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PROJECT MANAGEMENT

AND

CLAIMS AVOIDANCE SEMINAR

MARCH 16, 1984

• CRITICAL PATH PLANNING

• LAND PLANNING

• MANAGEMENT CONSULTING

• PLANT LOCATION

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ABOUT RALPH J. STEPHENSON, P.E.

Mr. Stephenson is an engineering consultant with a diversified background in land planning, facilities location, building design and construction, critical path method and technical management.

Educated at Lawrence Institute of Technology (Bachelor of Science, Mechanical Engineering) and Michigan State University (Master of Science, Civil Engineering), he has been associated with such firms as Smith, Hinchman & Grylls, Victor Gruen Associates, and the H. F. Campbell Company. With the latter two organizations Mr. Stephenson occupied executive positions as vice president. In 1962 he started his own consulting practice, specializing primarily in operational and management areas for owners, designers and contracting firms.

He is a registered professional engineer in the states of Michigan, Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, West Virginia, Virginia, Florida and Minnesota. He is a member of the Engineering Society of Detroit, the Michigan and National Society of Professional Engineers, Michigan Association of the Professions and the Great Lakes Area Development Council.

Since 1953 Mr. Stephenson has been associated at middle and upper management levels with the planning, programming, design, construction and operation of billions of dollars of industrial, commercial and public facilities in all parts of the United States and Canada. He has taught many technical and management seminars in the United States, Canada and Europe and has authored several magazine articles. He has also co-authored a book on critical path method. His broad experience has given him an understanding and appreciation of the nature of small, medium and large companies and for the need to solve their management problems through creative systematic and knowledgeable approaches.

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THINKING PATTERNS:

Why plan?..... to evaluate!

Why translate?..... to communicate!

Why control?..... to achieve!

Why correct?..... to maintain!

Why learn?..... to improve!

APPROACH PATTERNS:

1. Improve capabilities
2. Gain control
3. Create - Don't adapt
4. Experiment
5. Expand conceptual grasp
6. Don't deadhead - Keep learning
7. Solve problems
8. Define objectives

List of Glossary of Terms Used in Project Management & Managerment

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ACCELERATION
ADMINISTRATION
ADMINISTRATIVE SETTLEMENT
ADVISORY RELATIONS
AGENCY AUTHORITY
APPARENT AUTHORITY
ARBITRATION
ASSIGNED CONTRACTURAL REALTIONS
AUTHORITY
BASIC CONTRACTURAL RELATIONS
BENCH TRIAL
BUSINESS MODEL
BULLETIN
CARDINAL CHANGE
CHANGE
CHANGE ORDER
CLAIM
CLAIM AVOIDANCE
CLAIM POTENTIAL
CLOSED SHOP
CONSTRUCTION MANAGEMENT
CONSTRUCTIVE CHANGE
CONTRACT DOCUMENTS
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EARLY START (ES)
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EFFECTIVE
ELAPSED DURATION
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FIELD ORDER
FUNCTIONAL OPERATIONS
GENERAL CONDITIONS
GENERAL REQUIREMENTS
GENERIC CONSTRUCTION (G)
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MERIT SHOP
MONEY FLOW
MONITORING
MOTIVATION
NETWORK PLAN
NETWORK PLANNING
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OBJECTIVE - DIRECT
OBJECTIVE - END
OBJECTIVE - INTERMEDIATE
OBJECTIVE - PERIPHERAL
ONGOING ORGANIZATION
ORGANIZATION
OPEN SHOP
ORGANIZATIONAL STRUCTURE
OWNER FURNISHED ITEMS
PERCENTAGE FEE
PLANNING
PROBLEM
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PROFIT - FINANCIAL
PROFIT - SELF ACTUALIZATION
PROFIT - SOCIO ECONOMIC
PROFIT - VALUE SYSTEM
PROJECT
PROJECT DIRECTOR
PROJECT HISTORY
PROJECT MANAGER
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PROJECT ORGANIZATION
PROJECT STAGES
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QUESTION - OVERHEAD
QUESTION - RELAY
QUESTION - REVERSE
RECORD
RELATIONS - FORMAL FUNCTNAL
RELATIONS - INFORMAL
RELATIONS - TEMPORARY
RELATIONS - REPORTING
RELATIONS - STAFF
RESOURCES
RESPONSIBILITY
SCHEDULE
SHOP DRAWING

SPAN OF CONTROL

GOALS
HARD MONEY
HISTOGRAM
HYGIENE
INTERFACES
JURY TRIAL
LATE FINISH (LF)
LATE START (LS)
LEVERAGE
LIFE CYCLE COST
LINE ACTIVITIES
LINE OF ACTION
LITIGATION
LOG
MALADMINISTRATION
MANAGE
MANAGEMENT BY EXCEPTION (MX)
MANAGERIAL GRID
MATRIX
MATRIX MANAGEMENT
SPECIALIZED CONSTRUCTION(S)
SPECIFICATION
STAFF
STANDARD OF PERFORMANCE
SUBMITTAL
SUPERIOR KNOWLEDGE
SUSPENSION
TALENT
TERMINATION
TIME & MATERIAL CONTRACT
TOTAL FLOAT (TF)
TRAINING
TRANSLATION
TURNAROUND TIME
TURNOVER CYCLE
ULTIMATE DECISION MAKER-UDM
UNILATERAL MEETINGS
UNION SHOP
UPSET PRICE
VESTED AUTHORITY
WORKING DRAWINGS

GLOSSARY OF TERMS USED IN PROJECT MANAGEMENT AND MANAGERMENT

ACCELERATION - Contract work performed in a time period shorter than that originally contemplated by the contract; or contract work performed on time when the contractor is entitled to an extension of time for his performance.

ADMINISTRATION - Those activities considered to be supportive of the ex'e-cutive operations in an organization. Administrative costs may be considered the cost of management.

ADMINISTRATIVE SETTLEMENT - A resolution of a dispute through discussion between the disputing parties and agreement upon a mutually satisfactory settlement.

ADVISORY RELATIONS - The interaction of parties related to each other by an obligation, either contractural or informal, where the service performed is of an advisory nature only.

AGENCY AUTHORITY - A relation in which one person or organization acts on behalf of another with the other person's or organization's formal authority.

APPARENT AUTHORITY - A situation in which one person or organization acts on behalf of another person or organization without the other person's or organization's formal authority.

ARBITRATION - A method for settling disputes whereby an officially designated third party (usually one to three people) hears and considers arguments and determines an equitable settlement. Usually considered binding upon the parties.

ASSIGNED CONTRACTURAL REALTIONS - The interconnection of those parties bound by subsequent assignment of a contract to other than the initial parties.

AUTHORITY - The leverage, either vested or acquired over a long period of time, that allows an individual to carry out their responsibilities and duties.

BASIC CONTRACTURAL RELATIONS - The interconnection of those parties bound by the initial contract to perform in a certain manner for certain considerations to be paid.

BENCH TRIAL - A trial before a judge without the benefit of a jury.

BUSINESS MODEL - A graphic depiction of the elements which make up a business entity. The model usually identifies premises, objectives, and implementation. It recognizes basic business functions, business activities and manager activities.

BULLETIN - An official notice that a change is being considered and that it is desired that those affected parties to the contract provide an estimate of the cost of the proposed change. The bulletin is often given other names such as change estimate request, request for proposal, or proposed change notice.

CARDINAL CHANGE - A change that is outside the scope of the contract.

CHANGE - Any revisions to the contract documents that alter the scope of work agreed to.

CHANGE ORDER - An official notice that the changes specified in the change order are to be done. A properly executed change order is a revision to the scope of work and the contract documents.

CLAIM - A demand for something as due; an assertion of a right or an alleged right. In construction generally a demand for something as due, or in which the demand is disputed.

CLAIM AVOIDANCE - A technique and procedure for generation of situations in which the demand for what is due as a result of a contract agreement is honored without formal dispute, or in which the dispute is settled by a an administrative settlement.

CLAIM POTENTIAL - The measure of potential that any project has to encounter disputes during its implementation.

CLOSED SHOP - A work area in which only union workers can be employed on the job.

CONSTRUCTION MANAGEMENT - A system of attempting to better manage the construction process by providing expert construction knowledge and resources throughout all phases of the project. The goal of the process is to make available to the participants, information best provided by a expert skilled in construction practices, so that when the project moves into the field the managers can provide the owner with the highest potential for project success.

CONSTRUCTIVE CHANGE - An owner's action or inaction that has the same effect as a written directive.

CONTRACT DOCUMENTS - Usually considered to be the documents

which provide the full definition of the scope of work for which the parties are legally responsible. Could include the agreement, the drawings, the specifications, instructions to bidders, addendam, and any other material included by mutual agreement and clearly identified as part of the contract.

CONTROL - Maintaining firm, competent managerial direction of any given situation. Controlling leads to achievement. It is usually accomplished by the invisible use of leverage.

CRITICAL PATH METHOD - A mathematical modeling technique which allows the user to establish ranges within which resources can or must be used.

CUTS - Excerpts from catalogs, drawings, or flyers that depict a configuration to be used in the construction process.

DAILY REPORTS - Daily technical reports about the project containing data on manpower, weather, major activities, equipment on job, and other job related statistical information. Usually the daily report form is preprinted and in loose leaf form.

DEFECTIVE OR DEFICIENT CONTRACT DOCUMENTS - Contract documents which do not adequately portray the true scope of work to be done under the contract.

DELAY - A problem or situation beyond the control of the contractor, and not resulting from the fault or negligence of the contractor, which prevents him from proceeding with part or all of the work.

DEPOSITION - A written record of sworn testimony, made before a public officer for purposes of a court action. Usually the deposition is in the form of answers to questions posed by a lawyer. Depositions are used for the discovery of information, or as evidence at a trial.

DECISION TABLE - A tabular display of information depicting a defined situation which permits alternative courses of action to be evaluated by yes or no answers to explicit questions.

DECISION-TO-ACTION TIME SPAN - The amount of time required from the point at which a decision is made to the point where the decision is implemented. In a management structure it is important to insure that the full span of time from decision to action is covered, from shortest to longest.

DECISION TREE - A graphic device showing alternate courses of action from beginning a given situation point. The decision tree is used to graphically show the impact of various possible decisions at any given point in the

decision process. It can be quantified or unquantified.

DIARY - Similar to a log but dealing more with personal observations of the individual writing it relative to his feelings about the job and the people.

DIFFERING SITE CONDITIONS - Where actual site conditions differ materially from those indicated in the contract documents; or where unknown physical conditions at the site differ materially from those ordinarily expected to be encountered in work of the nature contemplated by the contract.

DIRECTED CHANGE - A written or verbal change that falls within the scope of the contract. The owner has the responsibility of paying for the change.

DOCUMENT CONTROL SYSTEM - A method of receiving, classifying, marking, storing, and retrieving documents received and sent on a project.

DYSFUNCTION - ORGANIZATIONAL - An organizational problem that hinders or prevents achieving objectives. May be temporary or permanent.

EARLY FINISH (EF) - The earliest possible date by which a task can finish in a network model if it has been started at its early start date.

EARLY START (ES) - The earliest possible date at which a task can begin in a network model if all tasks immediately preceding it have been completed by their early finish dates.

EDUCATION - The teaching and learning process by which the principles of doing things are conveyed to the learner.

EFFECTIVE - Of a nature that achieves identifiable goals and objectives in accordance with an action plan, and achieves worthwhile peripheral goals through intermediate accomplishments.

ELAPSED DURATION - The estimated or actual amount of calendar or clock time an activity requires to accomplish, considering all direct and indirect influences upon the task's activities. Includes temporary work delays and stoppages due to influencing actions on the task.

ENRICHMENT - Adding to the scope of work originally contracted for with the intent to avoid being charged or paying for the extra work. Often seen in as-noted remarks on submittals, or on inadequate identification of scope of work in a bulletin or change order.

EX'E-CUTIVE - The executing arm of the organization closest to the flow of expense and income experienced in achieving the organization's prime objectives. Closely related to line operations.

FIELD ORDER - An official notice that the actions or changes described in the field order are to be done. The field order is usually issued only in emergency situations where the time between decision and action does not permit issuance of a bulletin followed by a change order. A method of payment is usually specified in the field order.

FUNCTIONAL OPERATIONS - Management and staff direction of the application of resources to accomplish each specialized activity. Usually defined as a department or division of the company. Contrasts with project operations.

GENERAL CONDITIONS - The portion of the contract agreement that contains contractural-legal requirements for the work.

GENERAL REQUIREMENTS - The portion of the contract agreement that contains overall technical support specifications governing work on the job.

GENERIC CONSTRUCTION (G) - The field of business practice that encompasses all phases of the construction industry, including programming, planning, designing, building, operating, and maintaining facilities. Described best as the full set of activities shown in the line of action. (See line of action).

GOALS - The unquantified desires of an organization or individual expressed without time or other resources assigned. (see objectives for related definitions.)

HARD MONEY - A total price agreed to for the entire work, and to be paid in a mutually satisfactory schedule of payments

HISTOGRAM - A graph showing a quantity on the vertical axis measured against equal intervals of time shown on the horizontal axis. In construction, often a depiction of the resources required per day over a period of time.

HYGIENE - The elements in an organizational situation that are acceptable to an individual but do not necessarily motivate him. These same elements, if unacceptable to the individual may act as negative influences.

INTERFACES - Points at which different but related activities exert direct influences upon each other. Interfaces are often the points where direct objective activities contact dependent objective activities. Poor management of interface situations usually causes problems

and dysfunctions.

JURY TRIAL - A trial before a jury.

LATE FINISH (LF) - The latest allowable date by which a task can be completed in a network model without forcing those tasks that follow past their latest allowable start dates.

LATE START - (LS) - The latest allowable date by which a task can be started in a network model without forcing those tasks that follow past their latest allowable starting dates.

LEVERAGE - The effective use of vested and earned authority to solve problems and achieve goals and objectives.

LIFE CYCLE COST - The total cost of a system over its entire defined life.

LINE ACTIVITIES - Those activities that are most closely identified with the flow of basic expense and income related to the prime objectives of an organization.

LINE OF ACTION - A sequential statement of activities necessary to conceive, design, build and operate an environment. Related to the generic (G) construction process.

LITIGATION - The process of contending in court, either as a plaintiff or a defendant.

LOG - A permanently bound, dated, hand written record of job related events that have occured on a project. The log is usually in ink, and is maintained by an individual in responsible charge of the work with which the record deals.

MALADMINISTRATION - The interference of the owner in the right of the contractor to develop and enjoy the benefits of least cost performance.

MANAGE - To define, assemble and direct the application of resources.

MANAGEMENT BY EXCEPTION (MX) - A measuring and monitoring system that sounds an alarm to the manager when problems have appeared or are about to appear, and remains silent when there are no problems. The system identifies the problem area, thus permitting the effective manager to manage the exception while leaving the smoothly running operations to continue running smoothly.

MANAGERIAL GRID - A numerical grid which positions a manager in a matrix by defining his concern for people as compared to his concern for production. This grid has been highly

developed by Blake and Mouton and is useful in establishing managerial systems that are desirable and needed.

MATRIX - A two or more dimensional display of related data.

MATRIX MANAGEMENT - A management technique that employs a multiple command system. Usually results in one employee having two or more bosses on a time to time basis.

MEDIATION - An attempt to effect a settlement between disputing parties through the unbiased efforts of an objective third party, usually well known to those in dispute and acceptable to them. Mediation differs from arbitration in that it generally involves a single individual as the ruling party, is less formal, and is generally not binding. (this definition of mediation varies with the degree of legal significance attached the resolution of disputes, and the dispute location).

MERIT SHOP - A work area in which the workers may be either union or not, and in which there are no major jurisdictional boundaries governing assignment of work.

MONEY FLOW - The flow of income and expense measured against time.

MONITORING - Measurement of current project conditions and position against the standards of performance set for the job.

MOTIVATION - The elements of a given situation that encourage and make effective, successful and meaningful, the activities of those engaged in the situation.

NETWORK PLAN - A graphic statement of the action standard of performance to be used in achieving project objectives.

NETWORK PLANNING - A graphic technique of showing necessary and desired actions needed to achieve end, intermediate and peripheral objectives.

OBJECTIVES - Quantified targets derived from established goals (see goals). The most commonly used resources in converting goals to objectives are money, time, human abilities, human actions, equipment, and space.

OBJECTIVES - DEPENDENT - Objectives to be achieved that are affected by major influences beyond the manager's direct control. The dependent goal may be predictable or unpredictable.

Dependent goals, while usually beyond the manager's control, may well be within the company's ability to reach. Lack of correlation between company and individual effort to achieve

a manager's goals that are affected by others, may cause severe dysfunctions.

OBJECTIVES - DIRECT - Objectives that can be achieved by managing conditions within the manager's direct influence.

OBJECTIVES - END - Objectives realized from and upon total completion of the defined project work.

OBJECTIVES - INTERMEDIATE - Objectives achieved at specific and identifiable stages of the project, i.e. partial occupancy of a building, turnover of a mechanical system for temporary heat, or completion and issuance of foundation plan for early start of construction.

OBJECTIVES - PERIPHERAL - Objectives realized on an ongoing basis through the life of the project and achieved as an indirect result of project activities. Peripheral objectives may be personal, professional, technical, financial or social. Peripheral objectives might include staff promotion, profitable subcontractor operations, specialized experience, or achievement of design excellence in a special field.

ONGOING ORGANIZATION - The arrangement and interrelationships of people charged with providing supportive action on an ongoing basis within the company. Examples of functions contained within the ongoing design or construction organization are estimating, administration, legal, marketing, sales, purchasing, and accounting.

ORGANIZATION - The arrangement of resources (talent, skill, money, time, space, people, et al) that has evolved, or been selected, to accomplish the functions, activities, and management, and goals and achieve the objectives of a business or institution.

OPEN SHOP - A work area in which both union and non union workers can be employed on similar tasks.

ORGANIZATIONAL STRUCTURE - The catagories of parties to the planning/design/construction/operation process and how they are organized for the work. The organizational structure is shown by a set of relations between the parties that identifies the reponsibility and authority lines along which the project is to be implemented.

OWNER FURNISHED ITEMS - Those items furnished by the owner according to the contract documents.

PERCENTAGE FEE - A fee determined ultimately by a percentage of project cost, all as specified by the contract.

PLANNING - Establishing and arranging necessary and desired

actions leading to end, intermediate and peripheral objectives.

PROBLEM - A deviation from an accepted and/or approved standard of performance.

PROFIT - EDUCATIONAL & TRAINING - Fulfilment of learning and teaching goals held by individuals and their companies. (*)

PROFIT - FINANCIAL - Fundamentally, the difference between organizational cash income and organizational cash expense. Further definitions of financial profit are complex and often unique to an organization or project.

PROFIT - SELF ACTUALIZATION - Personal fulfillment realized after basic needs of shelter, safety, protection, love and freedom from hunger are achieved.

PROFIT - SOCIO ECOMOMIC - Company, group or individual achievement of social objectives within a financially profitable set of activities.

PROFIT - VALUE SYSTEM - Company and project fulfillment of personal, professional, technical, social and financial values held important by individuals and groups related to the company.

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

PROJECT DIRECTOR - The individual responsible for implementation of several projects upon which his company is engaged.

PROJECT HISTORY - A tabulation of the major events on the job, chronologically arranged for easy reference. Subjects included in the history should be:

-The plan or schedule governing the subperiod of the history.
-A brief recap of the major activities having an impact on the job.
-A reference to the documents in which the activities referred to are shown in detail.
-A summary of important job related conferences.
-Notes regarding points that may help resolve potential problems.
-Problems impacting on the job including reasons why the problems prevented proper progress.

The purpose of the project history is to give a quick, accurate look at past job events in a glance. The degree of detail is dictated by the potential for trouble that exists.

PROJECT MANAGER - One who helps establish objectives generated by a need, plans how these objectives are to be reached through a set of work actions, and then assembles and directs the application of available resources to achieve the objectives on one or more projects.

Usually the project manager is most concerned with supportive actions which bring resources to the point of effective use.

PROJECT OPERATIONS - Management and staff direction of resources to accomplish overall project activities. Contrasts with functional operations.

PROJECT ORGANIZATION - The arrangement and interrelations of people charged with actually achieving project objectives. (See organizational structure).

PROJECT STAGES - The groupings of actions that make up the entire project work sequence.

PROJECT SUPERINTENDENT - The manager involved in the actual construction process and most directly responsible for the expenditure of funds to carry out the project. Usually the superintendent is responsible for field execution of the work.

QUESTION - DIRECT - Asked with strong indication as to who or whom should answer.

QUESTION - OVERHEAD - Asked of a group without indication as to who or whom is to answer.

QUESTION - RELAY - Passed along to someone else by the party originally asked.

QUESTION - REVERSE - Returned to the questioner by rephrasing or rewording the original question.

RECORD - Any retained information that can be effectively used in the future.

RELATIONS - FORMAL FUNCTIONAL - Organizational connections that concern distribution and use of data, information and decisions that flow along formally defined transmission lines. Formal functional communications are usually written and are normally both from and to individuals and groups.

Formal relations are precisely defined and most day to day business is accomplished within the formal relation framework. The line expressing a formal functional relation usually has an arrowhead at each end to show a mutual exchange of responsibility and authority. If there is a

higher authority to be implied a single arrowhead can be used pointing to the superior party.

RELATIONS - INFORMAL - The natural channels along which organizationally related material is most easily and compfortably transmitted. The informal relation exists by mutual consent of the parties to the relation, and is stimulated to maximum effectiveness by a mutual profit gained from the relation.

Little, if any, authority normally is expressed in informal relations. Communications are usually oral and bne to one. Often informal relations define the hidden organization structure. A line defining an informal relation is usually shown dotted with an arrowhead at each end.

RELATIONS - TEMPORARY - Those relative created when extraordinary or unusual management demands must be met. The temporary relation is usually unstable and should be kept active for only short periods of time. The line expressing a temporary relation can have an arrowhead at one or both ends depending on the nature of the relations.

Extensive use of temporary relations creates business dysfunctions, breaks down morale and causes internal tensions.

RELATIUNS - REPORTING - The official channels through which each individual conveys, or is given raises, appraisals and evaluations; is fired, assigned or is provided professional, vocational and personal identity in the organization. The true organizational superior of an employee is usually that individual with whom he maintains a reporting relation. The line expressing reporting relations has an arrowhead at one end pointing to the superior.

RELATIONS - STAFF - The business patterns through which a person or group provides consulting services necessary to achieve goals and objectives. Staff personnel usually have little or no authority over those outside the staff group. The line expressing staff relations has an arrowhead at each end.

RESOURCES - The tools of the supportive and ex'e-cutive manager. Resources include time, talent, tools, equipment, time, money, experience, space, materials, as well as intangibles, such as enthusiasm, morale and leverage.

RESPONSIBILITY - The assignment, spoken or understood, that a person in an organization has as his part in maintaining the organization's health and vitality.

SCHEDULE - A graphic or written tabulation of project activities showing where the activities are to start and

finish. The schedule is derived from the plan of action and the network model by locking the tasks and the resources they require into a specific time position.

SHOP DRAWING - A submittal in the form of a drawing, usually made specially for the application shown. Shop drawings usually show details of fabrication and installation.

SPAN OF CONTROL - The number of organizationally related individuals a manager directly controls on a one to one basis.

SPECIALIZED CONSTRUCTION (S) - The field of business practice that encompasses single phases of the construction profession. Examples of S construction organizations are architectural/engineering offices, mechanical contractors, plastering contractors, and planning consultants, among others. Includes nearly any single organizational unit active in design, planning, construction or related fields.

SPECIFICATION - A narrative description of the various materials and systems to be incorporated in the work. The specification concentrates on identifying quality of materials, source of materials, allowable practices, and general requirements and conditions of the contract performance.

STAFF - A supportive unit of any organization in which the basic function is usually advisory in nature. Staff functions are occasionally defined as overhead or non production. They are considered to be the organizational partner of line operations. (see staff relations and line activities).

STANDARD OF PERFORMANCE - A well defined, explicitly stated, approved and accepted statement of the measurements to be used as a gage of performance, and goal and objective achievement.

SUBMITTAL - Any document submitted by contracting parties to the owner's agents for review for accuracy, responsibility of design, general arrangement, and approval. Submittals are used by the fabricator and the installer to show adequate details so the intent of the contract documents can be achieved. There is a mild ongoing professional controversy as to whether approved submittals are contract documents. Generally they are not considered contract documents, but aids to better fabrication and installation procedures.

SUPERIOR KNOWLEDGE - The owner's withholding specific data on matters of substance not known to contracting parties during the pre contract period.

SUSPENSION - An owner's or owner's agent action of stopping

all or a part of the work.

TALENT - A capacity for achieving identifiable success. Usually talent is considered an abstract resources.

TERMINATION - The dismissal of a contractor, from a project, for convenience, resulting from factors beyond the contractor's control, or for default when the contractor's performance is not acceptable.

TIME AND MATERIAL CONTRACT - An agreement in which payment for services and material is made only for those services and materials actually furnished. There may, or may not, be imposed a not-to-exceed amount on the total cost.

TOTAL FLOAT (TF) - The amount of discretionary time available to a task. The total float is the difference between the early and late starts or finishes. Formally it is defined as the duration of the task, subtracted from the difference between the late finish (LF) and the early start (ES): i.e. (LF-ES)-DURATION=TF.

TRAINING - The teaching and learning process by which specific, explicit methods and systems of doing something, usually by rote, are conveyed to the learner.

TRANSLATION - Recasting standard of performance information and data into graphic, narrative, mental, oral or other forms, to insure optimum use by those involved.

TURNAROUND TIME - The amount of time required to process submittals.

TURNOVER CYCLE - In the constuction or fabrication of several similar units, the amount of time required from the completion of one unit to the the completion of the succeeding unit.

ULTIMATE DECISION MAKER (UDM) - The individual or group at the lowest management level that has the authority to make a final binding decision in any job related matter.

UNILATERAL MEETINGS - A decision meeting at which only a portion of the parties affected are invited to participate.

UNION SHOP - A geographic work area in which all labor classified participants are required to belong to a specified union.

UPSET PRICE - A guaranteed maximum price agreed to in a time and material contract. (See time and material contract).

VESTED AUTHORITY - The endowing of privileges, strength and leverage from a superior, usually to a subordinate.

Generally gained quickly, rather than being earned by long and proven service in a related field within the organization.

WORKING DRAWINGS - The set of contract drawings that pictorially show the intended appearance of a job when complete.

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NETWORK PLANNING ABBREVIATIONS

A	Area
ABV	Above
AC	Air condition
ACCESS	Accessories
ACOUST	Acoustic
ACT	Activate
AD	Approve, deliver
AFD	Approve, fabricate, deliver
AL	All
ALT	Alteration
ALUM	Aluminum
AP	Approve
ASMBLY	Assembly
ASP	Asphalt
/	And
@	At
BAL	Balance
BALC	Balcony
BD	Board
BKFL	Backfill
BKFLG	Backfilling
BLDG	Building
BLKG	Blocking
BLT	Bolt
BM	Beam
BRG	Bearing
BRK	Brick
BSE	Base
BSMT	Basement
CASD	Check and approve shop drawings
C/B	Columns and beams
CER	Ceramic
CL	Column line
CLG	Ceiling
CLKG	Calking
CNTL	Control
CO	Cutoff
COATG	Coating
COL	Column
COMP	Complete
CONC	Concrete
CONCT	Connect
COND	Conduit
CONN	Connection
CONST	Construct
CONT	Continue
COOLG	Cooling
CONVTR	Convector
CP	Cap
CP	Complete
CT	Ceramic tile
CVR	Cover
D	Dummy
D	Duration
DAFD	Detail, approve, fabricate, deliver
DEMOL	Demolish
DIFF	Diffuser
DK	Deck
DPPRF	Damp proof
DR	Door
DRINKG	Drinking
DRN	Drain
DUCTWK	Ductwork
DWG	Drawing
E	East
EF	Early finish
EFRP	Excavate, form, reinforce, pour
EIB	Excavate, install, backfill
ELEC	Electric
ELEV	Elevator
ENERG	Energize
EQUIP	Equipment
ERCT	Erect
ES	Early start
E T/R	End time restraint
EXC	Excavation
EXP	Exposed
EXT	Exterior
EXTG	Existing

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F	For
FAB	Fabricate
FD	Fabricate, deliver
FDN	Foundation
FFG	Fill, fine grade
FINL	Final
FL	Floor
FLL	Fill
FLSHG	Flashing
FM	Form
FMG	Forming
FN	Finish
FOG	Floor on grade
FP	Fire protection
FRM	Frame
FRP	Form, reinforce, pour
FRPS	Form, reinforce, pour, strip
FTG	Footing
FX	Fixture
GLAZG	Glazing
GRD	Grade
GRDR	Girder
GRDG	Grading
GRLL	Grill
GRATG	Grating
HD	Head
HDWE	Hardware
HM	Hollow metal
HTR	Heater
HU	Hookup
I	Iron
I/C	In ceiling
IFW	In floor work
INCLDG	Including
INSTL	Install
INSTLG	Installing
INSUL	Insulation or Insulate
INT	Interior
ITMS	Items
JC	Janitor closet
LAYG	Laying
LF	Late finish
LN	Line
LS	Late start
LT	Light
LTH	Lath
LVL	Level
MACH	Machinery
MECH	Mechanical
MEMBRN	Membrane
MEZZ	Mezzanine
MH	Manhole
MLLWK	Millwork
MISC	Miscellaneous
MK	Make
MSNRY	Masonry
MTL	Metal
MTR	Motor
N	North
NLR	Nailer
NT	Not
OFD	Order, fabricate, deliver
OH	Overhead
OPNG	Opening
PARTN	Partition
PC	Precast
PERIM	Perimeter
PH	Penthouse
PHS	Phase
PILG	Piling
PIPG	Piping
PKG	Parking
PL	Plate
PLCP	Pile cap
PLG	Plug
PLSTC	Plastic
PLSTR	Plaster
PLTFM	Platform
PLUMBG	Plumbing
PNL	Panel
PNT	Paint
PNTG	Painting

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POURG	Pouring
PRES	Pressure
PRM	Primary
PROT	Protection
PRS	Piers
PVG	Paving
RAD	Radiant
RAILG	Railing
RD	Road
REINF	Reinforcing
REL	Relocate
REQD	Required
RESIL	Resilient
RESTL	Reinforcing steel
REMV	Remove
RFG	Roofing
RISR	Riser
RM	Room
RR	Railroad
RSC	Rolling steel curtain
RUBB	Rubber
RUFF	Rough
S	South
SBSTNTLY	Substantially
SDWK	Sidewalk
SETTG	Setting
SEWR	Sewer
SHT	Sheet
SIDG	Siding
SLB	Slab
SOG	Slab on grade
SPDRL	Spandrel
SPRNKLR	Sprinkler
SS	Structural steel
SS	Substation
ST	Start
ST	Street
STD	Stud
STL	Steel
STM	Steam
STR	Stair
STRP	Strip
STRUCT	Structural
SUPT	Support
SURF	Surface
SUSP	Suspension
SWTCHGR	Switchgear
SYS	System
TEMP	Temporary
TFT	Total float time
TK	Tank
TO/R	Toilet room
TPG	Topping
TR	Trim
T/R	Time restraint
TRANSFRMR	Transformer
TRD	Tread
TST	Test
TWR	Tower
UG	Underground
ULG	Unloading
UTIL	Utility
US	Underside
U T/R	Updating time restraint
VP	Vapor barrier
VENTILTR	Ventilator
VEST	Vestibule
W	West
WASHG	Washing
WK	Work
WLKWY	Walkway
WLL	Wall
WNDW	Window
WP	Waterproofing
WTR	Water
W T/R	Weather time restraint

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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

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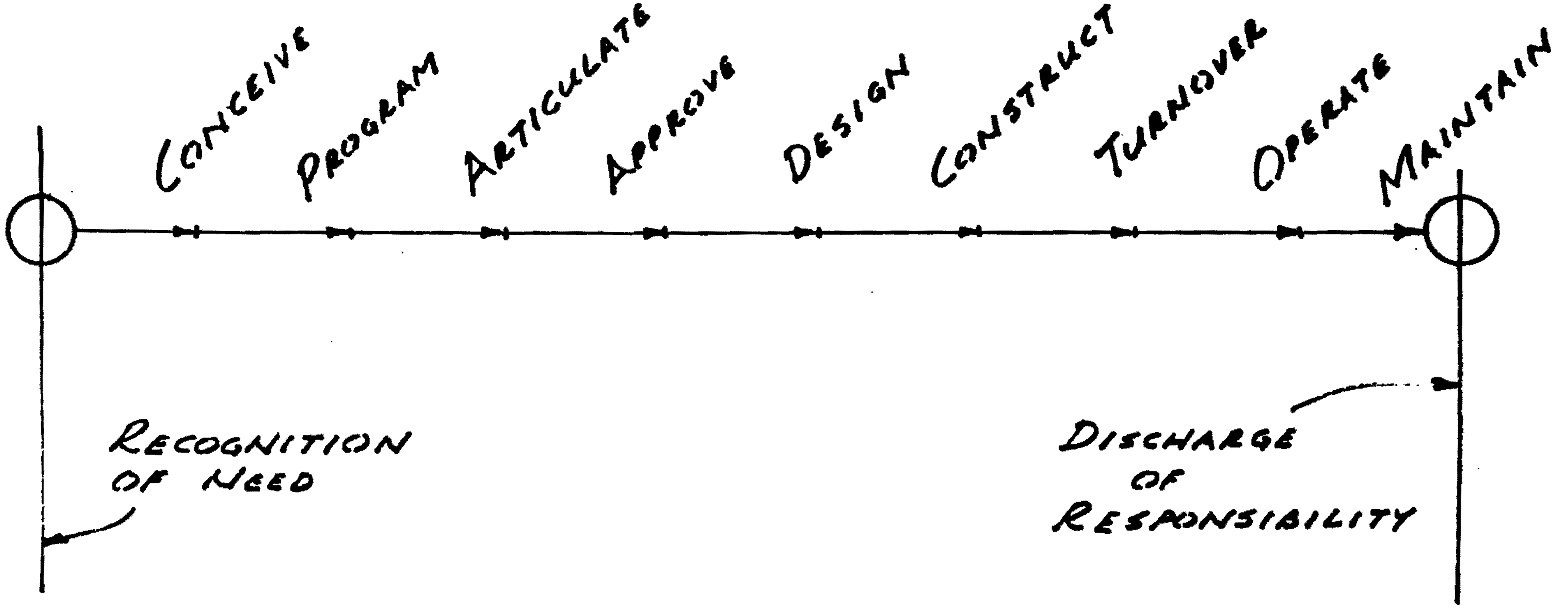

LINE OF ACTION

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ELEMENTS OF THE LINE OF ACTION

The line of action is a simple statement of the range of tasks necessary to conceive, design, build and operate an environment. The line begins at a point referred to as the recognition of need with these actions following:

- Conceive
- Program
- Articulate
- Approve
- Design
- Construct
- Turnover
- Operate
- Maintain

These all culminate at an end point called discharge of environmental design and construction responsibility. A brief description of each step is appropriate in understanding their importance to the total design and build concept.

Recognition of need is the point at which a requirement for a new environment is first felt. The good design build operation tries to become involved in this creative stage. There is a danger of getting in too early and giving away so much of the early work that the job may be lost through over-exposure at a later date. However, recognition of needs is the starting point and the sales activity starts here. Taking the points in order -

Conceive - During the conceptual period the need which may be for increased facilities, larger dollar volume, more efficient handling systems or a variety of other demands is visualized and put down in some rough form. It may be a pencil sketch or may remain an idea in someone's mind. Here the project sees its origin and it is this early idea that often carries through the entire project. A good conceptual grasp is essential if the project is to be successfully completed.

Program - During the programming phase, the needs of the concept are put into easily understood tabular form so many square feet for storage, so many square feet for office, so much height for shipping facilities, etc. The actual physical demands of the environment are set forth in the project program or project bible.

Articulate - Now the concept and program are combined into preliminary construction language. Floor plans are drawn in accordance with requirements. The functional arrangement is shown in accordance with the project bible. Materials are called out in terms of the demands of the concept.

Approve - This is a critical point in the line of action. By now sufficient work has taken place so the manager can understand the project and say: "I like this or I don't; change this, revise this; let's increase that a bit; let's cut down here." Finally saying: "OK, I'm satisfied with this set of ideas showing the concept and the program - let's move on!" Approval unlocks the design and construction period.

Design - In the design phase, products of the previous four steps are utilized concurrently to prepare a set of working drawings and specifications that translate concept into steel, concrete and space.

Construct - Next, the actual environment is built. Construction is the first point where something major and tangible happens as a result of the concept.

Turnover - When the project has been built, it is turned over with the appropriate operating manuals to the owner or tenant. Turnover is an important step since if done properly it insures that a valuable commodity, the completed environment, is properly given to those who must use it.

Neglect of good turnover procedures is often the cause of serious callback problems. We certainly wouldn't turn a complex piece of machinery over to

Turnover - (Continued)

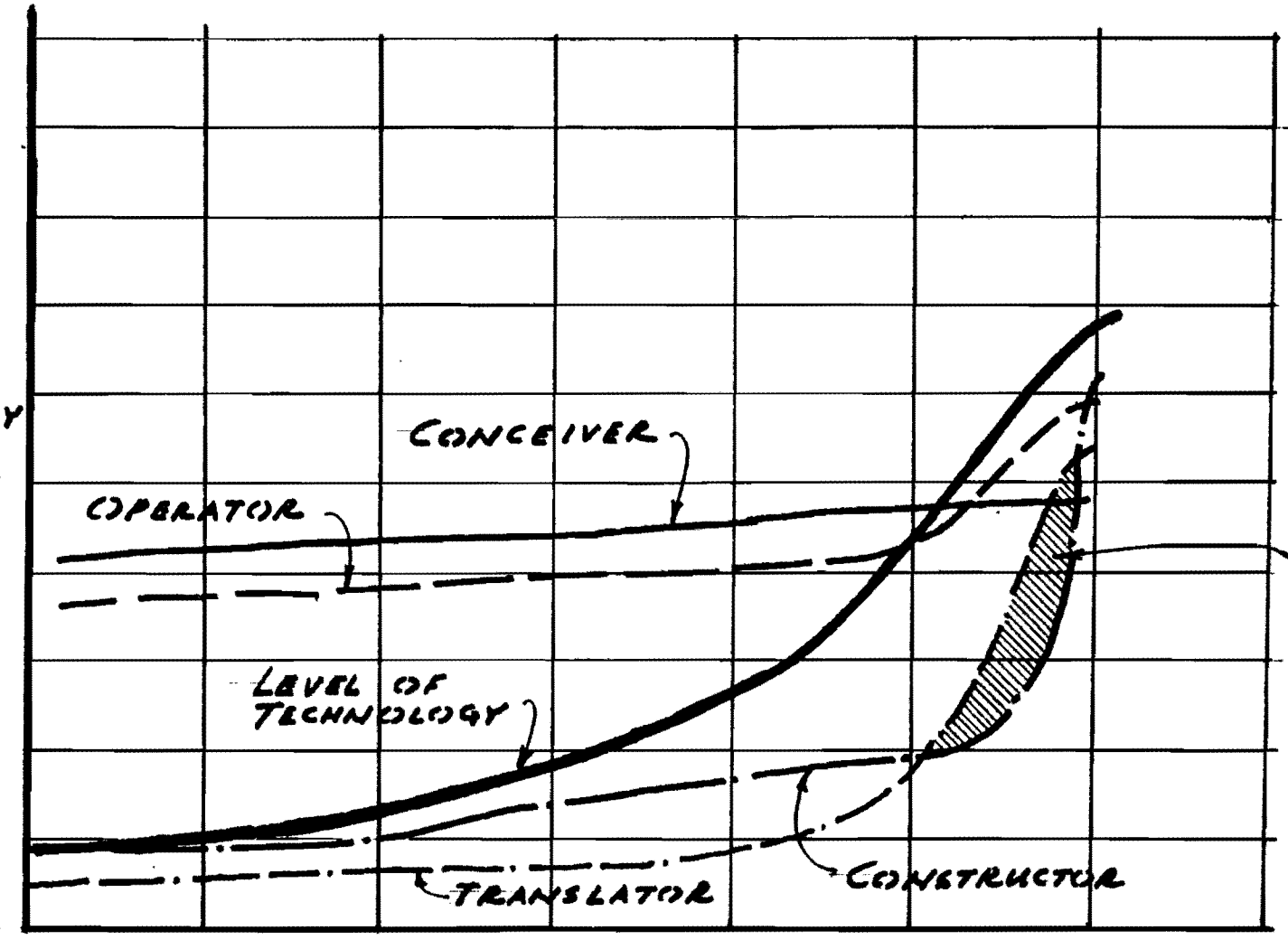
an amateur operator and expect he would make it perform 100% right from the start. Neither should we assume that an owner can take a new environment that has just been built for him and immediately operate it at full efficiency. Time should be spent during turnover to explain how this environment is to function.

Operate - The environment is now run-in and begins to achieve its full purpose. Operation can be an important responsibility although the design/build contractor should furnish his operational functions in connection with a new environment only on a paid contract arrangement and provided he is competent to operate the facility.

Maintain - Maintenance of the physical environment is the door opener for future projects. It also assures that the environment that has been nursed through the previous eight stages will be maintained correctly so as to work at its best for those who must use it. The maintenance contract is perhaps one of the least explored areas in the more sophisticated approaches to environmental design and construction.

The end of the line of action is when the designer and builder of environments has discharged his responsibilities. In a continuing trustworthy relationship, the line of action will have no end since before it is finished, a competent professional will be re-involved in another program at its beginning.

LEVEL OF TECHNOLOGY



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RJS. AGCK EXHIBIT 2 H/O 64

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PARTICIPANTS IN DESIGNING AND BUILDING ENVIRONMENTS

There are four basic participants in the process of designing and building environments. These are the

- Conceivers, - Translators, - Constructors, - Operators

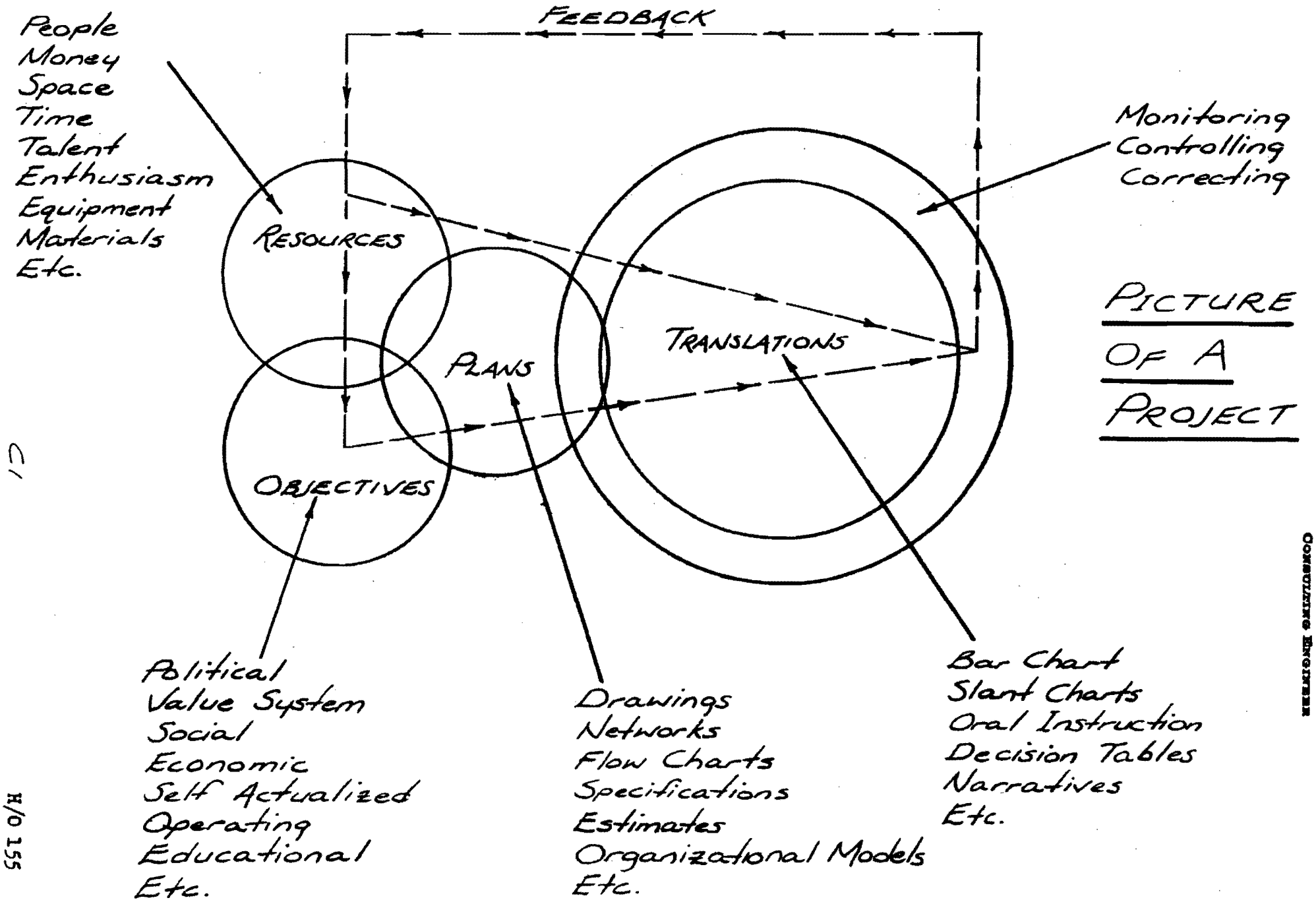
Conceivers - Those who conceive the idea and provide the wherewithall to bring the environmental program to a successful conclusion. The conceiver may be the owner but it may also be a governmental agency, a financial source, an architect, a contractor, a vendor or even a tenant looking for space. We identify the conceiver since he usually is the key person driving the project on to completion.

Translators - Those who translate the concept into construction language. Traditionally, we think of the architect/engineer as the translator. However, careful thought on this matter will show that there are many others who translate the conceiver's fundamental idea into some kind of understandable, workable construction language. Sub contractors, suppliers, vendors, manufacturers, contractors, the conceiver, himself, may all play a role in translating.

Constructors - Those who interpret the construction language and convert it into an actual physical environment. Occupying this role are the general contractor, sub contractors, vendors, suppliers, manufacturers and others who actually put the materials into place in the field.

Operators - Those who take over the completed physical environment and make it function on a continuing basis. Usually, the party responsible for this is an owner or tenant working through a plant engineer or building supervisor. In some instances the design/build contractor can become involved on a maintenance and operational basis, particularly if he has designed and built under a gross lease contract.

Identification of the parties to a project is important because it assists in defining the most important individuals in a given project situation. By accurate identification of the individuals concerned, their functional authority and responsibility can be established and optimum use made of their assistance.



PICTURE OF A PROJECT

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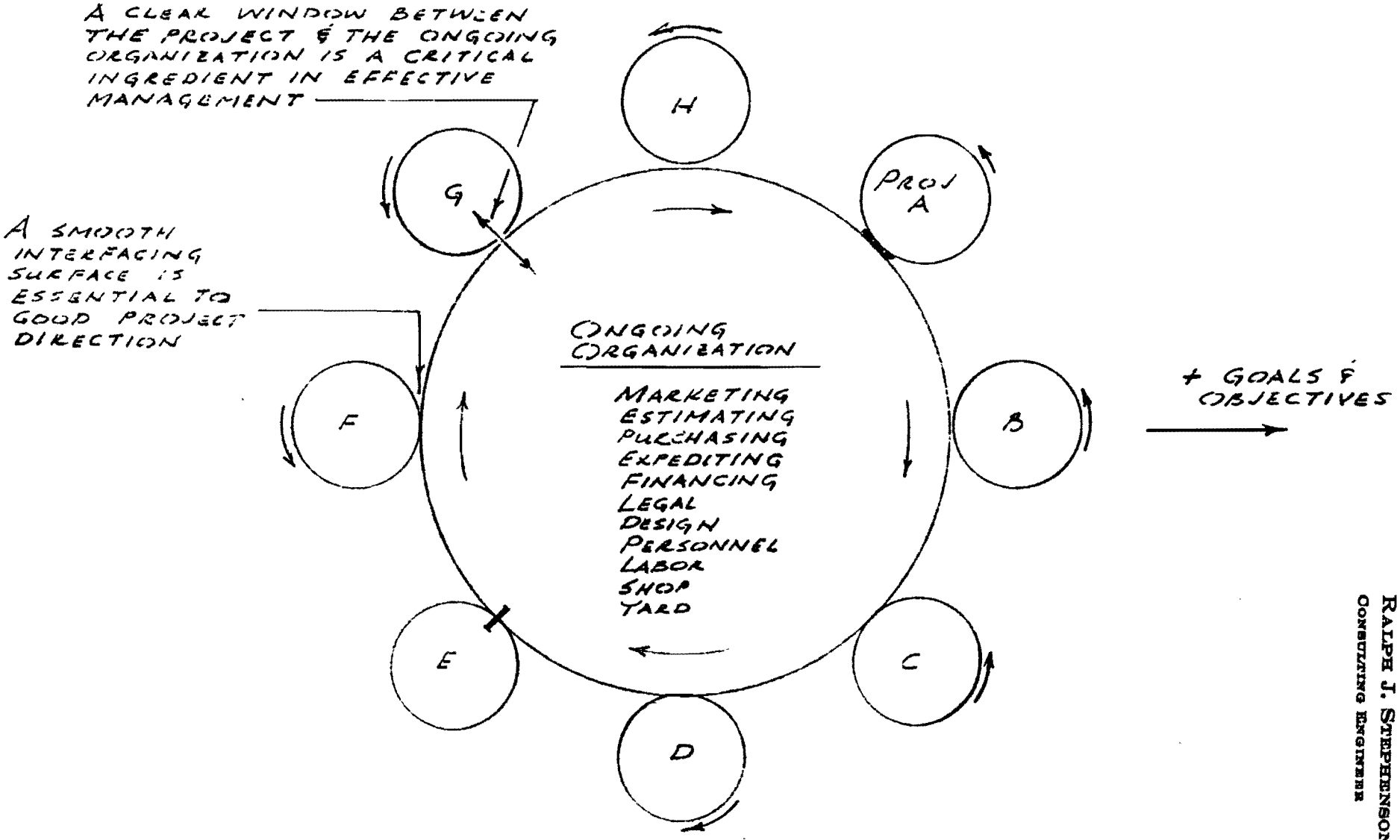

THE RELATION OF PROJECT MANAGEMENT TO ONGOING MANAGEMENT

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PROJECT MANAGEMENT

AN EXPLORATORY LOOK

Definition:

Project - A set of work actions having identifiable objectives.

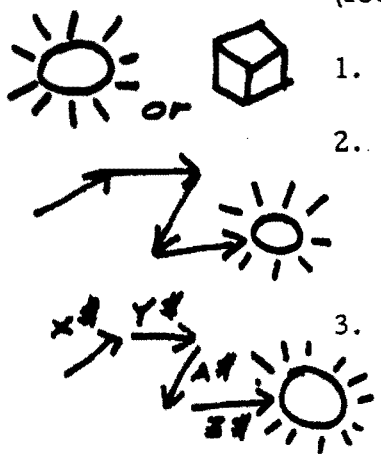
Effective - Of a nature that accomplishes identifiable objectives in accordance with the action plan, and achieves specified peripheral goals resulting from intermediate actions.

Manage - To direct the application of available resources.

Question?: What is different about project organization as compared to the ongoing parent organization?

1. Project organization is usually temporary (relatively).
2. Project organization may be on a different base than the ongoing parent organization.
3. Project authority positions tend to be vested first and earned later.

What is it?: A project seems to have the following characteristics (features) and requirements.



1. Its objectives must be clearly defined.
2. The desired course of action from start to finish is (and if it isn't, should be) explicitly stated as a standard of performance (if you can't plan it, you can't do it!)
3. The resources required to do each action from beginning to end are identified and made countable.

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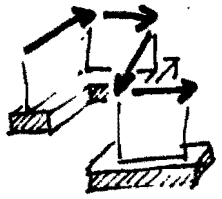
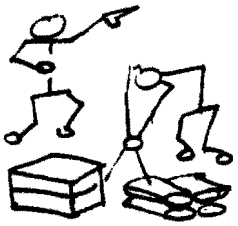
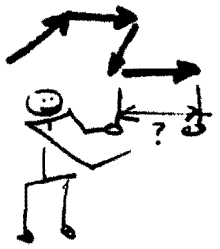


4. An organization structure should be (or is best) built <u>under</u> (not over) the resource framework to give the resource frame quality, continuity and monitorbility.

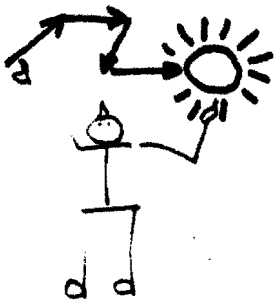


5. The resources needed to do the project can be assembled and put to work.

6. A method of isolating, identifying and correcting deviations from the standards of expected performance has to be devised and applied.



7. The performance should be measured to reward competence, and correct and improve lesser efforts as the project proceeds and upon its completion.



8. Outside management (ongoing management) usually sets both the starting and ending of the project.

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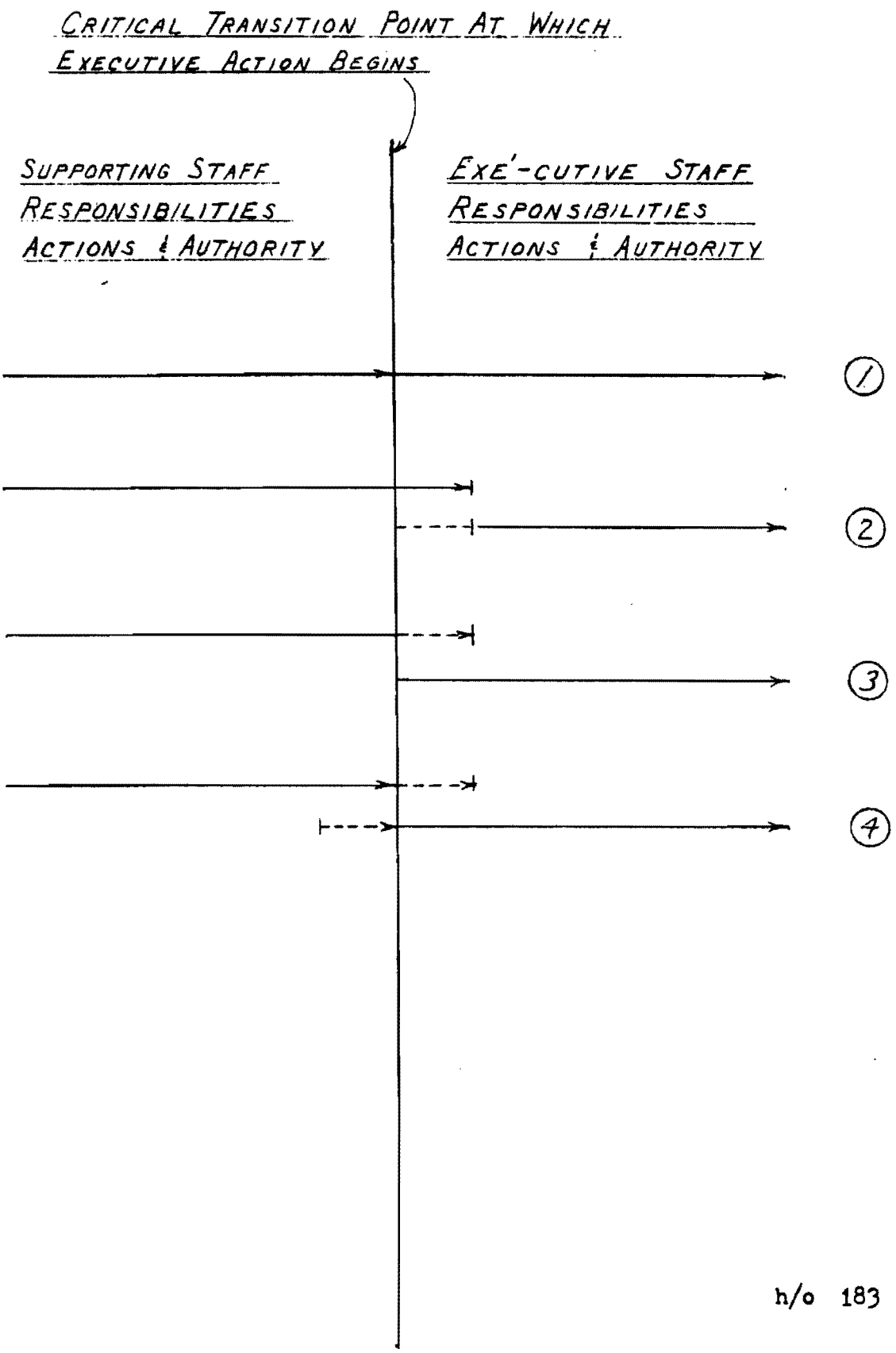

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WHAT FACTORS INFLUENCE PROFIT?

Business Volume
Field Efficiency (Effectiveness)
Office Efficiency (Effectiveness)
Executive Competence
Executive Interest
Diversity of Operation (Hedging)
Types of Contracts
Quality of Estimating
Unit Costs
Area Work Volume
Season of Year
Local Economy
National Economy
Governmental Policies
Caliber of Participating Contractors
Caliber of Competing Contractors
Caliber of Suppliers
Delivery Dates
Amount of Warranty Work
Caliber of Owner or Client
Type of Project

Size of Project
Quality of Dwgs & Specs
Location
Labor Relations
Caliber of Field Managers
Expediting Effectiveness
Project Planning
Project Scheduling
Withheld Amounts
Availability of Labor
Billing Procedures
Inventory Practices
Internal Education
Internal Training
Type of Business
Experience
Reputation
Staff Honesty
Caliber of Purchasing Skills
Profiling Procedures
Organizational Plans

CC

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PROFIT POTENTIAL LEVELS

In construction the concept of profit is complex and often misunderstood. There are many kinds of profit - financial, socio-economic, value system, self-actualization, education, enjoyment, technical and probably as many more equally important but less obvious.

If we view the various kinds of returns on investments relative to project management, it appears there are three major levels of profit potential available, that achieved by being certain to consider and include all elements of the project, that achieved by arranging these elements in an effective action sequence and the profit achieved by making effective use of discretionary or float time. These are identified as levels A, B and C respectively.

A brief discussion of each is given below.

Level A Profit Potential

The basic profit potential is realized when the manager and his project team have made certain to include all project elements in the estimating, planning and control process; when they have made certain that everything is counted and there are no missing pieces. Every element missed erodes the profit picture just as a missing piece of a jigsaw puzzle spoils the pleasure of assembling it.

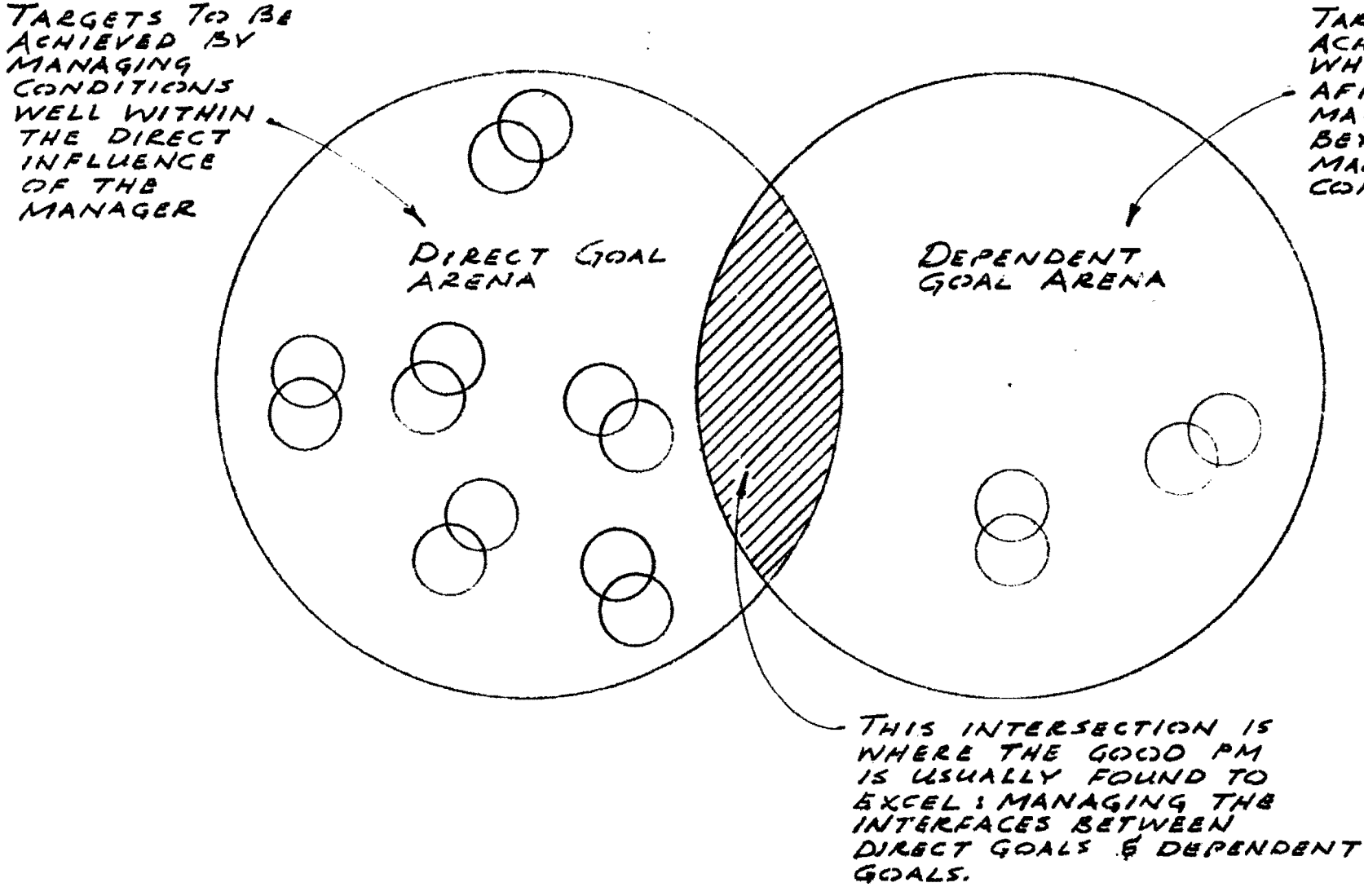
Level B Profit Potential

Once project elements are accounted for, they must be properly arranged in a logic pattern to produce the most effective plan of action. In any plan there are identified desired and necessary relationships. The proper expression of desired relations is a major factor in realizing level B profit potential. Here is where the true skill of the project manager begins to impact upon the job. The experienced, intelligent, knowledgeable manager will explore, simulate and select the most effective ways of assembling the job under his control. The level B profit potential is highest when the best ways have been selected.

Level C Profit Potential

This profit is highest when the job is scheduled well and a selection made as to where each task should be done in relationship to the discretionary time available to it. Often discretionary time is identified as float time. Where the good manager schedules the task when he has resource options (time, money, manpower, equipment, etc.) will largely determine how profitable the level C management work has been.

In a nutshall, level A profit potential deals with identifying all the elements involved. Level B profit potential is concerned with arranging these elements in a logical and effective action plan. The C level profit potential is engaged when the project is managed well by proper scheduling within allowable resource limits.



THE DIG/DEG INTERSECTION

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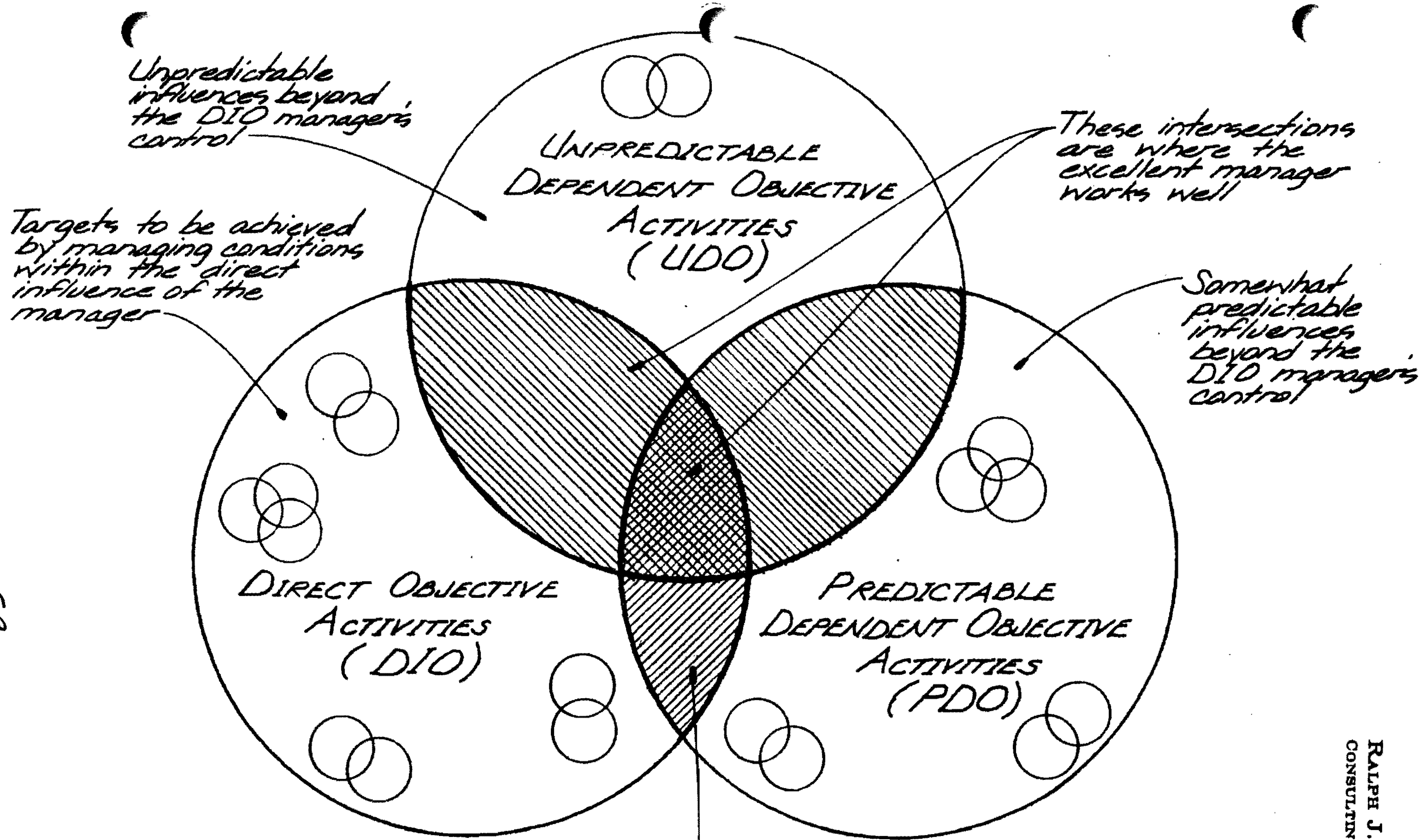

THE DIO/PDO/UDO INTERSECTION

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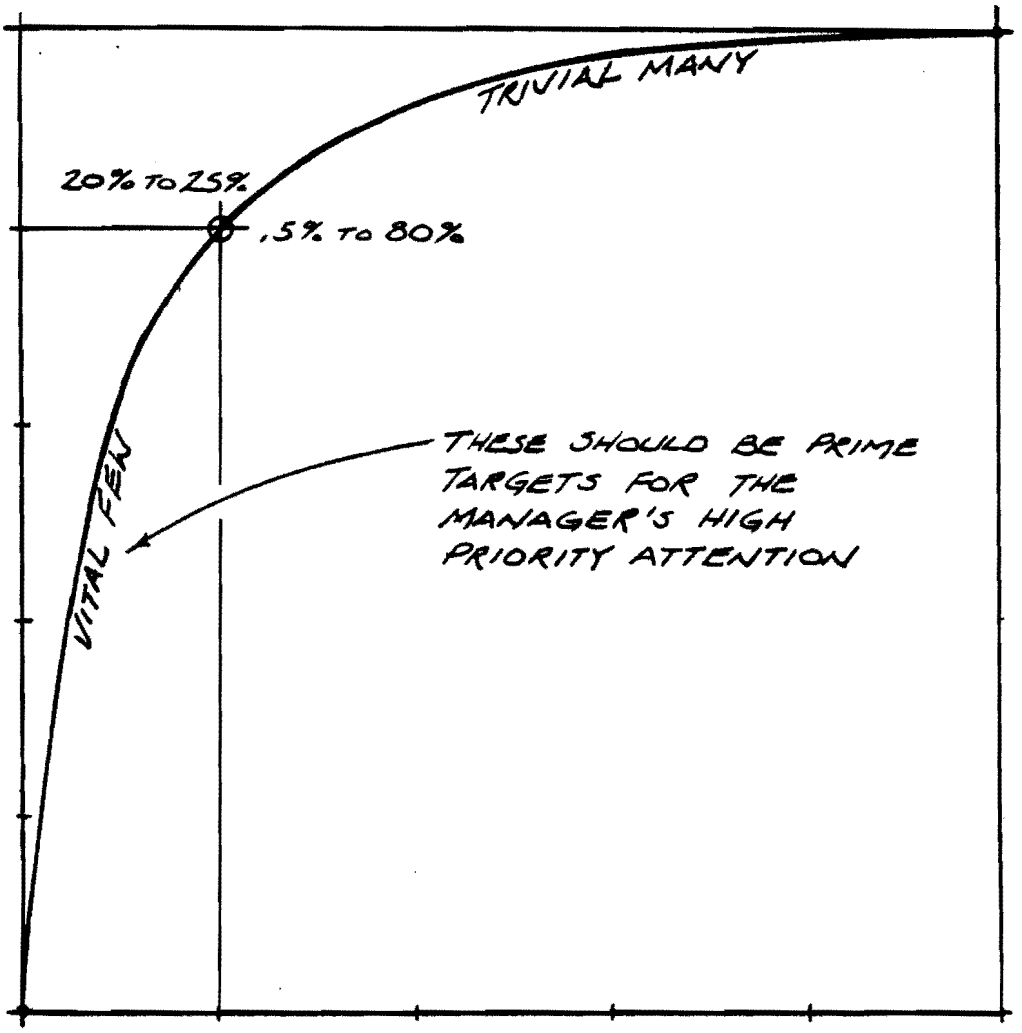
PARETOS LAW - IN AN OBJECT/VALUE SITUATION ONLY A FEW OF THE OBJECTS ACCOUNT FOR THE GREATEST PART OF THE VALUE.



VALUE OR UTILITY

PRICE
COST
DELAYS
MISTAKES
PROBLEMS
PROFIT
REJECTS
SALES
SAVINGS
SHIPMENTS
WASTE

OBJECTS OR RESOURCES

ACTIVITIES
CAUSES
OCCURANCES
PROBLEMS
RESOURCES
PRODUCTS
DECISIONS
FACILITIES
MATERIALS
METHODS
PRODUCTS
SALES CALLS
SERVICES
STAFF

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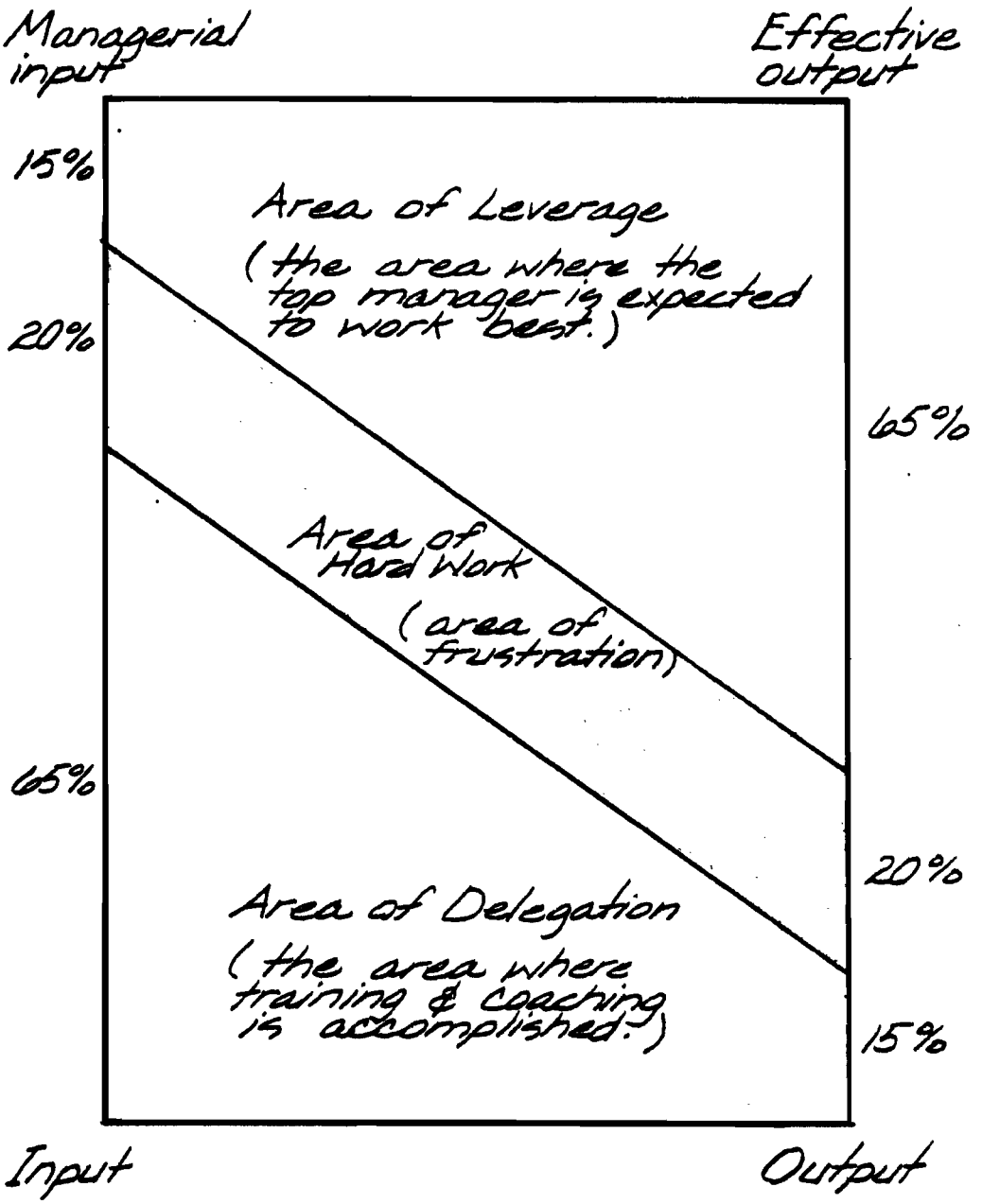

MANAGERIAL LEVERAGE

HO 210

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Characteristics of a Contract

A. Quality of Arrangements Possible

1. Negotiated - value competition only
2. Qualified - limited multiple - value competition possible
3. Unqualified - single value competition demanded

B. Services & Materials Provided

1. Provide all labor, material and management
2. Provide some labor, material and management
3. Provide management only
4. Provide material only
5. Provide labor only

→ a. Limited trades
→ b. All trades

C. Type of Contract Possible

1. Fixed cost - limited trades
2. Fixed cost - all trades
3. Fixed cost - limited trades plus fee for other trades management
4. Time and material plus fee - limited trades
5. Time and material plus fee - all trades

→ a. With upset price
→ b. With upset price and shared saving
→ c. With no upset price

RJS - AGCK
Exhibit 3

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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)

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PRINCIPLES OF EFFECTIVE AND USEFUL RECORD KEEPING FOR THE PROJECT MANAGER

A. Definition of record - Any retained information that can be effectively used in the future.

B. Types of records used in G construction
   1. Estimates
   2. Cost reports
   3. Field action reports
   4. Logs
   5. Testing reports
   6. Monitoring reports
   7. Project action plans
   8. Project schedules
   9. Money flow reports
   10 Priority checklists
   11. Phone records and logs
   12. Procurement tabulations
   13. Document control files
   14. Project histories
   15. Transmittals
   16. Bulletins, change orders, field orders
   17. Requests for information
   18. Schedules of values
   19. Requests for payment
   20. Shop drawing logs
   21. IOC's
   22. Proposed change orders
   23. Purchase orders
   24. Meeting minutes
   25. Proposals
   26. Permits
   27. Priority lists
   28. Resource curves and histograms
   29. Progress photos
   30. Punch list tabulations
   31. Sign offs on contract documents
   32. Sample logs
   33. Inspection reports

C. Reasons good design and construction project record keeping is essential.
   1. Sizable increase in the number of people to whom project managers are accountable.
   2. Increase in number of contested claims.
   3. Higher quality design and construction performance being demanded in an increasingly competitive business and professional environment.
   4. Demand for higher levels of cost control than ever before.
   5. Documentation demands being made by more complex financing arrangements in design and construction.
   6. Constant merging of disciplines with resulting extension of business arrangements into generic (G)

construction. Demands better and better communications.
7. Increasing use of electronic equipment allowing easier and better record keeping.

D. Basic classes of records
1. To record history of ex'e-cutive actions
   a. Daily reports
   b. Progress photos
   c. To do lists
2. To record opinions
   a. Daily management logs
   b. Diaries
   c. Phone logs
3. To record document processing
   a. Sample logs
   b. Shop drawing logs
   c. Transmittals
4. To record tabulated data and information
   a. Bid spread sheets
   b. Subcontractor lists
   c. Project directories
   d. Bulletin to change order tracking
   e. Field order to change order tracking
   f. Document control files
5. To record agreements and decisions
   a. Change orders
   b. Field orders
   c. Equipment data tabulations
   d. Meeting minutes
6. To record supportive activities
   a. Phone logs
   b. Management logs
   c. Transmittals
7. To record progress
   a. Color coded network models
   b. Monitoring reports
   c. Schedules of values
   d. Isoquant line comparisons
8. To record changes to the work
   a. Bulletins
   b. Change orders
   c. Field orders
   d. Memos of clarification
9. To record resource flow
   a. Money flow curves
   b. Manpower loading histograms
10 To record approvals
   a. Certificate of occupancy
   b. Shop drawing approvals
   c. Punch list tabulations
   d. Certificate of substantial completion
   e. Document sign off - schematics, design development, preliminaries, final contract documents
11. Record results
   a. Testing reports

b. Inspection reports

E. Basic rules for preparing record keeping forms

1. If a standard data form works, use it
2. Display information in a logical sequence
3. Provide adequate space for proper data entries
4. Preprint everything possible - remember, it costs about $85 per hour for your manager if he is not engaged in a profitable management/decision activity. Use the manager's time well
5. Keep the form readable
6. Prepunch the form for binders. Use large hole punches
7. Be certain enough detail is requested; you can always skip non applicable spaces
8. Provide date and signature spaces
9. Review all forms at least every year to see what should be discarded, revised or added

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Claim Prone Job Characteristics

During the profiling, proposing and negotiating period, it is often possible to gain a good insight into the expected nature of a job if one is fortunate (or unfortunate) enough to be the successful proposer. The problem job is becoming increasingly serious in our business and professional lives and it should be identified early. The problem job generally results in increased costs during the construction period and quite often requires arbitration or litigation to achieve resolution of costs and damages.

Thus, it is good policy for the perceptive owner, architect/engineer and contractor to become familiar with those characteristics that early identify a job as having potential for being a trouble project.

This list of characteristics is by no means complete, nor is it meant to imply that a job having these features will necessarily be claim prone. It is, on the other hand, an honest effort to state certain unique job features that have been identified in projects that have ended up in litigation or arbitration. The list is at random with no attempt to classify or characterize the features.

Claim prone job characteristics may include:

a. A wide spread in proposal prices.

b. Issuance of a large number of pre-bid addenda and instructions.

c. For subcontractors, a poor general contractor reputation if the project is being built by one prime.

d. For projects with separate primes, poor other prime contractor reputations.

e. More than four to six prime contractors involved(applicable on normal building work only).

f. Poor reputation of architect/engineer preparing contract documents.

g. Excessive how-to-do-it emphasis in contract drawings and specifications.

Claim Prone Job Characteristics
(continued)

h. Non-liable party involvement in responsible positions, i.e. non-liable construction manager.

i. Large numbers of allowance items.

j. Zero (or excessively small) tolerance specifications.

k. Poorly defined authority and responsibility patterns in the offices of the architect/engineer, the owner, the general contractor or other prime contractors.

l. Inexperienced specialty contractors.

m. Excessive number of pre-selected suppliers for key material and equipment.

n. Large dollar amount or numbers of owner purchased equipment.

o. Location in strike prone areas.

p. Location in jurisdictionally sensitive areas.

q. Heavy use specified for untried products and equipment.

r. Non-liable party involvement in establishing delivery commitments, i.e. construction manager, architect/engineer, owner representative.

s. Involvement of politically accountable owners, architect/engineers or other contractors.

t. Multi responsibility payment structures.

u. Excessively long time periods to award contracts after a proposal.

(Note: This often occurs in public work where many non-project approvals and agencies are involved.)

v. Poor owner reputation.

BOOBY TRAPS

There are many things that a Resident Engineer should not do. Good judgment is hard to describe, but knowledge of some common traps may be helpful.

Assumption of Authority. A Resident Engineer must not assume more authority than has been granted to him. He must not redesign the project or approve departures from the terms of the contract. He may be a designer trained in one of the disciplines involved in the work and may even have participated in the design of this project, but that work is finished and the design is frozen. Design modifications are a matter of concern to both parties to the contract and must be handled cautiously. The Resident Engineer may recommend changes, but clearance must be obtained from the office before changes are authorized.

Apparent Oversights. A frequent trap is the apparent oversight or error which the Resident Engineer thinks can be easily corrected. Often the solution now proposed was just as obvious to the designer but some other factor prevented its use. The safe way to proceed is to refer all such items to the office for comment before a change is made.

Too Much Control. Every right has a corresponding duty. When a Resident Engineer takes over too much control of the Contractor's operations, he may expose himself, B&V, and the Owner to claims that would not otherwise arise. Stopping the work falls in this category. For this reason our contract documents no longer reserve the right to stop the work. Liability claims against engineers frequently allege that the engineer had the power to stop the work and, therefore, should have stopped it before the injury or damage occurred. (See RE-0-20.7, RE-0-53.4, and RE-0-91.5)

Instructions to Wrong Person. A Resident Engineer should never give instructions directly to workmen. This does not mean that a Resident Engineer is not permitted to talk to workmen. He can point out discrepancies and make suggestions, but he should avoid giving specific directions or orders. Ordinarily, instructions and orders should be given to the Contractor's Superintendent. If the Superintendent is not available it may be necessary to give directions to the supervisor of the appropriate craft and follow up with the Superintendent later, but this method should be kept to a minimum.

Solving the Contractor's Problems. A Resident Engineer has a duty to call improper construction to the Contractor's attention, but he need not offer a solution to every problem. Construction techniques are the Contractor's responsibility. When the Resident Engineer suggests the solution to a problem, he may not be in a position to reject the result even if it is unsatisfactory.

Fraternization. It is easy to become too friendly with the Contractor's personnel. They have similar interests and often encourage the Resident Engineer to join them in off-duty activities. Sometimes the decisions rendered by a Resident Engineer have a direct or indirect economic impact on the Contractor's personnel. Consequently, a Resident Engineer can find himself in an awkward position if he has developed close personal ties with the Contractor's personnel.

BLACK & VEATCH

RE-0-20.5
Sep 1978

SETTLING DISPUTES

Negotiation is nearly always the preferable method of settling disputes arising during construction. If there has been some sort of damage to the work, the first step should be to have the damage repaired. It is in the interest of all parties to get the repair work done promptly at minimum cost. After the repairs are made, the parties can then argue over who will pay. Negotiators and lawyers work well with dollars, but when the damage has not been repaired, each evaluates his own client's potential liability under a "worst case" condition. Each then usually advises his client to "do nothing" and the situation deteriorates. This type of polarized situation can be avoided if remedial action is taken promptly.

Negotiation keeps the dispute within the control of the parties. Litigation or arbitration turns the matter over to outsiders. The proverb: "A poor settlement is better than a good lawsuit" has been found true by those who have experienced litigation.

For negotiation to be successful, thorough preparation is of the utmost importance. Frequently, there are only a few points that require negotiation; agreement can be obtained on all the other issues. By having the facts carefully documented, including the actual costs involved, the negotiation can proceed expeditiously.

A study of the negotiation process identified the following as factors contributing to success or failure:

a. Success Factors

Complete frankness on both sides.

Both sides have their position spelled out clearly in advance.

Prior exchange of detailed recitation of the facts.

Preservation of complete factual evidence.

Well prepared claim document.

b. Failure Factors

Lack of frankness - refusal to disclose actual cost information.

Inadequate preparation by one or more parties.

We can facilitate negotiation by establishing the position of each party and by preparing a written description of each item that is in dispute. If there has been adequate preparation, the B&V Project Manager can probably resolve the dispute by holding a meeting with responsible representatives of both sides.

Author: R. E. Vansant
Approved: R. E. Forman REF

STOPPING THE WORK

In the past, the contract documents reserved to the Engineer the power to order the Contractor to stop the work. Legally, every right has a corresponding duty. The right to stop the work was a power that was seldom exercised, but the correlative duty to stop the work when hazardous conditions were observed led to Engineers being held liable for failure to exercise the power. The right to stop the work was often interpreted by the courts as a duty to do something that the Engineer had not done.

A 1967 case involving a workman injured by collapse of trench illustrates the legal principle:

> The method of construction was solely a matter under the control of the Contractor, and the Defendant (Architect) had no right to interfere with the Contractor's execution of the work, but the Defendant had the right to insist that the work be carried on in a safe manner.
>
> We are of the opinion that if the Defendant knew or in the exercise of reasonable care should have known that the trench was unsafe either by reason of the Contractor's failure to properly shore the walls of the trench or by its failure to slope the sides of the trench in such a manner as to make the excavation a safe place to work, the Defendant had the *right and the corresponding duty to stop the work* until the unsafe condition had been remedied. (emphasis added)[1]

Current contract documents no longer reserve to the Engineer the power to stop the work. The Owner, of course, has the right to direct the Contractor to stop the work. The power to determine those portions of the work for which partial payment will be made and to reject defective work is sufficient for the Engineer's use in enforcing the contract requirements.

If portions of the work do not meet the requirements of the contract, the Engineer should inform the Contractor that payment will not be recommended for defective work until the work is corrected. When the potential cost of correcting defective work is greater than the value of the defective portion, the amount withheld should be sufficient to cover the entire cost of reworking.

[1] Nauman v. Beecher, 426 P2d 621, 1967.

RELATIONS WITH CONTRACTORS

The relationship between the Contractor and the Resident Engineer should be one of mutual respect. There are two primary drives that motivate a Contractor: pride and profit. Contractors have a large amount of pride in the quality and quantity of their work. An appeal to pride is often more effective than some other approach. If a Contractor is to continue in business, one of his primary goals must be profit. When requirements are structured so that the Contractor's profit is increased by following recognized procedures and completing high quality construction, the profit motive is being effectively utilized.

A Resident Engineer is assigned the task of obtaining construction in accordance with the drawings and specifications, but he must also have an understanding of the Contractor's problems. He must know how to be exacting in his requirements but not so strict and unbending as to be unreasonable. Sometimes minor modifications can be permitted to accommodate field conditions without affecting the design. Whenever there is any doubt concerning the acceptability of a modification, the Resident Engineer should check with the office before rendering a decision.

A Resident Engineer should not undertake direct supervision of the Contractor's workmen, but he can frequently offer helpful suggestions to the Contractor's Superintendent. A helpful attitude will gain the respect of the Superintendent and will better the Resident Engineer's position when he finds it necessary to "get tough" on a particular point. Suggestions are a delicate area because of the potential liability. In making suggestions, the Resident Engineer must be careful to insure that his recommendations are not interpreted as orders or directives. The Resident Engineer must keep in mind that work methods are not his responsibility and that failure to follow his recommendations is not sufficient ground for rejection of the work. The end result is what must be measured in determining contract compliance.

While the Resident Engineer must interpret what is required by the drawings and specifications, he has neither the power nor the authority to change or waive any provision of the contract. The only way that a definite contract requirement can be changed is by duly executed change order.

The following rules of conduct are fundamental in the relations between the Resident Engineer and the Contractor. They must be firmly fixed in mind so that their observance is automatic and unconscious.

1. Be sure you are right when you render a decision; never give "snap judgment" decisions – make the Contractor wait, if necessary, until the correct answer can be given.

2. Be friendly, but impersonal, in dealing with the Contractor.

3. Be fair, impartial, and open-minded. The Contractor should be given the benefit of any reasonable doubt.

4. Be patient, but not to the point of being imposed upon.

5. Be courteous and considerate at all times.

6. Be ready and willing to aid the Contractor by suggestions or advice to supervisory personnel.

7. Never attempt to dictate or direct construction methods. Even where a certain method is specified, the details of performance should be left to the judgment of the Contractor; he is responsible for the work and is entitled to freedom of action within reasonable limits. The Resident Engineer should, however, be satisfied that the procedure the Contractor is using will produce the desired end result.

8. Never give instructions to workmen or other subordinate employees of the Contractor. If the work is not being performed properly, inform the

RELATIONS WITH CONTRACTORS (cont'd)

Contractor's Superintendent so that he can take corrective action.

9. Perform inspections promptly so that the work is not delayed.

10. Never argue with the Contractor or his men regarding any matter pertaining to the work.

11. Never accept gifts, personal favors, or other gratuities from the Contractor.

RELATIONS WITH THE OWNER

The Resident Engineer must remember that at all times he represents Black & Veatch and that the firm is judged by his conduct both on and off the job. He must be extremely careful to make sure that the impression conveyed to all persons is a credit to a professional organization and that he cannot be accused of any conduct which could be considered questionable. All of his actions must demonstrate the highest degree of integrity and must be in accordance with the ethical standards of the engineering profession.

It is the Resident Engineer's responsibility to maintain close contact with the Owner's representatives and to keep them fully informed regarding the progress of the work. At the start of each project in a meeting of the Owner's representatives, the B&V Project Manager, and the Resident Engineer, a clear understanding should be reached regarding the duties and authority of each party during the construction period. Except for formal legal notices, it is ordinarily best for instructions from the Owner to the Contractor to be handled through the Resident Engineer, and B&V General Conditions require all communications from the Owner to the Contractor to be issued through the Engineer.[1] The Resident Engineer should notify the Owner's representative whenever there are events which may affect the cost or time of completion of the project or which may cause adverse public reaction. The person to be notified should be identified during the meeting described above.

There is usually one member of the Owner's organization who has responsibility for operation of the project after it is completed and has special interest in the details of the project. This person should be identified at the outset of the project so that he can be consulted as necessary.

In many of his duties, the Resident Engineer functions as an agent of the Owner, and responsibility for his actions may be imputed to the Owner. However, the Resident Engineer is not a general agent of the Owner since he may act only on the Owner's behalf to the extent set forth in the contract documents. In resolving disputes, the Resident Engineer must assume an impartial position and function as an arbitrator or judge, representing neither the Owner nor the Contractor, but deciding on the basis of the facts and the contract requirements.

At times it may be necessary to remind the Owner's representatives that the Owner has important responsibilities under the Contract. In addition to making timely payments, the Owner must respond to requests from the Contractor and must react to every action or failure to act by the Contractor. The Resident Engineer should advise the Owner well in advance when action by the Owner is required, particularly when the Owner's failure to act may contribute to delays in the work. Examples are as follows:

- Obtaining rights-of-way.
- Notifying customers regarding interruption of service.
- Closing streets.
- Operating valves.

Ordinarily the Resident Engineer should not attend City Council or public meetings of the Owner's governing body, unless specifically requested to attend by a representative of the Owner.

[1] Par 8.1, B&V General Conditions, 1976 Edition

Source: R.E. Vansant
Approved: R.E. Forman

DAILY LOG

Each Resident Engineer should keep a daily log (diary) covering the important events that occur at the project site. This log can be extremely important in settling disputes and constitutes a convenient chronological record of the project.

The daily log is a permanent record and may be subject to review by a wide range of persons. For this reason, it should contain facts only; supposition, hearsay or conjecture about events which have transpired should not be included. The facts which are included should be only those directly related to the work, and information about individuals or events which do not effect the work should not be included. For example, references to the personal habits of an individual, no matter how repugnant these habits may be to the Resident Engineer, should not be included in the job log unless those habits in some way affect the work.

The daily log should be kept in a bound field book. Entries should be lettered with a hard (2H or No. 3 or harder) pencil or a fineline ball point pen. Entries made with soft pencil, fountain pen, or felt tip pen may smear or run and should be avoided.

Pages in the daily log should be filled solid without gaps between entries. A line across the page can be used to separate entries made on different days. If an item was not recorded but is recalled subsequently, it can be recorded on the current day with a reference to the appropriate day. Erroneous entries should not be erased. A neat single line drawn through an entry clearly indicates deletion and avoids the questions that might be raised about an entry that has been erased.

The daily log should contain the following information:

1. Weather and ground conditions.
2. Work performed including the starting or completion of any unit of work.
3. Construction difficulties encountered and remedial measures employed.
4. Record of significant delays together with cause.
5. Materials and equipment delivered to project site.
6. Rejection of any item of work, material, or equipment together with reasons for rejection.
7. Description of any disputes involving Contractor, subcontractors, Owner, or Resident Engineer.
8. Oral instructions given by Resident Engineer or other representative of B&V to Contractor.
9. Brief description of any accident, particularly when there are personal injuries or other matters that might develop into litigation. (See RE-0-35.1 for additional information on accident reporting.)
10. Detailed record of materials used and work performed in connection with extra work or any other item for which there is reason to suspect that a claim for extra compensation may be filed.
11. Names of visitors and their business connection or official capacity.
12. Summary of important telephone calls.
13. Record of safety inspections including names of the persons making the inspection.
14. Description of unsafe acts and unsafe conditions called to the attention of the Contractor's superintendent.
15. On pipeline and sewer work, the location of underground utilities or obstacles and any associated difficulty.

The "Record of Men and Equipment" is described in RE-0-25.3. This record should be kept on the back pages of the daily log book and should cover the same period of time as that covered by the daily log.

Upon completion of the work, the daily log books shall be sent to the Kansas City office for permanent filing.

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CONTRACTOR DEFAULT

Contractor default is relatively rare, but when it happens, knowing what to expect can be important. The Surety is not likely to immediately take over management of the project. Since the Surety is entitled to all of the Contractor's legal defenses, the procedure defined in the contract documents must be followed explicitly. Otherwise, the Owner's right to recovery under the bond may be jeopardized. Initially, the Owner's attorney should be consulted to make sure that all notices and other necessary actions are properly prepared and delivered.

When a proper demand has beeen made by the Owner upon the Surety, some of the options available to the Surety are:

- Engage another contractor to complete the work, keeping control of the work.
- Obtain bids for completion of the work and submit them to the Owner for execution of a contract, assuming the responsibility for any increased cost up to the face amount of the bond.
- Does nothing, thereby making it necessary for the Owner to have the work finished and sue on the bond.

The Surety has no duty to actually complete the work. A performance bond binds the Surety to pay, up to the face amount, the cost of completing the work, but does not require the Surety to take over the work. The approach followed by a Surety will be based on an evaluation of the potential exposure to loss in relation to the face amount of the bond. While the maximum obligation of the Surety is limited by the bond amount, the Surety may become liable for more than the face amount when it takes over the work. Therefore, the Surety may avoid taking over the work when the potential loss exceeds the bond limit.

Taking Over. By taking over the work, the Surety avoids the need to solicit bids and can minimize the cost of completing the work. This alternative is usually preferred by the Owner and Consulting Engineer. While a delay often results and there is some increased coordination required, these factors are minimized. Payments are made to the Surety in the same way as payments were made to the Contractor before the default.

Obtaining Bids. This alternative is attractrive to the Surety since the amount of its liability is established early. From the Owner's standpoint this alternative is also acceptable because the Owner is relieved of the burden of soliciting bids and a contract to complete the project can be negotiated quickly. In addition, the Owner deals directly with the new Contractor without having everything pass through the Surety.

Another significant advantage to a public agency Owner is that the Surety assumes responsibility for modification of the drawings and specifications necessary to define the extent of the remaining work required. The time required to prepare contract documents, obtain bids, and negotiate a contract is often substantial, but no more than when the Surety does nothing.

Under this alternative there should be an agreement between the Owner and Surety regarding who will make payments to the Contractor and when the Surety will pay its obligation under the bond. The new contractor should also furnish performance and payment bonds since the original bonds are discharged by the award of a new contract.

No Action. When the Surety does nothing, the Owner must wait for the notice periods stipulated in the contract documents to expire before taking over completion of the work. After expiration of the notice periods, there is often an even greater delay while arrangements are made and decisions are reached. Additional engineering services and administrative effort are necessary to secure project completion. Also, the Owner must finance the remaining work even if the cost exceeds the contract amount. Because it may be necessary to

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CONTRACTOR DEFAULT (cont'd)

sue to collect from the Surety, careful cost records must be kept by the Owner during the period after default.

It is seldom in the Surety's best interest to choose this alternative. Only when the potential loss may exceed the bond amount is there an advantage to the Surety. When it does nothing, the Surety loses control of the cost of completing the work and the magnitude of its liability may be substantially increased if the remaining work is poorly managed. Also, if the Owner's representative requests the Surety to take charge of the work, he may be incensed if the Surety refuses.

If the Surety unreasonably refuses to pay its obligations under the bond in a timely fashion, the Surety may be liable for actual damages that exceed the bond amount.[1]

Payments. The first signal that a Contractor is in financial distress often comes in the form of a demand from an unpaid supplier. When the Owner or Engineer receives notice that there are unpaid bills, particular care must be exercised in making further payments to the Contractor. In case of default the Surety is entitled to receive the remainder due under the contract. If the Owner has improperly made payments to the Contractor that should have been applied to the satisfaction of claims or should have been paid to the Surety, the Owner may not receive credit for those payments.[2] In many jurisdictions there are statutes that govern the making of payments by a public agency Owner after notice of a claim has been received.

When this type of situation arises, it is prudent to require concurrence of the Surety before additional payments are made to the Contractor.

[1] Continental Realty Corporation v. Andrew J. Crevolin Co., 380 F Supp 246, 1974.

[2] Fort Worth Independent School District v. Aetna Casualty & Surety Co., 48 F 2d 1, 1931. Home Indemnity Co., v. United States, 376 F 2d 890, 1967.

CHANGED CONDITIONS

One of the most common problems experienced in construction work is encountering unexpected conditions after the work is started. The courts have defined these unexpected situations as *changed conditions*. There are two distinct types of changed conditions:

a. Subsurface or latent physical conditions at the site differing materially from those indicated in the contract documents. These situations are called *differing site conditions*. (see RE-0-91.3)

b. Unknown physical conditions at the site, of an unusual nature, that are materially different from those ordinarily encountered and generally recognized as inherent in work of the character covered by the contract.

Since *changed conditions* are nearly impossible to predict, contractors seldom make sufficient allowance for the risk, and *changed conditions* have often caused substantial increase in contractor costs. A contractor who suffers a loss has an incentive to attempt to recover all or part of the loss through claims or a lawsuit. During the last 20 years, the courts and boards of contract appeals have heard hundreds of cases arising from *changed conditions* and have often ruled in favor of the contractor. Consequently, it has become increasingly difficult to write a contract that will be upheld by the courts and that assigns the *changed conditions* risk to the contractor.

In recognition of this situation, the most up-to-date General Conditions provide a method for making contract modifications when *changed conditions* are encountered.[1] In 1976, a Wisconsin court explained the reasons for including a *changed conditions* clause:[2]

> The changed-conditions clause is a contractual innovation designed for the mutual benefit of both the government and the contractor. The government benefits by use of such a clause because the contractor no longer needs to add large contingency sums to his bid in order to cover the risk of encountering adverse subsurface conditions. The contractor benefits because he is awarded extra compensation if adverse subsurface conditions are encountered which materially differ from those indicated in the contract. Thus, much of the gamble is taken out of underground construction. The government does not have to pay the contractor a windfall price when only normal conditions are encountered, and the contractor suffers no disaster when unanticipated conditions arise. Furthermore, both parties benefit by the existence of an informal machinery for resolving problems through negotiation rather than litigation.

The effect of a *changed conditions* clause, sometimes called *unforeseen physical conditions* or *differing site conditions*, is to shift the risk of unexpected conditions to the Owner. A board of appeals described its effect:[3]

> The "changed conditions" clause permits an equitable adjustment to cover increased costs which are the direct and necessary result of changed conditions where the changed conditions lead directly to disruption, extra work, or new procedures.

While unusual subsurface conditions are the types of *changed conditions* most frequently encountered, *changed conditions* also apply to many other situations. For example, claims for extra payment have been upheld where actual grade elevations at the site were 6 inches lower than those shown on the contract drawings (requiring additional fill to meet finished grade elevations),[4] where, in reroofing, a second existing roof was encountered,[5] where gas lines in the

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[1] Par. 4.3, NSPE 1910-8, 1978; Par. , AIA A201, 1976.
[2] Metropoliten Sewage Commission v R.W. Construction, Inc., 241 NW 2d 371, 1976.
[3] Electronic & Missile Facilities, Inc., 69-2 BCA 7781, 1969.
[4] Anthony P. Miller, Inc. v US, 422 F2d 1344, 1970.
[5] Redman Service, Inc., 1963 BCA 3897.

Source: R. E. Vansant
Approved: R. E. Forman

CHANGED CONDITIONS (cont'd)

walls of houses were located in positions different than those indicated on the contract drawings,[6] and where the concrete frame of an existing building was seriously out of plumb and alignment.[7]

Sometimes a claim of *changed conditions* will be made when the contractor really should have anticipated the conditions. Such claims are admissions of lack of experience or knowledge and should be rejected. This situation may arise when a contractor with experience in one type of work shifts into a new field and fails to properly evaluate the data furnished in the contract documents.

There are many changes that are not compensable under *changed conditions* clauses. For example, when a contractor filed a claim for damages arising from assault on his work force by a mob in a labor dispute, a board of contract appeals ruled that the *differing site conditions* clause applies only to physical conditions and does not cover risks related to changed governmental, political, or economic conditions.[8]

When *changed conditions* are encountered, a careful record should be made of the actual conditions, including photographs. As soon as practicable after the *changed conditions* are recognized, a construction change authorization should be issued by the Owner and Engineer authorizing the contractor to proceed with the work and acknowledging that the contract price will be adjusted in a future change order. Thorough records must be kept of the work actually performed so that there will be a sound basis for the price adjustment.

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[6] Quiller Construction Co., BCA 3815, 1963.
[7] Gervyn Construction Corp. v US, Court of Claims, 154-74, 1979.

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[8] Cross Construction Company, Eng BCA 3676, 1979.

DIFFERING SITE CONDITIONS

If the subsurface conditions encountered are materially different from the information indicated by the borings and by the contract documents, the General Conditions require an equitable adjustment to be made.[1] The Contractor is required to notify the Owner when an unusual condition is encountered so that the situation can be evaluated, design changes can be made, if necessary, and more detailed record keeping can be initiated. (See RE-0-91.2)

To qualify as being *unknown and unusual*, the condition does not have to be a geological freak but must be reasonably unanticipated based upon examination of the contract documents and investigation of the site. It is easy to be influenced by hindsight and conclude that the condition should have been foreseeable. The proper test is: *Was the condition foreseeable at the time of bidding?*

One author's explanation of the foreseeability test is:

> The real engineering (and legal) question, however, is not whether the conditions were different from those which the Contractor expected, but whether the conditions were different from those which he should have reasonably expected and whether these differences caused a significant increase in the time or cost required for construction. The engineering problem, therefore, narrows itself not to change (because change is inevitable) but to whether the change should have been foreseen by a reasonable contractor.[2]

The Contractor is charged with knowledge of any subsurface conditions which are actually indicated in the information furnished to him. The *unanticipated* quantity, character, nature, or behavior of an *anticipated* material may be a changed condition, just as the present of an *unexpected* material may be grounds for a claim. For example:

(1) encountering substantially *more* and *different* rock than indicated;

(2) encountering *ledge rock* where none was shown in the borings;

(3) encountering a *fine silty* substance acting like quicksand where borings had indicated clay.

It is not essential that the *indications* relied upon be set forth explicitly in the contract. The indications may be inferred from reading the contract as a whole. Thus, the design and construction features of the contract may indicate the type of conditions reasonably expected to be encountered. Some examples are: contract documents indicated subsurface conditions permitting excavation *in the* dry, but actual conditions made it impossible or impractical to excavate in the dry; soils encountered were not capable of being compacted in accordance with the specified compaction method.

When differing site conditions are encountered that result in additional costs to the Contractor, the contract price must be adjusted by change order. The proper adjustment is the difference between what the reasonable cost of the work was under the conditions actually encountered and what the work would have cost if the conditions had been as contemplated by the contract.[3] While most differing site condition situations result in a claim by the Contractor for additional costs, theoretically the contract price should be reduced if the conditions encountered result in reduced costs.

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[1] Par. 4.3, NSPE 1910-8, 1978; Par. AIAA201, 1976.

[2] Sowers, George F., "Changed Soil and Rock Conditions in Construction", *Journal of the Construction Division*, ASCE, Vol. 97, No. CO2, p 257-269, Proceedings Paper 8509, Nov. 1971.

[3] Metropolitan Sewerage Commission v R. W. Construction, Inc., 241 NW 2d 371, 1976; Continental Drilling Company, 77-1 BCA 12,280, 1976; Roscoe-Ajax Construction Company, Inc., 458 F2d 55, 1972.

Source: R. E. Vansant
Approved: R. E. Forman

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CONSTRUCTIVE CHANGE ORDERS

Whenever a situation arises under which the Contractor should be entitled to a change order and the Engineer or Owner refuses to issue one, the courts will find for the Contractor under the concept of constructive change order. The circumstances that can give rise to constructive change orders are:

a. Insisting upon complete performance within the original performance period when the Contractor has encountered an *excusable* delay.

b. Drawings and specifications are defective, incomplete, or unperformable.

c. Erroneous interpretation of contract requirements.

d. Dictating the method of performance when not spelled out in the contract.

e. Unjustifiable rejection of work.

f. Permitting the Contractor to perform work that is clearly outside the contract.

A constructive change order has been defined by the Navy Department as:

> "Any conduct by a government representative which is not a formal change order, but which has the effect of requiring the Contractor to perform work different from that prescribed by the original terms of the contract."[1]

The doctrine of constructive change order has grown out of occasional unreasonable action on the part of Owner's representatives. The Engineer occupies a role somewhat like a judge in reviewing a Contractor's claims. If the circumstances call for a change order, we should recommend to the Owner that the change order be issued. In addition, we must be careful to make correct interpretation of contract requirements, must avoid dictating the method of performance, and must reject work only when clearly justifiable.

In 1972, the U.S. Court of Claims applied the doctrine of constructive change order to a situation in which a painting subcontractor was permitted to paint areas outside the contract. Even though the contractor was not ordered to do the work, the court found that the Contractor had relied on the project engineer for guidance. Instead of halting the work, he criticized the way it was being done. The court concluded that the Contractor did not act as a volunteer, but was operating with the tacit approval of the project engineer.[2]

1 Naval Material Procurement Newsletter, May-June 1969
2 Chris Berg, Inc., v. United States, US Court of Claims, No. 231-68, 1972

ENGINEERING CONTRACT GLOSSARY

All - term that is troublesome. Not many of the activities covered by Owner-Engineer agreements are sufficiently defined so that we can be sure that "all" work of that type has been performed.

As-Built - term to be avoided since we can never determine exactly what was built. Better term is "Conforming to Construction Records".

Assure - term to be avoided. One of its meanings is "to guarantee".

Complete - term that is troublesome. Its use can imply a "guarantee". Terms that do not imply completeness are usually better from the standpoint of potential liability.

Conforming to Construction Records - term used to describe recording on the original tracings changes during construction. This information is taken from construction records and is seldom complete.

Design Professional - term that covers architects, engineers, planners, and others who offer design services.

Drawings - graphic representations prepared by the Engineer for use during construction. Avoid using the narrower term *plans* when the full range of drawings is intended.

Engineering Supervision - term to be avoided. See Supervision.

Ensure - term to be avoided. Means "insure" or "guarantee".

Estimate - term that is sometimes taken to mean "bid" or "quotation". Better to use "opinion of probable construction cost". Estimate should be used only when actual cost is intended, as in a *payment estimate*.

Fee - term that has several meanings. EPA has defined it as "profit" or allowance above reimbursable costs, while common past usage has been as entire charge for engineering services. Term has also been used to cover service charges, as in *fee* for examining drawings. For Black & Veatch contracts use of *fee* should be restricted to the meaning assigned by EPA and other Federal agencies.

Guarantee - term that should not be used in an Owner-Engineer agreement.

Hold Harmless - troublesome term that should be avoided in Owner-Engineer agreements.

Indemnify - troublesome term that should be avoided in Owner-Engineer agreements.

ENGINEERING CONTRACT GLOSSARY (cont'd.)

Insure - term to be avoided except when used to describe an "insurance policy".

Opinion of Probable Construction Cost - the Engineer's opinion of what it may cost to construct recommended facilities. The term *estimate* has been used in the past, but professional liability insurers recommend against use of that term.

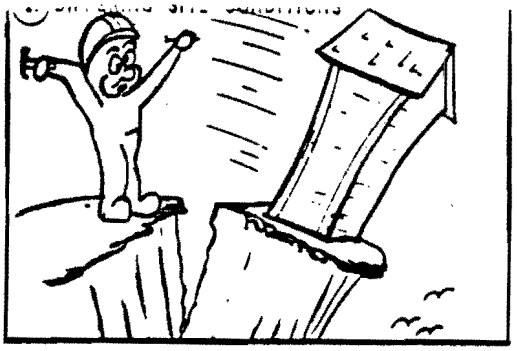
Prime Design Professional - designer having a contract directly with the Owner. He often subcontracts a portion of the design work to other design professionals.

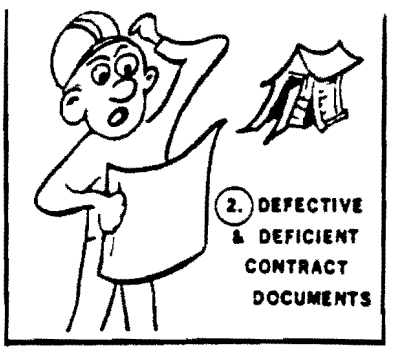
Resident Engineer - term used in Black & Veatch contract forms to describe field representative. See Resident Project Representative.

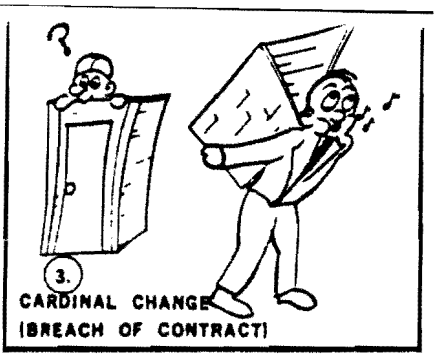
Resident Project Representative - term used in NSPE documents to describe resident engineering. Avoids implication that representative is registered as Professional Engineer.

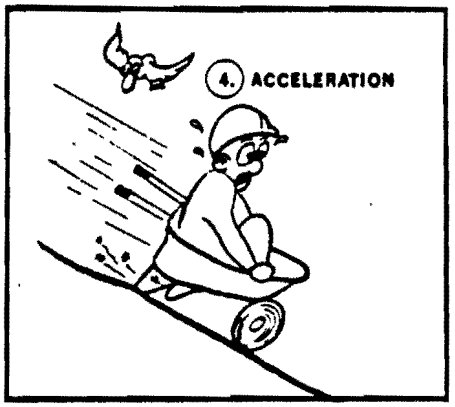
Supervision - term to be avoided. In the past it was used to describe resident engineering but courts have attached greater liability significance to "supervision" than was intended by engineering profession.

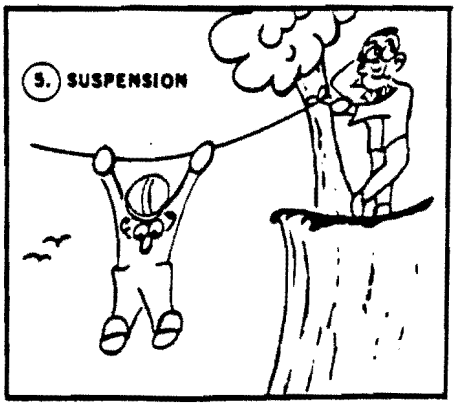
Warranty - term that should not be used in Owner-Engineer agreements.

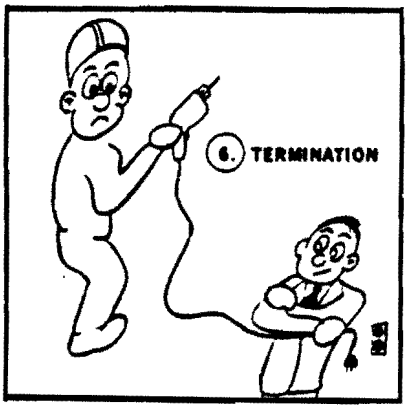


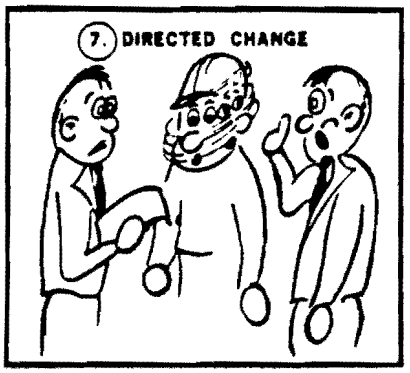


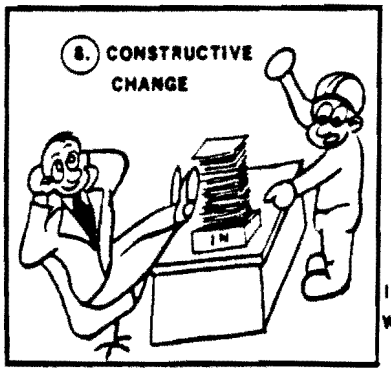


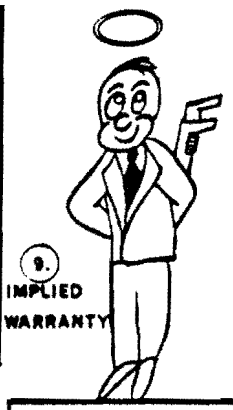


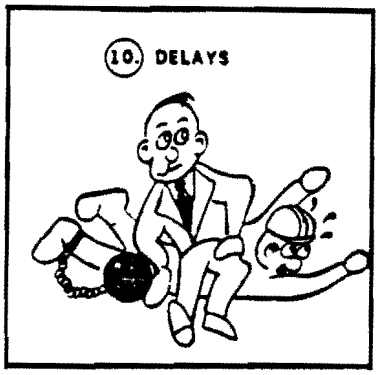


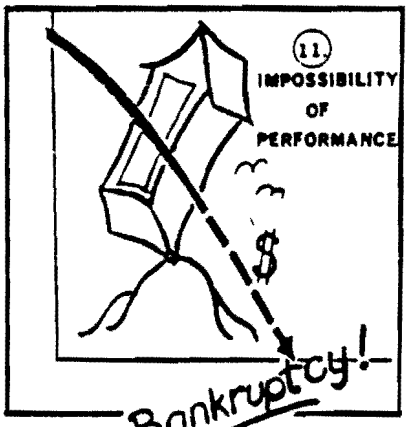


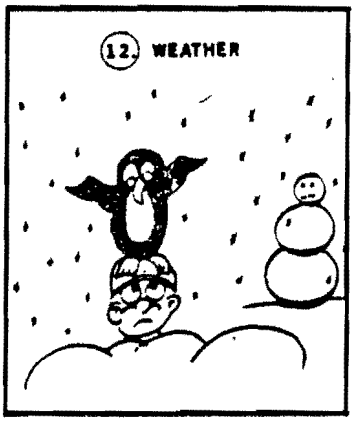


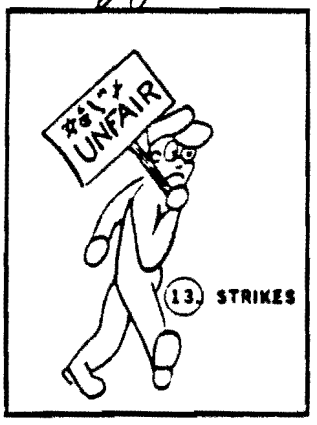


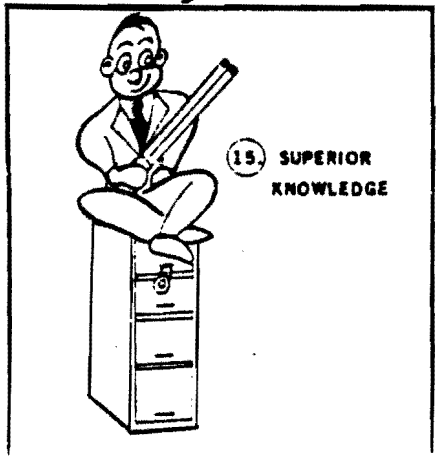












"16 Claim Types"

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KELLOGG

C34

V-A

		of occurrence (200 cases) Frequency	Rank
→	1. Differing Site Conditions. a) Subsurface or latent physical conditions at the site differing materially from those indicated in this contract or b) unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in this contract. (ASPR 7.602.4)	31%	8
→	2. Defective and Deficient Contract Documents. If the contractor is bound to build according to plans and specifications prepared by the owner, the contractor will not be responsible for the consequences of defects in the plans and specifications. This responsibility of the owner is not overcome by the usual clauses requiring builders to visit the site, to check the plans, and to inform themselves of the requirements of the work. (Spearin, 1918)	41%	4
→	3. Cardinal Change (Breach of Contract). A change that is outside the scope of the contract. Caution: most changes are inside the contract scope.	11%	14
✓	4. Acceleration. Performance of the contract work in a time period shorter than that originally contemplated by the contract or performing on time when the contractor is entitled to an extension of time for performance. (Cuneo)	35%	5
→	5. Suspension. The owner's directive that work be stopped on a part or the whole of the contract. In federal contracts, you can recover your actual costs.	31%	9
→	6. Termination. Two types. Termination for convenience resulting from factors outside the contract. Termination for default when the contractor's performance is not acceptable.	7%	15
✓	7. Directed Change. The owner enjoys the right to make any change that falls within the scope of the contract. The change may be verbal or written. In exchange for that right, the owner has the responsibility to pay you for the change.	48%	1
✓	8. Constructive Change. The owner's action or inaction that has the same effect as a written directive. A good example is constructive acceleration, when the owner fails to answer your justified request for more time.	42%	2
?	9. Implied Warranty. The implied provision of every contract, that neither party will do anything to prevent performance thereof by the other party, or that will hinder or delay him in its performance. (Fuller, 1947)	35%	6
→	10. Delays. A problem beyond the control and without the fault or negligence of the contractor, that prevents him from proceeding with any part of the work.	41%	3
?	11. Impossibility of Performance. Two types. Physical impossibility (example: the design drawings defy the law of gravity). Economic impossibility (when one job -- if continued -- will bankrupt the contractor).	18%	10
?	12. Weather. Good only for a time extension unless the conditions vary substantially from the norm. For a hurricane in Iowa, you should get time and money.	13%	13
?	13. Strikes. Good only for a time extension unless the other party precipitated the strike.	7%	16
→	14. Owner-furnished Items. The owner's failure to furnish items in accordance with his bid phase promises. Caution: get those promises in writing.	15%	12
→	15. Superior Knowledge. The owner's withholding, during the bid phase, of specific data on matters of substance. The key words are "specific" and "substance."	18%	11
→	16. Maladministration. Based on the implied warranty that the owner will not, by his actions or inactions, unreasonably interfere with the contractor's right to develop and enjoy least-cost performance.	33%	7

ACT FROM A PLAN
If you can't plan it, you can't manage it. Good plans shape good decisions.

A. Five essential planning questions for the manager to ask and answer
  1. What?
  2. Where?
  3. When?
  4. How?
  5. Who?

B. Five essential planning actions for the manager to take
  1. Set goals and objectives
  2. Prepare an action plan
  3. Organize the work
  4. Assemble the resources needed
  5. Do the job

C. Set goals and objectives
  1. Definitions
    a. Goals - Targets, desires, wishes and aims expressed without a time scale.
    b. Objectives - expressed goals upon which a time frame has been imposed.
  2. The DIG/DEG/DOG
  3. Be specific when setting objectives.
  4. Set objectives so that movement toward their achievement can be measured.

D. Prepare an action plan
  1. May be verbal,written or visual
  2. May be strategic or tactical, detailed or summary
  3. May be short, medium or long range (the manager must set the planning 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, the greater the probability that longer range needs, which truely measure the manager's effectiveness, will remain unfilled.
    b. The higher you are in the management structure, the larger and longer the planning scale you must use.
    c. The concepts of decision to action time span
4. Plan the work and work the plan!

E. Organize the work
  1. Plans should be built upon maximum integration of management viewpoints.
  2. Establish relationships through functional diagramming 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. Grapevine often used for informal feedback
b. Formal feedback system should be built by specific assignment (must have a standard of performance for the feedback system to work well).

5. Organize to accomplish goals and objectives.
a. Keep organization lean - avoid unnecessary overhead
b. Make provisions in the organization to delegate and train
c. Tend to build around targets and needs rather than people (there are major exceptions to this - watch carefully)
d. Provide for proper grading of decision to action time spans

F. Common planning failures

1. Not touching all organizational bases - what, where, when, how and who
2. Committing to too many goals and objectives at one time
3. Underestimating the value and need for good forward planning
4. Failure to challenge plans and actions at the right time.
5. Not providing proper escape hatches and safeguards
6. Failure to encourage timely, knowledgable participation
7. Not obtaining higher level approvals of goals and objectives
8. Inadequate monitoring and control of costs, progress, documentation and resource loading
9. Poor assignment of duties, responsibilities and actions
10. Failure to understand that planning is a major task of the manager

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NETWORK PLANNING MINITEXT

Symbols

1. Arrow or task ⟶

   A single definable action (or a single grouping of a number of definable actions) requiring resources.

2. Circle or node ◯

   The starting or ending point of a task .... a momentary point in time.

3. Dotted or dummy arrow ----→

   A symbol representing the existence of a relationship between tasks. Dummies have no resources allocated.

   Note: 95% of time a dummy goes from end of one task to start of another.

KEEP SYMBOLS SIMPLE !

Rules of Job Planning

1. All tasks preceding any single task must be complete before that single task can start.

2. The logic plan represented by a series of single tasks, nodes and dummies must be explicit.

Steps in Network Planning

1. Define scope of work.

2. Draw logic plan.

3. Approve logic plan.

4. Assign durations.

5. Compute ES, LF and TF

6. Analyze and recompute, if necessary. (May make additional resource allocation)

7. Issue.

Rules for Numbering Nodes

1. It is recommended the numbering sequence move down and to the right.

2. Normally, twenty numbers per hundred should be reserved for future use, and noted on diagram.

3. A node, having two or more arrows entering, or two or more arrows leaving, is numbered.

4. A node, having a single arrow entering, and a single arrow leaving, does not have to be numbered unless required by rule 5.

5. No more than one node in a sequence should be without a number.

Note: Node numbers are used to identify tasks. The final measure of whether node numbers are assigned correctly is whether any task in the network can be identified uniquely (the only one in the network) by its pair of node numbers.

i is the initial node number designation.

j is the end node number designation.

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2-YR. WORKING DAY CALENDAR STARTING JAN. 3, 1984

Date	W/D	Date	W/D	Date	W/D	Date	W/D	Date	W/D
Jan	1984	13	51	23	102	03	152	16	203
03	1	14	52	24	103	06	153	17	204
04	2	15	53	25	104	07	154	18	205
05	3	16	54	29	105	08	155	19	206
06	4	19	55	30	106	09	156	22	207
09	5	20	56	31	107	10	157	23	208
10	6	21	57	Jun		13	158	24	209
11	7	22	58	01	108	14	159	25	210
12	8	23	59	04	109	15	160	26	211
13	9	26	60	05	110	16	161	29	212
16	10	27	61	06	111	17	162	30	213
17	11	28	62	07	112	20	163	31	214
18	12	29	63	08	113	21	164	Nov	
19	13	30	64	11	114	22	165	01	215
20	14	Apr		12	115	23	166	02	216
23	15	02	65	13	116	24	167	05	217
24	16	03	66	14	117	27	168	06	218
25	17	04	67	15	118	28	169	07	219
26	18	05	68	18	119	29	170	08	220
27	19	06	69	19	120	30	171	09	221
30	20	09	70	20	121	31	172	12	222
31	21	10	71	21	122	Sept		13	223
Feb		11	72	22	123	04	173	14	224
01	22	12	73	25	124	05	174	15	225
02	23	13	74	26	125	06	175	16	226
03	24	16	75	27	126	07	176	19	227
06	25	17	76	28	127	10	177	20	228
07	26	18	77	29	128	11	178	21	229
08	27	19	78	Jul		12	179	23	230
09	28	20	79	02	129	13	180	26	231
10	29	23	80	03	130	14	181	27	232
13	30	24	81	05	131	17	182	28	233
14	31	25	82	06	132	18	183	29	234
15	32	26	83	09	133	19	184	30	235
16	33	27	84	10	134	20	185	Dec	
17	34	30	85	11	135	21	186	03	236
20	35	May		12	136	24	187	04	237
21	36	01	86	13	137	25	188	05	238
22	37	02	87	16	138	26	189	06	239
23	38	03	88	17	139	27	190	07	240
24	39	04	89	18	140	28	191	10	241
27	40	07	90	19	141	Oct		11	242
28	41	08	91	20	142	01	192	12	243
29	42	09	92	23	143	02	193	13	244
Mar		10	93	24	144	03	194	14	245
01	43	11	94	25	145	04	195	17	246
02	44	14	95	26	146	05	196	18	247
05	45	15	96	27	147	08	197	19	248
06	46	16	97	30	148	09	198	20	249
07	47	17	98	31	149	10	199	21	250
08	48	18	99	Aug		11	200	24	251
09	49	21	100	01	150	12	201	26	252
12	50	22	101	02	151	15	202	27	253
								28	254
								31	255

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2-YR. WORKING DAY CALENDAR STARTING JAN. 3, 1984

Date	W/D	Date	W/D	Date	W/D	Date	W/D	Date	W/D
Jan	1985	14	307	28	359	08	410	22	462
02	256	15	308	29	360	09	411	23	463
03	257	18	309	30	361	12	412	24	464
04	258	19	310	31	362	13	413	25	465
07	259	20	311	Jun		14	414	28	466
08	260	21	312	03	363	15	415	29	467
09	261	22	313	04	364	16	416	30	468
10	262	25	314	05	365	19	417	31	469
11	263	26	315	06	366	20	418	Nov	
14	264	27	316	07	367	21	419	01	470
15	265	28	317	10	368	22	420	04	471
16	266	29	318	11	369	23	421	05	472
17	267	Apr		12	370	26	422	06	473
18	268	01	319	13	371	27	423	07	474
21	269	02	320	14	372	28	424	08	475
22	270	03	321	17	373	29	425	11	476
23	271	04	322	18	374	30	426	12	477
24	272	05	323	19	375	Sept		13	478
25	273	08	324	20	376	03	427	14	479
28	274	09	325	21	377	04	428	15	480
29	275	10	326	24	378	05	429	18	481
30	276	11	327	25	379	06	430	19	482
31	277	12	328	26	380	09	431	20	483
Feb		15	329	27	381	10	432	21	484
01	278	16	330	28	382	11	433	22	485
04	279	17	331	Jul		12	434	25	486
05	280	18	332	01	383	13	435	26	487
06	281	19	333	02	384	16	436	27	488
07	282	22	334	03	385	17	437	29	489
08	283	23	335	05	386	18	438	Dec	
11	284	24	336	08	387	19	439	02	490
12	285	25	337	09	388	20	440	03	491
13	286	26	338	10	389	23	441	04	492
14	287	29	339	11	390	24	442	05	493
15	288	30	340	12	391	25	443	06	494
18	289	May		15	392	26	444	09	495
19	290	01	341	16	393	27	445	10	496
20	291	02	342	17	394	30	446	11	497
21	292	03	343	18	395	Oct		12	498
22	293	06	344	19	396	01	447	13	499
25	294	07	345	22	397	02	448	16	500
26	295	08	346	23	398	03	449	17	501
27	296	09	347	24	399	04	450	18	502
28	297	10	348	25	400	07	451	19	503
Mar		13	349	26	401	08	452	20	504
01	298	14	350	29	402	09	453	23	505
04	299	15	351	30	403	10	454	24	506
05	300	16	352	31	404	11	455	26	507
06	301	17	353	Aug		14	456	27	508
07	302	20	354	01	405	15	457	30	509
08	303	21	355	02	406	16	458	31	510
11	304	22	356	05	407	17	459		
12	305	23	357	06	408	18	460		
13	306	24	358	07	409	19	461		

DC

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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.

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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	

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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.

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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

FIRST LEVEL NETWORK - Summary Management Diagram

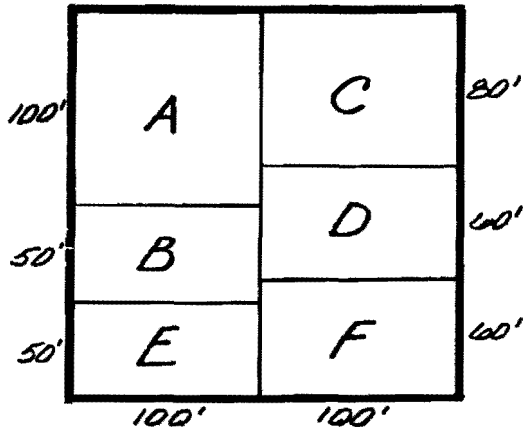
A diagram prepared very early in the project life. The summary network provides an overall look at the entire program, grouping major operations and containing tasks with durations from 10 to 50 working days. This network should normally contain 25 to 70 tasks exclusive of dummies.

SECOND LEVEL NETWORK - Working Diagram

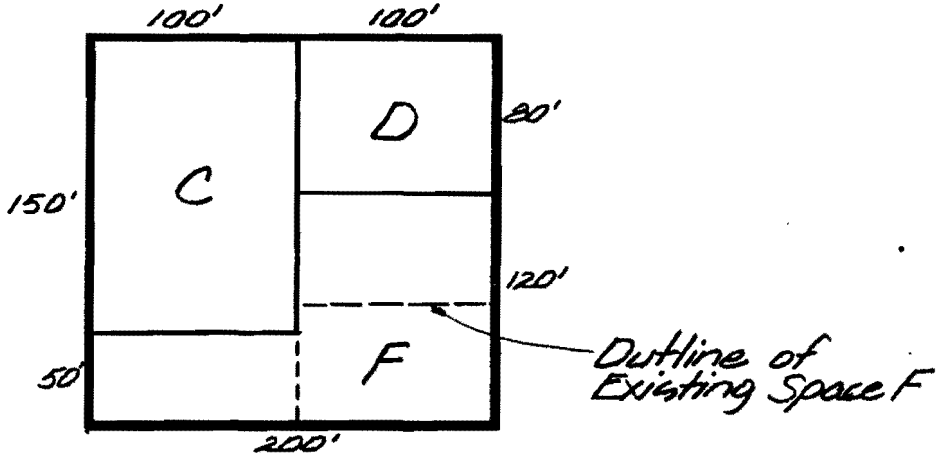
A diagram prepared when most data about major tasks is available and the actual project work is about to begin or is underway. The working network should be sufficiently detailed so as to define key points or milestones at closely spaced intervals. It should contain tasks with durations of one to 10 working days. The second level network is the one most commonly used during project implementation.

THIRD LEVEL NETWORK - Key Operation Sub Diagram

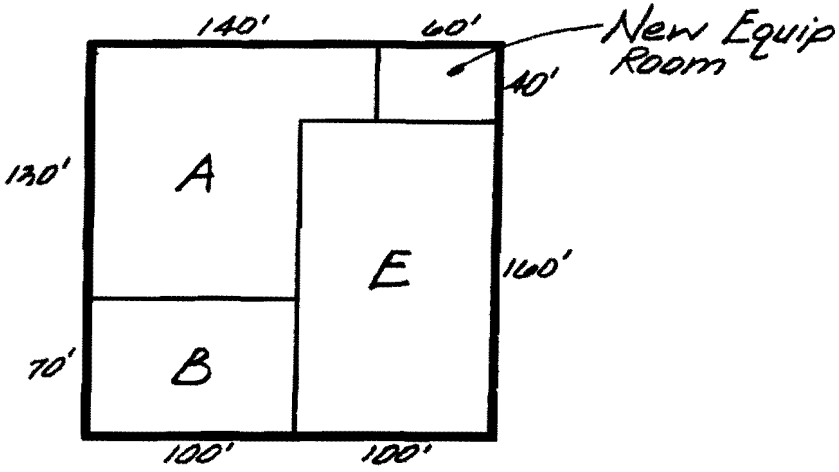
A diagram prepared for the detailed planning of smaller operations within the second level network. Task durations usually range from one to five working days. Most often these networks are prepared by or for sub-contractors, vendors, suppliers, manufacturers and conform to established early start/late finish limits determined from the second level network.



EXISTING 1ST FL



NEW 1ST FL



NEW 2ND FL

SCALE: 1" = 100'

SUMMARY MOVE PLAN

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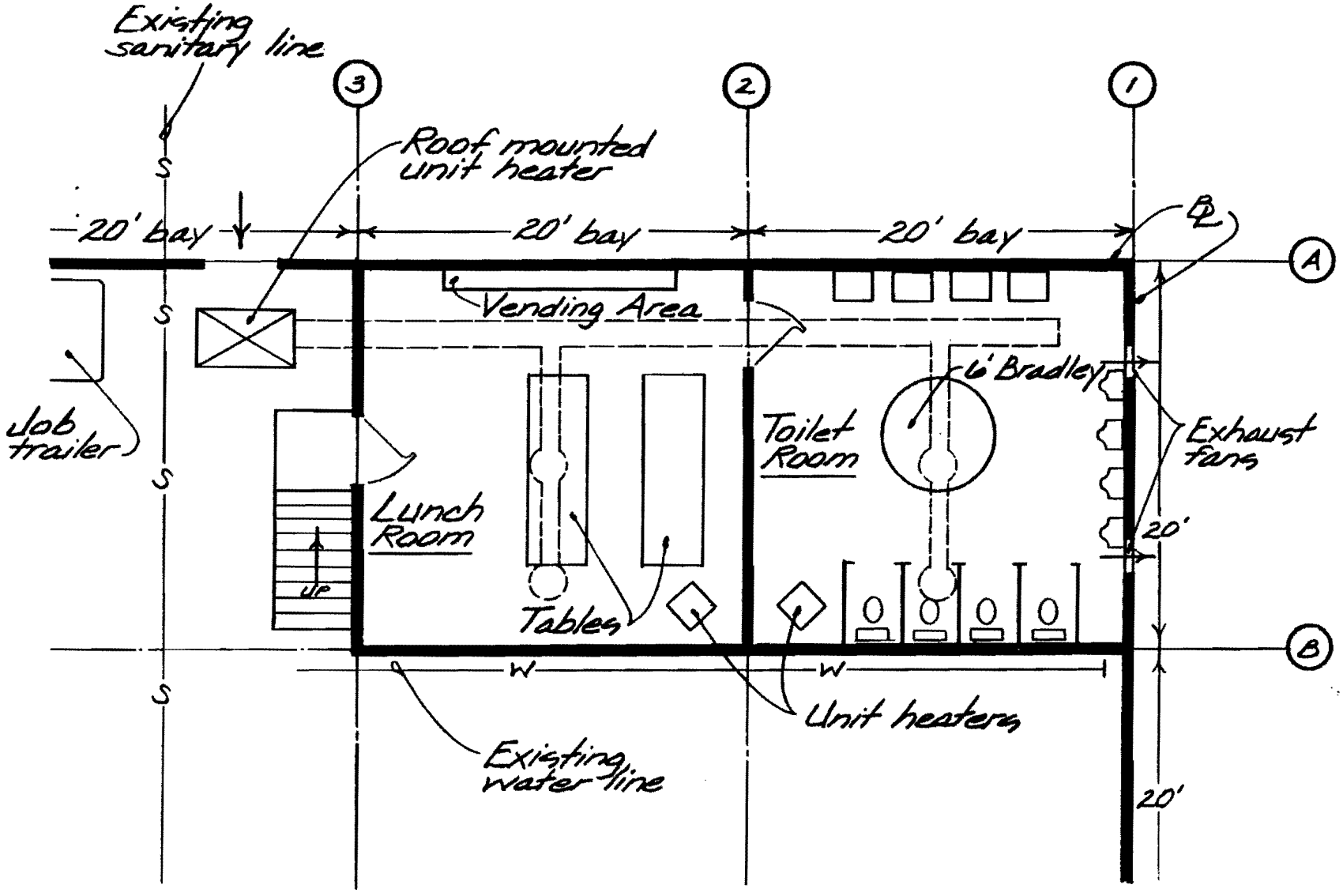
CONSULTING ENGINEER

D12

HO 209



STRAX COMPANY MEZZANINE

LUNCH & TOILET ROOM ADDITION

NORTH

SCALE 1/8"=1'-0"

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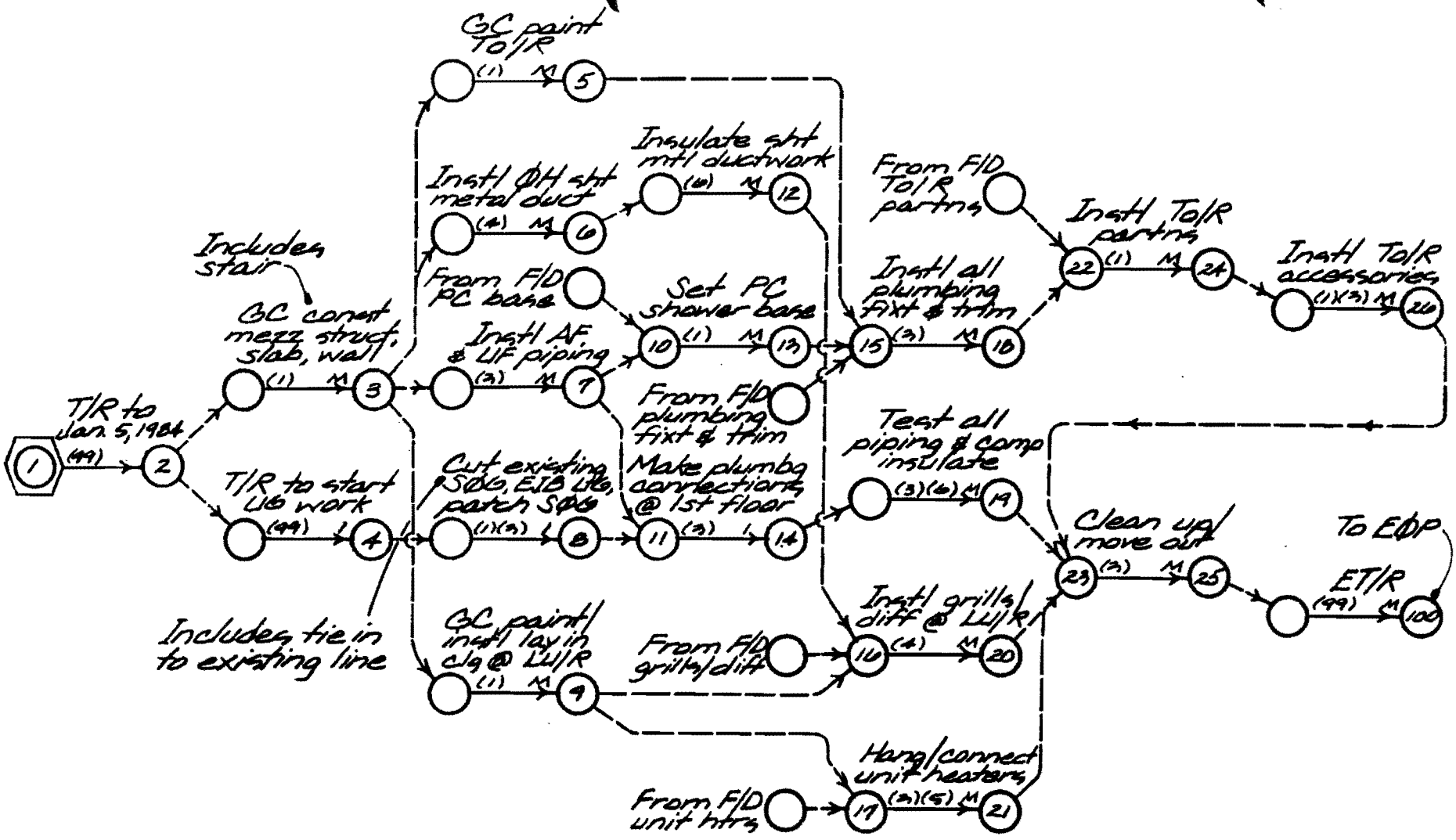

D14

HO 208

Responsibility Codes

1	Strax Manufacturing
2	Harbor Contracting - G.C.
3	Arco Mechanical Piping
4	Sency Sheet Metal
5	Bus Electric
6	Astro Insulators
99	Time restraints

Abbreviations

T/R	Time restraint	EJB	Excavate, instl, backfill
GC	General contractor	S/OG	Slab on grade
UG	Underground	PC	Pre cast
ΦH	Overhead	T/O/R	Toilet room
AF	Above floor	LU/R	Lunch room
UF	Under floor	1	1st floor
F/D	Fabricate/deliver	M	Mezz floor

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SCOPE OF WORK CHECKLIST ITEMS

1. Conditions existing as of the defined start of project work.
(Permits, contracts, easements, obstructions, pre-ordered materials, agreements, etc.)

2. Front end work
(Work involving permits, contract documents, procurement, detailing, fabrication, deliveries, approvals and other non-construction project items)

3. Off-site work
(Work outside the project property line that has a direct influence and is of importance to achieving project goals)

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4. Site work
(Work outside the building line and within the property line or contract limits)

5. Substructure
(Footings, foundation walls, piling, caissons and all related work which transmits loads to the sub-soil)

D/C

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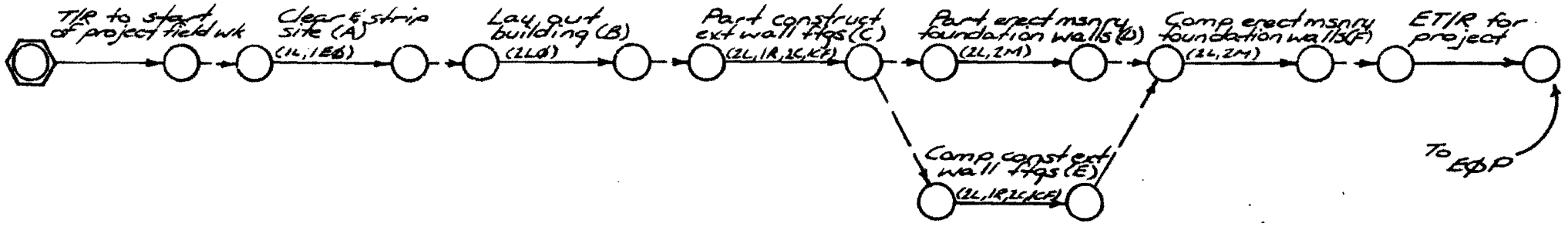
6. Superstructure
(All structural items which directly or indirectly transmit building loads back to the substructure)

7. Exterior skin
(All work to close the building to weather)

8. Interior rough work
(Interior work which can be totally or partially exposed to weather)

9. Interior finish work
(Interior work which must be partially or totally protected from weather)

10. Systems work
(Work which collectively makes up a total operating unit and can be identified as a separate work project from other project elements)



13

RESOURCE CODE

L Labors
EØ Equipment operators
LØ Layout engineers
R Reinforcing stl workers
C Carpenters
CF Cement finishers
M Masons

RESOURCE ALLOCATION

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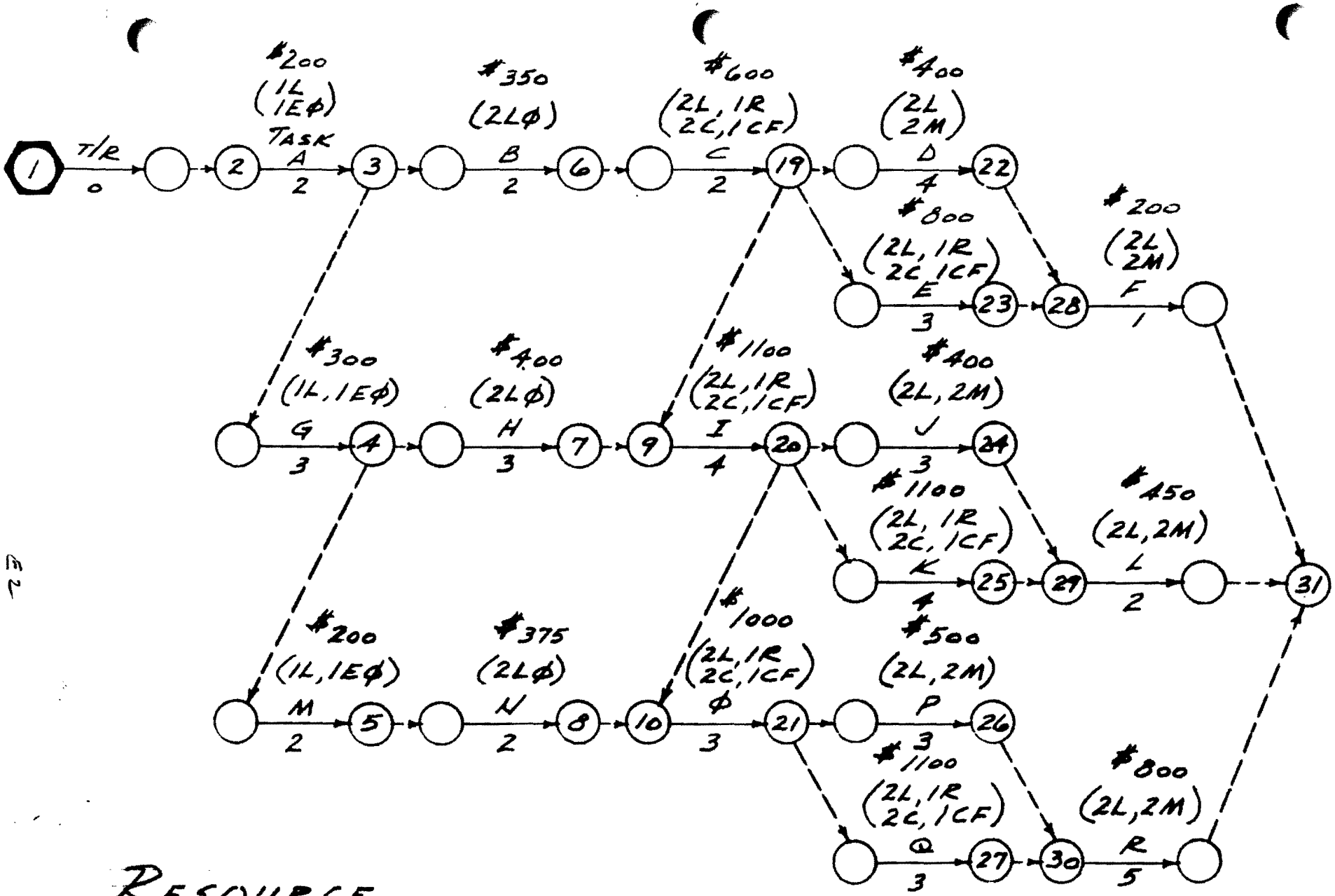


RESOURCE ALLOCATION

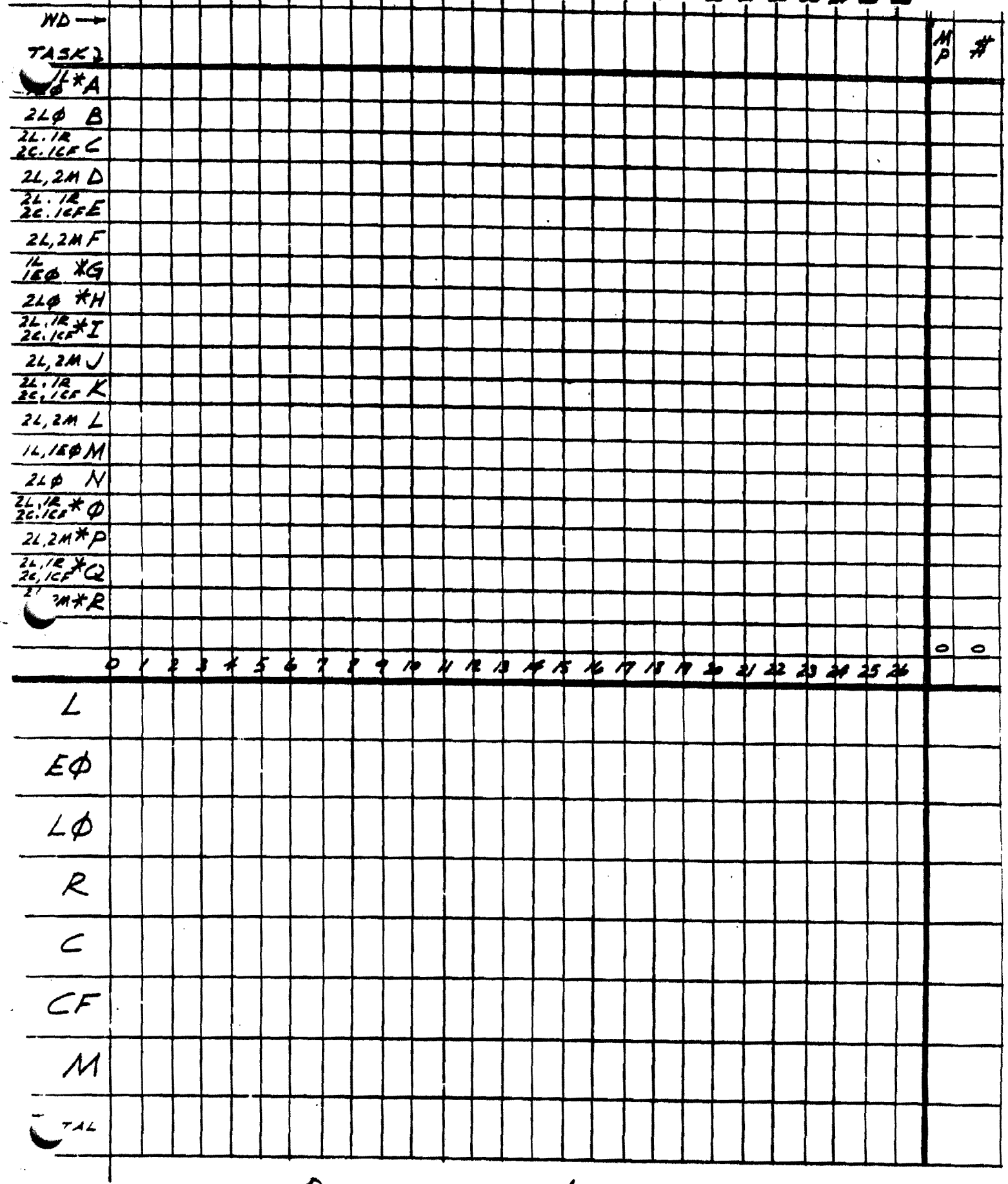
RALPH J. STEPHENSON, P.E.

MAY 29, 1968

RESERVED NODE NOS.

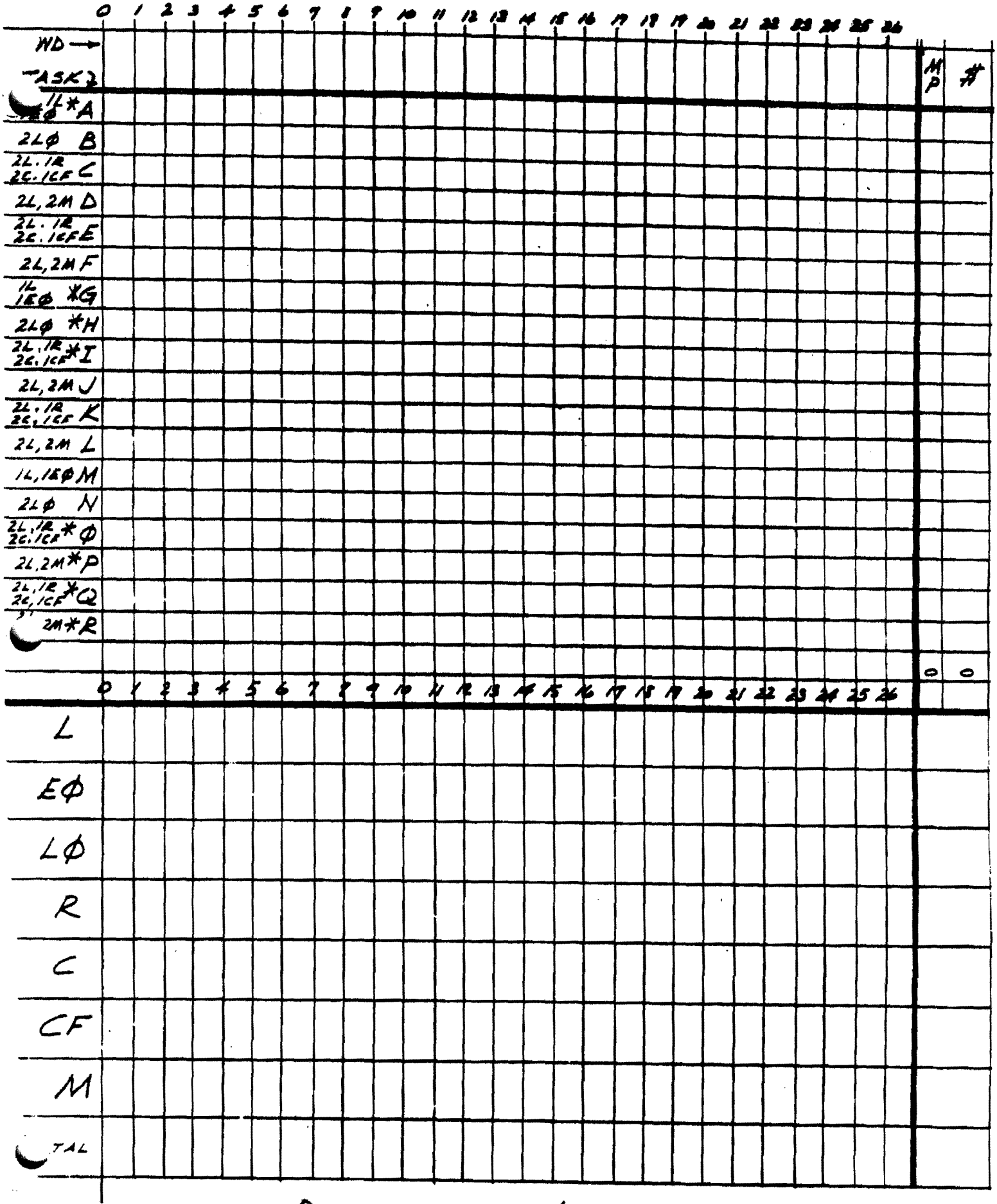
11	15
12	16
13	17
14	18

SHT. 1



RESOURCE ALLOCATION

MAY 29, 1968 E3 RALPH J. STEPHENSON, P.E.



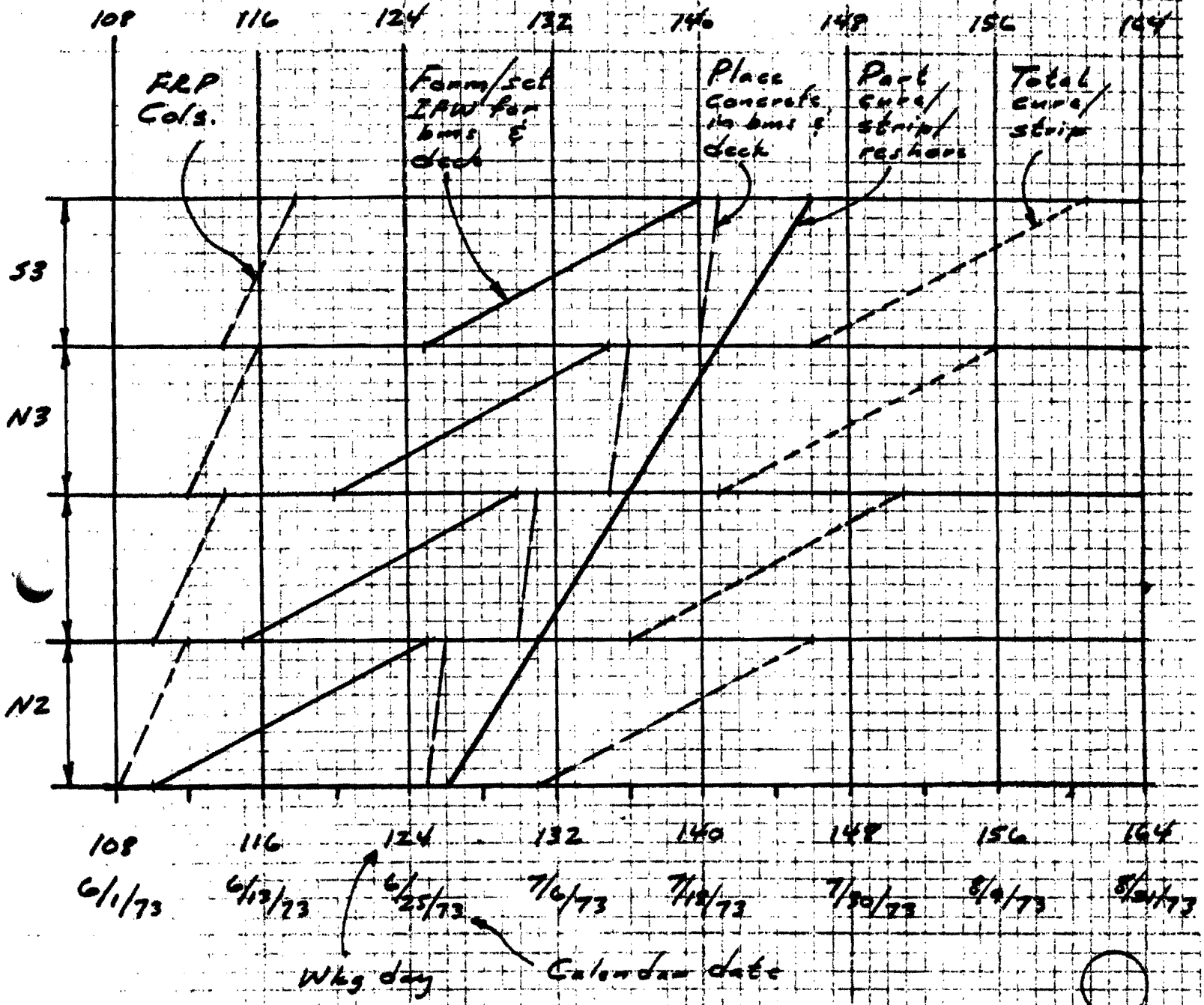
RESOURCE ALLOCATION

MAY 29, 1968 E4 RALPH J. STEPHENSON, P.E.

RALPH J. STEPHENSON CONSULTING ENGINEER 15064 WARWICK ROAD DETROIT 23, MICHIGAN PHONE 273-5026

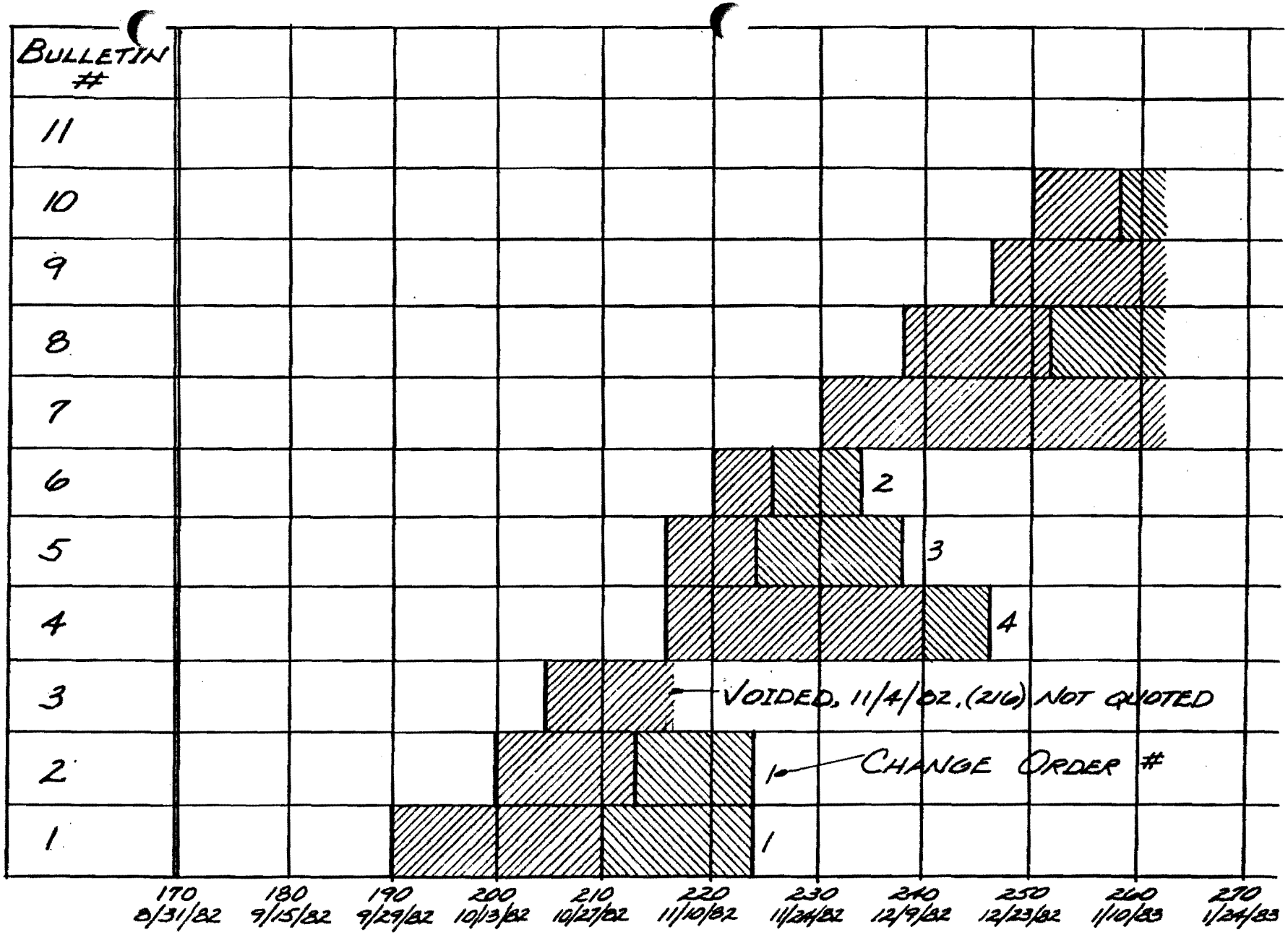
Subject Slant Chart - Floor Pours Date 3/1/73
N2, S2, N3, S3 Page (1)

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



ES

3/28/73



Bulletin quoting period

Quote evaluation period

BULLETIN/CHANGE ORDER RECORD

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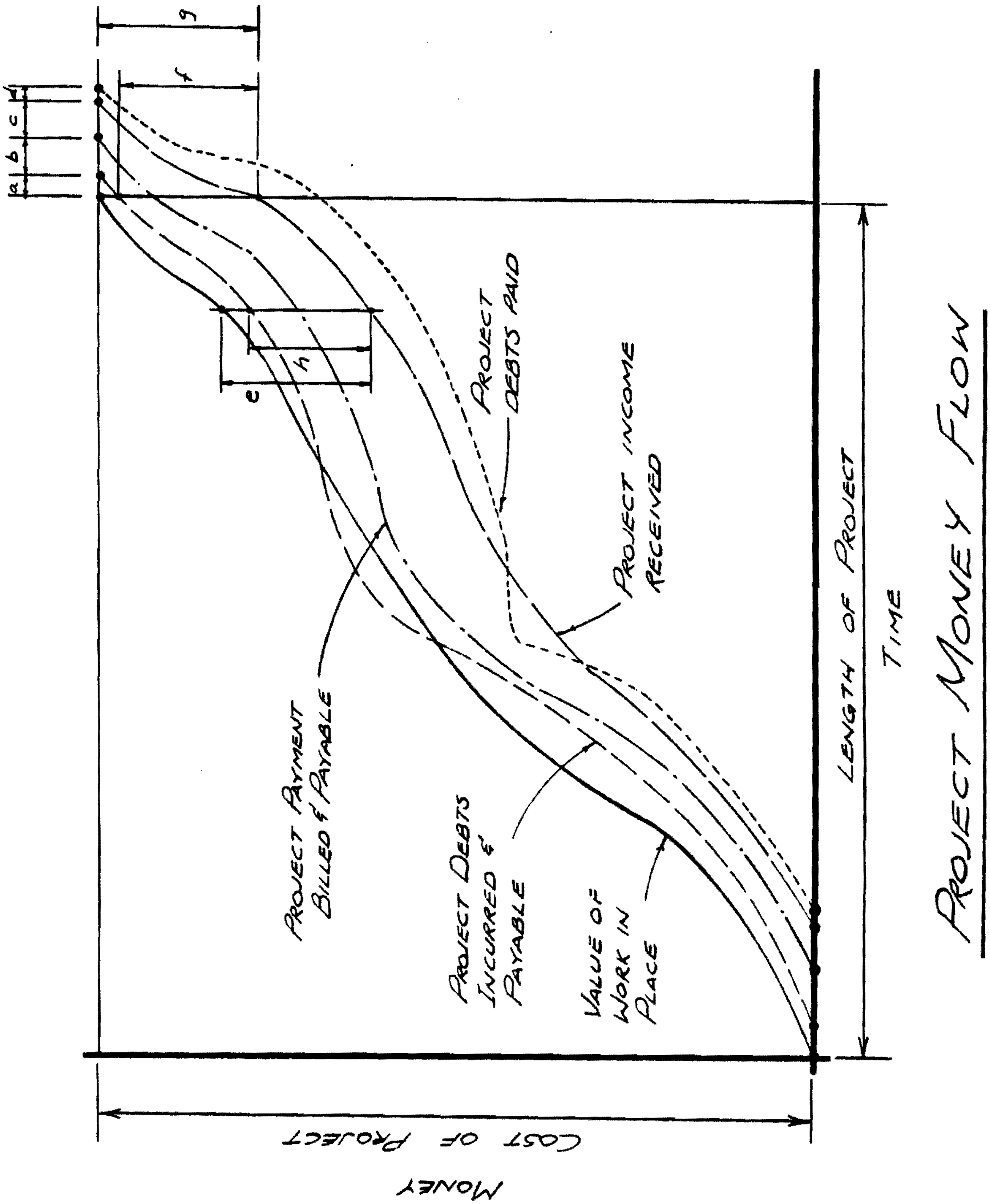
PROJECT MONEY FLOW
LENGTH OF PROJECT
TIME
COST OF PROJECT
MONEY
PROJECT DEBTS PAID
PROJECT INCOME RECEIVED
PROJECT PAYMENT BILLED & PAYABLE
PROJECT DEBTS INCURRED & PAYABLE
VALUE OF WORK IN PLACE
a
b
c
d
e
f
g
h

NETWORK MODEL FOR NEW OFFICE FACILITY HIGHLAND AND MORAN
KEITH, IOWA

VICTORIA MECHANICAL COMPANY

PROJECT NO 76-10 ISSUE NO. 1 DATED APRIL 26, 1976

RALPH J STEPHENSON P E - CONSULTANT

DATES ARE SHOWN AS MONTH,DAY,YR '0' IN TFT COL INDICATES CRITICAL ITEM

I	J	DAYS	RSP	LOC CD	AND DESCRIPTION	COST	NODE SEQUENCE E/S	L/S	E/F	L/F	TF
1	2	106	0		T/R TO START OF PROJECT		1026	1026	5316	5316	0
2	3	65	0	1	T/R POUR OUT 1ST FL SOG		6016	6226	8316	9226	15
2	4	69	0	2	T/R TO POUR OUT 2ND DECK		6016	6166	9076	9226	11
2	5	58	0	R	T/R TO C ER RF MTL DECK		6016	7206	8206	10086	34
2	6	70	0	R	T/R TO C LAY INSUL & RFG		6016	7166	9086	10226	32
2	7	102	0		T/R TO C EXT MSNRY&GLZNG		6016	6016	10226	10226	0
3	101	0	0		D		9016	9286	8316	9276	18
3	102	0	0		D		9016	9246	8316	9236	16
3	103	0	0		D		9016	10016	8316	9306	21
3	104	0	0		D		9016	10066	8316	10056	24
3	105	0	0		D		9016	9236	8316	9226	15
3	106	0	0		D		9016	9306	8316	9296	20
4	101	0	0		D		9086	9286	9076	9276	14
4	102	0	0		D		9086	9246	9076	9236	12
4	103	0	0		D		9086	10016	9076	9306	17
4	104	0	0		D		9086	10066	9076	10056	20
4	105	0	0		D		9086	9236	9076	9226	11
4	106	0	0		D		9086	9306	9076	9296	16
5	132	0	0		D		8236	10146	8206	10136	37
5	133	0	0		D		8236	10116	8206	10086	34
5	134	0	0		D		8236	10196	8206	10186	40
5	135	0	0		D		8236	10196	8206	10186	40
5	136	0	0		D		8236	10126	8206	10116	35
5	137	0	0		D		8236	10186	8206	10156	39
6	125	0	0		D		9096	10256	9086	10226	32
7	125	0	0		D		10256	10256	10226	10226	0
101	107	6	6	1	P INS SPRINKLER PIPG	2880	9086	9286	9156	10056	14
102	108	8	2	1	P INS SHT MTL DCT&FTINGS	4800	9086	9246	9176	10056	12
103	109	3	1	1	P INS DMSTC WTR PPG-CLG	720	9086	10016	9106	10056	17
104	110	4	1	1	P INS HTG&CLNG PPG IN CLG	960	9086	10066	9136	10116	20
105	111	9	1	1	INS TO/R PLUMBG RISERS	2160	9086	9236	9206	10056	11
106	112	4	3	1	P INS RUFF ELEC CNDT&FDRS		9086	9306	9136	10056	16
107	113	0	0		D		9166	10066	9156	10056	14
107	114	5	6	1	C INS SPRINKLER PIPG	2400	9166	10126	9226	10186	18
107	132	0	0		D		9166	10146	9156	10136	20
107	132	0	0		D		9166	10146	9156	10136	20
108	113	0	0		D		9206	10066	9176	10056	12
108	115	8	2	1	C INS SHT MTL DUCT&FTTNGS	4800	9206	10076	9296	10186	13
108	133	0	0		D		9206	10116	9176	10086	15
108	133	0	0		D		9206	10116	9176	10086	15
109	113	0	0		D		9136	10066	9106	10056	17
109	116	3	1	1	C INS DMSTC WTR PPG-CLG	720	9136	10146	9156	10186	23
109	134	0	0		D		9136	10196	9106	10186	26

I	J	DAYS	RSP	LOC CD	AND DESCRIPTION	COST	NODE SEQUENCE E/S	L/S	E/F	L/F	TF
109	134	0	0		D		9136	10196	9106	10186	26
110	117	5	1	1	C INS HTG&CLNG PPG IN CLG	1200	9146	10126	9206	10186	20
110	135	0	0		D		9146	10196	9136	10186	25
110	135	0	0		D		9146	10196	9136	10186	25
111	113	0	0		D		9216	10066	9206	10056	11
111	136	0	0		D		9216	10126	9206	10116	15
111	136	0	0		D		9216	10126	9206	10116	15
112	113	0	0		D		9146	10066	9136	10056	16
112	119	3	3	1	C INS RUFF ELEC CNDT&FDRS		9146	10146	9166	10186	22
112	137	0	0		D		9146	10186	9136	10156	24
112	137	0	0		D		9146	10186	9136	10156	24
113	118	6	4	1	ER INT MSNRY PARTNS		9216	10066	9286	10136	11
114	120	0	0		D		9236	10196	9226	10186	18
115	120	0	0		D		9306	10196	9296	10186	13
116	120	0	0		D		9166	10196	9156	10186	23
117	120	0	0		D		9216	10196	9206	10186	20
118	121	3	5	1	P ER STUDS FOR DRY WALL		9296	10146	10016	10186	11
119	120	0	0		D		9176	10196	9166	10186	22
120	122	0	0		D		9306	10196	9296	10186	13
121	122	0	0		D		10046	10196	10016	10186	11
121	124	3	5	1	C ER STUDS FOR DRY WALL		10046	10226	10066	10266	14
122	123	4	1	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
122	123	4	3	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
123	125	0	0		D		10086	10256	10076	10226	11
123	126	0	0		D		10086	10276	10076	10266	13
124	126	0	0		D		10076	10276	10066	10266	14
124	161	0	0		D		10076	10286	10066	10276	15
124	161	0	0		D		10076	10286	10066	10276	15
125	128	5	5	1	P HANG DRY WALL		10256	10256	10296	10296	0
126	127	3	1	1	C INS IN WLL MECH/ELEC WK	1440	10066	10276	10126	10296	13
126	127	3	3	1	C INS IN WLL MECH/ELEC WK	1440	10086	10276	10126	10296	13
127	128	0	0		D		10136	11016	10126	10296	13
127	163	0	0		D		10136	11026	10126	11016	14
127	163	0	0		D		10136	11026	10126	11016	14
128	129	5	5	1	COMP HANG DRY WALL		11016	11016	11056	11056	0
129	130	0	0		D		11086	11086	11056	11056	0
129	166	0	0		D		11086	11086	11056	11056	0
129	166	0	0		D		11086	11086	11056	11056	0
130	131	4	1	1	INS FIN TUBE PIPING	960	11086	11086	11116	11116	0
131	400	12	0	1	ET/R		11126	11126	11306	11306	0
131	170	0	0		D		11126	11246	11116	11236	8
131	170	0	0		D		11126	11246	11116	11236	8
132	138	6	6	2	P INS SPRINKLER PIPING	2880	9166	10146	9236	10216	20
133	139	8	2	2	P INS SHT MTL DUCT FTTNGS	4800	9206	10116	9296	10206	15
134	140	3	1	2	P INS DMSTC WTR PPG-CLG	720	9136	10196	9156	10216	26
135	151	3	1	2	P INS HTG&CLNG PPG IN CLG	720	9146	10196	9166	10216	25
136	153	8	1	2	INS TO/R PLMG RISERS	1920	9216	10126	9306	10216	15
137	152	4	3	2	P INS RUFF ELEC CNDT&FDRS		9146	10186	9176	10216	24
138	153	0	0		D		9246	10226	9236	10216	20
138	154	5	6	2	C INS SPRINKLER PIPG	2400	9246	10266	9306	11016	22
139	153	0	0		D		9306	10226	9296	10216	16
139	155	8	2	2	C INS SHT MTL DUCT&FTTNGS	4800	9306	10216	10116	11016	15
140	153	0	0		D		9166	10226	9156	10216	26
140	156	3	1	2	C INS DMSTC WTR PPG-CLG	720	9166	10286	9206	11016	30

I	J	DAYS	RSP	LOC CD	AND DESCRIPTION	COST	NODE SEQUENCE E/S	L/S	E/F	L/F	TF
151	153	0	0		D		9176	10226	9166	10216	25
151	157	2	1	2	C INS HTG&CLNG PPG IN CLG	480	9176	10296	9206	11016	30
152	153	0	0		D		9206	10226	9176	10216	24
152	159	3	3	2	C INS RUFF ELEC CNDT&FDRS		9206	10286	9226	11016	28
153	158	4	4	2	ER INT MSNRY PARTNS		10016	10226	10066	10276	15
154	160	0	0		D		10016	11026	9306	11016	22
155	160	0	0		D		10126	11026	10116	11016	15
156	160	0	0		D		9216	11026	9206	11016	30
157	160	0	0		D		9216	11026	9206	11016	30
158	161	0	0		D		10076	10286	10066	10276	15
159	160	0	0		D		9236	11026	9226	11016	26
160	163	0	0		D		10126	11026	10116	11016	15
161	162	3	5	2	P ER STUDS FOR DRY WALL		10076	10286	10116	11016	15
162	163	0	0		D		10126	11026	10116	11016	15
162	165	4	5	2	C ER STUDS FOR DRY WALL		10126	11046	10156	11096	17
163	164	4	1	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
163	164	4	3	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
164	166	0	0		D		10196	11086	10186	11056	14
164	167	0	0		D		10196	11106	10186	11096	16
165	167	0	0		D		10186	11106	10156	11096	17
166	168	6	5	2	P HANG DRY WALL		11086	11086	11156	11156	0
167	168	4	1	2	C INS IN WLL MECH/ELEC WK	1920	10196	11106	10226	11156	16
167	168	4	3	2	C INS IN WLL MECH/ELEC WK	1920	10196	11106	10226	11156	16
168	169	6	5	2	C HANG DRY WALL		11166	11166	11236	11236	0
169	170	0	0		D		11246	11246	11236	11236	0
170	171	4	1	2	INS FIN TUBE PIPG	960	11246	11246	11306	11306	0
171	400	0	0		ET/R		12016	12016	11306	11306	0
0	0	0					0	0	0	0	0

NETWORK MODEL FOR NEW OFFICE FACILITY HIGHLAND AND MORAN
KEITH, IOWA

VICTORIA MECHANICAL COMPANY

PROJECT NO 76-10 ISSUE NO. 1 DATED APRIL 26, 1976

RALPH J STEPHENSON P E - CONSULTANT

DATES ARE SHOWN AS MONTH,DAY,YR '0' IN TFT COL INDICATES CRITICAL ITEM

I	J	DAYS	LOC RSP	LOC CD	AND DESCRIPTION	COST	EARLY STRT E/S	EARLY STRT L/S	SEQ E/F	SEQ L/F	TF
1	2	106	0		T/R TO START OF PROJECT		1026	1076	5316	5316	0
2	3	69	0	1	T/R POUR OUT 1ST FL SOG		6016	6226	8316	9226	15
2	4	69	0	2	T/R TO POUR OUT 2ND DECK		6016	6166	9076	9226	11
2	5	58	0	R	T/R TO C ER RF MTL DECK		6016	7206	8206	10086	34
2	6	70	0	R	T/R TO C LAY INSUL & RFG		6016	7166	9086	10226	32
2	7	102	0		T/R TO C EXT MSNRY&GLZNG		6016	6016	10226	10226	0
101	107	6	6	1	P INS SPRINKLER PIPG	2880	9086	9286	9156	10056	14
102	108	8	2	1	P INS SHT MTL DCTG&FTINGS	4800	9086	9246	9176	10056	12
103	109	3	1	1	P INS DMSTC WTR PPG-CLG	720	9086	10016	9106	10056	17
104	110	4	1	1	P INS HTG&CLNG PPG IN CLG	960	9086	10066	9136	10116	20
105	111	9	1	1	INS TO/R PLUMBG RISERS	2160	9086	9236	9206	10056	11
106	112	4	3	1	P INS RUFF ELEC CNDT&FDRS		9086	9306	9136	10056	16
109	116	3	1	1	C INS DMSTC WTR PPG-CLG	720	9136	10146	9156	10186	23
134	140	3	1	2	P INS DMSTC WTR PPG-CLG	720	9136	10196	9156	10216	26
110	117	5	1	1	C INS HTG&CLNG PPG IN CLG	1200	9146	10126	9206	10186	20
112	119	3	3	1	C INS RUFF ELEC CNDT&FDRS		9146	10146	9166	10186	22
135	151	3	1	2	P INS HTG&CLNG PPG IN CLG	720	9146	10196	9166	10216	25
137	152	4	3	2	P INS RUFF ELEC CNDT&FDRS		9146	10186	9176	10216	24
107	114	5	6	1	C INS SPRINKLER PIPG	2400	9166	10126	9226	10186	18
132	138	6	6	2	P INS SPRINKLER PIPING	2880	9166	10146	9236	10216	20
140	156	3	1	2	C INS DMSTC WTR PPG-CLG	720	9166	10286	9206	11016	30
151	157	2	1	2	C INS HTG&CLNG PPG IN CLG	480	9176	10296	9206	11016	30
108	115	8	2	1	C INS SHT MTL DUCT&FTINGS	4800	9206	10076	9296	10186	13
133	139	8	2	2	P INS SHT MTL DUCT FTINGS	4800	9206	10116	9296	10206	15
152	159	3	3	2	C INS RUFF ELEC CNDT&FDRS		9206	10286	9226	11016	28
113	118	6	4	1	ER INT MSNRY PARTNS		9216	10066	9286	10136	11
136	153	8	1	2	INS TO/R PLMG RISERS	1920	9216	10126	9306	10216	15
138	154	5	6	2	C INS SPRINKLER PIPG	2400	9246	10266	9306	11016	22
118	121	3	5	1	P ER STUDS FOR DRY WALL		9296	10146	10016	10186	11
139	155	8	2	2	C INS SHT MTL DUCT&FTINGS	4800	9306	10216	10116	11016	15
153	158	4	4	2	ER INT MSNRY PARTNS		10016	10226	10066	10276	15
121	124	3	5	1	C ER STUDS FOR DRY WALL		10046	10226	10066	10266	14
122	123	4	1	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
122	123	4	3	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
161	162	3	5	2	P ER STUDS FOR DRY WALL		10076	10286	10116	11016	15
126	127	3	1	1	C INS IN WLL MECH/ELEC WK	1440	10086	10276	10126	10296	13
126	127	3	3	1	C INS IN WLL MECH/ELEC WK	1440	10086	10276	10126	10296	13
162	165	4	5	2	C ER STUDS FOR DRY WALL		10126	11046	10156	11096	17
163	164	4	1	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
163	164	4	3	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
167	168	4	1	2	C INS IN WLL MECH/ELEC WK	1920	10196	11106	10226	11156	16
167	168	4	3	2	C INS IN WLL MECH/ELEC WK	1920	10196	11106	10226	11156	16
125	128	5	5	1	P HANG DRY WALL		10256	10256	10296	10296	0

E12

I	J	DAYS	LOC RSP	CD	AND DESCRIPTION	COST	EARLY STRT SEQ E/S	L/S	E/F	L/F	TF
128	129	5	5	1	COMP HANG DRY WALL		11016	11016	11056	11056	0
130	131	4	1	1	INS FIN TUBE PIPING	960	11086	11086	11116	11116	0
166	168	6	5	2	P HANG DRY WALL		11086	11086	11156	11156	0
131	400	12	0	1	ET/R		11126	11126	11306	11306	0
168	169	6	5	2	C HANG DRY WALL		11166	11166	11236	11236	0
170	171	4	1	2	INS FIN TUBE PIPG	960	11246	11246	11306	11306	0

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RALPH J STEPHENSON P E - CONSULTANT

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I	J	DAYS	LOC RSP	LOC CD	AND DESCRIPTION	COST	LATE STRT SEQ E/S	L/S	E/F	L/F	TF
1	2	106	0		T/R TO START OF PROJECT		1026	1026	5316	5316	0
2	7	102	0		T/R TO C EXT MSNRY&GLZNG		6016	6016	10226	10226	0
2	4	69	0	2	T/R TO POUR OUT 2ND DECK		6016	6166	9076	9226	11
2	3	65	0	1	T/R POUR OUT 1ST FL SOG		6016	6226	8316	9226	15
2	6	70	0	R	T/R TO C LAY INSUL & RFG		6016	7166	9086	10226	32
2	5	58	0	R	T/R TO C ER RF MTL DECK		6016	7206	8206	10056	34
105	111	9	1	1	INS TO/R PLUMBG RISERS	2160	9086	9236	9206	10056	11
102	108	8	2	1	P INS SHT MTL DCT&FTTNGS	4800	9086	9246	9176	10056	12
101	107	6	6	1	P INS SPRINKLER PIPG	2880	9086	9286	9156	10056	14
106	112	4	3	1	P INS RUFF ELEC CNDT&FDRS		9086	9306	9136	10056	16
103	109	3	1	1	P INS DMSTC WTR PPG-CLG	720	9086	10016	9106	10056	17
104	110	4	1	1	P INS HTG&CLNG PPG IN CLG	960	9086	10066	9136	10116	20
113	118	6	4	1	ER INT MSNRY PARTNS		9216	10066	9286	10136	11
108	115	8	2	1	C INS SHT MTL DUCT&FITTNGS	4800	9206	10076	9296	10186	13
133	139	8	2	2	P INS SHT MTL DUCT FTTNGS	4800	9206	10116	9296	10206	15
107	114	5	6	1	C INS SPRINKLER PIPG	2400	9166	10126	9226	10186	18
110	117	5	1	1	C INS HTG&CLNG PPG IN CLG	1200	9146	10126	9206	10186	20
136	153	8	1	2	INS TO/R PLMG RISERS	1920	9216	10126	9306	10216	15
109	116	3	1	1	C INS DMSTC WTR PPG-CLG	720	9136	10146	9156	10186	23
112	119	3	3	1	C INS RUFF ELEC CNDT&FDRS		9146	10146	9166	10186	22
118	121	3	5	1	P ER STUDS FOR DRY WALL		9296	10146	10016	10186	11
132	138	6	6	2	P INS SPRINKLER PIPING	2880	9166	10146	9236	10216	20
137	152	4	3	2	P INS RUFF ELEC CNDT&FDRS		9146	10186	9176	10216	24
122	123	4	1	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
122	123	4	3	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
134	140	3	1	2	P INS DMSTC WTR PPG-CLG	720	9136	10196	9156	10216	26
135	151	3	1	2	P INS HTG&CLNG PPG IN CLG	720	9146	10196	9166	10216	25
139	155	8	2	2	C INS SHT MTL DUCT&FTTNGS	4800	9306	10216	10116	11016	15
121	124	3	5	1	C ER STUDS FOR DRY WALL		10046	10226	10066	10266	14
153	158	4	4	2	ER INT MSNRY PARTNS		10016	10226	10066	10276	15
125	128	5	5	1	P HANG DRY WALL		10256	10256	10296	10296	0
138	154	5	6	2	C INS SPRINKLER PIPG	2400	9246	10266	9306	11016	22
126	127	3	1	1	C INS IN WLL MECH/ELEC WK	1440	10086	10276	10126	10296	13
126	127	3	3	1	C INS IN WLL MECH/ELEC WK	1440	10086	10276	10126	10296	13
140	156	3	1	2	C INS DMSTC WTR PPG-CLG	720	9166	10286	9206	11016	30
152	159	3	3	2	C INS RUFF ELEC CNDT&FDRS		9206	10286	9226	11016	28
161	162	3	5	2	P ER STUDS FOR DRY WALL		10076	10286	10116	11016	15
151	157	2	1	2	C INS HTG&CLNG PPG IN CLG	480	9176	10296	9206	11016	30
128	129	5	5	1	COMP HANG DRY WALL		11016	11016	11056	11056	0
163	164	4	1	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
163	164	4	3	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
162	165	4	5	2	C ER STUDS FOR DRY WALL		10126	11046	10156	11096	17
130	131	4	1	1	INS FIN TUBE PIPING	960	11086	11086	11116	11116	0

I	J	DAYS	LOC RSP	CD	AND DESCRIPTION	COST	LATE STRT SEQ E/S	L/S	E/F	L/F	TF
166	168	6	5	2	P HANG DRY WALL		11086	11086	11156	11156	0
167	168	4	1	2	C INS IN WLL MECH/ELEC WK 1920		10196	11106	10226	11156	16
167	168	4	3	2	C INS IN WLL MECH/ELEC WK 1920		10196	11106	10226	11156	16
131	400	12	0	1	ET/R		11126	11126	11306	11306	0
168	169	6	5	2	C HANG DRY WALL		11166	11166	11236	11236	0
170	171	4	1	2	INS FIN TUBE PIPG	960	11246	11246	11306	11306	0

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I	J	DAYS	RSP	LOC CD	AND DESCRIPTION	COST	LATE E/S	LATE L/S	FINISH SEQ E/F	FINISH SEQ L/F	TF
1	2	106	0		T/R TO START OF PROJECT		1026	1026	5316	5316	0
2	3	65	0	1	T/R POUR OUT 1ST FL SOG		6016	6226	8316	9226	15
2	4	69	0	2	T/R TO POUR OUT 2ND DECK		6016	6166	9076	9226	11
101	107	6	6	1	P INS SPRINKLER PIPG	2880	9086	9286	9156	10056	14
102	108	8	2	1	P INS SHT MTL DCT&FTTNGS	4800	9086	9246	9176	10056	12
103	109	3	1	1	P INS DMSTC WTR PPG-CLG	720	9086	10016	9106	10056	17
105	111	9	1	1	INS TO/R PLUMBG RISERS	2160	9086	9236	9206	10056	11
106	112	4	3	1	P INS RUFF ELEC CNDT&FDRS		9086	9306	9136	10056	16
2	5	58	0	R	T/R TO C ER RF MTL DECK		6016	7206	8206	10086	34
104	110	4	1	1	P INS HTG&CLNG PPG IN CLG	960	9086	10066	9136	10116	20
113	118	6	4	1	ER INT MSNRY PARTNS		9216	10066	9286	10136	11
107	114	5	6	1	C INS SPRINKLER PIPG	2400	9166	10126	9226	10186	18
108	115	8	2	1	C INS SHT MTL DUCT&FTTNGS	4800	9206	10076	9296	10186	13
109	116	3	1	1	C INS DMSTC WTR PPG-CLG	720	9136	10146	9156	10186	23
110	117	5	1	1	C INS HTG&CLNG PPG IN CLG	1200	9146	10126	9206	10186	20
112	119	3	3	1	C INS RUFF ELEC CNDT&FDRS		9146	10146	9166	10186	22
118	121	3	5	1	P ER STUDS FOR DRY WALL		9296	10146	10016	10186	11
133	139	8	2	2	P INS SHT MTL DUCT FTTNGS	4800	9206	10116	9296	10206	15
132	138	6	6	2	P INS SPRINKLER PIPING	2880	9166	10146	9236	10216	20
134	140	3	1	2	P INS DMSTC WTR PPG-CLG	720	9136	10196	9156	10216	26
135	151	3	1	2	P INS HTG&CLNG PPG IN CLG	720	9146	10196	9166	10216	25
136	153	6	1	2	INS TO/R PLMG RISERS	1920	9216	10126	9306	10216	15
137	152	4	3	2	P INS RUFF ELEC CNDT&FDRS		9146	10186	9176	10216	24
2	6	70	0	R	T/R TO C LAY INSUL & RFG		6016	7166	9086	10226	32
2	7	102	0		T/R TO C EXT MSNRY&GLZNG		6016	6016	10226	10226	0
122	123	4	1	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
122	123	4	3	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
121	124	3	5	1	C ER STUDS FOR DRY WALL		10046	10226	10066	10266	14
153	158	4	4	2	ER INT MSNRY PARTNS		10016	10226	10066	10276	15
125	128	5	5	1	P HANG DRY WALL		10256	10256	10296	10296	0
126	127	3	1	1	C INS IN WLL MECH/ELEC WK	1440	10086	10276	10126	10296	13
126	127	3	3	1	C INS IN WLL MECH/ELEC WK	1440	10066	10276	10126	10296	13
138	154	5	6	2	C INS SPRINKLER PIPG	2400	9246	10266	9306	11016	22
139	155	8	2	2	C INS SHT MTL DUCT&FTTNGS	4800	9306	10216	10116	11016	15
140	156	3	1	2	C INS DMSTC WTR PPG-CLG	720	9166	10286	9206	11016	30
151	157	2	1	2	C INS HTG&CLNG PPG IN CLG	480	9176	10296	9206	11016	30
152	159	3	3	2	C INS RUFF ELEC CNDT&FDRS		9206	10286	9226	11016	28
161	162	3	5	2	P ER STUDS FOR DRY WALL		10076	10286	10116	11016	15
128	129	5	5	1	COMP HANG DRY WALL		11016	11016	11056	11056	0
163	164	4	1	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
163	164	4	3	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
162	165	4	5	2	C ER STUDS FOR DRY WALL		10126	11046	10156	11056	17
130	131	4	1	1	INS FIN TUBE PIPING	960	11086	11086	11116	11116	0

I	J	DAYS	LOC RSP	CD	AND DESCRIPTION	COST	LATE FINISH SEQ E/S	L/S	E/F	L/F	TF
166	168	6	5	2	P HANG DRY WALL		11086	11086	11156	11156	0
167	168	4	1	2	C INS IN WLL MECH/ELEC WK	1920	10196	11106	10226	11156	16
167	168	4	3	2	C INS IN WLL MECH/ELEC WK	1920	10196	11106	10226	11156	16
168	169	6	5	2	C HANG DRY WALL		11166	11166	11236	11236	0
131	400	12	0	1	ET/R		11126	11126	11306	11306	0
170	171	4	1	2	INS FIN TUBE PIPG	960	11246	11246	11306	11306	0

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I	J	DAYS	LOC RSP	CD	AND DESCRIPTION	COST	TOTAL FLT SEQ E/S	L/S	E/F	L/F	TF
1	2	106	0		T/R TO START OF PROJECT		1026	1026	5316	5316	0
2	7	102	0		T/R TO C EXT MSNRY&GLZNG		6016	6016	10226	10226	0
125	128	5	5	1	P HANG DRY WALL		10256	10256	10296	10296	0
128	129	5	5	1	COMP HANG DRY WALL		11016	11016	11056	11056	0
130	131	4	1	1	INS FIN TUBE PIPING	960	11086	11086	11116	11116	0
131	400	12	0	1	ET/R		11126	11126	11306	11306	0
166	168	6	5	2	P HANG DRY WALL		11086	11086	11156	11156	0
168	169	6	5	2	C HANG DRY WALL		11166	11166	11236	11236	0
170	171	4	1	2	INS FIN TUBE PIPG	960	11246	11246	11306	11306	0
2	4	69	0	2	T/R TO POUR OUT 2ND DECK		6016	6166	9076	9226	11
105	111	9	1	1	INS TO/R PLUMBG RISERS	2160	9086	9236	9206	10056	11
113	118	6	4	1	ER INT MSNRY PARTNS		9216	10066	9286	10136	11
118	121	3	5	1	P ER STUDS FOR DRY WALL		9296	10146	10016	10186	11
122	123	4	1	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
122	123	4	3	1	P INS IN WLL MECH/ELEC WK	1920	10046	10196	10076	10226	11
102	108	8	2	1	P INS SHT MTL DCT&FTTNGS	4800	9086	9246	9176	10056	12
108	115	8	2	1	C INS SHT MTL DUCT&FTTNGS	4800	9206	10076	9296	10186	13
126	127	3	1	1	C INS IN WLL MECH/ELEC WK	1440	10066	10276	10126	10296	13
126	127	3	3	1	C INS IN WLL MECH/ELEC WK	1440	10086	10276	10126	10296	13
101	107	6	6	1	P INS SPRINKLER PIPG	2880	9086	9286	9156	10056	14
121	124	3	5	1	C ER STUDS FOR DRY WALL		10046	10226	10066	10266	14
163	164	4	1	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
163	164	4	3	2	P INS IN WLL MECH/ELEC WK	1920	10136	11026	10186	11056	14
2	3	65	0	1	T/R POUR OUT 1ST FL SOG		6016	6226	8316	9226	15
133	139	8	2	2	P INS SHT MTL DUCT FTTNGS	4800	9206	10116	9296	10206	15
136	153	8	1	2	INS TO/R PLMG RISERS	1920	9216	10126	9306	10216	15
139	155	8	2	2	C INS SHT MTL DUCT&FTTNGS	4800	9306	10216	10116	11016	15
153	158	4	4	2	ER INT MSNRY PARTNS		10016	10226	10066	10276	15
161	162	3	5	2	P ER STUDS FOR DRY WALL		10076	10286	10116	11016	15
106	112	4	3	1	P INS RUFF ELEC CNDT&FDRS		9086	9306	9136	10056	16
167	168	4	1	2	C INS IN WLL MECH/ELEC WK	1920	10196	11106	10226	11156	16
167	168	4	3	2	C INS IN WLL MECH/ELEC WK	1920	10196	11106	10226	11156	16
103	109	3	1	1	P INS DMSTC WTR PPG-CLG	720	9086	10016	9106	10056	17
162	165	4	5	2	C ER STUDS FOR DRY WALL		10126	11046	10156	11096	17
107	114	5	6	1	C INS SPRINKLER PIPG	2400	9166	10126	9226	10186	18
104	110	4	1	1	P INS HTG&CLNG PPG IN CLG	960	9086	10066	9136	10116	20
110	117	5	1	1	C INS HTG&CLNG PPG IN CLG	1200	9146	10126	9206	10186	20
132	138	6	6	2	P INS SPRINKLER PIPING	2880	9166	10146	9236	10216	20
112	119	3	3	1	C INS RUFF ELEC CNDT&FDRS		9145	10146	9166	10186	22
138	154	5	6	2	C INS SPRINKLER PIPG	2400	9246	10266	9306	11016	22
109	116	3	1	1	C INS DMSTC WTR PPG-CLG	720	9136	10146	9156	10186	23
137	152	4	3	2	P INS RUFF ELEC CNDT&FDRS		9146	10186	9176	10216	24
135	151	3	1	2	P INS HTG&CLNG PPG IN CLG	720	9146	10196	9166	10216	25

E/8

H/O 143

I	J	DAYS	RSP	LOC CD	AND DESCRIPTION	COST	TOTAL FLT SEQ E/S	L/S	E/F	L/F	TF
134	140	3	1	2	P INS DMSTC WTR PPG-CLG	720	9136	10196	9156	10216	26
152	159	3	3	2	C INS RUFF ELEC CNDT&FDRS		9206	10286	9226	11016	28
140	156	3	1	2	C INS DMSTC WTR PPG-CLG	720	9166	10286	9206	11016	30
151	157	2	1	2	C INS HTG&CLNG PPG IN CLG	480	9176	10296	9206	11016	30
2	6	70	0	R	T/R TO C LAY INSUL & RFG		6016	7166	9086	10226	32
2	5	58	0	R	T/R TO C ER RF MTL DECK		6016	7206	8206	10086	34

E19

H/O 143

MANAGE BY EXCEPTION

Build an alarm system that goes off when something goes wrong but otherwise remains silent (MX).

A. MX provides management leverage
   1. MX payoff comes from forcing the manager to use forethought and self discipline
   2. Allows multiplying manager's energies and resources (the manager is a multiplier of the work of others)
   3. Allows use of input/output zones (modification of Pareto's Law)
      a. Zone 1 - A relatively small input of managerial resources gives control of a large part of the total results (critical zone for the manager)
      b. Zone 2 - A relatively large input contributes a small portion of the results (good delegation zone)
      c. Zone 3 -The zone where managerial input generates about the same corresponding amount of results (zero leverage, high frustration zone)

B. Examples of MX
   1. Thermostat
   2. Sprinkler system
   3. To do list
   4. Network model (CPM)

C. Questions to answer in MX
   1. What can I as a manager do that will contribute to achieving objectives? (planning)
   2. How can I determine if I am concentrating on the key items? (monitoring)
   3. What actions should I take to be most effective? (controlling and correcting)

D. Watch for the dangers in MX
   1. May encourage excessive conformity and misplaced self satisfaction
   2. May require excessive observation and data collection
   3. Tends to increase paper work
   4. If used incorrectly can give a false sense of security and well being
   5. Is silent only on items predetermined not to be critical. Conditions may change

E. The big advantage of MX is that much of the decision making is done in advance (much like a trouble shooter's manual, a decision tree or a decision table).

F. The manager must understand that once freed by a good MX system from the demands of routine work, he must fill his time with creative effort directed toward improving his plans, organization, staff and decisions.

G. MX is invaluable in detecting trends - movements toward or away from objectives.

H. Beware of overreaction to an MX alert. Remember MX is a tool of the manager, not the manager.

I. Four MX alert levels
   1. No unusual difficulties - everything OK

2. Moderate deviations - the situation needs the manager's attention and analysis
3. Above average deviations - the performance is unacceptable and needs corrective action, or is excellent and may be desirable to sustain
4. Unusally large deviations - the performance is vitally disturbed or is so good as to demand investigation by the manager now

J. Methods of reporting with MX
   1. Word of mouth
      a. Fast
      b. No record left
      c. Listener may appear to comprehend, but might not
   2. Written
      a. Permanent record available
      b. Can be studied anytime
      c. Easily systematized
      d. Irregular reports may allow critical factors to go unnoticed
   3. Charted
      a. Good for presentation to large numbers of people with limited amounts of time
      b. Subject to scale misinterpretation
      c. Requires special resources and talents to do well
   4. Electronically reported
      a. Easily used on selective basis
      b. Data available quickly
      c. High processing error potential

IDENTIFY VITAL TARGETS - Which inputs and outputs most affect the results, the conditions, and the performance the manager wishes to achieve?

A. Rarely is more than one problem out of four worth other than a manager's fleeting glance.

B. The good manager must quickly identify where his efforts are going to do the most good.

C. Must understand Pareto's law. Run samples of Pareto's principles.

D. Fewer than one third of the people a manager supervises require more than two thirds of his time. (Review this for accuracy)

E. Managerial misteps resulting from not understanding the vital target concept include:

1. Following prejudices
2. Sticking with pat systems
3. Doing what is easiest
4. Playing hunches

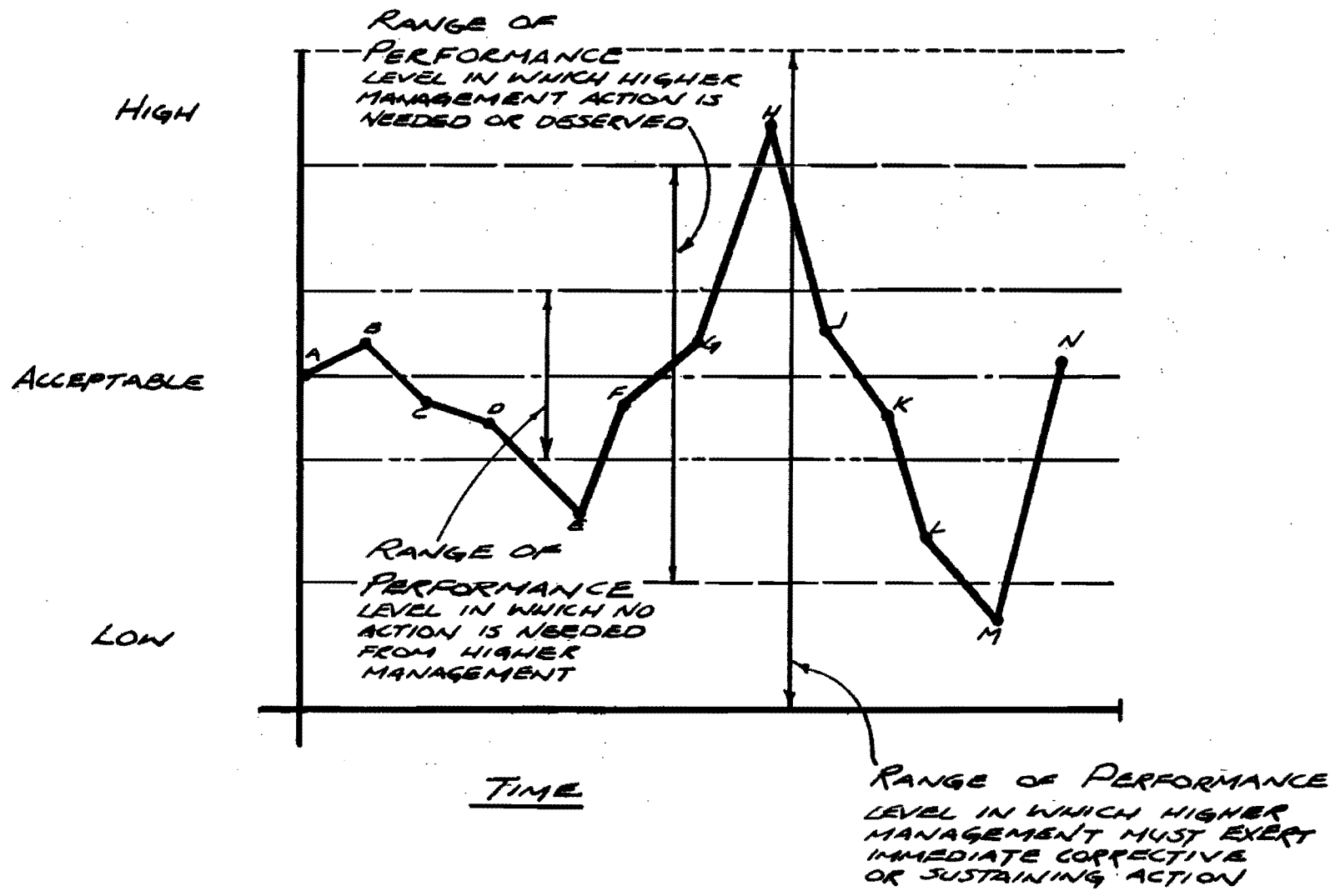
F. Picking the vital few

1. To do lists
2. Setting priorities
3. Rating systems
4. Critical tasks in network models

G. Moving from a situational view to the vital few. (change in perceptive scale.)

H. What to do with the trivial many

1. Delegate
2. Defer (how long?)



MANAGEMENT BY EXCEPTION (MX) AND PERFORMANCE LEVEL ACTIONS

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

STEPS IN MONITORING

1. Make pre inspection review of network model.

2. Personally inspect current project work.

3. Confer with key project management personnel.

4. Make qualitative/quantitative evaluation of project.

5. Identify problems - current and potential.

6. Prepare report.

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

CONTROL SYSTEM TECHNIQUES

Color Coding

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.

Description of Various Listings

The computer output is issued in five (5) major listings - by ascending order of node numbers (node sequence), by ascending order of early start dates (ES sequence), by ascending order of late start dates (LS sequence), by ascending order of late finish dates (LF sequence), and by ascending order of available float time (TF sequence).

Node Sequence

The node sequence is arranged in ascending order, first by i node number, then by j node number, where i node numbers are the same. This is the master list from which all revisions are made. It is also the listing used when referring from the arrow diagram into the computer printout for information.

CONTROL SYSTEM TECHNIQUES
(Page 2)

Node Sequence (continued)

All dummy arrows are shown in this listing since subsequent changes to the network (updating) must be shown on the node sequence list to revise the computer input.

Early Start (ES) Sequence

The early start sequence lists all tasks in ascending order of their earliest possible starting dates. The ES listing is used most often by field management as a check list.

Late Start (LS) Sequence

The LS sequence lists tasks in ascending order of their latest allowable starting dates. This is a monitoring document and is used by first drawing a line under the current date in the LS column, and next evaluating tasks that have not started and are above that line. These tasks will be those that have not met their latest allowable starting dates.

As a suggestion, all tasks that are in-work can be indicated as such by circling their late start date. When tasks are complete, a check mark can be placed in front of their late start dates or the task can be crossed off. Thus, a quick inspection will show which tasks above the current date have not yet started or been completed.

Late Finish (LF) Sequence

The LF sequence lists all tasks in ascending order of their latest allowable finish dates. This list is used the same as the late start list but by applying the procedure to the late finish column.

Total Float (TF) Sequence

The TF list shows all tasks arranged in ascending order of the amount of float time available to the task. Those tasks indicated by a CP in the total float column are critical.

This list gives a good picture of (1) the relative criticalness of all tasks, and (2) what tasks become critical as a project begins to lag behind late finish dates. For instance, if a project has lost five (5) working days and it is still essential to maintain current anticipated end dates, then all tasks yet to be done and having float time to and including five, are now critical.

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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.

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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.

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Monitoring #1

Project Status as of morning of Sept. 24 (working day 188)

Task	Color Code	Status	Was completed evening of	Will be completed
101 - 107		Comp.	Sept. 15	----
102 - 108		Comp.	Sept. 23	----
103 - 109		Comp.	Sept. 15	----
104 - 110		Comp.	Sept. 13	----
105 - 111		90% comp.	----	in 6 working days
106 - 112		Comp.	Sept. 22	----
107 - 114		Comp.	Sept. 22	----
108 - 115		50% comp.	----	in 4 working days
109 - 116		50% comp.	----	in 2 working days
110 - 117		80% comp.	----	in 2 working days
112 - 119		10% comp.	----	in 4 working days
133 - 139		50% comp.	----	in 4 working days
134 - 140		Comp.	Sept. 21	----
135 - 151		Comp.	Sept. 17	----
2 - 3		Comp.	Sept. 1	----
2 - 4		Comp.	Sept. 7	----
2 - 5		Comp.	Sept. 9	----
2 - 6		80% comp.	----	in 5 working days

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CONSULTING ENGINEER

November 1,

Subject: Monitoring Report #1

New Office Facility

Highland and Moran, Keith, Iowa

Victoria Mechanical Company

Project: 76:10

Monitored from Issue #1 dated April 26,

Date of Monitoring: September 24, (working day 188)

Target Completion Date: November 30, evening (working day 234) for fin tube piping

Actions taken:

- Inspected project
- Reviewed job progress with superintendent
- Evaluated job progress
- Color coded networks

General Summary

As of September 24, (working day 188) the project is basically in healthy condition. An evaluation of the job against late starts and late finishes shows that all major tasks are currently meeting or bettering late starts and late finishes.

Accurate information on exterior masonry and glazing status was not available from the general contractor. This work should be watched carefully since it affects hanging board upon which installation of our fin tube piping depends.

Projecting directly from late start/late finish sequences, it appears activities over the next two weeks should include:

- continuing installation of all major riser and overhead mechanical and electrical work
- installation of interior masonry partitions
- installation of insulation and roofing
- erection of exterior masonry and glazing

F10

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It is anticipated that on September 29, according to the current early start schedule, studs for drywall are due to start at the first floor. However, looking at installation progress of toilet room plumbing risers, it appears these are lagging early start/early finish targets. Therefore, interior masonry which restrains installation of studs will probably be late and may delay installation of in-wall work past the current desired early target of October 4, (working day 194).

In a conference with the drywall contractor on September 24 (working day 188) he said he would prefer to erect studs and install one side of the board. We told him that this was not a desirable procedure and asked him if he would leave both sides exposed. He agreed, providing we would be liable for any damage to his studs by our work. We agreed.

In summary, the project is moving fairly well. The superintendent is on top of the job and our projections for work over the next week indicate the job should stay healthy.

Ralph J. Stephenson, P.E.

RJS
m

F11

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

UPDATING

A revision of the network model to reflect needed changes to the logic plan or task resources as of a given date.

STEPS IN UPDATING

1. Determine need to update.
2. Remove completed tasks from the computer printout.
3. Correct and revise arrow diagram and computer printout.
4. Make new computer run and check with revised model.
5. Make final network and computer run revisions and issue updated network model and translations.

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CONSULTING ENGINEER

Pointers for Reading, Analyzing and Solving Case Studies

We will be using miniature case studies occasionally to point up various features of project planning and control systems. The suggestions below are to help you gain the most from the case study work.

Pointer 1

Read the case study carefully and try to get an overall managerial feeling for the situation and problems. The first scanning should be rapid with brief returns to specific problems. Underline and highlight key points as you go through the case study the first time.

Pointer 2

Where problems seem to exist in the description, isolate these even though they appear minor, and give them a mental priority ranking as you read through the study the first or second time. Identify problems to be solved and actions to be taken by asterisks or some other identifying mark.

Pointer 3

Clearly identify your position in the case study. What is it you are supposed to be, and how are you supposed to act? This activity is called internal role playing and is a good simulation technique for solving problems from your standpoint.

Pointer 4

Always ask yourself the basic questions about any situation - who?, what?, why?, when?, where? Without the answers to these five fundamental one word questions, an analysis may be incomplete and faulty.

Pointer 5

Be certain to answer the problem questions as fully as time permits. Normally the minutes allocated to a case study will be few and it is important to focus quickly upon the essential elements of the problems presented.

Pointer 6

When the case study is discussed, don't hesitate to bring out points you feel are important. Also learn from other's solutions. Remember there are usually many ways to solve problems and resolve difficulties.

H/O 163 9/77

CASE STUDY NUMBER ONE

Where Do We Go From Here?

Qitain University, a small private engineering, science, liberal arts school in the northwest United States city of Quitain, is about to embark on a major (for them) expansion plan. It involves the planning, design, and construction of a new university activities building, a modest athletic facility having a gym and indoor pool along with support facilities, and a small combined library and book store.

The expansion program has been written, the planner/architect/engineer selected, and the Board of Regents of the school have given the project a go ahead.

An organizational meeting is in progress with the following people in attendence:

-Frank Carlton - Vice President for university Planning and Operations

-James Tea - Program consultant for the university

-Fred Link - President of the planning/architectural firm of Link and Associates, the architects of record for the entire project

-Charles Redrock - Associate, chief architect and project manager on the project for Link and Associates

-Robert Hagal - President of Hagal Mechanical Engineering Company, the mechanical engineers for the project

-Stan Wiessman - President of Weissman Electric, the electrical engineers for the project

-Richard Goldmark - A wealthy alumnus and key mover in assembling the total funding for the program

The site of the new building group extends across two city public rights of way (ROW), Francis Avenue and Fourth Avenue. Some preliminary negotiations have been conducted with the City of Qitain by Mr. Carlton, of the University with the city manager, George Dell. It appears that vacation of the ROW's can be accomplished on a reasonable basis. Several live utilities are known to be in the two streets but exact sizes and locations have not yet been determined.

The discussion has generated several questions now being addressed. Some of these include:

1. The only available survey map of the area is an in-house student survey prepared 10 years ago as a semester project. A new survey has not been budgeted and might be challenged as a cost by the Board of Regents.

Should a new survey be made?

Why?

What should a new survey contain?

2. Should the Univestity retain a construction manager? If not, why? If yes, why?

3. How should the project be organized and what should be the role of the various parties involved?

4. Who should be the ULTIMATE DECISION MAKER on the project?

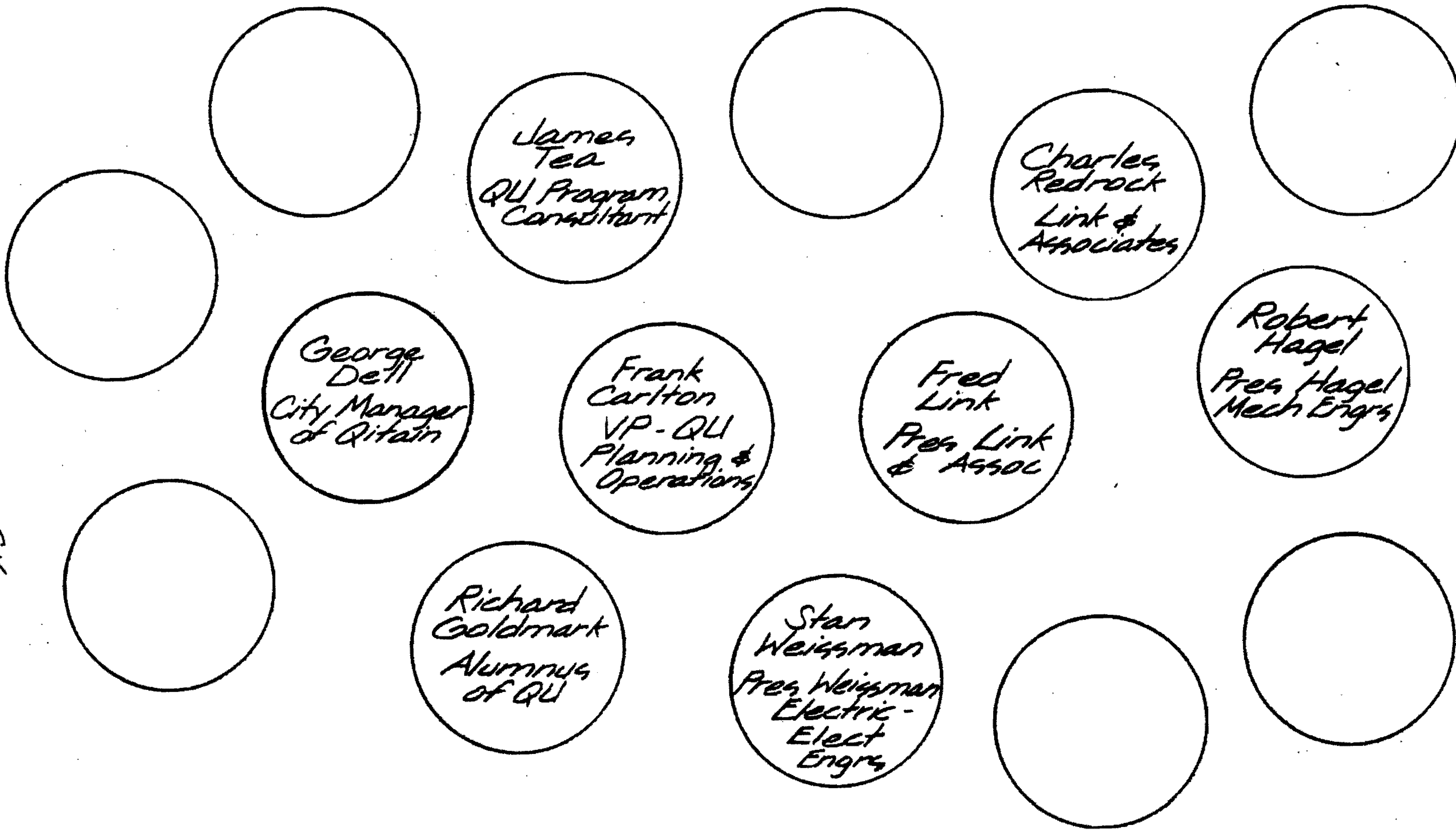
5. Should the University appoint a staff representative to the project? If so, what should be his authority, responsibilities and his activities?

6. The contracts for architectural, mechanical, and electrical design services are not yet awarded but all agree that the three firms at the meeting are the ones to do the job. With whom should the mechanical and electrical engineering contracts be with?

7. How do answers to the above questions affect the claim potential for the project?

8. If you were an alumnus and a local general contractor serving on the Board of Directors of the University, and acting as an ex officio advisor to the program group, how would you have answered questions 1 through 7 so as to maximize the potential for claim avoidance (CAV)?

9. What role would you recommend Mr. Goldmark be requested to play in the project?



QITAIN UNIVERSITY - PROJECT ORGANIZATION STRUCTURE

G4

CASE STUDY NUMBER TWO

What Do We Do With All This Equipment?

You are the general contractor (Young Construction Company) field superintendent on a new 140,000 square foot manufacturing plant being built for Telco, a large metal fabricating company,on a site adjoining its main manufacturing facility. The contract has been somewhat splintered by the desire of the owner to reuse several pieces of machinery and equipment now located in various parts of the existing plant. They also wish to provide several pieces of new equipment, some of which you and your subcontractors must set and hook up. Telco presently has several other contractors under direct contract to them on the job in the existing plant.

The contract drawings and specifications for your work are not very clear on who does what in this equipment installation and you are disturbed by the possibility that you may be middled into doing a sizable amount of work that is not really your responsibility.

In addition, the job to date has not gone too well for you and your subs, and they are reluctant to do any additional work, not clearly their responsibility. The mechanical contractor, Falstaff Inc., is proving to be particularly difficult. Gold Electric, the electrical contractor has been easy to get along with so far.

Typical of the problems that the equipment conditions pose can be seen by the following section from the specification:

> "Several pieces of equipment presently located in the present plant are to be relocated to the new plant and made operative there. Some of the existing equipment must not be deactivated until the new plant is operating. Work to be done includes, but is not limited to the following
>
> a. Two compressed air tanks located in the existing paint shop are to be reused. They are to be taken out of service only when the compressors in the new building are ready to run.
>
> b. Three paint spray booths were deactivated by the owner 4 years ago and removed and stored in the northwest corner of the existing building. The contractor is to reerect these in the locations designated on the drawings. Connections to the spray booths will be made by the owner."

The specification continues on in a like fashion describing nearly two dozen other items similar to those given in an

example above. You are concerned that nobody in the owner's office, your office, or among your subs has read this spec closely enough to clearly see the full scope of work for each party.

The owner's representative on the job is intelligent, interested in doing well for his company, and is well known for his fairness in dealing with contractors, architects, engineers, and other parties to his projects. He intensely dislikes surprises.

Consider the following questions:

1. How could you bring the full scope of work into view easily and clearly for each party to the job?

2. How would you convey your understanding of the scope of work to the owner?

3. How are your subcontractors involved in the clarification process?

4. What steps should you take to prevent the equipment problem from developing into a disputed claim?

5. How do you convey your concerns to the owner?

(1) Line #	(2) Equipment Description & Who Furnishes	(3) Present Location of Equip	(4) Final Location	(5) Action To Be Taken	(6) & By Whom	(7) Other Equip Affected	(8) Remarks
1	2 existing compressed air tanks (Telco)	Existing paint shop	New building paint dept	Relocate	Falstaff	New compressors must be ready to run	
				Set	Young & Falstaff		
				Hook up	Falstaff		
2	3 existing paint spray booths (Telco)	NW corner existing building	New building paint dept	Move & Set	Young	—	
				Hook up	Telco		
3	2 new paint spray booths (Falstaff)	New	New building paint dept	Erect	Young	—	
				Hook up	Telco		
4	6 existing column mounted jib cranes (Telco)	Cols 6C 5D 7D 3F 4C 2F	New bldg Cols 10A 11A 10B 11B 10C 11C	Remove	Telco	—	
				Move & Instl	Young		
5	2 new prefab shop offices 10'x15'x8' (Young)	New	1 in new bldg lab area 1 in existg bldg QA area	Erect	Young	In existg bldg after Telco clears space (watch!)	
				Mech/ Elect	Telco		

Abbreviations

NW Northwest
QA Quality Assurance

Equipment Activity Tabulation

Ralph J. Stephenson, P.E.
Consulting Engineer

CASE STUDY NUMBER THREE

Keeping the Records Straight

On May 11,1982, The Charles T. Sierra Company was awarded the general contract for installing a new paint system in the Southeastern plant of Hirtwell Ltd., a very large and competitive manufacturer of metal and plastic enclosures for mechanical and electrical equipment.

Hirtwell has a reasonably good reputation as a manufacturer; however on construction projects they have been very harsh on their architects, engineers, contractors and suppliers. This reputation is generally recognized as coming from Franklin Johnson, the former Vice President of Facilities. Mr. Johnson retired several months before you were awarded the contract for the new job. His successor, Paul Rolla, has reorganized the company's facilities department, and most of Mr. Johnson's staff have left.

The project manager for Hirtwell on this job is Tom Begn, a pleasant, but inexperienced graduate engineer. The architect/engineer for Hirtwell is Jones and Higgins, a local firm in Tucson, the location of the new plant.

You are Lee F. James, the project manager for Charles T. Sierra, and your boss, Mr. Sierra, has told you that he wants this job thoroughly documented. He has built six projects ranging in size from one to five million dollars for Hirtwell over the last eight years and has had disputed claims on every one. Mr. Sierra feels the previous Sierra job management has been too loose and sloppy. This time he wants a change. You have never worked on a Hirtwell job before, but have had two similar projects to this one previously. On one you were the engineer and on the other you were the project manager.

Your company is presently experimenting with two microprocessors in addition to the main computer. The main computer is used primarily for accounting and payroll purposes. You have access to one of the microprocessors, and Mr. Sierra has encouraged you to get your imagination to work and find some real and profitable uses for the equipment. You have great interest in the small computers but have never used them.

The project cost is $3,225,000 on a hard money contract. The next lowest bidder on the job, you are told, had a price of four million.

There are three other prime contractors working on the project, all on different parts of the total program. Their

contracts are smaller than yours, but ultimately much of your work will be required to interface closely with theirs.

Part of your contract is to install a new paint spray system which is relatively untried except for pilot runs made by the fabricator. The owner is purchasing the equipment, but you are totally responsible for its installation, hook up, check run and test. Controls for the system are also in your contract.

Consider the following questions:

1. What characteristics of the project lead you to believe it is possibly claim prone?

2. How would careful documentation of the job help avoid the claim disputes?

3. What document information might you wish to store and retrieve for the job?

4. What must a document control system provide you and Sierra to help avoid the disputed claim?

5. Of what use might a microprocessor be to you in the control and tracking of documents

6. What document records would you keep for the project?

7. The job superintendent has never worked on a Hirtwell job before. What would you discuss with him and when, if you are all trying to avoid the disputed claim?

cav cssty three ho

Ralph J. Stephenson, PE

Charles T. Sierra Company
Constructors, Frigate, Indiana

9/13/82

MINUTES OF PROJECT MEETING #9 - SE Hirtwell, Tucson

Date of meeting: Friday, September 10, 1982
Place: Job site, Tucson
Time: 8:00 AM to 9:45 AM
Attending:

Paul A. Rolla VP, Hirtwell
Tom T. Begn Project Manager, Hirtwell
Robert T. Hial VP, Sierra
Lee F. James Project Manager, Sierra
Fred Teal Superintendent, Sierra
James T. Darth Chief Engineer, Biotics
Fred X. Skone Engineer, Trielectric
Tom T. Stirton Project Manager, Jones & Higgins

From: Lee F. James, Sierra

To: All attending, Robert T. Kreitz, CRR

General Summary:

Lee James reported that all pit and foundation work was meeting dates between early and late starts and finishes. Still having difficulty getting dimensional information about mechanical and electrical sleeve and thimble sizes and locations.

Tom Stirton reviewed bulletin/change order tracking and said that of 11 bulletins issued to date, 6 had been quoted and 5 had been converted to change orders. A change order for the sixth will be issued later this week.

James Darth discussed equip delivery from his procurement tracking sheets (copy attached). All equipment ordered and 40% of the shop drawings have been submitted, with 20% returned. Mr. Darth asked for selective improvement in submittal turnaround times.

Fred Skone reported that .....

can be improved.

Old Business:

9.5.10 The additional software data needed for instrumentation has been received and sent to Tom Begn for owner review. Mr. Begn will confer directly with the architect/engineer re design characteristics. Action by TTB, TTS

9.8.3 Low strength concrete tests.....

resolved with no increase in cost.

New Business:

9.1 Paul Rolla said that a sizable addition to the work was under consideration by, and that it had been decided by Hirtwell to have it done under bulletin procedures, but that if the cost was more than budgeted it might be reissued for.....

good job.

Closing:

The next project meeting will be held Friday, September 24, 1982 at the job site, Tucson.

This report is the writer's interpretation of the matters discussed. The account will be considered agreed to by those attending the meeting and those receiving the report, unless Lee James of Sierra is notified within 2 weeks of your receipt of the report.

Lee F. James

Lee F. James, Project Manager, Sierra

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

HIRTWELL SE TUSCON

REC# DOC # DOC # DATE YR DCT CFR CTO IFR ITO
SUBJ CLASS
SUMMARY A
SUMMARY B

---

1 07115 07115 0726 82 LTR CRR CTS RTK RGH
CTL/COI/SPD
COIL CONTROL ASSEMBLY SHIPPED 7/16/82

2 07116 07116 0730 82 LTR CTS FRS RGH KLP
STS/DEL/DAM/RFI
STRUCTURAL STL DEL TO JOB DAMAGED. WHAT TO DO?

3 07117 07117 0730 82 SBM CTS JAH LFJ TSS
SHD/FRA/UON/URG/FAN
DWG D2287433SBM FAN 1 SUBMITTED FOR APV. URGENT!

4 08001 08001 0802 82 PRQ CTS HWL RGH PAR
PRQ
PYMT REQ 2. AMOUNT = 47243.45

5 08002 08002 0802 82 BUL JAH CTS TSS LFJ
RFP/SHL/REV/FAN/UFV
BULL 8 REVISE SHELL SHAPE/FAN SIZE FOR UNIT 5

6 08003 08003 0802 82 PUO CTS CRR RGH RTK
CON/CTL/IST/RFI/SFW
PURC ORD ISSUED FOR ADDTNL INSTRUMNTN
NEED MORE DATA RE:SOFTWARE

7 08004 08004 0804 82 LTR CTS TRE LFJ FXS
MTR/MCC/RFI
REQUEST FOR MOTOR START REQUIREMENTS

8 08005 08005 0804 82 MLG FRS CTS KLP RGH
STS/DAM
RESPONSE TO 07116. REFABBED STEEL SHPPD 8/4/82
RETURN ACTION MAILGRAM TO FOLLOW

9 08006 08006 0805 82 HWM CTS CTS RGH LFJ
REL/APV/SBM/COS/PNT
INSTRUCTIONS TO RELEASE PAINT COLORS FOR PURCHASE

10 08007 08007 0806 82 LTR HWL CTS PAR RGH
SAF/PSS/RFI
REQUEST CHECK OF SAFETY REQMTS FOR PAINT SPRAY SYSTEM

REC# DOC # DATE YR DCT CFR CTO IFR ITO
SUBJ CLASS
SUMMARY A
SUMMARY B

---

11 08008 0809 82 LTR CTS HWL LFJ TBB
SHD/TUO
REQUEST TO EXPEDITE SHOP DWG TURNAROUND
PRESENTLY TAKING TOO LONG

12 08009 0810 82 BUL JAH CTS TSS LFJ
RFP/CWK/ANB/EMB/PIT
BULLETIN #15-PRICE SOUTH PIT REVISIONS

13 08010 0810 82 LTR JAH CTS TSS LFJ
HLD/CWK/ANB/EMB
ENGINEER PUTS HOLD ON CONCRETE WORK AT SOUTH PITS
PENDING PRICING AND RELEASE OF COR

14 08011 0811 82 TMS CTS TRE LFJ FXS
BUL/RFP/EMB/ELE
REQUEST TO QUOTE BULL 15-S PIT REVISIONS

15 08012 0811 82 TMS CTS BIM LFJ JTD
BUL/RFP/ENB/MEC
REQUEST TO QUOTE BULL 15-SOUTH PIT REVISIONS

16 08013 0812 82 COR JAH CTS TSS LFJ
CWK/REV/ELV
CHANGE ORD 1-REVISE CONCRETE WALL ELEVATIONS

Project History for Period #7

Schedules or Networks in Effect During Period:
Network model issue #4 dated 3/8/82, sheets 1, 2, 3, 4, 5

08001 8/2/82 - CTS submits payment request #2 to JAH. Amount of $47,243.45.

08002 8/2/82 - Bulletin #8 issued for revisions to shell shape and fan size for fan unit #3.

JAH APPEAR TO BE ASKING FOR A NO COST CHANGE. IS THIS SO?

08004 8/4/82 - CFR requests motor starter information from TRE. Need data for HWL electrical engineering department.

WHY COULDN'T HWL GET THIS INFORMATION FROM THE ARCHITECT/ENGINEER?

08005 8/4/82 - FRS writes CTS that structural steel delivered to the job damaged on 7/30/82 has been refabbed and will be shipped on 8/4/82. Instructions for return of damaged steel to follow.

08006 8/5/82 - RGH gives CTS instructions to release paint colors for purchase of materials.

WERE THE COLOR AND FINISH SCHEDULES RELEASED BY THE OWNER AND THE ARCHITECT PREVIOUSLY? IF NOT, WHY?

08007 8/6/82 - HTL writes CTS requesting check of safety requirements for the paint spray system. Checked these earlier but are concerned about possible violations in the proprietary equipment being used.

WAS THIS PART OF CTS CONTRACT REQUIREMENTS? WHAT WAS THE RESULT OF THE CHECK?

08008 8/9/82 - CTS requests HWL expedite shop drawing approvals. Presently taking an average of 24 working days from leaving CTS office to receipt back. Had agreed on 16 working days in June 1982.

HOW WERE THE SUBMITTALS TO BE DELIVERED AND PICKED UP BY CTS?

Friday July 9, 1982

Hitwell SE Tucson, Arizona

- All new bldg ftgs complete today at NE corner. Moving to NW corner ftg concrete work Monday.
- Still having trouble with delivery of embedments in pit walls. Biotic says dimension on dwgs wrong. Must clarify. Have meeting with Tom Monday to review.
- Hit flowing water at 9:00 A.M. ~~P.M.~~ on ~~7/8/82~~ 7/9/82 E & 8-C. Began pumping at 10:15 A.M. today. Notified Tom Begay of Hitwell and Tom Stirton of Jones and Higgins of water at 9:45 AM today. Still pumping at 5:30 P.M. Will check ~~Sat~~ Sunday on water levels.
- Rod busters & carpenter held up by water. Sent them home at 11:00 AM.
- Mr. Rolla and Mr. Stirton visited job at 1:15 P.M. Left at 2:30 P.M. Complimented housekeeping and progress (except water!)

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

Case Study #4

The Wasted Treatment Plant

The project is a 25 million dollar waste treatment plant. You are the project manager and superintendent. Your involvement has been especially heavy for the past three weeks right after the job was obtained. It is apparent to you that the contract documents are poor, the owner is painfully indifferent to all influence except political pressures and the job is definitely claim prone.

What steps do you take now (within the first two months of this 2½ year job) to protect your company's interest?

Consider these questions:

1) How would a summary network diagram be of use?

2) What special activities should you be certain to include in the early summary diagram?

3) Who should be invited to the initial network planning session?

4) With whom should you discuss the problems that you see on the horizon?

RALPH J. STEPHENSON, P.E.
CONSULTING ENGINEER

Case Study #5

The Sneaky Boiler Contractor

You have just completed and activated a sizable boiler house addition. The contract for boiler installation was a separate agreement with the owner, Carlton State College, with all other contracts direct with your firm, the Shoenite Construction Company, general contractors. As the job is being closed out, Jerry Biel, the physical plant director for the college comes to you confidentially and says the boiler contractor, Laguna, is claiming extra costs because Shoenite Construction interferred with his erection procedure by not providing a slab on grade from which to erect the tube systems and the boiler walls.

Actually Laguna, because of their separate contract with the owner, paid little or no attention to your requests as project manager to keep the area clear and early filled the slab on grade sector with material and equipment before you could possibly have built the slab.

Early in the job you prepared a detailed critical path diagram of all elements of the project including the boiler work. The boiler diagram was prepared in consultation with Laguna, and approved by their superintendent. The network clearly showed the slab on grade being built prior to loading the area with boiler equipment.

Consider these questions:

1) What potential problems exist here for you and Shoenite Construction Company?

2) What steps should you take immediately?

3) What is your own position in this matter? Why?

4) Describe the problem the owner has and how Shoenite Construction and you might help him resolve it.

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Case Study #6

The Case of the Weak Primes

Your firm, the Oldenburg Construction Company, has just negotiated a time and material upset price contract for doing the architectural and structural prime contract work with the local hospital authority for a three story 7 million dollar surgical addition. Contracts are all prime with the other major contractors being mechanical, electrical, communications, food service, and medical equipment.

The owner's representative, Don Larson, has asked your opinion of using a critical path plan for the entire project. He has had a previous good experience with this system and is willing to pay for its cost if you and the other primes want to work with him on it.

The other prime contractors are not as strong as you would like and traditionally tend to underman their work. There is strong feeling in yours and Mr. Oldenburg's mind that the job will not run well unless a well defined plan of action can be prepared that all agree to. You are faced with several decisions:

1) What is your response to Mr. Larson?

2) What factors influenced you in deciding the course of action you would like to take?

3) If it is decided to go ahead with the network diagram, how do you propose to work with the other contractors?

4) Who should prepare the network diagram?

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Case Study #7

The Case of the Generous Owner

The job is a crash program to add a new paint line to the Farnsworth Automobile Company's Olethe Plant. The job was bid and let on a fixed contract to your company, Page Construction, but the nature of this kind of work traditionally is such that you expect as much as 7% of the original bid capital cost of 4 million dollars will be added in changes and additions to the base contract.

The owner has purchased 600 tons of structural steel erected for the job on a separate basis and may add this to your contract paying you a percentage fee for handling the work. The Farnsworth Company is a very production oriented company. They have built hundreds of millions of dollars worth of plants over the past few years and are hard nosed about design and construction.

Some important questions are suggested:

1) If you were the president of Page Construction Company, what would your attitude be toward adding the structural steel fabrication and erection on a percentage fee to your base contract arrangement?

2) What would be the advantages of preparing a network diagram at the early stage of the job?

3) What would be the disadvantages of preparing a network diagram for the project?

4) As a superintendent on the project for Page, how could you insure to the highest degree that the job will be a financial and public relations success for Page Construction Company?

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Case Study #9

The Case of the Dependent Tasks Additions

A small glass firm, Crystal Glass, is constructing a new plant to produce plate glass with a relatively untried water float process. Your company, Douglas Design and Build, has been awarded the superstructure work built upon a substructure by others. You have designed and are building the superstructure exclusive of equipment installation.

There are some minor delay problems attributable to the earlier let foundation work but not serious enough to bother you financially. However, as the job proceeds, the owner begins to revise his work and add to your contract. Some of these owner revisions do not change Douglas' operations but delay completion of your superstructure work since decisions are not made promptly by Crystal. For those revisions which obviously change the price, you are issued change orders. For owner activities that affect you but don't cause apparent increases in your costs, no concern is shown by Crystal whatsoever.

Now, however, you, as the project manager, realize that your costs due to owner imposed restraints are getting serious. You had prepared a good critical path diagram at the start of the project. You also have accumulated all of the information on what delays were imposed, who imposed them and which tasks were affected. Your next course of action calls for considering several questions:

1) Do you do anything? If the answer is no, why?

2) If the answer is yes, what do you do first?

3) What records will be required to support a claim for additional costs?

4) What could you have done to avoid what will be an obviously unpleasant confrontation with your client regarding extra work and extra cost? What should you do now?

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Case Study #10

The Case of the Frozen Job

It is winter and you are temporarily shutting down outside work on this new 190 thousand square foot 2-story reinforced concrete department store (as agreed in early negotiations with the owner). Frank Babbet, the owner's representative, is astonished. He was not aware of the winter shutdown agreement, having been assigned to the job by your client, Lathrup Merchandisers, after it had started in the field. He is very angry that nobody had said anything to him up to now about the shutdown. In fact, when he was assigned to the project about two months after it started, he participated in the critical path diagramming session with you and the other contractors. The diagrams were prepared by an owner's network consultant with whom you get along very well. These diagrams make no mention of a winter shutdown but do allow a comfortable amount of winter weather delay time within the tasks.

Your original agreement with the owner to shut the job down was oral and the man with whom you discussed it has been reassigned to another city so is not available for discussions or confirmation. You sense you are in trouble and, as project manager and superintendent for your company, must sit down and think this problem through.

1) Where did you and your company make your basic mistake if any?

2) What should you have done to protect your original position and agreement?

3) The new owner representative is competent and understanding. He has an excellent reputation for being fair but firm. What should your approach to him be?

4) How do you visualize your company salvaging its reputation, its profit, and the account?

5) Should you have gone on record early about the shutdown agreement? How?

6) Should the procedure have been incorporated in the early network diagram prepared with the owner? How?

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Case Study #11

The Case of the Missing Slab on Grade

It is September 15. The contract has just been let for a new addition to Stockton High School and your firm, Detail Systems, Inc. has been awarded the entire mechanical contract.

A pre-proposal network diagram was prepared by the owner and his consultant showing a broad time structure within which each of the building elements of the project was to be occupied. The occupancy move diagram had been provided to all contractors at the pre-bid meeting. You received a copy, as did the successful general contractor. You are now a sub to this general contractor. Your own position is as project manager and in reviewing the job, you reaffirm it is going to be difficult and require continuous effort on your part to meet the target occupancy dates.

The owner has retained a well respected consultant to prepare the detailed job network in conjunction with the contractors selected. You are at the first meeting, ready to prepare the plan and after about two hours of discussion are shocked to learn that the general contractor has decided, because of long steel delivery dates and longer than expected durations required for close-in masonry, he will defer pouring the slab on grade until next spring on one of the major new facilities of the project.

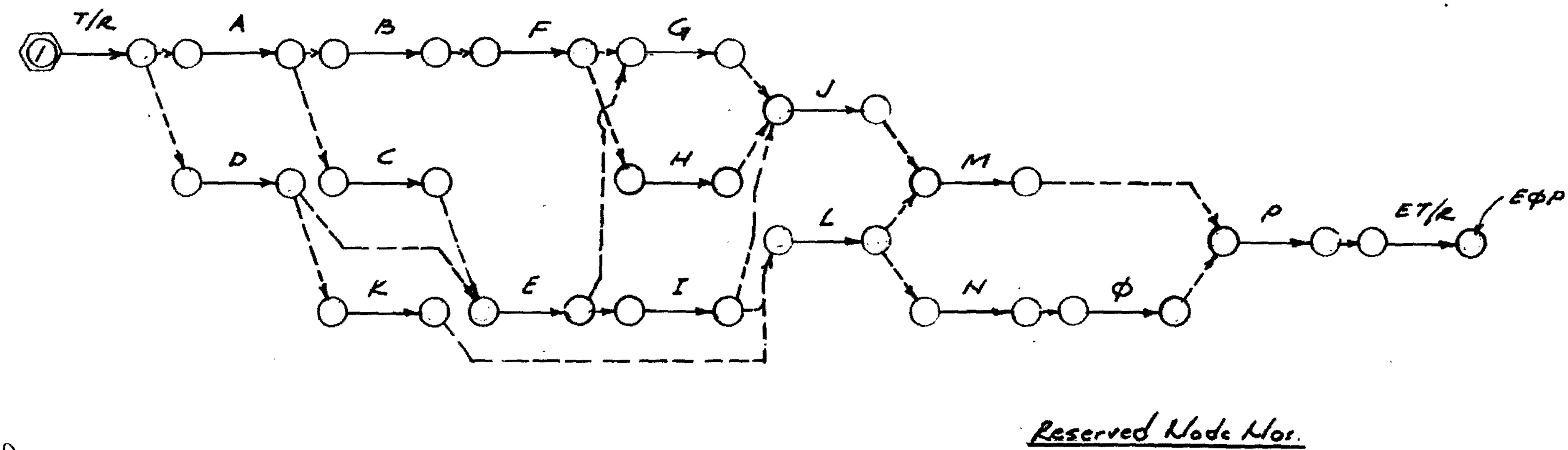
You perceive immediately this will be very harmful to you and the electrical contractor since the change runs counter to the diagram of work you prepared having a slab on grade available from which to work. It also is not in accordance with the plan of work you gave the general when you were awarded the contract.

The owner is startled at the general's action since the general contractor's attitude toward him is that he cannot finish the first facility of the program as had been shown in the occupancy diagrams even though he, the general, was well aware of the requirement when he bid the job.

The meeting has reached a crisis. The owner is an understanding and competent man. The architect is young, ambitious but is a comer. The general is not a strong contractor. Things are, at this moment, very tense.

Consider these questions:

1) What is your role in the situation?
2) How do you react to or with the general contractor?
3) How do you react to or with the electrical subcontractor?
4) How can you help everybody get out of this dilemma?
5) What problems will the project probably face throughout its life?
6) What could you have done earlier to prevent such difficulties from arising?



SOLUTION TO EXERCISE #1
ARROW DIAGRAM

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