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Productivity in the construction industry in the Republic of South Africa: a holistic approach to resources utilization

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to resolve the problem; and bringing it to the attention of his superior will reflect on his own competence.

Very often the resolution of a problem is dependent on a management decision, which may be outside the province of the junior supervisor. Hence it is all-important for all levels of management and supervision to have a medium through which existing problems can be aired, and recommendations for their resolution encouraged.

As part of the research two separate methods were introduced to improve site communications, and encourage employees to define problems and recommend possible solutions. These were the formation of a site productivity committee, and the application of the cybernetic discussion technique.

14.5 Improving Communications - Site Productivity Committee

The first method which the author applied was the organization of a site productivity committee. The committee consisted of all the team leaders on a particular site through whom management would be able to communicate with the rank and file workers. This made it easier to overcome the language barrier.

Meetings were held during an extended lunch hour, and were preceded by a braai (barbecue) for the participants. White supervision shared in the meal with the black team leaders and this helped to create a relaxed atmosphere. The subject matter for discussion included the following items :

- A review of results achieved and bonuses earned

- Encouragement to team leaders to raise and discuss any matter which they

consider is adversely affecting their production.

- Encouragement of ideas for productivity improvement.

- Contributions from management as to how workers could improve their performance and hence earn bigger bonuses. This included practical site case studies. Those present were encouraged to participate in suggesting better and simpler ways to get the work done; which they did.

One of the case studies involved the loading and discharge of a concrete mixer. After analyzing and discussing the operation the participants concluded that the original team of five workers could be reduced to three. This labour reduction was subsequently implemented without any opposition, and the redundant workers were transferred to other operations.

This experiment proved to be a positive educational experience. The meeting and discussion was consonant with the black man's traditional practice of the 'INDABA', which involves discussion and the development of consensus.

14.6 The Cybernetic Discussion Technique

Eighty-four people including contract managers, site agents, foremen, chargehands, storemen and site clerks, participated in discussion in four separate sessions.

This type of discussion is a method for accumulating complex ideas from groups of people in a relatively short space of time. Ideas and opinions are collected from the individual participants at random. As the collection process proceeds, a process of evaluation and synthesis also occurs. Thoughts are captured, fed back and recaptured.

PRODUCTIVITY IMPROVEMENT PROGRAMME DISCUSSION SESSION

Discussion Station	Questions for discussion
A	Wastage of materials exists on all contracts, what are the causes of wastage, and how can wastage be reduced?
B	People are the most important resource in our company and the source of production. Random observation on contracts shows that some workers are idle at any one time, or not fully productive. What are the reasons for this wastage of manpower, and what can be done to improve manpower utilization?
C	Is our day to day planning effective, and how can we improve our planning so that contracts can be started with minimum time loss, and resources - manpower, materials, and machinery - can be used more effectively?
D	Profit and work continuity depend upon a contract being delivered on or ahead of programme to the required quality. What can be done to improve our relationship with the client's representatives, get ahead of programme and ensure acceptable work quality?

Participants are thus able to get much closer to the reality of the problem or to the shape of group opinions and ideas; closer than is possible with any survey questionnaire techniques or brainstorming.

14.6.1 Basic Concepts

The cybernetic technique can best be appreciated by considering the vast memory banks and data manipulation potential that the brain capacity of each person within a group makes available. When the potential of each member of a medium size group is multiplied by the number of group members, the capability of the group as a whole is staggering.

14.6.2 Application

This technique was applied as part of the research which the author conducted in a construction company. Its purpose was to encourage staff participation, create a heightened sense of awareness with regard to resources utilization, and encourage new ideas and suggestions for improved operations.

14.6.3 Procedure

The area of concern was divided into four questions as shown on the page opposite. Each question constituted a station at which the participants in the discussion were grouped. The questions were formulated so that there was some overlapping of the subject matter to be discussed. This was considered to be desirable because it encouraged some participants, who may have been constrained by senior members in one group, to state their opinions and ideas in another group.

Each participant in the session was assigned an itinerary card from a computer-generated random number table. By following his itinerary card he was able to interact with the other participants in eight different groups. This was done by moving half the people at each station to a new station every 10 minutes, while the remaining half maintained the continuity of the discussion. Thus each participant had two sessions (20 minutes) at each discussion station. New members brought fresh ideas. Also, because the moving half did not move as a body but dispersed, inter-personal barriers did not carry forward from station to station.

There was no chairperson as is the custom at a formal meeting. A person was assigned to each station as a recorder. His/her function was to review what had been said previously for the benefit of the new participants who came to the station, and to maintain a record of all that was said. The recorder was neither a discussion leader nor a participant. As the session proceeded the recorder noted the ideas, viewpoints, opinions and all complaints which were introduced. The record did not identify the source of the views expressed.

After the session had ended each recorder assembled his station's input material and it was then edited. The information thus obtained provided a clear picture of the participants' views regarding their requirements for improved performance and ideas for optimizing results.

The resultant input was edited and prefaced by the writer to provide a "Building and Construction Site Vade Mecum" (manual). See Appendix C.

Management had been unaware of some of the matters raised during the discussion sessions, and subsequently took action to remedy unsatisfactory situations and practices. The manual was issued to the construction staff, and provided a guide towards improved

site practices and hence improvements in productivity.

14.6.4 Conclusions regarding the cybernetic discussion sessions

- Random thoughts were shaped by the participants into concepts or ideas that could be acted upon by management and participants.

- The session itself was an educational experience during which people developed a fuller understanding of the whole area of concern through self expression and listening to others. The technique provided real participation, and a feeling developed that the participants themselves need to solve the problem.

- In the cybernetic session both the supervisors and their subordinates were in a better position to contribute and influence one another than they would have been in a formal discussion group which had a leader or chairman.

- Later interviews which the author conducted with persons who had participated in this session were much more fruitful because of the fuller understanding of the overall area of concern. Also much less time was spent in the follow-up interview because the interviewer was able to come directly to the point.

- The introduction of the vade mecum on sites provided site management and supervision with a ready reference to productive practices. It heightened their sense of awareness regarding the utilization of resources, and thus made a positive contribution to productivity improvement.

Usually it is for management to talk and for employees to listen. These discussion sessions provided an opportunity for the company to listen to its employees, and

particularly to the lower levels of management and supervision. The information obtained may normally have been stifled by the bureaucracy that is inherent in the formal hierarchy of an organization. Kenneth Bolding (1967 : 202) expressed it thus :

'The very purpose of a hierarchy is to prevent information from reaching higher levels. It operates as an information filter and there are little wastebaskets all along the way'.

The autocratic style of management prevalent in the construction industry discourages effective dialogue. The latter is essential for the participation by all concerned in the achievement of improved resources utilization and better productivity. Attitudes and management styles cannot change overnight; but the above discussion technique can readily be introduced to provide employers and employees with a forum for effective dialogue.

CHAPTER 15

MOTIVATION

SYNOPSIS

This chapter discusses the fundamentals of motivation and incentive plans, and how financial motivation is an integral part of the management functions in the holistic approach to productivity improvement.

A gain-sharing and a profit sharing model for management and supervisory personnel was developed, and their practical application is described, as are the resultant benefits obtained.

A separate bonus incentive plan, applicable to hourly paid workers, is discussed, and the development of a simplified administrative procedure for the plan is described.

The importance and necessity for the regular review and up-dating of incentive plans is stressed.

15. MOTIVATION

One of the essential elements for a productive climate is motivation.

A motivator is an influence that has an uplifting effect on attitudes or performance.

Biesheuvel (1984 : 41) states : *'Work motivation results from willingness to make an effort in pursuit of certain objectives that will satisfy both the needs of the individual worker and of the employer, if the individual is not self-employed'.*

The needs of individuals vary, and are classified by Gellerman (1963 : 52) into the following hierarchy :

- Food, clothing and shelter - this meets the basic biological needs.
- Safeguarding and preserving his right to what he has, i.e. security.
- Some luxuries
- Status
- Achievement for its own sake.

It will be seen that the first two needs apply to the majority of black workers in the construction industry with the last three needs being more relevant to the white minority. This difference, however, is due to the differences in the groups' respective material well-being and not because of any intrinsic differences in black and white needs.

This point is emphasized by Orpen (1976 : 129) : *'All that we know about human motivation indicates that, under comparable conditions, black and white workers possess the same major needs and same essential goals'.*

This means that black workers, after satisfying their material needs, aspire to luxuries, status and achievement, and should thus react to the same motivators as white workers.

The fulfillment of the black workers' higher order of needs will depend on his performance which is a function of his ability; and improvements in his ability will depend upon the effectiveness of his training and development of technical and managerial skills.

15.1 Sharing the 'Production Pie'

The implementation of the Wiehahn Commission's report (1979) and the ensuing legislation have removed the restrictions of work reservation, and have afforded workers the protection of industrial courts against wrong-doing by employers.

However, little progress has been made in increasing productivity. Legislation can stipulate minimum wage scales, but cannot ultimately enhance the material well-being of employees. The legalization of black trade unions has already resulted in demands for higher wages, shorter hours, and in strikes. There are, and will be, continuing demands fc a bigger 'slice of the pie'. and the sharing of the pie will become a major issue. Unless a bigger pie is baked, increases in wages and salaries can only come at a cost to the shareholders with the concomitant risk of weakening the economic foundations of the enterprise and endangering its future and survival.

A practical riposte to this challenge is PRODUCTIVITY BARGAINING - a joint method of negotiating increased earnings for employees, BASED ON INCREASES IN PRODUCTIVITY. This means that employees share in the savings and/or increased value realized through joint labour/management productivity efforts.

An important point that is often overlooked by employees (and by black[16] workers in particular) in the course of industrial bargaining is the fact that they take away, in the form of wages and salaries, the largest portion of the total value created by an enterprise.

An analysis of the distribution of the value created by one of the leading construction groups shows that the employees' share of the total value amounted to 73%, in terms of salaries, wages, pensions and other benefits. This far exceeded the 4% paid as dividends to shareholders, and 8% retained for growth and continuation.

The division of the value created is illustrated in Figure 15.1

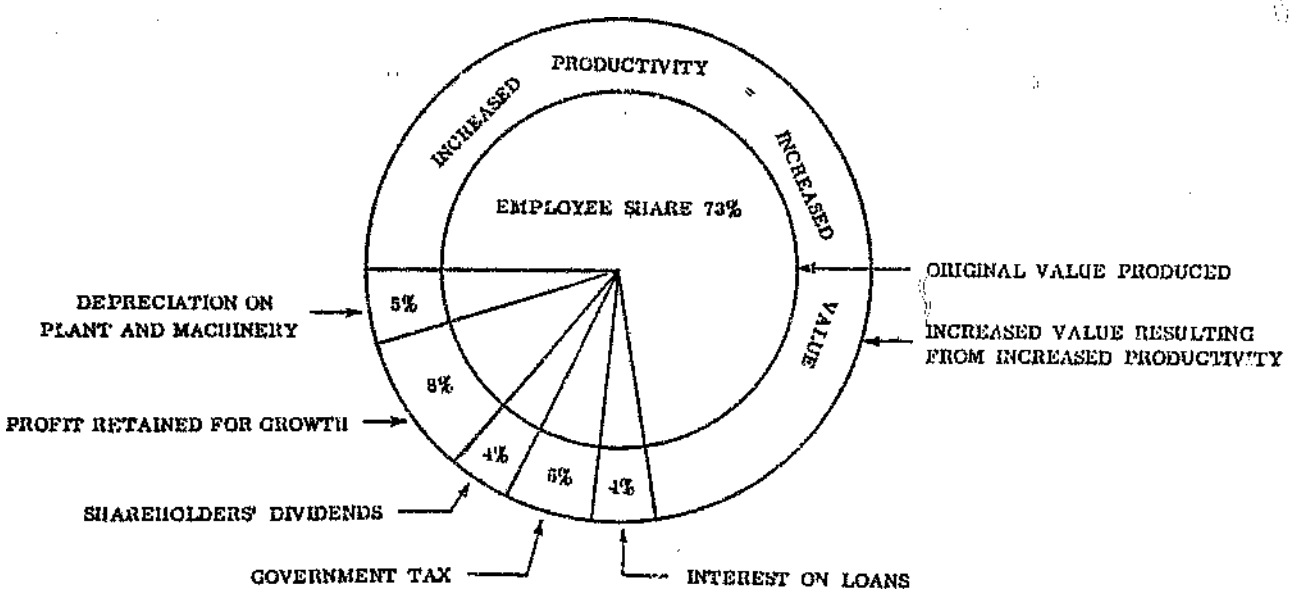


FIGURE 15.1 DISTRIBUTION OF CREATED VALUE

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[16] See section 14.3. The black employee perceptions of their position in industry and formulae for achieving improved productivity.

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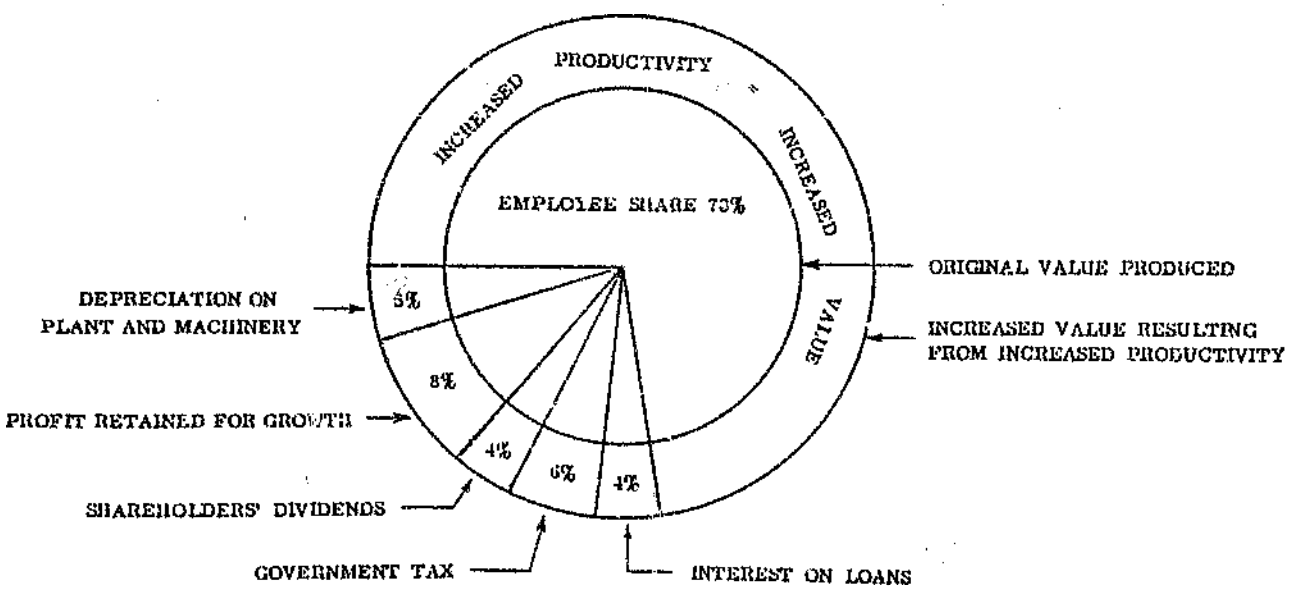


FIGURE 15.1 DISTRIBUTION OF CREATED VALUE

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[18] See section 14.3. The black employee perceptions of their position in industry and formulae for achieving improved productivity.

The foregoing indicates that employees are by far the largest 'shareholders' in the company and as such have most to gain from an increasingly economically viable undertaking, and have most to lose should the company collapse.

Any increase in productivity will provide a greater store of value (as indicated by the outer circle) which can be shared by employer and employees. Hence it is only through increases in productivity that workers can improve their material well-being. Thus it is in the common interest of both employer and employee (including responsible trade union leadership) to co-operate towards improving resources (manpower, machinery, materials and money) utilization, the result of which will be increased productivity and production value to be shared.

The future of the free enterprise system is dependent upon participation. Participation in industry cannot be limited to decisions regarding working conditions and methods. It must be extended to participation in sharing of the production value cake that is baked, with the knowledge that the larger the cake the bigger everyone's individual slice will be.

Increases in production value will not be achieved without improving the basic management functions, and motivation in particular; bearing in mind that construction is a PEOPLE business, and people have needs which must be fulfilled.

15.2 Financial Incentives

Workers will not be motivated unless their needs are met. These needs, as previously discussed, have a substantial material base, and the question which arises in every worker's mind is :

'WHAT'S IN IT FOR ME?'

The Gravesian (Graves C W) concept puts it as follows :

'The question is not how do you motivate people but, instead, how do you relate what you are doing to their natural motivation flow'.

There is a large and responsible body of opinion in favour of incentive payment as a motivator towards increased productivity. The International Labour Office[17] mentions:

'There is evidence from a number of industries and countries that payment by results is often associated with relatively high productivity'.

Laufer and Borcherding (1981) quote producdvity gains of 10% to 45% from the introduction of financial incentive programmes.

Yet, there are some executives who are opposed to financial incentives for their workers. Their reasoning is usually reflected in remarks such as: 'I don't have to bribe my workers to do a day's work'. This is, indeed, anomalous with their personal welcome of, and participation in, share option plans and profit sharing schemes.

Their attitude assumes that in their organization all is well regarding the quality of management and the performance of managerial functions in areas such as planning, and the elimination of productivity inhibitors. This assumption can only be detrimental to the company's enterprise; because IN EVERY FIELD OF HUMAN ENDEAVOUR THERE IS ALWAY$ POTENTIAL FOR IMPROVEMENT.

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17 Higher productivity in Manufacturing Industries; I.L.O., Geneva (1954).

15.3 Motivation as a Function of Performance

According to Orpen (1976) studies have shown that extra satisfaction will produce extra effort, and that the black worker will be motivated to improve his performance if he sees a close relationship between effort and reward, and will value the reward received.

Adam, et al (1981 : 164) confirm that *'It is generally agreed that certain rewards lead to high levels of motivation provided that the rewards are perceived by the worker to have value or importance'.*

Laufer and Borcherding (1981) identify the determinants of performance to be ability, motivation, role perception, and facilitating and inhibiting conditions not under the control of the individual. The last two factors are influenced by management. Thus improved performance is dependent on ability, motivation and the quality of management.

Motivation must not be selective. It must apply to all employees. An effective plan must of necessity include management, all levels of supervision and hourly paid workers.

15.4 Productivity Inhibitors

An essential precursor to productivity improvement and the introduction of motivation plans, is the identification of the elements which inhibit production, and in consequence act as demotivators. Foremen's opinions as reported to the author revealed numerous demotivators as shown in the following list.

DEMOTIVATORS OF FOREMEN

The following are some demotivating factors which foremen believe affect their productivity:

1. Managers are overly cost anxious (emphasis of quantity over quality)
2. Petty savings result in time wastage
3. Communications with management and other foremen are poor
4. Unplanned transfer of labour breaks up gangs and means loss of key men
5. No feed-back re progress, profit and loss is given by management
6. Quality and training of labour is poor
7. Shortage of materials results from internal stealing
8. Status and lack of recognition of foremen lead to their opinions being disregarded
9. Foremen are under utilized : job is not challenging
10. Foremen should participate in planning
11. Labour absenteeism is rife
12. Demand for overtime working is excessive (no payment for overtime)
13. Hourly paid Artisans earn more than foremen
14. The materials and management planning are poor
15. Foremen are unable to motivate employees
16. Foremen need to improvise and borrow tools
17. Black employees have transport problems
18. There are comprehension problems; language difficulties lead to instructions being given but not carried out
19. Safety procedures are inadequate; labour is not safety conscious
20. Foremen are not allowed to take strict disciplinary action
21. Foremen have no say in selection of new employees

22. There is a lack of practical experience on the part of immediate superiors
23. There is much project confusion in the absence of or because of wrong instructions
24. Rework results from an excessive number of variation orders
25. Poor supervisory training is provided

The removal of impediments to productivity can achieve considerable improvements in both employee morale and bottom line profits. It proves to the workers the commitment of management to improved performance.

15.4.1 Marginal taxation

A negative factor regarding the acceptance of financial incentives by higher earning groups, is marginal taxation. Additional incentive income can put the recipient into a higher income bracket, and the resultant additional taxation can negate most of the additional incentive earnings.

In Israel, to overcome the disincentive of high taxation on productivity bonuses, an income tax law was passed whereby lower rates of taxation are charged for additional wages earned under approved incentive plans. The Israel Institute of Productivity played an active role in the implementation of this law which stimulated productivity.

15.5 Fundamental Requirements of an Incentive Plan

The following are fundamental requirements in the formulation of an incentive plan

- It must only include those parameters which are within the control of the participants.

- Employees should be consulted and a consensus established regarding production norms.
- The basis of measurement must be understood by all concerned. It must be clear, simple and rational.
- Employees must be able to measure their performance and results against a set goal.
- The plan must be equitable and its structure must not provide causes for query or dispute.
- Performance and reward must be closely related.
- The reward must be perceived to be suitable in relationship to the effort and performance.
- It must be educational in essence, and its parameters must stimulate a sense of awareness and caring for the resources being used.
- It must stimulate effort and performance.
- It must encourage and retain the best performers.

15.6 The Practical Application of Financial Motivation

Financial motivation is one of the elements in the holistic approach to productivity improvement. To be meaningful it must also contain the elements of

- Participation :

  Sharing in any material wellbeing which the participant has helped to produce

- Measurement :

  Clearly defined norms and criteria must be established by which performance can be monitored and evaluated.

- Education :

  Participants must know what to do to improve their performance.

- Communication :

  Participants must be informed of the company's objectives and be able to discuss problems as well as make suggestions for improved operations.

It has already been stated that motivation must not be selective and must apply to all employees. However, the responsibilities of managerial and supervisory staff vary markedly from those of the hourly paid workers. Consequently different incentive schemes must be considered for supervisory employees and the direct workers. Their practical application will now be discussed and it will be shown how these plans form part of the holistic approach to productivity improvements.

15.6.1 Gain-sharing plans for site management and supervisory personnel

During the course of this research the author found that the only financial incentives for management which obtained in some companies, were share purchase plans. The dividend payments (if any) on these shares depend on total company results, and company dividend payment policy. The latter takes into account profit allocation to

reserves and dividend cover. The usual attraction of this type of share purchase plan is the hopeful future appreciation in the value of the shares, when the holder can dispose of them at a profit.

This plan has numerous shortcomings as a motivational medium for contract management. It does not reflect individual contract performance, nor does it meet most of the fundamental requirements of an incentive plan as set out in section 15.5.

It is for these reasons that the author developed two gain-sharing plans to encourage participants to improve the utilization of resources under their control; reduce wastage through better planning; assume a proprietary interest in the application and usage of these resources; and afford them financial participation in any resultant gain.

Thus employees are afforded the opportunity to earn more money, but are not of necessity paid more. Should there not be any gain, then there is, of course, no extra pay.

Gain-sharing differs from profit sharing in that participants only share in gains, but are not responsible for contributing towards any losses. This does not apply in the case of literal profit-sharing. The participants are therefore in a win-win situation, without their basic emoluments and benefits being at risk.

Participants should include all monthly paid staff who can contribute to improved contract results and who are responsible for making things happen - for the better. They comprise contracts managers, site agents, quantity surveyors, foremen, chargehands, storemen and, in some cases, site clerks.

TABLE 15.1

PERCENTAGE OF THE SHARE OF PRODUCTION VALUE

1	Total contract value		R1 431 000
2	Materials costs	R 361 000	
3	Plant costs	R 66 000	
4	Sub-contractors	R 672 000	
5	Total material and service costs	R1 099 000	
6	Production value (1)-(5)		R 332 000
7	Site management and supervision		R 65 000
8	% Site man. and sup. of prod. value = (7) / (6) . 100		19.6 %
9	Site wages	R 176 120	
	...		

TABLE 15.2

COMPUTATION OF SUPERVISORY GAIN-SHARING RESULTS

		Base Tender Value (A)	Change (B)	Actual Value (C)
1	Total contract value	R1 431 000		R1 431 000
2	Materials costs	R 361 000	- 5 %	R 342 950
3	Plant costs	R 66 000	- 2.5 %	R 64 350
4	Sub-contractors	R 672 000	- 5 %*	R 638 400
5	Total materials and services (2)+(3)+(4)	R1 099 000		R1 045 700
6	Production value (1)-(5)	R 332 000		R 385 300
7	Gain in production value (6C)-(6A)			R 53 300
8	Change in site wages	R 176 120	-10 %	R 17 612
9	Total gain (7C)+(8C)			R 70 912
10	Site supervision share at 19.6 % of (9)			R 13 899
11	Company share of gain at 80.4 % of (9)			R 57 013
12	Site supervision share as % of basic salaries of R65 000 = R13 899 / R65 000 . 100			21.4 %
13	Tendered profit (after contingencies) R31 000			
14	Profit increase = (R 57013 - R 31 000) / R 31 000 . 100			183.9 %

*Part of sub-contractors' planned work done with own labour

15.6.2 Gain-Sharing models

In the course of this research two gain-sharing models were developed for this class of employee. Both were implemented using different companies for the experiments. The two schemes, their implementation, and the results they gave, will now be discussed.

15.6.2.1 Plan A : Share of production value

The concept of production value discussed in section 10.9, chapter 9, provides a unique basis for the development of a group incentive plan for site supervision. It has already been shown that a high production value is dependent on maximizing turnover, and minimizing materials, services and sub-contractors' costs, without increasing site salaries and wages.

The structure of this plan affords site management and supervision the opportunity to participate in any gain in the production value achieved, in accordance with their existing percentage share of the production value after buy-out[18]. This percentage is computed by dividing site supervisory salaries by the production value.

Table 15.1 shows how the base for the supervisory share of production value is computed.

As shown in Table 15.1, the site management team's share of the production value is 19.6%. Their basic salaries are guaranteed in terms of the plan; but should they increase the production value, then their income will be increased by 19.6% of any gain achieved.

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[18] After *"BUY OUT"* includes the finalization of major cost items such as bulk materials and sub-contractor services, after the contract has been awarded.

TABLE 153

GAIN-SHARING . LAN "A" PAY-OUT SCHEDULE

Contract: Example Period: 3 Months

(1)	Turnover Budget			600'000
(2)	Turnover Acual			632 000
(3)	Materials Costs		158 000	
(4)	Plant Costs		32 000	
(5)	Subcontractor Costs		286 000	
(6)	Sundry Services Costs		29 000	
(7)	Total Materials & Services Costs			505 000
(8)	Production Value	(2) - (7)		127 000
(9)	Site Wages: Gain + (Loss -)			+ 7720
(10)	Net Production Value	(8) + (9)		134 720
(11)	Site Supervision Share @ 19.6 % of (10)			26405
(12)	Participating Payroll			21750
(13)	Participation %	(11)/(12)-1 x 100		21,4%
(14)	Less Turnover Penalty			Nil
(15)	Less Reserve Account Retention	(13) / 3		7,1 %
(16)	Participation Pay out %	(13) - (15)		14,3 %

PARTICIPANT (A)	BASIC SALARY (B) 3 months	PARTICIPATION FACTOR (C)	PARTICIPATION SALARY (D) =(B)x(C)	PARTICIPATION PAY-OUT (E) =(D)x (16)/100	RESERVE ACC RETENTION THIS PERIOD (F) = (D)x (15)/100	RESERVE ACC. BALANCE TO DATE (G)
Contract Man.	12000	0-3	3600	514,80	255,40	255,40
Site Agent	9900	1·0	9900	1415,70	702,90	702,90
Foreman	6000	1·0	6000	858,00	426,00	426,00
Quant. Surv.	7500	0·3	2250	321,75	159,75	159,75
			21750	2110,25	1544,25	1544,25

APPROVED BY : _____ DATE : _____

The production value, as computed, excludes wages costs. Supervision is, of course, responsible for controlling this cost element, and the production value must therefore be adjusted by any savings or excess in wage costs. This adjustment is shown in Table 15.2 which provides an example of how the supervisory share of the gain is computed on total contract results using the figures shown in Table 15.1.

The format of the results shown in Table 15.2 highlights the major elements of income and cost. The supervisory share of the gain is shown on line (12) as a percentage of the participant's salary.

Thus, if the duration of the contract had been 12 months and a participant's annual salary were R24 000 then his gain-share would have amounted to 21.4% of R24 000, i.e. R5 136,00.

The application of the plan includes certain safeguards and controls which will be discussed in the following sections, and the detailed calculation of periodic results and distribution of gain, are shown in table 15.3.

15.6.2.2 **Plan B : Sharing in profit improvement**

This is a direct profit participation plan, which does not highlight the cost performance of the different factors as set out in Plan A.

Actual profits for the period are compared with the contract profit percentage base after buy-out. In the example shown in table 15.5 the percentage was set at 6.0. If there is a profit gain, then an agreed percentage of the gain is set aside for the participants as their share. In this particular application the share agreed to was one

TABLE 15.4

COMPUTATION OF BASE PROFIT PERCENTAGE

CONTRACT NO._____

CONTRACT: _____ BASE PROFIT [%]

INCOME CATEGORY	THIS PERIOD: TURNOVER (1)	PROFIT % AFTER BUY-OUT (2)	(1) x (2) =(3)	TO END OF CONTRACT TURNOVER BUDGET (1)	PROFIT % AFTER BUY-OUT (2)	(1) x (2) =(3)
Own Work						
Domestic S/C						
Nominated S/C						
P'& G						
TOTAL						
BASE PROFIT % FOR PERIOD = TOTAL (3) / TOTAL (1)			[%]			[%]

SITE AGENT : _____ APPROVED BY: _____ Q.S. DIRECTOR

SITE Q.S. : _____ _____ MANAGING DIRECTOR

TABLE 15.5

GAIN-SHARING PLAN "B" PAY-OUT SCHEDULE

Contract: Example Period: 3 months

(1)	BUDGET Contract turn over	600 000
(2)	ACTUAL Contract Turn over	632 000
(3)	Base profit percentage: 6,0% (2)x(3)/100	37 920
(4)	TOTAL ACTUAL PROFIT	76 920
(5)	Profit / Gain (Loss) = (4)-(3)	+ 39 000
(6)	Participants' share : 1/3 of gain = 1/3 x (5)	13 000
(7)	Less turn over Penalty : % of 6	NIL
(8)	Less reserve account retention (if any) 1/3	4 333
(9)	Available for distribution = (6) - (7) - (8)	8 667 *
(10)	Participating pay roll = Total Col. (D)	43 470
(11)	Participation percentage = (9)/(10). 100	19,938 %

PARTICIPANT (A)	BASIC SALARY (B)	PARTICIPATION FACTOR (C)	PARTICIPATION SALARY (D) =(B)x(C)	PARTICIPATION (E) =(D)x(11)/100	RESERVE ACC RETENTION THIS PERIOD (F)	(G)
Contract Man.	12000	0,5	6000	1196.27	598.14	
Site Agent	9900	1,0	9900	1973.86	986.93	
Gen. Foreman	7500	0,9	6750	1345.80	672.90	
Foreman	6000	1,0	6000	1196.28	598.14	
Foreman	6000	1,3	7800	1555.15	777.58	
Chargehand	5400	1,3	7020	1399.64	699.82	
			43 470	8667.00	4333	

APPROVED BY : _____ DATE : _____

third.

The profit percentage may vary from month to month depending on the work content in the contract; e.g. the mark-up on own labour activities may vary from that on nominated and domestic sub-contractors. The base profit percentage against which actual profit is compared must therefore be computed in terms of the actual work completed. The format for the computation of the reference period profit percentage is shown in table 15.4. The method of apportioning the gain to the individual members of the group is the same as that for Plan A, and a specimen calculation of periodic results and distribution of gain are shown in table 15.5.

The following conditions apply to both Plans 'A' and 'B'.

15.6.3 **Sharing of gain**

Plans A and B are group schemes, and all participants share in any of the contract's improved results.

In practice there will inevitably be inequalities in performance amongst the members of the team. Salaries are usually more related to service than to performance. Hence, it is usually desirable to apply some suitable performance factor to basic salaries when calculating the apportionment of any gain to each member in the group.

This was done by assessing the performance and contribution to improved resources utilization of every member of the group, and allocating to him a PARTICIPATION FACTOR. The participation factor was agreed to in discussions between site management and the participants.

The norm for the participation factor is 1.0. Extraordinary performance will merit a factor greater than 1.0, whereas sub-norm performance will be identified with a factor of less than 1.0.

For example, a young foreman with relatively little service, but a good performance record may merit, say, a 1.5 participation factor, whereas a new learner may start on a participation factor of, say, 0.3.

Similarly a quantity surveyor responsible for three contracts may have the following participation factors.

Contract	Participation Factor
A	0.3
B	0.4
C	0.3

The establishment of the participation factor is best done in discussion between the contracts manager, site agent and participant. It should be subject to quarterly or special achievement review. This provides management with the opportunity to review performance and encourage the weaker members of the group to improve their efforts, and hence their earnings.

15.6.4 Performance and pay reference period

Bonus results should be computed monthly and consolidated quarterly for the three monthly period, and payment is then made on the consolidated results.

The monthly calculation sheet (Table 15.2) provides a simple and meaningful picture of economic performance and highlights income and costs (in Plan A). It also provides participants with a progressive guide during the quarter regarding their performance.

A quarterly measuring period, having a broader time base than the monthly operation, provides more realistic economic results.

The monies earned and paid out are also more substantial. The time period, however, is short enough for the participants to relate performance and reward.

15.6.5 **Safeguards**

It is possible to record profitable interim results and suffer losses in subsequent periods. A reserve account is therefore maintained into which is placed a third of the bonus earned in every measuring period, and the balance is paid to the participants.

Any losses during a subsequent pay period are deducted from the reserve account.

Any credit balance in the reserve account is paid out after the finalization of the contract, i.e., after the contracted maintenance period.

Should a participant resign or be dismissed from the company's service before the completion of the contract, then he forfeits his right to the reserve account.

During the early stages of a contract it is possible to be behind programme and still show a profit.

In order to discourage this situation, participants are penalized by the loss of 10% of

TABLE 15.6

GAIN-SHARING PLAN TURNOVER PENALTIES

Target Turnover	Actual Turnover	% Turnover of Target	Bonus Earned	Penalty	Pay Out
R300 000	R300 000	100 %	R900	Nil	R900
R300 000	R297 000	99 %	R900	10 %	R810
R300 000	R285 000	95 %	R900	50 %	R450
R300 000	R270 000	90 %	R900	100 %	Nil

their bonus for every 1% they are down on their turnover target (a lower ratio can be used if the foregoing discipline is considered to be too stringent. This was the case shown in appendix D.)

An example, in Rands, of the applicable penalties is shown in Table 15.6.

15.6.6 Administration

It has been found that all the information required for the administration of the plans is usually readily available from the standard accounting records, and that the necessary computations do not require additional administrative staff.

15.6.7 General

Gain-sharing bonuses which are based on performance should supplant subjective additional payments that are not based on performance. Such payments include:

- Subjective ex gratia payments to foremen at the end of a job
- Guarantee deals with foremen 'if they build the job well'.
- Subjective mid-year 'special' bonus for senior staff.

It should be stressed to participants that the plan is being introduced as a company privilege, and that the company reserves the right to amend or withdraw the plan at its discretion.

15.7 Results of Gain-Sharing

The introduction of the plans was preceded by induction sessions during which the

philosophy and structure of the plan were explained to the participants. This was followed up with cybernetic discussion sessions (refer to section 14.6) which afforded the participants the opportunity to identify problem areas, productivity inhibitors, and propose ways and means to resolve these and improve operations. By doing so they would improve resources utilization, and productivity, and increase their own personal income from a share of the resultant economic gain.

Each participant received an outline of the plan and the conditions of its application. This was done in the form of a contract (refer to Appendix D). The original and copy were signed by the participant and a company representative. The original was retained by the company and the copy by the participant.

The sense of awareness and participation which the plan stimulated encouraged contracts managers and site agents to manage the financial aspects of their contracts more effectively. This they did through negotiating better sub-contractors' prices, improving collections, pursuing claim recoupment and disclosing all the contract profits.

A year's operation of the plan in which 69 site managerial and supervisory personnel were involved, encompassing 18 contracts, resulted in an overall gain of R1 980 000, of which R495 000 accrued to the participants, and R1 485 000 to the company.

Other individual contract applications showed a 15% improvement in profit before tax with the participants' gain being an additional 18.8% on their basic pay.

The improved results obtained did not represent the full potential for improvement, especially in the areas of labour and materials utilization. Improvement in these areas is dependent on changes in attitude, improved planning, control, materials handling, work simplification, and education. These aspects involve an extensive learning curve,

the top of which had not been reached during the time that the gain-sharing plans were in operation under the author's surveillance.

15.8 Incentives for Hourly Paid Workers

One of the inhibiting factors in introducing incentives is the necessity to establish an allowable time for a particular activity.

Construction activities are invariably unique to the contract. Usually they are not of extended duration, and this rules out work study on economic grounds as a means for establishing work values for measuring labour performance.

In these circumstances, the practical method of establishing a work value includes consideration of the following aspects :

- The tender allowable labour cost
- Reassessment of this cost in terms of site conditions, working methods, materials handling, and previous comparable performance - if available and applicable.

Working and materials handling methods in particular, should be reviewed with the emphasis on creativity and innovation to ensure that people resources are used effectively, and that the activity is completed to the specified quality and in the shortest time and at least cost.

Experience has shown that there is a reluctance at supervisory and management levels to establish the necessary work values. Reasons for this reluctance can be ascribed to:

- Inertia
- Lack of practical experience in the evaluation and establishment of work values.
- Lack of commitment to the concept of total resources utilization - particularly so far as labour is concerned.

The result is that sites seldom recover their labour allowables. This is exemplified in the 'W' contract. Total hourly paid wages amounted to R361 598. The allowed cost for the activities was R248 592. Thus the excess cost was R113 006.

Hence labour cost recovery (efficiency) was R248 592 / R361 598 = 68.7%.

15.8.1 Standard hours incentive plan

The activity production plan (fig. 13.4) provides for the allocation of labour to the different contract activities, and a time allowance for the completion of the activity concerned.

The plan is an integral part of the holistic approach to productivity. It was applied to five different contracts. The work included excavation, concrete placement, bricklaying and general construction activities. It proved to be effective and readily understood by the workers to whom it was applied.

The manpower and time allowances provided the norms for a practical incentive plan for hourly paid employees. Section leaders were provided with a time target to complete a defined activity with a set number of men. If the team completed the activity in less time than allowed, or with a reduced complement, then the hours saved were paid to the team as a bonus for the early completion of the task set. The

worker's basic wage was guaranteed for the time that he was at work.

15.8.2 Example of incentive plan application

The allowables for a particular concrete paving activity were reviewed in accordance with the principles set out above. It was found that by co-ordinating the work of shuttering, the batching plant, concrete placement, and screeding, the actual cost could be reduced to below the contract allowable cost for this particular activity.

An economical size labour team was constituted to do the necessary work and a group incentive was offered to the workers for the completion of the daily allotted task. The black supervisors' bonus was 20% greater than that of the team members. This proved to be a successful application. The workers earned an additional 17.7% on their basic pay and the company's recovery on labour cost, after the payment of bonuses was 119.7% as compared with the overall contract average of 68.7%. This showed a 74.2% improvement on labour utilization.

An interesting and significant difference between the performance of workers on incentive and those not on incentive pay, was the fact that the incentive workers' activity rating was close to 100%, whereas the site average was 68.7%.

15.8.3 Self discipline

During the research it was found that a practically conceived incentive plan can encourage the concept of self discipline. In one case the author introduced an incentive without altering the existing team complements, although it was considered that the team sizes were excessive. It was therefore suggested to the team leaders that should they complete the job with fewer people in the time allowed, then each remaining team

member will earn that much more. This resulted in a request from some of the teams for the transfer of some of the workers who were not doing their fair share of the work. The remaining members of the team completed the work required within the allotted time and earned their bonus for early completion and having a reduced team.

15.8.4 Hourly paid incentive plan administration

A common inhibitor to the introduction of incentives for hourly paid workers, is concern at management level for the amount of paper work and the attendant additional administrative cost that such incentive schemes would entail.

An incentive scheme need not involve excessive paperwork. It should in fact be an integral part of the work planning (13.3.1.10), labour attendance control (13.4.4) and pay procedure.

An administrative procedure was designed by the author to form part of such an integrated system. It provides information to the participants regarding the activities to be completed, their allowable labour complement and completion time; and a record of their completed work and bonus earned. The site cost clerk attended to the necessary paperwork, and no additional clerical staff was required.

Details of the procedure are set out in the form of a procedure schedule (refer to Appendix E), together with the attendant documents which include a work record sheet and bonus payment schedule.

15.8.5 Safeguards

The following safeguards and disciplines were built into the hourly bonus incentive

plan.

15.8.5.1 Quality control

Quality of production was promoted by the use of quality assurance check lists (refer Appendix F). The penalty applicable to the foreman who accepted work which was subsequently rejected by the client was a further safeguard for the maintenance of quality standards. This penalty involved the deduction of any hourly bonus paid for work that proved to be faulty from the foreman's gain share (refer to Gain-sharing contract, Appendix D).

15.8.5.2 Absenteeism

Increased earnings from bonus pay can contribute to absenteeism because of increased earnings over a shorter period of time. This was discouraged by imposing the following penalties.

Should a worker be absent without permission or due cause for one day during the month, then he forfeited 25% of his bonus earnings. Should he be absent for two days, then he forfeited 50% of his bonus. Should he be absent for 3 days or more during the month, then he forfeited all his bonus.

15.8.6 Advantages of the Bonus Incentive Plan

When operating under the rules of an incentive bonus plan it is in the interest of the supervisor to complete the work allocated, to acceptable quality, in the shortest time, and with the least number of men.

The supervisor and the team leader, in particular, cannot afford to tolerate absenteeism from the work place during the course of the day. This does happen on large sites with thinly spread supervision.

Under an incentive bonus scheme employees can increase their earnings without having to resort to overtime. This helps to reduce the need for overtime working, which is uneconomical.

It was found that the worker's effort is at a much higher pitch during a shorter work day; and work completed per hour during this period exceeds that during similar periods of overtime which is paid for at rates in excess of ordinary time. It should be noted that bonus hours were paid at ordinary time rates.

The improved productivity that results from the incentive scheme permits the earlier completion of the contract with benefits for all concerned.

It can be concluded that if a suitable incentive bonus scheme is introduced the company gains, employees earn more, quality in maintained, and the client obtains beneficial occupation at an earlier date, as well as a saving on costs.

15.9 Incentives in Construction Contracts

Public authority construction contracts often include penalties for late completion. Seldom, however, does a contract contain an incentive for the builder to complete the work ahead of schedule and at a reduced cost.

The penalty for late completion often spurs the builder to accelerate the contract through overtime work and the employment of additional labour. These practices

adversely affect the profit margin and yield little benefit to all concerned.

The following are some arrangements which are recommended to promote production and cost disciplines and which will benefit both the contractor and owner.

- Set a cost target for the contract and pay a bonus or penalty as a percentage of any cost saving or over-run on the cost target.

- Similarly, pay a bonus per day for early completion or penalty for late completion.

- Pay a bonus or penalty for under-run or over-run of targeted direct man hours.

The above incentives, and the establishment of labour cost and productivity targets, are especially relevant to cost reimbursable contracts.

15.10 Conclusion

It is appreciated that motivation is a very complex subject. It is also highly subjective in that not all individuals will respond positively to the same motivational stimuli. In these circumstances the writer opted to identify a common need and desire, which in this case was material well being. Hence the development and application of the financial incentive experiments.

The application of both the supervisory and hourly paid incentive plans proved to be successful with benefits accruing to the employees and the company. The continued stimulation and maintenance of these plans is, however, important.

Numerous financial motivation plans, after an initial period of success have, in time, lost their effectiveness with resultant dissatisfaction amongst employees and employers. The most consistent reason why motivation plans become ineffective after a period of time, is because they have not been reviewed and updated to ensure that they continue to satisfy employees' needs.

Dissatisfaction is a manifestation of want. It is perpetual discontent which prompts change - for the better.

Management must be sensitive to discontent and desire. It is the characteristic of wanting something badly enough that makes people work for it, and it is this diligence, ingenuity and creativity on which industrial progress is built.

On the basis of the results achieved it can be concluded that suitably designed and implemented incentive plans which conform to the criteria set out in section 15.5 can improve productivity and benefit the participants concerned.

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CHAPTER 16

A HOLISTIC APPROACH TO PRODUCTIVITY IMPROVEMENT

SYNOPSIS

This chapter describes how the different management functions, and the innovations deve oed during the course of this research, are integrated to provide a holistic approach to productivity improvement.

The relationships between inputs and outputs are established by the application of a Klein-type econometric model. Further refinements of the model lead to the development of a hierarchical rating of the contributions of the various management function inputs to the productivity process.

A method for testing the hypothesis is described and applied to three separate contracts. The method provides an index of management performance, and shows that the application of the holistic method of productivity improvement described in this thesis is indeed effective.

The contributions to knowledge which were developed during the course of this research are listed.

16. A HOLISTIC APPROACH TO PRODUCTIVITY IMPROVEMENT

It has been stated in Chapter 1 that the practical answer to productivity improvement must be sought in a holistic systems approach.

Jan Smuts (1927 : 103 : 105) in discussing holism stated that *'a holistic organism consists of parts, but it is more than the sum of its parts, and if these parts are taken to pieces the organism is destroyed and cannot be reconstituted by again putting together the several parts'.*

'A whole, which is more that the sum of its parts, has something internal, some inwardness of structure and function, some specific inner relations, some internality of character or nature, which constitutes that more'.

In the industrial organism the essential ingredient which produces that *more*, is creative and innovative management, and its capacity to organize, plan, co-ordinate, motivate and control. Take that away, and the inputs of manpower, materials, machinery and money, will remain sterile, with the resultant under-achievement in output.

The '*more*' emphasizes that there are a multiplicity of factors which affect productivity, and that there is therefore no unitary simple solution. The answer lies in a holistic approach - the improved exercise of all the relevant management functions, and innovative and creative construction and materials handling methodology.

The interactive model, figure 2.2, sets out the main factors which affect productivity. These have been reviewed during the course of this research, and innovative procedures have been developed to aid management in the quest for achieving higher levels of productivity through improved resources utilization.

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FIGURE 16.1

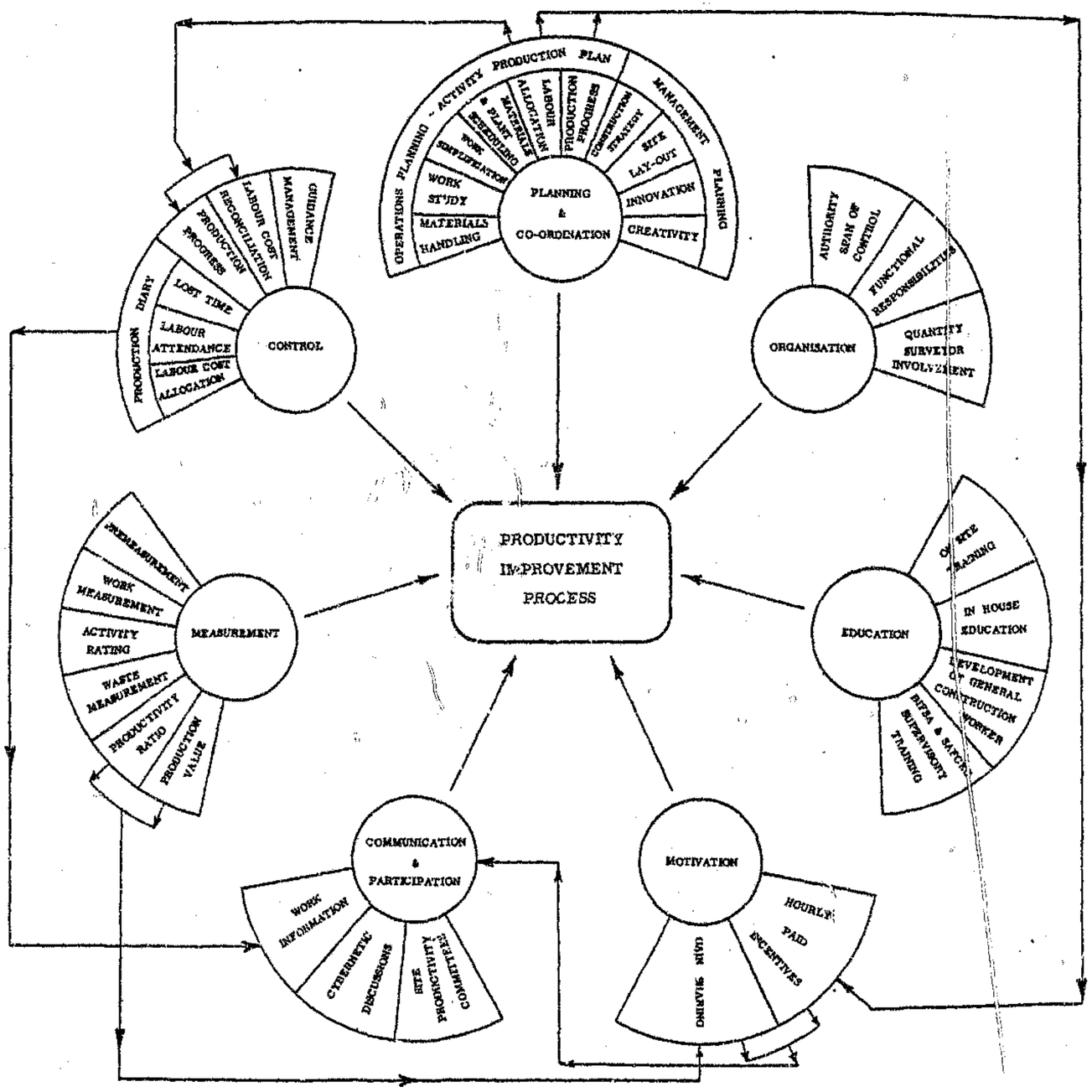


FIGURE 16.1 INTERACTIVE MODEL SHOWING THE FUNCTIONAL ELEMENTS IN THE PRODUCTIVITY IMPROVEMENT PROCESS

Figure 16.1 shows a more detailed interactive model which features the functional elements in the productivity process, and the innovations which have been developed and applied in the course of this research. It illustrates the interdependence of the different elements and how their sub-elements provide the input for the effective exercise of the inter-related functions. The word *'process'* is used advisedly in preference to *'programme'*. Programme connotes a finite content and time span, whereas a process is ongoing, which productivity improvement should be.

The following is a description of the management functions and their elements portrayed in fig 16.1

1. **Planning**

Planning is the starting point of the construction process. The activity production plan provides for labour allocations, materials and plant scheduling, and progress control. Management planning includes construction strategy and site lay-out. Innovation and creativity are the essential inputs for improvements in work simplification and materials handling.

The activity production plan provides input for the control functions of labour cost reconciliation, and production progress. The labour allocation programme and production progress reports also provide the basic data for the structure of the hourly paid incentive plan.

2. **Control**

The production diary, which provides for recording of lost time, labour attendance and labour cost allocation, serves as an important element in the

control function. It also provides work information and thus facilitates communication.

3. **Measurement**

The measurement function is shown with its different measuring elements. The productivity ratio and production values which provide the means for measuring total contract productivity also provide the input and basis for the gain-sharing plans which constitute a major element of the motivation component (5).

4. **Communication and Participation**

The cybernetic discussions and site productivity committees provide employees with a medium for participation and a forum for effective communication.

5. **Motivation**

Motivation is stimulated by the gain-sharing plans for supervision and the bonus incentive scheme for hourly paid workers. The results of these incentives are a measure of employee performance and, conversely, improved productivity is a measure of the success of the applied incentives. Also, additional earnings provide employees with participation in any productivity increases. Thus the incentive plans contribute to improved productivity and participation.

6. **Education**

The education function is shown with its elements of training and in-house education.

7. **Organization**

The organization function includes the elements of span of control, the definition of functional responsibilities, and the importance of the positive involvement of the quantity surveyor in construction activities.

The dynamics of the interactive relationships presented in fig. 16.1 will now be discussed.

16.1 Establishing a Relationship Between the Different Productivity Input Elements and Specific Outputs

It was mentioned in chapter 1 that every construction enterprise is unique. This quality of uniqueness also applies to every building and construction project. Individual projects differ in a multitude of different ways. For example:

- construction is inherently itinerant. It is not an ongoing process industry. The duration of the contract will vary with size and complexity; and the average life of a project ranges between one and three years.

- every site is different in size and in terrain, and this may call for different methods of materials handling.

- architectural designs differ, as do the constituent materials.

- design differences often demand unique construction methods.

- different methods demand the appropriate labour skills input.

- the size and composition of the labour force will vary with the completion status of the contract.

The foregoing changes present continuing challenges to management and supervision to use the resources at their disposal in the most effective manner. It will be appreciated that in such changing circumstances the relationships between the different inputs and resultant outputs involve innumerable variables.

A further complication in quantifying the variables is the fact that much of the input data, particularly in the area of cost, is unreliable (ref. section 10.7).

In these circumstances, the development of a mathematical interpretation of figures 2.2 and 16.1 in terms of a Klein-type econometric model cannot be precise, but can provide guidance to the achievement of greater productivity and improvements in outputs.

To do this it is necessary to establish the proportional relationships between the elements affecting productivity and the outputs which provide important indicators of the effectiveness of resources utilization, and hence productivity.

The management function inputs shown in fig. 2.2, and supplemented by the productivity elements and developments shown in fig. 16.1, can be related to the following outputs:

1. A Total Management Performance Rating (TMPR) which provides a base for a Management Performance Index (MPI) (ref. section 16.2).

2. The overall objectives of the construction process which are:
   - to complete the project timeously;
   - to effect the construction within the projected cost;

TABLE 16.1

MATRIX SHOWING INPUT-OUTPUT RELATIONSHIPS

RELATIVE VALUE RATING (RVR) (1)	INPUTS	OUTPUTS				
			CONTRACT OBJECTIVES			
	Management functions and Productivity Elements (2)	MFPR MAX (3)	COMPLETION TIME (4)	COST (5)	QUALITY (6)	PRODUCTIVITY RATIO (7)
20	PLANNING -	80	71	80	30	80
	Project strategy	10	10	10		10
	Project plan	5	5	5		5
	Site lay-out	5	1	5		5
	Activity plan	10	10	10		10
	Labour requirement plan	10	5	10		10
	Handling methods	20	20	20	20	20
	Work simplification	20	20	20	10	20
5	ORGANISATION -	20	15	20	5	20
	Organogram	10	5	10		10
	Function responsibility definition	10	10	10	5	10
5	CO-ORDINATION -	20	20	20	15	20
	Materials scheduling	10	10	10	5	10
	Cont/Consult relationship	5	5	5	5	5
	Cont/Subcont relationship	5	5	5	5	5
15	CONTROL -	60	50	60	40	60
	Managerial	10	10	10	10	10
	Labour	20	20	20	20	20
	Materials, equipment	20	20	20	10	20
	Costs, P&G, budgetary	10	-	10		10
20	MEASUREMENT	80	59	70	25	80
	Labour-performance, effort activity	20	20	20		20
	Lost time	10	10	10		10
	Materials wastage	10	5	10	10	10
	Rework	10	10	10	10	10
	Plant down time	5	5	5		5
	Quality	5	5	5	5	5
	Financial contract results	10	2	5		10
	Overall productivity measure	10	2	5		10
10	COMMUNICATION/PARTICIPATION	40	32	32	17	40
	Mission Statement	10	2	2	2	10
	Autocratic meetings	10	10	10	5	10
	Participative meetings	10	10	10	5	10
	Site productivity commitees	10	10	10	5	10
15	MOTIVATION	60	60	60	30	60
	Bonus payment : ex gratia	20	20	20		20
	Supervisory profit/gain sharing	20	20	20	20	20
	Bonus incentive for hourly paid workers	20	20	20	10	20
10	EDUCATION	40	33	33	33	40
	In house education	10	3	3	10	10
	Outside training	10	10	10	3	10
	In house training	10	10	10	10	10
	On site training	10	10	10	10	10
	TOTAL (Management Performance Rating) = Σ(RVR . MFPR)	6000	5075	5650	2750	6000

- to produce acceptable quality.

3. The Productivity Ratio (ref. section 10.9), which provides an overall measure of economic productivity of the resources applied in the construction process.

Table 16.1 shows in matrix form the proportional relationships between the management function inputs and the foregoing outputs, based on the author's extensive experience of the industry and honed by the research that forms the basis of this thesis.

A number of measurement factors and a series of rating values were developed in order to establish the input - output relationships, and the values were set relative to the effect which the different functions have on overall contract performance. The method and rationale for establishing these values is discussed in appendix G. These factors and rating values were also used to test the hypothesis (ref. section 16.2).

16.1.1 Measurement factors

The following are the measurement factors used.

1. A Relative Value Rating: RVR
2. A Management Function Performance Rating: MFPR
3. Total Management Performance Rating: TMPR

RVR (Relative Value Rating)

The total RVR score amounts to 100. The individual ratings when multiplied by the MFPR's indicate the relative importance of function in optimizing resources utilization and hence improving productivity.

MFPR (Management Function Performance Rating)

Three sets of values were used to assess managerial performance in the execution of the different functions. These values are on a sca' 'o 5, 0 to 10, and 0 to 20. The scale applied was dependent on the effect of the function on resources utilization and productivity.

TMPR (Total Management Performance Rating)

This is the sum of the product of the MFPR's and RVR's. i.e.

$$TMPR = \sum (MFPR.RVR)$$

Description of the Matrix

Column (1) shows the RVR of the management functions which affect the productivity process.

Column (2) lists the management functions and productivity elements involved in the productivity process.

Columns (3) to (7) show the outputs which are affected by the effectiveness of the exercise of the management functions and the application of the productivity elements listed in column (2).

The numbers shown in columns (3) to (7) are the value ratings. The ratings for the productivity elements are shown on the left side of each column, and the sum total of

the elements for each management function are shown on the right side of each column. Thus the MFPR for column (3), value rating for the management function of planning is 80, and the rating of the planning function relative to completion time, column (4), is 71.

The MFPR's shown in column (3) in the matrix are based on the assumption that all the management functions affecting the respective outputs are being exercised in an effective and exemplary manner, and that the targeted outputs are being achieved.

The management function values vary for the different outputs; and the values depend on the number of productivity elements and the extent of their influence on the particular output.

The Total Management Performance Rating (TMPR) for the different outputs is shown on the bottom line of the matrix.

16.1.2 Relationships between Inputs and Outputs

By multiplying the RVR by the individual Management Function Performance Ratings (MFPR), i.e. column (1) by the management function ratings in columns (3) to (7), we can obtain the following relationships.

Total MFPR	≈	1600Pl + 100Or + 100Co + 900Cn + 1600Ms + 400Cm + 900Mt + 400Ed
Completion Time	≈	1420Pl + 750Or + 100Co + 750Cn + 1180Ms + 320Cm + 900Mt + 300Ed
Cost	≈	1600Pl + 100Or + 100Co + 900Cn + 1400Ms + 320Cm + 900Mt + 300Ed
Quality	≈	600Pl + 25Or + 75Co + 600Cn + 500Ms + 170Cm + 450Mt + 400Ed
Productivity Ratio	≈	1600Pl + 100Or + 100Co + 900Cn + 1600Ms + 400Cm + 900Mt + 400Ed

Where : Pl is planning

Or is Organization

Co is Co-ordination

Cn is Control

Ms is Measurement

Cm is Communication

Mt is Motivation

Ed is Education

The above relationships now contain proportional values of the management function inputs relative to the outputs under consideration.

The relationships between input and output can now be reorganized into hierarchic form after computing the Management Function Performance Rating (MFPR) of each management function as a percentage of the Total Management Performance Rating (TMPR), as shown on the last line of table 16.1. This is done for each resultant output. The results of these computations are shown in table 16.2.

TABLE 16.2

HIERARCHIC TABLE PROVIDING A GUIDE TOWARDS THE RECOMMENDED ALLOCATION OF MANAGERIAL RESOURCES TO OPTIMIZE THE PRODUCTIVITY IMPROVEMENT PROCESS

		OUTPUTS				
	MANAGEMENT FUNCTIONS	Completion Time	Cost	Quality	Productivity Ratio	$\bar{x}$
I	Planning	28.0	28.?	21.3	26.6	26.2
N	Measurement	23.3	24.?	17.6	26.6	23.7
P	Control	14.8	15.	21.3	15.0	16.4
J	Motivation	17.6	1?.?	16.0	15.0	15.9
T	Education	6.5	.8	.2	6.7	8.0
S	Communication	6.3	.7	6.0	6.7	6.3
	Co-ordination	2.0	1.8	2.7	1.7	2.0
	Organisation	1.5	1.8	0.9	1.7	1.5
	TOTAL RESOURCE APPLICATION	100.0	100.0	100.0	100.0	100.0

This table shows the managerial functions in hierarchic order relative to their contributions to the productivity process affecting the different outputs. These outputs are:

- the timeous completion of the project;
- the completion of the project within the allowed cost parameters;
- the production of acceptable quality;
- the achievement of the optimal productivity ratio which provides the overall measure of the effectiveness of resources utilization.

It will be noted that planning, measurement, control and motivation, emerge as the functions requiring prime managerial attention. The high ratings, and hence the importance of the planning and measurement functions is in conformity with the basic control model presented in fig. 7.1. There cannot be any purposeful action without planning, nor continuing effective action without an evaluation of results based on measurement.

However, the remaining functions of education, communication, co-ordination and organization, constitute an important 17,8% of management's responsibility and attention spectrum. These functions, as shown in figures 2.2 and 16.1, make an important contribution to the productivity process, and as such, are an essential part of the holistic approach to improving the utilization of resources, and hence productivity.

The research has so far shown that the apportionment of management input resources as shown in table 16.2 is generally applicable. There will, however, be exceptions as in the case of high-tech projects where quality is of paramount importance; or in cases where there is a critical urgency to complete the structure irrespective of cost.

In these cases one can apply a "priority factor" to the basic proportional apportionment of resources in order to obtain the desired relationship between inputs and outputs.

For example: in the case of a high-tech contract requiring early completion, it would be necessary to fine tune the planning function, increase control and motivation, and improve communication and co-ordination.

Hence the following treatment can be applied, as shown in table 16.3, in order to obtain the revised hierarchic order of management inputs.

TABLE 16.3

REVISED HIERARCHIC TABLE SHOWING THE EFFECT OF THE APPLICATION OF A PRIORITY FACTOR ON THE APPORTIONMENT OF MANAGEMENT RESOURCES

	MANAGEMENT FUNCTIONS	BASIC APPORTIONMENT OF MANAGEMENT RESOURCES (1)	PRIORITY FACTOR (2)	(3)=(1)x(2)	REVISED APPORTIONMENT OF MANAGEMENT RESOURCES (4)=(3)/Σ(3)
	Planning	26.2	1.5	39.3	25.2
I	Measurement	23.7	1.0	23.7	15.2
N	Control	16.4	2.0	32.8	21.1
P	Motivation	15.9	2.0	31.8	20.4
U	Education	8.0	1.0	8.0	5.1
T	Communication	6.3	2.0	12.6	8.1
S	Co-ordination	2.0	3.0	6.0	3.9
	Organisation	1.5	1.0	1.5	1.0
		110.0		155.7	100.0

The above table now shows a different hierarchic order of management inputs, with the main emphasis on the functions of planning, control and motivation, followed by measurement, communication, education, co-ordination, and organization.

Thus the hierarchic table provides a guide for management towards allocating resources to the management functions in an order of importance. It further stresses the fact that optimal utilization of resources, and hence improvements in productivity, will not be obtained without a holistic approach to the effective exercise of all the applicable management functions.

16.1.3 Quantifying the input - output relationships

The input - output relationships shown in section 16.1.2, can be quantified by the introduction of a Management Unit (Mu) which will provide an indication of the management content inherent in the execution of the management functions involved in achieving the different outputs.

The contract "Techtrain", featured in fig. 13.1, was used as an applied example to establish the input - output relationships. On this particular contract, the General Foreman was at the centre of the total construction effort (as is usually the case). His management input and time will therefore be treated as the basic Management Unit (Mu), and the other contract team members' inputs will be related to his, in terms of Mu's.

16.1.3.1 Definition of a Management Unit (Mu)

In the context of this research, one Mu is equal to the basic daily salary of a General Foreman, who is applying himself diligently to his work, and discharging his

TABLE 16.5

CONTRACT TEAM MANAGEMENT FUNCTION INPUTS

RELATIVE VALUE RATING (RVR) (1)	MANAGEMENT INPUT FACTOR (MIF)		0.6	1.5	1.1	1.0	0.9	0.8	0.7	4.4
	Management functions and Productivity Elements (2)	MFPR MAX (3)	CONTRACT MANAGER (4)	SITE AGENT (5)	ASS. SITE AGENT (6)	GENERAL FOREMAN (7)	FINISHING FOREMAN (8)	SITE QUANTITY SURVEYOR (9)	ASS. QUANTITY SURVEYOR (10)	CHARGE HAND (11)
20	PLANNING -	80	22	71	19	38	21			8
	Project strategy	10	10	10						
	Project plan	5	1	5						
	Site lay-out	5	1	5						
	Activity plan	10		1	4	3	3			
	Labour requirement plan	10		10	5	5	5			
	Handling methods	20	5	20	5	10	3			3
	Work simplification	20	5	20	5	20	10			5
5	ORGANISATION -	20	20	10						
	Organogram	10	10	5						
	Function responsibility definition	10	10	5						
5	CO-ORDINATION -	20	5	10	13	10	10			
	Materials scheduling	10			10	5	5			
	Cont/Consult relationship	5	5	5						
	Cont/Subcont relationship	5		5	3	5	5			
15	CONTROL -	60	10	10		40	40			30
	Managerial	10	10							
	Labour	20				20	20			20
	Materials, equipment	20		10		20	20			10
	Costs, P&G, budgetary	10		10						
20	MEASUREMENT	80	10	10		20	15	55	45	10
	Labour-performance, effort activity	20						20	20	
	Lost time	10				10	10			1
	Materials wastage	10						10	10	
	Rework	10						10	10	
	Plant down time	5	5	5		5				
	Quality	5				5	5	5	5	
	Financial contract results	10	10	10						
	Overall productivity measure	10						10		
10	COMMUNICATION/PARTICIPATION	40	20	30		5	5			
	Mission Statement	10	10							
	Autocratic meetings	10	5	10		5	5			
	Participative meetings	10	5	10						
	Site productivity committees	10		10		10				
15	MOTIVATION	60	40	30		5				5
	Bonus payment : ex gratia	20	20	10						
	Supervisory profit/gain sharing	20	20							
	Bonus incentive for hourly paid workers	20		20		5				5
10	EDUCATION	40		5						
	In house education	10								
	Outside training	10		5						
	In house training	10								
	On site training	10								

responsibilities in an exemplary manner.

It is assumed that the managerial and supervisory salary scales relative to that of the foreman are proportional to the management inputs expected from the different members of the supervisory team.

16.1.3.2 Applied example

Table 16.4 shows the composition of the site management and supervisory team of the "Tr:htrain" contract, and their respective monthly salaries.

TABLE 16.4

COMPOSITION OF SITE MANAGEMENT AND SUPERV[illegible]ON TEAM

(Salary ref. 1986)

	R Basic monthly salary
Contract Manager	1 320*
Site Agent	3 300
Assistant to Site Agent	2 420
General Foreman	2 200
Finishing Foreman	1 980
Site Quantity Surveyor	1 760
Assistant Quantity Surveyor	1 540
Chargehands (6)	1 613

*This represents his salary allocation to this contract.

16.1.3.3 Contract team management function inputs

Table 16.5 shows the extent to which management and supervision exercised the different management functions on this contract. The scale of values used is the same as that in table 16.1.

Column (1)	shows the Relative Value Ratings as in table 16.1
Column (2)	lists the management functions and productivity elements.
Column (3)	shows the maximum management function performance ratings for the different functions and elements.
Column (4) to (11)	list the members of the construction team, and the numbers opposite the management functions and elements represent and quantitative but not qualitative values of their execution of the management functions.

The numbers in the horizontal line above columns (4) to (11) indicate the Management Input Factor (MIF) applicable to the different team members. This factor is the proportion of the team member's salary relative to that of the General Foreman. The reason for the low MIF of the Contract Manager is that he is in charge of three different contracts, and only one third of his salary has therefore been apportioned to "Techtrain". Similarly the high MIF of the charge hands is because there are six on the team relative to the one General Foreman.

The numbers on the left side of columns (3) to (11) show the values for the productivity elements, and the numbers on the right side of these columns show the total value of the management function, i.e. Management Function Value (MFV).

16.1.4 Quantifying the management inputs

Referring to table 16.3, the relative Management Function Value (MFV) of the input for the different functions can be obtained from the following relationship.

MFV = RVR (MIF . Individual Management Function Ratings)

This will apply to the functions of planning, organization, control, measuremen , communication / participation, motivation, and education.

Applying the above relationship we have:

Planning MFV = 20[(0,6x22) + (1,5x71) + (1,1x19) + (1x38) + (0,9x21) + (4,4x8)]
= 4 654

Organization MFV = 5 [(0,6x20) + (1,5 x 10)]
= 135

Co-ordination MFV = 5 [(0,6x5) + (1,5x10) + (1,1x13) + (1x10) + (0,9x10)]
= 256,5

Control MFV = 15 [(0,6x10) + (1,5x10) + (1x40) + (0,9x40) + (4,4x30)]
= 3 435

Measurement MFV = 20[(0,6x10) + (1,5x10) + (1x20) + (0,9x15) + (0,8x55) + (0,[illegible]45) + (4,4x10)]
= 3 480

Communication MFV = 10[(0,6x20) + (1,5x30) + (1x5) + (0,9x5)]

= 665

Motivation MFV = 15 [(0,6x40) + (1,5x30) + (1x5) + (4,4x5)]

= 1 440

Education MFV = 10 (1,5x5)

= 75

By substituting the foregoing Management Function Values in the input - output relationships developed in 16.1.2, we obtain the following Relative Management Units (RMU's) for the following outputs.

Completion time ≈ (1420x4654) + (75x135) + (100x256,5) + (750x3435) + (1180x3480)
+ (320x615) + (900x1440) + (330x75)
= 14 844 655 RMU's

Cost ≈ (1600x4654) + (100x135) + (100x256,5) + (900x3435) + (1400 x 3480)
+ (320x615) + (900x1440) + (300x75)
= 16 964 350 RMU's

Quality ≈ (600x4654) + (25x135) + (75x256,5) + (600x3435) + (500x3480)
+ (170x615) + (450x1440) + (400x75)
= 7 398 563 RMU's

Productivity Ratio ≈ (1600x4654) + (100x35) + (100x256,5) + (900x3435) + (1600x3480)
+ (400x615) + (900x1440) + (400x75)
= 17 717 050 RMU's

Total Relative Management Units input for the above listed outputs

= 56 914 618

If we relate the Relative Management Units input for the different management functions, to the Total Relative Management Units input for a specific output, and present the inputs in hierarchic order, then we obtain the results shown in table 16.6. This represents the priority of management resources allocation on the "Techtrain" contract.

TABLE 16.6

HIERARCHIC TABLE SHOWING THE PROPORTIONAL INPUT OF MANAGEMENT RESOURCES RELATIVE TO SPECIFIC OUTPUTS

		OUTPUTS				
	MANAGEMENT FUNCTIONS	Completion Time	Cost	Quality	Productivity Ratio	$\bar{x}$
I N P U T S	Planning	44.5	43.9	37.7	42.0	42.0
	Measurement	27.7	28.7	23.5	31.4	27.8
	Control	17.3	18.2	27.8	17.4	20.2
	Motivation	8.7	7.6	8.8	7.2	8.1
	Education	0.2	0.1	0.4	0.2	0.3
	Communication	1.3	1.2	1.4	1.4	1.3
	Co-ordination	0.2	0.2	0.3	0.2	0.2
	Organisation	0.1	0.1	0.1	0.1	0.1
	TOTAL RESOURCE APPLICATION	100.0	100.0	100.0	100.0	100.0

It will be seen that the above order of management input values is in the same ranking as the hierarchy shown in table 16.2, but the relative proportions of management inputs vary appreciably.

It is noteworthy that this contract was running behind on completion time, and considerable management resources were expended on the planning function - planning

and replanning. Motivation of the workforce was poor, and little attention was given to education, communication, co-ordination, and organization.

In order to have improved the overall performance of this particular contract, the values of the management inputs should have conformed to the apportionment of resources as shown in table 16.2.

16.1.5 Computation of the cost of additional management input

The economics of applying additional management resources in order to obtain improvements in specific outputs, can be evaluated by computing the cost of a management unit.

This can be done as follows.

Consider the General Foreman (who is full time on the site) as the basic management unit.

Say:	Basic monthly salary is	R 2 200
	Sundry benefits and employment costs	35% of basic salary
	Number of working days per month	23

Then the cost of one Mu =

(Management Unit per working day) = R2 200 x 1,35 / 23

= R 129,00

Hence the cost of additional management input will be the applicable Management Input Factor multiplied by the value of the Mu, i.e. Rands (MIF.Mu).

Thus the Mu cost per member of the management team can be derived and that permits the evaluation of the economic merits of increasing management input in the exercise of the specific management functions, in order to obtain a particularly desired output.

16.2 Testing the Hypothesis

The hypothesis was tested at contract level on three contracts which were distinctly different.

- NSI comprised two storey school buildings with concrete structures and brick walling. The terrain was level and this simplified the problems of materials handling.

- TPO2 was a large hostel complex, which included some housing and a large industrial kitchen. The work included excavation (blasting), concrete shuttering and placement, brickwork, steelwork and all the ancillary finishing trades. The terrain was uneven and sloping, and presented materials handling challenges. These challenges were met by developing and applying the innovative handling methods described in chapter 11.

- TDS2 was a large multi-storey hospital complex which required innovations in construction methods and materials handling. This contract followed on TPO1 and included some of the methods previously develo

It should be noted that the holistic approach was implemented some time after the commencement of the contracts which were the subject of this testing procedure.

The system of measurement which was developed by the author (ref. appendix G), was used to gauge the extent to which actual practice conformed to the ideal; and to assess the level of improvement achieved after the application of the holistic approach to productivity improvement.

The measurement encompassed the following factors.

1. Management Function Performance Rating: MFPR
2. Relative Value Rating: RVR
3. Total Management Performance Rating: TMPR

   The Total Management Performance Rating = (MFPR . RVR)
4. Management Performance Index: MPI

   This index is arrived at by dividing the total management performance rating (TMPR) by the maximum Total Management Performance Rating.

   i.e. MPI = TMPR / TMPR max

By using this index it is possible to compare management performance before and after the application of the holistic approach to productivity improvement. The applicable indices are as follows:

1. MPIb - Actual management performance index before the application of innovation and holistic approach
2. MPIa - Actual management performance index after the application of innovation and holistic approach

TABLE 16.7

EVALUATION OF MANAGEMENT PERFORMANCE AND CONTRACT PRODUCTIVITY BEFORE AND AFTER THE IMPLEMENTATION OF THE INNOVATIVE HOLISTIC APPROACH TO PRODUCTIVITY IMPROVEMENT

RELATIVE VALUE RATING (RVR)	Management Functions and Productivity Elements	CONTRACT PERFORMANCE RATING MAXIMUM (MFPRmax)	RS1		TP01		TDS2	
			BEFORE ACTUAL (MFPRba)	AFTER ACTUAL (MFPRaa)	BEFORE ACTUAL (MFPRba)	AFTER ACTUAL (MFPRaa)	BEFORE ACTUAL (MFPRba)	AFTER ACTUAL (MFPRaa)
20	PLANNING -	80	30	62	35	64	45	72
	Project strategy	10	5	8	8	8	9	9
	Project plan	5	4	4	4	5	5	5
	Site lay-out	5	1	4	3	3	5	5
	Activity plan	10	4	10	3	10	0	10
	Labour requirement plan	10	5	8	4	8	8	10
	Handling methods	20	7	16	9	16	9	17
	Work simplification	20	4	12	7	14	9	16
5	ORGANISATION -	20	10	20	13	18	10	18
	Organogram	10	4	10	7	10	10	10
	Function responsibility definition	10	6	10	6	8	8	18
5	CO-ORDINATION -	20	17	10	15	15	14	17
	Materials scheduling	10	8	8	8	8	8	9
	Cont/Consult relationship	5	5	5	4	4	3	4
	Cont/Subcont relationship	5	4	5	3	3	3	4
15	CONTROL -	60	32	43	35	41	34	49
	Managerial	10	7	10	7	8	4	8
	Labour	20	10	12	12	14	12	17
	Materials, equipment	20	10	14	10	12	12	6
	Costs, P&L, budgetary	10	5	7	6	7	6	8
20	MEASUREMENT	80	30	53	32	56	38	63
	Labour-performance, effort activity	20	10	14	12	16	12	16
	Lost time	10	6	10	4	10	6	10
	Materials wastage	10	4	6	4	6	5	8
	Rework	10	0	3	4	4	4	7
	Plant down time	5	3	2	0	2	3	4
	Quality	5	0	0	0	0	0	0
	Financial contract results	10	6	8	8	8	8	8
	Overall productivity measure	10	0	10	0	10	0	10
10	COMMUNICATION/PARTICIPATION	40	5	22	13	35	12	34
	Mission Statement	10	0	10	0	3	0	10
	Autocratic meetings	10	5	5	10	2	8	7
	Participative meetings	10	0	7	0	4	0	7
	Site productivity committees	10	0	0	3	5	4	10
15	MOTIVATION	60	13	53	21	60	20	60
	Bonus payment : ex gratia	20	13	10	20	20	20	20
	Supervisory profit/gain sharing	20	0	20	0	20	0	20
	Bonus incentive for hourly paid workers	20	0	20	1	20	0	20
10	EDUCATION	40	4	4	13	13	13	13
	In house education	10	0	0	0	0	0	0
	Outside training	10	0	0	0	0	0	0
	In house training	10	4	4	10	10	10	10
	On site training	10	0	0	3	3	3	3
	TMPR (Management Performance Rating) = Σ(RVR.MFPR)	6000	2100	4200	2580	4860	2800	4980
	MPI (Management Performance Index) = TMPR/TMPRmax		0.35	0.70 + 100%	0.43	0.76 + 76.7%	0.48	0.83 + 72.9%
	Productivity Ratio		1.12	1.57 + 40.2%	0.98	1.39 + 41.8%	1.08	1.46 + 35.2%

These two indices can be expressed as follows:

MPIb = (MFPRba . RVR) / (MFPR max . RVR)

MPIa = (MFPRaa . RVR) / (MFPR max . RVR)

where: MFPRba is the actual Management Function Performance Rating before the introduction of innovation, and MFPRaa is the rating after the introduction of innovation.

MFPR max is the maximum Management Function Performance Rating.
RVR is the Relative Value Rating.

16.2.1 Rating Values

The basis of, and scale of MFPR and RVR values, are set out in appendix G.

16.2.2 Scoring

A zero rating indicated that the function was completely neglected. A maximum rating indicated that the function was executed in an effective and exemplary manner. A part score indicated that management had taken cognisance of the particular function and the score value was the author's assessment of the effectiveness of management's action.

16.2.3 Assessment of Test Results

The results of the test are shown in table 16.7.

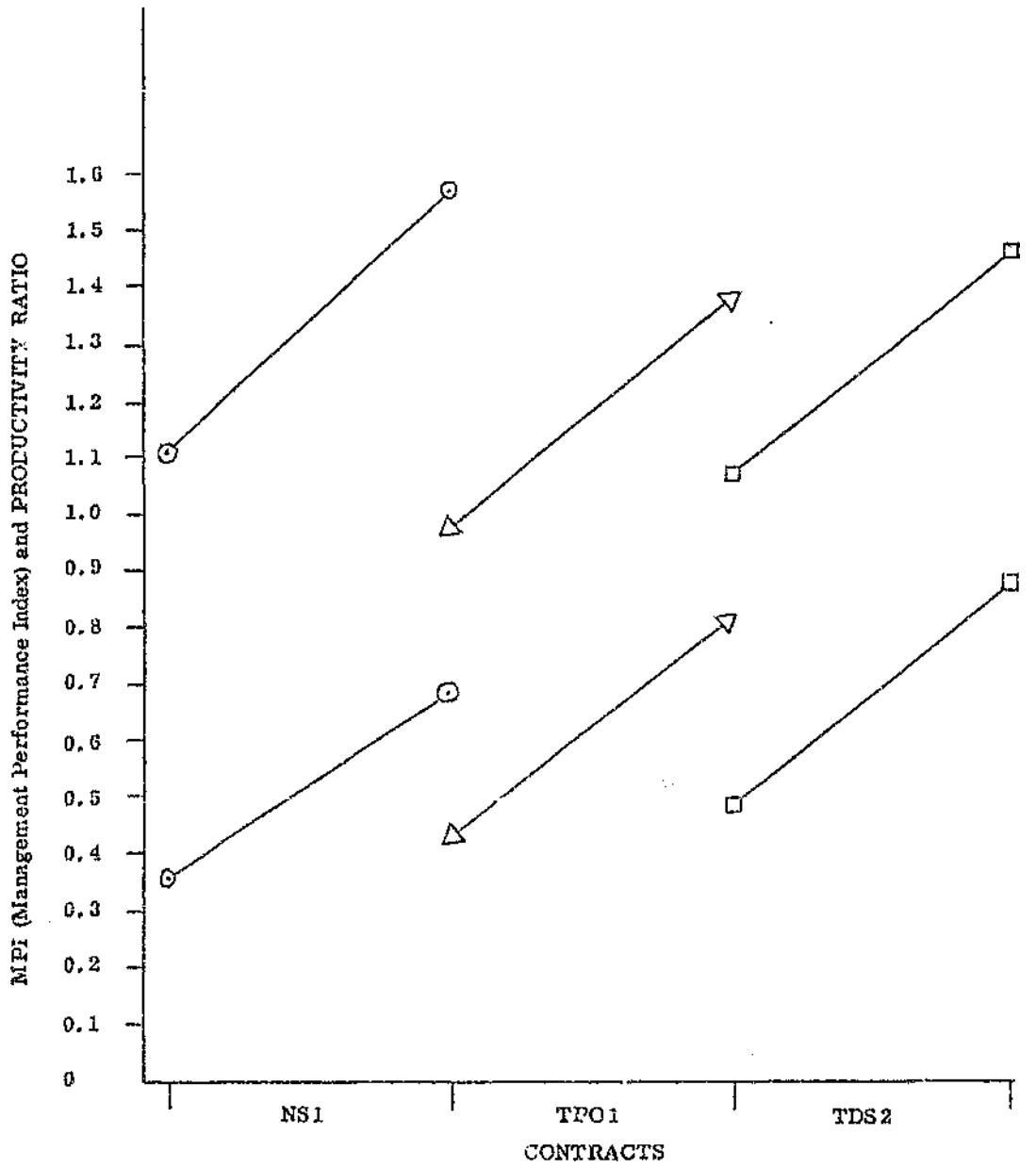


FIGURE 16.2 GRAPH SHOWING CONTRACT IMPROVEMENTS IN MPI AND PRODUCTIVITY RATIO AFTER IMPLEMENTATION OF THE INNOVATIVE HOLISTIC APPROACH TO PRODUCTIVITY IMPROVEMENT

The contracts were evaluated in accordance with the rating scale which has been discussed, and a MPI (Management Performance Index) was computed in order to assess changes in management performance. Changes in contract financial performance were then assessed by comparing productivity ratios before and after.

The MFPR's for the respective contracts show the areas in which improvements were made. The most important and effective improvements were made in the areas of planning and measurement, and this provided a basis for better control of the resources employed.

The introduction of gain sharing plans for supervisory management helped to generate a proprietary interest in contracts and a heightened sense of awareness regarding resources / utilization and wastage.

The bonus incentive plans for hourly paid workers stimulated improved activity and a sense of self discipline. The latter is illustrated by a particular case in which the team leader requested that one of his team members, who was slacking, be transferred. He subsequently increased production with a reduced team complement.

Little progress was made in the area of education and training which are both, of necessity, long term projects.

An important contribution to improved contract results was the introduction of innovative materials handling procedures. These were discussed in chapter 11.

The improvements recorded were indeed considerable, as shown by the changes in MPI and the productivity ratios. This was further confirmed by improvements in contract profits.

The changes have been plotted in Figure 16.2, and the resultant slopes show a distinct correlation between the MPI and productivity ratio.

This indicates that the MPI method of evaluation is realistic and that the resultant index is indeed an indication of management performance.

16.3 Contributions to Knowledge

This research has encompassed a broad spectrum of the construction industry and has resulted in contributions to knowledge and innovations in the areas of productivity and resources utilization. The results of this research include the following.

1. Proof that the construction industry does not use its resources effectively, and that this particularly applies to the industry in the R.S.A.

2. The development of a total economic measure of contract productivity based on a productivity ratio. This has enabled the measurement of productivity in the construction industry, and permits the evaluation of the ineffective use of its resources; particularly in the areas of labour and materials.

3. The identification of deficiencies in the bulk of the labour force (black) resulting from discriminatory legislation, poor education, and lack of skills

4. The development of an interactive model by the author which identified the main management functions which affect productivity. It illustrated their interactions and emphasized that productivity improvement is dependent on improving the management functions and applying them in a holistic manner.

5. The establishment of the dynamics of the functional interactions shown in the model, by the application of a Klein-type econometric modelling technique.

6. The development of a method for quantifying the relationships between the management function inputs and the resultant outputs of contract objectives, viz: to build a structure of acceptable quality timeously, within the allowed cost; and optimize resources utilization.

7. The establishment of a hierarchy of management function inputs in relationship to contract outputs. This provides important and practical guidance to management regarding the apportionment of contract management and supervisory resources.

8. The establishment of a management unit (Mu) which permits the evaluation of the economic merits of employing additional management and supervisory resources.

9. The establishment of a scale of management function ratings which permit the comparative evaluation of management performance.

10. The development of a gain-sharing plan based on the productivity ratio measure of contract productivity.

11. The development of simplified and economic administrative procedures for the administration and control of an incentive plan for hourly paid workers.

12. The development of an effective and reliable method for recording lost time at direct worker level, and of labour cost allocation.

13. The development of innovative equipment to facilitate materials handling and reduce

handling costs.

14. The production of a "Building and Construction Site Vade Mecum".

15. The integration of the above developments into the design and practical implementation of a holistic approach to productivity improvement in the construction industry; and hence the proof of the initial argument that only a holistic approach will result in the optimal utilization of resources and sustainable improvements in productivity.

CHAPTER 17

DISCUSSION AND CONCLUSIONS

17. DISCUSSION AND CONCLUSIONS

The research reported in this thesis has established the major factors which influence the level of productivity in the construction industry It has also established how these factors are applied (implemented) in current construction practice.

Experiments that included aspects of the management functions and materials handling have confirmed that effective improvements in the productivity of the industry are dependent on a holistic approach.

The relationships which were established between the management function inputs and contract objective outputs also defined the dynamics of the interactive productivity models featured in figures 2.2 and 15.1; and the valuation of management inputs permits the establishment of the economic merits of increasing contract management and supervision cadres.

The hierarchic table which was developed in chapter 16 provides contractors with an important guide to the application of management resources towards the execution of the different management functions.

The practical application of the econometric model and experimentation with management inputs relative to desired outputs merits further research.

The following sections will analyze the proposals for improving productivity in the light

of the experimental findings.

17.1 Organization

The functional responsibilities of management and supervision, on larger contracts i seldom clearly defi d. This can, and does, result in the duplication of functions and/or the neglect of functions.

It was found that the clear definition of responsibility helped identify duplications as well as areas of neglect. The use of the functional analytical technique (ref. chapter 13) made it possible to reduce staff and their attendant cost.

It is essential that all members of the management team have a clear brief regarding their responsibilities, and the contribution they are expected to make to the economic wellbeing of the contract. This should include the quantity surveyor/s who should be part of the production team and participate as a 'building economist' rather than a 'measurer'.

As a member of the construction team the quantity surveyor can make important contributions in the following ways :

- By premeasuring work to be done, and helping to resource activities by providing labour allowables for the different activities, and by assisting in the planning of team sizes and activity time spans.

- By identifying , measuring and reducing wastage of labour, materials, equipment during the production process; and not, as is the usual practice, by recording wastage after the fact. It has already been mentioned in Chapter 9 that some

production waste, e.g., over-excavation and substitution can only be measured at the time of occurrence.

- By negotiating with subcontractors for best rates.

- By helping to identify more economical sources of supply.

- By recommending the substitution of suitable and more economical materials and quantifying the cost of alternatives.

- By advising on equipment and handling methods.

- By helping to create a general awareness at site level regarding the value of the resources employed and wastage taking place.

17.3 Supervision

The first effective supervisory level of control is that of foreman. It has been established that his span of control currently ranges between 30 and 40 and that the position of foreman is, in large measure, the preserve of whites of whom there are relatively few entering the industry. If this position is maintained, and taking demographic projections into account, it must be expected that this span will broaden with a resultant decrease in supervisory effectiveness. The situation therefore calls for the accelerated development of black supervisors.

The 'white supervisory syndrome' i.e. the non-working supervisor - is an unnecessary waste of well qualified productive labour, and it behoves the industry to address itself to this situation and develop and apply a strategy for its elimination.

17.3 Planning

There was found to be considerable reluctance amongst contract management to do the necessary advance planning. This is one of the major reasons why effective site work seldom starts on day one of the contract.

Neglect of planning was found to extend to site lay-out which resulted in insufficient thought being given to transport lines, and location of materials and equipment. This contributed to excessive handling, mislaying of materials and equipment, unnecessary reordering, materials damage, and production delays.

The level of housekeeping on sites was generally found to be poor. This again must, in part, be ascribed to inadequate planning, and more so to a lack of caring on the part of management and supervision.

The introduction of a housekeeping check list by the author on some of the sites investigated, helped to focus the attention of site management on this matter, and resulted in noticeable improvements.

17.4 Measurement

Measurement is the basis of control. There was found to be a reluctance to premeasure work; especially labour content. This adversely affected labour allocation for the different activities, and it has been shown that most observed activities were overmanned.

The introduction of the activity production plan introduced the discipline of premeasurement, and assisted with the economic manning of labour activities.

There is a need to speed up the production and presentation of contract results. Premeasurement, which provides a measure of the construction content of an activity, will assist to do so. The application of the productivity ratio as a measure of productivity will further assist management to evaluate contract progress more effectively.

None of the contracts surveyed maintained records of the cost of rework. The introduction of such records is an essential discipline for upgrading construction quality and reducing the cost.

17.5 Materials Utilization

It has been assessed that materials wastage can amount to as much as 2.5% of total contract value. This could well be the difference between contract profit and loss. Materials wastage, like accidents, is avoidable, providing due care is taken. The materials wastage on the sites surveyed was found to be excessive, and this is an area that requires the urgent attention of management.

17.6 Labour Utilization

Site cost records have revealed under-recoveries on the employment of the contractor's own labour. The effort rating of observed site labour was assessed at only 80% of the allowable for labour cost recovery. This low labour effort tallies with the assessment expressed by senior executives in the construction industry at a seminar[19] held in June 1987, that labour productivity can be increased by a minimum of 30%. Improvements of this order on a national scale would be equivalent to a gain of approximately R 500

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[19] "Profit from Productivity, Prod. 87". A one day seminar for top executives in building and construction organized by the construction unit of the National Productivity Institute.

million per annum. This would yield the attendant benefits of higher earnings for employees, lower construction costs for owners, and higher profits for contractors.

The industry must address itself to the problem of late starts and early finishes. In response to the author's questioning, a gathering of 68 site personnel, including management, estimated that these practices account for a daily loss of approximately 11% of productive labour time.

The vade mecum contains suggestions for the reduction of this loss.

Another wasteful practice is overtime work. It is fatiguing and costly, and productivity levels during this time are usually of a very low order. If additional time is required to be worked, then the introduction of double shift work is more economical and productive.

Research revealed few records of lost time, except in those instances where management considered that a successful claim for the loss could be submitted to the owner. Records of lost time and delay are of paramount importance in identifying and reducing the causes of the under-utilization of labour resources.

The introduction of the production diary proved to be effective in recording lost time. These records revealed delays in the provision of materials and equipment and made it possible to quantify the lost time involved.

17.7 Materials Handling

It has been shown that approximately 80% of the labour force is engaged in materials handling. Thus, any reductions in materials handling will make a direct contribution

to improved productivity. It therefore behoves the industry to recognize this and accept the challenge of introducing innovative, simpler and more effective means of handling both materials and equipment. This will require the training of staff in work simplification, and the initiation of industry based research into improved materials handling methods.

17.8 Incentive Plans

The research did not reveal any incentive plans based on performance measurement on any of the sites investigated (Those implemented by the author are excluded). Mid-year, and/or year-end bonuses, based on management's subjective decisions, obtained in all the companies surveyed. The only incentive bonus which applied to hourly workers, and only on some contracts, was a weekly "good attendance bonus".

It was found that the introduction of gain-sharing and hourly paid incentive plans proved to be effective. The gain-sharing plans for supervisory staff prompted an increased sense of awareness and proprietary interest in the utilization of the company's assets and resources. Hourly paid workers who were offered an incentive bonus based on productivity improved their efforts, and there was a perceptible improvement in their utilization of productive time and in their self discipline. The latter helped to simplify the task of supervision.

Productivity incentive schemes can provide companies with the opportunity to contribute to, and promote a social responsibility programme. The workers could be involved in developing and administering the programme; and the necessary funds could come from a suitable gain-sharing plan.

17.9 Participation

We are living in the midst of an ongoing social revolution. The current authoritarian and paternal style of management is being questioned and is becoming increasingly unacceptable to workers at all levels. People want to be part of the decision making process, and management philosophies must therefore increasingly encourage participation.

The concept and fundamental essence of participation is summed up by John Naisbitt (1982:159) *'People whose lives are affected by a decision must be part of the process of arriving at that decision'.*

The concept of political power-sharing which is currently (1989) under discussion will in time extend to industry. Autocracy must in time give way to participative decision-making. This will call for new and different management styles and attitudes as stated by John Naisbitt (1982:188)'*...If you develop the skills of facilitating people's involvement in decision-making processes, you can become a very effective leader in your community and in your work. **The new leader is a facilitator, not an order giver'.***

With advances in education, and encouragement from management, it will be found that employees are increasingly able and willing to participate in decisions at all levels; and the organization that does not let them do so will not only turn them off, but will also waste valuable intelligence.

A great deal of knowledge exists among employees at all levels and this knowledge and an increased willingness to contribute to the common good can be utilized providing they are afforded participation in the enterprise. This has been proved during the course of the cybernetic discussion sessions which produced the site vade mecum, and

the 'Indabas' conducted during site productivity meetings.

17.10 Awareness

A further important contributory factor to the successful introduction of the holistic approach to increased productivity, which includes materials handling, was the stimulation of awareness, caring, and a questioning attitude amongst supervisors. This is illustrated by the following case which arose on one of the contracts that had been the subject of some of the experimentation described in this thesis.

Improved contract results[20] prompted the chief executive of the company concerned to visit the site to inspect operations, and acquaint himself with the innovations which had been introduced, and the changes made. The inspection was followed by a discussion attended by the author, the c.e., site management, and supervision. Having listened to site management's review of operations, the c.e. put the following question to the senior foreman.

"You have been with our company for the past sixteen years. What makes this contract different from all the others you have worked on?"

The reply was :

"Mr Lampert's influence, and the fact that we started asking ourselves questions."

The practice of the holistic approach to improved productivity and the emphasis on materials handling proved to be successful, and this was confirmed by the results

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[20] The company originally expected a loss of R250 000, but eventually realized a profit on this contract.

achieved.

17.11 Looking to the Future

Influx control and work reservation have been abolished. The repeal of this legislation has accelerated the integration of blacks into the commercial and industrial sectors. These ongoing changes present continuing challenges to the country, and management in particular, to ensure the effective and productive utilization of human resources. This challe ; is in part defined by the following Gravesian concept.

"The present problem with productivity is a sign of growth in our culture and not decay and it will force us to find new and innovative ways to manage people based on who we have now become".

Much remains to be done to improve management functions, introduce innovation, establish a heightened sense of awareness and commitment at supervisory levels, and promote skills development and education.

Training, in particular, has been emphasized as contributing more than 40% to achieving improved productivity, by workers earning less than R999 per month (Project Free Enterprise, 1984).

Education is the development of knowledge, and the dissemination of knowledge regarding resources utilization can often make a greater contribution to productivity improvement than capital investment.

The U.S., however, has tended to invest capital to achieve productivity improvement. Kirkland (1982:1214) states :

'Productivity in this country (U.S.) traditionally has resulted from the use of cheap and abundant energy to add horsepower to manpower, and through the introduction of tools purchased with cheap and abundant capital'.

In South Africa we have a different situation. The majority of our workers is black, lacking basic education and skills, and the capital we must invest is not to add horse-power to manpower, but to add brain power to man power through improved basic education and the development of cognitive and technical skills.

In this regard, the educational and behavioural sciences have a great deal to contribute.

The development of industry follows a universal pattern. It is therefore instructive to take cognisance of the developments in a country such as the U.S.A., in an effort to anticipate the challenges which the South African construction industry will be faced with.

An American study team researching the construction industry observed[21] :

'Despite the prowess of the more than two dozen contractors who gird much of the free world, each doing more that $1 billion worth of construction annually, and despite the sophistication of giant corporate clients for construction whose annual building bill runs to billions of dollars, too much of the industry remains tethered to the past, partly by inertia and partly by historic divisions - management vs labour, union vs open shop, business vs government'.

To quote J. Robert Fluor, Chairman of Fluor Corporation, the giant California-based construction organization :

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[21] The Business Roundtable Summary Report (1983 : 12)

'The bottom line of this adversial dance is a constant state of confrontation'.

In the Republic of South Africa, two job universes have existed in the past : one, white, doing skilled work, supervising and managing; the other black, unskilled, using little initiative and being lowly paid.

The emergence and development of black trades unions carries the potential for the polarization of the industry into two distinct factions, and the entrenchment of the past differences between black labour and white management.

A situation can be foreseen in which these factions will consistently pull in opposite directions in the belief that by so doing, one side can profit at the expense of the other. Nothing is further from the truth.

The newly established trades unions in the construction industry have already demanded, and obtained (through strike action) pay increases. These demands will continue.

It is not possible to eliminate the two job universes simply by increasing the wages of black workers. The answer is to transfer skills to them, afford them increasing participation in all facets of the construction process - particularly with regard to methodology and supervision, and motivate them to improve productivity.

Management must respond by offering the labour force positive answers to the question: *'WHAT'S IN IT FOR ME?'.*

Productivity bargaining is an inevitable element in future industrial relations. For this type of bargaining to be practical and effective, it is essential that the *BARGAIN* be clearly defined.

The *BARGAIN* must perforce be based on agreed production norms, given specific work circumstances. Acceptable work (production) norms must be the basis for standard remuneration. Should the worker exceed the standard then he would, as a matter of right, have earned more, and thus be entitled to more pay.

Pay increases cannot be given ad infinitum, and must be related to improvements in productivity.

Trades unions can play a positive role in the industry, and must be encouraged to participate in the development of the work force and the stimulation of improvements in productivity.

It is noteworthy that a formal study of the productivity of construction workers conducted by Allen (1979 : 17) in the U.S.A., concluded that union workers are more productive than non-union workers.

There must be a realization amongst all concerned that maximum prosperity can only be attained by co-operation between employers and employees. The redistribution of wealth demanded by the trades union will serve little purpose without wealth creation.

17.12 Management's Challenge

The changing industrial climate presents management with the challenge to review and reassess company philosophies and practices.

Studies sponsored by The Roundtable (1983) have revealed that more than half the time wasted during construction is attributable to poor site practices, which are in turn attributable to poor or outdated management practices.

Improvements in productivity will therefore demand changes in management attitudes and practice.

Firstly, it will demand very much stricter and more effective planning disciplines. Supervision will be required to ensure the creation of conditions in which the hourly paid worker can optimize his effort.

This will demand :

- better communication and clear understandable instructions.
- the development of skills.
- the timely provision of materials, tools and equipment.
- the encouragement and control of quality.
- the implementation of effective safety programmes.
- the reduction of waste.

The reduction of waste means getting by with fewer resources, and this point is succinctly expressed by Thomas J.Murrin (1981:76), President of the Public Systems Company in Westinghouse : *'We are going to have to do more with less - fewer people, less money, less time, less space, fewer resources in general - and I think that's probably a pretty good definition of productivity'.*

Secondly, there will have to be a change in labour relations. The industry is today, and will be in future, almost entirely reliant on black labour. Black supervisors and managerial personnel will have to be developed in order to improve and reduce the span of control. The development of black supervisors will also help to improve communication at the supervisor/hourly paid worker interface.

Workers will have to be brought into the decision making process. People have a right to participate in decisions which affect their well-being and their future. With encouragement they will also make a contribution in the areas of work simplification and improvement in materials handling and overall productivity.

The challenge which the construction industry (and all other industries) is facing, is CHANGE. We cannot hope to achieve an improved, and different result in output, unless we change our input and/or process.

That input must take the form of a greater caring for, and awareness of the utilization of our resources, especially people, materials, machinery and money. This must be accompanied by a greater commitment to developing people, and improving work quality and safe working practices.

The precursor to change is perforce courage - courage to stop doing what we are doing.

- It takes courage to discontinue long-standing, accepted practices which may be non-productive.

- It takes courage to reduce manpower complements that have been based on estimated production norms, but which can be shown to have a low activity rating.

- It takes courage, discipline, and ongoing commitment to reduce wastage and implement high levels of site house-keeping and materials control.

Progressively this courage will promote creativity and innovation in the critical areas

of materials handling and total resources utilization.

Thus by working courageously and smarter, not harder, the overall goal of improvements in real productivity will be achieved.

The leaders in the construction industry in their concern for bottom line results - profits, seem to lack the appreciation that profit is not an end in itself, but a product of effective utilization of resources: manpower, materials, machinery and money.

The potential for improvements in productivity has been proved on numerous occasions. The following example of achievement which was reported at the N.P.I. conference on productivity held at the University of Pretoria in August 1985, is noteworthy. A C.M.G.M. construction company representative described how several of their bricklayers, under ideal conditions, and with effective motivation, laid over 4000 stock bricks per day; compared with an average in the industry of 300 to 400 per day. (This is a practical example of ordinary people doing extra-ordinary things; indeed, a winning practice).

It has been found that management subscribes to productivity improvement in word. The productivity conferences organized annually by the N.P.I. are part of the ongoing discussions. But these will remain sterile until there is complete commitment at all levels of management and employees to reduce wastage and improve resource utilization. Improvements will not be achieved without missionary zeal; without dedication, without motivation; and, above all, without a deep sense of caring.

- Caring for people, materials, machinery and the money spent on sub-contractors and services;

- Caring for the client and the quality of the end product.

It is only when the industry truly cares about all aspects of its undertakings that there will be effective and concerned planning, materials scheduling, materials handling, and resources utilization. The product of such action must perforce be improved productivity with resultant benefits for the owner, contractor, employees, and users, and the country's economy.

CHAPTER 18

RECOMMENDATIONS

SYNOPSIS

This chapter sets out recommendations for the construction industry which were developed during the course of this research.

The implementation of these recommendations will assist contractors to apply a holistic approach to the utilization of the resources at their disposal, and hence improve productivity.

The recommendations include proposals for improvements in the areas of organization, supervision, training, education, communication and participation, labour utilization, measurement, resources control, motivation, site operations and materials handling.

18. RECOMMENDATIONS

The results of this research have positive practical implications for the construction industry and its constituents, i.e. contractors, owners and consultants. The implementation of the following recommendations will improve resources utilization and hence productivity.

18.1 Organization

A company must have a clearly defined mission that employees can subscribe to and participate in. This mission can best be expressed in a mission statement which should be the product of management and employee consultation.

Functional responsibility should be clearly defined and checked to ensure that functions are discharged at the correct level and not duplicated. Periodic functional analysis will assist in this regard.

The quantity surveyor should be part of the construction team and should actively participate in planning, controlling waste and procuring materials and sub-contract services.

18.2 Supervision

The span of control at foreman level should be reduced from the present of approximately 35 to 16. This will require the development and promotion of non white supervisors.

The practice of the non-working supervisor should be eliminated and all first line supervision should be productively employed.

Training

The development of black foremen should be accelerated through structured education and training.

The available training facilities in the building and civil engineering sectors should, where practical, be consolidated and rationalized. Since much of the labour is common to both sectors, the career paths of trainees should similarly be rationalized so that skills training courses and facilities can be merged. This will help to establish a common pool of skilled labour and reduce the cost.

The industry should :

- introduce the practice of on site training, with trainees engaged in productive but not critical activities.

- use the construction of sub-economic housing, and of civil engineering infrastructure in black areas as training for the development of black artisans.

- develop a category of qualified general construction workers who through having been subjected to multidisciplinary skills training will be skilled in all the general construction activities.

18.4 Education

Skills training should be accompanied by continuing in-house non-formal education. This will help to broaden the employees' comprehension base for the assimilation of cognitive skills, and his further productive development.

Craft training should be introduced at school level. This will help to stimulate an early interest in technology and encourage school leavers to pursue a technological career.

18.5 Communication and Participation

The introduction of site productivity committees based on the 'Indaba' practice will afford black workers the opportunity to participate in the planning and allocation of work. These committees can also serve as an educational and communications medium.

Cybernetic discussion sessions for supervisory staff will provide a medium for their participation and the exchange of ideas. The latter, as has been proved, can contribute much to improved resources utilization and better productivity.

Early liaison between the owner, consultants and contractor, can help to reduce wastage.

The possibility should be explored of convening a conference of representatives of all the relevant professional bodies with the purpose of establishing guidelines and a code for co-operation.

18.6 Labour Utilization

Overtime should be reduced and eliminated as far as possible. If a contract is to be

accelerated, then thought should be given to working multiple shifts.

Skills wastage can be minimized by maintaining employee records which provide comprehensive information regarding the training undergone, and skills qualifications attained.

The practice of regular team activity ratings should be introduced. This will help to assess whether excess labour is being employed.

Month end absenteeism (in the case of monthly paid hourly workers) can be reduced by paying different groups of employees on different days of the week during the month.

18.7 Measurement

The concept and practice of using the productivity ratio as a measure of total contract productivity should be introduced. It should, however, be complemented by the discrete measures discussed in chapters 7, 8 and 9. These will help identify the underutilization of labour resources, and materials wastage.

An agency should be established which will collect, and disseminate productivity data to the industry, based on the productivity ratio. This will provide the following advantages :

1. It will permit contractors to measure their performance against industry norms.
2. It will provide a basis for worker remuneration and incentive payments.
3. It will provide a basis for the realistic evaluation of labour productivity.

The collation should be done on a sectoral, regional and national basis.

18.8 Control

Consideration should be given to the introduction of zero base budgeting for the purposes of cost control.

Maintenance of records and the analysis of all lost time can help to reduce continuing losses. Reliable lost time records can be obtained by introducing the use of a production diary at all supervisory levels. The use of this diary will also simplify labour cost allocation.

It is essential to record the time and costs involved in rework. Reliable records will help to reduce these costs.

The format and attendant administrative work involved in producing contract reports should be regularly reviewed to ensure that :

1. They are meaningful and provide information regarding the achievement of operational objectives.

2. They provide a reliable basis for decision making.

3. They are produced timeously and at least cost.

18.9 Motivation

Incentive plans should be periodically reviewed and up dated to ensure that they continue to satisfy employees' needs and fulfill the fundamental requirements of

incentives, as set out in chapter 15.

Gain-sharing plans should be introduced for supervisory staff in order to provide them with a proprietary interest in the company's operations and the utilization of resources.

Bonus incentive plans should be introduced for hourly paid workers.

Construction contracts, where possible, should be formulated to include incentives for cost saving.

Government should be approached to reduce taxation on incentive earnings from approved productivity incentive plans.

18.10 Site Operations

The contractor should take the following action :

- Ensure that a site layout plan is prepared for every site and revised, if needs be, in accordance with construction progress.

- Premeasure work to facilitate the planning and allocation of resources; particularly the provision of materials, labour and services.

- Ensure good housekeeping and materials and waste control. This can be facilitated by the use of a housekeeping check list. Site management and supervision can also be motivated to improve their housekeeping by introducing a "Good Housekeeping" competition. The check list shown in appendix A provides for the evaluation of housekeeping levels.

- Appoint a co-ordinator who will be responsible for promoting, developing and introducing work simplification, and innovative methods to handle materials.

- Train foremen and supervisors in work simplification, materials handling, work measurement, and technological developments.

- Use quality assurance check lists for the main construction activities in order to provide guidance regarding correct technical procedures and to promote quality.

Further recommendations regarding site operations are set out in the "Building and Construction Site Vade Mecum".

18.11 Materials Handling

The construction business mainly involves the handling of materials. It is therefore recommended that research be instituted in the universities to develop innovative materials handling equipment and procedures for the building and construction industry, and develop suitable educational courses for the industry's personnel, in work simplification and waste reduction.

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APPENDIX A

HOUSE KEEPING CHECK LIST

This check list should be completed by site management at regular intervals in order to assess the level of site housekeeping. It should also be completed by contracts management and head office staff when evaluating site housekeeping levels.

HOUSE KEEPING CHECK LIST

CONTRACT : ..... DATE: .....

PARTICIPANT:..... ASSESSED BY :.....

A.	ACCOMMODATION				
1.	Site Office	**Remarks**	**Yes**	**Part**	**No**
1.1	Well maintained site office externally		----	----	----
1.2	Notice board in use with emergency contacts up to date		----	----	----
1.3	Tidy, clean, well ventilated, good lighting, plan table, internal notice board		----	----	----
1.4	Efficient drawing filing system		----	----	----
1.5	Efficient document filing system		----	----	----
2.	**Change Rooms**				
2.1	Clean and neat		----	----	----
2.2	Lighted and ventilated, with washing facility		----	----	----
3.	**Toilet Facilities**				
3.1	Clean and hygienic		----	----	----
3.2	Adequate in number		----	----	----
B.	**STORES**				
1.	**Lock-up Stores**				
1.1	Theft protected		----	----	----

1.2	Separate inflammable section with fire fighting equipment	----	----	----
1.3	Clean and tidy	----	----	----
1.4	Accessible storage bins and shelves, labelled where necessary	----	----	----
1.5	Tools marked and catalogued	----	----	----
1.6	Tool issue register	----	----	----
1.7	Tools and equipment well maintained	----	----	----
2.	**Bulk Storage**			
2.1	Location of materials according to site layout plan to avoid multiple handling	----	----	----
2.2	Bases and bins or sides (bulkheads) for sand and stone to prevent spreading	----	----	----
2.3	Cement and timber stored off ground, properly covered and ventilated	----	----	----
2.4	Easy access to handle materials	----	----	----
2.5	Suitable security against theft	----	----	----
C.	**PLANT AND EQUIPMENT**			
1.	Neatly stacked according to site plan as near to work place as possible to facilitate bulk handling eg. off the ground	----	----	----
2.	Plant and equipment clean and well maintained	----	----	----
3.	Wheelbarrows and shovels cleaned after use (minimal concrete/mortar encrustation)	----	----	----

D.	**WORK PLACE**			
1.	**General**			
1.1	Easy and safe access to working area	—	—	—
1.2	Safe walkways, ladders, handrails, scaffolding, etc.	—	—	—
1.3	Excavations made safe	—	—	—
1.4	Suitable protective clothing worn by all - hardhats, footwear, and dust masks, goggles, gloves, etc. where necessary	—	—	—
1.5	Safety guards on cutting tools	—	—	—
1.6	Safety committee with regular minuted meetings	—	—	—
1.7	Work place tidy - no random excess equipment, materials or rubble which might provide a safety hazard	—	—	—
1.8	Working materials and equipment neatly stacked for easy procural and handling	—	—	—
1.9	Storage bins in place containing small items of equipment or materials eg. wedges, clamps, etc.	—	—	—
1.10	Adequate and effective tools being used.	—	—	—
1.11	Materials wastage: No excessive timber off-cuts, concrete spillage, water leaks, over excavation, etc.	—	—	—
2.	**Completed work**			
2.1	Cleaned in preparation for next trade	—	—	—
2.2	Protected from damage			—

	Safety			
	General			
	Site security - Effective vehicle and personnel control	---	---	---
	Tip excess rubble	---	---	---
	Clean, level and direct (shortest possible route) transport lines for moving materials and equipment	---	---	---
	Planning			
2.1	Site layout plan showing location of offices, bulk material storage, access, water points, power points, flow lines	---	---	---
2.2	Overall contract programme - up to date	---	---	---
2.3	Weekly contract planning system	---	---	---
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2.5	Allowables provided by Q.S. for the assessment of required labour, plant and material resources	---	---	---
2.6	Lost time control recording and analysis	---	---	---
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APPENDIX B

MISSION STATEMENT

This mission statement, after approval by management, was issued to all site supervisory staff. They, in turn, explained it to the lower levels of site personnel whose literacy was questionable.

MISSION STATEMENT

1. **Our Overall Mission is to:**

   - Build quality structures at least cost, and to our clients' complete satisfaction within the agreed time;
   - to provide gainful employment for our personnel;
   - to achieve effective utilization of our capital resources.

2. **Inter-Dependence**

   We believe in the concept of ' -partite partnership consisting of:

   - Our Clients
   - Our employees
   - Our shareholders

   The participants in this partnership are inter-dependent, and it is in their mutual interest to optimize resources utilization and hence share in the resultant economic gain.

3. **Market Leadership**

   We must continue to identify our market; build on our strength; and compete on quality.

4. **Quality**

   We are committed to the production of quality products which will afford our clients satisfaction, beneficial occupation, and afford us pride of association.

Quality is the product of caring; Caring for our clients' needs; for our workmanship, materials, equipment and machinery.

The only way to do it is doing it right the first time. Reducing and eliminating rework is a direct way to improve productivity at no cost input. Quality cannot be inspected into a job; it can only be built into it.

5. Management

Management is responsible for the effective utilization of the resources at their disposal.

Management is performance, and good performance cannot be achieved without the practice of guidance management - to make things happen and create the necessary conditions in which all employees can develop to their full potential; to optimize their own performance; and to use the resources at their disposal in the most productive manner.

The effective practice of guidance management requires the prompt reporting of results which show the extent to which we are on course towards achieving our objectives.

6. Control

Control cannot be achieved without measurement. We cannot control what we can't measure; and we cannot control what we don't measure. We must therefore measure and monitor the utilization of all our resources in order to achieve their economically effective utilization; and this must be done at least administrative cost.

7. Participation

We believe in the concept of participation :

- Participation with our clients, consultants, architects, and sub-contractors, to ensure mutual benefits for all concerned.

- Participation by all employees in a concerted effort to achieve productivity by innovation and creativity.

- Participation by all employees, through suitable gain-sharing and incentive plans, in any economic improvements in company results to which they have contributed.

8. **Planning**

Objectives and effective resources utilization cannot be achieved without meticulous **PLANNING AT ALL LEVELS OF RESPONSIBILITY.** Planning must also include strategies for improving resources utilization as well as contingency plans in case the original plan cannot be implemented.

9. **Education and Development**

We believe that in every field of human endeavour there is (continuing) potential for improvement.

People are our most important asset, and we are therefore committed to motivate and develop all our people to their full productive potential. This will be achieved by in-house education and skills development, and supplemented when necessary by outside

educational and training facilities.

10. Improving Resources Utilization

10.1 Manpower

We can improve the utilization of our people by :

- ensuring that they have the necessary materials, plant and equipment in the *right* place, and at the *right* time
- reducing as far as is possible lost time (standing time)
- removing all demotivators
- providing them with effective motivation by rewarding good performance
- reducing and eliminating rework
- encouraging commitment to the achievement of higher quality in the work produced.

10.2 Materials

We are committed to reducing and eliminating wastage of materials in all possible circumstances. This can be achieved by :

- better storage
- better and reduced handling
- avoiding rework
- ensuring the availability of sufficient but not excessive materials on site. (This involves careful attention to procurement and scheduling.)

10.3 **Plant and Machinery**

Plant and machinery are our production aids. With due care and maintenance they will assist us in our striving to achieve quality and zero defects.

Hand and power tools are part of our assets, and their care, maintenance and safeguarding will help us to achieve increasing productivity with resultant benefits for all concerned.

11. **Change**

We are committed to change; because to survive in this dynamic world, one must adapt; and to adapt, is to change.

We realize that we cannot hope to succeed in an ever changing world by applying yesterday's methods to today's work and expect to be in business tomorrow.

12. **Attitudes**

If we are to satisfy our customers, then we must appreciate their requirements. To achieve and improve, we must be perpetually dissatisfied with past achievements. Our ultimate success will be based on a belief in ourselves; in what we are doing; in our colleagues and staff; and in our total enterprise.

APPENDIX C

BUILDING AND CONSTRUCTION SITE VADE MECUM

This section represents the edited results stemming from the cybernetic discussion experiment described in chapter 14.

It was compiled in this form to serve as a vade mecum for site and main office managers on the planning and management of construction sites.

The vade mecum was used by the company for whom it was prepared. It formed an integral part of the holistic approach, and the overall results which were obtained are discussed in chapter 17.

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INTRODUCTION

The guidelines published in this manual were provided by members of staff during discussion sessions regarding ways and means to improve site productivity. The participants in these discussions included Contracts Managers, Site Agents, Foremen, Chargehands, Stores Personnel, Equipment Yard Management, Quantity Surveyors, Training O ..s and Cost Clerks.

The subject of discussion was how best to improve the utilization of the company's resources, with specific reference to manpower, materials, machinery and equipment and money.

Materials wastage, which results in unnecessary financial losses was commented upon and the recommendations made to reduce wastage are an important part of this manual.

Relationships with clients, professional teams and sub-contractors were also discussed, and the opinions expressed are also included.

Most participants stressed the importance of planning at all stages of the contract, and the fact that effective action based on sound planning can help to reduce and eliminate many of the delays which incur unnecessary costs.

Much of the contents of this manual will be known to the reader; but much of the detail may not be practiced. It must be emphasized that many little steps can add up to one giant stride, and the continuing implementation of the ideas and practices recorded in this manual will help site management to improve operations and thus achieve overall objectives, which are :

- to satisfying our clients;

- that the company and it's employees enjoy mutual prosperity;
- and that we provide a constructive and responsible service to the community in which we work.

It is too easy to forget the detail. Keep referring to this manual. It will stimulate your sense of awareness, caring, creativity and innovation which are, indeed, the hi..d to excellence, prosperity and success.

Harry Lampert

1. PLANNING

Planning is essential on every job. Effective economy cannot be taken without a detailed plan. There should be close liaison at the tender and planning stage of a job between the Estimator and the Contract Managers, who have the practical experience of the work to be done and can thus make a positive contribution to the formulation of the tender.

Close liaison must be maintained with the client so as to obtain the earliest possible notification of the award of the contract. This will permit early preparation for construction before the actual signing of the contract.

1.1 PRE-PLANNING

Pre-planning should commence from day one, as soon as advice is received that the contract has been obtained.

All the necessary documents such as bills of quantities, sureties, proof of insurance, certificate of good standing from Workmen's Compensation, applications for water, power and telephones, hoardings, licenses, etc. must be attended to immediately. Delays in the pre-planning can delay the contract by as much as two months.

A checklist should be drawn up which will assist in starting up the job.

- Expedite the signing of the initial contract.
- Apply for all connections early.
- Considerations must be given to all options with regard to labour, plant and materials.
- The pre-plan should also include both the sequence and method of

operations.

- Consultations should be had with architects regarding details necessary for the different activities. The consultation should also include engineers. These consultations should be done timeously to avoid any delays in construction.

- Management must avoid being pressured by Architects into making commitments in terms of programme which are difficult to meet.

- Arrange your suppliers and open accounts if your site is an out of town job.

- Check the documents before you start so that you do in fact start where required. There would be a loss of productivity if you had to change direction in mid-contract.

- Think through every activity before committing resources to work.

- Inform the labour office of your labour requirements.

- The labour office should have more control over the movement of labour between sites.

- Get plant organized early on.

1.1.1 Site establishment and lay-out

Careful attention should be given to site establishment and site lay-out.

Site lay-out can and does have a considerable effect on overall construction costs. The lay-out must take into account the location of site offices; labour accommodation; the storage of materials and equipment; location and number of toilets (can reduce lost time); materials and labour flow lines.

A detailed scale site plan should therefore be completed before commencing site operations. Ensure that your site establishment is being planned so that all facilities are in the right place to avoid having to move them at a later stage.

EFFECTIVE SITE PLANNING CAN HELP SAVE ON MATERIALS HANDLING.

Approximately 80 percent of our manpower consists of labourers whose basic work involves excavation, backfilling, moving equipment and materials. Therefore, since most of your manpower are involved in materials handling it is a fact that construction is largely a materials handling exercise. Hence, it is essential to ensure that the handling of materials is done at least cost.

It must be borne in mind that additional handling adds to the cost of your product (the completed structure), without adding any extra value. There is also the constant danger to the materials being transported (chipped bricks, spilled concrete, etc.).

In practice, for example, positioning of cement sheds and cement silos in relation to the concrete mixer should be such as to ensure the shortest possible route to areas of construction. This should also apply to materials storage locations.

The site should be planned so that storage space is allocated to materials close to their final location, e.g. different coloured roof tiles for their respective houses.

1.1.2 Site planning : guidelines

As mentioned earlier, the site plan must show the necessary storage facilities for materials, plant and equipment.

Adequate transport routes must be provided so that there is ready access to materials, equipment and working areas.

Transport lines must be the shortest possible, and materials should be delivered as close to the work areas as is possible in order to avoid doul multiple handling.

1.1.2.1 Uniflow

The concept of one directional flow should be practiced wherever possible. This will help to keep people and materials moving, without the hold up and congestion which occurs when the same pathways are used for movement in opposite directions.

1.1.2.2 String diagram

Doubt about the shortest transport route can readily be resolved by using a string diagram.

The scale plan of the site should be mounted on softboard which will allow plastic headed pins to be pressed in along the proposed route. A piece of string is then strung around these pins along the full length of the route. Remove the string and measure it's length. This will give the route length to the scale of the site plan.

The same procedure is then followed for the alternative route, and the lengths compared. The shorter length of string will indicate the shorter route.

1.2 Overall Contract Planning

Call for drawings well ahead of time and study them carefully. Problems can arise when architects' drawings differ from the engineer's drawing. Both sets of drawings must be studied and any differences that may come to light should be resolved in good time.

Lack of detail can hold up progress. This can be eliminated by planning three to four weeks ahead. In these circumstances absence of detail can be identified and action can be taken to obtain the necessary information.

Insufficient thought is given to asking the professional team for dates on which drawings will be supplied and work details obtained. This should be done in good time.

Delays in receiving architects' decisions can hold up the contract and it is desirable that a time limit should be formally recorded as to when decisions are required.

Programmes should be updated at regular intervals and new targets set. Shift charts should be regularly drawn for the different work sections. Problems should be anticipated in good time.

Regular site progress meetings should be held.

Work continuity is very important. Do not start work where you cannot get continuity; even if this goes against the concept of higher turnover.

Marked up plans of all reticulation completed on a contract should be kept in the site office.

This will allow the main contractor to plan his work so that there are no delays

regarding plumbing work.

On large jobs the plumber should do ground work as soon as possible.

CRITICAL PATH NETWORKS can be useful and effective and supervisors must be acquainted with their reading and application.

If the job is big enough, consideration should be given to the appointment of a planner. A computer on site will also help the planning process.

An essential element of good planning is an effective site filing system. This will avoid lost time in looking up documents.

1.2.1 Start up operations

THE PRIMARY OBJECTIVE MUST BE TO START EXCAVATIONS OR THE NECESSARY EARTHWORKS ON DAY ONE OF SITE HANDOVER. DELAYS IN STARTING THE JOB ARE SELDOM MADE UP, AND OFTEN RESULT IN FRUSTRATION, ADDITIONAL COST AND POSSIBLE PENALTIES.

The absence of permanent site offices should not delay commencement of work. A caravan, suitably equipped, including company stationery, filing facilities, etc. can be towed to the site and used as a site office while construction work is in progress and until "permanent" offices and other accommodation are established.

1.2.2 Activity planning

Correct setting out and planning of the job is essential for achieving economic results, and this involves thinking ahead and anticipating events.

[illegible] and Architects should be encouraged to participate in short term [illegible] will help to anticipate any problem areas, and resolve them in good [illegible] with regard to activity sequences. Consideration must be given to [illegible] planning.

[illegible] PLANNING of activities is essential to ensure smooth and steady [illegible] progress. Site planning should involve the foreman and possibly, the team [illegible] taking the team leader involvement will help to motivate their teams.

foreman should be aware of the overall goals of the programme, and must find time plan his works well in advance.

Also, a worker must know what he is doing and why he is doing it. He must be told what the objective of his work is, e.g. whether his structure will carry a slab or whether it is a temporary structure which will eventually be knocked down.

2.3 Activity and labour [illegible]ning

An initial operations plan should be compiled and then broken down into various elements. This will enable the site to plan its labour more effectively.

The general foreman on site should have a list of labourers and their related skills.

A site agent's manual regarding the orientation of new employees should be available.

The labour department should be told timeously about future labour requirements so that they can contact other sites for labour of a particular skill.

Care should be taken to ensure that workers can use their experience productively, i.e.

put the right man in the right job.

Labour can often be trained to do certain artisan tasks and thus ensure better labour utilization and lower costs.

Labour requirements should be carefully planned on the basis of measuring the work content in the different activities. Invariably this will permit a reduction in the labour force, and result in better contract profits.

Measurement of work to be done is an integral part of planning and essential for the effective use of labour and materials.

The daily/weekly site programme now being introduced is helping to allocate labour more effectively.

There should be a greater exchange of information between sites on specialist experience required.

The chargehand must also be advised of work in good time so that he can advise his labour on "what's next?".

It is important to get the co-operation of the work force. You must tell them how much they must do and when. The whole job must be explained to them.

The daily planning can best be done by using the weekly/fortnightly planning sheet. The weekly/fortnightly production plan must include contingency activities. These should be of a non-critical nature so that they can provide for the productive employment of site labour in cases where planned activities (usually critical) cannot be proceeded with.

(Reasons : absence of key personnel, equipment breakdown, weather, etc.).

The above plan will provide for a worker's daily task and set a work target which must be achieved. This will provide the basis of advance clear cut instructions to the team leaders for the daily work to be done.

It is important to get supervision feed back when planning a job.

All activity programmes must be updated weekly. Bar charts are helpful in this regard.

At the end of every day there should be a site supervision meeting during which the day's work is summarized and a plan made for the following day's/week's action.

1.3 Employment of Sub-contractors

Sub-contractors must be appointed timeously, and the most important 'subbies' should be organized first, i.e. don't get the painter organized before you have an earthworks 'subby'.

Check their financial standing before employing labour only sub-contractors.

You should be more selective when employing sub-contractors so that situations do not arise where 'fly by night' sub-contractors are emplo, d by you. This will avoid situations where other sub-contractors have to be employed to rectify their work.

Labour only sub-contractors are supposed to be specialists in their field. They should be held responsible for their work.

'Labour only' sub-contractors must be checked regularly. This is very important as often

they cannot afford to be penalized. Sub-contractor guarantees should be demanded. Retention money often does not cover rectification.

1.3.1 Sub-contractors : planning

Bring in sub-contractors in advance for consultation and advice on required starting dates.

'Subbies' should be involved in both the initial plan and the daily or weekly plans. 'Subbies' tend to be cut out of planning. This especially applies to day to day decisions. Getting the 'subby' involved in planning will also help to get him committed to your programme.

A major portion of planning involves plumber and electrician subbies, and due consideration must be given to integrating their work into the construction process.

Sub-contractors should receive drawings and information as soon as they are received by the main contractor so that they can plan their own work.

Sub-contractors must be advised in good time and be made aware of any changes to programmes. This particularly applies to any starting date alterations.

1.3.2 Sub-contractors : control

Meet with sub-contractors at least weekly to review progress and any programme changes. This will help to resolve problems.

All sub-contractors' work should be co-ordinated at the same meeting, at least once per week. Much of their work is interdependent, e.g. ceilings and electrical.
Sub-contractors' queries should be recorded and handed to the site manager concerned

so that they can be assessed and if needs be, brought to the architect's attention.

Towards the end of a contract it is particularly important to co-ordinate the work of sub-contractors so that their work does not clash and that they have good access to their work places.

Sub-contractors must be treated firmly but fairly; given a programme and given advance notice when they are required on the job. Allow adequate time for ordering and delivery of material. Do not wait until the last minute.

In case of non-performance by a 'subby', he should be advised in writing with insistence on performance and possible reminder of potential penalties he may suffer. Non-performance by one sub-contractor can have a deleterious chain reaction effect on other dependent activities.

Sometimes one is the guilty party in the case of sub-contractor performance by not providing access. This is the result of poor planning.

2. LABOUR MANAGEMENT

2.1 The Importance of Labour

People are the most important resource in your company, and the source of production. It must be emphasized that people must be treated as such - the most important resource - and if you do, then you will get far better results than is normally the case.

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2.2 Improving Productivity

Have the right man to do the right job.

Do not fire him immediately if he does not perform, but try him on something else, and make sure that he understands what is required of him. It is a fact that if a worker is interested in his job he will be more productive.

A labourer's skills are often not utilized when he is transferred from one site to another. Supervisors and site agents should communicate with one another and check the labourer's work and skills record so that he can be employed most productively. This can be facilitated by stating on his transfer form the work he has been doing and what skills he has.

The 'wage system structure' may be at fault for labour not being fully productive. This may occur where labourers earning the same wage are doing different tasks with different skills requirements. A method of overcoming this would be to pay them a basic wage plus a premium for the different tasks. As a whole you can only improve as far as your weakest link will allow you to, and that is the quality of labour you are using.

Timeous completion of all site inspections and meetings will help work continuity.

2.3 Equipment Handling

A common occurrence on sites is for a labourer or labourers to carry single items of equipment. This is costly, and should if possible, be avoided. Instead, wheeled platforms should be used where possible to transport multiple items. These platforms should be able to be manhandled, or trailed behind a small tractor or dumper truck.

Where cranes are available, unit loads of equipment stored in suitable racks can be transported without being removed from the racks.

This also applies to small items such as wedges, thimbles, clamps, connectors, etc. which should be stored in bins which can be stacked vertically, and which can be economically stored on site and loaded into trucks.

2.4 Wasteful Labour Practices

The following are some examples of wasteful labour practices.

Site supervision has become accustomed to working with teams of certain sizes and they continue working with the same number of workers without review. This particularly applies to the number of artisans who are allocated assistants. These assistants are often not fully productive. It is important to review the ratio of labourers to artisans in terms of the labour content of the activity under consideration.

It is important to ensure that the artisan spends as much time as possible in exercising his skills, and that he does not get involved in work such as fetching of materials which can be done by labourers at less cost. The artisans must be taught and encouraged to use their labourers more productively.

Labour practices die hard. White truck drivers do not do any loading or any off-loading. The same practice now applies to black truck drivers and drivers of other transport equipment. They sit in their cabs when they could be productive loading or off-loading their vehicles. The team leader, as the highest paid members of a labour team should set the example by working.

Overtime should be avoided at all costs. Pre-plan tasks so that they will end at 4.30 p.m.

If overtime must be worked, then set a time target for the task to be completed. The overtime will then be more productive.

It is important to pre-plan all materials and equipment requirements before sending a team out to do the job. Labour wastage results from workers waiting for instructions or waiting for materials; and from lack of preparation of the workplace prior to their arrival

If workers are given incorrect drawings and sizes then there will be a wastage of manpower in doing the re-work.

Quality must not be sacrificed for speed. The cost of labour and material to rectify bad workmanship must be taken into account.

Quality can be overdone through unnecessary work.

Inaccurate quantity calculations can result in labour waiting for material, e.g. if sand and stone quantities run out during a concrete pour before completion then the labour will stand idle until the situation is resolved.

Pre-planning is essential to solve your labour utilization problems.

Wastage of labour results from lack of pre-planning and not measuring the work in advance.

YOU PLAN WHAT THE WORKER IS DOING NOW BUT YOU DON'T PLAN WHAT HE IS GOING TO DO NEXT.

2.5 Lost Time

Late starts and early finishes are the source of considerable time losses.

A warning bell should be sounded five minutes before starting time to encourage the prompt start of work.

Rigidly enforce start up times, e.g. after tea and lunch breaks.

Enforce a ruling that workers stay at their work place during tea breaks and return to the work place 5 minutes before the end of their lunch.

The extended morning tea break is in fact breakfast, when some workers cook their food because they leave home without having eaten. Therefore, consider a longer morning tea break and shorter (later) lunch break, e.g. 20 minutes each.

Time is often lost because an artisan stands while the labourer fetches and puts away his tools. This is aggravated on multistorey buildings. Consider paying the labourer for an extra 20 minutes per day overtime so that the artisan can work a full day. But the effectiveness of this practice must be supervised.

There should be a strict control on absenteeisms.

Random checks should be done on time-keeping as well as gang checks.

Management by Example

If you want workmen to report at 6.50 a.m. you should arrive at 6.40 a.m. - "do as I do, not as I tell you".

2.6 Site Labour Complements and Organization

It is important to have an organization chart which must be updated as the contract progresses.

Most sites employ unnecessary labour (just in case it is needed).

Site labour should be divided into teams, each with a leader, so that each labourer knows whom he has to report to. As far as possible established teams should be left together working for the same foreman. This simplifies the communications problem, but their size must be controlled relative to the activity on which they are engaged.

The size of the team must be flexible and suited to the labour content of the activity undertaken. Much labour is wasted when fixed team sizes are employed on site.

Too much labour on one activity causes inefficient work and idleness.

Do not assign too much labour to a confined area.

Mark hard hats - to keep track of workers : this ensures that they are not wasting time in areas where they should not be.

Give representatives from various groups of labourers the opportunity to state grievances. Give credit where credit is due. This will result in a more positive reaction. This is important at all levels.

Safe working conditions will ensure that a worker keeps his mind on the job and does not worry about his work place.

Interference with labour force by unauthorized people disrupts continuity of work.

Labour Targets and Norms

It is essential to set production targets for all activities. This is the most effective way to control labour productivity.

These will be based on the labour allowables which should be provided by the Q.S. The allowables should, however, be adjusted, relative to site conditions and practical aspects of labour performance for the activity under consideration.

Where production targets must be brought to the workers' notice, and a specific time must be set for every task. Labour must be made to understand exactly what is required of them and they should be constantly checked. If the contract is running late, then it is better to employ more resources to speed up the job, than to 'whip up' frenzied activity which could result in work having to be redone, i.e. haste makes waste.

An effective way to issue instructions is to use a *Job Card System*. The team leader's card is filled in with what he has to do for the day.

TIME AND METHOD STUDY is an effective means for setting labour norms and improving methods. It is important to maintain records of time taken on the different activities and constantly review the methods being used.

This also applies to the location of work being done, e.g. two mortar mixing stations may be more economical than a single central one. This could reduce the amount of handling involved.

2.8 Continuity of Employment

Lack of continuity of work leads to a loss of manpower, and this should be avoided if at all possible.

Skilled labourers are often not kept on when a job is finished. In the long run, if kept on, better productivity will result. New labourers are usually not familiar with the work areas, plant, etc.

A daily directive, based on advanced planning should be issued to all workers, especially unskilled labourers. This will help to ensure continuity of activities and avoid lost time.

2.9 Labour Communications

The language barrier should be crossed. We must improve communications between supervisors and labourers. It is recommended that supervisors attend language courses. Learning a worker's language will improve communications and help him to be more productive. The language course should concentrate on 'Construction' Zulu as the general Zulu course deals with a lot that is not really needed. This applies equally to the other ethnic languages.

The course should teach key phrases. These should be available in a booklet form.

The course should also include material on local customs and tribal differences.

2.10 Labour Relations

It is important to give workers recognition and avoid disrespectful treatment. Good relationships between the workforce and management can contribute to better manpower

utilization and a keener application amongst workers to their tasks.

The worker should be made part of the 'Team', and treated as a person, not a number. You should not hire and fire people without due cause. The company's policy is to dismiss workers on a "last in - first out" basis, and this often results in losing good new people and being left with some of the old hands who do not perform.

You must improve communications between sites regarding labour availability and labour transfers. The hiring and firing results in a 'don't care' attitude amongst workers regarding late starts and early finishes because they believe they won't be there for too long. Artisans are transferred between sites but this does not apply to general workers.

The labour office and labour officer should be used to facilitate labour transfers.

You do not use our labour offices sufficiently. This applies particularly to the situation where people have to be dismissed.

The labour office can provide sites with important guidance on warnings for non-performance, and dismissals.

The site agent should be allowed to pick and choose whom he wants to keep and not be strictly controlled by the concept of LIFO.

Adequate shelter and changing facilities must be provided on sites. This will afford them security for their possessions, and shelter in case of rain.

2.11 Motivation

Motivation is important and must go right down the line.

You must instill a sense of pride in your people.

Some foremen get better results because of the way they treat their people - they motivate them.

Incentives will help a contract get ahead of programme. Incentives can best be applied to teams of workers. A task should be set for them and if they finish the task ahead of the time allowed, then they should be paid a bonus. It is important in these circumstances (as in all cases) to check the quality of the work done.

Incentives should be considered for supervisors.

Teamwork is essential and incentive schemes for teams can stimulate this.

Visits from, and interest and involvement of top management in site operations affords workers encouragement and stimulation.

2.12 **Employee Education and Training**

There is a need for increased training and skills development.

It is appreciated that the industry at this stage is anti-training because of the costs involved. But unless your people are continually educated and their skill level improved you will not get better labour utilization.

Often lack of labour performance is due to management not providing the conditions in which people can optimize their efforts.

It is often argued that the present available labour is not of a good standard. This has

always been the case. and to improve output you need to improve your labour training and development.

The best of your labourers should be sent on courses such as bricklaying and carpentry.

2.13 Supervision

There are instances when site management personnel leave the site during the day on unofficial business. Labour slows down when there is no supervision.

Too many labourers per supervisor results in inefficiency and idleness.

The ratio of supervision to labour must be checked and improved if at all possible.

The ratio of supervisors to labourers is too low. There is a need for more supervisors; consideration should be given to the appointment of junior foremen.

An effective way to overcome the shortage is to develop black supervisors. They have the advantage of being able to communicate effectively by means of a common language.

Foremen must be consistent in their instructions, i.e. they must not change their minds too often as this will lead to a loss of credibility in the workforces' eyes.

Foremen must monitor and plan their labour so that they know exactly the type and number of workers they require, and their daily cost.

Supervisors must check on their labourers - is an individual idle? If so, direct him to the next job if he has completed the task, or else investigate the reason for his idleness.

It is important that supervision be dissatisfied with productivity otherwise low performance becomes the accepted norm, and is then very difficult to change. Some labourers don't really understand what they are doing. Supervisors need to explain better - there should be a better follow up by supervisors on the work which the labourer is doing.

Team leaders need more training. They should be better informed regarding daily activities.

Management/team leader relationships must be good.

The way to achieve quality production is through better supervision.

3. MATERIALS MANAGEMENT

3.1 Materials Planning and Control

Planning must be applied to all supplier's services. There should be a materials plan and follow up procedure.

Schedules of required materials should be drawn up together with the order and promised delivery dates. Delivery dates regarding materials and plant to be delivered to site should be followed up in good time to ensure the timeous arrival of the necessary equipment and material. This particularly applies to deliveries from the yard.

A schedule of orders and deliveries should be kept on site. This is essential, particularly for bulk orders.

There should be a procedure for expediting orders placed.

Plan for deliveries, and issue advance instructions where material is to be stored.

Advise storeman in advance of deliveries and storage locations.

The storeman should strike off in a requisition book when materials have been delivered.

All materials must be checked for quantity and quality.

Communications on site within the contractor's team must be effective. You must advise people who are responsible for ordering materials of the site's requirements in good time in order to avoid delays.

On big contracts the storeman should be given minimum and maximum stocks quantities. Materials quantities must be watched very carefully in order to ensure that there is minimal wastage of left over materials.

Train storemen in materials knowledge, security and storage methods.

Use pictures, e.g. of windows if necessary, to help him identify materials.

Keep the site tidy so that deliveries can be accommodated and materials are readily accessible.

All excess material must be sent back to the yard, and not dumped on site.

Refer to the section on "Materials Wastage" for more information on materials utilization and control.

3.2 Materials Wastage

3.2.1 Supervision

Effective supervision is all important to ensure materials control and reduction in wastage.

Site supervision must make people aware of the cost of wastage with regard to materials and also teach them ways and means to overcome this.

Site supervision must educate employees to use materials and tools correctly and effectively.

Much wastage is caused through carelessness.

A helpful education medium is to exhibit a display board showing materials and tools (pictures with their relative costs); this will help to make staff aware of the cost of the materials and tools they are using.

The setting of a good example must come from the top. Site supervision can set such an example by ensuring the collection of tools and materials which can be re-used.

3.2.2 Planning

Good site planning and organization result in less wastage of materials, and proper planning of off-loading on site is essential to avoid wastage.

Flow lines are important so that spillage of materials can be avoided.

Careful planning should precede the ordering of materials. Pre-plan and issue the

correct amount of materials needed.

There should be co-ordination on site regarding materials utilization, e.g. all foremen on site should be advised of the expected deliveries of materials on a day to day basis. Materials should be allocated to respective teams and they should be responsible for them. They should be made to pay for lost tools.

3.2.3 Causes of wastage

The following situations should be avoided.

Over issue of material which then is left at the work place or stolen.

Lack of communication between trades.

Bad quality material delivered and not checked.

Rush orders resulting in higher prices and not being able to 'shop around' for deals.

Over-ordering at the latter stages of a Contract.

Double ordering : incorrect ordering; ordering material which obviously is not suitable, even though it is specified.

The attitude of site supervision is a major cause of material wastage. For example, ordering from the bills of quantity.

3.3 How to Reduce Wastage

Avoid having unqualified people ordering materials. They tend to over order and this results in wastage.

A proper standardized filing system is required to avoid double ordering.

In case staff is changed, the site must be able to continue the system of control.

The storemen must be aware of material on order, when to expect it, and where to have it placed. Maintain a re-order register.

Do not rely on suppliers to take off quantities from drawings or schedules. Do it yourself.

Plan and pre-measure the work and give suppliers specific orders regarding quantity and descriptions. Check before ordering - if in doubt, then query.

Right quantities should be ordered at the right time for the different sections of the site.

Check deliveries; if bad quality, then contact supplier immediately.

Promptly return all goods which are not to specification or may have been over ordered.

Bulk ordering of general requirement for all sites should be practiced. These materials can be kept in a central store and drawn from there as and when required.

Bulk buying will permit the negotiation of better prices.

Items ordered should be cut down to actual needs and not ordered by the box full.

Sufficient time should be allowed for delays between requisitioning, ordering and date required on site. This will permit selective buying.

3.3.1 Bricks

Frequent breakages occur due to multiple handling, and often due to lack of supervision awareness.

The following action will help to reduce brick wastage.

- Palletise - keeps bricks clean
- Site Planning - will help to shorten flowlines
- Site Quantities - premeasure and deliver only what is required at work place
- Use half bricks (face) as headers
- Use chipped face bricks as commons.

3.3.1.1 **Brick cutting**

Wastage occurs when a bricklayer uses his trowel to cut bricks down to size. This particularly applies to hollow face bricks. Consideration must be given to the use of brick cutting machines and the supply of cut bricks to the bricklayers at their work stations. This can save materials, speed up production and ensure better quality work.

Misusing face bricks where common bricks are specified is a waste.

3.3.2 **Cement**

Cement packets not always completely emptied before being thrown away.

Waste incidence	**How to reduce waste**
Losses from silos due to wind and spillage	Protect with plastic screens and provide a solid base

Pockets go hard	Cement should be stored off the ground in order to avoid wastage of the bottom layers of bags.
Half used pockets	Control the issue of bags and the return of empties to ensure that the right quantities are used.
Over ordering	Pre-measure and order according to anticipated usage.
Incorrect concrete mixes	Supervision must check scales and bucket sizes. Sell empty cement pockets.

3.3.3 Concrete

Concrete wastage can result from over excavation.

It is necessary to pre-measure concrete requirements before ordering. Concrete has to be ordered to the nearest half cubic metre.

Concrete wastage often occurs during a late pour or after dark. In these circumstances the driver may dump any excess concrete to waste.
Excess concrete should wherever possible be used in footings and blinding.

Concrete mixes must be monitored. For example, a cube test of 45 MPa when the required strength is 30 MPa means that extra cement has been used and is wasted and will not be paid for by the client.

Foremen should check levels of slabs and surfaces before pouring, so that extra concrete is not poured and wasted.

Check Ready Mix truck before off-loading and also before it leaves site to ensure that it has been completely emptied.

Other examples of material wastage include using brickwork to support mesh and leaving the bricks in the concrete; screeds that are too high; concrete walls that are too thick. The latter can result from not working to specified dimensions.

3.3.4 Hired Equipment

Return equipment to the yard as soon as it is no longer required on site. Where equipment has been damaged advise yard immediately to write this equipment off so as to avoid further hire charges.

Check on availability of equipment in our own yard and on other sites before hiring from outside companies.

When returning equipment on transfer notes, ensure that a signature is received from the driver who accepts the goods for delivery to the yard.

HOSE DOWN SHUTTERING AND SUPPORT EQUIPMENT IMMEDIATELY AFTER POUR TO AVOID RESULTANT DAMAGE FROM CONCRETE ENCRUSTATION.

Wastage of materials can result from using excess support materials (braces and belt).

Formwork should be re-used as soon as possible after it has been stripped.

Stripping of shuttering and deck plates should be handled with more care and the correct items should be used for each job.

3.3.5 Mortar

Mortar mixing should be controlled. The man doing the mortar mixing should be trained to assess the number of gauges that are required for the day.

Mixes must be checked regularly, in accordance with the specification.

Mortar droppings should be picked up where possible and re-used.

Mortar should be mixed in a mixer and not by hand so that quantities can be properly controlled.

Mortar should be mixed on a suitable board.

Mortar mixed on sand results in wastage and also makes for a poor mix.

Calculate the quantity of mortar still required by bricklayers at say 2 p.m. Let bricklayers work until their mortar is finished.

Slump the sand.

3.3.6 Plaster

Use plastic sheeting under plasterers' work and pick up dropped plaster for rework. Charge 'labour only' sub-contractors for wastage.

3.3.7 Reinforcing

Avoid double ordering.

Check orders - have a good filing system

Sell excess steel as scrap.

3.3.8 Sand

Attempt to get the load dumped where it is to be used;

Do not dump too close to excavations;

Premeasure the quantities required;

Avoid over ordering;

Always check quantities delivered, especially sand and stone, to guard against short delivery;

Store on concrete blinding base with surrounding lip to contain spreading;

Use bulkheads, if needs be;

Improve supervision;

Improve site planning;

3.3.9 Sub-contractors

Sub-contractors must be made aware of the cost of materials they are wasting.

Sub-contractors must be responsible for their wastage of materials; especially 'labour only' sub-contractors. Sub-contractors should be charged with any cleaning that is required resulting from their work.

A record of material used by 'labour only' sub-contractors must be kept.

There should be control of mortar mixing by sub-contractors.

Work having to be re-done requires extra material : do the job right the first time.
Sub-contractors' work must also be supervised, and not just your own;
Charge sub-contractors (labour only) for materials used in re-work.

The supply of materials to 'labour only' sub-contractors should be stricter.

3.3.10 Timber

Because timber has to be bought in 300mm modules, architects / engineers should be made aware of this so that in their design, material can be saved and off-cuts can be used. Standardize as far as is possible.

Order to cut lengths where practical, rather than ordering random lengths which can result in wastage and off-cuts.
Well planned and thought out cutting lists will help to reduce waste.
Design form work for the carpenters.
Simplify instructions as far as is possible.
Check that waste allowance is not added on to orders more than once.
Check deliveries for quality and size.
Stack off-cuts and stripped formwork for re-use.
Use timber off-cuts for making wedges and hangers.
De-nail timbers.
Transfer unused timber to other sites.
Expensive shuttering materials such as shutter board is often cut up with little concern for materials utilization, with the result that a great deal of scrap is left over.
Fires lit by staff who live on site are often fuelled with useful materials.

3.4 Materials Salvage

Consultants may cancel windows, doors and other specified items. If the owner does not require this material then it should be returned to the yard.

Any over ordered goods which the supplier may refuse to have returned should be delivered to the yard.

The yard should advise the buyer of all these new materials which are available so that when he gets a request for this type of material he can refer the site to the yard and save the cost of re-purchasing these materials.

Materials, where possible, should be re-used. Careful thought and planning will help to achieve this.

Housekeeping and Storage

Provide drums in all working areas so that workers can store small size materials such as spacer blocks, fittings, clamps and wedges.

Management must insist on workers picking up any loose materials and placing these into the storage drums. The material can be resorted at a later stage for re-use. This will save both materials and wasted space.

Use three sided storage bins for sand and stone.
Ensure the creation of a site layout plan indicating materials storage spaces.

It is essential to keep the site and particularly the work place clean and tidy. This makes for productivity and safety.

Materials should be neatly stacked after having been used so that there is ready access to them for later use.

All fittings should be cleaned before stacking and small fittings should be stored in suitable containers.

The storeman must be strict in the issuing of materials.

Deliveries should be checked for quantities, especially sand and stone.

Goods may be lost before delivery (between leaving supplier and arriving at site).

When materials such as sand and stone are delivered, the carrier certificate should be checked against the quantities and delivery note, and a physical measure should be made.

Deliveries should not be accepted after 4 p.m.

All storage facilities should be secure.

The site agent must ensure that there is proper control of staff and goods received on site. This applies to site storemen and security guards.

Security personnel should be properly trained and supervised.

A schedule of expected deliveries of materials should be given to the site clerk or storeman so that they know what should be delivered and when.

A rubber stamp should be used on each site to mark transfer notes.

Goods ordered incorrectly are often damaged before being returned for credit.

Spot check deliveries - ensure that trucks have not got false bottoms.

Check ready mixed concrete deliveries, i.e. reconcile what has been poured with the supplier's invoice. Check amount in silos.

3.5 General

Make employees aware of costs.

Set up a display of samples of materials with their relative prices in order to create a sense of awareness regarding costs.

Wastage can result from lack of motivation. We must give our people a sense of belonging and bring them into the planning process.

Develop a sense of pride in the job and ensure that we have a goal to work to.

Initial incorrect instructions can result in the wastage of materials through using the wrong materials.

Re-work is an area which can involve a considerable loss of materials.

Avoid delays in the supply of materials, to ensure production continuity.

Ensure that suitable plant and equipment is used to move materials. This will also avoid breakage and wastage.

If a site is properly organized people will respect the material that they are using.

Safety can be endangered if incorrect materials are used.

Wastage occurs through bad handling of materials. This results in damage to shutters, loss of fittings and wastage of sand, stone and cement.

4. PLANT AND EQUIPMENT MANAGEMENT

4.1 Planning and Procural

Contracts managers should discuss with the foreman what equipment will be required on the particular job. Failing to do this will result in a waste of time when the job is started.

The planning and procural of major plant must be done timeously in order to avoid hold ups.

Carefully plan equipment and plant requirements and schedule their arrival on site to avoid paying unnecessary hire rates.

Do not incur costs for plant that you are not using.
Plan your machinery requirements. Get the maximum use from your plant and then get it off site.

Excess equipment such as two compactors instead of one on a non-critical activity can incur unnecessary cost. In case of critical activities ensure that there is stand-by plant. This will also apply in the case of faulty equipment.

If this is not feasible then ensure that you have a contingency plan for the employment of labour in case of plant breakdown or inclement weather. Non-critical activities should

[illegible] plant.

[illegible] suppliers as well as the yard.

[illegible] systems and methods, and use standard equipment wherever [illegible] standardization of equipment, will help reduce learning curves, and will [illegible] replacement parts to be transferred from one contract to another.

[illegible] must be effectively used. Equipment that has been bought for a [illegible] project should not be 'hoarded' but released to other jobs that require it. This [illegible] company money.

[illegible]

[illegible] your equipment and report any major defects to your manager.

[illegible] of plant needs to be planned and good communications must be maintained [illegible] maintenance team and the contract team.

[illegible] of plant is important because breakdowns waste both the yard's time and [illegible] time.

It is important that she personnel be able to identify faults on machines. This will avoid the yard having to make additional trips to a site.

A plant manual must be available listing part numbers of the various machines. It must also provide operating and maintenance instructions.

Plant breakdowns should be investigated, especially if they recur regularly. This is

be held back for this purpose.

Insist on prompt service from suppliers as well as the yard.

Standardize formwork systems and methods, and use standard equipment wherever possible. The standardization of equipment, will help reduce learning curves, and will enable accessories/replacement parts to be transferred from one contract to another.

Plant and equipment must be effectively used. Equipment that has been bought for a particular project should not be 'hoarded' but released to other jobs that require it. This will save the company money.

4.2 Maintenance

Look after your equipment and report any major defects to your manager.

Maintenance of plant needs to be planned and good communications must be maintained between the maintenance team and the contract team.

Maintenance of plant is important because breakdowns waste both the yard's time and site's time.

It is important that site personnel be able to identify faults on machines. This will avoid the yard having to make additional trips to a site.

A plant manual must be available listing part numbers of the various machines. It must also provide operating and maintenance instructions.

Plant breakdowns should be investigated, especially if they recur regularly. This is

essential to avoid lost and unproductive time.

It is important to ensure that the correct tools, in good condition, are provided for the man on the job and that he knows how to use them correctly. It is the responsibility of site management to constantly check equipment and ensure that it is maintained in good condition. This applies to the cleanliness of equipment as well as to it's maintenance.

Repair any damage to formwork as soon as possible, e.g. coffers.

Wheelbarrows with faulty wheels are a major cause of loss of manpower productivity.

Faulty power tools, cables, etc. and equipment especially on high rise buildings, can be dangerous and lead to lost time.

4.3 Equipment Cleaning

Establish responsibility for the cleaning and maintenance of site equipment.

The timeous cleaning of equipment can safeguard the quality of the equipment, and save a great deal of money.

For example, shuttering should be hosed down immediately after every pour. This will eliminate concrete encrustation on shutters, clamps and equipment; make stripping easier and quicker, and eliminate the necessity for chipping concrete off shutters before re-erection, and avoid the resultant damage from this cleaning operation.

Wheelbarrows, shovels and all mortar mixing and carrying equipment should be cleaned before any residue is allowed to set.

5. HOUSEKEEPING AND QUALITY

5.1 Housekeeping

You cannot do too much with regard to good housekeeping. Overall good housekeeping will save materials and facilitate labour productivity as well as improve safety.

It is essential to have clean working areas before workers can commence their work; and workers should be encouraged to continue maintaining a clean working area and to clean up when they have finished a job.

Productivity can be improved by ensuring that equipment such as scaffolding and decking is stacked away immediately after usage so that it is not in anybody's way, and can easily be retrieved.

Constantly clean up the site. If a back-log accumulates then more manpower will be required to clean the job.

5.2 Quality

Quality is free!. Quality comes with caring; Caring for your materials, your people, your clients, and the community you serve.

Quality is also important in maintaining a good relationship with the architect. The better the supervision, the better the quality will be.

Acceptable quality of work is often dependent on the acceptable quality of (specified) material. This particularly applies to the type and colour of bricks.

Use materials effectively. Formwork, design and construction should be such so as to avoid having to do additional work in repair and rubbing down of concrete.

5.3 Work Standards

Early agreement should be reached with the consultant regarding the acceptable quality of work. Samples of work such as plastering, brickwork and shuttering should be submitted for approval and once accepted should then act as a standard. Supervision can then instruct and guide the workers to ensure that these standards are maintained throughout the contract.

Quality standards must realistic.

When submitting a sample for the Architect don't produce your best work, i.e. don't spend three hours on a small panel wall which cannot be re-produced as the job goes on. Your work must be in accordance with what can be reproduced regularly.

When attempting to ensure acceptable work quality, the person doing the work must be shown exactly what to do and regular checks on his work must be made.

Maintain you own quality control as the job progresses - do not wait for bad workmanship or mistakes to be pointed out to you by the professional team.

Completed work should be locked up.

Some sites have personnel sleeping in completed areas overnight, and this can result in damage to completed work.

Once an area has to be patched or repaired it is generally not as good as if it had been done properly in the first place or been protected from damage.

Avoid situations where work will obviously have to be re-done, i.e. do it right the first time.

Avoid the pressure of being behind programme. This may affect your quality.

Have a correctly qualified supervisor to oversee work with which he is familiar.

Use work record labels showing the completion of sequential activities. The signature of the approving authority should be placed against every activity as it is completed and accepted. These activities for example could be :

- shutter work complete;
- steel placed, inspected;
- concrete poured.

The label should be kept for control and quality control purposes.

6 CLIENT AND CONSULTANT RELATIONSHIPS

Seeds of unhappiness in a relationship with the owners can be sown soon after becoming the successful tenderer, when top management agree to unrealistically short programmes.

Attempt to build up a good relationship with the professional team and the Clerk of Works from the beginning of the contract, and obtain their confidence.

Be professional at all times - act like 'Contractors' not 'Jobbers".

Establish your credibility from the outset and thus gain the respect and trust of the professional team. Problems which might arise later in the contract will then be much easier to resolve if there is mutual respect between all concerned, and the desire to deliver a good building.

If more than one team of Architects is on a contract it is vital to establish who has the 'final authority'. THERE MUST BE AN ULTIMATE DECISION MAKER. Great diplomacy is needed at all times, but your company's interests must also be safeguarded.

Contracting is very much a give and take situation, but never give unnecessarily to the detriment of the company.

A record book of verbal instructions should always be kept on site and definite answers to queries obtained from the professional team. This will reduce hold ups to contract progress.

It is important that common sense and good team work prevail. The end result will then be a good building and a satisfied client.

Poor relationships can often be attributed to a lack of professional approach in dealings with the architect / client team. The contracting team should be honest with the architect / client at all times. Mistakes should be brought to his attention so that he can give a ruling.

Provide the client's representative with the best available facilities. Give him a good table to work on; clean his office; consult him often and make him feel part of the team.

Work at having a good relationship with the client's representative and obtain his confidence so that there is no need to change either representative or contract management.

See the other person's point of view. Help the architect by preparing long lead schedules of what is required in the way of decisions and when they are required.

Inform the client of non-availability of specialized materials in good time so as to agree on and obtain substitutes. Some Government jobs may have been pre-planned five or ten years previously. The original material specified may no longer be available. Check this out with the architect and after agreement submit new samples in good time to ensure that the substitute material is acceptable.

Try and assist the professional team with any problems they may be having; for example, the positioning of existing services, manholes, etc.

6.1 **Client Relationships**

Consult with the client regarding changes to suit your equipment and method of working. This can save you a lot of money.
Keep the architect informed and consult him on problem areas. This is essential to avoid doing work which is later found to be incorrect.

Do not accuse the professional team of hold ups without giving them sufficient notice regarding required information.

Do not execute wrong detail when it would appear to be so. First check with the architect.

In case of a query to a consultant ensure that you get answers to all the details in order to avoid repetition of the query.

When submitting programmes to the architect, they must be such that the early part of the contract is spread out and the latter part is perhaps compressed. This will help you to get ahead of programme and establish completion credibility. You must be aware of where you are going on the contract. This will avoid crises and again improve your relationship with the client team.

6.2 Personal Relationships

Try and understand the client's representatives in order to avoid personality clashes.

Try to get to know the client on a personal basis away from the work environment. Involve them in our social functions.

Do not ignore him, include him in day to day activities.

Occasional social get-togethers with the sub-contractors and the professional team could in some instances help create a more informal atmosphere in which quite a few problems could be resolved amicably.

It is important not to be indebted to the professional team. There should be a striving for contractors to be treated as equal professionals. You have to improve your image as a professional. You only have ourselves to blame for your image, if it is wanting.

It is important to maintain some contact with the professional team after the contract has been completed. This will improve relationships with the various professions and maintain contact for future jobs.

6.3 Inspections and Consultations

Give consultants adequate notice of required inspection or consultation.

Punctuality can help improve relationships with the client. Lack of punctuality will cause unhappiness and may result in future problems when the architect is urgently needed on site.

An early understanding should be reached with the clerk of works on the matter of punctuality of inspection of work. This will avoid hold ups. For example, inspecting the roof timeously so as to avoid any hold up in putting on the tiles.

Advise the clerk of works in good time, of work to be done and the methods to be used and get his agreement on the work by consultation. This can eliminate a lot of problems and unhappiness.

Use an 'inspection sheet' which sets out the work which has been done. This sheet should be submitted two days in advance to the clerk of works who is due to inspect the work concerned. After inspection, a signature should be obtained on this inspection sheet confirming that the work is acceptable. This procedure simplifies inspection and can avoid future queries.

Problem areas should be sorted out well in advance to avoid the representative making hasty decisions which may embarrass him at a later stage.

A schedule of required information should be brought to the architect's attention as soon as possible when a job has started. This avoids frustrating the architect with urgent requests for information.

A time limit should be recorded with regard to when decisions are required by the contractor.

When more than one person is involved in making a decision then a decision maker must be appointed at the start of the contract and his name formally recorded. This should be written into the contract.

A formal query book must be used by all sites.

Query sheets are useful for bringing queries to the architect's attention at site meetings. It also serves as a formal written record. When dealing with queries the contractor must avoid confusing the architect with irrelevant queries. Queries must relate to work in the near future. It must be appreciated that the architect cannot supply information for the whole job all at once.

Do not accept verbal instructions on planned changes. It is essential to have written instructions signed by both the architect and the site agent.

6.4 Correspondence

Correspondence should be kept to a minimum, but not to the detriment of the company. It should be clear and concise. Loyalty to the company is essential at all times. It is appreciated that professional teams are sometimes difficult to pin down for answers, thus the abovementioned verbal instruction book and a great deal of tact and patience is necessary.

If the architect does not perform then he must be advised in writing. This will cover the contractor in the case of a dispute.

Variation orders should be priced as early as possible and given to the P.Q.S. so that the client can assess his budget. This avoids omissions being submitted at a later stage of the job.

Certificates should be accurately measured every month and not 'thumbsucked'. The added advantage of this is that our costing system will be more accurate.

Extras should be brought to the P.Q.S.'s attention immediately they become apparent.

6.5 General

Rainy weather causes delays, so it is essential that foundations be poured as soon as possible.

It is wise to divert from the established programme during good weather in order to complete as much of the outside work as soon as possible so that inclement weather will not affect the work programme.

A feedback system should be set up between the site and estimating department. The Estimator should be made aware of how his allowables are bearing up on a particular contract that he has priced.

Constantly review site operations. Think of alternatives; how the job can be done more efficiently and economically.

At the finishing and snagging stage it is essential to have a well qualified 'finishing' foreman, i.e. one who can communicate well with the clerk of works as well as being a good 'finishing' man. It is essential that when snagging is done that this is

accomplished in as pleasant a manner as possible. Appoint the right man for the right job!

Attempt at all times to finish the contract before the completion date but never at the risk of delivering an unsatisfactory product. At all times strive to give the client what he is paying for.

You need a businesslike attitude with regard to time, quality and money.

DO TODAY WHAT YOU CAN DO TODAY, BECAUSE IT MIGHT RAIN TOMORROW!

APPENDIX D

GAIN-SHARING PRODUCTIVITY PLAN CONTRACT

This document was completed in duplicate and signed by the participant and a company representative in the presence of two witnesses.

The plan applied to supervisory personnel, and was administered by the company's financial manager.

_____

("THE COMPANY")

GAIN-SHARING PRODUCTIVITY PLAN

CONTRACT :_____ COMMENCEMENT DATE:_____

PARTICIPANT:_____

1. PURPOSE

The purpose of the plan is to encourage participants to improve utilization of resources i.e. people, plant and money as represented by permanent and consumable materials. This can best be achieved by reducing wastage through better planning and a proprietary interest in the use of these resources.

Improvement in resource utilization will lead to the provision of the best service to the Company's clients i.e. the owners/developers of the construction projects undertaken; to better production; increased company income; reduced working cost; and also to IMPROVED EARNINGS FOR EMPLOYEES.

2. BASIC EARNINGS

The basic earnings of participants in the programme are guaranteed.

The Gain-Sharing Plan offers employees an ADDITIONAL, positive opportunity to increase earnings pro-rata to profit improvement.

3. BONUS EARNINGS

3.1 Bonus earnings will depend upon improvements in gain over and above a profit budget cost for the contract.

3.2 Should the budget be exceeded then participants will receive an agreed share of the gain.

3.3 The monthly profit and loss shall be calculated in accordance with the company's monthly cumulative profit and loss format, subject to verification and determination by the Managing Director in his final discretion, which he shall properly exercise.

4. PROFIT GAIN

In order to achieve a gain, it will be necessary to :

4.1 Be ahead of the production programme.

4.2 Reduce the labour cost below the tender allowable.

4.3 Reduce wastage of materials and services and ensure the best possible utilization of plant.

Improvements in the above areas of operation will best be achieved through :

4.4 *Better thinking* about the work to be done, the methods to be used, and particularly the development of ways and means to improve and reduce the labour content in materials handling.

4.5 *Better planning* to help ensure that working time is not wasted in awaiting instructions, plant or materials. It will also help to keep sub-contractors on target.

4.6 *Reduction of wastage* be it of materials, plant or labour.

5. BONUS PAY PERIOD

5.1 Monthly operating targets will be set for income and all the costs associated with the contract and bonus results will be computed monthly.

5.2 Payouts will be made one month after the end of each measuring period, on the consolidated results for these periods.

5.3 The measuring periods will be :

Performance Reference Period	Pay-out Date
1. Nov, Dec/Jan, Feb, March	1st week May
2. Apr, May, June	1st week August
3. Jul, Aug, Sept, Oct	1st week December

In each calendar year.

6. RESERVE ACCOUNT

6.1 One third of the bonus earned in every measuring period will go into a reserve account and the balance will be paid to the participant.

6.2 Any losses during a subsequent pay period will be deducted from the reserve account.

6.3 Any balance in the reserve account will be paid out after finalization of the contract, i.e. on completion of the final account.

6.4 Any profit which is in excess of double the budgeted profit in any performance period, will be transferred to the reserve account.

6.5 Should the participant resign or be dismissed from the company's service before the completion of the contract then he will forfeit his right to the reserve account.

7. TURNOVER DISCIPLINE

During the early stages of a contract it is possible to be behind programme and still show a profit.

In order to discourage this situation, participants will be penalized by the loss of 5% of their bonus for every 1% they are down on their turnover target.

Example : (In Rands)

TARGET T/O	ACTUAL T/O	% T/O OF TARGET	POTENTIAL BONUS	BONUS DEDUCTION	NET BONUS
300 000	300 000	100%	900	Nil	900
300 000	297 000	99%	900	5%	855
300 000	285 000	95%	900	25%	675
300 000	270 000	90%	900	50%	450
300 000	240 000	80%	900	100%	Nil

8. BONUS CALCULATION : EXAMPLE

Bonus earned will depend upon the extent of the gain.

The gain will be computed as a percentage of the total amount of the payroll of the participants in the plan. Thus the bonus earned by individual participants will be this percentage of his basic pay for the period under consideration, during which he was active on the contract, multiplied by his bonus participation factor.

Example:

Individual's basic monthly pay (say)	=	R 1 500,00
Percentage bonus		
earned at monthly salary	=	25%
Participation Factor	=	1.0
Total earned over three months	=	3 x 1500 x 0.25 x 1.0
	=	R 1 125,00
Average monthly amount	=	1 125 / 3 = 375,00
Gain-share	=	R 750,00

Your participation factor is [ ]

10. **REJECTION BY CLIENT OF COMPLETED WORK**

If work should be rejected by a client after it has received the participant's approval (i.e. has been held out by the participant to be properly and contractually correct and complete), and bonus has been paid to hourly workers for such work, then the total bonus paid to the hourly workers will be subtracted from the participant's gain-share (bonus).

11. The plan is introduced as a Company privilege.

11.1 The company reserves the right by written notice to amend or terminate the Plan at its discretion, but not sooner than the end of the measuring period during which notice is given.

12. I have received a copy of the foregoing Gain-Sharing Productivity plan and agree to the terms thereof.

Example:

Individual's basic monthly pay (say)	=	R 1 500,00
Percentage bonus		
earned of monthly salary	=	25%
Participation Factor	=	1.0
Bonus earned for three months	=	3 x 1500 x 0.25 x 1.0
	=	R 1 125,00
Less reserve account	=	1 125 / 3 = 375,00
Cash pay out	=	R 750,00

9. Your participation factor is [ ]

10. **REJECTION BY CLIENT OF COMPLETED WORK**

If work should be rejected by a client after it has received the participant's approval (i.e. has been held out by the participant to be properly and contractually correct and complete), and bonus has been paid to hourly workers for such work, then the total bonus paid to the hourly workers will be subtracted from the participant's gain-share (bonus).

11. The plan is introduced as a Company privilege.

11.1 The company reserves the right by written notice to amend or terminate the Plan at its discretion, but not sooner than the end of the measuring period during which notice is given.

12. I have received a copy of the foregoing Gain-Sharing Productivity plan and agree to the terms thereof.

WITNESS;

1. _____ _____

SIGNED BY PARTICIPANT

2. _____ _____

DATE

Approved and agreed on behalf of the Company by : _____

Duly authorized

APPENDIX E

HOURLY PAID BONUS ADMINISTRATION PROCEDURE

HOURLY PAID BONUS ADMINISTRATION PROCEDURE	No 003
	DATE 24 August 1986
	PAGE 1 of 3

Action	Op No	OPERATION DETAIL	DOCUMENT
		WEEKLY	
Site Agent/ Foreman	1.	Completes labour planning sheet. Records against work detail the team ref. no. to whom the work has been allocated.	Labour planning sheet
		WORK RECORD SHEET	
	2.	**NOTE:** A separate work record sheet must be kept for each team. This sheet is to be completed in duplicate	Work record sheet
Foreman	3.	Complete the following information at the top of the sheet. Contract name; date issued; activity; location; team leader; ref. no.; team complement.	
	4.	Record in work record control book (separate page per team) date issued; work record sheet ref. no.	Work record control book
	5.	Starting at 1 (top of page), transcribe from labour planning sheet: work description; allowed hours; allowed team size.	
	6.	Complete applicable quality assurance sheet	Quality Assurance sheet
	7.	Remove yellow and white work record sheets from pad and place on team leader's clipboard together with quality assurance sheet	
Team Leader	8.	Reports for job; checks work record sheet on clipboard.	
	9.	Reports to foreman with work record sheet on clipboard.	
Foreman	10.	Explains work details; endorses on work record sheet date and time work started and gives any necessary additional verbal instructions. If needs be, writes instructions in production diary.	Production Diary
Foreman / Team Leader	11.	As job progresses, complete the appropriate operations listed on Q.A. sheet and sign.	Quality Assurance Sheet

HOURLY PAID BONUS ADMINISTRATION PROCEDURE	No 003
	DATE 24 August 1986
	PAGE 2 of 3

Action	Op No	OPERATION DETAIL	DOCUMENT
Team Leader	12.	On completion of work, team leader present clipboard to foreman.	
Foreman	13.	Check work. If satisfactorily completed, sign work record sheet; date and time finished; sign checked by.	Work Record Sheet
	14.	Check and sign quality assurance sheet.	Q.A. sheet
	15.	Allocates next job to Team Leader.	
	16.	Team Leader returns clipboard to site office.	
Site Clerk		**DAILY**	
	17.	Check all clipboards for completed work.	
	18.	Refer to production diary daily sheets for team size at work during course of job.	
	19.	Record name and clock number of all team members on Bonus payment schedule.	Bonus payment schedule
	20.	If team size larger or smaller than allocated, then write in team actual as compared with team allowed.	Job strip work record sheet
	21.	If difference between team allowed and team actual, then calculate adjusted allowed hours.	
	22.	Calculate total hours worked.	
	23.	Subtract total hours worked from allowed hours (adjusted allowed hours) = Bonus hrs.	
	24.	Record bonus hours on bonus payment schedule.	Bonus Payment schedule
	25.	Write in the different number of team members per bonus category and their respective bonus rates.	Work record sheet

HOURLY PAID BONUS ADMINISTRATION PROCEDURE	No 002
	DATE 24 August 1986
	PAGE 3 of 3

Action	Op No	OPERATION DETAIL	DOCUMENT
	26.	Calculate the total team bonus earned.	
	27.	Record in work record control book, work record ref no.; date work completed; total team bonus earned	Work Record Control Book
	28.	Endorse on Bonus payment schedule: work record sheet ref no.; amount of bonus earned by each team member; total bonus earned by team.	Bonus payment schedule
		WEEK END	
	29.	Submit work record sheet, work record control book, and bonus payment schedule to site agent / contracts manager for approval.	Work Record sheet; Control book Bonus payment schedule
Site Agent / Contracts Manager	30.	Check bonus values earned; (approve) sign Control book and bonus payment schedule.	
	31.	Submit bonus payment schedule to time office with time cards for payment.	Bonus payment schedule Time cards
	32.	When work record sheet is complete i.e. all seven work instruction sections used, file white copy by team leader in control book in ref number order; yellow copy to team leader.	Work record sheet

WORK RECORD SHEET

AE-3

CONTRACT:..... Date Issued:.....

ACTIVITY:..... Location:.....

TEAM LEADER:.....

TEAM NO. [ ]

TEAM COMPLEMENT

Artisan	Skill	U/Skill	Total

1

WORK DESCRIPTION

ALLOWED HOURS	START DATE	TIME	ACTUAL HOURS	TEAM ALLOWED		ADJUSTED ALL. HRS	BONUS HOURS
	FINISH DATE	TIME		TEAM ACTUAL			

Work Checked by

Bonus Calc. by | Date

@ R

@ R

@ R

Total Team Bonus

2

WORK DETAIL

ALLOWED HOURS	START DATE	TIME	ACTUAL HOURS	TEAM ALLOWED		ADJUSTED ALL. HRS	BONUS HOURS
	FINISH DATE	TIME		TEAM ACTUAL			

Work Checked by

Bonus Calc. by | Date

@ R

@ R

@ R

Total Team Bonus

3

WORK DETAIL

ALLOWED HOURS	START DATE	TIME	ACTUAL HOURS	TEAM ALLOWED		ADJUSTED ALL. HRS	BONUS HOURS
	FINISH DATE	TIME		TEAM ACTUAL			

Work Checked by

Bonus Calc. by | Date

@ R

@ R

@ R

Total Team Bonus

4

WORK DETAIL

ALLOWED HOURS	START DATE	TIME	ACTUAL HOURS	TEAM ALLOWED		ADJUSTED ALL. HRS	BONUS HOURS
	FINISH DATE	TIME		TEAM ACTUAL			

Work Checked by

Bonus Calc. by | Date

@ R

@ R

@ R

Total Team Bonus

5

WORK DETAIL

ALLOWED HOURS	START DATE	TIME	ACTUAL HOURS	TEAM ALLOWED		ADJUSTED ALL. HRS	BONUS HOURS
	FINISH DATE	TIME		TEAM ACTUAL			

Work Checked by

Bonus Calc. by | Date

@ R

@ R

@ R

Total Team Bonus

6

WORK DETAIL

ALLOWED HOURS	START DATE	TIME	ACTUAL HOURS	TEAM ALLOWED		ADJUSTED ALL. HRS	BONUS HOURS
	FINISH DATE	TIME		TEAM ACTUAL			

Work Checked by

Bonus Calc. by | Date

@ R

@ R

@ R

Total Team Bonus

7

WORK DETAIL

ALLOWED HOURS	START DATE	TIME	ACTUAL HOURS	TEAM ALLOWED		ADJUSTED ALL. HRS	BONUS HOURS
	FINISH DATE	TIME		TEAM ACTUAL			

Work Checked by

Bonus Calc. by | Date

@ R

@ R

@ R

Total Team Bonus

WORK RECORD CONTROL BOOK

TEAM: _____

REF. NO.	DATE ISSUED	BONUS PAYMENTS			
		WORK REFERENCE	DATE COMPLETED	TEAM BONUS PAID	APPROVED BY

BONUS PAYMENT SCHEDULE

WEEK ENDED _____

CON RACT:

CLOCK NO.	NAME	REF.	BONUS	REF.	BONUS	REF.	BONUS	TOTAL BONUS

APPENDIX F

QUALITY ASSURANCE CHECK LISTS

CONCRETE QUALITY ASSURANCE

CONTRACT:	SECTION:
JOB DESCRIPTION	DRWG.REF. / RESPONSIBILITY:

OPERATION	BY	DATE	REMARKS
☐ CLASS REQUIRED. ☐ MPA:_____ ☐ MAX. STONE SIZE:____mm			
☐ CEMENT TYPE: ☐ O.P.C.(ORDINARY PORTLAND CEMENT.) ☐ S.R.C.(SULPHUR RESISTANT.) ☐ SLAGMENT. ☐ R.H.C.(RAPID HARDENING CONCRETE.)			
☐ VISUAL SLUMP TEST CHECK AND FULLY MIXED.			
☐ BATCH HAS BEEN SAMPLED ACCORDING TO REQUIREMENTS FOR TESTING.			
☐ STATE METHOD OF CONCRETE PLACEMENT.			
☐ FULLY VIBRATED. ☐ FLOATED / FINISHED. ☐ CURING:DATE STARTED._____ DATE COMPLETED._____ METHOD OF CURING. ☐ SHUTTERING. ☐ PLASTIC WRA . ☐ MEMBRANE SPRAY.(CURING COI OUND) ☐ WET HESSIAN WRAP. ☐ WET SAND. ☐ POND.			

FORMWORK QUALITY ASSURANCE

CONTRACT:	SECTION:
JOB DESCRIPTION	DRWG.REF. / RESPONSIBILITY:

OPERATION	BY	DATE	REMARKS
☐ FINISH REQUIREMENT. DETAIL:			
☐ SHUTTER DESIGN ESTABLISHED.			
☐ PANELS CHECKED FOR QUALITY AND FINISH REQUIRED.			
☐ ASSEMBLED SHUTTER CHECKED AGAINST DESIGN.			
☐ PLASTIC PLUGS INSERTED.			
☐ PANELS OILED.			
☐ STEEL PLACED AND SPLICED.			
☐ SPACERS PLACED TO ENSURE SUFFICIENT CONCRETE COVERAGE OF REINFORCING.			
☐ SHUTTER PLUMBED.			
☐ SCHUTE ERECTED TO AVOID CONCRETE SPILLAGE.			
☐ SHUTTER STRIPPED.			
☐ SMALL ITEMS PLACED IN CONTAINERS. I.e.Clamps,wedges etc.			
☐ ALL EQUIPMENT CLEANED.			

EXCAVATION QUALITY ASSURANCE

CONTRACT:			SECTION:
JOB DESCRIPTION		DRWG.REF.	RESPONSIBILITY:

OPERATION	BY	DATE	REMARKS
☐ SET OUT (SURVEYOR / ENGINEER)			
☐ LATEST REVISED DRWG. USED.			
☐ FINAL CHECK RELATIVE TO DRWG. & BUILDING LAY--OUT.			
☐ OFFSET PEGS IN POSITION.			
'CAVATION MARKED OUT. ☐ . IND MARKS. ☐ FISH LINES. ☐ PLANK PROFILES.			
☐ DEPTH GAUGES PROVIDED.			
☐ COMPLETED EXCAVATION CHECKED.			

APPENDIX G

MEASUREMENT FACTORS AND RATING VALUES

MEASUREMENT FACTORS AND RATING VALUES

The rating values used in tables 16.1, 16.4 and 16.6, were established on the basis of the author's experience of site operations. The values were set relative to the effect which the different functions have on overall contract performance and, where applicable, performance measurement was done in accordance with the methods discussed in chapters 7, 8, 9 and 10.

RVR (Relative Value Rating)

The total RVR score amounts to 100. The individual ratings when multiplied by the MFPR's indicate the relative importance of the function in optimising resources utilization and hence improving productivity.

The planning and measurement functions are considered to be of paramount importance and therefore have the highest RVR. This is in conformity with the basic control model presented in Figure 7.1. There cannot be any purposeful action without planning, nor effective continuing action without an evaluation of results based on measurement. These functions are then followed in the order of importance by control, motivation, communication/participation, education, organization and co-ordination.

MFPR (Management Function Performance Rating)

Three sets of values were used to assess managerial performance in the execution of the different functions. These values were on scales of 0 to 5, 0 to 10, and 0 to 20; and the scale applied was dependent on the effect of these functions on resources utilization and productivity.

The application of the ratings and the assessment of rating values is discussed in sections 16.1 and 16.2.

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