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Ralph J. Stephenson P.E. P.C.
Consulting Engineer

MICHIGAN DEPARTMENT OF TRANSPORTATION - Office of Small Business Liaison

CRITICAL PATH METHOD SEMINAR

Port Huron, Michigan

Wednesday, February 26, 1992

Instructor - Ralph J. Stephenson, P. E.

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MICHIGAN DEPARTMENT OF *TRANSPORTATION*
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Mt. Pleasant, Michigan Wednesday, March 18, 1992

Instructor -Ralph J. Stephenson, P. E.

Ralph J. Stephenson, P.E., P.C.
Consulting Engineer 323 Hiawatha Drive
Mt. Pleasant, Michigan 48858

(517) 772-2537

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MDOT Critical Path Planning Seminar -by Ralph J. Stephenson, P. E.

Port Huron, Michigan -Wednesday, February 26, 1992 *Mt. Pleasant, Michigan -Wednesday, March* 18, 1992 *Notebook index*

Ralph J. Stephenson PE Consulting Engineer

THINKING PATTERNS

Why plan? ..... to evaluate Why translate? ..... to communicate Why control? .....••.... to achieve Why correct? .....•... to maintain Why learn? ..•..••..... to improve

Ralph J. Stephenson PE Consulting Engineer

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4. Be creative
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Ralph J. Stephenson PE PC Consulting Engineer

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1. Financial
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B. ELEMENTS OF MULTI VALUE COMPETITION

1. Competence
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LEVEL 1 .. INCLUDE EVERYTHING

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RALPH J. STEPHENSON. P.E.

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Ralph J. Stephenson PE
Consulting Engineer

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Positive ~ Perfomance Improvement Cycle

Time

(from The 9 Master Keys to Management -Lester R. Bittlel)

Ralph J. Stephenson PE PC Consulting Engineer

NINE MAJOR STEPS TO EFFECTIVE PROJECT MANAGEMENT

DEFINITIONS

- PROJECT -A set of work actions having identifiable objectives, and a beginning and an end.
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PLAN VISIBLY!

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Act From A plan

• If you can't plan It, you can't manage It.
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A. Five essential planning questions for the manager to ask and have answered.

1. What?
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B. Essential planning actions for the manager to take

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1. Definitions

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b. Objectives -Expressed goals which have been quantified

1. Be specific when setting objectives -projects are objective oriented
2. Set objectives so that movement toward their achievement can be measured

D. Prepare, have approved and translate an action plan

1. May be mental, verbal, text written or graphic
2. May be strategic or tactical, summary or tactical
3. May be short, medium or long range (the manager must set the time scale)

a. The shorter the time interval covered by the plan, the greater is the chance the plan will succeed. However, the shorter the time interval covered, the greater is the probability that longer range

needs, which truly measure the manager's effectiveness, will remain unmet

b. The higher you are in the management structure, the larger and longer are the planning scales you must use (the higher you are the further you are expected to see)

4. A good manager plans the work and then works the plan

E. Organize, assemble the resources, set the project systems & do the Job

1. Build plans based on optimum integration of management viewpoints
2. Define relationships through functional diagraming of interconnections

a. Formal
b. Informal
c. Reporting
d. Staff
e. Temporary

3. Make clear cut assignments

a. The manager should not assume a person will automatically know his full pattern of responsibilities.
b. Don't leave definition of authority and responsibility to chance. Be specific.

4. Build a feedback system

a. Organizational grapevines are often used for informal feedback
b. Formal feedback systems should be built by specific assignment (must have a standard of project performance defined before a formal feedback system can be put in place)

5. Keep organization goal and objective oriented

a. Keep organization lean· avoid unnecessary staffing
b. Provide delegation and training opportunities
c. Tend to build around objectives and needs rather than people (there are major exceptions to this· distinguish these early)
d. Provide for proper grading of decision to action time spans

F. Common planning failures

1. Not touching all organizational and management bases· use the

what, where, when, how and who system

2. Committing to too many objectives at one time
3. Underestimating the value and need for good forward planning
4. Failing to challenge plans and actions at the right time
5. Not providing proper escape hatches, mouseholes and safeguards
6. Failure to encourage timely, knowledgeable staff participation
7. Failure to obtain higher level approvals of goals and objectives
8. Inadequate monitoring and control of costs, progress, documentation and resource allocation

9. Poor assignment of duties, authOrity. responsibilities and actions; and

10. failure to understand that planning is a major responsibility of the manager

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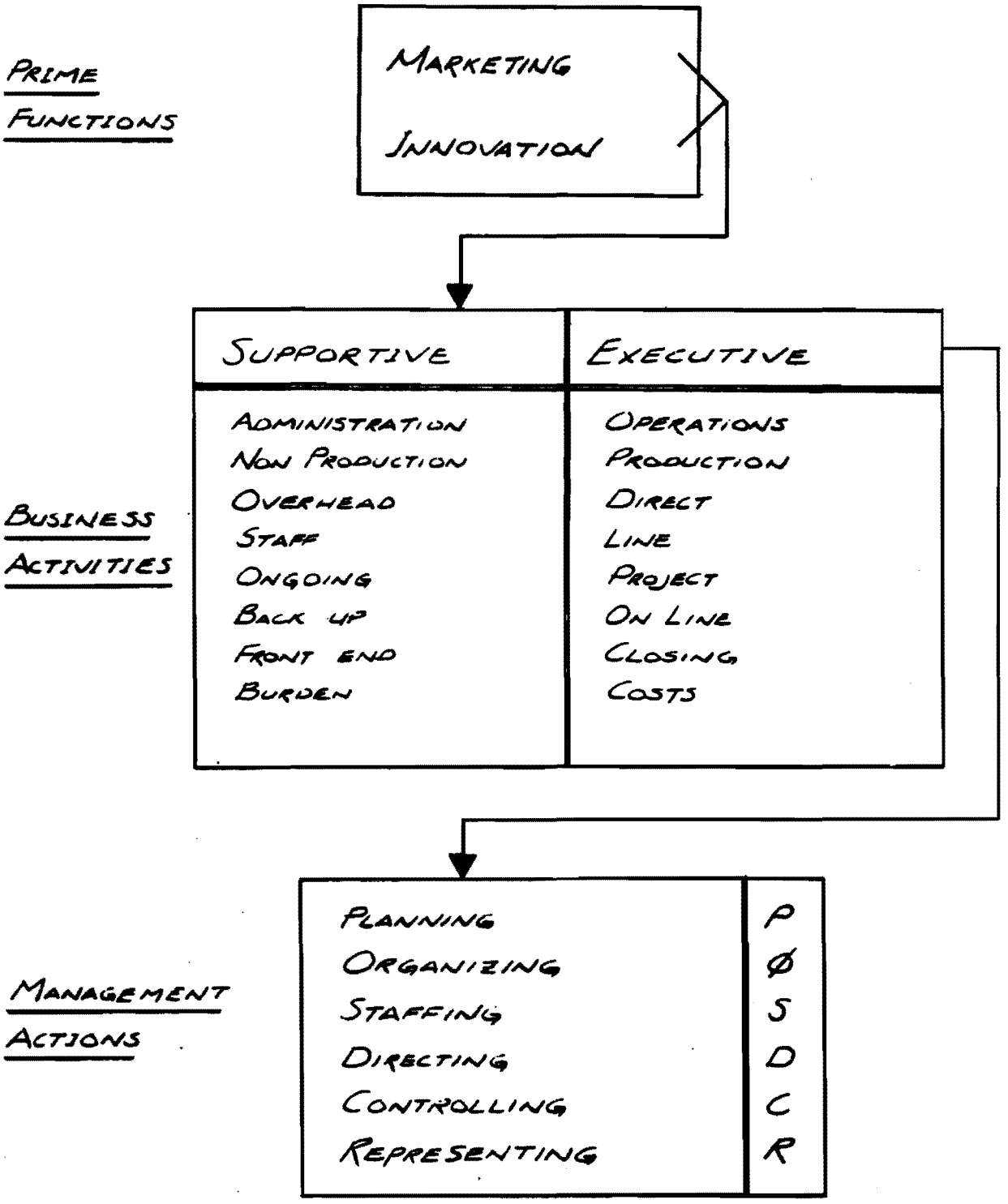
ELEMENTS OF BUSINESS & MANAGEMENT



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RALPH J. STEPHENSON, P.E.
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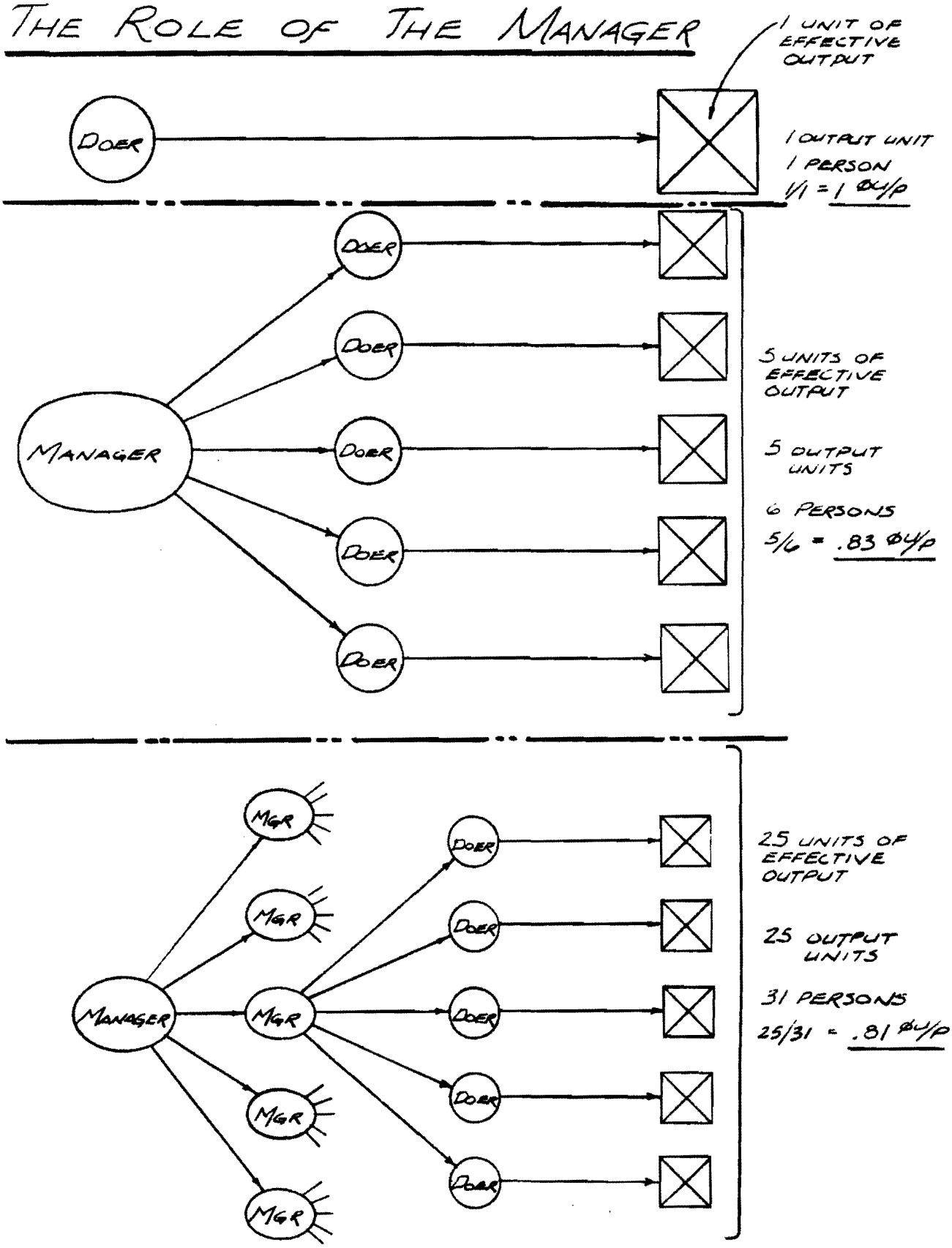
THE ROLE OF THE MANAGER



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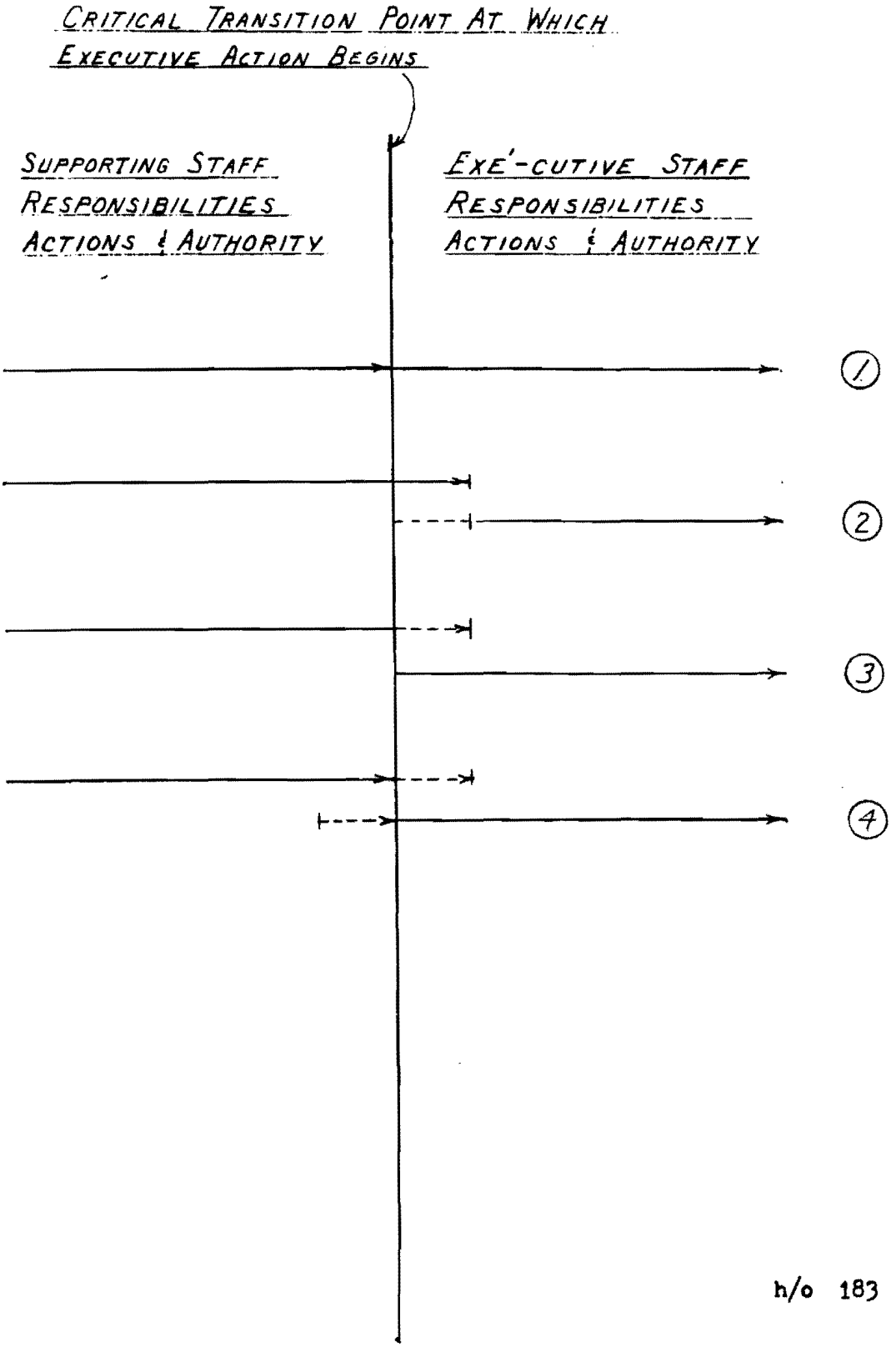

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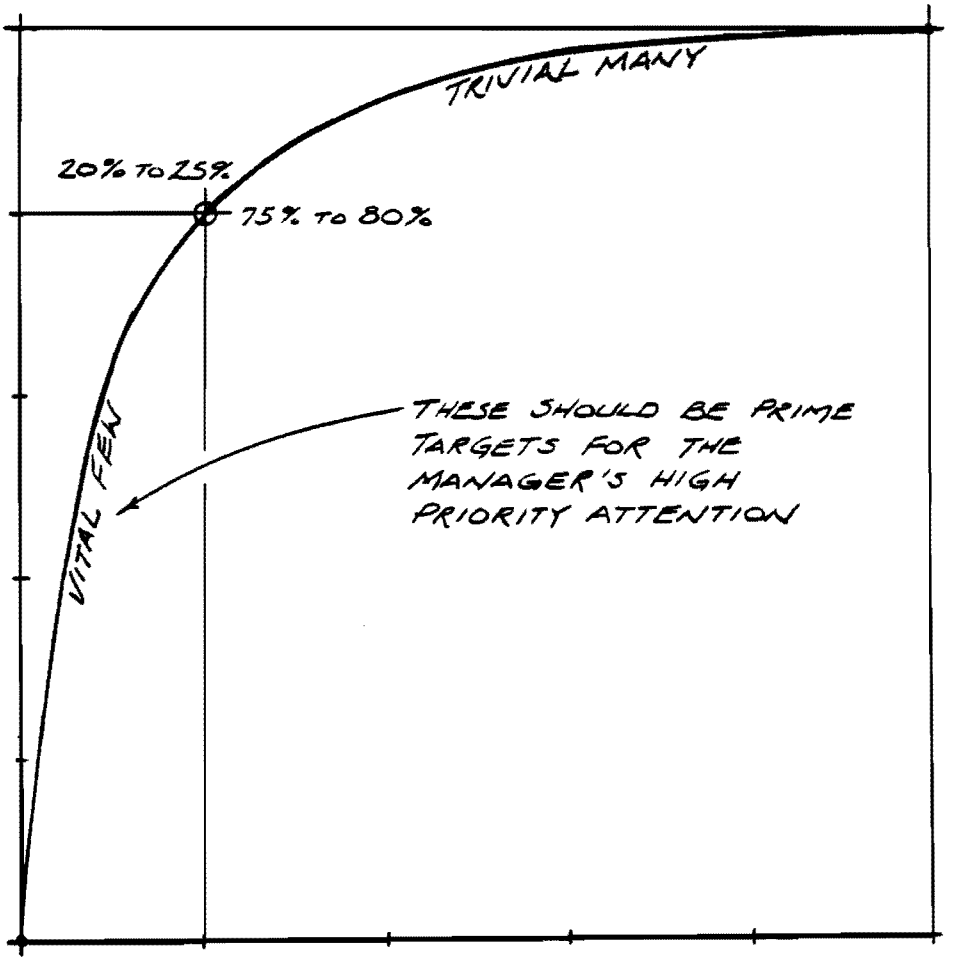

VALUE OR UTILITY

PRICE
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ACTIVITIES
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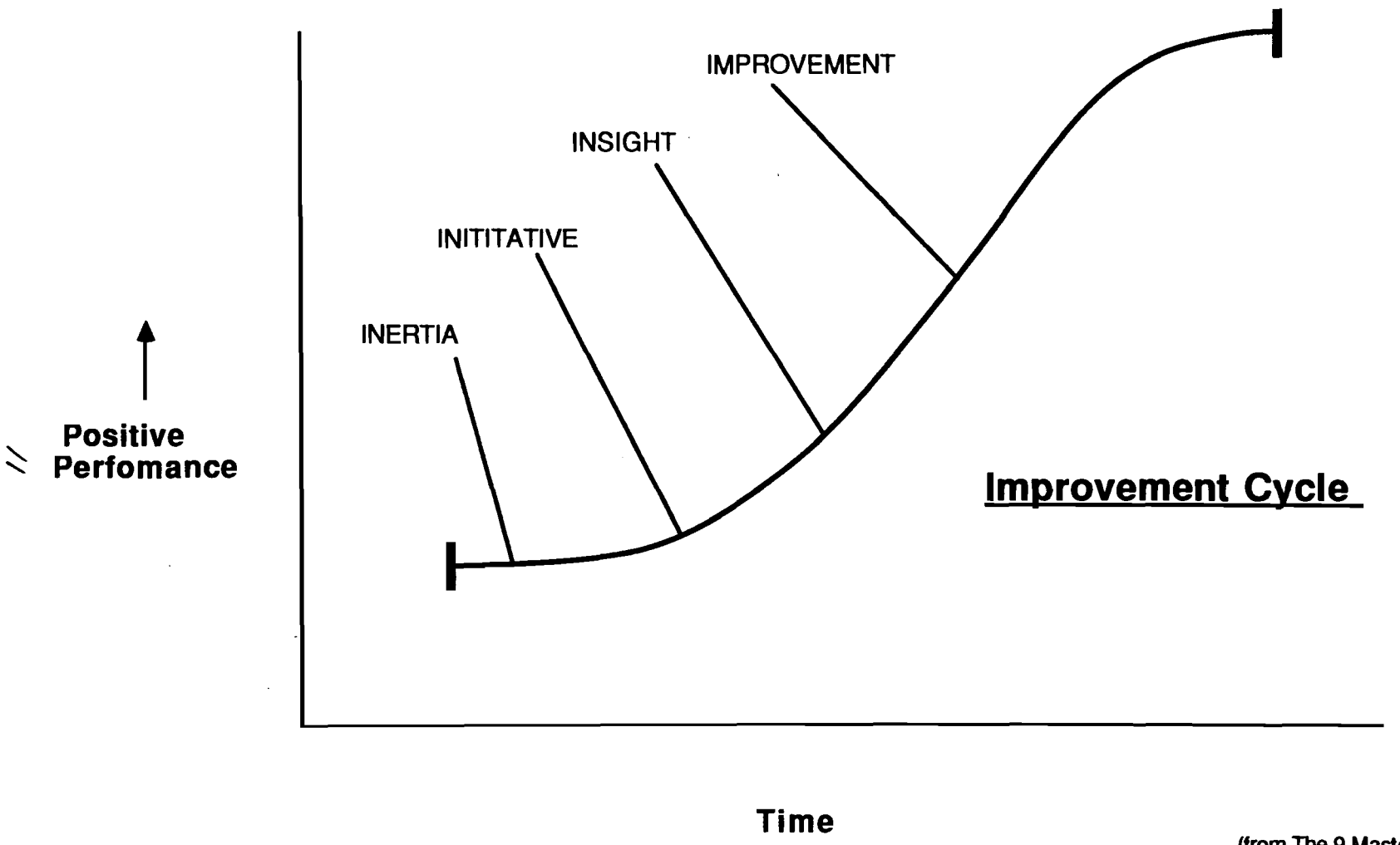

(from The 9 Master Keys to Management - Lester R. Bittlel)

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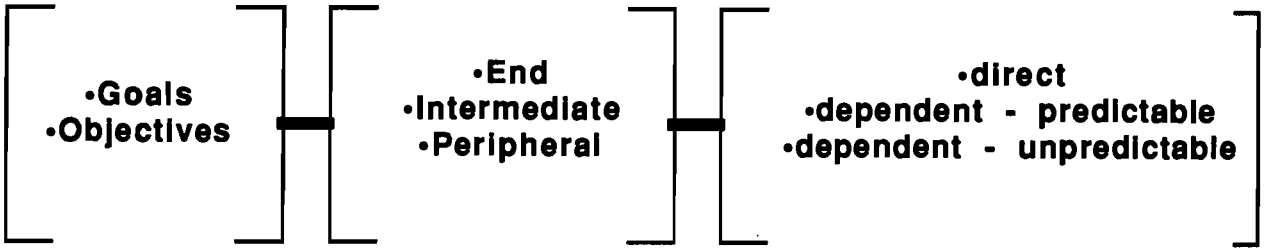

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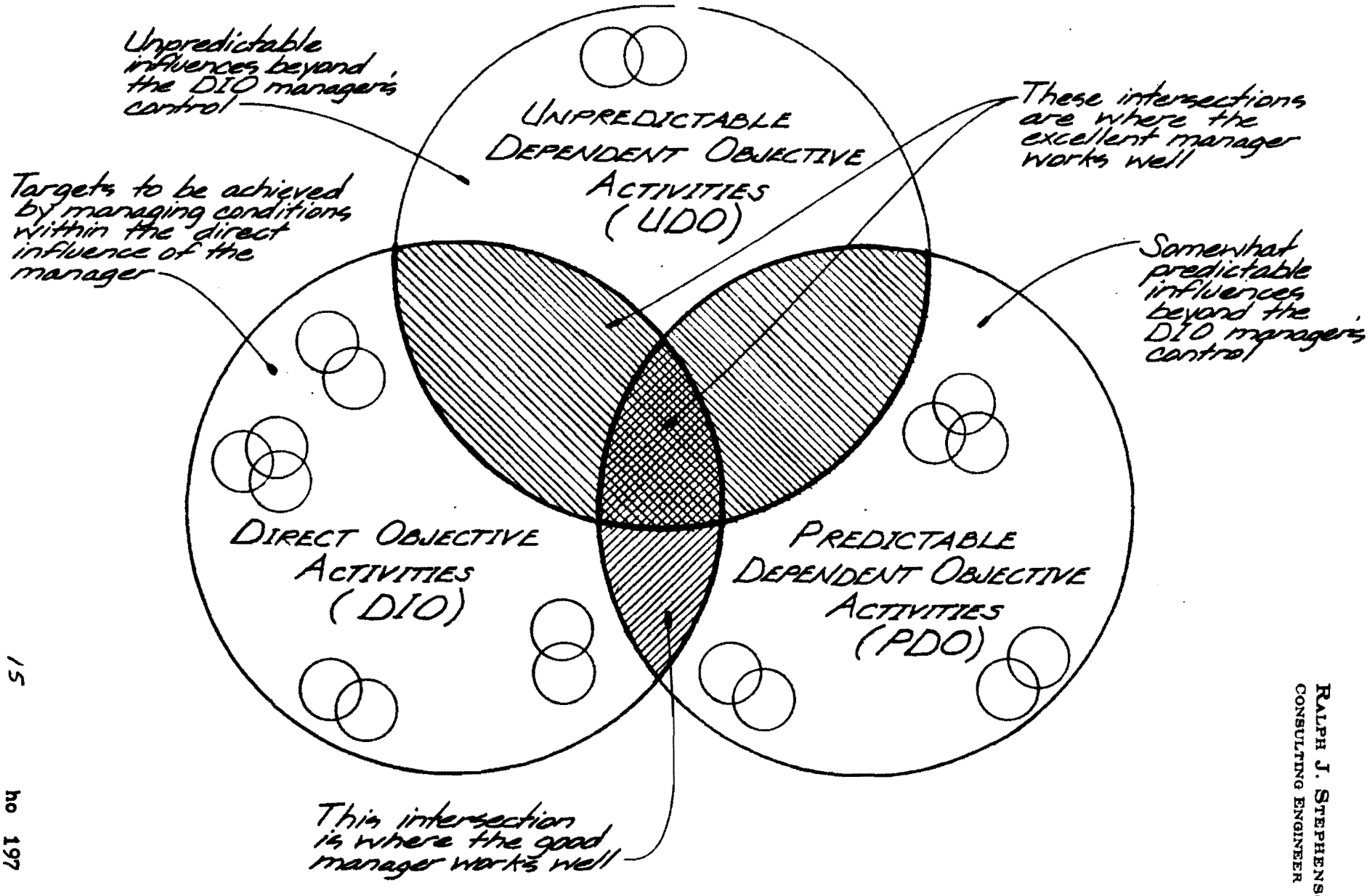

THE DIO/PDO/UDO INTERSECTION

RALPH J. STEPHENSON, P. E.
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3. Set objectives so that movement toward their achievement can be measured

D. Prepare, have approved and translate an action plan

1. May be mental, verbal, text written or graphic
2. May be strategic or tactical, summary or tactical
3. May be short, medium or long range (the manager must set the time scale)
    a. The shorter the time interval covered by the plan, the greater is the chance the plan will succeed. However, the shorter the time interval covered, the greater is the probability that longer range

needs, which truly measure the manager's effectiveness, will remain unmet

b. The higher you are in the management structure, the larger and longer are the planning scales you must use (the higher you are the further you are expected to see)

4. A good manager plans the work and then works the plan

E. Organize, assemble the resources, set the project systems & do the job

1. Build plans based on optimum integration of management viewpoints
2. Define relationships through functional diagraming of interconnections
   a. Formal
   b. Informal
   c. Reporting
   d. Staff
   e. Temporary
3. Make clear cut assignments
   a. The manager should not assume a person will automatically know his full pattern of responsibilities.
   b. Don't leave definition of authority and responsibility to chance. Be specific.
4. Build a feedback system
   a. Organizational grapevines are often used for informal feedback
   b. Formal feedback systems should be built by specific assignment (must have a standard of project performance defined before a formal feedback system can be put in place)
5. Keep organization goal and objective oriented
   a. Keep organization lean - avoid unnecessary staffing
   b. Provide delegation and training opportunities
   c. Tend to build around objectives and needs rather than people (there are major exceptions to this - distinguish these early)
   d. Provide for proper grading of decision to action time spans

F. Common planning failures

1. Not touching all organizational and management bases - use the

what, where, when, how and who system
2. Committing to too many objectives at one time
3. Underestimating the value and need for good forward planning
4. Failing to challenge plans and actions at the right time
5. Not providing proper escape hatches, mouseholes and safeguards
6. Failure to encourage timely, knowledgeable staff participation
7. Failure to obtain higher level approvals of goals and objectives
8. Inadequate monitoring and control of costs, progress, documentation and resource allocation
9. Poor assignment of duties, authority, responsibilities and actions; and
10. Failure to understand that planning is a major responsibility of the manager

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

CPM EXERCISE #1

Project starts with task A.
D can be concurrent with A.
B must follow A and precede F.
C follows A.
E cannot begin until both C & D are complete.
F precedes G & H.
G Cannot begin until E is complete.
H, G, & I must precede J.
I follows E and precedes L.
K follows D.
L cannot begin until K is complete.
J & L must be complete before M can start.
N cannot start until L is complete.
O follows N.
P is the last task and can start only when M & O are complete.

H/O 37

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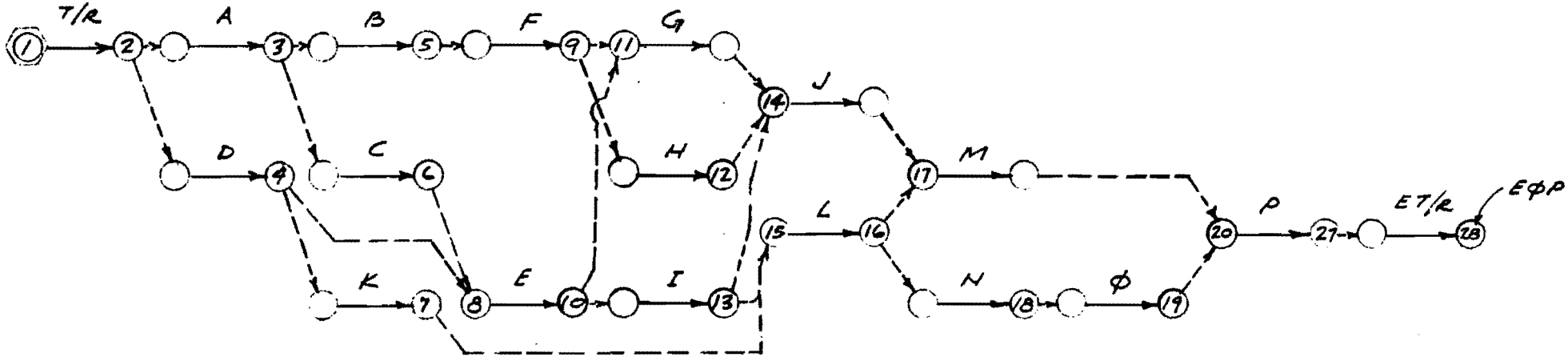
CONSULTING ENGINEER

SOLUTION TO EXERCISE #1
ARROW DIAGRAM



Reserved Node Nos	
21	24
22	25
23	26

SOLUTION TO EXERCISE #1
ARROW DIAGRAM

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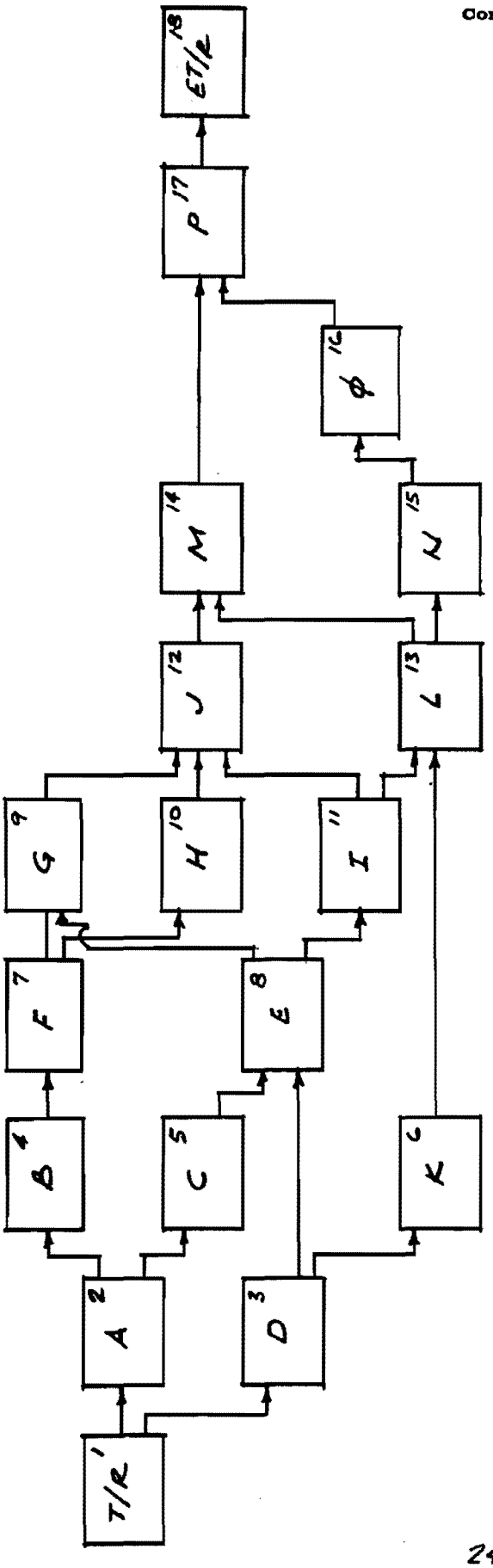
CONSULTING ENGINEER

H/O 133



SOLUTION TO EXERCISE #1
PRECEDENCE DIAGRAM

H/O 129

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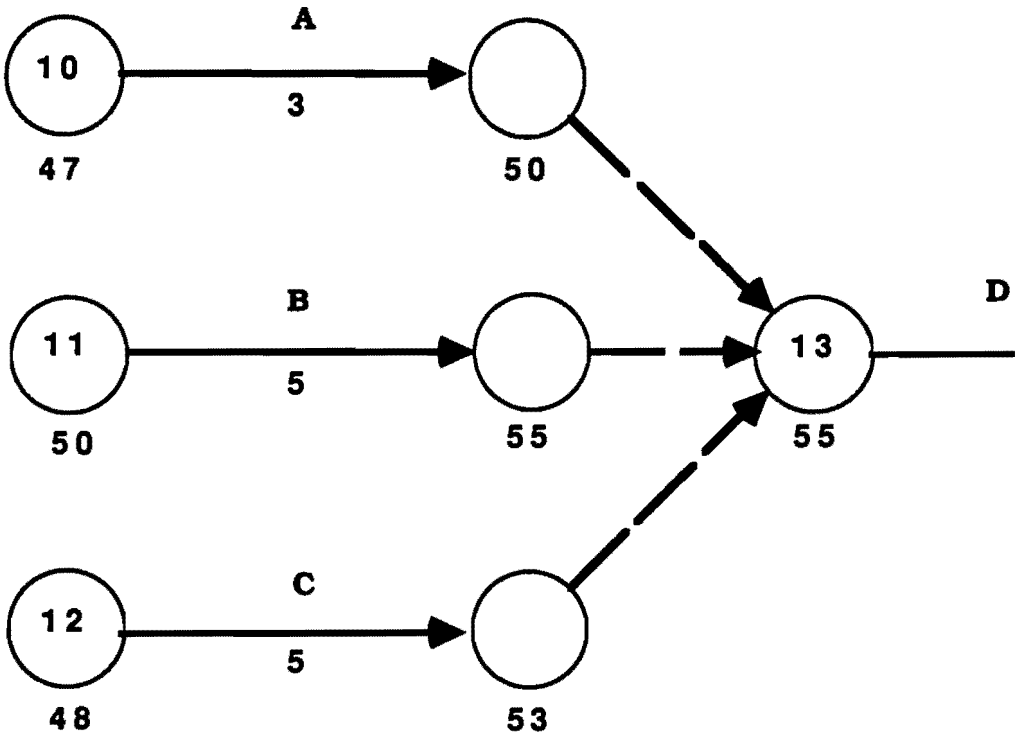
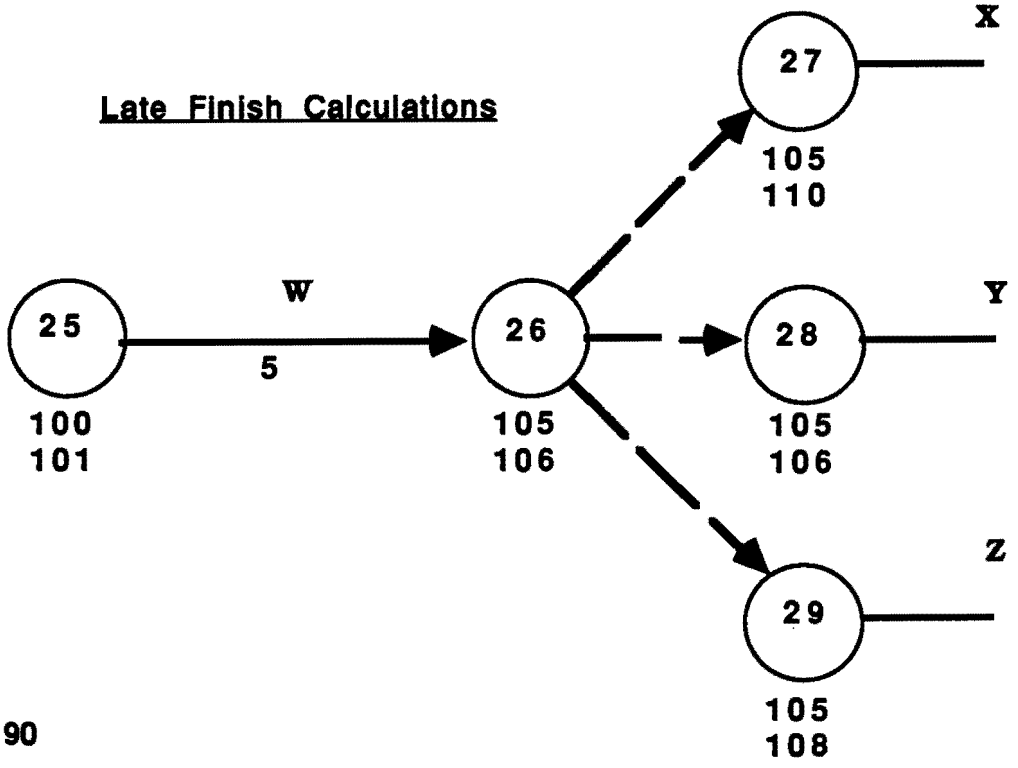
Consulting Engineer

Early Start Calculations



Late Finish Calculations



2 year working day calendar starting on January 2, 1991

Ralph J. Stephenson PE PC - 323 Hiawatha Drive,
Mt. Pleasant, Michigan 48858, ph 517 772 2537

Jan, 1991
02 001
03 002
04 003
07 004
08 005
09 006
10 007
11 008
14 009
15 010
16 011
17 012
18 013
21 014
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31 022
Feb, 91
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27 041
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Mar, 91
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Apr, 91
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May, 91
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21 100
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29 105
30 106
31 107
Jun, 91
03 108
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07 112
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Jul, 91
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Aug, 91
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Sep, 91
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Oct, 91
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Dec, 91
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2 year working day calendar starting on January 2, 1991 -

Ralph J. Stephenson PE PC - 323 Hiawatha Drive,
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Jan, 1992
02 256
03 257
06 258
07 259
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Feb, 92
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Mar, 92
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Apr, 92
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May, 92
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08 347
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Jun, 92
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09 368
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Jul, 92
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Aug, 92
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Sep, 92
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11 434
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Oct, 92
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Nov, 92
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Dec, 92
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31 511

4 year working day calendar starting on January 2, 1991 -
Ralph J. Stephenson PE PC - 323 Hiawatha Drive,
Mt. Pleasant, Michigan 48858, ph 517 772 2537

Jan, 1993
04 512
05 513
06 514
07 515
08 516
11 517
12 518
13 519
14 520
15 521
18 522
19 523
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Feb, 93
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25 550
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Mar, 93
01 552
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03 554
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Apr, 93
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May, 93
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Jun, 93
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28 636
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Jul, 93
01 639
02 640
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12 645
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14 647
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19 650
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26 655
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Aug, 93
02 660
03 661
04 662
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09 665
10 666
11 667
12 668
13 669
16 670
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30 680
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Sep, 93
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28 700
29 701
30 702

Oct, 93
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04 704
05 705
06 706
07 707
08 708
11 709
12 710
13 711
14 712
15 713
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25 719
26 720
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Nov, 93
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Dec, 93
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4 year working day calendar starting on January 2, 1991 -

Ralph J. Stephenson PE PC - 323 Hiawatha Drive,
Mt. Pleasant, Michigan 48858, ph 517 772 2537

Jan, 1994
03 766
04 767
05 768
06 769
07 770
10 771
11 772
12 773
13 774
14 775
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18 777
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21 780
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Feb, 94
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22 802
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Mar, 94
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Apr, 94
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18 841
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May, 94
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Jun, 94
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Jul, 94
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Aug, 94
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11 922
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Sep, 94
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Oct, 94
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Nov, 94
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16 990
17 991
18 992
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22 994
23 995
25 996
28 997
29 998
30 999

Dec, 94
01 1000
02 1001
05 1002
06 1003
07 1004
08 1005
09 1006
12 1007
13 1008
14 1009
15 1010
16 1011
19 1012
20 1013
21 1014
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29 1019
30 1020

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

CPM EXERCISE #2

Z, T, & L are the first tasks and can be concurrent.
X must be complete before N can start.
Q follows H.
C must follow L and precede W.
S follows B & W and precedes D & V.
N must be complete before M can begin.
K & D must be complete before R & X can start.
A must follow Z.
G precedes Q and follows V.
H cannot begin until F & R are complete.
D must be complete before F can start.
U follows B and precedes K.
W cannot start until T is complete.
M is the last task & follows Q.
B cannot begin until A & T are complete.

Z2	C6	M4
T4	W1	R5
L1	S3	U2
X3	B1	A2
N4	D2	F3
Q2	V3	G4
H3	K1	

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

EXERCISE #3

1. Project begins with a time restraint (T/R) followed directly by task A.
2. Task A restrains tasks B and G.
3. Task H follows task G.
4. Task M follows task G and restrains task N.
5. Task C is restrained by B and restrains D, E and I.
6. Task I is restrained by H and restrains J, K and O.
7. Task O is restrained by N and restrains P and Q.
8. Tasks D and E restrain F.
9. Task L cannot start until J and K are complete.
10. Tasks P and Q must be complete before R can start.
11. Tasks F, L and R are not related to each other but can be completed simultaneously.
12. When tasks F, L and R are complete the project is complete.

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

EXERCISE #4

- Project starts with T/R task A

- Tasks B, C, D follow task A directly and can be concurrent

- Task E is restrained by task C and restrains tasks G, H and J

- Task F follows task C and precedes task J

- Tasks G and H are restrained by task D

- Task K is restrained by tasks G, H and J and must be done before tasks N and M can begin

- Task L is restrained by task K and must be complete before task P can start

- Task P is restrained by tasks M and N and restrains task Q from beginning

- Task R cannot begin until task Q is complete and R is the last task in the network

- Task B restrains tasks G, H and J

Factors in evaluating network models - ho 260

Factors are to be rated from 1 to 10 with 1 meaning the network fails to satisfy even mininum requirements of the factor. 10 means the factor is satisfied fully and expertly.

__1. Quality of goal & objective definition
Do the goals & objectives meet the needs of the project & of the project organization?

__2. Completeness of laundry list
Does the laundry list contain all reasonable activities to be accomplished for successful completion of the project?

__3. Accuracy of logic relationships
Are the interrelationships between activities shown correctly? Are concurrent and sequential tasks properly diagrammed?

__4. Completeness of activity description
Is the exact definition of each activity apparent from reading the description?

__5. Reasonablness of duration assignment
Do the durations shown represent times to do the activity that are reasonable, and achieve the objectives of the project?

__6. Correctness of calculations
Are the ES/EF's & LS/LF's properly computed?

__7. Quality of network appearance
How well was the diagram presented? Could you understand what the job was all about from reading the network without explanation?

__8. Presence of abbreviations,task #'s,issue #'s,sheet #'s,codes & dates
Is there enough supplementary information on the logic plan so you can read it without having someone explain it to you?

__9. Overall appearance of network
Does the overall plan appearance reflect quality & competence of execution? Does it give you confidence that the person who prepared it knew what they were doing?

_____ Total
*****

_____ Average (total divided by 9)

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

QUESTIONS TO BE ASKED

1) WHAT? -- What is the scope of the activity?
-- What is the standard of performance?
-- What are our objectives?
-- What are our goals?
-- What is needed to start?

2) WHERE? -- Where will the work take place?

3) WHEN? -- When does the work start?
-- When is the work supposed to finish?
-- When will the work be completed?

4) HOW? -- How do I know when the job is done?
-- How do I know if we've done a good job?
-- How do I get out of the job when it's done?

5) WHO'S? -- Who's responsible?
-- Who's in charge?
-- Who's doing the work?
-- Who's liable?
-- Who's in charge for my client?
-- Who's the ultimate decision maker? (UDM)

H/O 186 4/80

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

Chicago Area Weather

Source: Jack Kolstadt

Week		Working Day	Total Working Days Worked	Loss in Working Days
Dec.	1	234	3½	1½
	2	239	3½	1½
	3	244	4	1
	4	249	3	2
Jan.	1	256	2-1/5	2-4/5
	2	261	2-1/5	2-4/5
	3	266	3½	1½
	4	271	3	2
Feb.	1	277	3	2
	2	282	3	2
	3	287	4	1
	4	292	3½	1½
Mar.	1	297	4½	½
	2	302	4½	½
	3	307	4	1
	4	312	3½	1½
Apr.	1	320	3½	1½
	2	325	4½	½
	3	330	4	1
	4	335		0

H/O 136

Ralph J. Stephenson PE PC
Consulting Engineer

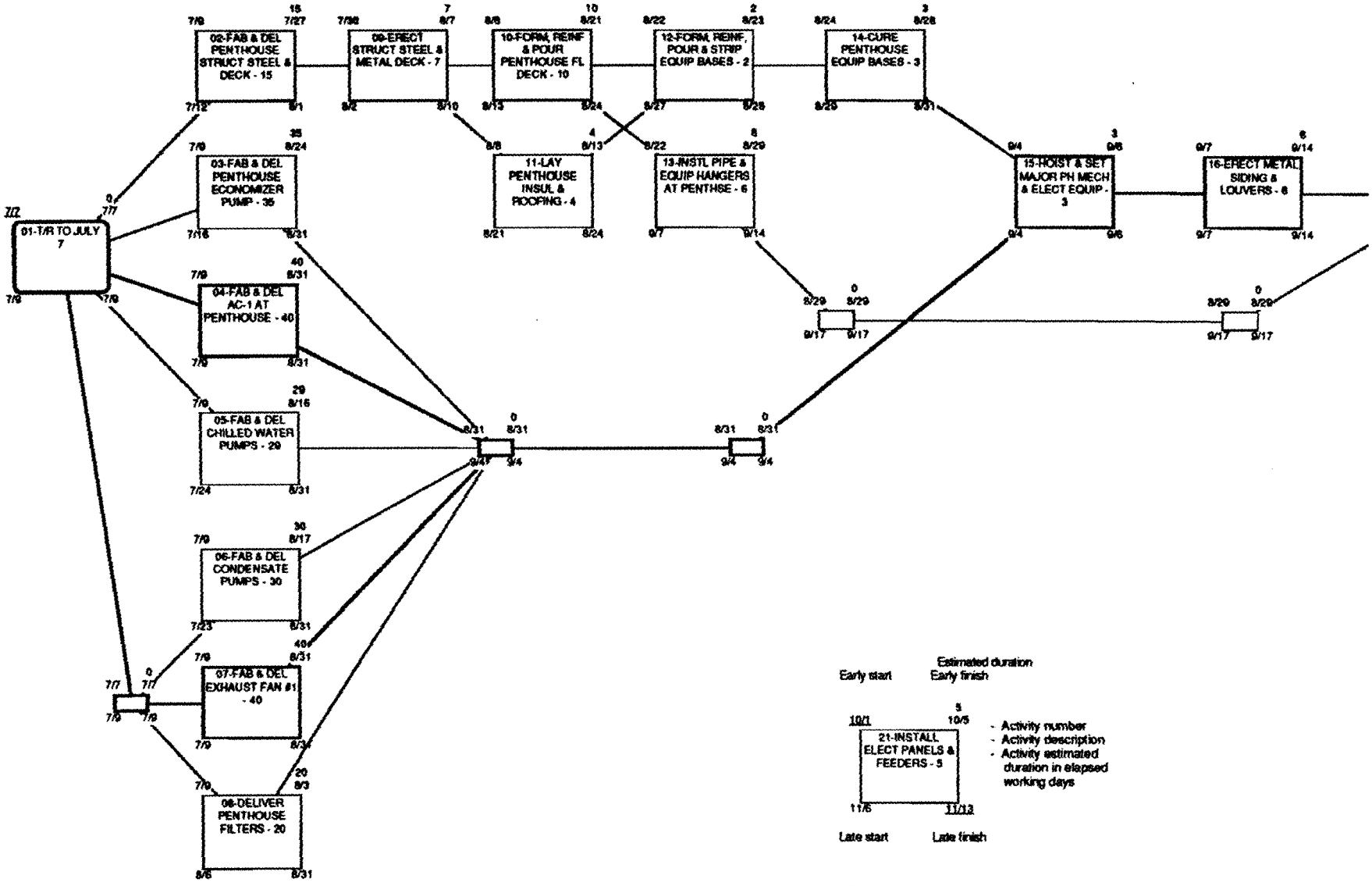
TRANSLATE

To recast project planning & management information into other graphic, narrative & oral forms to insure effective use by those involved.

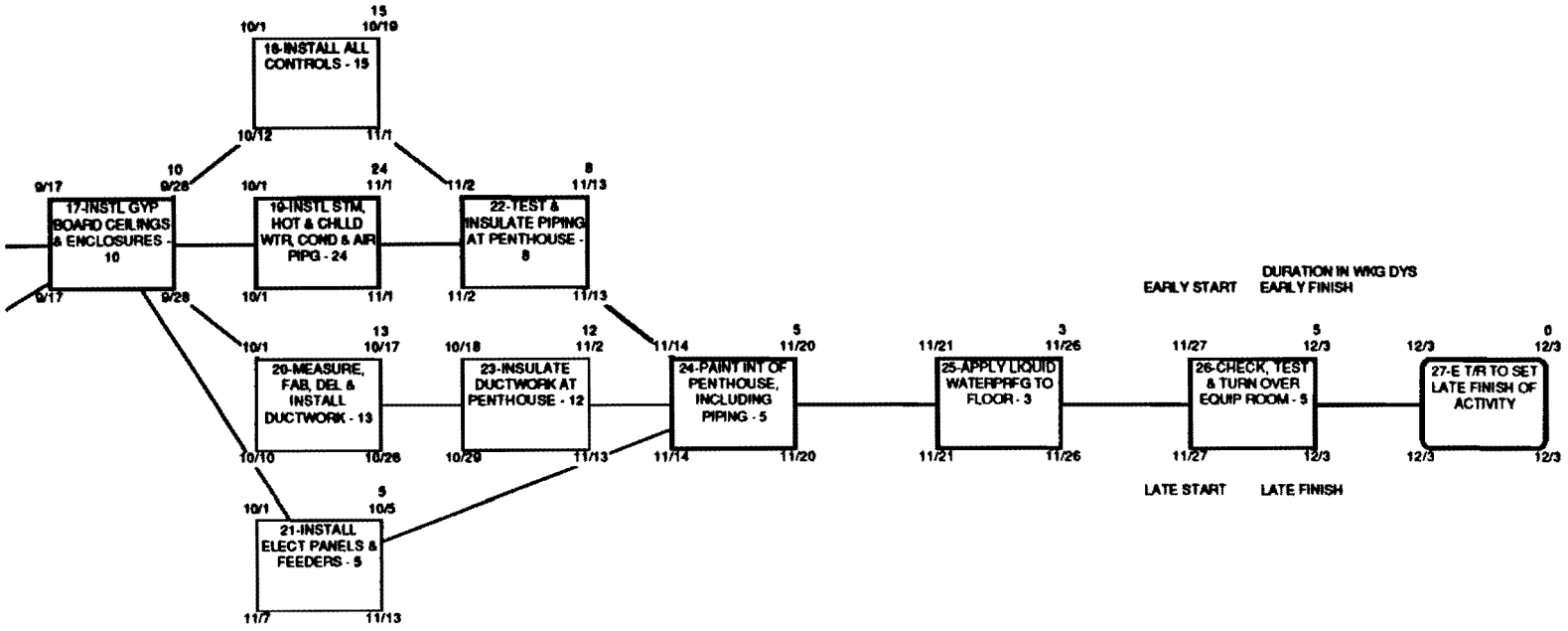
Ralph J. Stephenson PE PC
Consulting Engineer

SCHEDULE

To lock individual project tasks & the resources needed to do them into a specific time position.



ACTIVITY DATA KEY



Base Plan of Action

NETWORK MODEL FOR CLARION OFFICE BUILDING PENTHOUSE MECHANICAL EQUIPMENT ROOM #1

Luther Mechanical Contractors
Washington D.C.

Issue #1 - July 7
330 clarion base plan
disk 162

Reserved Activity Numbers

041 046
042 047
043 048
044 049
045 050

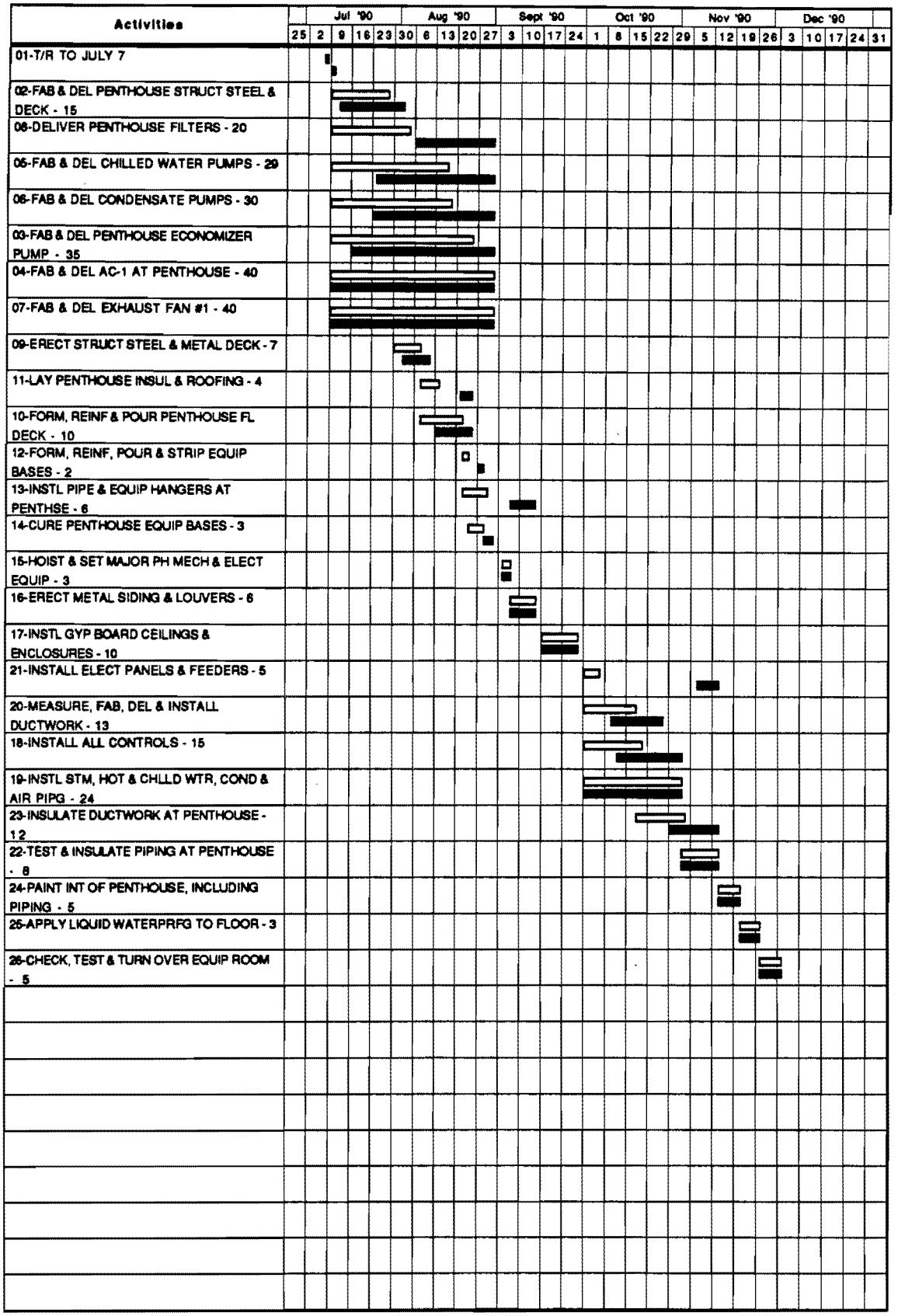
sheet ph-1

	activity	early start	early finish	late start	late finish
1	01-T/R TO JULY 7	7/7/90	7/7/90	7/9/90	7/9/90
2	02-FAB & DEL PENTHOUSE STRUCT STEEL & DECK - 15	7/9/90	7/27/90	7/12/90	8/1/90
3	08-DELIVER PENTHOUSE FILTERS - 20	7/9/90	8/3/90	8/6/90	8/31/90
4	05-FAB & DEL CHILLED WATER PUMPS - 29	7/9/90	8/16/90	7/24/90	8/31/90
5	06-FAB & DEL CONDENSATE PUMPS - 30	7/9/90	8/17/90	7/23/90	8/31/90
6	03-FAB & DEL PENTHOUSE ECONOMIZER PUMP - 35	7/9/90	8/24/90	7/16/90	8/31/90
7	04-FAB & DEL AC-1 AT PENTHOUSE - 40	7/9/90	8/31/90	7/9/90	8/31/90
8	07-FAB & DEL EXHAUST FAN #1 - 40	7/9/90	8/31/90	7/9/90	8/31/90
9	09-ERECT STRUCT STEEL & METAL DECK - 7	7/30/90	8/7/90	8/2/90	8/10/90
10	11-LAY PENTHOUSE INSUL & ROOFING - 4	8/8/90	8/13/90	8/21/90	8/24/90
11	10-FORM, REINF & POUR PENTHOUSE FL DECK - 10	8/8/90	8/21/90	8/13/90	8/24/90
12	12-FORM, REINF, POUR & STRIP EQUIP BASES - 2	8/22/90	8/23/90	8/27/90	8/28/90
13	13-INSTL PIPE & EQUIP HANGERS AT PENTHSE - 6	8/22/90	8/29/90	9/7/90	9/14/90
14	14-CURE PENTHOUSE EQUIP BASES - 3	8/24/90	8/28/90	8/29/90	8/31/90
15	15-HOIST & SET MAJOR PH MECH & ELECT EQUIP - 3	9/4/90	9/6/90	9/4/90	9/6/90
16	16-ERECT METAL SIDING & LOUVERS - 6	9/7/90	9/14/90	9/7/90	9/14/90
17	17-INSTL GYP BOARD CEILINGS & ENCLOSURES - 10	9/17/90	9/28/90	9/17/90	9/28/90
18	21-INSTALL ELECT PANELS & FEEDERS - 5	10/1/90	10/5/90	11/7/90	11/13/90
19	20-MEASURE, FAB, DEL & INSTALL DUCTWORK - 13	10/1/90	10/17/90	10/10/90	10/26/90
20	18-INSTALL ALL CONTROLS - 15	10/1/90	10/19/90	10/12/90	11/1/90
21	19-INSTL STM, HOT & CHLLD WTR, COND & AIR PIPG - 24	10/1/90	11/1/90	10/1/90	11/1/90
22	23-INSULATE DUCTWORK AT PENTHOUSE - 12	10/18/90	11/2/90	10/29/90	11/13/90
23	22-TEST & INSULATE PIPING AT PENTHOUSE - 8	11/2/90	11/13/90	11/2/90	11/13/90
24	24-PAINT INT OF PENTHOUSE, INCLUDING PIPING - 5	11/14/90	11/20/90	11/14/90	11/20/90
25	25-APPLY LIQUID WATERPRFG TO FLOOR - 3	11/21/90	11/26/90	11/21/90	11/26/90
26	26-CHECK, TEST & TURN OVER EQUIP ROOM - 5	11/27/90	12/3/90	11/27/90	12/3/90

Listed in early start early finish order

Clarion Office Building
Equipment Room

Clarion base network model • ho 381
derived from issue 1, dated July 7



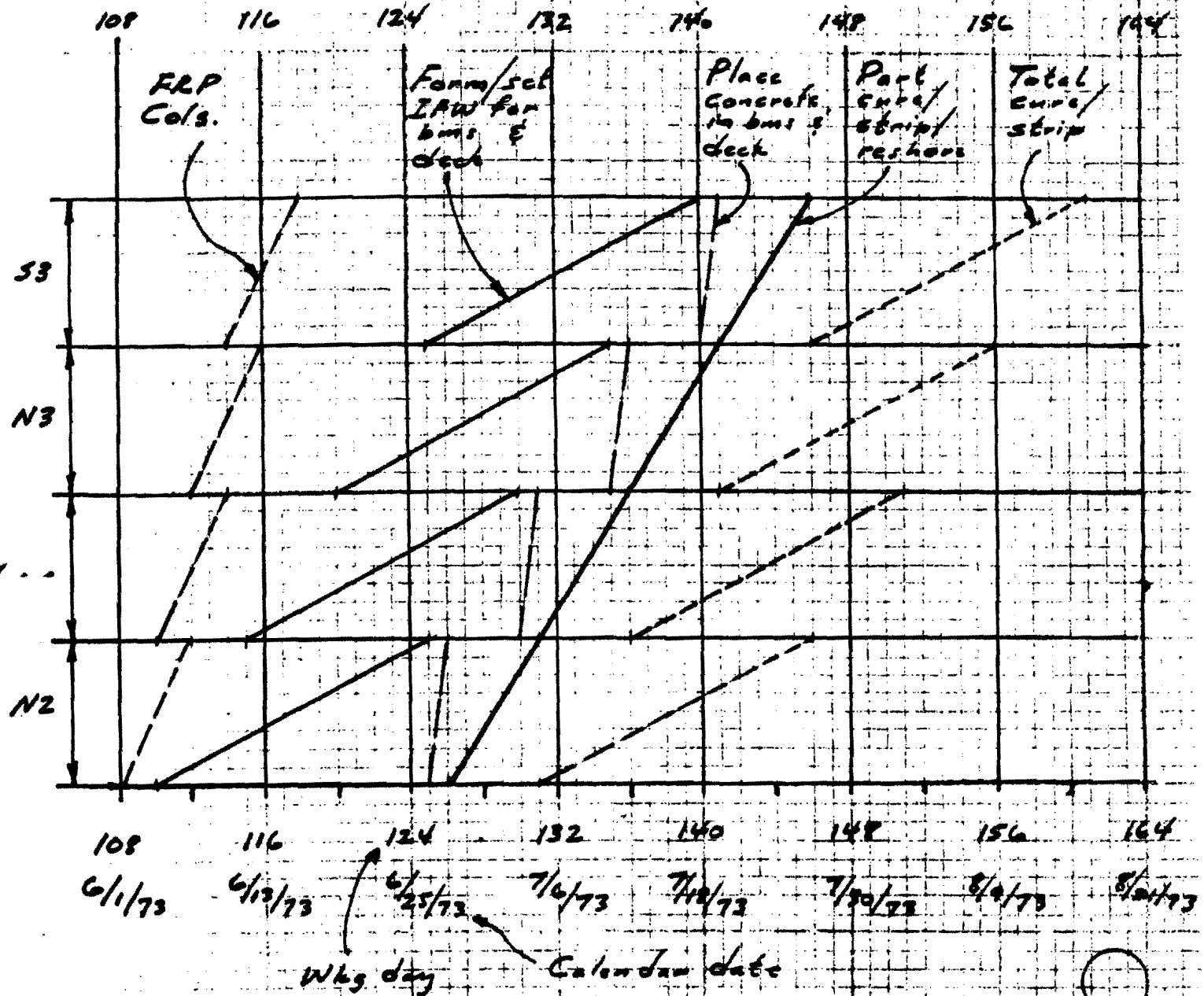
• Open bar shows early starts & finishes
• Solid bar shows late starts & finishes

RALPH J. STEPHENSON CONSULTING ENGINEER 15064 WARWICK ROAD DETROIT 23, MICHIGAN PHONE 273-5025

Subject Slant Chart - Floor Pours Date 3/1/73

N2, S2, N3, S3 Page (1)

Data from Summary Network - Shts 1, 2, 3, 4



8/28/73

H/O 70

Project ______________________ Date __________ **Ralph J. Stephenson**
Sht __________ Consulting Engineer

ITEM PROCESSING SCHEDULE

Item	Date shop dwgs to be submitted			Date of shop dwg approval			Date fabrication complete	Date item on job site
	Subm 1	Subm 2	Subm 3	Subm 1	Subm 2	Subm3		

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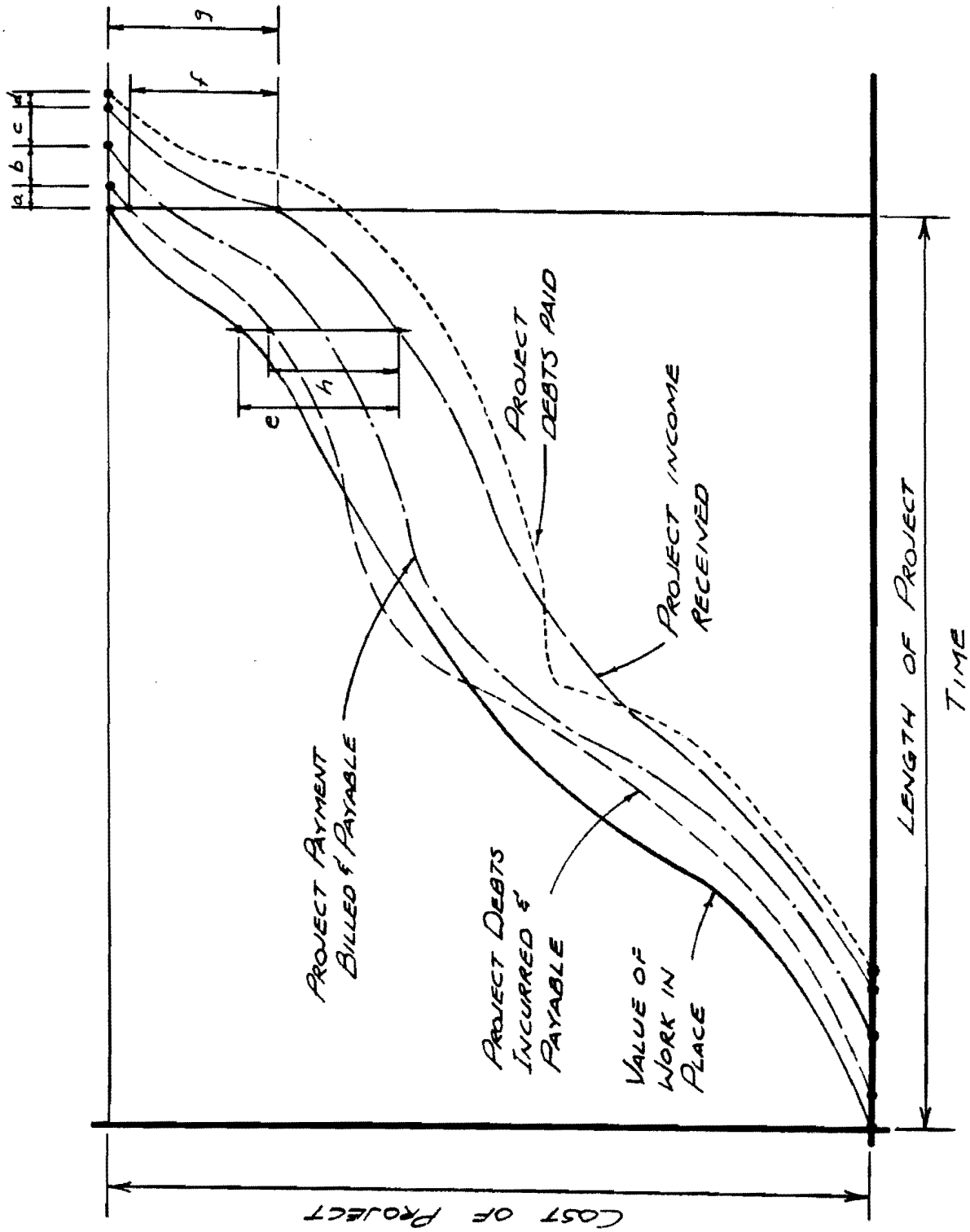

PROJECT MONEY FLOW

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Turnover Cycle (t) Example

Definitions:

x = completion date in working days (wd)

i = starting date in working days

d = duration in elapsed working days to complete one unit

t = turnover cycle in working days (the number of working days between the completion of one unit and the completion of the next)

n = number of units

Basic equations:

$$x = i + d + t(n-1)$$

$$i = x - d - t(n-1)$$

$$t = \frac{x - i - d}{(n-1)}$$

Examples:

For x unknown

i = 160

d = 7 wd

t = 4 wd

n = 11 units

For i unknown

x = 325

d = 10 wd

t = 6 wd

n = 21 floors

For t unknown

x = 352

i = 280

d = 9

n = 15 sectors

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CONSULTING ENGINEER

COLOR CODING

	1	2	3	4	5	6
IS TASK CURRENTLY PAST EF DATE?	N	N	Y	Y	Y	
IS TASK CURRENTLY PAST LF DATE?	N	N	N	N	Y	
WILL TASK MAKE LF DATE?	Y	N	Y	N	—	
COLOR CODE GREEN	X					
COLOR CODE ORANGE			X			
COLOR CODE BLUE		X		X		
COLOR CODE YELLOW					X	

Color coding is used to qualitatively evaluate project status. The status indicator colors described below are drawn on the solid task arrows, with the end of the color line shown at the approximate percentage of the task complete. The color line end is dated with the current calendar date.

Green

Task on time - currently not past early finish (EF) date.

Orange

Task on time - currently past early finish (EF) date.

Blue

Task behind - currently not past late finish (LF) date.

Yellow

Task behind - currently past late finish (LF) date.

Note that the evaluation is made on the basis of the current date. Changes in color are significant, indicating a deteriorating or improving sequence of work depending upon the progression. Color coding is primarily used to locate undesirable trends in work progress and to show job history.