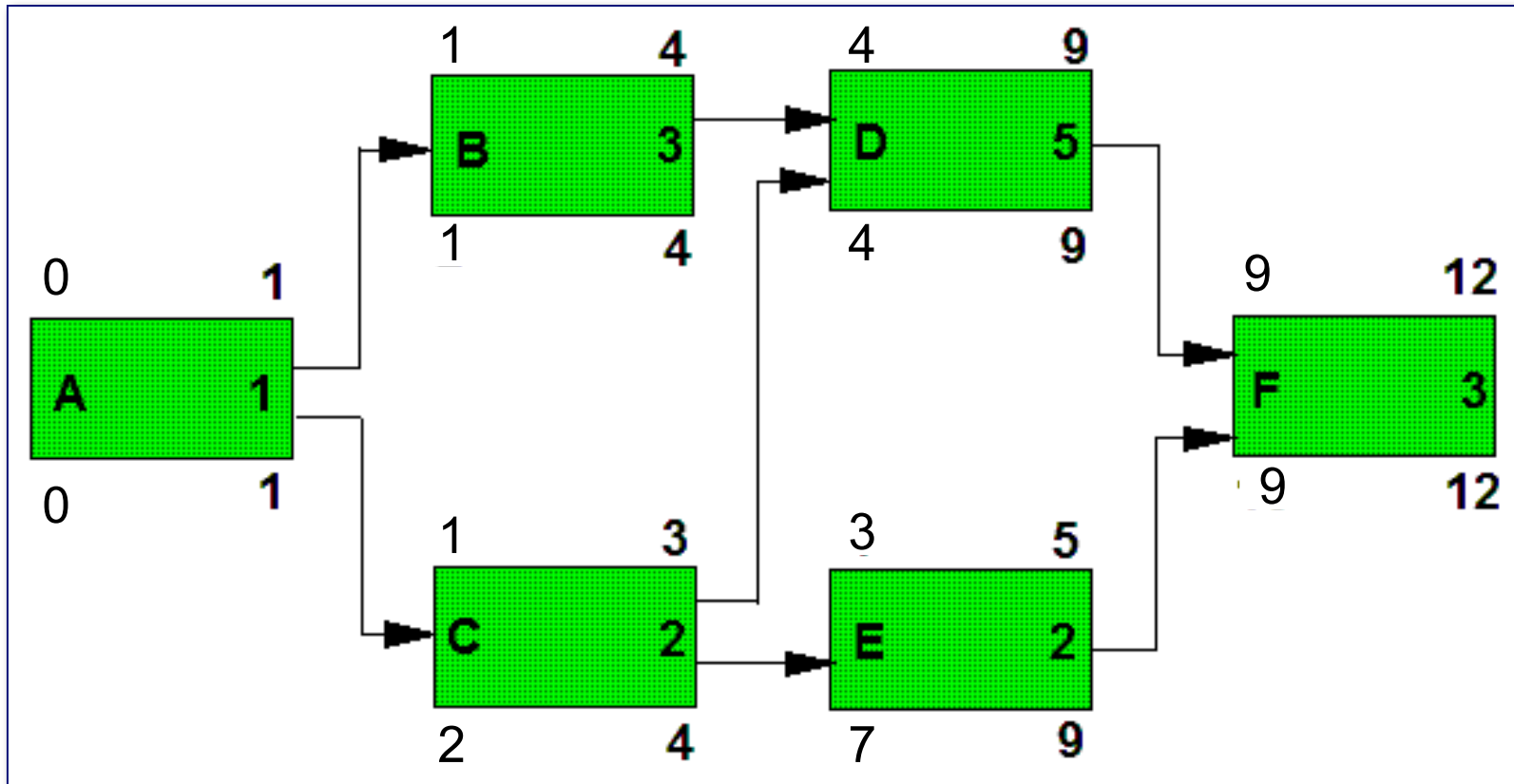
- Right to left (finish to start)
- Determines Late Start (LS) and Late Finish (LF)
- $LF - \text{duration} = LS$

Forward Pass Calculations – Early Schedule



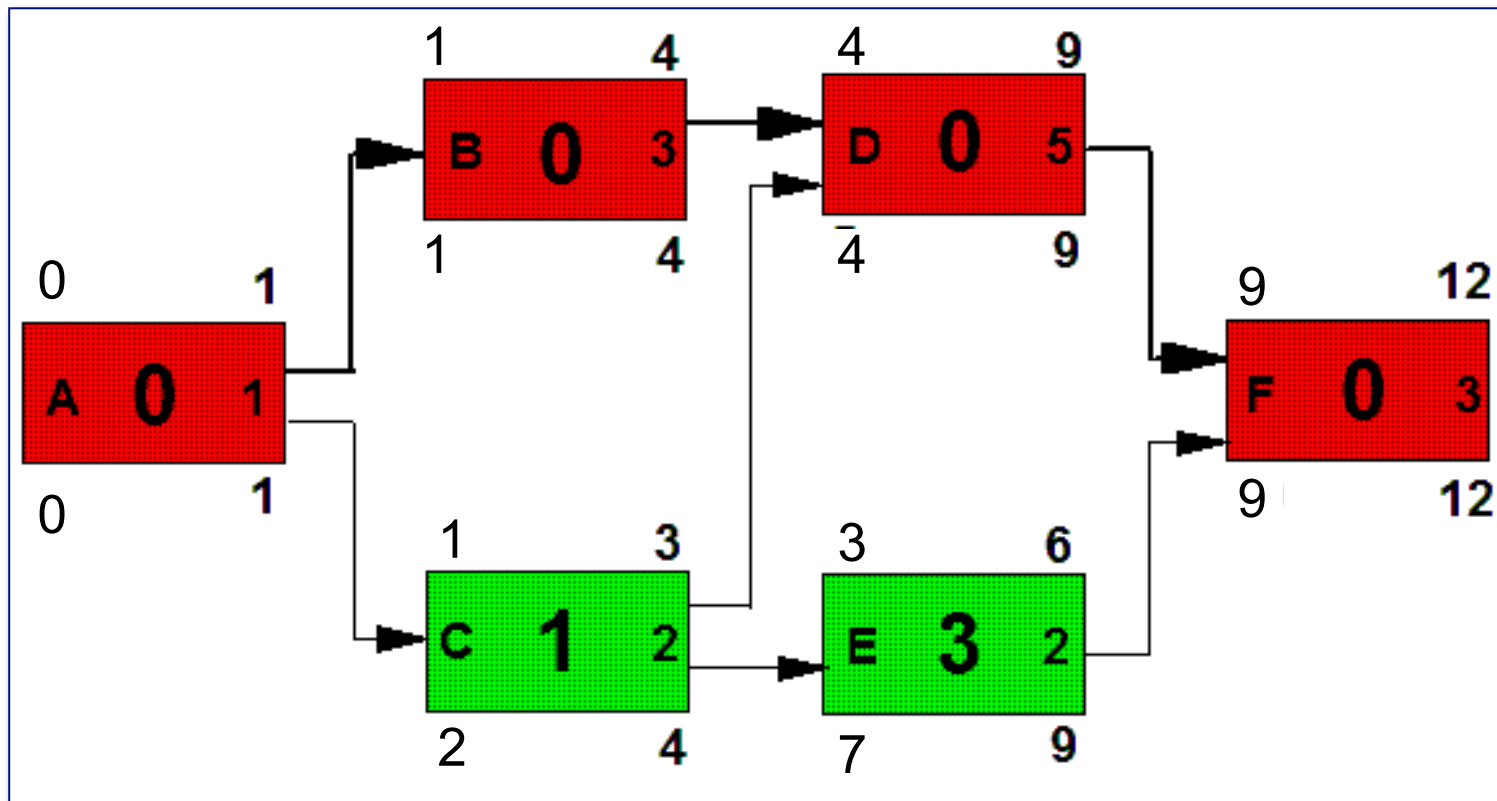
$$ES + \text{duration} = EF$$

Backward Pass Calculations – Late Schedule



LF – duration = LS

Critical Path





Exercise: You do it!

Task	Preceding Activity	Duration
A	Start	5
B	A	4
C	B	6
D	B	2
E	C	7
F	C, D	1
G	E, F	5

What is the Critical Path for the tasks listed in the table above and the total duration?



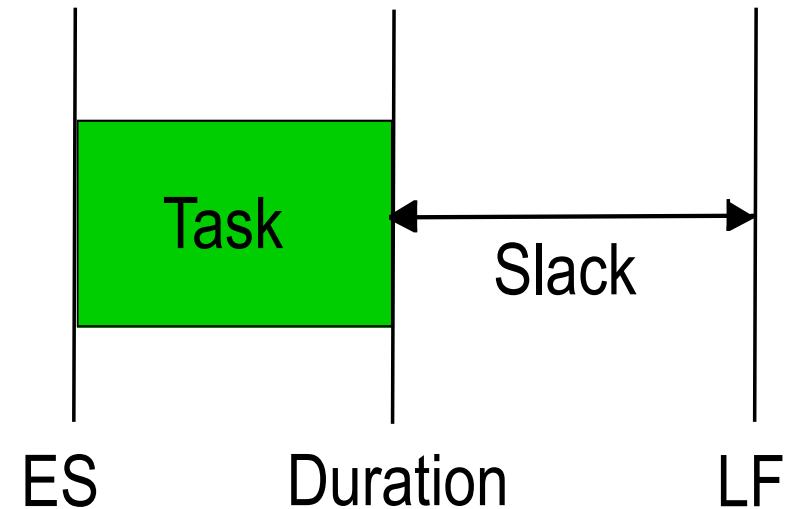
Slack in the Early Start to Late Finish Window

■ Total Slack

- Time that a task can be delayed without impact to earlier **schedule of the project**

■ Free Slack

- Time a task can be delayed without impact to earlier **schedule of its successor tasks**



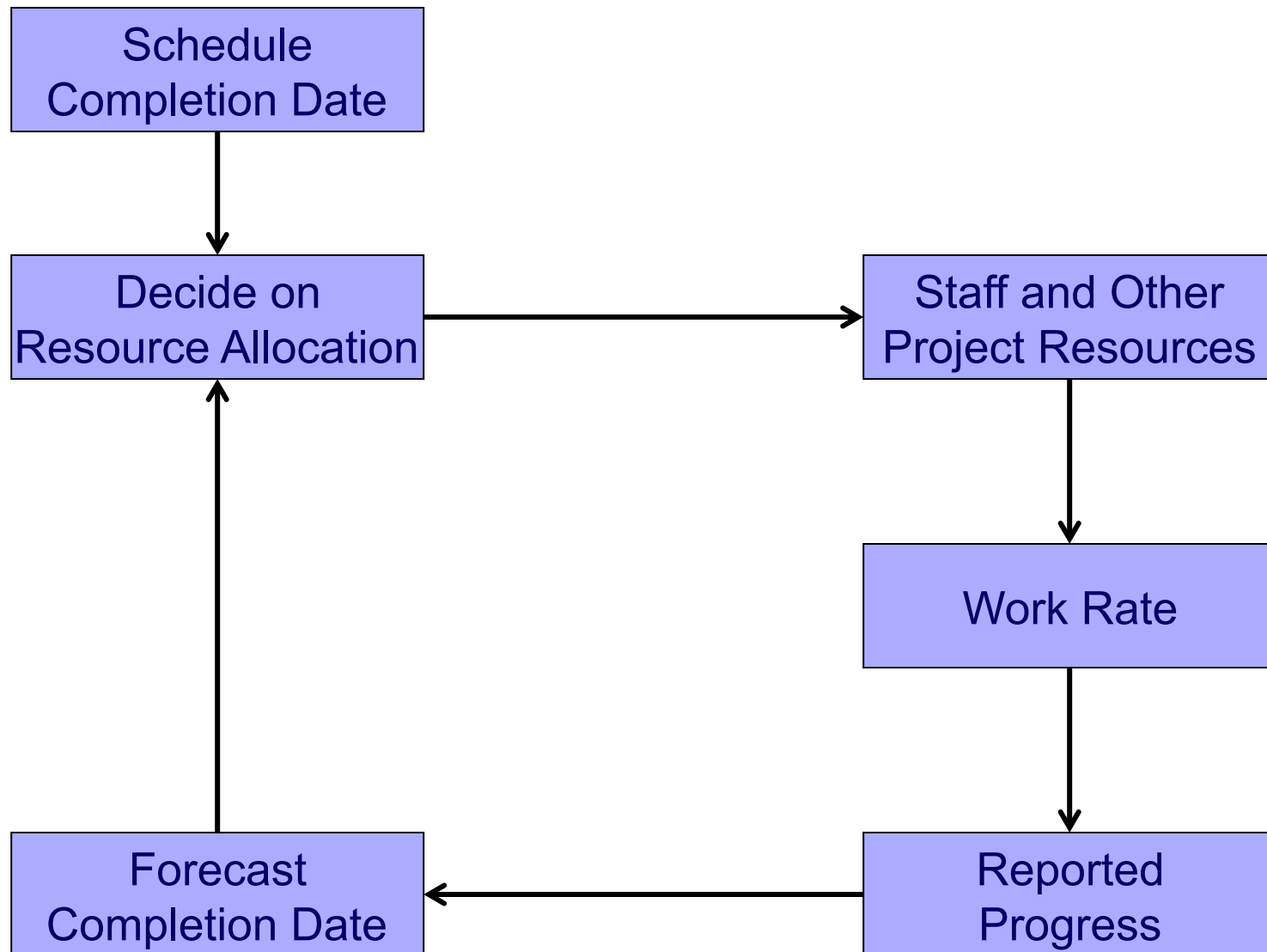
**Do Not Plan to Use Slack
to Bail Out the Project!**

Are Smart-Phones Schedule Blockers or Productivity Enhancers?





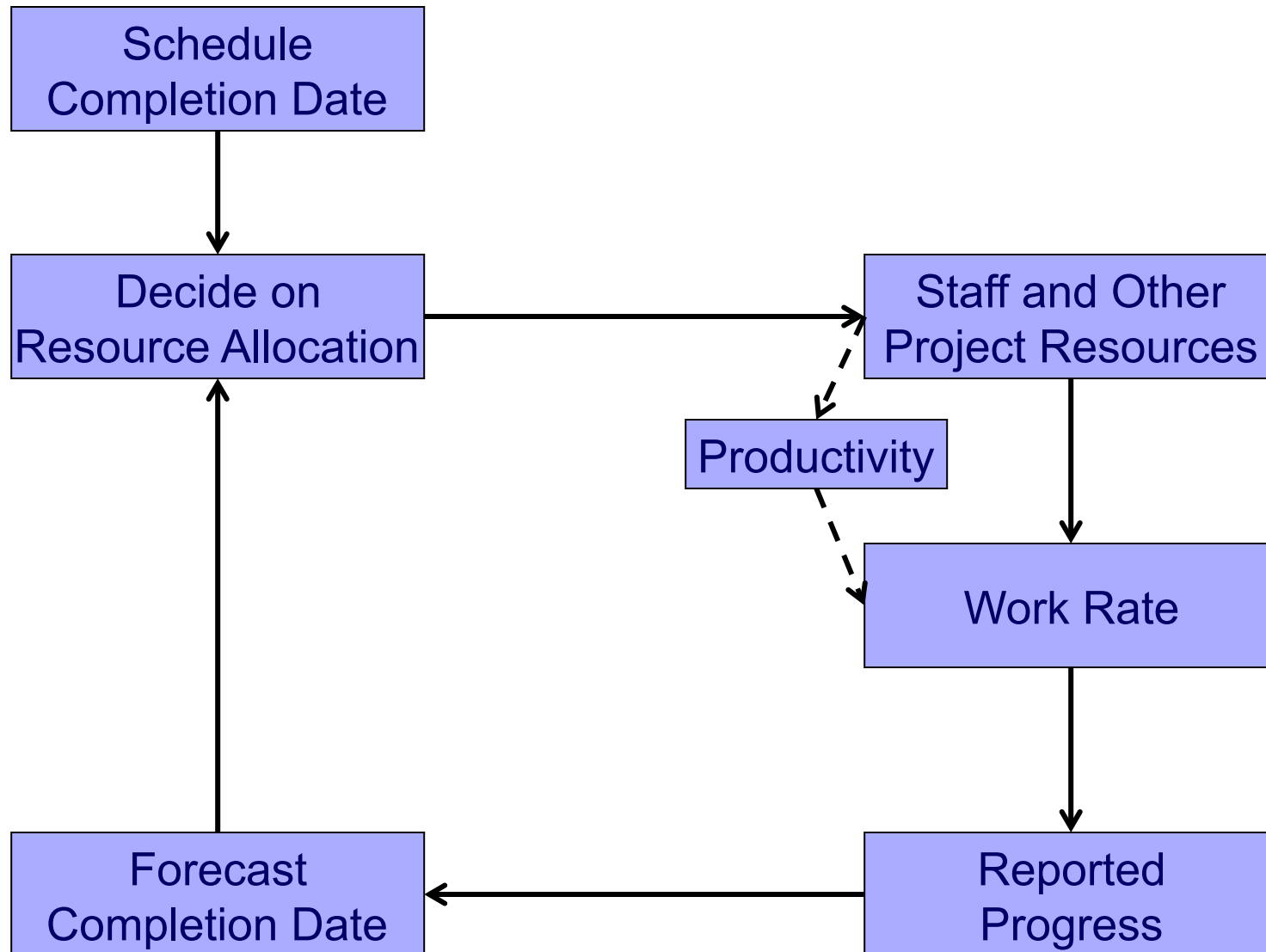
Simple Model: Software Project Process 1/2



Simple Model: Software Project Process 2/2

- 1 Project resources: available staff, facilities, equipment
- 2 Work completed on project reported through project control system
- 3 Reports accumulate and are processed to create project's forecast completion date by adding indicated time remaining to current date
- 4 Assess remaining time based on work rate
- 5 Compare with original scheduled completion date to determine forecasted completion date
- 6 Feedback loop closed: difference causes adjustments in magnitude or allocation of resources

Adding More People to a Late Project 1/2

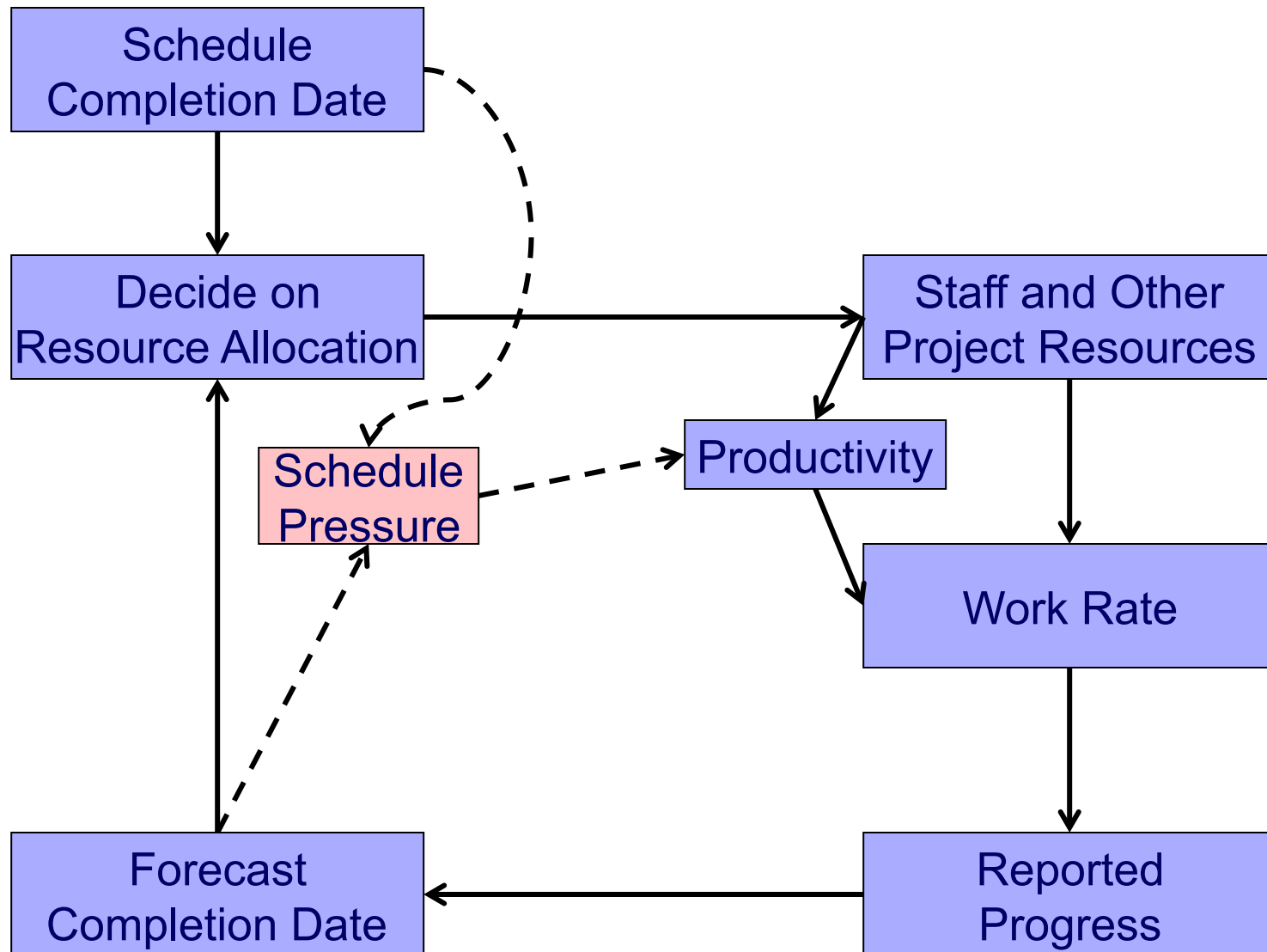




Adding More People to a Late Project **2/2**

- Model suggests direct relationship
 - *Increase people resources => Increase in work rate*
- Problem with More People:
 - Higher communication, training cost
 - Lower project team productivity
 - Lower progress rates
 - Delay to already late project
 - Additional round of loop
 - More people ...
- **Recall: Brook's Law:** adding more people to a late project makes it later!

Adjusting Schedule of Late Project 1/3



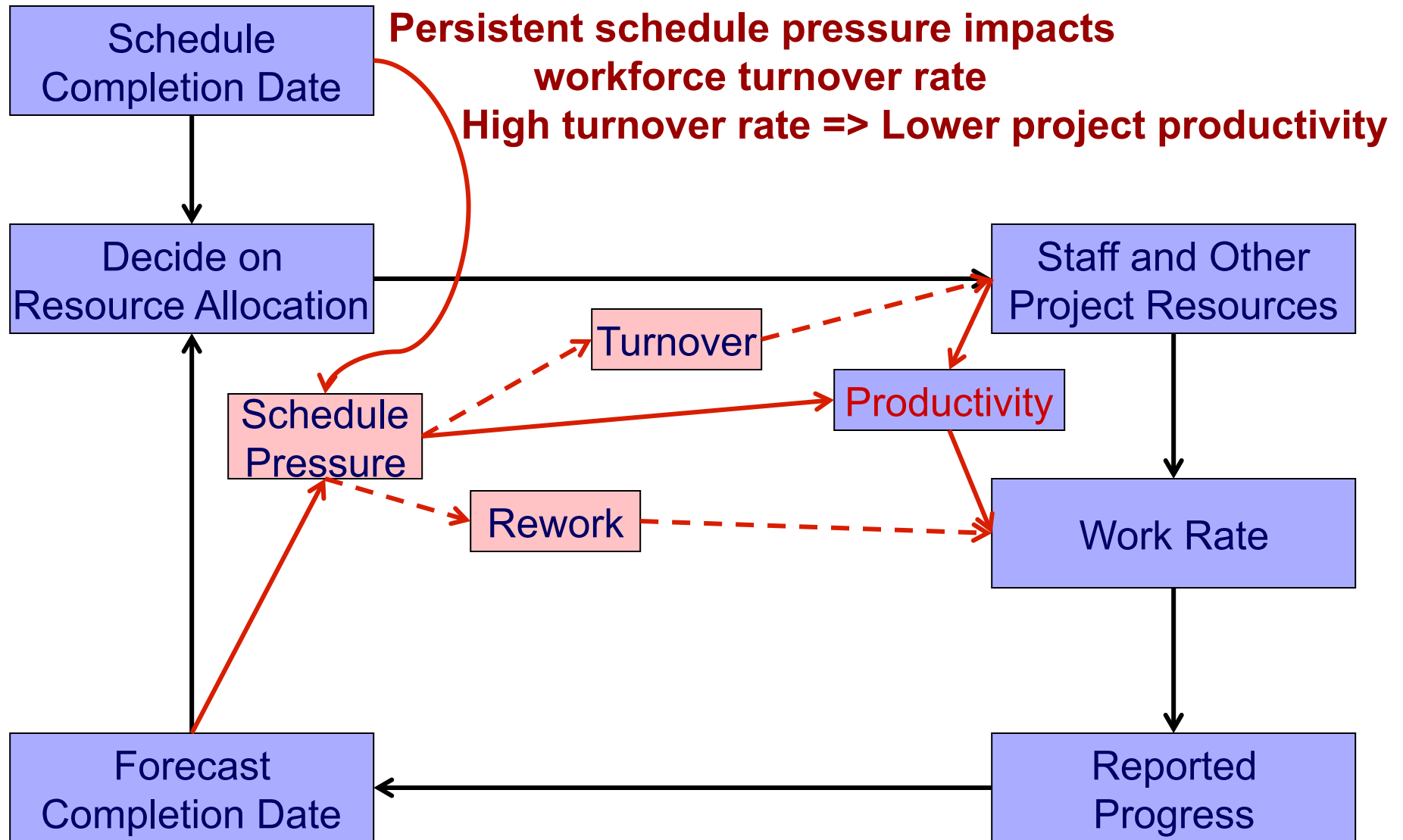


Adjusting Schedule of Late Project 2/3

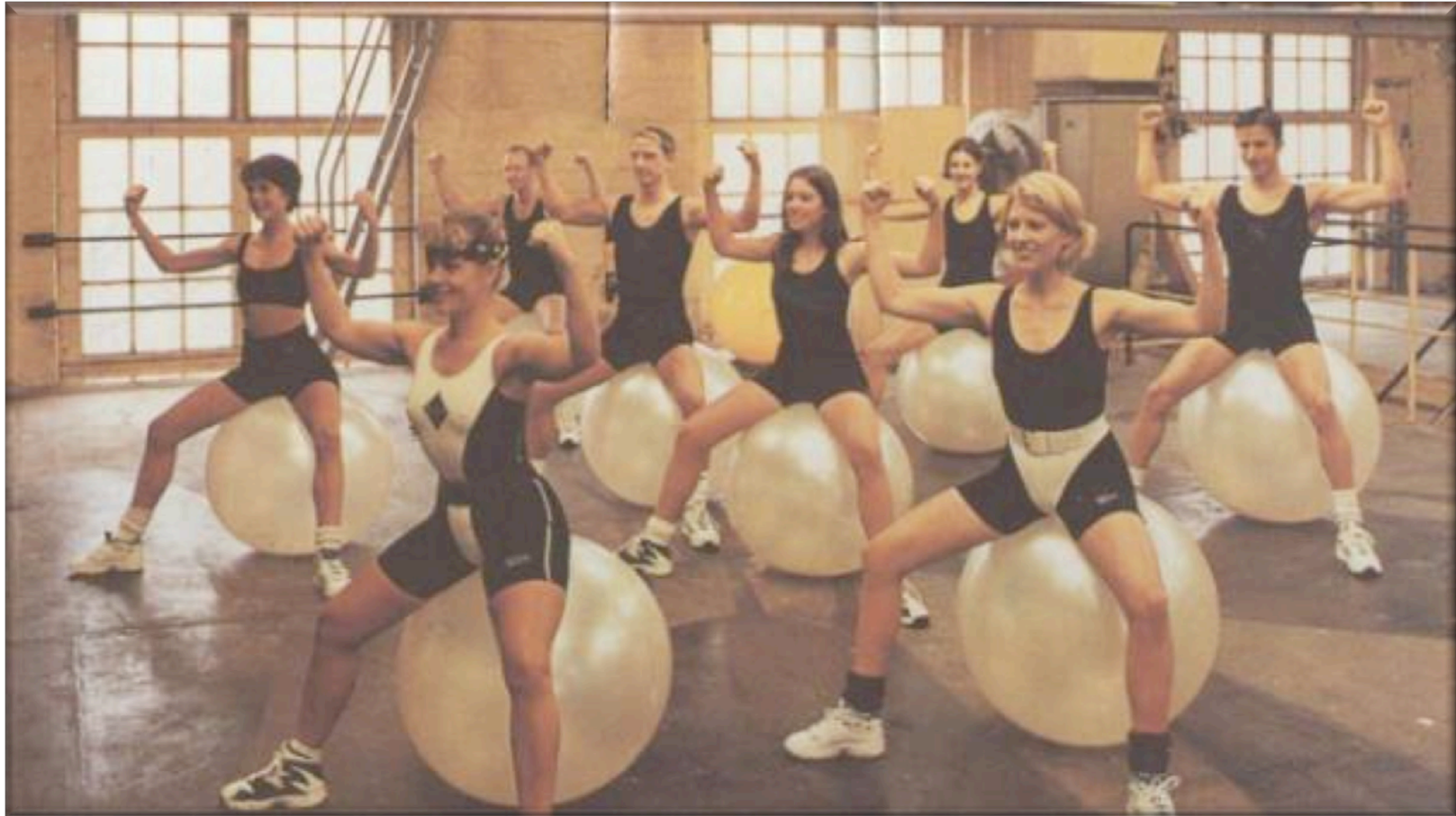
- **Schedule pressures impact developers' actions**
- **Project behind schedule:**
 - **Developers work longer hours**
 - **Concentrate only on essential tasks**
 - **Barry Boehm found number of staff-hours devoted to project increased by 100%**
- **Schedule pressure → Increased error rate → Rework
→ Lower productivity**

**People under schedule pressure work faster; not better ...
diminished software quality results in lower productivity**

Adjusting Schedule of Late Project 3/3



Beware: Short-term effects of swallowing Bubble Gum...





Homework and Reading Reminders

- **Complete Homework 4 – Software Risk Tables and Risk Sheets**
 - Due by 11:55pm, Tonight, October 2nd, 2012
- **Read Critical Chain Paper**
- **Complete Homework 5 – Software Schedule**
 - Due by 11:55pm, Tuesday, October 9th, 2012