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Management of Engineering Projects

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Synopsis:

Modern Management Techniques are described. While almost all the developed countries have adopted modern techniques of management, we in Pakistan, are lagging much behind. The result is that our projects are usually completed much behind schedule, with overruns in costs and suffer due to in-efficiency and lack of controls. PERT & CPM are described. Management plays a very important rôle in the control of projects and as such the role of management is fully described. The position of the Manager, his duties and responsibilities are explained. The manager in an organisation is in a position of providing leadership. As such the qualities of a good and successful leader are described. The manager as a leader has full authority to carry out his works, the meaning of this authority and its delegation is explained. There is always a large scope for improvement of existing methods. However, it is human nature to resist a change. People have therefore to be properly motivated to accept change. Different theories of motivation are explained. Many organizations favour management by objectives. In this method; objectives and targets are set for everybody by the management. How this is done is described. No project can be a success unless it is properly planned. Planning is therefore the key to success. This also includes long range planning. Project planning as well as long range planning is also therefore dealt with. No long range planning will be successful unless the chief Executive gives it full support and commitment. This is explained. The most important part of modern management is the preparation of the Net Work Chart. It's function and preparation is therefore described. The author, a few years back, had handled a very prestigious project. It was the construction of National Bank of Pakistan, Principal office building at Lahore. He had prepared a New Work Chart for the designing of this project. The preparation of this chart and determination of the critical path is fully explained. The control of project cost and time schedule is another important aspect of Project Management. This is described. Proper communication between the management, how this is done and various alternatives available are explained. Hiring and firing is another important aspect of Project Management. This is described. Proper communication between the management, how this is done and various alternatives available are explained. Hiring and firing is another important part of management. How this should be done is also described.

Introduction:

It is an accepted fact that the management techniques and other procedures used in our engineering industry can be improved to a large extent. While more advanced countries have adopted concepts of modern management we in Pakistan are still following age old formulas inherited from the past for the management of our projects. We must however, acknowledge the fact that there has been some superficial improvement by the use of computers for accounting, cost control and design purposes etc. The basic problem is that engineering management is too busy to fight fires caused by yesterday's mistakes and as such it does not have time to think about today much less tomorrow. Moreover, the notion that overheads must be kept to the minimum does not allow the supervisory staff to think and plan ahead. However, the author is of the firm conviction that once modern management techniques are adopted and given time for practice there can be tremendous saving not only in the cost of projects but also in their completion time. To achieve this objective modern techniques have to be practised by every-body in the management of the project right

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down to supervisory level. The use of these methods must be an attitude, a frame of mind and not a compulsion and it must be practised continuously.

The most important development in the field of project management has been the emergence of two basic techniques – PERT & CPM. These techniques are basically similar in approach but are quite different in implementation. While PERT is event oriented and is followed by most of the engineering industry, CPM is activity directed and is followed by the construction industry. PERT (Project Evaluation Review Technique) was developed by a joint team set up by US Navy Special Project Office and included representatives from Lockheed Aircraft Corporation and consulting firms of Booze and Allen and Hamilton. An important feature of PERT is its statistical approach of uncertainty in activity time estimates and calculation of probability estimates of meeting specified time schedule. CPM (Critical Path Method) was evolved from a parallel joint effort initiated originally at the Du Pont Company and later having association with Remington Rand Univac & Manchly Associates. It must however be clearly understood that by applying the latest techniques of project management the idea is not to make anybody work harder or difficult but the application will help the project to be completed at lesser cost and at a faster rate making the work for those who supervise more pleasant and rewarding.

The Role of Management

The manager is a person who has the ability to state a goal and reach it through the efforts of others and satisfy those whose judgement must be respected under conditions of stress. Thus a manager has to plan, organize, supervise and check other's work. This however does not mean that the foreman or supervisor is not to use his own imagination. Rather the opposite is required. All the employees are involved in decision making and once the schedule is set it becomes everybody's responsibility to achieve the targets. The Manager is however required to oversee the project and give guidance whenever required.

The Responsibilities of a Manager are:-

- (1) To ensure the health and survival of the organization.
- (2) To make maximum use of human and material resources.
- (3) To evaluate changes in environment.
- (4) To set a course for the future.

His Aims should be:-

- (1) To appraise with analytical ability and judgement.
- (2) To decide objectives.
- (3) To make objectives known.
- (4) To plan achievement of objectives

He is required to:-

- (1) Organize resources.
- (2) To coordinate with other departments.

He has to control by:-

- (1) Comparing plans and performances.
- (2) By taking collective actions.
- (3) By re-appraising.

The Managers in an organization are in a position of leadership. They have formal authority and it is this formal authority which gives them the right to lead. They are responsible for their

show. They are answerable to top management for whatever happens in their department. They are in actual fact responsible for the doing of their subordinates. Thus they have full control over them. They have powers to hire and fire the people. They give directions, allocate duties and responsibilities and make commitments about organizational resources. They have power to give rewards and take disciplinary actions. These are the powers delegated to managers due to their position. They thus have the leadership and cause people to do certain things and not to do certain things. They have the authority to order.

This is thus the formal concept of leadership. But this is not the concept what most managers have in mind while dealing with their subordinates. In a Managerial leadership the most successful manager is the one who manages in such a way as to win the willing support of his subordinates. Such managers always have willing workers to assist them.

Leadership is not an easily defined matter. According to "Contingency theory" of leadership, effective leadership is successfully matching the characteristics and behaviour patterns of the leader with characteristics and behaviour patterns of the followers in a particular situation. However, this would not work in all the situations. In some cases quick authoritarian action would be needed. Here the kind of leader needed would be quite different from the one required under normal circumstances.

The Research of social scientists on leadership reveals that subordinates like to be consulted about their work. They would like to give their opinion. It makes them to think that they are also important and that the leader is interested in them, in their work and that he appreciates their ideas. Here then the qualities of the leader play their part. In case he is not in agreement with the view points of his subordinates, he must not reject them authoritatively, rather with sound arguments, convince his subordinates about his own judgement. A good leader is the one who can carry his subordinate with him in such circumstances.

However, sometimes, the work of a subordinate is of routine nature. In such circumstances there is not need of being "consultative" or "participative" in decision making. Such methods sometime result negative reaction among the subordinates. Thus the research into leadership has not so far been as helpful as most of us would like to be. It has so far shown that leadership is not a simple and easily defined matter.

A successful leader must have the following six basic essentials.

(1) Courage

Courage is a virtue in man. A leader must have courage, physical courage at some levels, but normal courage at all levels. He must be ready to do things because he thinks it to be right. He must have courage to take decisions and to stand by them.

(2) Will Power

This is the determination to see that his decisions are implemented.

(3) Judgement

This is cool balancing of pross and cons. This is essential because the greater a Man's courage, the stronger his will power, the bigger the disaster if he chooses the wrong course.

(4) Flexibility of mind

The only living organisms which survive are those which adapt themselves to change. The

B. A. Chowdhry

leader must have this ability to cope with circumstances, with the changing world and unexpected developments. A good leader will hold balance between will power and flexibility. He has to see that his determination does not reach the level of obstinacy. If he can hold balance between will power and flexibility he is a successful leader.

(5) Knowledge

A good leader must have the knowledge of what his subordinates are doing and is an expert on it so that he can help and remove all technical difficulties of his subordinates.

And last but most important is No. 6

(6) Integrity

A leader must be a man of integrity so that no one can point a finger towards him. He should be a model for others to follow.

A leader must not forget that he deals with lives, motives, hopes, fears, feelings, instincts and emotions of human beings, no two of whom are exactly alike. These are the things that cannot be measured or weighed.

A good manager is always sensitive to the feelings of his subordinates. He respects their thinking, listens to them and if does not agree with them, does it tactfully. A good manager must be well aware of the feelings of other people. Managers are normally sent on "sensitivity training" where small group of people are brought together who try to analyse each others thinking and reasons why they have the particular ideas and how people react to them.

The top manager as such should see that his subordinate managers have all the above mentioned qualities.

Authority

Normally it is accepted that responsibility and authority go together. A Manager required to do a certain thing must have the authority to get it done from his next echelon. He should also have authority over the use of machines and equipment. However, in actual practice authority usually is not commensurate with responsibility. The President of a Bank has the responsibility of running the Bank successfully, but there are a lot of things he has no control or authority over them. The competition, the economy, labour unions, the market trends, government laws, money market etc. etc. All managers as such have to live within the frame-work of certain constraints which they must accept and it should not become an excuse.

According to "Acceptance theory of authority" supervisors have only such powers as subordinates allow them to exercise. This means that manager's real authority can be nullified if his subordinates do not accept. This of course rarely happens but happen it does. In the "Mutiny on the Bounty" the ship's crew mutinied and threw captain Bligh into the sea. In 1776 the American colonies threw off all the powers of English King George III. In 1789 French beheaded King Louis XVI. Only recently in 1974 public pressure forced President Richard Nixon to resign the Presidency. In 1979 the public revolution forced Shah of Iran to leave the throne. In our own country the public pressure forced Gen. Ayub Khan to give up the Presidency. Similarly it was public pressure which forced Mr. Bhutto in 1977 to have a dialogue with Pakistan National Alliance.

However subordinates in business and business organizations usually never rebel, but once in a lifetime this can be expected. This happens when the frustration and dis-satisfaction among the

people reaches the point of no return and they then have no alternative. The manager should manage in such a way that this point of no return is never reached.

Delegation of Authority

Unless the organization is very small the Chief Executive cannot supervise everybody in the organization. He must have others to help them. He will have to delegate certain responsibilities and authority to them. The principle of delegation is necessary to ensure that every one is being supervised. Delegation takes place at all levels of management down to the last man in the chain.

Assignment of responsibility should be matched with the necessary authority to act, otherwise delegation will not be effective. Delegation of authority cannot be the result of sudden inspiration and panic appointments can be expected to bring no success. People have to be prepared and trained for positions of responsibility and authority should be delegated in a planned manner. An organizational chart will be helpful as it indicates the channels of authority.

Coupled with delegation is the principle of control. One cannot effectively delegate unless he knows how to control those to whom he has delegated. In other words one should delegate only what he can control. A system of control should be built in the organization which measures the performance of those who are entrusted with responsibility.

The delegation of responsibilities is broad at high level and narrow and specific at bottom levels. There is a broad area in the middle cadre where the recipients of a delegation may have to develop their own jobs, that is they have to decide how the job is to be done, which of the things they have to do themselves and which they should delegate to subordinates. Their work is confined to their general mission limits and thus contribute to the work of the whole organization. A marketing manager is required to sell products or services. How he does it, what he delegates to his subordinates is not spelled out in delegation.

Check for Management's Effectiveness

Once a job is in progress, it is essential that some checks are applied to ensure that the job is progressing satisfactorily and within the estimated cost. A common method is to compare the job costs with project estimates and to compare the progress with the schedule. These reports are generally obtained on fortnightly basis. Another method of checking progress is by activity sampling. This consists of observing a small percentage of total project activity. The sample should however be large enough to give a representative look of the project. This activity sampling thus gives us the pace of progress of the whole project.

Improvement of existing methods

Very often and this is true to a large extent, management feels that there is a large scope of improvement in the existing methods of execution. Whatever the motivation, the aim should be to change or modify the existing methods for better results. This can be done as follows:-

- (1) Make out a complete note of how the job is being done presently.
- (2) Keeping the objective of the job in mind, critically examine each detail, particularly the movement of men and material, the processes that take longer time, bottlenecks and wasteful activities.
- (3) Develop new techniques eliminating unnecessary bottlenecks and wasteful activities.

B. A. Chowdhry

(4) Use the new methods.

It is human nature to resist a change. The workmen will not willingly accept new techniques. It is therefore essential that before the introduction of a new technique, people are taken into confidence and the advantages of the new method are fully explained. In fact for any new method, the mental attitude has to be accordingly changed. People do not accept changes for fear of failure, fear of loss of prestige, fear of job or uncertain future. The most successful manager is the one who takes a calculated risk.

The implementation of the new techniques thus needs careful monitoring. All efforts should be made to get cooperation from both the supervisors and workmen. For this purpose, the manager must be fully conversant with the behavioral sciences which deal with the study of human behaviour. In this connection a reference may be made to Abraham H. Maslow's theory. According to this theory the needs of a person fall into a rank or order. This means that a person will exert to satisfy his most basic needs first. Once these are satisfied these are replaced by new ones and then he is motivated to attain them. Needs once satisfied are no more motivators but there are always new needs to replace them.

Man's most basic needs are provision of food, clothing and shelter. Once these are satisfied he will long for security and status. It must be noted that more a need is satisfied the less it is the motivator. However, Maslow points out that a man is always motivated by his needs as a higher need may occur before his basic need is fully satisfied. When his security and status needs are satisfied he will try to find satisfaction for ego, praise etc. A little praise by a supervisor will be more than a motivator for a workman. A manager's job is to create an atmosphere where there is personal involvement of everybody in the work. It has been observed that when a man finds that most of his needs are satisfied by his work he becomes personally involved in it.

For introduction of any change for improvement the personal involvement of all concerned is the basic requirement. They have to be motivated for this purpose.

Most of us during our life time do certain things we would not very much like to do if left to ourselves. In such cases we are unwilling workers and drag our feet. We also do many things about which we are very enthusiastic. We are some how motivated to do them. We therefore do these things with much more interest. This interest may be on account of some of our needs or it may be by nature. An Engineer who of his own free will is trained in theoretical and design work will feel himself at ease in a design office. He will willingly do this job. If posted to a field he would perform his duty reluctantly although he cannot say no due to his own circumstances and needs. Vice versa is similarly true. A good manager therefore must bring out the best in his people and tap their "interest reserve" and "effort reserve". This way they would make their maximum contribution and would enhance the organizational effectiveness. A good manager is therefore, one who puts the "right man on the right job". A manager successful in this exercise will save a lot of bother for himself. He will have willing workers working for him.

Motivation does not mean that one has to overwork, it causes people to work more intelligently. They have some goals before them, such as one of their own needs, promotion, bonus, increments. It may be even a good word of appreciation from the Boss. Motivated persons are always concerned about their contribution in the overall achievements. They have initiative and would try to do things more effectively. They try to do things more comprehensively even if not fully defined. They will try to do the maximum and would not be satisfied with the minimum. One thing must be noted carefully. A motivated person will work up to the upper limit of his capabilities and not beyond.

Social Scientist McGregor is well known for his theory X & Y. Theory X presumes that people are lazy and have to be given a reward as motivation. Theory Y presumes people want to be productive and will be motivated if allowed to have some say and control over their jobs. McGregor said that many managers are theory X Managers. I personally disagree with him and in my experience most of our managers are theory Y Managers although rewards will make them work still harder and further motivated.

According to another social scientist Herzberg, a pay raise to an employee just makes him less unhappy and does not improve his positive motivation. This also is not fully true. Many of us have the experience of receiving a pay raise which provided satisfaction and reinforced motivation. However, I do agree with Herzberg, that to generate greater positive enthusiasm, one should manage in a more participative way and let people have more opportunities for self fulfilment. But monetary benefit is one of the best motivators particularly in our country where salaried people are very hard pressed persons and it is extremely difficult for most of them to make both ends meet.

Argyris is another well known name of a social scientist. According to him the best way of motivation is to "fuse" the goals of the individuals with those of the organizations. If the organization sinks, they also sink. They could achieve their goals if they toiled for the organization to achieve its goals.

It must however be understood that motivation growing out of sanctions "punitive actions" cannot be neglected. There are certain people, who cannot be motivated except by punitive actions. Such people are those who are frequently absent or come late or do not take interest in their work. They sometimes spoil the peaceful working atmosphere in an organization. Such people are normally disciplined by use of sanctions and they usually mend their ways. Although normally punitive actions are less effective as motivators than positive actions, they still have their own value. They do have substantial effects.

Management by objectives. MBO

Many organizations favour management by objectives. This is particularly suited to middle and lower supervisory levels although it can apply to higher level of managers too. It is easy for a person to show that he is doing his job whole heartedly, is completely immersed in it and is trying to do it well. He normally would not give attention to his achievements while working hard. A salesman may be working from morning to evening calling on many of his prospective buyers but in the end may not get any order. He might be thinking himself to be a dedicated hard working salesman, but in the organization's point of view his achievement is nil. While he thinks in terms of activity his organization thinks in terms of objectives. He has achieved nothing – the main objective of the organization is unfulfilled.

In management by objectives the main focus is on achievement - not on activities. If a salesman works only for four hours a day but gets sufficient orders as per the target of the organization, he is regarded much better than a salesman who works from morning to evening but cannot fulfil his target of accomplishment.

In management by objectives the organization's need to achieve growth and profit are integrated with manager's need to contribute and develop themselves.

MBO is a system whereby every department and every individual manager or supervisor is committed to securing improvements by:-

- (1) Reviewing critically and restating the organization's goals. If he has anything to say, he must come forward at this stage.
- (2) Clearly stating key results and performance standards expected from the Manager or supervisor.
- (3) Discussing job improvement plans with each manager.
- (4) Carrying out systematic performance review to discuss a person's progress towards results.
- (5) Carrying out potential reviews to identify persons with potential for advancement.
- (6) Succession planning and enabling managers to take stock of the present knowledge and skills and to acquire those required for future jobs.

MBO represents an approach of total commitment not only to achieve the set goals but also to their enlargement on the one hand and human enrichment on the other.

All employees have their needs. Their ability and willingness to set and achieve objectives is increased if these needs are met, MBO provides a system to meet them by using the following methods.

| <u>Employee's Need</u> | <u>Method of Fulfilling them</u> |
|--|---|
| (1) What do you expect from me? | Unit objectives, key results analysis, job improvement plans. |
| (2) Give me an opportunity to perform | Make organizational structure and atmosphere conducive to initiative. |
| (3) Let me know what I am doing | Performance review |
| (4) Help me when I need it | Potential review & counselling |
| (5) Acknowledgement of my contribution | Appreciation, salary structure/raise. |

A successful manager realises that objectives:-

- (1) Must be supported by improvement plans for men and machines.
- (2) Have been established through participation of all concerned.
- (3) Be understood and accepted by all connected with it.
- (4) Be the right objectives.

MBO must be seen as a way of thinking and a way of life rather than a collection of techniques.

Planning

For a project to be a success its proper planning is a must. There is a human tendency to avoid planning and assume that everything will turn out satisfactorily if we just start the project. This

never is the case. Unless there is proper planning i.e. clearly making out a formal statement of the nature of future activities and how they are to be carried out, the project is most likely to run into difficulties. There could be technical crises and or unanticipated expenditures on the project. Many engineers/managers would have to spend much unreimbursed overtime solving the problems and rectifying the mistakes. One of the major problems with the Engineering Manager in carrying out proper planning is reluctance to make the necessary schedule and cost estimates. Very often technical people whose skills and knowledge are most vital in preparing proper schedules and cost estimates are the first to protest the "paper work" demand of management. Only mature and experienced people realise the importance and effectiveness of proper planning and one of the major jobs of the manager is to sell this idea to his subordinates.

Although we here are primarily concerned with project planning but many projects do not see the light of the day because there had not been long range planning in the organization. So before we pass on to project planning a few words about long range departmental planning.

Top management in any organization has a critical role in long range planning. There is no denying the fact that for the success of an organization, long range planning, is one of the most important requirement if not the most important. However in actual practise, very few companies, particularly the small ones and too few government departments try to do effective long range planning. It is not a simple job. It is very difficult, involved and demands total and devoted attention of the Chief Executive. It cannot be left to the middle cadre of executives.

Several years ago Mr. S.C. Beise, the then President of Bank of America remarked that in the thirties commercial banks did not go in aggressively for saving deposits. The result was the Banks did not involve themselves in Real Estate financing. After world War II there was a boom in the building industry in America with the result that many small financing companies came up to fill the need. Today, these small companies have grown into big financing companies and are giving a tough time to commercial banks. Commercial banks had to make a lot of effort to come back in the field of savings and real estate loaning but due to lack of foresight the banking industry gave birth to one of their toughest competitors. The Banking industry in America has learnt their lesson well which every other industry should note.

A study of top-most fastest growing companies in USA, reveals that all give highest priority to long range planning. There are many reasons for effective long range planning. It prevents adhoc decisions, random decisions, that unnecessarily narrow down the choices for tomorrow. Effective planning gives the organization a frame work of objectives, goals to be achieved and a strategy to be followed and this forms the basis of decision making from top to bottom. The planning should be comprehensive and total. Planning means futurity of present decisions, i.e. all decisions are made today keeping in view their long range effects. It is also a reasoning about how you get from here to there.

Long Range Planning means development of a comprehensive, reasonably uniform programme of plans and strategy for the whole company stretching over a long period of time.

Majority of largest companies throughout the world have some sort of long range programme and have specific staff for the same to help the top executives. In a seminar held at Fortain bleau near Paris, a few years ago, to discuss strategic business planning, there were about one hundred top executives of the world's largest companies. It was surprising to note that although the approach was different, there was a large degree of comparability among basic planning definition, principles and procedures.

There can be no effective long range planning without the Chief Executive's firm support and commitment. The single most important problem in corporate planning is the belief of some Chief Executives that planning is not a function with which they should be directly concerned. They think that this task can be delegated to subordinates. From this point until the planning is presented to him, he almost abdicated his responsibility. When the plan is finally presented to him it is too late for him to exert much influence on it. It is therefore essential that the Chief Executive assumes full responsibility for his organizations's long range planning. He can hire some assistant to help him but main line of action should come from his personally. George Humphery used to say that the best fertilizer ever invented was the foot step of the farmer. Similarly the best effective planning in an organization is active participation of the Chief Executive in doing it.

Now let us pass on to project planning. The first and foremost task is that project goals should explicitly be stated. The project plans will therefore include the following:-

- (1) Statement of project goals
- (2) Date of completion of the project
- (3) Date of completion of the intermediate tasks
- (4) Complete budget of the project
- (5) Availability of financial resources with respect to time.
- (6) Availability of human resources with respect to time.

There can be no further planning unless the project goals are explicitly and clearly defined.

Explicit expression of project goals is therefore the primary duty of the project manager who is ultimately going to be responsible for the proper execution of the project. There should be no ambiguity in defining the project goals. There would hardly be an Engineer who has not worked on a project which overran its cost and time allocation. In the preparation of design and specifications everything must be standardized and clearly defined with particular attention to control on output, quality and completion time. Any slackness in this respect would mean that the project may be behind schedule both as to budget and time - a situation which is cause No. 1 of rifts between the client and contractor. The contractor can take advantage of such a situation and put up many claims. Thus the first and foremost part of project planning is to define clearly, explicitly and in unequivocal terms the project goals.

A good project manager knows his goals. In Engineering projects the goals are usually tangible. Even in a design job the goals can be well defined. Tangible results in a design project could be a model, a set of working drawings, specifications, schedule of quantities, bending schedule of bars and construction and unsatisfactory performance.

Consider the following two statements of goals.

I) A General Statement

We shall design a multistorey building for Principal Office, National Bank of Pakistan at the Mall Lahore.

II) An Explicit Statement of Goals

We shall design a multi-storey building for Principal Office of National Bank of Pakistan at the Mall Lahore. It would be about 10 storeys high preferably with two basements to cater for parking and services. The total covered area should be around 155,000 sq. ft. so that after accommodating all the departments it leaves sufficient space to cater for at least 10 years future expansion.

sion in staff. The building would be centrally airconditioned having sufficient number of lifts. Our completed package will consist of detailed designs and specifications, working drawings and complete tender documents suitable to invite competitive bidding.

The general goal stated above expressed by the top management is reasonable. But it is not at all a satisfactory goal for planning an engineering project. For engineering projects, the main question is what are the deliverable items. Once these are listed, the Manager would find no difficulty in describing them in sufficient detail as what is to be done and when.

One major reason why engineering managers land into difficulties the fact that many engineering projects are allowed to proceed on their own without any one ever having bothered to list clearly and state explicitly the deliverable items called for by the contract.

Now the next step in planning is the preparation of the Net Work Plans.

The Net Work Plan

The completion of a project is the result of completion of a sequence of inter-dependent activities. Even in straight-forward projects, the design engineer has to complete the design, detailed drawings are to be prepared, materials & manpower is to be arranged and work is to be carried out according to a set schedule. Only then the project can be completed. To achieve these objectives, a "Net Work Plan" is prepared to effectively control the project. The plan provides the basic information for scheduling of estimates and controlling the project. The "Net Work Plan" represents in a graphical manner the dependency relations of a project. This graphical representation is called the "Net Work Chart". In this chart the arrows represent activities and boxes represents the events. An arrow goes from one event to another provided the first event is the immediate predecessor of the second. If an event requires many activities to be fulfilled before it can occur then more than one arrow will enter the box corresponding to those activities. It is usually difficult for a beginner or an inexperienced engineer to prepare a realistic Net Work Chart. It needs a lot of experience to prepare a workable chart. Another important factor is that hundreds of events may be involved in a project. It is the duty of the manager to select such events for the preparation of a Net Work Chart which are important and have bearing on the completion of the project. An ideal Net Work Chart should consist of about 20 to 50 such events. This would be the main or high level Net Work Chart and each event of this chart can further be expanded to be some one else's i.e. a lower level Net Work Chart. This would be necessary for budgeting and scheduling of the project. The first event in all Net Work Charts is "START". It is always useful to make out a list of all the activities, activity times and events that must be accomplished to complete a project before preparing a Net Work Chart. It is usually to start with the last event and work backwards.

It is rather easy to prepare list of events and activities. But how is the activity time to be obtained? The easiest is that the project manager himself decides arbitrarily how much time each activity is likely to take. This is "Father knows best formula". But this approach has a number of drawbacks. First of all the Manager may be a victim of his own wishful thinking. Secondly in such a case his sub-ordinates will resent the decision of the boss having been thrust upon them and will never have the sense of participation in decision making. They would thus absolve themselves of all the responsibilities to complete the job on time. Rather they would like to see the boss's estimate go wrong to prove that their participation in decision making was essential. There is a lot of inconvenience in getting the employees who are to carry out the job give their time estimates. But experience shows that most successful project plans are made which are based on the estimates provided and agreed upon by the persons who are to carry out the job. The sense of participation in decision making by sub-ordinates fulfils their ego, and then they would do their best to achi-

even their goals. A good project manager should be able to get commitment from his subordinates for the time estimates which he thinks are reasonable and at the same time giving them a sense of participation in decision making. A logical discussion can easily convince them about the reasonable time estimates. Nothing should be thrust upon the subordinates from the top.

If left to themselves it is very often that subordinates give arbitrary time estimates without taking into consideration the handicaps and difficulties one usually faces. On the other hand, some subordinates may over-estimate the difficulties and give unrealistic time estimates. It is here where the experience of the project manager comes into play and he has to select the proper time estimates. A Manager who knowingly pressurises a subordinate to commit unrealistic low estimates is inviting a disaster. Realistic estimates can easily be arrived at from the backup material for similar jobs carried out earlier. A good manager must dig up previous reports and one would find that more than required material is available.

Activities time once accepted are then tabulated. Now the Net Work Chart will give clearly the time relationship of the project. We can thus answer all questions whether the job can be finished in time or not and which activities are most important.

The main two concepts in Net Work planning are critical path and slack paths. With the Net Work Chart we can easily determine the critical path. This is the sequence of activities which shows the earliest time of completion. The primary job of net work planning is to clearly state the critical path and fix the time it would take to cover this path. This then is the maximum time the project would take for completion. "Slack" for an event is the difference between latest completion time and earliest completion time.

Net Work Chart

Figure II is a Net Work Chart prepared by the Author a few years ago for the construction of National Bank of Pakistan, Principal office building at Lahore. The Net Work Chart was constructed for preparing the design of the building up to the stage of awarding the contract. This is based on the following supporting documents:-

- (1) Net Work Plan - Event list Form A
- (2) Net Work Plan Figure I
- (3) Net Work Plan - Activity list Form B

After completion of Net Work Chart, Net Work Plan - Completion time and slack, Form C was prepared. It was then easy to determine the critical path which has to be watched very carefully by the project manager. You would observe that we have not gone into a lot of elaboration. In fact most of the events when elaborated will form the Net Work Charts for the managers incharge of different departments. However, this Net Work Chart is sufficiently clear and well defined to provide a sound overall basis of control. This Net Work Chart is then exhibited at a prominent place for everyone to see and find out where they stand. It is equally useful to the manager as well as to the workers. Fortnightly meetings are then held to evaluate the progress.

The Time Schedule

It is always advisable for an engineering manager to transfer his Net Work Chart into a schedule normally known as a time schedule. This schedule will clearly state on which date to start a particular activity and its expected progress over a certain period. The horizontal line represents the time while activities are shown on the vertical line. Normally activities are marked in black over the period and actual performance is marked in red just under the black line. This enables the manager

to know progress at a glance. Usually only those activities which are on the critical path are taken on the schedule, as these activities have no slack time and manager cannot afford to neglect them. As for activities which are not on the critical path are concerned it is for the manager to decide when to start them. His decision is based on several considerations such as availability of manpower, funds and equipment, machinery etc. etc. This schedule is usually discussed with the supervisory staff in meetings from time to time which often keeps on changing. However, all efforts are made not to change the final date of completion as any delay in it will adversely affect the profits of the company. After the project estimates and time schedule are framed, their control becomes top priority.

Control of the Project Cost and Time Schedule

All the documents i.e. Net Work Chart, schedule and estimates are the raw material for the control of the project. Effective control is to be exercised by comparing the progress and actual expenditure with the Budget estimates. The manager has therefore, to see that:

- (1) Budget estimates are not exceeded by actual expenditure.
- (2) The delivery commitments are met.
- (3) To give early warning to the management in case there is any anticipated failure in delivery and commitment of budget estimates.

One of the major responsibilities of the manager is to avoid "surprise" for his management and to avoid being surprised himself. He must also pass on this "no surprises" concept to his assistants. For proper control of the project, therefore, a successful manager should keep the following charts in his office:

- (1) Budgeted manpower expenditure versus time.
- (2) Actual manpower expenditure versus time.
- (3) Budgeted material expenditure versus time.
- (4) Actual material expenditure versus time.
- (5) Percentage completion of the whole project versus time.
- (6) Percentage expenditure versus time.

Communication:

For a successful manager it is essential that there is proper communication between the manager and his staff. The whole essence of communication is contained in this sentence.

"I know that you believe you understand what you think I said, but I am not sure you realise that what you heard is not what I meant".

In fact communication is the biggest problem. Things go wrong because there is no proper communication. You must have come across this problem many a time when an assistant says, Sir, I did because you asked me to do it that way although you never meant it to be done in the way it was done. The question is that any simple statement goes through two filtering processes. The first person comes up with an idea and he translates his concept to second person who understands it through his own listening apparatus forming his own conception of the idea. During this process the idea observed by the second person may not be the same as conceived by the first person.

Let me give an example. A boy madly in love with a girl asks her a simple question. "Do you love me". Now the girl does not want to hurt the boy. She also thinks him to be a nice person but has no romantic feelings for him. So she says "I like you very much". Now in her mind what she means is that you are a nice person, I don't want to hurt you but I have no romantic feelings for

you whatsoever. But this is not what he hears. He wants to be accepted, to be loved. So what he hears is "I almost love you. If you let me get to know you better, I am sure I can fall in love with you". Now the words have never changed. They both agree that words she said were "I like you very much", still they totally disagree what she meant.

In the language of behavioral science both transmission and reception of communication are influenced by the voice, values, attitudes needs and intellectual standards of both sender and the receiver.

With the view point of a manager there are three types of interpersonal communication. Refer Fig. III.

The circles represent people in your organization. You the manager are M. Now it depends upon you what type of communication network you adopt in your organization. It will largely depend on the style of management you adopt and kind of persons you have in your department. For a complex highly technological development project, all channel communication network is probably the best. In this case there is greater communication among the staff, hence the better will be the operation. However, for straight-forward simple operation, all channel communication will be more time consuming and unnecessary. Here you might prefer the wheel. Here you just tell the people what to do and they will carry out the instructions as you wish.

It is clear that an autocratic manager would prefer to have a wheel or even a chain type of communication network while a participative manager is more likely to have an all channel communication network. To select the particular type of communication networks a lot depends upon the circumstances, the nature of the job, the persons to work with and the nature of the manager himself. And now this brings us to the second most important aspect of communication. This is your attitude towards your subordinates. The attitude of the manager plays a very important part as every subordinate is concerned how his communication is going to be received by the manager. One extreme is where the manager is prepared to hear the worst, he is not influencing the subordinate rather he is encouraging him to state the facts. He is generating openness by his attitude. Here the subordinate will tell the truth as fully as he can and manager will get a most accurate and useful account. The other extreme is where the manager is not prepared to hear anything contrary to his own thinking. The climate is not at all supportive. His attitude provokes defensiveness. Here the subordinate will say only those things that the manager wants to hear.

The instructions should be complete and clear in details as to exactly what is to be done and how it is to be done. Although many instructions at site are verbal the best method is to convey them in writing so that they can be referred to without reliance on imperfect memory or faulty interpretation. Good communication ultimately leads to a well run organization, whereas poor communication leads to duplication, errors, poor coordination and ineffective utilisation of resources. Good communication is key to successful management.

Hiring & Firing

Hiring

Hiring is normally not only more pleasant than firing but is more important too. If hiring is done properly, there will be much less firing and lot of peace for the management. Firing always creates tension within the organization which ultimately affects its working. If hiring is done on merit and purely on merit and not on recommendations of an important person, then there won't be much regrets. The major tool which the manager has for selection is the personal interview. A

good manager will be able to assess completely and thoroughly the abilities of the candidate during the interview. It is however necessary that the manager creates environment in which the communication takes place and the candidate feels completely at home. The interviewer has to be a good observer as within a short time period he has to assess the applicants technical capabilities, personality and suitability to the organization.

Firing

Firing is the most unpleasant job. The mode of terminating an employee has a great effect on the reputation of the organization. It also effects the morale of the other employees. The process is therefore to be handled very carefully. The need to terminate an employee can be due to any of the following reasons:-

- (1) Performance not up to the mark.
- (2) Unwilling worker.
- (3) Completion of a project with no further works in hand.
- (4) Overall retrenchment in the organization.

The process of firing is so distasteful that many managers postpone the decision to act. However a good manager will find that nothing is gained by delaying a decision. Any delay will create a vague atmosphere of disapproval for the employee and this would be a big strain on him. So it is much better if action is taken immediately as the need arises.

The way the termination is carried out is critical. If carried out properly and for the right reason, it can be beneficial to the employee as well as to the organization. The following principles must therefore be observed for this process:-

(1) Complete honesty:

While terminating one must speak the truth and the whole truth, nothing should be kept hidden. It is the tendency of some managers as well as the natural instinct to "soften the blow" while terminating an employee. If this is done by telling untruth or half truth, it is going to affect the integrity and reputation of the manager as well as the organization. If reason to terminate is unsatisfactory work, say so. If is lack of work, say so. State clearly the basic issue. The Manager must fully justify his action. If action cannot be justified, there will be a serious question whether action was proper or not.

(2) Do not discuss specifics

Discussing of specifics will only result in a haggling session. Suppose you have a technician whose work is reported unsatisfactory by five of your engineers with whom he happened to work. If you enter into discussion about each engineer's complaint, you will find that the employee will give all sorts of excuses for the complaint. And since all your knowledge of things is second hand, you won't be able to counter his excuses. An employee who has been under-performing, will be preparing his excuses for a long time which your second hand knowledge may not be able to counter. The important thing is that as a result of serious thinking, management comes to the conclusion that the working of the employee is unsatisfactory and the manager must be sure that his conclusion is soundly based.

(3) Try to recommend positive action to the employee:

A manager must realize that being fired is a crisis in the career of an employee. This can have positive or negative ultimate effects. Which effect it will have is directly related to how the manager handles the situation. The manager can explain to the employee that his performance is not up to

the mark in this particular situation and that this does not mean that he would be a failure in some other situation. Moreover he can mention some other job opportunity to him. The employee must feel that the end of the world has not come for him and that the manager and the organization are concerned about him as an individual. The manager should try to realize and relieve the anxiety of the employee as far as possible.

(4) Be a good listener:

An employee who has been fired will have a lot to say by way of criticising the organization. He has a great deal to get off his mind. He would not desire an answer but would like to air his grievances to the full. So the manager should not adopt a defensive attitude - rather let the employee say whatever he wants and be a good listener. He must *not* and I repeat *Not* by his word or action indicate his agreement or disagreement with the employee. Even if the manager is directly criticised he should not get himself involved in a discussion. There is little he can gain by having and argument with him.

The terminated employee must immediately be removed from the premises. His loyalty towards the organization ends the day he is fired. In certain cases there could be destructive reaction from him. If any notice is to be given to the employee this should be regarded as penal pay. The employee should be expected to leave the premises at the very day he is terminated.

A lot can be achieved by using the right management techniques by way of efficiency, lowering cost of production, earlier completion of projects and better controls. The advanced countries have done it and are reaping a rich harvest. Why shouldn't we? It is already tried. It is nothing new. Give it a sincere trial and results would be beyond expectations.

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Form A: Network Plan – Event List

Task Construction of our Principal Office building at Gore-
Preparation of Tender Documents and Award of Work.

| Event No. | Immediate Predecessor Activities | description |
|-----------|----------------------------------|--|
| 001 | | Start |
| 002 | (a) | Site Selection Studies Completed. |
| 003 | (b) | Site Selection Report Ready. |
| 004 | (c) | Soil Test Studies Completed. |
| 005 | (e) | Aggregate Selection Studies Completed. |
| 006 | (g) | Assessment of General Requirements Completed. |
| 007 | (i) | Environmental Studies Completed. |
| 008 | (d) | Soil Test Report Received. |
| 009 | (f) | Aggregate Selection Report Received. |
| 010 | (h) | General Requirements Report Received. |
| 011 | (j) | Environmental Studies Report Received. |
| 012 | (k)(l)(m)(n) | Complete Design Report Received. |
| 013 | (o) | Conceptual Design Completed & on hand. |
| 014 | (p) | Structural Design Completed & on hand. |
| 015 | (q) | Architectural Design Completed & on hand. |
| 016 | (r) | Electrical Installation Design Completed & on hand. |
| 017 | (s) | Plumbing & Sanitary Installation Design Completed & on hand. |
| 018 | (t) | Airconditioning Studies Completed & Design on hand. |
| 019 | (u) | Elevators Studies Completed & Design on hand. |
| 020 | (v)(w)(x)(y)(z)(aa) | Detailed Design/Drawings Completed & on hand. |
| 021 | (bb) | Specifications, Control & Contractual Documents on hand. |
| 022 | (cc) | Bids Received. |
| 023 | (dd) | Bids Evaluated. |
| 024 | (ee) | Contract Awarded. |

B. A. Chowdhry

Form B: Net work Plan – Activity List

Task Principal Office Building, Lahore.

| Activity No. | Activity Time in Weeks Units. | Activity Description |
|--------------|-------------------------------|--|
| a | 4 | Complete Site Selection studies |
| b | 2 | Prepare Site Selection Report |
| c | 4 | Complete Soil Test Studies |
| d | 3 | Receive Soil Test Report |
| e | 2 | Complete Aggregate Selection Studies |
| f | 1 | Receive Aggregate Selection Report |
| g | 4 | Assess the General Requirements of the Project |
| h | 1 | Receive General Requirements of the Project |
| i | 3 | Complete Environmental Studies |
| j | 2 | Receive Environmental Studies Report |
| k | 0 | Dummy |
| l | 0 | Dummy |
| m | 0 | Dummy |

Form B: Network Plan – Activity List

Task Principal Office Building, Lahore.

| Activity No. | Activity Time in | Activity Description |
|--------------|------------------|--|
| n | 0 | Dummy |
| o | 8 | Complete Conceptual Design of the Project |
| p | 12 | Complete Structural Design of the Project |
| q | 8 | Complete Architectural Design of the Project |
| r | 6 | Complete Electrical Installation Design of the Project |
| s | 4 | Complete Plumbing & Sanitary Installation Design of the Project. |
| t | 10 | Complete Airconditioning Design of the Project |
| u | 4 | Complete Elevator Design of the Project |
| v | 0 | Dummy |
| w | 0 | Dummy |
| x | 0 | Dummy |
| y | 0 | Dummy |
| z | 0 | Dummy |

Form C: Network Plan – Completion Times and Slack

Task Principal Office Building, Lahore
 Time Units Weeks

| Event No. | Earliest Completion Time | Latest Completion Time | Slack Time |
|-----------|--------------------------|------------------------|------------|
| 001 | 0 | 0 | 0 |
| 002 | 4 | 4 | 0 |
| 003 | 6 | 6 | 0 |
| 004 | 10 | 10 | 0 |
| 005 | 8 | 12 | 4 |
| 006 | 10 | 12 | 2 |
| 007 | 9 | 11 | 2 |
| 008 | 13 | 13 | 0 |
| 009 | 9 | 13 | 4 |
| 010 | 11 | 13 | 2 |
| 011 | 11 | 13 | 2 |
| 012 | 13 | 13 | 0 |
| 013 | 21 | 21 | 0 |
| 014 | 33 | 33 | 0 |
| 015 | 29 | 33 | 4 |
| 016 | 27 | 33 | 6 |
| 017 | 25 | 33 | 8 |
| 018 | 31 | 33 | 2 |
| 019 | 25 | 33 | 8 |
| 020 | 33 | 33 | 0 |
| 021 | 37 | 37 | 0 |
| 022 | 45 | 45 | 0 |
| 023 | 48 | 48 | 0 |
| 024 | 50 | 50 | 0 |

Critical Path

NATIONAL BANK OF PAKISTAN
 NETWORK PLAN
 PRINCIPAL OFFICE BUILDING
 LAHORE

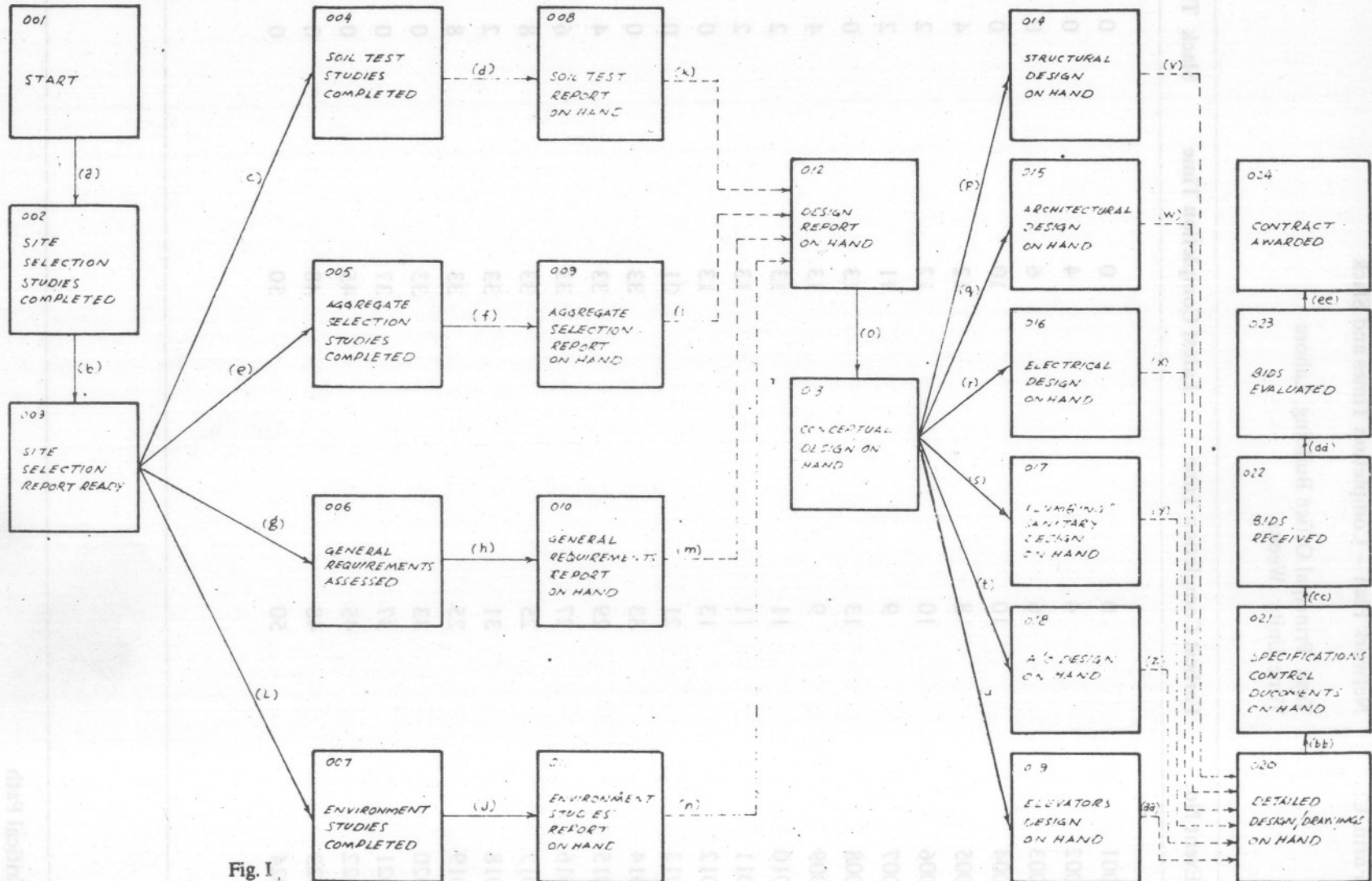
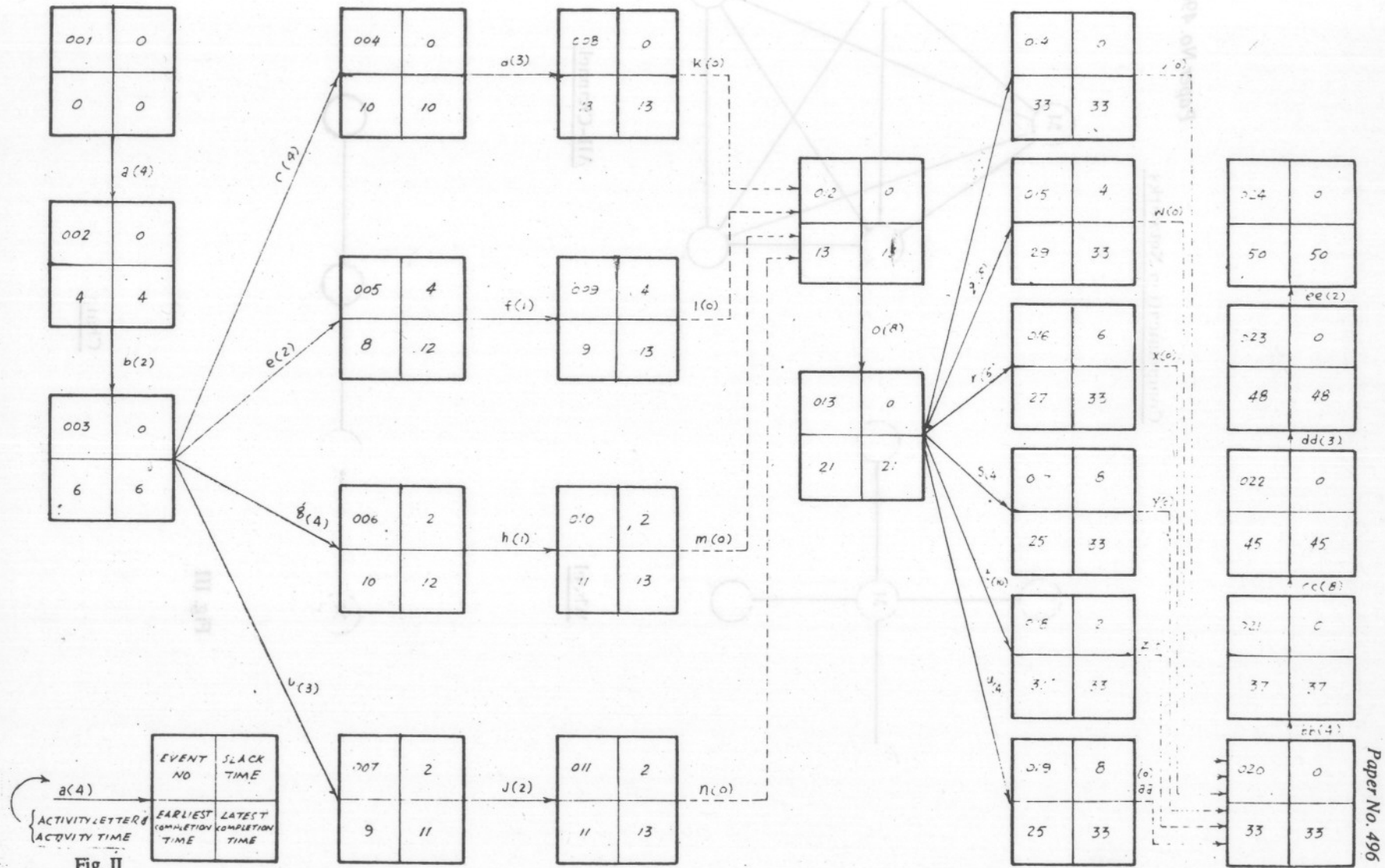
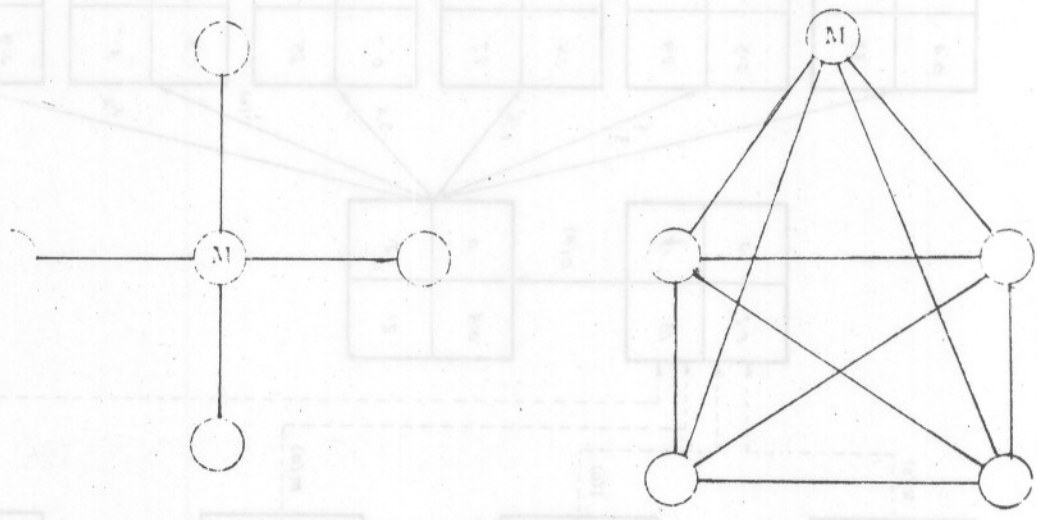


Fig. I

NATIONAL BANK OF PAKISTAN
 NET WORK CHART
 PRINCIPAL OFFICE BUILDING
 LAHORE



Communication Networks



Wheel

All-Channel

Chain

Fig. III