MANAGEMENT INFORMATION ORGANIZATION AND ROUTING

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ABSTRACT: Numerous studies and research have attempted to collect, organize, and disseminate information to the various managers and supervisors in the construction industry. Most efforts have not been successful because of the limited scope of their objective functions. Results are presented of a field study conducted to determine, among other things, construction management information organization and flow. A description is given of how the information required by each construction manager or supervisor is organized into reports (by information type and by management level), the contents of these reports, the purposes these reports serve, how often they are issued, and who receives and prepares these reports. Also described are information flow, report organization by information type and by management level, and information processing. A typical organization structure is identified in the study and used as an illustration. It is also concluded that information should flow in all directions (i.e., upward, downward, and laterally) within the organization.

INTRODUCTION

There is a constant flow of information within the construction organization. This information covers many aspects from the objectives through the strategies, planning and control, to detailed operations of the organization as well as the projects the organization is involved in. For the individual managers at the various management levels, this information proves to be of real significance. For proper decision making that leads to optimal utilization of resources and for keeping all managers at a level informed of each other's activities and problems, usable information is particularly necessary. A good flow of information facilitates access to information. At the present time, useful and good information organization and flow can be very worthwhile attributes, especially when one looks at the general context of the information explosion that is occurring in the construction industry. Also, information flow leads to greater involvement so that managers at the various levels can also have a better understanding of what is happening and can make a better contribution. These managers can then appreciate the depth of their responsibilities and their interrelationships with other members of the organization on similar or related subjects.

The lack of information in the construction industry regarding the step-by-step procedure for organizing and routing usable information prompted the writer to conduct a study of 16 construction firms, involving 177 construction personnel, to determine, among other things, the techniques and procedure for information organization and flow. Initially, letters were sent to 75 owners or presidents, or both, of construction firms in Austin, Dallas, Fort Worth, El Paso, Houston, Junctiton, San

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TABLE 1.—Characteristics of

Name of firm[a] (1)	Number of people interviewed (2)	Construction specialty[b] (3)	Business form (4)	Single or multi-office (5)	Geographic area(s) served (6)
					FIRST
B.H.C. Co.	9	B	Corporation	Multi-office	Southern U.S. (25–30 states)
Bob Kay Const. Co.	12	B-H-HV-I-MU-F	Corporation	Multi-office	Worldwide
Boyd Corporation, Inc.	8	H-M	Corporation	Single-office	Within 70 miles radius (Texas)
Gliding Const. Co.	6	B-HV-I-F	Corporation	Multi-office	Worldwide
Kileen Bros. Co.	13	H-HV	Corporation	Multi-office	Texas
Moonbay, Inc.	4	B-HV-MU-CM-F	Corporation	Multi-office	Worldwide
Pinto, Inc.	6	H-MU	Corporation	Multi-office	South & East U.S. (about 20 states)
Brown Prater Co.	5	HV-MU	Partners	Single	Texas & New Mexico
Subtotal	63				
					SECOND QUESTIONNAIRE
Construction Corporation	6	B-HV-I-F	Corporation	Multi-office	Worldwide
Corvent, Inc.	20	B-H-HV-I-MU RR-CM-E-F	Corporation	Multi-office	Worldwide
Covetter Consultants, Inc.	27	CM-F	Corporation	Multi-office	Worldwide
Lionell Const. Co.	10	B-HV-I-F	Corporation	Multi-office	Texas, Oklahoma, Louisiana & Foreign
Marrows Limited	19	B-HV-RR	Corporation	Multi-office	Eastern half of U.S.
Zellow, Inc.	13	B-HV-MU	Corporation	Multi-office	Texas, Louisiana & Arkansas
Bayshore International	7	B-H-HV-I-CM-E-F	Corporation	Multi-office	Worldwide
Noel, Inc.	12	HV-MU	Corporation	Multi-office	Texas, Louisiana, Oklahoma, Arkansas
Subtotal	114				
Grand Total	177				

[a]Names shown are fictitious to hide the identities of the actual companies interviewed.
[b]Construction Specialty: B—Building, H—Highway, HV—Heavy, I—Industrial, MU—Municipal Util-
[c]Manual Cost Accounting.
[d]Numerous other systems for design, analysis, etc.

Antonio, Temple, Richardson, and Bryan, Texas, asking permission to interview key management and supervisory personnel. A summary of the objectives, proposed procedure, and the nature of problems the study proposed to solve was attached to these letters. As a result of the responses received, 40 of the owners/presidents were approached again and 372 questionnaires were given out. Sixty-three questionnaires were returned for analysis. In addition, personal interviews were conducted with employees of another eight contractors using a revised questionnaire.

Construction Firms Interviewed

Dollar Volume, in Millions (Billings)		Non-Craft Employees		Average Craft Employees		Firm's Existing Information System(s)		
1977 (7)	1982 (8)	1977 (9)	1982 (10)	1977 (11)	1982 (12)	Planning (13)	Cost/finance (14)	Project control (15)
QUESTIONNAIRE								
910	300	700	230	3,200	1,050	CPM	Estimating Cost accounting	Project Control System including Cost Control
1,030	2,050	2,000	3,000	10,000	20,000	CPM	Estimating Accounting	
16	27	50	65	225	320	None	None	None[c]
203	364	380	540	1,900	3,560	CPM	Estimating Cost accounting	PMIS including Cost Control
40	25	40	20	300	140	None	None	None
152	286	320	400	1,400	2,600	CPM	Accounting Estimating	Cost Control
69	22	120	50	1,000	300	CPM	Estimating	Cost Control
80	120	110	140	4,000	6,500	CPM	Estimating	None
2,500	3,194	3,720	4,455	22,025	34,470			
(In-Depth Interview)								
2,180	3,194	10,150	13,800	18,500	27,700	CPM	Accounting Estimating	PMIS including Cost Control
6,500	13,600	30,750	44,240	56,000	117,000	CPM	Cost accounting Estimating	PMIS Cost Control Finance[d]
1,142	3,610	204	262	—	—	CPM	Budgeting Estimating	Cost Control
110	250	191	450	850	19,500	CPM Bar Chart	Payroll Estimating	
180	83	320	130	1,600	850	CPM	Estimating	Cost Control
284	578	500	1,030	21,200	43,400	CPM	Cost accounting Estimating	PMS
302	2,180	1,540	7,000	2,800	16,800	CPM	Cost accounting Estimating	PMIS Cost Control Finance[d]
18	28	55	80	1,100	1,800	CPM	Estimating	Cost Control
10,716	23,589	43,715	66,992	102,050	227,050			
13,216	26,783	47,435	71,447	124,075	261,520			

ities, RR—Railroad, MC—Professional Construction Management, E—Engineering, F—Foreign.

All of the 16 firms involved in the study are located in Texas, although their businesses are national in scope. Eight of the firms have international operations. All are rated in the medium-to-large category by the Associated General Contractors. Table 1 gives a summary of the characteristics of the construction companies that participated in the study. The first questionnaire was designed to elicit detailed information on the four areas of functions and responsibilities of management, reporting structure, types of organizations, and identification of management lev-

els. The revised questionnaire covered the same areas as the first one except that the questions were condensed. Also, the format was somewhat different in that direct questions were asked on their functions, responsibilities, etc. In both questionnaires, charts were used in the areas concerning organization types, management levels, and reporting structure. The persons interviewed were asked either to draw their own chart or modify the chart that was closest to their organization. The data for this study were updated in February 1983.

The management information organization reports by recipients, and by preparing parties, information flow, and information processing that this paper presents, resulted from the summary of the responses received from the interviews conducted. First, the raw data were assembled together by the classification of the people interviewed. For example, all the reports received by all the presidents were assembled. Secondly, the most common reports, etc., from each classification were selected. For a classification with five or more managers, information need, report, etc., were considered common when enacted by 60% or more of the managers in that classification. Seventy-five percent was used as the lowest acceptable percentage for four or less managers in a classification. The number of responses obtained was not adequate for elaborate statistical analysis. However, based on personal judgment and the consistency of the results received from the managers interviewed, it is inferred that the percentages and the sample sizes used give a good representation of the companies in the medium-to-large contractor category. The findings were so consistent that no problem was encountered in identifying the common information needs, reports, reporting structure, etc., in any classification.

This paper first differentiates between "information" and "data." It then describes how the information required by each construction manager or supervisor is organized into reports, the contents of these reports, the purposes they serve, and the frequency at which they are issued. The paper finally focuses on information routing and information processing.

Management Information Organization

Information Type.—Information is defined as "the behavior-initiating stimuli between sender and receiver and in the form of signs that are coded representations of data" (Ref. 5, p. 438). Data differ from information in that data are considered signs—usually recorded observations. Data do not affect the behavior of people or machines; however, data may become information if behavior becomes affected. For example, the data base for computer systems consists of masses of such signs that are not affecting behavior. Until the data are actually viewed, and properly organized for a manager so that he/she reacts to them, they are not information. Thus, management information is not just the forms and reports produced. It includes all the data and intelligence—cost, financial, schedule, trend, forecast, productivity, duration—that are really needed to plan, operate, and control a particular project or the organization, or both, as a whole.

Full and free information to everyone is an appealing idea, but the

result can be so much information that the organization can fail to function effectively. Under such circumstances, construction personnel may be flooded with information they do not need to do their work, to the point that they cannot concentrate on the information they need. Furthermore, sorting and selecting from among the myriad reports may be so time-consuming that there is little opportunity to do anything else. The information thus loses its reliability and value when the manager receives too much or scanty information. In the interest of economy, only information that is necessary is provided and that which is supplied to others is simplified as far as possible. The crucial requirement is to determine what is really important and requires immediate or quick action.

Construction personnel require simple and concise information in an inexpensive form so that it is possible to optimize the effectiveness of the organization and its resources. The study identified the information needs of the project and functional managers as detailed and formalized project cost, schedules, and financial information (Refs. 1–10 and K. A. Tenah, et al., "Construction Organization Structure and Its Functions," unpublished report). From the study, it was also discovered that managers at the director, president, and construction management levels require the summary format of the cost, schedule, and financial information (10–13). Thus, it can be concluded that the information required by the managers at the five levels identified fall into four basic groups: summary and narrative, schedule, cost, and financial information. Therefore, the reports issued to these managers to satisfy their needs are of four basic types, i.e., summary and narrative (designated S) reports, schedule (or T) reports, cost (or C) reports, and financial (or F) reports. These reports are issued monthly. However, the field project team requires more detailed analysis and information of individual account or categories of accounts in between the monthly reports in order to quickly and accurately: (1) Keep track and control of the project scope, cost, and schedule; (2) identify any deviation from the established budget; (3) develop forecast of labor manhours, materials, cost, and schedule; and (4) evaluate and control labor performance. To satisfy this need, a fifth group of reports called the forecast and trend reports is added to these four basic groups. The individual detail reports coming from each of the five groups of reports are listed in Tables 2 through 6.

Summary and Narrative Reports.—These are reports which basically go to the board, the president, and the construction management levels. Each of these reports covers at least one of the following areas: schedule, cost, finance, and forecast and trend. They are prepared manually. The summary and narrative reports and their designations are listed in Table 2.

Schedule Reports.—These are used by the appropriate engineering, construction, and project personnel to plan their work and monitor progress. The schedule reports (Table 3) are usually prepared either manually or by computer from precedence or other networks.

Cost Reports.—These provide the project personnel with information necessary to monitor and control the project budget, forecast, cost, and commitments. The cost reports (Table 4) are consistent, easy to use, and in a format for convenient comparison. They can be prepared manually or by computer.

TABLE 2.—Summary and Narrative Reports Listing

Designation (1)	Title of report (2)
S1	Board's summary report.
S2	President's narrative report.
S3 thru S6	Vice-presidents' (finance, engineering, operations, and administration) narrative reports, respectively.
S7	Procurement directors narrative report.
S8	Chief engineer's narrative report.
S9	Chief accountant's narrative report.
S10	Public relations director's narrative report.
S11	Operations manager's narrative report.
S12	District/division engineer's narrative report.
S13	Procurement manager's narrative report.
S14	Construction manager's narrative report.
S15	Labor relations manager's narrative report.
S16	Project manager's narrative report.

General Comments: The S1 report goes to the director's level, S2 through S10 go to the president's level, S11 through S15 go to the construction management level, and the only one going to the project management level is S16.

TABLE 3.—Schedule Reports Listing

Designation (1)	Title of report (2)
T1 and T2	Master schedule and master network, respectively.
T3 and T4	Engineering summary and detail schedules.
T5	Procurement schedule report.
T6 and T7	Construction summary schedule and construction summary schedule by responsibility.
T8 and T9	Construction 90/180 day schedule report and the 90/180 day schedule by responsibility.
T10	Construction weekly work plans.
T11	Schedule report by total float.

TABLE 4.—Cost Reports Listing

Designation (1)	Title of report (2)
C1	Project summary cost status report.
C2	Detailed cost estimate report.
C3 and C4	Original/current project budget report, and original/current project budget report by responsibility.
C5 and C6	Cost and commitments by control code and by the purchase order number reports.
C7	Direct material cost and commitments by purchase order number by responsibility.

TABLE 5.—Financial Reports Listing

Designation (1)	Title of report (2)
F1	Multi-phase financial status report.
F2 and F3	Programmed and actual contract cost reports.
F4	Project file report.
F5	Project payment report.
F6	Contractor payment approval report.
F7	Fund requirement project report.
F8	Project accounts report.
F9	Vendor, contract, invoice, allotment of funds, reimbursable expenses, and composite project cost files.
F10	Change order files report.
F11	Job progress report on uncompleted work.

TABLE 6.—Forecast and Trend Reports Listing

Designation (1)	Title of report (2)
A1 and A2	Summary and detail manhour overrun reports.
A3 thru A5	Project performance, the responsibility performance, and performance summary reports, respectively.
A6	Quantity and unit rate report.
A7	Detailed analysis report.
A8	Manhours summary report.
A9	Percent complete and manhour percentage report.
A10 and A11	Manpower equivalency and block summary reports.
A12	Current budget and trend forecast report.
A13	Quantity forecast report.
A14 and A15	Detailed labor forecast review report and labor forecast review report by responsibility.

TABLE 7.—Board's Summary Report

Management Level:	Director	Report #S1
Recipient(s):	Board of directors and its chairman.	
Prepared by:	President.	
Purpose:	To provide the directors and the shareholders with a current awareness of the financial status (i.e., profitability, dividends, etc.), progress and problems of the company.	
Frequency:	Once or twice a year and as required.	
Contents:	(a) Current jobs' time and cost status; (b) jobs completed during the reporting period; (c) latest environmental and competitive information and effects; (d) company's financial report; (e) market and planning development; and (f) general comments.	

TABLE 8.—Master Schedule and Master Network

Management Level:	Project Management	Reports #T1 and T2
Recipient(s):	Construction manager, the project manager, the chief engineer, the vice-presidents, the resident project engineer, and the client.	
Prepared by:	Chief planning/scheduling engineer or the project planning/scheduling engineer.	
Purpose:	To provide a summary schedule of the project activities, to assist in project planning, and to provide a framework for the development of detailed schedules for each phase and/or area of responsibility.	
Frequency:	T1 and T2 reports are prepared after the project award and issued monthly. Re-scheduling occurs only when absolutely required and with proper approval.	
Contents:	(a) Major engineering/design activities; (b) major procurement activities; (c) major construction activities; and (d) major start up activities.	

General Comments: The master schedule and master network are intended to give a complete picture of the project without excessive detail and in a simplified manner. They list approximately 50 work items with each item further divided into its engineering, procurement, construction, and start up activities.

TABLE 9.—The Project Summary Cost Status Report

Management Level:	Construction Management	Report #C1
Recipient(s):	Construction manager, division/district manager, the project manager, and the client. Copies are sent to the project accountant and the resident project engineer.	
Prepared by:	Project cost engineer.	
Purpose:	To provide an overview of the project's total cost and budget status, and to forecast and control the total cost of the project based on current information.	
Frequency:	Monthly and/or as required.	
Contents:	(a) Each major cost code (broken down into labor, material, equipment, and total for the code); (b) original and current estimates; (c) cost commitments and expenditures; and (d) projections to project completion (total amount, variance—in both dollars and percentage).	

Financial Reports.—These are produced from reassembling the various basic information from invoices, change orders, contracts, allotments of funds, budgets, etc. The major purposes of the financial reports (Table 5) are: (1) To help plan and control the project's funding, cost, change orders and claims, and other major project financial concerns; and (2) to help serve as a basic accounting tool and audit trail.

Forecast and Trend Reports.—These reports provide the project team with such facts as: (1) Labor, manhours, cost, and material and schedule forecasts; (2) labor performance evaluation and control; and (3) deviations in project scope, cost, and schedule. The trend and forecast reports (Table 6) are prepared and issued weekly by either computer or manual means.

TABLE 10.—Multi-Phase Financial Status Report

Management Level:	Construction Management	Report #F1
Recipient(s):	Construction manager and the division/district manager. Copies are sent to the project manager, the project resident engineer, and the client.	
Prepared by:	Project cost engineer.	
Purpose:	To provide a current awareness of the cost and financial status of each major project element; to alert management to potential cost overrun areas or fund shortages; and to highlight trends in the cost and financial status of the project.	
Frequency:	Monthly and/or as required.	
Contents:	(a) Description of the phase and phase number; (b) budget, estimated costs, and contract amount for the phase; (c) allotment of funds, approved outlays, and balance; and (d) unpaid commitments, and commitments to complete.	

TABLE 11.—Summary Manhour Overrun Report

Management Level:	Functional Management	Report #A1
Recipient(s):	General superintendent, the area superintendent, and field/office engineers. Copies are sent to project manager, the planning scheduling engineer, and the resident project engineer.	
Prepared by:	Project cost engineer.	
Purpose:	To highlight the significant potential manhour overruns for the top 20 to 25 manhour overruns.	
Frequency:	Weekly.	
Contents:	(a) Account number, account description, and percent complete; (b) current budget manhours and forecast manhours; and (c) overrun manhours for account and total project manhours overrun.	

General Comments: Account is considered overrun when it is 200 or more hours over the forecast and is below 75% or 80% complete.

Management Reports.—The reports listed in Tables 2 through 6 are at this point properly organized into good and useful information so that they satisfy the information needs of the managers receiving them. To do this information organization, the recipient(s), the preparing party or parties, the purposes(s), the frequency, and the contents for each report are determined. Samples of these management reports (taking the first ones for each of the reports from the five groups) are presented in Tables 7 through 11. The contents of these reports illustrate how reports are organized into good and usable information.

Information Flow

Reports Organization by Information Type and Management Level.—The cost, planning and scheduling, financial, and trend and forecast re-

TABLE 12.—Reporting

Key P: Manager preparing report A: Addressee—directly responsible C: Copy—for review, comments, or information (1)	S Summary Reports S1 Board's summary report (2)	S2 President's narrative (3)	S3 Vice-president—finance narrative (4)	S4 Vice-president—engineering narrative (5)	S5 Vice-president—operations narrative (6)	S6 Vice-president—administrative narrative (7)	S7 Procurement director's narrative report (8)	S8 Chief engineer's narrative report (9)	S9 Chief accountant's narrative report (10)	S10 Public relations director's narrative (11)	S11 Operations manager's narrative report (12)	S12 District/division engineer's narrative (13)
MANAGEMENT RECIPIENTS												
1. BOARD OF DIRECTOR'S LEVEL												
Board of Directors	A											
Chairman of the Board of Directors	A											
2. THE PRESIDENTS' LEVEL												
The President	P	A	C	C	C	C						
Vice-President Finance			A	C	C	C		C	C	C	C	
Vice-President Engineering			C	A	C	C		C	C	C	C	
Vice-President Operations			C	C	A	C		C	C	C	C	
Vice-President Administration		P	C	C	C	A		C	C	C	C	
Client Agency Director of Procurement							A			C		
Chief Engineer				P			C	A	C	C	C	
Chief Accountant			P				C	C	A	C	C	
Public Relations Director						P	C			A		
3. CONSTRUCTION MANAGEMENT LEVEL												
Operations Manager					P		C	C	C	C	A	C
Assistant/Deputy Chief Engineer								A	C	C	C	
Chief Estimator							C		C	C	C	
District/Division Engineer								P				A
Procurement Manager							P					
Construction Manager											P	C
Labor Relations Manager												
Public Relations Officer										P		
4. PROJECT MANAGEMENT LEVEL												
Project Manager												C
Assistant/Deputy Chief Estimator							C		C	C	C	
Planning/Scheduling Engineer												
Cost Engineer Estimator												
Purchasing Agent Accountant									P			
Safety Engineer												
Field Office Engineer												
Project Engineer												P
5. FUNCTIONAL MANAGEMENT LEVEL												
General Superintendent												
Superintendent(s)												
General Foremen/ Foremen												
Field Engineers												
Subcontractors												

				T Schedule Reports										
S13 Procurement manager's narrative report (14)	S14 Construction manager narrative report (15)	S15 Labor relations manager narrative report (16)	S16 Project manager narrative report (17)	T1 Master schedule (18)	T2 Master network (19)	T3 Engineering summary schedule (20)	T4 Engineering detail schedule (21)	T5 Procurement schedule (22)	T6 Construction summary schedule (23)	T7 Construction summary schedule by responsibility (24)	T8 Construction 90/180 day schedule (25)	T9 Construction 90/180 day schedule by responsibility (26)	T10 Construction weekly work plans (27)	T11 Schedule report by start flow (28)
				A	A									
				A	A									
				A	A									
				A	A									
	C			A	A									
C														
C	C													
			C											
C	C	C	C			A								
A			C			A		A	A		A			
C	A	C	C	A	A	A		A	A		A			
		A												
		C												
	P	C	A	A	A	A		A	A		A		C	A
			C											
				P	P	P	P	P	P	P	P	P	C	P
													C	
P														
		P												
							A		A	A	A	A		
			P	A	A	A	A	A	A		A		A	
											A			A
												A	P	
													A	
							A		A	A	A	A	C	
										A		A		A

TABLE 12.—Reporting

Key P: Manager preparing report A: Addressee—directly responsible C: Copy—for review, comments or information (1)	C Cost Reports							F Financial Reports						
	C1 Project summary cost status report (2)	C2 Detailed cost estimates (3)	C3 Original/current project budget (4)	C4 Original/current project budget by responsibility (5)	C5 Cost and commitments by control code (6)	C6 Cost and commitments by purchase order number (7)	C7 Direct material cost and commitments by purchase order number by responsibility (8)	F1 Multiphase financial status report (9)	F2 Programmed contract costs report (10)	F3 Actual contract cost report (11)	F4 Project file report (12)	F5 Project payment report (13)	F6 Contractor payment approved report (14)	F7 Fund requirement projection report (15)
MANAGEMENT RECIPIENTS														
1. BOARD OF DIRECTOR'S LEVEL														
Board of Directors														
Chairman of the Board of Directors														
2. THE PRESIDENTS' LEVEL														
The President														
Vice-President Finance														
Vice-President Engineering														
Vice-President Operations														
Vice-President Administration														
Client Agency	A		A					C			A	A		A
Director of Procurement														
Chief Engineer														
Chief Accountant														
Public Relations Director														
3. CONSTRUCTION MANAGEMENT LEVEL														
Operations Manager	A							A				A	A	A
Assistant/Deputy Chief Engineer														
Chief Estimator														
District/Division Engineer														
Procurement Manager					A	A								
Construction Manager		C	C					C	C			A	A	A
Labor Relations Manager	A													
Public Relations Officer														
4. PROJECT MANAGEMENT LEVEL														
Project Manager	A	A	A		A	A		A	A	A	A	A	A	A
Assistant/Deputy Chief Estimator														
Planning/Scheduling Engineer														
Cost Engineer	P	P	P	P	P	A		A	P	P	P	P	P	A
Estimator		A						P	A	A				
Purchasing Agent		A			A	P	P							
Accountant	C	A						P	A	A				

				A Forecast and Trend Reports															
F8 Project accounts reports (16)	F9 Vendor, contract, invoice, allotment of funds, reimbursable expenses, and composite project cost files reports (17)	F10 Change order files (18)	F11 Job progress report on uncompleted work (19)	A1 Summary overrun report (20)	A2 Detail overrun report by responsibility (21)	A3 Project performance report (22)	A4 Responsibility performance report (23)	A5 Performance summary report (24)	A6 Quantity and units rate report (25)	A7 Detailed analysis report (26)	A8 Manhour summary report (27)	A9 Percent complete and manhour percentage (28)	A10 Manpower equivalency report (29)	A11 Block summary report (30)	A12 Current budget and trend forecast report (31)	A13 Quantity forecast report (32)	A14 Detailed labor forecast review report (33)	A15 Labor forecast review report by responsibility (34)
			A															
			A			C					C	C		C				
	A		C	C		A		A	C	C	A	A	C	A	C	C	C	
	P	C C P	P	C P	P	A P	P	A P A	A P	P C	A P A	A P	C P	A P	A P	A	P P	P P
P	P	C									A						A	

TABLE 12.—Reporting

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Safety Engineer														
Field Office Engineer			A			C				A				
Project Engineer	C	A	A		A	A		A	A	A	C	C		A
5. FUNCTIONAL MANAGEMENT LEVEL														
General Superintendent				A			A							
Superintendent(s)				A			A							
General Foremen/ Foremen				A			A							
Field Engineers				A			A							
Subcontractors				A			A							

ports described in the previous section provide the horizontal information. However, they are interrelated and are structured by management levels. Each level of management receives only the reports and level of detail it needs. There are five levels of reports: the board of directors, the president, the construction management, the project management, and the functional management (Refs. 1–13 and K. Tenah, et al., unpublished report). As has been noted by now, most of the information provided by these reports is familiar to all experienced owners and engineers. What is different is the manner in which it is produced and presented. As seen in Table 12, each management report is prepared by qualified personnel (designated by letter "P"), and sent to the manager directly responsible for the report or addressee (designated by letter "A"), with copies (designated by letter "C"), to managers above, below, or at the same level or sublevel as the responsible recipient or addressee for their information, comments, or review. This method of producing and transmitting reports differs from the present practice in the construction industry. At the present time, most management reports are sent directly to their responsible recipients or addressee and they in turn circulate these reports laterally, above or below them. The method presented in Table 12 allows managers to simultaneously receive information so that action(s) can be taken at the same time. Thus, this method eliminates the time between when an addressee receives report(s) and when the report(s) get(s) into the hands of the manager(s) at the same level, below or above them. Together the horizontal and vertical organization of the information provides the report structure which organizes and presents most of the information necessary for the management team to effectively carry out its management role. Table 12 shows the report(s) (Tables 2 through 6) each manager or supervisor receives to perform his/her role.

Flow of Information.—The flow of information is a necessity in order to help construction personnel carry out their duties more efficiently and effectively. It has already been stated that benefits accrue when it is possible to ensure the provision of the facts at the right time. When more people are added to the organization and the volume of work increases, the drive for growth then concerns the proper utilization of data. The information provided links the internal and external affairs so that work can be continued and monitored. The information provided is also used to guide the way. Information can be strengthened from participation and involvement.

For the organization to function properly, it is essential that infor-

Structure (*Continued*)

(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
	A	A C		A C		A	A		A	A C	A	A	A C	A	A C	A C	A C	A
		A A		A A	A	C	A		A A	A A	C	C	A A	A	A A	A	A A	A
					A A A		A A A		A A	A A			A A		A A	A A	A A	A A A

mation flows freely in all directions, i.e., upward, downward, and laterally, unless such free flow of information is detrimental to the objectives of the firm. Vertical and lateral flow of information allows the managers to learn simultaneously of the organization or projects and their problems so that decisions and instructions can be made and received uniformly, with opportunities for clarification and adjustments to be made as quickly and as efficiently as possible. Thus timing, reliability, scope, means, accuracy, value, and feedback are effectively achieved. This information flow will concern many aspects of the company: from company objectives and strategy, through the planning and control to the detailed operation of the company and the projects in which the company is involved. Fig. 1 is a typical organization chart that was identified in the study (10, 11, 13, K. Tenah, unpublished report), and shows the directions in which information flows. The information flow paths or communication lines are indicated by solid lines, broken lines, and solid/broken lines.

Information Processing

Information processing, simply put, means taking raw data or input and converting it into the desired reports, files, or answers to inquiries. It involves organization, storage, searching, and retrieval of information. Information processing may be done manually or by computer, or both. The entire subject has received an increased amount of attention in recent years (1–10), not only because simpler information processing systems are urgently needed, but also because planning, designing, and controlling of information and information systems rely on an extensive data base of high quality in order to be a useful tool in solving the complex problems of today and of the future.

The summary and narrative, cost, schedule, and financial reports examined earlier are so simple in format and content that they can all be processed manually. This makes their use easy and suitable for small and medium as well as large size construction and engineering organizations. Cost, schedule, and financial reports can be produced entirely by computer or partially by computer and partially by manual means. The summary and narrative reports should always be produced manually. Because of the turnaround time (i.e., the frequency of production) and the contents, the trend and forecast reports do not lend themselves to easy and quick manual processing.

It is to be noted that the extensive use of a computer has now become

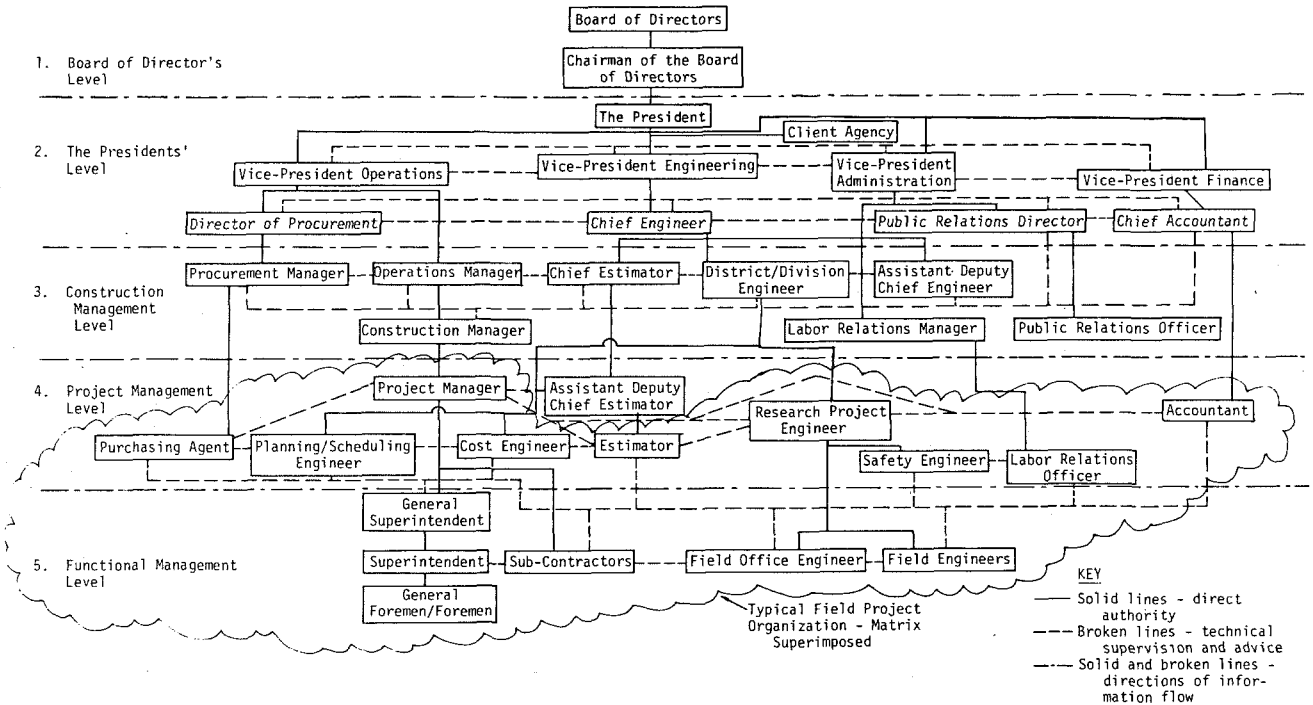

FIG. 1.—Typical Organization Chart

very common. Procedures, too, have become more standardized and there has been a considerable interflow of information. With computer service, speed, accuracy, and economy are the notable characteristics. It is certainly more difficult to function in a medium or large organization without any formal computerized information processing system. However, the cost of the service by computer should always be checked to see if it is justified, because in some respects economic forces can cause changes from computer to manual or vice versa.

Summary

This paper has examined how the information required by the construction personnel is organized into reports, the contents of these reports, the purpose(s) they serve, and the frequency at which they are issued. Also described here are the benefits accrued from good information organization and flow. Finally, the means of processing these reports and how they are routed (information flow) were examined. The aim of this paper is to present step-by-step methods for organizing and routing information in a construction firm.

Conclusions

The conclusions drawn from the study are as follows:

1. Information is behavior-affected data. Information going to construction personnel include data and intelligence (cost, financial, duration, productivity, etc.) that are really needed to plan, operate, and control a particular project, as well as the organization as a whole.
2. Information required by the construction personnel at the five levels of management fall into five basic groups, i.e., summary and narrative reports, cost and accounting reports, planning/schedule reports, financial reports, and trend and forecast reports.
3. Information loses its reliability, accuracy, and value when the manager receives too much or scanty information.
4. Information should be organized and prepared under careful supervision which includes checking for accuracy, purposes served, contents, and recipient(s).
5. A method of preparing and routing management reports was developed (Table 11) which allows: (1) Managers to simultaneously receive information so that simultaneous action can be taken; (2) information to flow in all directions (i.e., upward, downward, and laterally) within the organization; and (3) managers to think ahead and to stay in closer touch with every major commitment and resource.
6. Information processing may be done manually, by computer, or both. Although an extensive use of computers in information processing has now become very common, the cost of this service should always be checked to see if it is justified.

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