Reticular and Linear Planning of Erecting Yards Aided by Personal Computer

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This study has been carried out during the Course of Ergotecnica Edile hold at the Istituto Dipartimentale di Architettura e Urbanistica of Catania University, and it has been addressed to the students of the Faculty of Civil Engineering (manufacturing and direction of civil works).

The present study aims at instructing the students as refers to planning, through computers, erecting yards. Work-planning is specifically important with reference both to the starting program and to the carrying on of the work. Within this context, work-planning is useful as regard the control and contingent corrections of the work. In the latter case, divergences between work-evolution and forecast are of primary value.

Because of complex economic and organizative reasons, the connection between working-forecast and following verifications is likely to be realized through computers.

The following program is implemented by an Olivetti M20 Personal. Computer, and the BASIC language is used under the O.S. PCOS.

The minimum configuration has the following features:

RAM memory	160 Kb
Mass memory	2 X 320 Kb FD
Video terminal	Graphic capabilities: 512 X 256 px
Line printer	" " hard copy

CONTENTS

Our aims can be resumed as follows:

i) cut off of working time;
ii) cut off of unfruitful breaks;
iii) cut off of costs in the same working time.

Planning contents aim at singling out and shaping each activity in sequential and logical manner; furthermore, singling out temporal interrelations among development cycles is the second aim; the final target is to coordinate all the activities with necessary resources.

PLANNING TECHINIQUES - PERT SYSTEM

PERT method (Progress Evaluation and Review Technique) is based on an oriented graph in which each activity takes place between two events; further activities can concur to those events if the logical (reticular) connections among them is possible.

Leaving aside the reticular connection, it is necessary to know the (presumed) length of each action. By extending PERT to CPM (Critical Path Method), we get the list of activities which shows the (maximum) works' length.

It is possible to shorten the length of the erecting yard by intervening especially on the length of the activities of the critical path.

PROGRAMMING AND MANAGING ERECTING YARDS (PMEY)

The PMEY operates on two types of data: the first field of action refers to each activity of the erecting yard (normal length,

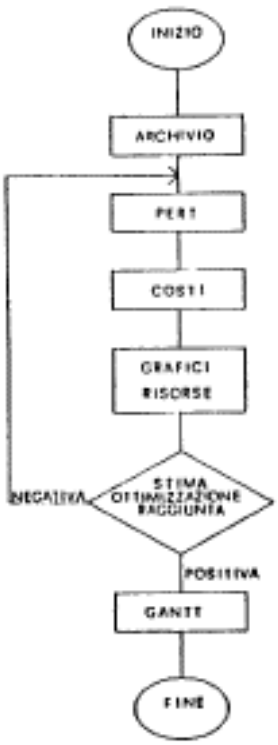

fig. 1

quantity of work, necessary resources, resources' cost); secondly, the PMEY operates on logical and temporal relationship among each activity.

The PMEY operates on the foregoing data in order to get the following answers:

i) temporal boundaries of the development of each activity;
ii) time boundaries within which any time lag in the ful filment of each activity does not imply any variation of the erecting yards' length;
iii) list of the activities which specifically condition the erecting yards' length;
iv) cost's specification under various sides;
v) necessary available resources.

In order to get the foregoing results, the user will utilize the following procedures (fig. l):

FILE

The first operative stage required to the user is the creation of a file containing the available resources, which must be assembled in four basic items:

i) manufacture;
ii) machineries;
iii) materials;
iv) energy;

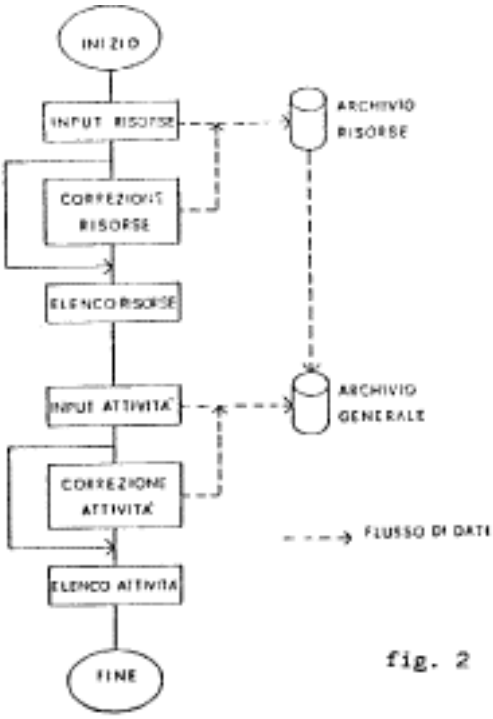

fig. 2

The performed procedure is illustrated in fig.2. It is neces

sary to specify the name, the cost per unit and the theoretic performance (with reference to machinery) of each resource. Thus, the creation of the activities' file must be realized; within this context, each activity will have the result of singling out the resources which are necessary in order to obtain the required performance (work/our). The files must be always be updated; updating is necessary due to different reasons: either compulsed (i.e. the change of the daily machinery rent cost), and the other one determined by experience (i.e. work value in specific circumstances).

PERT

Fig. 3 illustrates PERT procedure.

The necessary input for each erecting yard is constituted by the list of activities to be done (among the filed activities), by work quantity which is performed by those activities and by interre-

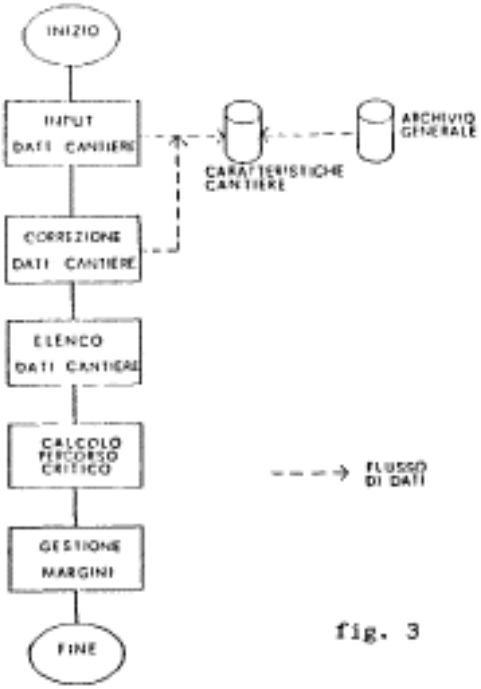

fig. 3

lated data linking them. The just mentioned data are constituted (following Parolini's tabulare method), for each activity, by activities' codes which start only when the same activity is exhausted. By applying this method, the development of PERT reticulate becomes superfluous avoied and it can be substituted by a tabulate.

Finally, the critical path computing (whose algorithm we do not illustrate herein because of lack of space) takes place. The just mentioned critical path computing gives as output the starting and final day and the allowed margin for each activity. The last datum (which is null for the activities of the critical path) is the quantity of time which can be lost during the activity, without delaying (as refers to the final day). A tabulate representing the output of a critical path computing is showed in fig.4.

PERT - Percorso critico

	ATTIVITA'	DURATA	DATA IN.	DATA FIN.	MASSIMO RITARDO
1	TRACCIAMENTO per scavo	1	0	1	CRITICA
2	SCAVO A SEZ OBBLIGATA muri sost.	1	1	2	CRITICA
3	GETTO CLS 200 FREDDO muri sost. est.	2	2	4	CRITICA
4	LAV. FERRO muri sost. est.	3	1	4	CRITICA
5	FREF. CASS. muri sost. est.	2.5	1	3.5	7
6	POSA FERRI muri sost. est.	6.5	4	10.5	CRITICA
7	POSA CASS. muri sost. est.	4.5	10.5	15	CRITICA
8	GETTO CLS Rbk 200 FRED muri sost. est.	3.5	15	18.5	CRITICA
9	DISARMO muri sost. est.	2.5	18.5	21	CRITICA
10	RECINZIONE cantiere	4.5	21	25.5	CRITICA
11	GETTO CLS 200 FREDDO fognature	.5	4	4.5	10.5
12	POSA TUBI fognature	3	4.5	7.5	18
13	RINT. RILEV. STRAD.	1	25.5	26.5	CRITICA
14	GETTO CLS 200 FREDDO banchinamenti	.5	26.5	27	CRITICA
15	BANCHINAMENTI	1.5	27	30.5	CRITICA
16	LAV. FERRO fondazioni travi	19.5	10.5	30	3
17	CASS. fondazioni travi	6.5	15	21.5	20.5
18	SCAVO GENERALE	4	18.5	24.5	5
19	TRACCIAMENTO fondazioni tali	1.5	24.5	26	5
20	GRU montaggio	.5	30.5	31	CRITICA
21	CONF. CLS 200 sottofond. fond	2	31	33	CRITICA
22	GETTO CLS sottofond. fond	2	31	33	CRITICA
23	POSA FERRI fond. travi fond	17	33	50	CRITICA
24	POSA CASS. fond. travi fond	13	50	63	CRITICA
25	CONF. CLS Rbk 250 fond. travi fond	13	63	76	CRITICA
26	GETTO CLS fond. travi fond	13	63	76	CRITICA
27	DISARMO fond. travi fond	6.5	77	83.5	25
28	LAV. FERRI fond. pilastri	.5	50	50.5	18
29	FREF.CASS.PILASTRI fond. fond	.5	63	63.5	5.5
30	POSA FERRI pilastri fond.	.5	50.5	51	18
31	POSA CASS. PILASTRI fond. fond	1	63.5	64.5	5.5
32	CONF. CLS Rbk 250 pilastri fond.	.5	76	76.5	CRITICA
33	GETTO CLS pilastri fond.	.5	76	76.5	CRITICA
34	DISARMO CASS.PILASTRI fond fond	.5	76.5	77	CRITICA
35	LAV. FERRO solaio p.t.	6.5	31	37.5	39.5
36	FREF. CASS. SOLAIO p.t. fond	6.5	64.5	71	5.5
37	POSA CASS.SOLAIO p.t. fond	12.5	77	89.5	CRITICA
38	POSA FIGURATE solaio p.t.	7.5	89.5	97	CRITICA
39	POSA FERRI solaio p.t.	5.5	97	102.5	CRITICA
40	CONF. CLS Rbk 250 solaio p.t.	4.5	102.5	107	6
41	GETTO CLS solaio p.t.	4.5	102.5	107	6
42	DISARMO SOLAIO p.t. fond	6.5	139	145.5	5.5
43	LAV. FERRI pilastri p.t.	1	102.5	103.5	CRITICA
44	FREF CASS.PILASTRI p.t. fond	1.5	89.5	91	14.5
45	POSA FERRI pilastri p.t.	2	103.5	105.5	CRITICA
46	POSA CASS. PILASTRI p.t. fond	3.5	105.5	109	CRITICA
47	CONF. CLS Rbk 250 pilastri p.t.	.5	109	109.5	4
48	GETTO CLS pilastri p.t.	.5	109	109.5	4
49	DISARMO CASS.PILASTRI p.t.	1.5	109.5	111	4
50	CONF. MURI DI CONTENIMENTO per muri fond	2.5	111	113.5	27

fig. 4

MARGINS

The management of the margins makes the rigid critical path method flexible; furthermore, it aims at optimizing the use of resources and at adapting it at particular circumstances.

Actually, delay or anticipation of each activity or group of activities can occur. In the latter case those activities must have the same margin (since they are on a continuous temporal development), without the insertion of further activities on their path.

COSTS

This procedure (fig. 5) aims at managing cost forecasting; it is thus possible to intervene, eventually, on each activity listed in the file. Weekly cost's analysis is made distinctly on each of

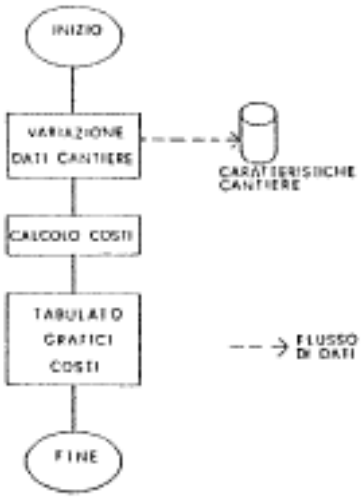

fig. 5

the four type of resources (as illustrated in fig. , 6, 7, 8, 9, 10) and it is shown tabularly and graphically as concerns partial and total trends, in order to obtain a clear and detailed frame of the time and cost trend.

After analysing graphics and tables, the user can change input data. The first case suggests to operate as follows:

i) either varying the crew composition, the number of machineries, the quality of materials and, finally, the output of the crew.

ii) or changing temporally (anticipating or delaying) all activities requiring economic obligations which are incompatible

with the available resources and the programs of the user, taking into account the estimated time as it results from the critical path calculation and from the most recent variations of the first day of each activity.

COSTI CANTIERE (x1000)

PERIODO	MANO D'OPERA	MACCHINE	MATERIALE	ESECUZIONE	PARZIALE	TOTALE
0 - 6	33202	1119	34041	6	48204	48204
6 - 12	30479	897	3026	7	17595	65801
12 - 18	33622	341	42438	10	57804	123586
18 - 24	22290	9208	32298	11	59893	183480
24 - 30	31344	836	37428	9	49618	233098
30 - 36	9753	478	9329	23	19585	252684
36 - 42	31239	563	342	11	32156	284840
42 - 48	31239	563	342	11	32156	317997
48 - 54	32318	301	30182	12	22925	299622
54 - 60	9748	163	10012	8	20192	319814
60 - 66	31239	269	33906	28	33462	353276
66 - 72	32583	683	37814	15	53859	406136
72 - 78	9468	222	14545	47	26495	432632
78 - 84	13531	518	-16972	3	-2887	429993
84 - 90	8987	46	4475	2	13511	443504
90 - 96	3758	93	9785	3	17442	461047
96 - 102	10434	447	1319	9	12233	473281
102 - 108	35274	486	35715	36	48032	521914
108 - 114	35287	183	24462	15	40069	561984
114 - 120	13743	469	7534	6	21731	583715
120 - 126	14809	46	7462	4	22403	606119
126 - 132	12767	46	9081	5	21901	628020
132 - 138	12513	291	23876	25	34737	662938
138 - 144	15163	187	4654	28	19968	682906
144 - 150	15081	94	16977	23	32100	715955
150 - 156	17704	303	23745	19	42003	757808
156 - 162	19137	563	10059	6	29852	756811
162 - 168	14262	187	9470	8	23949	810760
168 - 174	10841	478	17442	42	28835	839365
174 - 180	8021	752	3918	12	16699	856065
180 - 186	4765	563	3595	3	10927	866993
186 - 192	4765	563	3595	3	10927	877921
192 - 198	4765	563	3595	3	10927	888848
198 - 204	3869	399	3228	3	10451	899500

fig. 6

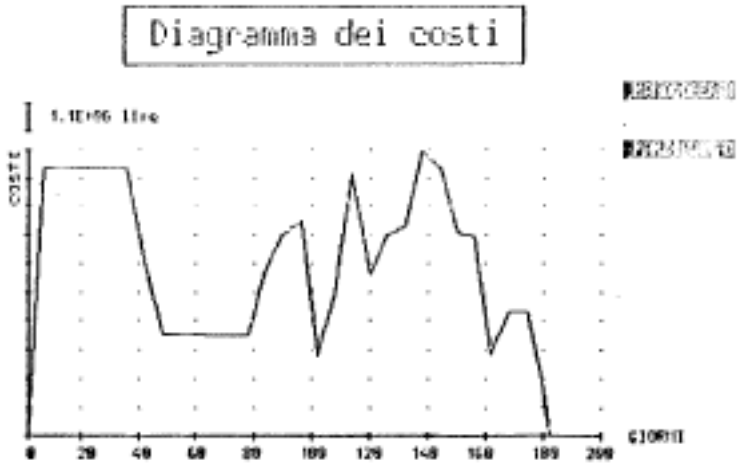

fig. 7

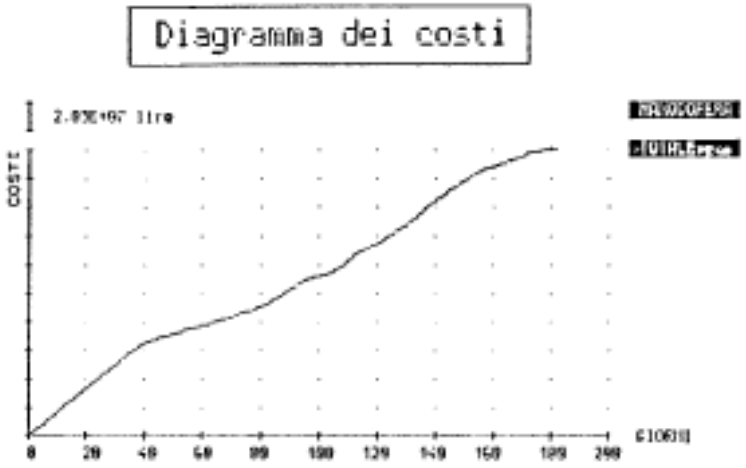

fig. 8

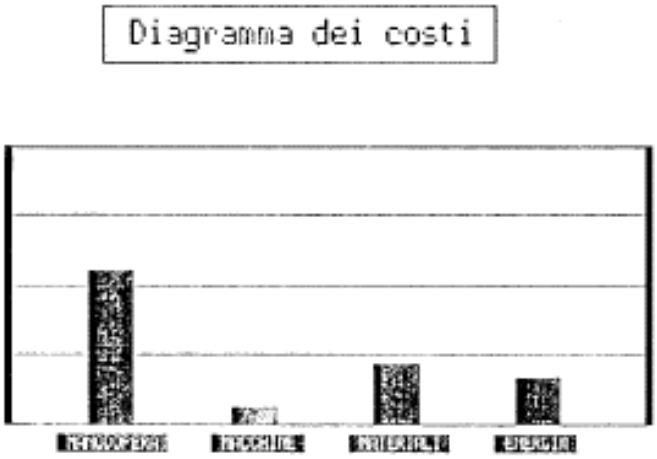

fig. 9

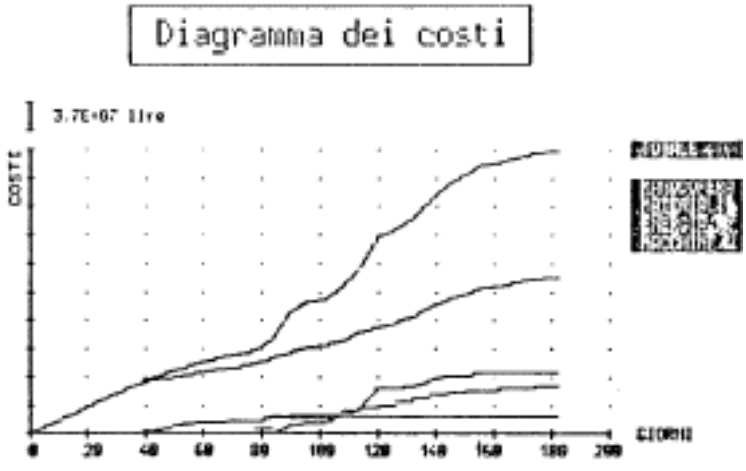

fig. 10

GRAPHICS OF RESOURCES

The use and the optimization of the resources is one of the most interesting aspects concerning planning and management of erecting yards. A confirmation of this assessment results by considering the usefulness of informations concerning the use of a given material in order to get supplies at the right time in the management phase, and in order to arrange for stocking, in the planning phase.

By this procedure, the graphics show, for each resource, the work-time in the abscissa and, in the ordinate, the amount of each resource which must be used (fig. 11, 12).

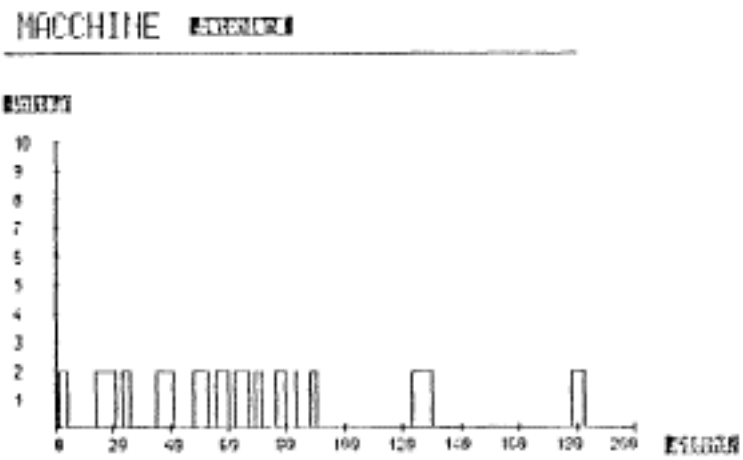

fig. 11

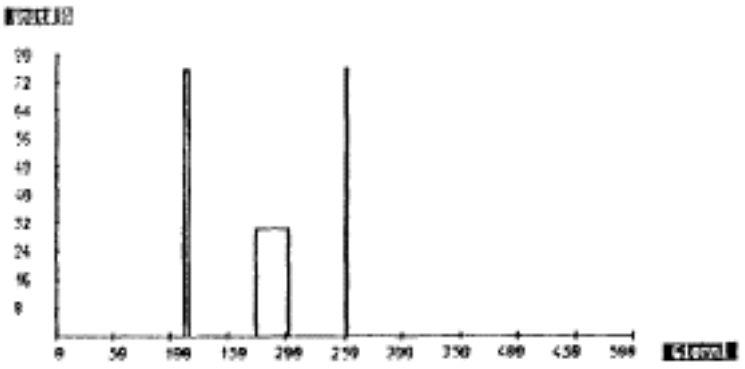

fig. 12

GANTT

Gantt's graphical representation is constituted by (putting in abscissa the days of work) the bars (one for each activity) whose length is proportional to the time required for the activity (fig. 13).
The bars which refer to the critical path are specifically underlined.
Thus, we finally get a summarized frame of the temporal phases of an erecting yard. Furthermore, we get indications for a control of any eventual difference between forecasts and real achievements.

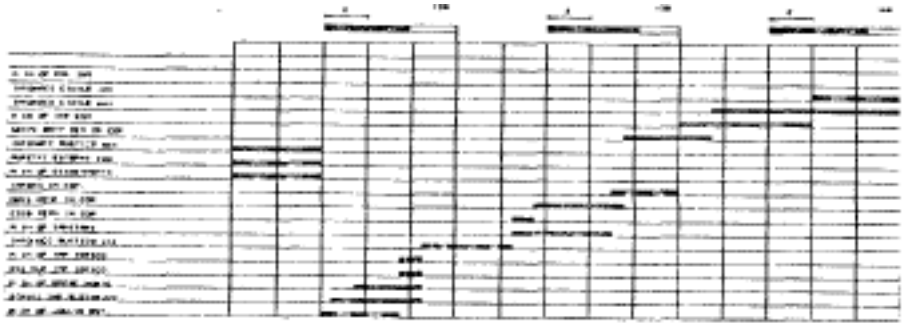

fig. 13

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