# Engineering and Project and Construction Management Productivity Improvement

If engineers and project and construction management personnel are unable to effectively manage their own time, they may find it increasingly difficult to manage their subordinates' time or engineering and construction projects and increase production rates. Unfortunately, it is difficult to measure the productivity of engineers and project and construction management personnel because their work requires analytical reasoning and other types of cerebral activities, before they perform calculations and any type of analysis on paper or on computers. When trying to determine the production rates of engineers and construction managers, one cannot merely measure output, as is done to determine production rates for construction jobsite workers. Rather, a different technique should be used for measuring whether engineers and construction managers are managing their time effectively and working at their theoretical maximum achievable capacity.

One method that helps determine the effectiveness of how engineers and project and construction managers are using their time is a **time-management study** (TMS). Time-management studies are similar to productivity improvement studies in that they measure the amount of time a worker is productive, but they also provide insight into how a worker is using his or her time during a work period. When analyzing the productivity of engineers and other construction team members, TMS provides information on the exact activities performed during specific work periods. Since TMSs are an important aspect of productivity improvement, they are discussed in detail in Section 8.12.

This chapter includes information about engineering and project and construction management productivity variables, distractions, roadblocks, and issues. It also includes a discussion about conducting meetings and resolving conflicts because these activities consume a great deal of the time of engineering and project and construction management professionals. This chapter also covers methods for improving engineering and project and construction management productivity and conducting a TMS.

# 8.1 Productivity Variables

The productivity rates of engineers and project and construction management personnel are affected by some of the same variables that affect the productivity of construction workers. Among these variables are varying energy levels caused by

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- Fatigue,
- Levels of concentration,
- The total amount of work to be performed,
- Motivation,
- Alertness, and
- Interest in a project.

Due to fluctuating blood sugar levels after meals, the peak work hours for most workers are between 9:00 and 11:00 a.m. and between 1:00 and 4:00 p.m. In the construction industry, project and construction managers accomplish more during afternoon peak work hours than they do during morning peak work hours, but this could be due to the work performed in the mornings requiring more immediate problem solving, which detracts from production-related work. Project management personnel are also more productive during Wednesdays and Thursdays, which reflects the planning and organizing activities that occur earlier in the week at construction jobsites.

**Engineering productivity** is affected by the location of the work being performed because a quieter environment is more conducive to analytical work. Overtime is prevalent among engineers who work in the engineering and construction (E&C) industry, but the overtime is used mainly as a means of performing work in an environment with fewer interruptions and a quiet atmosphere. Engineers work overtime either in the early morning hours or after other employees have left the office at the end of the day. In addition, engineers and construction management personnel often work on Saturdays or Sundays in order to prepare weekly plans in an atmosphere that allows them to concentrate on the task at hand, and not on multiple tasks, as they are required to do during typical workdays.

#### 8.2 Productivity Distractions

In their typical work environment, engineers and project and construction managers encounter a variety of distractions that prevent them from performing their assigned work tasks. In addition to performing their assigned work, engineers and project and construction managers are required to manage the work of others and to be part of a team. The **interdependency** of project teams—that is, the dependence of team members on the work of other team members—makes it important for engineers and project and construction managers to be able to switch between work tasks while they are waiting for others to provide them with information.

The items that most frequently keep engineering and project and construction management team members from completing their assigned tasks on time are (Kerzner 2005, p. 317):

- Incomplete work,
- Rework,
- Delayed decisions,

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- Poor communication,
- Telephone interruptions,
- Casual visitors,
- Waiting (for people, decisions, data, memos, information, and so forth),
- Failure to delegate, and
- A poor information retrieval system.

Of the items in this list, the two that cause the most work delays are delayed decisions and poor communication. More information about workplace distractions is available in Roper and Juneju (2009).

It is impossible for employees to be productive 100% of the time, but the productivity of engineering and project management personnel should not fall below 6h in an 8-h workday (75% efficiency). The profits of firms are based on maintaining high productivity levels, and assigning a monetary value to time helps to illustrate the importance of maintaining engineering productivity rates above 75%. For engineers earning \$50,000 a year, with benefits equivalent to 40% of their weekly salary (\$20,000), the value of their time is \$0.56 per minute {[(\$70,000/52 weeks/year)/40 hours/week]/60 min/hour}, or \$33.65 per hour. At a \$100,000 salary (benefits 40,000, the value of their time is 1.12 per minute [(140,000/52 weeks/year)/40hours/week]/60 min/hour}, or \$67.31 per hour. At a salary of \$100,000/for every 2 h of lost productivity per day, the cost is \$134.62, or a total of \$673.10 per week and \$2,692.40 per month. Totaling the cost of the lost productivity for each project team member illustrates that inefficient work hours substantially reduce profits. Since it is difficult to measure the productivity of engineers and project and construction managers, firms might not be able to determine the actual losses caused by the decreased productivity of their personnel.

To reduce the time lost to **productivity distractions**, engineers and project management professionals should investigate the adoption of strategies such as the ones listed in Table 8-1. Additional strategies for producing higher levels of productivity are listed in Table 8-2.

# 8.3 Productivity Roadblocks

The activities that keep engineers and project and construction management team members from focusing their time on their assigned work tasks are called **productivity roadblocks**. Several examples of productivity roadblocks are listed in Table 8-3.

# 8.4 Productivity Issues

Engineers and project and construction managers have to deal with unique productivity issues because they are responsible for managing the work processes that occur on E&C projects. In addition to their daily work assignments, they are responsible for making sure that projects are managed as efficiently as possible while not exceeding the budget or missing scheduled completion dates. Project managers spend the majority of their time on four activities (Kerzner 2005, p. 334):

Strategies
Ask whether each trip is necessary
Avoid writing or reading useless memos
Control telephone time
Do not procrastinate
Do the hard part first
Follow schedules
Have only relevant people attend meetings
Know your energy cycle
Learn to delegate
Learn to say no
Look ahead
Make decisions quickly
Manage by exception
Refuse to do the unimportant
Send out meeting agendas
Shut off in-house visits for set periods
Travel light
Work at travel stops
Read e-mails only twice a day
Return phone calls only twice a day

Table 8-1. Strategies for Eliminating Productivity Distractions

Source: Adapted from Mackenzie (1972).

#### Table 8-2. Strategies for Increasing Productivity

Strategies Classify activities Conduct a time analysis Establish opportunity cost activities Establish priorities Focus on opportunities, not problems Plan solid blocks of time for important matters Practice calculated neglect Practice delegation Train the system (boss, subordinates, and peers)

Source: Adapted from Mackenzie (1972).

- 1. Meetings (8 hours/week),
- 2. Productivity Distractions (10 hours/week),
- 3. Conflicts (12 hours/week),
- 4. Planning and Replanning (10 hours/week).

Because the time spent on these four activities totals 40h per week for typical project managers, they likely would not be able to perform all of their assigned work activities without working more than 40h per week. One way for project managers

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Activities
Day-to-day administration
Having to explain "thinking" to superiors
Impromptu tasks
Lack of information in a ready format
Lack of sufficient clerical support
Late appointments
Too many levels of review
Too many people working in a small area
Union grievances
Unscheduled appointments or drop-ins

Table 8-3. Activities That Reduce Productivity

Source: Adapted from Kerzner (2005), p. 33.

to prevent having to work overtime is to reduce the amount of time they spend on these four activities. Other activities that lead to the inefficient use of time at the project management level are the following (Mackenzie 1972, p. 6):

- Lack of planning,
- Lack of self-control,
- Activity traps,
- Managing versus doing,
- People versus task skills,
- Ineffective communication,
- Organizational bottlenecks.

## 8.5 Conducting Meetings

Engineers and project and construction managers might be able to increase their productivity during the week by conducting more effective meetings and reducing the time required for meetings. Meetings provide an opportunity for people to share information and clarify their performance. They enable participants to provide input into decision-making processes and provide managers with an opportunity to identify members who have the ability to perform tasks or make decisions. They increase the probability that decisions will be implemented and provide a venue for reinforcing organizational values (Kieffer 1988). Not all employees agree that meetings are listed in Table 8-4.

## **Meeting Agendas**

When preparing to conduct a meeting, the meeting chair should define the purpose of the meeting and plan what will be accomplished during the meeting. If the chair of the meeting is unclear as to the purpose of the meeting, then he or she should solicit input from potential meeting attendees. Once the purpose of a meeting has

Complaints
Boring
Too frequent or not frequent enough
Diverted by members with a hidden agenda
Dominated by formal leaders or by a few influential or verbal people
Not focused on important issues
Poorly organized or poorly led
Subverted by members whose behaviors are destructive
Too long

Table 8-4. Common Complaints about Meetings

Source: Adapted from Kieffer (1988).

been defined, then an **agenda** should be developed and distributed to everyone who will be attending the meeting. The agenda should include all of the topics that will be discussed at the meeting, with the most urgent topics listed first to ensure that they will be covered during the meeting. Meeting agendas should be distributed to attendees at least one week before the meeting date, unless a meeting is scheduled on short notice.

To ensure that a meeting does not exceed the time allotted for it, the meeting chair should start the meeting on time. Having to wait for late arrivals to a meeting is disrespectful to the people who have arrived on time. Starting on time also sets a precedent that demonstrates that all meeting attendees should be present at the beginning of the meeting. The first activity in a meeting should be a review of the agenda to verify its accuracy and to add items that have surfaced since the agenda was developed and distributed to meeting members.

While a meeting is being conducted, the chair is responsible for ensuring that meeting attendees follow the agenda. If the meeting attendees would like to discuss topics that are not on the agenda, the new items should be discussed as new business toward the end of the meeting. As a meeting progresses, the chair of the meeting should assign responsibility for following up on **action items** to the appropriate person and indicate dates for the completion of each action item. Toward the end of the meeting and remind attendees of their responsibilities for completing action items. Meetings should be concluded at the scheduled time, as this demonstrates concern for the next commitment of the people attending the meeting. If some agenda items are not addressed by the end of the meeting, they should be included in the agenda for the next meeting, at the beginning of the agenda. Meeting minutes should be distributed in a timely manner to remind meeting attendees of the tasks they were assigned to perform during meetings.

#### **Disruptive Meeting Attendees**

One of the most difficult aspects of conducting meetings is dealing with difficult attendees. Meetings might be disrupted if any of the attendees exhibit one or more

Behaviors
Challenging attempts to move the group toward decisions
Conducting side conversations
Insisting on a precise, clear definition of each idea to the point that the group does not accomplish anything
Interpreting criticism of ideas as a personal attack
Joking about everything that happens
Talking for the sake of being heard
Urging the group to take action before a problem is clearly identified
Waving off or negating all suggestions or new ideas from others
Talking for long periods

Table 8-5. Behaviors That Are Disruptive in Meetings

Source: Adapted from Kieffer (1988).

of the behaviors listed in Table 8-5. Some of the disruptive behaviors that are mentioned in Table 8-5 might occur when a meeting is conducted without adequate preparation or when there is no meeting agenda to keep attendees focused on the meeting tasks.

To minimize the time required for meetings, the meeting chair should limit the amount of time commandeered by meeting attendees. When trying to steer meetings back to the original agenda, the chair should adopt strategies that help to neutralize meeting attendees who are being disruptive. The following paragraphs provide suggestions on how to neutralize disruptive behaviors by meeting attendees.

The chair should listen to meeting members but not become involved in debates with them. It is usually not effective to ignore disruptive meeting attendees, as they may merely continue their behavior. Trying to persuade them to join the main discussion sometimes helps to make them feel that the other meeting attendees respect their ideas and contributions. If this does not work, then the chair should speak with them in private about their behavior. If meeting chairs try to resolve issues during meetings, additional disruptions might occur when the disruptive attendees escalate their negative behavior in retaliation or withdraw from meeting interactions entirely. When discussing problems, the chair should focus on the behaviors causing problems and not attack the person exhibiting the behaviors. It is also not constructive to mention past arguments between meeting attendees (Kieffer 1988).

Sometimes attendees use disruptive behavior when they want to contribute to a meeting but have not determined the best technique for accomplishing this objective. If a meeting chair recognizes that this is happening, he or she should help the disruptive attendees to participate in the meeting by using strategies such as inviting them to planning meetings, asking them for specific suggestions, or providing them with responsibilities for tasks that result from decisions made during the meeting (Kieffer 1988). Meeting attendees could also share in the responsibility for dealing with disruptive attendees by not allowing unacceptable behavior to go unchecked and by using group censure to neutralize them. If other techniques for neutralizing disruptive behavior are not effective, then meeting attendees have the option of

walking out of the meeting when the disruptive behavior prevents them from achieving their objectives, or the disruptive meeting attendee might be excluded from further meetings.

# 8.6 Conflict Resolution

**Conflict resolution** is not about avoiding conflicts, but rather it is concerned with managing conflicts without dedicating too much time to the process of solving them. Some of the principal causes of conflicts are listed in Table 8-6.

Conflict results from individual differences, backgrounds, and values, and if it is used constructively, it might help release energy in stressful situations. The negative aspects of conflict include

- Diverting energy away from the tasks that need to be accomplished,
- Destroying morale,
- Polarizing individuals and groups,
- Deepening differences,
- Obstructing cooperative actions,
- Producing irresponsible behavior,
- Creating suspicion and distrust, and
- Decreasing productivity.

## **Causes of Conflicts**

Conflicts arise from four areas:

- 1. Facts related to the present situation or problem,
- 2. Methods to be used to achieve goals,
- 3. Goals related to how people want things to be accomplished, and
- 4. Values that represent long-term goals and qualities.

auses
uthority issues
ommunication failures or inaccuracies
ompetition for limited resources
ifferences over methods
rustration and irritability
ack of cooperation
ersonality clashes
esponsibility issues
ubstandard performance
alue and goal differences

#### Table 8-6. Principal Causes of Conflicts

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Conflicts that arise over facts are easier to resolve, and the hardest to resolve are conflicts that arise over value differences.

# **Conflict Management Strategies**

Each individual addresses conflicts by using his or her own inherent strategies, but there are also specific techniques for addressing conflicts. The five main techniques used to address conflicts are:

- 1. **Withdrawing:** This occurs when an individual retreats from an actual or a potential conflict situation.
- 2. **Smoothing:** This happens when someone emphasizes areas of agreement and deemphasizes areas where there are differences.
- 3. **Compromising:** This involves an individual or individuals searching for solutions that bring some degree of satisfaction to the parties in conflict.
- 4. **Forcing:** This is when someone exerts his or her viewpoint at the potential expense of the viewpoint of someone else, and this could result in open competition.
- 5. **Confrontation:** This occurs when an individual addresses a disagreement directly and in a problem-solving mode.

When one is trying to reduce the amount of time spent on solving a conflict, it helps to depersonalize the conflict by not allowing judging of the conflicting parties and instead focusing on issues or disagreements about facts. This process keeps the process moving forward, even if it is only in small increments.

When dealing with conflicts, management personnel should realize that each person has his or her own conflict management style. Several common conflict management styles are:

- 1. **Competitor:** People with this style are power oriented, they prefer win/lose solutions, and they may suppress, intimidate, or coerce people into conflict. This style is effective when quick decisions are required or when important but unpopular decisions must be implemented. This style might be used when a person knows he or she is right and does not have time to listen to all sides of the argument before making a decision.
- 2. **Avoider:** This style involves low assertiveness and uncooperative behavior. This style works in no-win situations of little importance or for problems that will disappear in the near future.
- 3. Accommodator: This style is used by people who have little concern for personal goals or who realize the conflict is more important to someone else. It is also used when harmony is important, when another person needs to win, or when the parties are bargaining or negotiating several issues.
- 4. **Compromiser:** This style is most useful when expediency is required above principle and when short-term solutions are required rather than achieving long-term objectives. It is the least time-consuming style.

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ources	
Confusion and uncertainty about change	
avoritism	
nterdepartmental or intradepartmental relationship history	
Overly competitive environment	
oorly defined tasks	
listory between two people	
unitive or threatening management style	
evere economic downturns	
Inclear or arbitrary standards	
Inreasonable levels of pressure and pace	

Table 8-7. Common Sources of Conflicts

5. **Collaborator:** This style involves depersonalizing conflict and goals. Feelings, attitudes, and opinions are accepted as legitimate concerns, but analyzing facts and potential solutions is also important. The analysis necessary for this style is time consuming, so it is usually used only in important conflicts.

In conflict resolution, it is important to understand the source or sources of conflict because understanding the source of conflict helps identify acceptable solutions. Some common sources of conflict are listed in Table 8-7.

Conflicts do not normally arise from immediate problems; rather, they develop over time. The five stages of escalation to open conflict are as follows:

- 1. *Anticipation*, which occurs when a change is being made and problems are forecast;
- 2. Rumor, or the realization of conscious but unexpressed differences;
- 3. *Discussion*, where information is shared, questions are asked, and sides are expressed;
- 4. Open dispute, during which opinions are expressed and lines are drawn; and
- 5. *Open conflict,* during which people join forces on one side or the other of the argument.

## **Engineering and Construction Industry Conflicts**

If a conflict is addressed in the early stages, before it becomes an open conflict, it might be resolved in less time. In the construction industry, the types of conflicts that frequently occur are **external conflicts** and **internal conflicts**. External conflicts occur between owners and architects/engineers (A/Es), between A/Es and engineers, between A/Es and contractors, and between contractors and material suppliers or subcontractors. Internal conflicts occur at construction jobsites and usually involve disagreements over methods and procedures, who should be performing specific work items, the perception of unequal treatment of workers, the need for overtime