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What does the construction foreman do?

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Despite his acknowledged role in the execution of construction projects, the crew foreman's function has received little attention. The study described here tries to answer three questions: How does the foreman divide his workday time and on what subjects? With whom does he communicate? Can a correlation be detected between the way he divides his time and the performance of his crew? The research is based on a sample of 24 foremen in the USA and 32 in Israel. The findings throw more light on the perennial discussion to what extent the foreman is manager or supervisor, and whether one can replace replanning with pre-planning.

Keywords: Carpenters, communication, construction, foremen, planning, productivity.

Introduction

The wealth of research on the functions of managers in general industry at all levels (e.g. Mintzberg, 1973; Stewart, 1982; Skeaf, 1967), contrasts with the relative paucity of attention given to this aspect in the construction industry. Few efforts have been made to study the construction foreman's work systematically. However, Borcherding (1977) endeavoured to describe the functions of on-site work foremen by asking them to complete a questionnaire about how they perceived their job. Also using a questionnaire, Lemna *et al.* (1986) examined the productivity characteristics of construction foremen and established, *inter alia*, that the earmark of an efficient foreman is his superior planning, which results in less effort being expended in managing his team.

Great importance is attached to the study of the construction site foreman, whose job is less structured than that of his industrial counterpart (e.g. Guest, 1956; Evans, 1956). With each project, and sometimes at each floor level, he has to grapple anew with the selection of work methods, the organization of the work site, and the logistics of materials, equipment and tools (Stinchombe, 1959).

The present study is part of a more comprehensive project about work teams at the construction site, the aim of which is to gain a better insight of how they operate from various perspectives, e.g. organization, productivity, work safety, incentives, etc. The study proceeds on the premise that before one can postulate the normative behaviour of work foremen, one must have a clear understanding of the contextual situations in which they operate and how they actually perform their functions. This calls in the first place for descriptive studies, to be followed by diagnostic studies that examine the effects of alternative approaches of foremen on crew performance. Finally, prescriptive procedures for the site foreman can be developed.

Against this background, we single out for study the way in which first-line supervisors of

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formworking carpenters carry out their work at the construction site. The choice of this particular trade is predicated by the primacy of formworking in building construction. It precedes all other trades, sets the pace for those trades and determines the finite physical dimensions of the concrete. The carpenter's relative latitude makes him prone to greater incidence of error. Working in a three-dimensional world, his activity is more difficult to grasp and hence more complex to plan, follow up and measure. The need for the greater variety of ancillary materials that he requires, demands more attention to logistics, both in the construction and disassembly phases of the formwork.

It is the intention of this study to answer the following questions:

1. What percentage of time do foremen devote to each of their various activities?
2. What are the characteristics of communication between a foreman and his crew?
3. Can one discern differences of behavioural patterns of foremen that would account for differences in crew productivity?

The data reported in this paper were obtained through on-site interviews conducted in Texas, USA and in Israel.

The position of first-line supervisors in the USA is much the same as foremen in charge of single crews. The lowest ranking supervisors in Israel, however, are usually responsible for a number of trade crews, such as formworkers, ironworkers and cement masons, though most of their time will be devoted to the supervision of formworkers. Due to the wider responsibilities of Israeli foremen they are generally aided by supervisory assistants who are responsible for the other trades.

Research methodology

The research methods used to study managerial work are manifold. Mintzberg (1973) enumerates seven methods: secondary sources; questionnaires and interviews; critical incidents and sequences of episodes; diaries; activity sampling; unstructured observations; and structured observations. Employing the latter to study the work of five executives, Mintzberg concluded that this method is appropriate for a small sample, and that its main weakness lies in its inefficiency (it consumes much researcher time) and in its inability to interpret some activities.

The data for this study were collected in interviews with foremen. The effectiveness of the interview as a preferred method has been established by other researchers (e.g. Kay and Meyer, 1962). Snyder and Glueck (1980) asserted that certain operations such as planning, cannot be tangibly sized up through observation. They recommend that managers be questioned directly as a means to bridge this deficiency.

Much effort was invested in ensuring the validity of the data:

1. Pilot studies were conducted so as to refine and clarify the questionnaire and define categories, as well as to train the interviewer.
2. To check the veracity of the interviews, structured observations were carried out on a proportion of the samples (eight foremen in Israel). These corroborated the findings of the interviews.
3. Systematic care was exercised in picking superior construction sites from the point of view

of quality of management (e.g. operating in an environment of advanced information, planning and control practices). The interviewees were selected for their ability to be articulate and cooperative. Preparatory talks were held with site managers and foremen to gain an insight into the companies they were working for and the projects they were working on.

Thus projects that served as a basis for this study were not a representative cross-section of Texan and Israeli construction sites, but rather a select sample.

The following provides a background to the sample used in the study (Laufer and Shohet, 1988):

- The number of construction sites investigated: 24 in the USA and 32 in Israel.
- The mean value of projects: \$19.5 million in the USA (median = \$10 million) and \$5.5 million in Israel (median = \$6 million).
- The mean size of formworker crews: 10.9 in the USA and 9.4 in Israel (common median = 8.0).
- The percentage of crews with an assistant foreman: 70.8% in the USA and 93.0% in Israel.
- The amount of time invested in managerial activities by assistant foremen: 40.7% in the USA and 42.7% in Israel.
- The average proportion of skilled carpenters: 67% in the USA and 50% in Israel.
- The average length of experience in the trade: 7.4 years in the USA and 8.2 years in Israel.
- The average proportion of formally trained carpenters showed a wide gap between the two countries: 41.1% in the USA and 7.6% in Israel.
- The proportion of formworkers who are able to read blueprints: 17.8% in the USA and 9.8% in Israel.

Data were gathered regarding the amount of time foremen spent on their various activities, which included the following:

(A) Monitoring and inspecting (control) the pace and quality of work.
(B) Giving instructions.
(C) Reading blueprints.
(D) Planning work (task planning, scheduling and layout).
(E) Manual work.
(F) Writing reports.
(G) Collecting and distributing materials.
(H) Attending meetings
(I) Holding telephone conversations.
(J) Travelling away from the site.

Figure 1 shows the mean percentage of time spent by US foremen on these various activities. The five most salient activities were monitoring and inspecting the pace and quality of work (18.0% of their time), giving instructions (17.1%), reading blueprints (16.8%), planning work (14.7%) and undertaking manual tasks (10.6%). Figure 2 shows the mean percentage of time spent by Israeli foremen on these various activities. The five most time-consuming activities were monitoring and inspecting the pace and quality of work (33.7% of their time), giving instructions (21.2%), reading blueprints (9.8%), planning work (8.9%) and

attending meetings (8.4%). Besides time devoted entirely to planning, some of the Israeli interviewees pointed out that they also spent additional time planning while undertaking other tasks and after the regular working day.

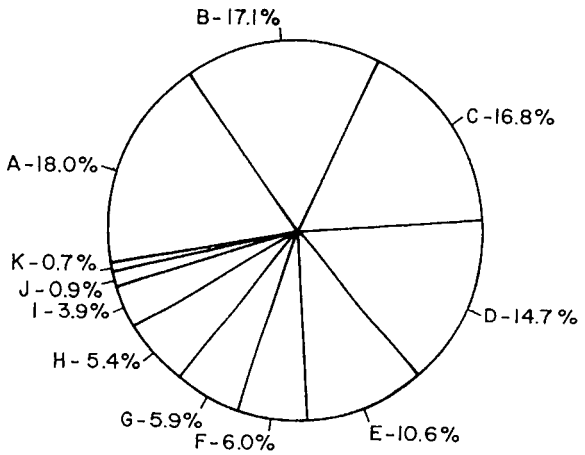

Fig. 1. Distribution of the foreman's time in the USA. A, monitoring and inspecting work; B, giving instructions; C, reading blueprints; D, planning work; E, manual work; F, writing reports; G, collecting and distributing materials; H, attending meetings; I, holding telephone conversations; J, travelling away from the site; K, other.

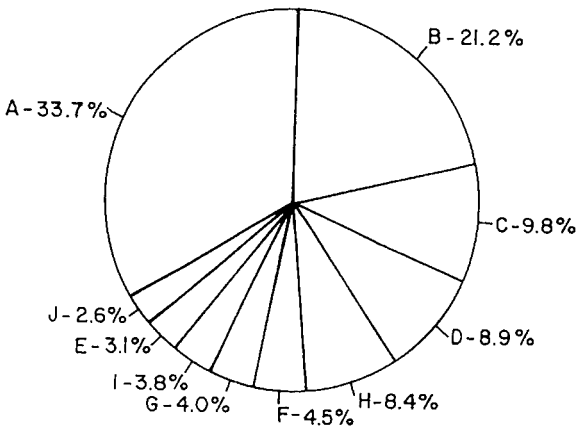

Fig. 2. Distribution of the foreman's time in Israel. A, monitoring and inspecting work; B, giving instructions; C, reading blueprints; D, planning work; E, manual work; F, writing reports; G, collecting and distributing materials; H, attending meetings; I, holding telephone conversations; J, travelling away from the site.

A comparison of these results reveals noteworthy differences between the amount of time spent by Israeli and US foremen (1) monitoring and inspecting the pace and quality of work, (2) reading blueprints, (3) planning work and (4) undertaking manual tasks. Student's *t*-tests were undertaken to examine these differences. The differences were found to be significant for all four categories at the $P<0.01$ level.

A second comparative analysis was carried out after clustering the activities into the following three groups:

1. *Activities related to planning and co-ordination*: planning work, reading reports and blueprints, attending meetings.
2. *Supervisory activities*: giving instructions, monitoring and inspecting the pace and quality of work.
3. *Other activities*: writing reports, collecting and distributing materials, holding telephone conversations, manual work, travelling away from the site.

Figure 3 shows the mean percentage of time spent by Israeli and US foremen on these three categories. US foremen spend 36.9% of their time planning and co-ordinating, whereas their Israeli counterparts only spend 27.1%. In contrast, Israeli foremen spend 54.9% of their time on supervisory functions. Two factors may explain these differences:

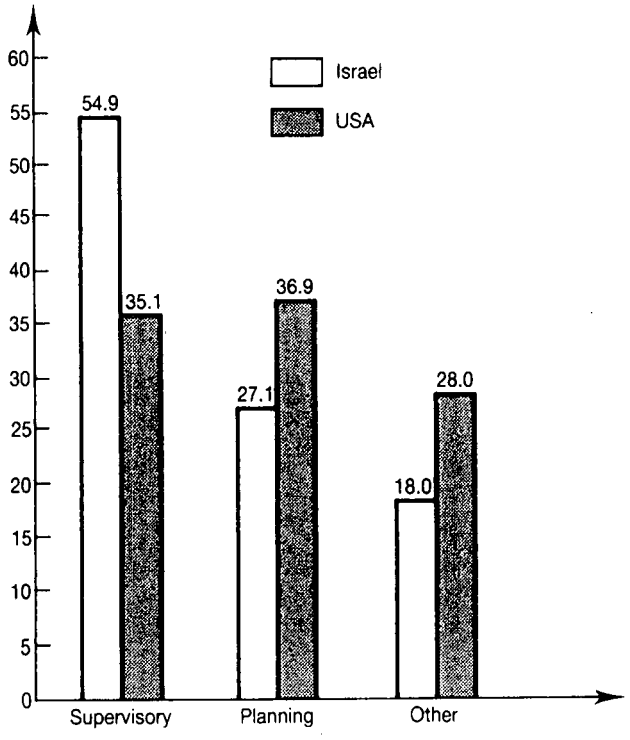

Fig. 3. Comparison of foremen in the USA and Israel by type of activity (%).

1. These may in part be attributable to the planning environment on-site, i.e. the amount of planning provided by senior management to the foreman and, therefore, the degree of certainty/uncertainty the latter faces. A study by Laufer (1987) showed that Israeli foremen are faced with a high level of uncertainty. The greater the uncertainty, the more difficult planning becomes, and with it grows the tendency to control rather than plan (Laufer, 1988).
2. Foremen in Israel are responsible for more than one trade group, and hence they have a heavier workload than their counterparts in the USA. Research has shown that when planning has to be undertaken alongside the execution of tasks, foremen give preference to routine work rather than planning (Shore *et al.*, 1962).

Communication

The questions centred on communication between foremen and formworking carpenters. The interviewees were requested to classify communications transmitted to the formworking group according to:

1. *The addressees of communications*, e.g. the assistant foreman, not more than two formworkers, more than two formworkers.
2. *Topics of communication*, e.g. the method of implementation ('how to'), the organization of implementation ('who does what'), the personal problems of the crew.
3. *Manner of communication*, e.g. explaining blueprints, demonstrating 'how to', others (e.g. plain talk).

The questions were phrased accordingly, e.g. 'Out of 10 times you speak with the formworkers, how many times do you speak with (1) assistants only, (2) not more than two formworkers and (3) more than two formworkers.'

Figure 4 shows the mean percentage of communications made by foremen in the USA and Israel. The following summarize the main findings:

1. *The addressees of communications*: In the USA, foremen transmit 43.9% of information to assistant foremen, 29.2% to one or two formworkers and 26.9% to a group of more than two formworkers. In Israel, foremen transmit the bulk of information to assistant foremen (68.1%), and hardly ever to more than two formworkers (1.6%).
2. *Topics of communication*: In the USA, foremen discuss work methods with subordinates in 54.8% of cases and work organization in 29.5%. In Israel, foremen discuss work methods in 75% of cases, but work organization in only 13.8%.
3. *Manner of communication*: Foremen in the USA employ the method of demonstration in 47.3% of cases and blueprints in 29.3%. In comparison, foremen in Israel employ the method of demonstration in 54.4% of cases and blueprints in 38.4%.

The final communication-related question the foremen were asked to consider was 'How many out of 10 talks you hold with the formworkers are initiated by them?' In the USA, 39.8% of talks were initiated by the workers, compared to only 21.9% in Israel.

A comparison between the USA and Israel may be summed up thus: Israeli foremen initiate most communications, directing them primarily to assistant foremen. US foremen meet with larger work groups, deal with work organization problems (within-group), and a

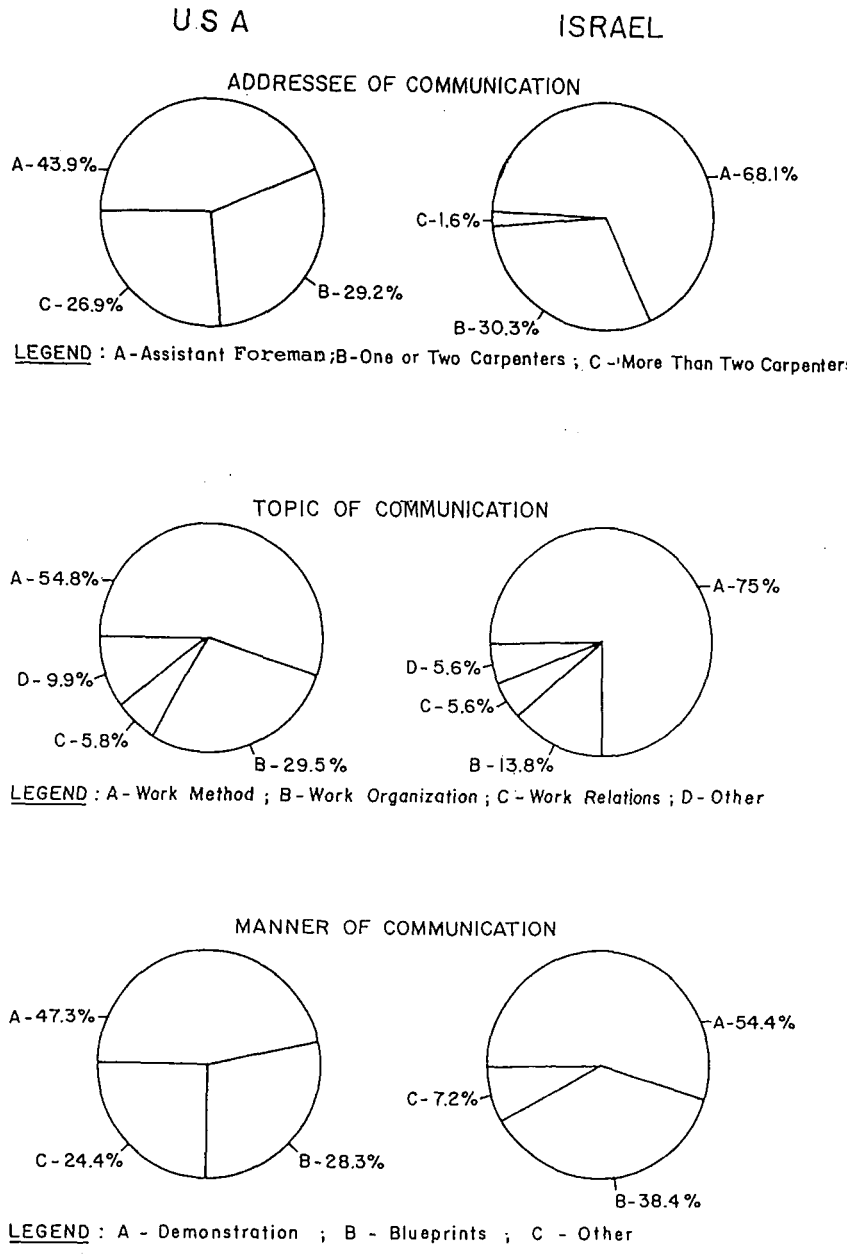

Fig. 4. Breakdown of communication between foreman and crew by addressee, topic and manner of communication.

large part of the communications they deal with are initiated by the workers. This difference in communications characteristics may in part be attributed to:

1. Different organizational structure. Israeli foremen, being responsible for more than one trade group, have to channel their communications through group leaders. Also, Israeli

workers don't have as much access to foremen as in the USA, which is why they maintain close contact with their respective leaders.
2. The lower level of skills of Israeli workers compels Israeli foremen to allot more effort to methods of implementation ('how to').

Foreman and crew performance

A study by Hinze and Kuchenmeister (1981) found that the foremen of productive crews have several traits in common. The present study assumed a link between the distribution of time spent by foremen on different activities and the quality of management, hence accounting for a difference in crew productivity.

To select a valid sample that would mirror the foregoing criteria, the 32 foremen in Israel were scrutinized for conspicuous characteristics in the following respects:

1. Crew productivity was unquestionably higher or lower than the rest.
2. Crew productivity was unaffected by any other clearly identifiable productivity factor, such as crews with very high or very low levels of skills or with very simple or very complex jobs.

Of the 32 crews, 8 qualified for use in our study. The productivity rating of all 32 crews investigated in Israel was assessed within the wider scope of the study (Laufer and Shohet, 1988). A similar assessment of the US crews was not possible because of budgetary limitations.

Crew productivity was measured by using three process-oriented yardsticks:

1. *Work sampling*. This yardstick has been found to give reliable indications of productivity (Handa and Abdalla, 1989; Thomas *et al.*, 1984). The work samples were classified in three categories according to Parker and Oglesby (1972): effective work, essential contributory work and ineffective work. A total of 400 samples were collected at each site within 1 day.

2. *Safety sampling* followed a similar pattern to work sampling, except that the observed work was classified into work safety categories. This method has been found to be dependable outside the construction industry (Pollina, 1970; Tarrants, 1980), and is considered by construction safety experts as credible. It is also endowed with rich diagnostic potential (Laufer and Ledbetter, 1986).

To date, the routine procedure of work safety sampling is still beset with difficulties, both in the data collection and the analysis phases. In an unpublished empirical study at the Building Research Station of Technion in Israel, it was found that a rigorously conducted safety sampling, if implemented by a trained observer and if confined to similar operations, yields reliable and valid results. Based on the aforesaid endorsement, a safety sampling study was initiated together with the work sampling. For the sake of simplicity and in order to quantify the time during which the worker is exposed to danger or creates a dangerous situation, only two work safety categories were identified:

- *Unsafe act/situation*: the hazardous use of tools or equipment, or the hasty execution of work in an unsafe place or under unsafe conditions.

- *Safe act/situation*: the worker performs his job without risk of hazard to himself or others, and his surroundings are considered safe.

3. *Organizational quality of the work station.* The observer evaluates the settings on a scale of 1 (very low) to 5 (very high). The evaluation is systematic and takes into account:

- *Material disposition*: the conditions of storage of raw materials, tools and equipment in terms of usefulness of selection, ease of access, security and waste of material.
- *Safety and ancillary equipment*: scaffolding, ladders, railing, netting, elevators, chutes, protective walling, dumping and removal, quality of access passages, etc.
- *General housekeeping*: tidiness, maintenance of ancillary services.

Before the study proper commenced, the observer was trained how to apply the above described criteria in a pilot study.

Table 1 shows the productivity ratings of the two groups of foremen. All differences between them were shown to have a significance of $P < 0.05$. It should be noted that with an effective work rating of 32.1%, which four crews achieved on average, productivity is indeed high. Oglesby *et al.* (1989) reported the productivity ratings of different construction trades, and productive carpenters achieved an effective work rating of 29%.

Table 1. Productivity ratings of productive and unproductive crews

Productivity measure	Productive crews	Unproductive crews
% of total time in effective work category	32.1	27.5
% of total time in unsafe acts category	1.8	9.0
Quality of work station organization (1 = very low, 5 = very high)	3.5	2.2

A comparison of the time spent by both US and Israeli foremen on their various activities is shown in Table 2 (based on the results of our interviews). In order to test the validity of the interviews, the eight preselected foremen were observed directly. Sampling observations were made at regular intervals during 1 day on each site (Peer, 1986). The results were fairly consistent with the data obtained during the interviews, particularly with respect to the trend, i.e. the differences between the productive and the unproductive crews were always in the same direction. Because our observations of the foremen were made on only 1 day, and in order to maintain a uniform yardstick of comparison (interviews with all 32 foremen), the analysis of the data was based on the interviews. Table 2 summarizes the prominent findings:

- The foremen of productive crews spend 9.6% of their time on planning, compared to 2.1% by foremen of unproductive crews ($P < 0.05$).

Table 2. Comparison of distribution of foreman's activities: Productive and unproductive crews (% of time)

Activity	Productive crews	Unproductive crews
Monitor and inspect	25.0	39.6
Give instructions	25.2	16.7
Read blueprints	11.8	7.3
Plan work	9.6	2.1
Attend meetings	11.0	9.7
Complete reports	5.5	2.1
Other activities	11.9	22.5
Total	100.0	100.0

- The foremen of productive crews spend a total of 21.4% of their time on the reading of blueprints and planning, compared to 9.4% by foremen of unproductive crews.
- The foremen of productive crews allot 25% of their time to monitoring and inspection, whereas foremen of inefficient crews allot 39.6% of their time.

Discussion

When the communications aspects and the activity characteristics of the foreman are juxtaposed, we obtain a vivid profile of the foreman as a leader of workers. The mean percentages of time devoted by foremen to various activities shown below are based on the assumption that the time devoted to communication equals approximately the time 'giving instructions'.

The time distribution profile of US foremen (in descending order) is as follows:

1. Planning work (32%).
2. Monitoring and inspecting the pace and quality of work (18%).
3. Clerical functions and storekeeping (12%).
4. Manual work (11%).
5. Outside liaison (10%).
6. Coaching and instructing (10%).
7. Co-ordination within crew (5%).
8. Attention to personal problems of crew (2%).

The time distribution profile of Israeli foremen (in descending order) is as follows:

1. Monitoring and inspecting the pace and quality of work (34%).
2. Planning work (19%).
3. Coaching and instructing (16%).
4. Outside liaison (15%).
5. Clerical functions and storekeeping (8%).
6. Co-ordination within crew (3%).
7. Manual work (3%).
8. Attention to personal problems of crew (2%).

(*Note:* The negligible attention given to personal problems is common in both the USA and Israel.)

The converse relationship of planning *vs* supervision between the foremen of the two countries has its cause in the different ambient conditions in which they operate: Israeli foremen (a) face a more difficult planning environment, (b) are in charge of a larger number of trade crews and (c) work with trade crews whose skills are less than their counterparts in the USA. These factors account for the greater amount of time devoted by foremen to supervision at the expense of planning. Israeli foremen who succeed in giving more time to planning achieve higher levels of productivity with their crews.

The difficulties faced by managers in devoting adequate time to planing is discussed by a number of researchers (e.g. Mintzberg, 1973). Haas *et al.*'s (1969) findings outside the construction industry confirm that managers at all levels feel that they ought to devote more of their time to planning than they do in practice.

No doubt there is substance to the contention of managers that part of the planning is done during the execution process. But it is equally true that, because planning is a highly interdependent decision process, for it to be effective (i.e. for it to achieve higher crew/team performance), at least some time must be devoted entirely to planning in order to produce consistent, and well thought-out, workable plans.

Conclusions

This study has presented a detailed picture of how foremen in the USA and Israel devote their time to the various activities involved in their managerial function, and the manner in which these are communicated. What emerges from the study is that US foremen can be seen more as managers-cum-planners, whereas their Israeli counterparts can be seen more as supervisors-cum-inspectors.

The widespread assertion made by foremen/managers that the normal work pressures they experience on construction sites limits the amount of time they can devote to planning is not upheld by the findings of this study. Foremen of efficient crews do find time, demonstrating again that better control is attained by better planning, and that planning during execution leads to improved productivity at the construction site.

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