CHAPTER 2 - PROJECT BREAKDOWN

PROJECTS ARE LARGE AND COMPLEX

- USE A HIERARCHICAL STRUCTURE TO BREAK THEM DOWN
- RESULT: “WBS” = “WORK BREAKDOWN STRUCTURE” (DEFINED LATER)

EXAMPLE: LARGE PROJECT ORGANIZATION & BREAKDOWN

STAGES	OPERATIONS	SUBOPERATIONS	ACTIVITIES
CLEAR RESERVOIR SITE			
CONSTRUCT DAM			
RELOCATE HIGHWAY IN RESERVOIR AREA			
RELOCATE AREA RESIDENTS			
RELOCATE RAILROAD			
CONSTRUCT POWERHOUSE			
	FOUNDATION		
	STRUCTURAL FRAME		
	CAST FLOOR SLABS		
		EXCAVATION	
		BACKFILL	
		FORMWORK	
		INSTALL REBAR	
			PROCURE REBAR
			CUT REBAR
			BEND REBAR
			PLACE REBAR
			TIE REBAR
		POUR CONCRETE	
		CURE CONCRETE	
	PLACE ROOF AND ROOFING		
	INSTALL TURBINES AND GENERATORS		
CONSTRUCT POWER DISTRIBUTION LINES			
CONSTRUCT WATER CONDUIT			
CONSTRUCT RECREATION FACILITIES			

WORK (TASK) CONSIDERATIONS

- WHAT IS THE WORK THAT NEEDS TO BE DONE?
- WHO TO INSTRUCT TO DO IT?
- WHO IS RESPONSIBLE?

WHAT IS AN ACTIVITY?

- "AN ACTIVITY IS A UNIQUE UNIT OF THE PROJECT THAT CAN BE DESCRIBED WITHIN PRESCRIBED LIMITS OF TIME"
- USUALLY REQUIRES RESOURCES (LABOR, MATERIAL, EQUIPMENT, MONEY, TIME)
- BUT, DOES NOT HAVE TO COST MONEY, NEED RESOURCES, OR USE UP ANY TIME.
- IN GENERAL, CAN BE EQUATED TO PROJECT, STAGE, OPERATION, OR SUBOPERATION (WBS)
- IN PRACTICE, ACTIVITIES MUST BE DETAILED ENOUGH TO ALLOW THE EFFICIENT USE OF "FINISH-TO-START" PRECEDENCE
- DUMMY ACTIVITIES (ZERO COST, ZERO DURATION)
  - TO EXPRESS THE DESIRED NETWORK LOGIC
  - TO MAINTAIN A NUMBERING SYSTEM
  - TO MARK MILESTONE EVENTS (START, FINISH, IN-BETWEEN EVENTS)
  - TO HIGHLIGHT IMPORTANT DECISIONS THAT NEED TO BE MADE

TYPES OF ACTIVITIES

- ESTIMATOR'S RECAP SHEET, SUMMARY SHEETS, ETC.
  - PROVIDE AN IDEA OF THE TYPES OF ACTIVITIES INVOLVED IN A PROJECT
  - RECAP SHEETS TEND TO BE OF LARGE SCOPE – NOT DIRECTLY USEFUL FOR PLANNING AND SCHEDULING
    - FOUNDATION, FOOTINGS, COLUMNS, SLABS, ETC.
  - UNIT PRICE BID-ITEMS ARE ALSO INADEQUATE BECAUSE THEY TEND TO BE MATERIALS-ORIENTED
    - CONCRETE, SAND & GRAVEL, BACKFILL, ETC.
- USUALLY NEED A FINER LEVEL OF DETAIL TO DEFINE ACTIVITIES.

ACTIVITY CLASSIFICATION

- **PRODUCTION ACTIVITIES**
  - CAN BE TAKEN DIRECTLY FROM PLANS AND SPECS
  - INVOLVE THE APPLICATION OF RESOURCES
    - MATERIAL, LABOR, EQUIPMENT
  - PRODUCT-ORIENTED
  - MUST NEVER BE OMITTED FROM SCHEDULE
- **PROCUREMENT ACTIVITIES**
  - MATERIALS
    - ROUTINE OR SPECIALTY?
    - OMIT COMMON MATERIALS PROCURED ON DAY-TO-DAY BASIS
  - LABOR
    - ENOUGH OF EACH NECESSARY CRAFT
    - TRAINING IS PROCUREMENT
  - EQUIPMENT
    - LEAD TIME FOR PURCHASE / RENT
    - LEAD TIME FOR ORDERING / MANUFACTURE (E.G., TBM)
    - MOBILIZATION TIME
    - ERECTION OF CRANE
    - ASSEMBLY OF TUNNELING SHIELD
  - FUNDING
    - INCREMENTAL BUDGETS / LOANS MUST BE APPROVED
  - PERMITS & LICENSES
  - ENGINEERING APPROVALS & INSPECTIONS
    - E.G., APPROVAL OF SHOP DRAWINGS BY A/E
      - GIVE NOTICE IN ADVANCE
  - WORK-SITE CONSTRAINTS
    - OBTAIN ADDITIONAL SPACE AS NEEDED
      - OPERATIONS, STORAGE
      - AVOID TWO LARGE CREWS IN THE SAME SPACE
      - DO NOT POUR CONCRETE PILE CAPS WHILE DRIVING PILES
      - UTILITY CREWS (GAS, WATER, ELECTRICITY) PREFER TO WORK ALONE ON THE SITE
- **MANAGEMENT DECISION ACTIVITIES**
  - TO SELECT METHODS BASED ON ACTUAL SITE CONDITIONS
  - WHETHER TO HEAT & HOUSE CONCRETE
  - LABOR HIRING AND FIRING
  - PERSONNEL VACATIONS

DEGREE OF PROJECT BREAKDOWN

- HOW MUCH DETAIL IS ENOUGH FOR A GOOD SCHEDULE?
- DEPENDS ON SCHEDULE'S USE
- WHO IS THE USER? WHAT IS THEIR INTEREST & CONTROL?
  - EXTENSIVE DETAIL AT PRODUCTION LEVEL (SUPERINTENDENT)
  - SUMMARIES AT MANAGEMENT LEVEL (VICE PRESIDENT)
- START AT DETAILED LEVEL AND AGGREGATE TO PRODUCE SCHEDULES FOR VARIOUS USES WITHIN THE ORGANIZATION.
- NO UNIVERSAL ANSWER – DECISIONS MADE AS NEEDED

GUIDELINES FOR ACTIVITY DEFINITION

- BY TYPE OF WORK, BY LABOR CRAFT, OR BOTH, E.G.,
  - BY TYPE OF WORK
    - CONCRETE BLOCK MASONRY
    - EXTERIOR BRICK MASONRY
  - BY LABOR CRAFT
    - ELECTRICAL
    - PLUMBING
- BY PROJECT ELEMENTS, E.G.,
    - FOOTINGS
    - COLUMNS
    - INSTALL MACHINE BASE
  - THIS METHOD SHOULD BE COMBINED WITH THE ONE ABOVE. OTHERWISE, IT MAY NOT PROVIDE A CONVENIENT BREAKDOWN FOR DETERMINING THE WORK OF EACH TRADE.
- BY LOCATION, E.G.,
  - FORMWORK FOR 2ND FLOOR COLUMNS
  - POUR EA3 COLUMN
- BY USE OF IMPORTANT EQUIPMENT, E.G., CRANE
- BY SUBCONTRACT
  - USE SUBNETWORKS FOR WORK WITH DIFFERENT ENTITY RESPONSIBILITY
- BREAK REPETITIOUS WORK TO ALLOW OVERLAPPING
- DO NOT INCLUDE MORE THAN ONE MAJOR LABOR OR EQUIPMENT RESOURCE IN EACH ACTIVITY (TO FACILITATE CONTROL)

TABLE 2.3

Activity List with Dependencies – Remodeling Chemical Laboratory

No.	Activity List	Depends Upon
1	Strip room	—
2	Repair walls and ceiling	1, 5, 7
3	Repair floor	1, 5
4	Lay vinyl floor	3, 12, 13, 14
5	Rough-in plumbing and electrical	1
6	Finish plumbing and electrical	2, 3, 5, 9, 10, 11, 19
7	Replace existing fume duct	1
8	Install new fume hood	2, 3, 16
9	Install 1/3 base cabinets (*)	2, 3, 8, 15
10	Install wall cabinets	2, 3, 7, 15
11	Install chemical sink	2, 3, 5, 9, 17
12	Paint cabinets	6, 8, 9, 10, 11, 18
13	Paint walls and ceiling	2, 3, 6, 8, 9, 10, 18
14	Obtain vinyl floor covering	—
15	Obtain cabinets	—
16	Obtain fume hood	—
17	Obtain chemical sink	—
18	Painter availability	—
19	Install 2/3 base cabinets (*)	2, 3, 9, 15

(*) Breaking Activity “Install base cabinets” in two is an example of breaking repetitious work to allow overlapping.
It allows Activity “11 - Install chemical sink” to start after Activity “9 - Install 1/3 base cabinets”.
Thus, Activity “11 - Install chemical sink” can overlap with (instead of follow) Activity “19 - Install 2/3 base cabinets” to save time.

PLANNERS ATTITUDES AND ASSUMPTIONS

- PLANNER MUST
  - UNDERSTAND
    - THE PROJECT
    - THE METHODS TO BE USED
    - THE POSSIBLE ALTERNATIVES
  - KEEP AN OPEN MIND
  - SEARCH FOR OPTIMALITY (IN A DESIGN SENSE)
- PLANNER MUST NOT PLACE ANY ARBITRARY RESTRICTIONS ON ACTIVITIES
  - ONLY RESTRICTIONS TO BE CONSIDERED ARE THOSE FORCED
    - BY PLANS AND SPECS
    - BY THE METHOD CHOSEN BY FIELD PERSONNEL
- PLANNER MUST NOT CONSIDER RESTRICTIONS IN SPACE OR TIME
- PLANNER SHOULD ASSUME UNLIMITED RESOURCES
  - RESOURCE LIMITATIONS MAY BE INCONSEQUENTIAL (ACTIVITIES USING SAME RESOURCES MAY NOT OVERLAP)
  - THEY BECOME THE SUBJECT OF RESOURCE ALLOCATION (DEALT WITH SEPARATELY AFTER START TIMES ARE COMPUTED)
- ONLY TECHNOLOGICAL PRECEDENCE CONSTRAINTS SHOULD BE HARDWIRED INTO THE SCHEDULE NETWORK.
  - CANNOT POUR CONCRETE UNLESS THE REBAR IS IN PLACE.
  - CANNOT PLACE THE REBAR UNLESS THE FORMWORK IS IN PLACE.
- HARDWIRING RESOURCE CONSTRAINTS IS TEMPTING BUT MAKES IT VERY DIFFICULT TO ADJUST PROJECT DURATION OR COST TO SUIT MANAGEMENT OBJECTIVES.
  - PEOPLE FORGET WHY CERTAIN PRECEDENCE CONSTRAINTS WERE INSERTED IN THE NETWORK AND ARE RELUCTANT TO REMOVE THEM