

LECTURE SIX: LABOUR, MATERIAL & EQUIPEMENT UTILIZATION

INTRODUCTION:

Good project management in construction must vigorously pursue the efficient utilization of labor, material and equipment. Improvement of labor productivity should be a major and continual concern of those who are responsible for cost control of constructed facilities. Material handling, which includes procurement, inventory, shop fabrication and field servicing, requires special attention for cost reduction. The use of new equipment and innovative methods has made possible wholesale changes in construction technologies in recent decades. Organizations which do not recognize the impact of various innovations and have not adapted to changing environments have justifiably been forced out of the mainstream of construction activities.

Observing the trends in construction technology presents a very mixed and ambiguous picture. On the one hand, many of the techniques and materials used for construction are essentially unchanged since the introduction of mechanization in the early part of the twentieth century. The work could not have done any faster or more efficiently in our day, despite all technological and mechanical advances in the time since, the reason being that no present system could possibly carry the spoil away any faster or more efficiently than the system employed.

The United States construction industry often points to factors which cannot be controlled by the industry as a major explanatory factor in cost increases and lack of technical innovation. These include the imposition of restrictions for protection of the environment and historical districts, requirements for community participation in major construction projects, labor laws which allow union strikes to become a source of disruption, regulatory policies including building codes and zoning ordinances, and tax laws which inhibit construction abroad. However, the construction industry should bear a large share of blame for not realizing earlier that the technological edge

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held by the large U.S. construction firms has eroded in face of stiff foreign competition. Many past practices, which were tolerated when U.S. contractors had a technological lead, must now be changed in the face of stiff competition. Otherwise, the U.S. construction industry will continue to find itself in trouble.

With a strong technological base, there is no reason why the construction industry cannot catch up and reassert itself to meet competition wherever it may be. Individual design and/or construction firms must explore new ways to improve productivity for the future. Of course, operational planning for construction projects is still important, but such tactical planning has limitations and may soon reach the point of diminishing return because much that can be wrung out of the existing practices have already been tried. What is needed the most is strategic planning to usher in a revolution which can improve productivity by an order of magnitude or more. Strategic planning should look at opportunities and ask whether there are potential options along which new goals may be sought on the basis of existing resources. No one can be certain about the success of various development options for the design professions and the construction industry. However, with the availability of today's high technology, some options have good potential of success because of the social and economic necessity which will eventually push barriers aside. Ultimately, decisions for action, not plans, will dictate future outcomes.

LABOUR PRODUCTIVITY:

Productivity in construction is often broadly defined as output per labor hour. However, it is important to note that labor productivity is a measure of the overall effectiveness of an operating system in utilizing labor, equipment and capital to convert labor efforts into useful output, and is not a measure of the capabilities of labor alone. For example, by investing in a piece of new equipment to perform certain tasks in construction, output may be increased for the same number of labor hours, thus resulting in higher labor productivity.

Construction output may be expressed in terms of functional units or constant dollars. In the former case, labor productivity is associated with units of product per labor hour, such as cubic yards of concrete placed per hour or miles of highway paved per hour. In the latter case, labor productivity is identified with value of construction (in constant dollars) per labor hour.

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Ratio of value of goods or services produced in a period of time by hours of labor used to produce them.

$$\text{Labour productivity} = \text{output} / \text{labour cost}$$

Productivity in the Construction Industry

Because of the diversity of the construction industry, a single index for the entire industry is neither meaningful nor reliable. Productivity indices may be developed for major segments of the construction industry nationwide if reliable statistical data can be obtained for separate industrial segments. For this general type of productivity measure, it is more convenient to express labor productivity as constant dollars per labor hours since dollar values are more easily aggregated from a large amount of data collected from different sources. The use of constant dollars allows meaningful approximations of the changes in construction output from one year to another when price deflators are applied to current dollars to obtain the corresponding values in constant dollars. However, since most construction price deflators are obtained from a combination of price indices for material and labor inputs, they reflect only the change of price levels and do not capture any savings arising from improved labor productivity. Such deflators tend to overstate increases in construction costs over a long period of time, and consequently understate the physical volume or value of construction work in years subsequent to the base year for the indices.

FACTORS AFFECTING JOB-SITE PRODUCTIVITY

Job-site productivity is influenced by many factors which can be characterized either as labor characteristics, project work conditions or as non-productive activities. The labor characteristics include:

- age, skill and experience of workforce
- leadership and motivation of workforce

The project work conditions include among other factors:

- Job size and complexity.
- Job site accessibility.
- Labor availability.
- Equipment utilization.

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- Contractual agreements.
- Local climate.
- Local cultural characteristics, particularly in foreign operations.

The non-productive activities associated with a project may or may not be paid by the owner, but they nevertheless take up potential labor resources which can otherwise be directed to the project. The non-productive activities include among other factors:

- Indirect labor required to maintain the progress of the project
- Rework for correcting unsatisfactory work
- Temporary work stoppage due to inclement weather or material shortage
- Time off for union activities
- Absentee time, including late start and early quits
- Non-working holidays
- Strikes

Each category of factors affects the productive labor available to a project as well as the on-site labor efficiency.

Factors for Labor Performance analysis

Performance analysis is a common tool for assessing worker quality and contribution. Factors that might be evaluated include:

- Quality of Work - caliber of work produced or accomplished.
- Quantity of Work - volume of acceptable work
- Job Knowledge - demonstrated knowledge of requirements, methods, techniques and skills involved in doing the job and in applying these to increase productivity.
- Related Work Knowledge - knowledge of effects of work upon other areas and knowledge of related areas which have influence on assigned work.
- Judgment - soundness of conclusions, decisions and actions.
- Initiative - ability to take effective action without being told.
- Resource Utilization - ability to delineate project needs and locate, plan and effectively use all resources available.
- Dependability - reliability in assuming and carrying out commitments and obligations.

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- Analytical Ability - effectiveness in thinking through a problem and reaching sound conclusions.
- Communicative Ability - effectiveness in using oral and written communications and in keeping subordinates, associates, superiors and others adequately informed.
- Interpersonal Skills - effectiveness in relating in an appropriate and productive manner to others.
- Ability to Work Under Pressure - ability to meet tight deadlines and adapt to changes.
- Security Sensitivity - ability to handle confidential information appropriately and to exercise care in safeguarding sensitive information.
- Safety Consciousness - has knowledge of good safety practices and demonstrates awareness of own personal safety and the safety of others.
- Profit and Cost Sensitivity - ability to seek out, generate and implement profit-making ideas.
- Planning Effectiveness - ability to anticipate needs, forecast conditions, set goals and standards, plan and schedule work and measure results.
- Leadership - ability to develop in others the willingness and desire to work towards common objectives.
- Delegating - effectiveness in delegating work appropriately.
- Development People - ability to select, train and appraise personnel, set standards of performance, and provide motivation to grow in their capacity. Diversity (Equal Employment Opportunity) - ability to be sensitive to the needs of minorities, females and other protected groups and to demonstrate affirmative action in responding to these needs.

These different factors could each be assessed on a three point scale: (1) recognized strength, (2) meets expectations, (3) area needing improvement. Examples of work performance in these areas might also be provided.

The various Factors affecting labour productivity are as follows:

1. Design factors
2. Execution plan factors
3. Material factors
4. Equipment factors
5. Labour factors

6. Health and safety factors
7. Supervision factors
8. Working time factors
9. Project factors
10. Quality factors
11. Financial factors
12. Leadership and co-ordination factors
13. Organization factors
14. Owner factors
15. External factors

Manpower Factors:

- Lack of experience
- Absentism
- Alcoholism
- Misunderstanding among labourers
- Age
- Lack of competition among labourers
- Disloyalty
- Personal problems

External Factors:

- Supervision delays
- Variations in drawings
- Incomplete drawings
- Rework
- Design changes
- Inspection delays from authorities
- Payment delays
- Complex design
- Implementation of government laws
- Lack of training sessions

Resource Factors:

- Lack of required construction material
- Lack of equipment
- Insufficient lighting
- Poor site condition
- Material storage location
- Poor access to site
- Violation of safety rules
- Inadequate transportation facilities
- Inflation
- Lack of incentive
- Crew size
- Payment delays

Miscellaneous Factors:

- Shortage of water and power supply
- Accidents during construction
- Weather conditions
- Overtime working

Guidelines to Improve Productivity:

1. Providing proper training to labourers
2. Motivation to workers
3. Proper material procurement and management
4. On time payment
5. Systematic flow of work
6. Discipline at work
7. Clearing all legal documents
8. Planning of funds
9. Proper resource utilization
10. Advanced equipment planning

MATERIAL MANAGEMENT:

Materials management is an important element in project planning and control. Materials represent a major expense in construction, so minimizing *procurement* or *purchase* costs presents important opportunities for reducing costs. Poor materials management can also result in large and avoidable costs during construction. First, if materials are purchased early, capital may be tied up and interest charges incurred on the excess *inventory* of materials. Even worse, materials may deteriorate during storage or be stolen unless special care is taken. For example, electrical equipment often must be stored in waterproof locations. Second, delays and extra expenses may be incurred if materials required for particular activities are not available. Accordingly, insuring a timely flow of material is an important concern of project managers.

Materials management is not just a concern during the monitoring stage in which construction is taking place. Decisions about material procurement may also be required during the initial planning and scheduling stages. For example, activities can be inserted in the project schedule to represent purchasing of major items such as elevators for buildings. The availability of materials may greatly influence the schedule in projects with a *fast track* or very tight time schedule: sufficient time for obtaining the necessary materials must be allowed. In some case, more expensive suppliers or shippers may be employed to save time.

Materials management is also a problem at the organization level if central purchasing and inventory control is used for standard items. In this case, the various projects undertaken by the organization would present requests to the central purchasing group. In turn, this group would maintain inventories of standard items to reduce the delay in providing material or to obtain lower costs due to bulk purchasing. This organizational materials management problem is analogous to inventory control in any organization facing continuing demand for particular items.

Material management is defined as an integrated approach to manage the entire need, flow and cost related to materials. Its main aim is to maximize Return on Investment.

Return On Investment (ROI)=[Gain from investment-cost of investment]/cost of investment

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Role of material management:

1. To arrive at right quality of materials.
2. To arrive at right quantity of materials.
3. To procure the materials from right source.
4. To ensure materials are delivered at right time.

Objectives of material management:

1. To buy desired quality of materials at lowest price.
2. To maintain high inventory turnover by reducing excess storage, carrying costs and inventory loss occurring due to deterioration.
3. To maintain continuity of supply, preventing interruption of flow of materials.
4. To maintain specified material quality level.
5. To develop reliable alternate sources of supply.
6. To minimize overall cost of acquisition by improving efficiency of operation.
7. To hire, develop, motivate and train personnel.
8. To develop and maintain good supplier relationship.
9. To achieve high degree of co-operation and co-ordination.
10. To maintain good records and control.