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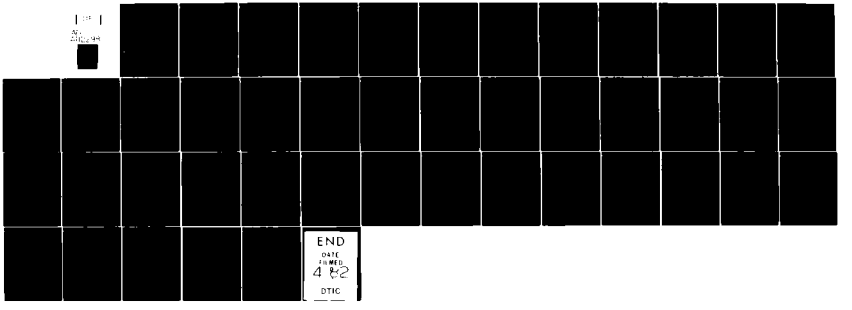

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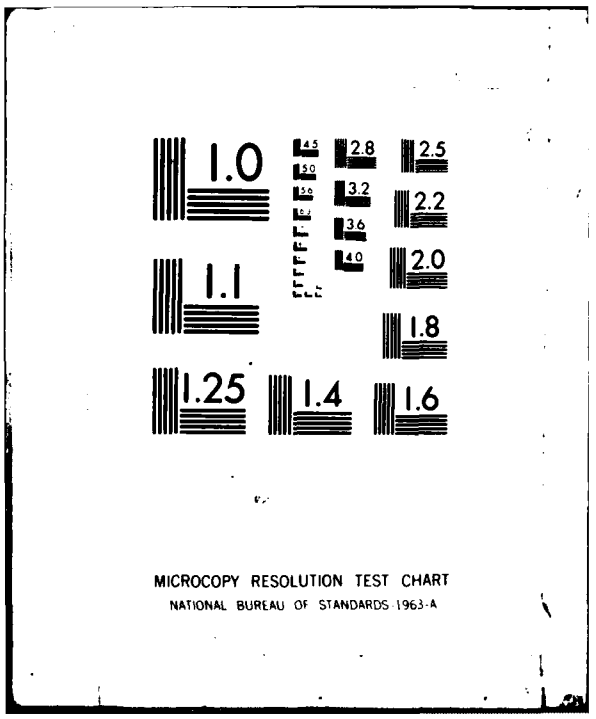
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ORGANIZATION AND MANAGEMENT OF CONSTRUCTION IN DEVELOPING COUNTRIES

by

Maria Pavlidou

CIB W65 Commission

On

Organization and Management of Construction

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ORGANIZATION AND MANAGEMENT OF CONSTRUCTION IN DEVELOPING COUNTRIES/CIB W-65 COMMISSION		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Maria Pavlidou		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. ARMY CONSTRUCTION ENGINEERING RESEARCH LABORATORY P.O. BOX 4005, Champaign, IL 61820		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE February 1982 13. NUMBER OF PAGES 61
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from the National Technical Information Service
Springfield, VA 22161

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

construction
Developing nations

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Discussion covers organizational forms for construction in developing countries; management of design, the firm, and the project; the influence of human factors; the role of mass housing and industrialized construction; and specific practices in India, Malta, Roumania, Turkey, South Africa, and the West Indies.

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INTRODUCTION

W-65, a Working Commission of the International Council for Building Research (CIB) has the Terms of Reference: "To develop effectiveness calculations and techniques for evaluating singularly and collectively various organisational forms used in the planning, architecture, engineering, construction, and ownership for both conventional construction and industrial construction. The aim is to provide tools which will enable comparisons to be made between ultimate organisational structures and management doctrines in the enterprises responsible for each facet of the building process."

One program of W-65 is its Rapporteur-by-Correspondence program. This program is to provide a single report which presents a cohesive, integrated explanation of the research in progress in the Commission on a specific topic. This work by Dr. M. Pavlidou is the first fruit of this program. This report can be obtained from the National Technical Information Service (NTIS), Springfield, VA 22161.

W-65 consists of 33 researchers and practitioners applied to countries. These experts have organised into several task groups to address cooperative research in narrowly defined subject areas within the Commission's Terms of Reference. Information on the activities of W-65 can be obtained by writing to the Coordinator. The parent organisation, CIB, is comprised of many Working Commissions directed to all aspects of building engineering and science. Information on CIB can be obtained from the Secretary General CIB, Postbus 20704, Weena 704, Rotterdam, Holland.

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PREFACE

About four years ago an effort was initiated to form a Task Group by correspondence on Organisation and Management of Construction in Development Countries. Terms of Reference for this Task Group were drawn and they were sent to a number of experts in different developing countries (all the experts that we then knew of). We asked them to contribute to this research by sending a paper on any or on all of the issues of the Terms of Reference or on any other issues that they might prefer. The responses by letter were considerable, but the papers received were not many. Some experts though had promised to send a paper at a later time.

To facilitate responses a questionnaire based on the Terms of Reference was prepared and was sent to a number of experts. Some responses of completed questionnaires did come up. Since this material was not very much, research was facilitated by other published papers and reports, such as papers presented at the previous CIB W-65 Symposia, at the Seventh CIB Congress in 1977, at the published discussions at these Meetings, at Diploma Theses published during the last 5 years on the Human Factor in Construction by graduates of the Engineering School of the University of Thessaloniki, Chair of Construction Equipment and Management -- Professor N. Panayiotopoulos, reports of the United Nations and articles from construction journals. Also, discussions with engineers and foremen working with multinational construction companies in developing countries and last (but not least) the Panel Discussion at TIMS XXIII, Athens, July 1977 (Session TAII-4) on "Contributions of Management Science Techniques for Construction in Developing Countries," directed by me and with panelists A. Nagabhushana Rau, The Hindustan Construction Co. (India), Fount Smothers, Louisiana State University, John Woodward, University of Stirling (Scotland) and Miss Xafa, Helliniki Techniki Co. (Greek multinational).

Out of these we prepared this Monograph. It is not a complete work, since there are many more topics that have not been covered. We consider this to be a preliminary version of the Monograph, hoping that is may stimulate more reports and answers from experts in developing countries. If that is the case, it will be really worthwhile to prepare a final version, much more detailed and complete.

The outline of the Monograph is as follows:

III. The Human Factor

IV. Mass Housing and Industrialised Construction

V. Country Reports

VI. Epilogue

I would like to express my sincere thanks and gratitude to the Coordinator of CIB W-65, Dr. L. R. Shaffer, for his encouragement and valuable help throughout this work. Also, to the correspondents of this Task Group (quite numerous to name them all), who really got interested in this work. More thanks should go to the contributors for this monograph and especially to A. Nagabhushana Rau (India), Professor E. Beiu and his colleagues for two reports (Roumania), Professor Joseph Galea (Malta), Professor G. S. Birrell (Canada), Professor O. J. Uzomaka (Nigeria), and Professor Panayiotopoulos (Greece).

Thessaloniki, June 1981
Maria Pavlidou

INTRODUCTION

Till the recession of the recent year, construction activities have increased continuously and relatively more than the rest of the economy in most industrialised countries and in all developing ones. In Europe the construction sector employs directly 6 to 10 percent of the total labor force and 10 to 15 percent if those employed in the building materials and components industries are included. In developing countries the percentages differ somehow. Thus, the labor force employed directly in construction is a greater percentage of the total labor force, usually 10 to 15 percent or even greater. However, in some countries the labor force employed in the materials and components industry is a small percentage, because of the type of construction (mainly infrastructure) and of the materials used (a number of them imported, less sophisticated transformational procedures, etc).

Another important index is the percentage of construction in the formation of the GNP, which is 10 to 20 percent in developed countries and even more in some developing ones. As far as total investments are concerned, the construction industry accounts for more than half of total investments and even more of total gross fixed capital formation. Even after the recession of the recent years, which in some countries was quite severe, the above percentages have not become lower, but exact numbers are not available for a number of developing countries. Furthermore, there are no reliable estimates of the numbers of the self-employed and the do-it-yourself builders.

As in all production sectors, organisation and management are crucial for the better use of the available financial, material and human resources through productivity increase and development of manpower effectiveness. Construction in all countries has a number of peculiarities when compared with other secondary production sectors, the most important ones being the following:

- It does not have permanent installations, as do almost all of the other secondary production sectors, except for specific cases of construction (e.g., group of prefabricated buildings), which however account for a small portion of the total output of construction in almost all countries. In many cases the job site is extended over a vast area, sometimes even hundreds of kilometers, thus creating problems of coordination of interrelated activities.

- It does not have on-line production, except for some components used in prefabricated structures. It is non-repetitive and mostly an assembly operation.

- It is scattered throughout the country.

- It is labor-intensive, except for specific types of infrastructure projects, in which modern technological methods are being used. Such projects, however, account for a small percentage of the total construction of any one country and in some developing countries we may not find them all together.

Thus, construction managers have to take account of all the above and find ways to cope with the relevant organisational and management problems, which are quite different from the ones found in other secondary production sectors.

However, construction is not a service industry. It does include many services, but the end result is a product [18]. Therefore, all the organisational and management efforts should deal with this industry as a purely production sector.

Developing countries have themselves a number of characteristics, not all of them the same, which create different conditions for the construction sector, thus multiplying the types of problems to be encountered by management. Because they differ between themselves very much, we tried to group them in categories according to their availability of capital, the existence of human skilled and specialised resources, the degree of industrialisation, the existence of infrastructure, etc. We may then analyse all the matters pertaining to construction in each of these categories. Since we do not have detailed data on construction in all developing countries, we divide them into three broad categories:

1. Poor - Underdeveloped

These are countries in Asia and Africa, most of them former colonies, which have a great shortage of capital, inadequate skilled human resources, low degree of indusrialisation, economy traditional or dual, low ability of technological adaptability. The needs for housing and infrastructure are quite intense. There is also shortage of entrepreneurs and entrepreneurial spirit, as well as managerial abilities. Very large and overpopulated countries could also be grouped in this category.

2. Medium - Developing

These are countries in North Africa and South Africa, Middle East, South America, South-East Asia, etc, which are at a stage of development. Their capital resources are satisfactory but not abundant, they have skilled human resources but the specialised technical personnel is lacking or inadequate, they have a low to medium degree of industrialisation with considerable prospects of improvement and their infrastructure is inadequate. They usually have severe housing problems in their urban and semiurban areas.

3. Rich - Underdeveloped or Developing

These are mainly oil producing countries, which have abundant capital but in all other aspects belong to either one of the previous categories. Sometimes the capital they have is much more than they can use (or are willing to use) for developmental purposes, so they invest it in foreign countries, usually already fully industrialised ones.

A main characteristic of these countries is that the manpower is quite backward and is inadequate from the qualitative point of view for major developmental undertakings. Thus, along with most modernised activities, which are carried out by foreigners, almost all major construction projects are undertaken by foreign construction companies, some of them of a multinational nature.

Some common characteristics of developing countries regarding construction, found in almost all of them, are the following:

a) Infrastructure is inadequate, however it is a prerequisite for all their developmental efforts. Also, repair and maintenance of existing structures is insufficient.

b) There is a general housing problem, therefore building construction is intense, often absorbing capital that could be used for other basic infrastructure projects.

c) There is a general shortage of contemporary building materials, due to the inadequate production of the building materials industry of each country. The quality of the locally produced materials is sometimes not very high. Almost always materials and equipment are partly imported.

d) The economies of developing countries are either agricultural or dual. This fact has a great effect on the efficiency and the productivity of the manpower working in construction. This is intensified by lack of training of all but the highest degree technical personnel (engineers).

I. Organisational Forms for Construction in Developing Countries

The traditional contracting procedure is usually initiated by a contractor or developer or owner, who commissions a designer or consulting office to produce complete set of drawings and specifications for the project to be constructed. Usually these drawings follow a brief given by the developer or owner. The contractor executes the project according to the design and either uses it himself or gives it to others that will use it.

The boundaries of the different phases of this procedure, as well as the exact content of each phase cannot be drawn up precisely. The brief may be prepared by a consultant or consulting office giving alternative designing solutions for the project to be constructed. The owner, developer or contractor may assign to the same or to another consulting group the preparation of detailed drawings and studies for one or more alternative solutions. However, the brief can be very general and be prepared by the owner, according to his special interests. Phase I of the designs may contain alternative layouts as well as specifications for each alternative, to be used by the consultants of Phase II of the design. The number of alternatives to be studied and designed in detail would usually be decided upon by the owner, based on the information and recommendations provided by Phase I of designs. Such a case is quite often followed in Public Works construction and in industrial construction.

There could be many more variations of the content and the boundaries of the previous modes of actions. In all such cases, the completed project will be used either by the owner or by others to whom the owner or developer gives this responsibility.

The above procedure could be given graphically as follows:

Fig. 1

The traditional organisational approach to construction could be illustrated as follows:

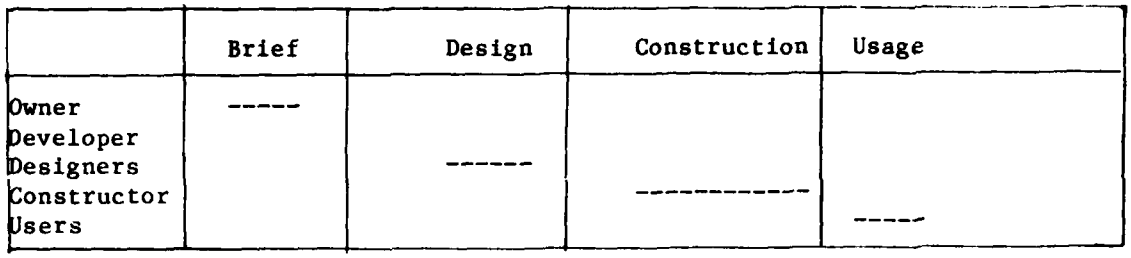

Fig. 2

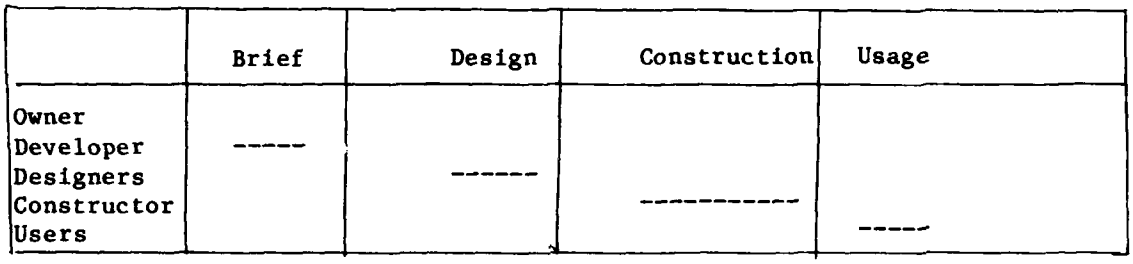

Fig. 3

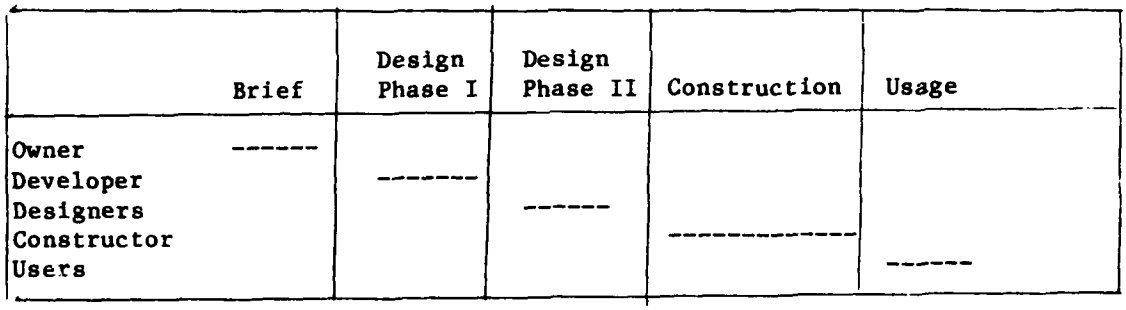

Fig. 4

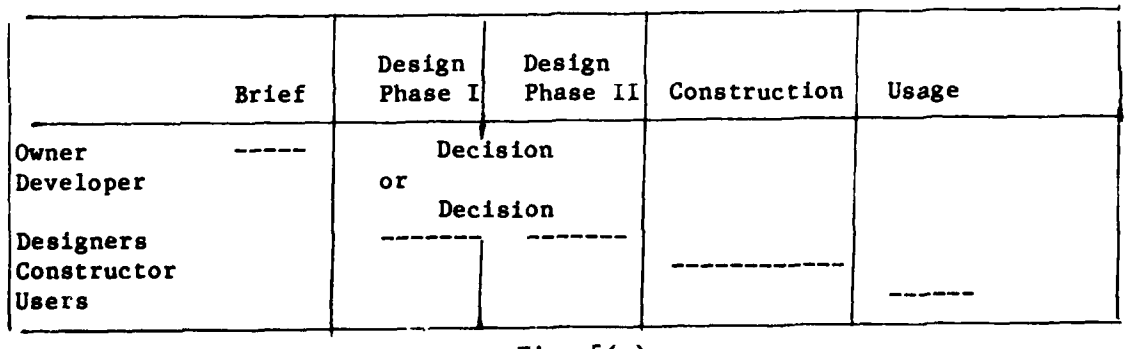

Fig. 5(a)

	Brief	Design Phase I	Design Phase II	Construction	Usage
Owner					
Developer	------				
Designers		-------	-------		
Constructor				----------	
Users					------

Fig. 5(b)

	Brief	Design Phase I	Design Phase II	Construction	Usage
Owner (of land)	------				------
Developer	- - - -	Decision			------
Designers		------	------		
Constructor				----------	------
Users					------

Fig. 6

Note: In all diagrams the owner could be himself the user.

The above diagrams could include the following cases:

a) The owner (of land and capital) assigns the design phase to consultants, then invites tenders for the project based on the completed design and then gives the project to use either by himself (capital investment) or by others on sale (construction enterprise) or by others free (benevolent construction, public works paid by the Government or municipality, etc). These cases are given in Fig. 2.

b) The owner assigns the coordination and general management of all the previous procedures to a developer. The decisions on who is to prepare the designs, which constructor or group of constructors is to be awarded the contract and by which procedure (tendering, direct awarding by invitation, etc), and how the user is to be given the change to use the project (sales, leasing, tolls, free usage, etc) may be taken either by the owner or by the developer or some by the one and some by the other or commonly by both. These cases are depicted in Fig. 3.

c) In Figures 4 and 5 we have a procedure for more complicated projects, where it is hard to include reasonable specifications in a brief before working out an appropriate layout. Thus, designing has to be done in two Phases, as mentioned before. In Figure 4 the Phase I layout is worked out by the developer, while in Figure 5 all designs are prepared by consultants, the same for both Phases or different ones for each Phase. Again, the decisions on who is to design in Phase I, which layout is to be chosen and who is to work on Phase II, etc, may be taken by either the owner or the developer or commonly by both.

d) Finally, in Figure 6 we have a more complicated arrangement, which may be used in buildings, as well as other types of construction. In the case of buildings the diagram would mean the following. The owner of land does not have adequate capital to finance the project. He also does not intend to provide the management effort nor the coordination of all procedures, so, he assigns a developer for the project, with whom he discusses possible exploitation of the land. They thus prepare a brief, on the base of which Phase I design is prepared by a consultant. The decision on the alternative is taken by either one of them or jointly by both. Phase II is prepared as usually. The developer does not finance the project. The contractor who gives the lowest bid is asked to finance the project himself. When the project is finished he is to own part of the finished project, constructed according to the designs he has been given. He may sell his part to make up his capital and profit, thus bringing in new users - owners of what they use - or he may keep it as capital investment and manage his property either by using it himself or by letting it to others (new users but not owners). The owner of land gets in exchange for his land part of the finished project, which he may use himself or sell it to others or let it to other users. Finally, the developer, who may have also collaborated in some part of the design or the construction, is either paid by the constructor in cash or given an agreed part of the finished project.

e) A variation of the above could result if the developer finances the project, besides coordinating all of the procedures. The constructor gets a contract according to his tender (possibly the one with the lowest bid) and is paid for the work. The developer will own part of the project when it is finished, to make up his capital, his compensation for coordination and management and his profit. This variation may include more speculation than the one previously discussed.

Such arrangements can be realised only when land is quite expensive and there is high speculation. Another prerequisite is that the land owner or the constructor or both do not have enough capital to undertake the project altogether. What is more important in these arrangements is that we have many owners-users of the finished product, who have themselves participated in some phase of the construction process. Given that owners-users may have a significant opinion about the form, the design, the materials used, the finish time, etc of the project, we can understand that owners-users, who have come prospectively into the scene at an early stage, take an active part in the management process and quite often they have the last word in the decision-making process.

Except for the above, we have the package deal, which is an integrated contracting procedure. A package deal may result from the previous diagrams when the developer or the constructor undertakes more than one of the project phases, as well as the management of the whole project. The advantages of the package deal may be increased efficiency, a wider range of competition when package-deal bidders are available and unified responsibility. However, when the package-dealer is not competent or when there is no competition we may have adverse results.

There are some marked differences in the overall procedure when the package deal is controlled by the developer or by the constructor, however, it would take too much space to analyse them here. The choice between the better

arrangement would be influenced, among others, by the type of structure (housing, industrial premises, road construction, bridges, dams, etc), its size and the degree of variety or special designs that users of the project might expect.

In the developing countries all of the above mentioned modes of construction are employed occasionally. Referring to the three categories of developing countries, we may note the following:

In the first category of poor countries, construction is either of a small scale, including housing and small infrastructure projects, as dams, ports, airports, highways, irrigation projects, etc. Construction of the first type is undertaken by local entrepreneurs and organisationally it usually follows Figures 2 or 5. In some housing projects Figure 6 might also apply.

Construction of large projects are financed either by the government from national resources or through international organisations (World Bank, AID, etc). In most cases local construction companies are not qualified to undertake the projects, either because they lack adequate mechanical equipment, or because they do not have the organisational structure to handle such large projects, or because they do not have experience and skilled personnel for the specific type of construction. Either because of this inadequacy or because of strict specifications that foreign organisations may impose, foreign companies are apt to undertake such projects. The organisational forms usually used are the ones depicted in Fig. 3, Fig. 4, Figs. 5, and Fig. 7, which is a variation of Fig. 5(a), with the following differences: the brief is prepared by the owner (government) and approved by the Financier, who may also add quality specifications and restrictions. The decision on the alternative lay-out to be chosen is taken by the financier, who also sets the terms of bidding for the contractors. When the project is ready to be used by the people, the Owner (government) has to pay back a long-term loan to the Financier.

	Brief	Design Phase I	Design Phase II	Construction	Usage
Owner (of land) Developer- Financier Designers Constructor Users	Brief	Decision ------	------	----------	long term loan arrange- ments ------

Fig. 7

In the second category of developing countries we may have all of the previous organisational forms. However, loans from international organisations are less frequent, therefore Fig. 7 is used accordingly. We may have though loans from foreign commercial banks, who don't interfere with the construction processes. The only consequence among the different modes of deciding might be a delay in the starting of construction.

Except for the above simple diagrams, we may have a number of combinations resulting from either merging some of the functions under one entity or breaking down others. We will mention two such variants, the first one usually employed in the public sector and the second on the private sector (referred

to for India in [9]; also found extensively in the Middle East, Greece and elsewhere).

a) The design division of the responsible public agency prepares designs, drawings, economic estimates and tenders. The project is undertaken by the contractor who gives the lowest bid and execution is carried out under supervision of the appropriate department (or division) of the public agency. This arrangement is quite traditional and stems from the fact that the public agency does not have equipment and a business-organised department to construct the project itself, however it wants to have not only a direct eye on the execution, but the right to control timeliness and quality of the works.

From the organisational point of view it is completely without justification, since the public servant who is assigned as supervisor does not know the organisational and communication lines of the construction company. It may also result in an unadmissible form of management, where the construction staff have two bosses, one is the public office engineer supervisor and the other is the company's project manager or foreman.

b) A private financing agency (developer) appoints to consultants the preparation of layout and detailed designs. Competitive tenders are invited, the one selected may not be the one with the lowest economic bid, but other considerations may also prevail, as earlier finish of the project, proposals for better quality materials, etc. The supervision is done by engineers of the construction company to which the contract was awarded, who is also responsible for the quality and timeliness of the work (this is a variation of Fig. 3).

Finally, in the rich but not developed countries we have abundant capital, severe construction needs, inadequate local construction companies and a strong desire to produce as much construction as possible and as quickly as possible. The most frequent practice is to invite foreign design firms and foreign constructors either by tendering or by contract awarding. The organisational forms most frequently used are the ones of Fig. 2, Fig. 3, Fig. 5(a), Fig. 5(b) and the package deal form.

Regarding organisational structures, we may say that local small scale companies have simple usually functional organisation forms, while foreign construction companies have more complex and efficient organisation forms, usually of the project management type, since such an organisation would be more effective than others for a company based for a large project abroad. More specifically, all types of project organisation [7] are occasionally used by such companies depending on the overall organisation of the company, the type and number of projects they construct, other possible parallel activities, etc. It is anticipated that mechanisation as well as the execution of more than one project simultaneously by the same company may drive firms to introduce more advanced organisational forms (questionnaire - question D).

The structure of construction firms in developing countries can be described as above. However, relevant responsibilities are not clearly defined [22]. The extent of the responsibilities assigned to each level depends on contingency, situational and environmental factors. Thus, the same company may have different responsibility charts for different projects or for different time periods even of the same project. These may vary greatly depending on

the individuals assigned to each job, the type of project, environmental factors, such as type and place of material providers, kind of interaction with public authorities and supervisory agencies, other projects executed simultaneously by the same company, etc.

In any case, the success of any organisational form depends critically on the quality of the people who have to apply it. Personnel may distort the form or even ignore it completely to match the needs of the common task to their individual talents (Seventh CIB Congress, Discussion in Section D).

II. Management Methods in Construction

There are two management approaches in any industrial environment. The organisational or quantitative approach and the behavioral approach. The first one uses quantitative management techniques, while the second one belongs to the realm of the behavioral sciences. Because of the peculiarities of the Construction Industry compared to the conventional Industry, a number of attitude characteristics of the labor force, that are usual in conventional manufacturing industrial environments, are of far greater importance at the construction job-site. The importance of such attitude characteristics is even greater in the developing countries, where workers have not yet developed in their majority an industrialised way of thinking.

In this section we will discuss the quantitative management approach, while the behavioral one will be discussed in the next section, together with other issues relevant to the human factor in construction.

The quantitative methods used vary from simple accounting to elaborate management science techniques. Even though in almost all countries we have a situation where some firms use quite simple quantitative techniques, while others have sophisticated Management Information Systems to help their decision processes and their managerial actions, in developing countries we have a rather peculiar situation of extremes. According to all reports,* small and indigenous firms use intuitive management approaches with quantitative techniques aiming mostly at accounting, while some large foreign firms having a large and complex contract, as well as severe organisational, coordination and allocation problems, may use elaborate management systems. However, their practices do not get through to the construction population of the country, because they make no efforts to train or educate indigenous subcontractors, engineers, foremen, etc. Even more, they make no effort to transmit the mentality of quantitative management to the local construction people.

Another comment regarding the management methods used is that very seldom (as, for example, in India or in Israel) experts in a developing country create management methods or systems adjusted to the specific needs and conditions of their country. Such systems have good possibilities of success and widespread use. However, in most cases engineers in developing countries aim at using quantitative management techniques learnt in industrialised countries (through their studies, work, book reading, articles, etc). Quite often though prevailing conditions are not the most suitable for these techniques and as a

* Also, extensive oral discussions with engineers and managers, whose firms have long been contracting in the Middle East and Africa.

result they may not have a rather restricted effect on cost reduction, time saving, better allocation of resources and an overall picture of a well-run and organised project. In some cases the unappropriateness of such techniues for the specific situation has the consequence of adverse results, thus creating a mistrust towards quantitative management.

The peculiar thing is that, while it takes a long time for an advanced technique to get through and be applied in a developing country, mistrust stemming from adverse results spreads widely very fast, thus hindering the use of even simple quantitative management techniques, which might otherwise break the iron curtain of conservatism and backwardness that prevails in almost all developing countries.

When we talk about management regarding construction, we may mean different things in the macro and in the micro level. Talking about the macro level first, we may say the following: in each country the whole sector is organised according to specific well-stated principles. Each organisational unit is then managed by those who are appointed for this job or who have the capability of influencing the sector to a degree that could be called "managing" the sector. Some examples of this overall management are the following:

a) In socialist countries construction is carried on mostly by the state. The government sets the goals, works out long-term development plans and yearly programs and takes the responsibility of applying them through its agencies and institutions. Thus, it has to organise the whole sector and manage all the formal and preplanned part of it. Additionally, there exists "do-it-yourself" construction and possibly self-employed construction activities for the erection of private dwellings and for their maintenance. The state can hardly organise these activities; it can however manage them sufficiently by controlling the availability of construction materials in the free market.

b) In market economies the construction sector is divided into public and private. The distinction is very important, since their modes of operation may be distinctly different. The sector as a whole is explicitly or implicitly organised by the government.

The case of explicit organisation is when there exist approved long-term development plans, which include the prospects for the construction industry as a whole system, including design, construction processes, building materials.

The case of implicit organisation is when long-term development plans do not exist or they do exist, but they do not include detailed prospects for the construction industry as a whole. However, even in this case, government sets out legislation on the way public and private works should be executed, on the conditions pertaining to construction activities (e.g., the contracting conditions between private enterprises and the state), on construction manpower employment and their social security, on incentives for more activity either for the construction processes or for the building materials production, on conditions for government-subsidised or bank loans for the construction industry, etc.

A government may in this way encourage or discourage enterprises to undertake activities in construction, thus absorbing entrepreneurial capital from other sectors or forcing construction firms to undertake other activities. It may enlarge or diminish the work-force employed in construction. May finance or heavily tax construction activities or the recipients of their products, thus creating a flow of capital towards or away from construction and affecting respectively the share of construction in the formation of GNP and of fixed assets.

Thus, there exists at any given time a clear-cut government policy on construction activities throughout the country. Quite often, this policy may extend to formulating incentives directed toward construction enterprises undertaking activities abroad. The state in such cases acts in a similar way to that towards manufacturing exporting companies, with one difference. The matter is more complicated for construction activities, because they involve human and equipment capital, whose use is exported temporarily and which when repatriated should have the least possible damage.

Besides this explicit or implicit organisation of the sector, the state proceeds to its management on the macro level. Regarding the public construction, this management may be exercised only at the top level, which is decision-making and coordination of projects. In other cases it may be extended to financial management, design and supervision management. For some part of construction, which is executed by state agencies (it may include only maintenance activities, but may also include erection of projects), the government goes all the way to management of the firm and management of the project, descending to the very micro level.

As for the private construction, the state exercises management either directly or indirectly. The objects of direct management are design and consultant offices, construction firms and independent engineers. The main tool of management is through contract awarding. Thus, design of some infrastructure projects may be awarded before the construction of the projects has been decided upon, so that consultant offices do not run out of jobs. The sequence of certain infrastructure projects, as well as their grouping together (or partitioning) to formulate larger (or smaller) contracts may be decided upon on the grounds of rational and continuous flow of work for private construction firms (both design and execution). Similarly, completely independent construction may be indirectly managed through appropriate legislation. Quite often the outcome of such management is not the one anticipated or desired. The state may then alter legislation or regulations, sometimes against roaring objections of interested parties, as engineers, architects, construction firms, workmen, etc.

In most of the developing countries the above described macro organisation and management of the sector take place quite often in a very realistic and sound way. There are no papers exclusive on this topic prepared for this research, however, one can get the above from [24], [25], [26], [27], [29], [30], [12], [16], [13], and [6], as well as questionnaires received (question D). Discussions with engineers and project managers working in other developing countries reinforce the above opinions.

One more comment on this issue is that more emphasis should be given to the macro problems of developing countries instead of searching extensively for

micro solutions to the construction industry problems (Comments by Gouzalez-Gandolfi, UN Representative, Seventh CIB Congress, Discussion Session H).

Among the first priorities for construction in developing countries, mainly the ones belonging to the two first categories (page -5-), is the research and decisions pertaining to mass low-cost housing schemes. By this we mean for which the total cost does not exceed a reasonable percentage of the national income (h), the total number satisfies a reasonable portion of demand, measured in number of houses per thousand inhabitants to be built in one year (b), and the average unit cost (G) is related to the national income per inhabitant (i). The relation that is usually admitted is

$$G = IO \frac{h}{b} i$$

For developing countries of the two first categories, this relationship gives a very low average unit cost, which should not exceed, according to accepted viewpoints, the income of a family of n persons in two years, i.e. $G \leq 2 n i$. Therefore, we either have to find new building techniques for such housing, which may cost that low or establish different ways of construction other than the owner/constructor relationship. Most developing countries devote quite some effort and money in research for usage of cheaper indigenous building materials and for new design and structural solutions that may be cost-saving. However, reduction* of cost for most countries is not adequate to meet the terms of the previous relationship. So, other solutions are being introduced, as site-granting, granting of certain indigenous building materials, encouraging of self-help or organising aided self-construction, etc.

There is a dangerous point of all of these, as pointed out many times by construction people from developing countries. We may result in cheap construction, which is unsuitable for the needs of the inhabitants, not containing necessary basics and not qualified for a long-term life. Thus, inhabitants may leave houses abandoned, in spite of the general housing shortage, running and maintenance costs may be disporportionately high and the physical and economic life of such buildings may be too short. Therefore, there must be some caution before low-cost housing schemes are launched.

On the micro level we may distinguish (according to the practice of W-65 up to now) management of design, management of the firm and management of the project. We will deal with each one of them separately, as they are practiced in developing countries.

A. Management of Design

By management of design we mean a composite process, which aims at insuring competent quality of design work and efficiency with which the work is executed. For the first role of management, the managers should employ staff of appropriate competence and in sufficient numbers to execute the assigned task. We therefore have a resource allocation problem. For the second role we have

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* Achieved up to now.

an organisational, a technological as well as a contingency problem. Management methods and techniques may be used for this end.

Although in developed countries advanced organisational forms (e.g., matrix), as well as quantitative management techniques have been reported as used in design (W-65 Symposia, questionnaire for this research, general articles on the topic, etc), in developing countries the situation is quite different. When design is done independently, and that is the case in rather large projects, the organisational form is usually functional. Management is most often intuitive, which means that the skills, knowledge and expertise of individuals gathered by practice are used as management tools. Quantitative techniques as well as analytical ones of the management science type are very seldom used. Such applications (at least reported ones) have occurred almost always in large design-consultant offices coming from highly industrialised countries and being awarded a design contract in a developing one.

As with many other words in our discipline, the word "design" is a multimeaning one. In building construction every action pertaining to the building and taking place after the preparation or the approval of the town planning scheme and before actual construction (excavations, etc), is considered to belong to the design phase. Thus, we have:

- General layout design
- Architectural design
- Structural design
- Hydraulic (water supply, etc) and Electrical (electricity supply, air conditioning, etc) design
- Special features design (lifts, escalators, acoustics, hospital equipment, etc)
- Development works design (roads, water supply systems, sewage, environmental protection or rehabilitation, gardening, etc)
- Quantity surveying
- Economic cost estimating
- Tender preparation
- Technical specifications preparation

Each one of those may have two stages. The preliminary one includes an analysis, preparation of preliminary plans and possible alternatives. The final stage includes the preparation of working drawings for the alternative chosen, as well as other details.

For infrastructure construction we have similar types of design, including the economic aspects of the project. There may even be a debate if scheduling and the preparation of time and cost bar charts or networks for the management of the project belong to the design process, since design consultants should know

about bills of quantities, cost estimating and technology used and should therefore be able and responsible to prepare them. Even though traditionally (or academically) we consider the later to belong to the construction phase and more specifically to the management of the construction process, it is often argued that construction actually starts at the construction site, therefore all previous preparations should belong to the design process. In fact, in most cases of public works the construction process starts when a firm is awarded the contract. Scheduling, including time and cost bar charts and network analysis, is often prepared beforehand either by the public department or by the designer. In such cases it is actually true that scheduling is part of the design process. Of course, it will be updated as work progresses. It may also be a policy of the department not to have any detailed scheduling before the contract is awarded and to ask the contractor to submit his scheduling plans soon after he gets the contract. In those cases scheduling should rather be considered to belong to the construction process and therefore be a part of management of the project.

We will consider in the following comments that the design process includes all planning, calculating, estimating and drawing that is necessary for the construction to take place. In large and in sophisticated projects designs have all the previously mentioned schemes, while in simple low-cost subsistence projects (which very often exist in developing countries), the design scheme may include only a simple planning diagram, the details being decided in site by the contractor according to the encountered situation.

A serious barrier to the quality and to the management of design in developing countries has been reported to be inadequate communication between the site and the designer (Seventh CIB Congress - Discussion in Section D). In developing countries the situation is quite varied. There are frequent cases, usually in private dwelling construction and in countries or regions which are quite backward, where the design is quite primitive, prepared by the dwellers themselves or by craftsmen of the trade. Such a design may include one or two rooms and an auxiliary space (kitchen, toilet, storage, etc). However, in the same country we may have the other extreme: a large consulting firm, indigenous or foreign, preparing elaborate designs for a large infrastructure or housing project and using advanced management techniques (e.g., India, Nigeria, Turkey, et al).

It is interesting to note here that a great many developing countries, especially between the ones belonging to the second category (page 5), do have specialised consulting firms, which are quite competent. It may often happen though that, while such indigenous firms are not always given the opportunity of a contract needing specialised and advanced technology and know-how, such contracts are awarded to foreign firms on a much higher bill, on the ground that they are "well-known" in the field and reportedly competent. This policy, which is quite common in many developing countries and has its origin in an overall lack of confidence, hinders the prospects of development and modernisation of the construction industry, denies to the local firms the opporunities of experience and creates a capital flow out of the country. This last issue is very crucial and important, because it is well known that a primary systemic element of the construction industry is capital.

Another important barrier for design consultants in developing countries is the difficulty of obtaining necessary and useful data (engineering, climatic,

social, etc). It is often the case that designers have information only from sources (books, articles, etc) published in developed countries with different climatic, social, etc, conditions. Developing countries are for the last years gathering relevant information through research studies and statistical inference, but this data, however complete they are, are often not published and do not become available to all design consultants. Education and training of designers often takes place in other countries, where conditions pertaining to construction are different. Thus, designers working in or for developing countries should get training on local conditions and on their consequences to design. As examples we may mention that in hot-humid climates, which are evidenced in a number of developing countries, provision should be made for

- adequate ventilation
- protection for solar radiation
- protection from insect and rain

On the contrary, in hot-dry climates we may need small ventilation openings to avoid the hot, dusty external air.

As a conclusion we may say that for complex and sophisticated design an integrated approach based on collaboration and coordination of all the design phases and all the disciplines involved will have very improved results, since, beside all other benefits of this approach, a number of communication and information-availability problems may be dealt with in a much more efficient way. For more simple designs information availability, prototypes and standardisation may result in impressive improvements.

B. Management of the Firm

From published reports, as well as from discussion with construction managers working in developing countries, it follows that there is no clear-cut management style for the construction firms. The most usual style, which is almost always used by indigenous firms, is the authoritative type of management. Thus, the resources of the firm are utilised in a rather personal way by the people in charge of the firm, who are either its owners or senior partners. We very seldom and only in very large firms find employed managers. They usually have either the authoritative style or are financially oriented. Their greatest concern is usually the economic viability and development of the firm.

Trying a comprehensive analysis of the issue, we should say that management of a construction firm should start with corporate planning. This includes the definition of the firm's objectives, the strategies to be followed for this end, the implementation of these objectives and the information necessary to support these processes. For corporate planning to be comprehensive we must have a sound internal organisation of the firm, since that is a crucial factor for its possibilities and capacities. The financial and the production capability of the firm are also factors that should be well known.

In developing countries corporate planning is usually primitive. Except for very large firms, undertaking many projects simultaneously, most other

construction firms have the owner or head of the firm do all corporate planning himself by putting together in his head pertinent information, plans and schedules. Even though putting thoughts on a piece of paper certainly gives great opportunities of improving this planning, this is seldom done. However, large indigenous firms and foreign construction firms carry on some more elaborate corporate planning.

The next management task is to decide on the construction methods and the technology that the firm will use, which will depend on the type of construction, the requirements of the clients and the technological and financial capabilities of the firm. Construction costs come as a consequence of this stage. Construction prices, which the firm will charge to its client are a result of this stage in connection with the objectives and goals of the firm.

Management of the firm has also to deal with internal organisation and with human resources problems. It is also closely related to management of the project. This is very natural since the construction industry is a production sector and the product is the construction project itself, which is an integrated entity with its own management problems.

Construction firms are characterised by their size and their specialisation, as well as their organisational structure and the management patterns they use. Generally speaking, we may group construction firms into the following categories [17].

a. Petty contractors and artisan technicians - They are small contractors who undertake specific jobs either as subcontractors or as piece-rated builders. They may or may not have semiskilled or unskilled workers to assist them. They don't have any clear management patterns and the most common managerial actions that they really exercise are the ones necessary for the security of new jobs.

b. Small and medium indigenous firms - They are the contractors who undertake the bulk of construction in developing countries. They are most often inadequately equipped with machinery, poorly organised and bound to the owner or principal manager of the firm. The construction techniques they use and their know-how are restricted, therefore they undertake ordinary infrastructure projects and improvements of existing works. Their management patterns do not have a specific trend, but they depend on the attitudes and the style of the owner of the firm.

As an exception in this category we should mention the existence of small or medium highly specialised firms (e.g., foundation works, concrete prestressing, etc), which may have advanced technological equipment, adequate know-how on their specialisation and a rather efficient organisational structure.

c. Large indigenous companies - Such companies do not always exist in developing countries. When they do exist, they usually do not have a complex organisational structure. Their management patterns vary considerably, depending on the personality pattern of the owners or head managers of the company.

d. Multinational companies - They are companies that undertake consulting, design, construction or a combination of those on an international level.

Their impact on the intensity of construction activities in developing countries as well as their contribution to the overall developmental processes are very significant, therefore we will briefly analyse their overall behavior.

Multinational firms undertake a very considerable portion of construction in developing countries. The exact percentage of this undertaking is hard to estimate, because it varies not only between countries, but also between years in the same country. In [24] it is estimated to be 25 percent of the activities in monetary terms, but this is a quite old estimate. Anyway, it gives a measure of significance that these firms have for the developing countries.

Their activities usually include large scale projects, which are beyond the abilities of the local industry. The types of projects are either infrastructure, such as transport, communications and utilities, or industrial plants. The client in the first case is either the government or a government subsidised organisation, while in the second it may be the government or an international company or, less often, a private local firm, such as mining, oil digging or processing, agricultural processing, etc. Multinational firms may also construct hotels and office buildings for international companies or government subsidised housing projects. Their undertakings include feasibility studies, planning, design supervision and management of construction. One firm may not do all of the previous activities for the same project, even though it may be well qualified to facilitate competitive bidding. However, it may undertake more than one of the previous activities in different combinations.

The importance of multinational construction firms stems from the fact that large infrastructure and industrial projects, which require advanced technology for their execution, would not be realised if such firms had not an international range of activities. The same is true for projects that require exquisite promptness during their execution, either regarding strict quality specifications or short time duration of construction. For such projects the contractor should provide efficient professional and managerial skills. Multinational construction firms may also guide the client of a developing country in obtaining financial aid for such projects in the form of long-term loans, since they readily know by experience the relevant procedures, the specifications for briefs and drawings that should be submitted for approval and all other pertinent information. It may also be that they provide their own working capital, which may be recovered on the basis of some agreement.

Competition among multinational construction firms is quite intense. Such firms have gone abroad for work either because the domestic market is saturated already or to expand their highly specialised activities or because profits are anticipated to be higher than domestically. It is interesting to note that some developing countries have also entered the market of international construction, examples being Greece, Taiwan, and Korea. Some companies of such countries undertake more work abroad than domestically. There are even examples of firms working abroad through a subsidiary, which undertakes no domestic work at all. Skilled and higher technical personnel, as well as equipment, may interchange between the two firms by contract or by leasing.

Multinational construction firms are usually among the largest of their kind in the country of origin. Their size, as well as the diverse services they can provide in the area of their specialisation, gives them important

advantages for strict competition. As for international design firms, we may note that they are usually highly specialised rather than diversified. It also happens that companies of a particular country tend to seek contracts in specific regions of the world, although not always for the same types of projects. For example, Greek multinational construction firms do not undertake projects in Latin America, but they do undertake different types of infrastructure projects as well as simple industrial complexes.

A multinational construction firm does not aim at working permanently in a particular developing country, since they only aim at projects with higher profit. They usually set a temporary office while the work is on and usually leave when the project is finished, taking also their personnel and equipment. Quite often the Project Manager or an assistant Project Manager stays over with a minimum of necessary staff to complete paperwork and financial matters. It may also be that a financial specialist of the firm has a rather permanent presence in a particular country (not necessarily staying permanently there), trying to negotiate project contracts with the responsible agents of prospective clients. Such a staff specialist may prove very valuable, especially if he has a good knowledge of his firm's capabilities as well as the clients needs.

Cooperation of international construction firms with other construction entities is quite usual. This cooperation may have the form of joint venture, usually with another international firm of the same or of different country of origin. Multinationals don't usually pursue joint ventures with local firms, however, it may be required by the client (often being the government) or it may be considered by the client as a feature of preference. In the not unusual cases when an international firm asks a local one to undertake a project jointly, it does so because of its familiarity with local conditions, with manpower recruitment, with the rules and regulations, etc.

The most usual aim of a local client, even more so if the client is a government, when they force or encourage joint venturing with a local firm is a) to give a job to a local enterprise, b) to grasp the opportunity of technology transfer, c) to achieve a better consideration of local conditions. However, the second and third aims are not always successfully achieved for the following reasons:

- The technological gap between the two companies is so large, that the local personnel cannot benefit from the cooperation, since they remain auxiliary till the finish of the project.

- The multinational firm does not really want to transfer any of its know-how, considering it a technological asset, similar to is capital assets, which should not be given without a reward.

- The local manpower is not really eager to learn or to be trained, therefore they don't take any advantage from the contact with the firm's personnel.

As for the consideration of local conditions, this can be achieved only if the members of the local firm are well-aware of the relevant problems, sensitive to their importance and capable of communicating these problems to the international firm.

For better results on the previous aims the client (government or other) should:

- Make sure that the local firm does actually get a job and does not make an agreement with the multinational to receive a commission and leave the scene.

- Encourage or demand that the international firm provides training and expertise to a minimum number of local personnel and for different skills and specialisation.

- Coordinate or supervise the consideration of local conditions and of environmental factors.

Subcontracting is a more preferred practice by the multinational firms. The recipients may be either smaller or specialised multinational companies or local firms. It is also possible that a multinational subcontracts most of the actual construction work and does herself the software and the management job. Subcontracting is generally preferred for jobs that are labor-intensive, since it will save the firm of recruiting abundant local manpower, with all the uncertainties and risks that their employment may entail.

Another issue is the possible imposing of limitations from the host country on the number of specialties that the foreign employees may have. Regulations may restrict the total number or duration of stay of incoming personnel, thus obliging the multinational either to employ local personnel or to train some. Generally speaking, multinational construction firms working in developing countries employ rather capital-intensive techniques. Even if their approach is less mechanised than for some other (mainly U.S.) construction firms, they are much more capital intensive than all the local ones. Quite often they adopt more mechanised ways of working then they would do in their home country to avoid problems relevant to recruitment and managemet of local labor. Also, to increase productivity and quality of construction, to cut down time (so that they get-their-money-and-go sooner), to avoid possible transportation and communication problems, to make better utilisation of their equipment and the money they have invested in it.

Included in the risks of a foreign company working in a developing country are the possible consequences of the political instability and turmoil that is prevalent in a good number of them. It has often been the case in the past years that political turmoil results in a halt of operations, breaking of the contract from the government and in some cases even nationalisation of any capital assets (equipment, etc) that the firm may have brought in the developing country. Multinational construction firms know that for this and for many other reasons their risks are high and they usually consider higher profit percentages in their tender preparation.

Lately, there has been some criticism in some rather advanced developing countries about multinational construction firms. The criticism regards not only the construction firms themselves, but much more the officials who decide on awarding a contract to a multinational firm. The criticism says that the advantage from such arrangements are only the ones for the firm herself. There are no actual benefits for the locals and no considerable transfer of technology takes place, at least comparable to the extra cost that the

multinational incurs. The country could as well send employees abroad and train them or pay the same amount to a local firm and they would be able then to subcontract the "hard" portion of work, or subcontract the design phase or bring in foreign highly specialised consultants for the whole duration of the project or for part of it, etc. Of course, such criticism may occur with reason only when the country is already entering an era of rather advanced developmental stage. It is interesting to note that Greece, which is such a country, continues to award contracts to multinational construction firms, especially for hydroelectric works and other specialised projects, even though there are numerous Greek international firms working in countries of the Middle East, Africa, etc.

C. Management of the Project

The construction project is the core of the construction activity and is itself an integrated set of actions. As such, it deserves special managerial effort, since it produces the end result - the construction project. Its importance is similar to the importance of production management for the other secondary production sectors and even greater, since construction is much less standardised than manufacturing. We should also mention here that a couple of years ago management of construction was almost equivalent with management of the project.

The main objects of management of the project are resource allocation for the execution of what the designs call for, coordination of activities to ensure timeliness of the work and cost optimisation, concern for the manpower working for the completion of the project.

While management of the project is a well-developed issue and a discipline full of content in industrialised countries, it is very intuitive in developing ones. Low degree of rationalisation, workers, subcontractors and contractors whose training and work is very often deficient in quality, low degree of standardisation and mechanisation, have as a result the acceptance of any kind of product from the construction sector, given the great needs for both infrastructure and housing projects. Management of the project is therefore not forced by any competitive means to produce more efficiently and has thus remained in its majority in traditional, sometimes even primitive standards.

Not intending to undervalue the issue of management of the project altogether, we should mention that occasionally there is usage of quantitative management techniques. Most often they are of the Gantt chart type and less often of the network family, as Critical Path Methods and other variations, including optimisation of time or cost or both or of manpower usage. The success of such endeavors is not always very considerable, because prerequisites for their usage are not always met.

It has repeatedly been realised that when a management technique, quantitative or other, is introduced and used in a company or at the site, its success depends not only on the way it is introduced and applied, but also on the environment in which it is used. In our case the most crucial factor of this environment is the human factor, about which we will discuss in a subsequent section. In any case, we should note that out of reports on the implementation of network techniques, we come to the conclusion that they tend to be

successful in relatively small, sufficiently autonomous and ambitiously expansive companies, who undertake civil engineering jobs of uniform size, characterised by high flexibility, relatively low uncertainty and important time and resource limitations. Such prerequisites are not always encountered in developing countries and it seems that this is the reason of the very low degree of implementation of quantitative management techniques. Probabilistic techniques (including PERT and others) are much less often implemented for all the above reasons and for lack of statistical data.

All in all, what we encounter most is intuitive management by the people in charge of the project site. In the best cases we may have a contingency approach (in the Fred Fiedler sense) by the project manager, who may be task oriented or behavioral oriented according to situational factors. In any case, construction projects, being an accumulation of a great number of varied tasks, call for a rather task-oriented approach for their execution and that is what we most often encounter not only in developing, but also in well-industrialised countries.

We should also note in this section that in many developing countries the construction sector is a purely dual sector, as is the rest of the economy. While the bulk of construction is carried on by small and medium size firms using traditional and often low quality ways, there exist in many of them (India, for example) large private companies, which execute specialised projects, such as hydro-electric ones using modern heavy construction equipment and plant and fully mechanised methods of construction [19]. Such companies operate with an elaborate organisational structure, highly competent technical personnel and efficient managers. However, their practices have a comparatively small influence on the modernisation of the total sector.

III. The Human Factor

The human factor in construction is a very decisive one. Even when the sector is quite advanced and with a high degree of mechanisation, it is the most labor intensive single secondary production sector. Since the construction jobs are not well standardised, initiative and a task-oriented attitude are factors that may have a very considerable impact to the productivity of the manpower.

A great number of construction workers in developing countries are semiskilled or unskilled. From the employment point of view, it is well-known that the social and political function of construction in this aspect is that it can provide employment for a large sector of the population having no special skills. This is true not only in developing countries, but also in industrialised ones. Subsistence farmers from rural areas seeking paid employment in the towns, rely heavily on construction work for a livelihood. It has also been reported that during recessions governments in developing countries hinder mechanisation of operations, so that the industry is more labor-intensive and more people are employed. Labor in such countries (e.g., India), both skilled and unskilled is not only readily available, but also cheap.

In any case, this issue, which is both social and political, is a very crucial one, because since the rate of unemployment is permanently high, ambitions to increase productivity by mechanisation, standardisation and industrialisation are all restrained. However, these countries have huge needs for housing, which needs broaden with time and whose satisfaction is a social responsibility of the government. It is beyond discussion that if capital was abundant, as it is in the developing countries of the third category (page -5-), the problem would only be a time variant.

Productivity of manpower is what matters most for the people responsible of the sector and for managers of specific projects. However, in most developing countries productivity is not very high. This is due to lack of training and expertise, poor coordination, little or no initiative, as well as other more specific reasons. Cultural and religious patterns may influence labor, wage rates and productivity rates. Also, geographical and climatic conditions may create unagreeable working environment for the personnel, thus lowering productivity.

However, from the worker's point of view, productivity is not their main concern. It seems that there are other issues, which are much more decisive for their attitude toward their work and consequently for their productivity. A research was carried on in various construction sites in Greece, aiming at identifying the attitudes and needs of construction workers. The research was conducted by the Chair of Engineering Equipment and Management of the Engineering School of Thessaloniki during the last 5 years, using very extensive questionnaires (more than 200 questions). Some of the questions were crisscrossed in different wording to spot inaccuracies of the responses. Even though Greece is not the most typical of developing countries, we report here some of the findings, which are quite descriptive of the needs and problems of the people who actually carry on all construction activities on site.

A great deal of the questionnaire is based on a Maslow approach to needs. Regarding physiological needs, some 60 to 65 percent said that they have a self-owned house,* and some 55 to 59 percent have a bathroom in it. Same issue in an adjacent geographical area in a research of 1976 gave the numbers of 48 and 53 percent. Out of those, some 32 percent made the house by their own savings, some 24 percent by inheritance, some 21 percent making a loan, and some 12 percent from their wives. It is notable that while a bit more than half have a bathroom, all of them have a T.V. at home. This is not a very proper way to give priorities to needs, since the cost of a bathroom with basic hygiene furniture does not cost very much. However, it is indicative of the approaches of these people, their rural origin and their cultural behavior.

In the question "What are the basic requirements of their branch", the answers were as follows: some 50 percent asked for higher wages, some 26 percent for less working hours, some 25 percent for better social security and medical service, some 24 percent lowering the age when they may receive pension, some 20 percent wanted stable jobs. Some 14 percent did not express a clear requirement, however from crisscross questions they were rather eager for more security in their jobs. It was a general remark that the insecurity that a great percentage felt made them indecisive in answering sometimes very simple questions. Continuing on questions about their job, some 57 percent wanted to work overtime, more than 90 percent (in a specific geographic area, but also quite high in the others) said they would be more concerned if they were to receive a prim or bonus.

Asked "What gives greater satisfaction in one's life", they answered having lots of money (28%), having a good and pleasing job (61%), realising plans that one has made for his life (54%), having the approval of other people (56%), having an agreeable family (more than 90%). However, asked if they know of any really happy man, only 55 percent answered that they did know one. Almost 70 percent of them believed that his happiness was due to his money and to a good job. At the question (asked at a much different stage at the questionnaire) what would make him more satisfied with his job, almost 40 percent said that they would like a better pay, almost 30 percent did not give a clear answer and the others said other things. It follows from all the above that the wage matter is very crucial for these construction workers. We should also note here that a great percentage of the workers that participated at the questionnaires were skilled or semi-skilled.

Regarding security questions, it is interesting to note that some 90 percent would rather have a stable job even with less pay, some 54 percent believed that if they were fired they would not find a job very easily, some 40 percent believed that they might be out of their present job. Even though the Ministry of Employment has inspectors who should visit work sites, construction workers said that they hardly ever see the inspector at their site, thus feeling less secure about their job. They were also not very pleased with their social security. Even though they were not very aware of it, we should also say that precautions against accidents are not at all satisfactory in Greece. Relevant legislation is still incomplete, workers have a minimum of awareness

* The estimates are based on research mainly in Northern Greece. Research is continued in other parts of Greece and in Cyprus, where findings are quite different.

while they work and it is mostly intuitive, there is no relevant training. These were shown in their answer that more than 25 percent had at some time some accident on site. Regarding social and esteem needs, they seemed to be quite content and satisfied, most likely because their colleagues were of a similar background, social and cultural status. This is probably the reason that, while they seemed to be discontent with the job itself, they are not very unionised and are not in any kind of general uprest. We should also mention here that quite often, especially for skilled workers, their wages are as high or even higher than for a graduate engineer. However, they still have the feeling of low pay, because they consider that the contractor makes lots of money out of their job and they do not get a fair share.

We could go on and describe a lot more about these construction workers, as their family status, their plans for their children, their social and political attitudes, their religious attitudes, the way they spend their leisure time, etc. Even though Greece is not the most typical of developing countries, the construction sector is probably closer to them. More specifically, construction workers have attitudes that are generally less developed than that for most other working sectors. This is probably due to the fact that the majority of them come from rural areas, a considerable percentage are still connected with agriculture and a great percentage have less than 10 years working in construction.

The above description is quite indicative of the manpower in construction. The topic is very wide and one could probably analyse a lot about specific characterisics of the manpower and their possible effect on the productivity of the sector.

IV. Mass Housing and Industrialised Construction

Virtually all developing countries have acute housing needs both in the urban and in the rural areas. Economic and social development, as well as population growth, increase these needs every year. Development also creates social awareness of the housing needs, thus increasing demands on the governments of the respective countries.

Even though there is a social responsibility of every government to facilitate the satisfaction of such acute shortages, it is utterly impossible to achieve such an objective in a short time period, even in the case of overabundant capital. Mass housing schemes are initiated in almost all developing countries as an answer to this problem, since it is obvious that the construction sector cannot produce but a limited number of houses on a piece-like basis, however well we may organise it.

Mass housing is often connected with low-cost or even with low-quality houses. This is not generally true and it shouldn't be. Mass housing means a scheme by which we may have many houses prepared in an organised manner and in short time. Thus, we may have large complexes of low-rise buildings, each having a considerable number of dwellings or high-rise complexes. Such complexes may or may not be low-cost. In fact, in many developing countries of the third category (page -5-), that is, developing countries with abundant capital resources, mass housing often means luxury dwellings with conveniences and equipment found in well-developed urban areas of industrialised countries. Therefore, we will discuss mass housing in general and then we will deal with low-cost housing.

The crucial factor in mass housing is the time it takes to complete a scheme, as well as the total cost, or rather cost overruns. Various approaches may facilitate a rather prompt execution of a large scale construction. Intense coordination of activities, optimal resource allocation, control of materials inventory and equipment utilisation may be used to achieve minimum time and cost overruns. A great variety of available techniques may be used to this end. To use them we should of course have complete and reasonable designed drawings, since inefficiencies or lack of drawings may have as a consequence long delays of operations.

In fact, design is a very crucial factor in mass housing. It must explicitly consider all local conditions, be repetitive and use materials that may readily be found in the vicinity. It must also be very flexible, since possible alterations affect the whole project in a multiple way.

Industrialised construction has emerged as an answer to mass housing, as well as a number of basic infrastructure works. Its development depends to a large extent on the organization development of the construction sector as a whole. Competent construction companies should be capable to carry on production of design, of materials and components and of the building product in an integrated way. They should develop new design patterns for closed building systems, appropriate building techniques and management tools. The result of this effort should not lower the quality of buildings and should satisfy the special requirements that users might have.

Another way by which the government may facilitate the development of industrialised construction is by establishing common rules and standards for building systems in the form of modules, conventions for joints and other technical standards, thus extending the use of standardised solutions to different design problems. Such an approach would help deveop an independent and specialised construction industry, producing building materials and components and allowing a wide range of applications and design solutions, so that any users requirements and desires would be met economically and efficiently.

For almost all industrialised construction modes (at least the ones that have emerged up to now) a considerable capital investment is necessary for installations where prefabricated elements may be prepared, as well as for equipment to be used at the erection stage.

For the development of industrialised construction a reorganization of the whole sector of construction in the country must be achieved. There must be a joint effort to this end from designers, constructors, industrialists and governmental agencies for establishing the necessary technical standards and passing appropriate legislation. Incentives for the standardised development of the sector must be established.

Because of all these prerequisites, few developing countries have achieved some considerable progress in industrialised construction. They are mainly countries which are not very backward and have adequate capital resources, as are the oil-producing countries. They have introduced industrialised building methods to supplement traditional ones in meeting their acute housing demands. To arrive at the most appropriate level of industrialisation, the level of managerial skills, the availability of capital and the use of readily available materials are among the most important criteria that should be used. In such cases industrialised building leads to a considerable increase in labor productivity and a reduction of overall costs of construction. If capital is available, the degree of industrialisation should be in conjunction with the training of skilled manpower and of managers for this type of construction.

Many developing countries have initiated some effort on industrialised construction, but quite a number of them got disappointed, their reports being very pessimistic and condemning this mode of construction. We think that they are quite wrong. The reason for their failure is not that industrialised construction is bad, but it is because they had as yet no prerequisite to launch such schemes. There is no production sector which is more productive by conventional methods than by industrialised ones. However, there are some very crucial factors that were critical for the development of industrialisation in construction in most developing countries, the most important being the following:

1. Labor in most developing countries is abundant and at cheap rates. In these countries this fact is almost always connected with a high degree of unemployment or underemplomont. At all times construction has been considered to be the safe way to provide emplomont to non-skilled or lightly-skilled workers. Therefore, it is against the interests of workers to use mechanised techniques for construction and not labor-intensive ones. Governments in such countries would not provide incentives for a general substitution of traditional construction by industrialised one. It is beyond saying that this situation is formulated because of lack of abundant capital, since otherwise

one could proceed simultaneously in industrialisation of construction, so that housing needs are satisfied, and creation of jobs in other sectors by appropriate investments.

2. Heavy machinery and equipment, as well as specialised technical personnel are necessary for a general adoption of advanced techniques. These are scarce in developing countries, are usually imported and it is not possible to acquire many of them because of both capital and currency restrictions.

3. In some cases legislation pertinent to technical performance of buildings can not readily be used for industrialised construction, because it is suitable for conventional construction only. Also, some other controls are hard to achieve, because bills of quantities are absent and some components are available in a ready-to-incorporate form. Even more, some clients may consider that their specific requirements will not be readily met, since industrialised construction can not be as flexible as conventional building.

It is evident that the fault for the failure of industrialised construction in such countries should not be accredited to the method but to the users. Legislation and controls should be thus applied, so as to facilitate the process and not to hinder it. In the production of goods we do not proceed to quality or quantity controls during all the phases of the process, but for the finished product or for completed stages in its production. It is the responsibility of the producer to do all intermediate controls, so that the finished product is satisfactory. A similar approach should be initiated for industrialised construction and controls should be applied to completed parts and components, as well as the completed product, rather than otherwise.

As for the satisfaction of special requirements of users, it seems that both the users-clients and the producers were not ripe enough for industrialised construction. Users did not understand that we have entered the era of standardisation and we can not have custom-ordered products for too much longer. The producers on the other hand did not consider adequately the specific needs and preferences of their clients, copying most likely somebody else's product without the necessary alterations.

From all the above we can conclude that industrialised construction can not just be launched in a country, if some basic prerequisites are not met. Industrialisation in construction and even more in building is an <u>evolutionary</u> and not a <u>revolutionary</u> process, as it was thought in some developing countries.

All in all, mass housing is an acute need for developing countries. For its satisfaction it seems that industrialised construction can play at the moment a restricted role, while other approaches may be more useful and appropriate, such as:

1. Rationalisation to the greatest possible degree of conventional construction.

2. Partial prefabrication, in situ or otherwise, of basic small-size components, so that a minimum of equipment and machinery is used.

3. Extensive use of local building materials and research for the possible use of other locally found materials for building purposes. Building research institutes may help a lot to this end.

4. Core housing may play an important role, provided that design and organisation of construction are so arranged, that core houses do not transform into squatters.

The above approaches can always result in low-cost housing, with one caution. The end result should be designed to be of adequate quality, otherwise we will have created squatters instead of reasonable housing complexes.

V. Country Reports

We will now discuss more specifically practices in several developing countries, according to reports from experts from these countries:

1. India [28], [19], [9], [22]

India has a population of more than 700 million and it is estimated that it urgently requires more than 15 million dwellings in urban areas and more than 76 million dwellings in rural areas to fully house the population (estimates of 1976 [9], [22]), besides other urgent infrastructure needs. These needs can hardly ever be met sufficiently, even with a very effective construction sector, since the increase in population continues at a high rate, there is deterioration of old dwellings and destruction of some every year by national disasters. The present rate of construction is 3 to 4 dwelling units per thousand of population. This rate should be raised to at least 10 dwelling units per thousand of population for a construction period of about three decades to make housing rather adequate. Such an endeavor could be accomplished by a well organised and efficient construction industry using industrialised methods for mass housing under well designed low-cost schemes. Such a policy would call for mechanised time-saving techniques and for overabundant capital resources.

The situation though is rather different. Capital resources are very restricted, since the country has a very low national income per inhabitant. Unemployment and underemployment are very acute, both in urban and in rural areas, due to the low degree of industrialisation, therefore mechanised and industrialised construction techniques cannot be introduced country-wide, even if there were no restriction on capital investments. The construction industry, both building and infrastructure, is not well organised. It is tradition bound using conventional building materials and construction techniques. Building operations are labor intensive, employing large numbers of semi-skilled and unskilled workers and are greatly influenced by local site conditions regarding availability of building materials, construction modes that can possibly be employed, etc.

Mass housing schemes have been designed by various Government or Government-subsidised organisations, aiming at low-cost housing. Most of these schemes are quite efficient, but they are applied in a restricted scale because of the beforementioned capital and employment restrictions. Both public and private housing projects are government subsidised directly or indirectly. In many cases self-construct programs or aided self-construct programs are initiated,

usually quite successfully. In such programs there is granting of design and skilled labor.

In spite of all the efforts for mass housing schemes, the bulk of construction is still undertaken by small artisan-like entities. Some general characteristics that are usually encountered in this type of construction are the following:

- There occur very considerable cost and time overruns. For cost up to 350 percent and for time up to 170 percent [22]. These indexes are descriptive of the general inefficiency of the construction sector. Some of the reasons for these overruns are the following.

- Architectural and structural drawings are not supplied on time. There are also frequent changes in architectural details and specifications at the finishing stage due either to inefficiencies of the design or to changing and harsh local conditions.

- There is lack of planning for materials procurement and considerable delays in the supply of materials.

- The coordination of the total process is inadequate. The consequences are more crucial at the job-site.

Mass housing has been considered as capable of overcoming most of the above difficulties. However, even though such projects are constructed with standardised techniques and with prefabricated components, we still have overruns, which are often quite considerable. Nonavailability of basic or other materials, as cement, steel, pipes, etc may be the reason. Coordination is often poor or even not formal between the working teams (main, contractors, subcontractors, etc). For industrialised techniques to be productive, there has to be a continuous flow of work both at the prefabrication stage and at the on site process. However, in most parts of India the economy is purely dual and there are labor shortages during the harvest season. There are also delays at decisions to be taken at the finishing stage.

Manpower, except for the great irregularity in employment, has quite a number of other drawbacks. They are quite indifferent towards the whole construction process, industrialised or other. Therefore, they resume little responsibility, do not bother for handy solutions, do not mind very much for delays in operations. Because of poor coordination and poor management, there is great percentage of time spent by technicians and skilled workers in auxiliary jobs, which should be done by unskilled ones. There is also great percentage of idle time. Bad quality of what is produced has as a result often dismantling and rebuilding of bad work.

To cure some of the ills that have been mentioned, the experts in [22] propose an Integrated Management System for building projects comprising of:

- A Master Network, by which primary objectives should be identified and work divided into manageable units for planning and control purposes.

- Detailed micro networks for precontract planning, land development and execution of construction.

- A checklist of the various drawings needed at the design, estimate and execution stages, in relation to the relevant networks, to be used for coordination purposes.

- To overcome shortages and delays due to materials, prepare a materials management chart in relation to the relevant networks. Also, detailed travel charts for men and materials at site.

- Line of balance planning for mass housing projects to maintain continuity of labor for repetitive work.

In a dual economy, as that of India, the construction sector is also dual. This is more evident in the size and nature of the construction companies. They range from small private units to well organised corporate companies. The ones concerned with buildings are mostly of the first type, while most of the corporate ones work on large civil engineering works.

Since India is a very large country with considerable variations in the needs, population mentality and culture, the sector of construction has by necessity many facets. It seems therefore that one could proceed almost endlessly in describing and in analysing the issues.

2. Malta

The report by prof. Galea (6) gives a very comprehensive general view of the overall conditions in the Republic of Malta (geographical, geological, historical, political, economic), as well as all factors pertaining to the construction sector (building materials supply and production, construction methods, construction industry organisation, public construction, architectural and civil engineering firms, contracting systems and project management, education of personnel). It follows from the report that the construction needs are quite restricted in Malta, which is after all a very small nation. The organisation of the sector is quite traditional. Management at all stages (planning, design, execution) is rather intuitive. Most of the building is carried on by small building teams. However, there is usually very little coordination between them and it is not uncommon for certain work to have to be redone because of damage by the team of another trade. There is very little, if any standardisation, even on mass housing schemes. Management is rather pragmatic and no scientific method of control is usually adopted.

Public works (mainly infrastructure) are to some considerable degree connected with the military. It seems that this sector is much better organised and managed by public departments.

Construction firms, both design and contracting, are either small or intermediate. There are few larger firms, but they mainly work abroad in the Middle East. They have permanently staffed offices, efficient design section, workshops for maintenance and servicing of plant and equipment, well trained and competent staff. Their management approach is more efficient, for quantitative control they employ simple bar charts. There is no great use of scientific management techniques, although architecture and civil engineering students take courses on project and office management, professional practice, etc. It is generally felt by prof. Galea that the sector can be improved

greatly, especially regarding the management aspects, which will have a very considerable effect both on the cost and the quality.

3. Roumania

Two reports by prof. Beiu and his colleagues discuss extensively about industrialised construction and about management methods of the Operations Research realm.

In the first report [1] the effects of mechanisation on site as well as industrialisation on OMC are discussed. Organisational problems are reduced by mechanisation, but a new department for the appropriate use (and maintenance) of the mechanical equipment is needed.

In industrialisation we have centralisation of activities and wide use of prefabricated elements (their volumes increased 4 times in 10 years and they account 20 percent of all concrete works). Techniques pertaining to concrete cast in situ have to be improved and standardised, as with the use of formworks, stock scaffoldings, reinforcements with welded frames and grates, central mixing and transporting with automixers, etc. Also, slip-forms, lifting, etc should be wider used. The organisation of building companies in Roumania is then reviewed from the aspects of the degree of industrialisation and mechanisation of construction.

In the second report [2] an integrated management system of production (SICOP) for the activities of construction is presented. This system has been initiated by the Centre of Organisation and Cybernetics of Construction in Bucarest. The system contains subsystems for production, planning, mechanisation, personnel, financial. It is a very advanced and elaborate management system.

4. Turkey

In Turkey, a country with acute housing needs, there is a growing tendency for mass low-cost housing construction [3]. Initially this policy has been applied for post disaster housing projects. The two prefabrication plants are established in Ankara and serve the whole country, using a light-weight panel system of the closed type. However, since the existing building codes and regulations are generally issued for individual construction, they sometimes cause additional problems in obtaining building permits for such housing developments. As more private enterprises aim at producing considerable numbers of housing units at reduced time duration and cost, a number of them concentrate on the rationalisation of conventional methods, some using quite advanced prefabrication systems. It is anticipated that this tendency will grow considerably during the coming years.

In the second report [21] core housing is explored as an approach to low-cost housing. This is a solution that turned to be advisable when the user's resources are limited, so he might start with a minimum core, which would satisfy his housing needs in a basic way, and improve the building as the possibilities are improved.

This approach has both technical and organisational problems related to planning, material production, finance and control. These problems had not been

dealt with adequately in the application of core housing in Turkey, with the result of unwanted squatter establishments. The conclusions of a research on the matter are that core houses must have an open ended technology. This means that the spatial organisation and the building system must be extendable in alternative ways. Also, the realisation of core must be preferably carried out by the public sector. This will lead to industrial systems, that can be better organised and managed. For this end a public organisation can be established in order to realise such developments or at least to control the development. Another conclusion is that if the user realises the development, he should be provided with materials, basic machinery and technical knowledge or aid.

5. South Africa

The report by Dr. Miners [10] on Industrialised Building in South Africa is very interesting and very revealing of a case where industrialized building was not so successful in meeting the needs of the clients. At first technological problems were dealt with and entrepreneurs were bringing in know-how or developing industrialised systems. Long distances between metropolitan areas and a fragmented market were the major problems during the first period. Also, in rural areas the capital intensive methods of industrialised building could not be afforded.

Considerations of meeting urgent urban housing needs in low-cost by industrialised methods were not very encouraging because they are capital intensive and relatively sophisticated. Conventional building methods with a very high degree of rationalisation were considered more appropriate. The obstacles for industrialisation were many. Building regulations referred to conventional construction, so there was a problem of how to judge technical performance. A special Board was established for this reason. Another obstacle was that tendering procedures and conventional contracts were not suitable for industrialised building. Most systems were of the "closed" type, therefore the flexibility in meeting clients requirements was restricted. Cost comparisons were also very difficult, as was financial adminstration and control, because bills of quantities could not be provided.

Altogether, technological problems were solved efficiently, but the other economic, social and administrative problems have not been solved yet. It seems that the social environment is not yet ripe for the actual rationalisation of construction.

6. West Indies

There is a current trend in some Western Indian islands, especially Trinidad, Tobago and Jamaica, towards the introduction of a wide range of industrialised building systems to cope with the present demands for more housing. In the other smaller, less developed islands the only form of construction is the conventional one. In the report by Dr. Chin [5], which is very comprehensive on the issue, industrialised building systems are classified as follows:

a. Industrial production of building components by assembly line techniques, as window doors, kitchen cupboards, etc.

b. Prefabricated panelised units, either factory or site produced.

c. Industrialised on-site construction techniques using special machinery and forms.

d. Monolithic box units, usually factory produced, which may be completely self-contained mobile homes or room size units.

It is reported that 25 percent of total housing construction in Jamaica has been constructed during the last 15 years by industrialised techniques of the second and third category. In Trinidad and Tobago the policy of the Government is to develop combinations of traditional and industrialised construction systems best suited to local conditions and locally produced materials. There are many unemployed workers in these islands, which means that traditional techniques cannot be abandoned all together. It seems from the report that industrialisation of construction is in a good way, adjusting itself to the specific needs and conditions of the islands.

The above seem to be facilitated by the fact that oil revenues have provided the islands with abundant capital for investments and for spending [8], as well as the fact that there are considerable deficiencies of trained and skilled manpower.

VI. Epilogue

From all reports on construction in developing countries, as well as from experience, it follows that most efforts towards organising and managing the sector try to achieve problem solving rather than problem planning. It seems that planning is rather inadequate and maybe this is the reason for the failure of some new endeavors. This planning can be considered of having three phases, which are interrelated and interdependent. They are:

a. resource planning

b. organisational planning

c. implementation and control planning

Of all three, we will try some analysis of the first.

The production factors of construction can be categorised as follows:

a. Materials of all kinds and land used in the construction process

b. Water

c. Energy, as oil, electricity, gas, other energy-productive materials and lubricants, as well as other means used for the operation of equipment (e.g., compressed air)

d. Special services, as consultants, lawyers, advertisements, patent-usage, etc. Also, costs for transportation of people and materials

e. Direct and indirect taxes, overhead costs, profit

f. Heavy and light equipment, used directly and indirectly during construction, as well as spare parts for them

g. Skilled and unskilled labor, including higher technical and administrative personnel

The degree to which each factor influences the final output is different for every kind of construction, depending also on the prevailing economic, political and social conditions. In this manner it is possible to have substitution of some factor by another. Developing countries should very carefully examine the alternatives that they may employ to find the one most suitable to their specific needs. For a rather comprehensive analysis of the contribution of each production factor in the construction processes in a developing country see [16].

A very important interrelationship between the several factors of construction is that pertaining to cost. It is probably the most important one and it can give us a good insight to the development of the sector as a whole. Assuming that these factors are independent of one another, we may call S the total cost of a construction project as follows:

$$S = K_m + K_o + K_e + K_p$$

where K_m is the cost for all materials used, including water and fuel, as well as use of land. K_o is the cost for special services, direct and indirect taxes, overhead costs and profits of the enterprise. K_e is the cost due to the use of construction equipment, including depreciation, operating and maintenance costs, but not including wages and salaries of skilled and unskilled labor used for the operation or the maintenance of the equipment. K_p is the total cost for wages and salaries of skilled and unskilled manpower working in all parts of the project, including higher administrative, technical and engineering personnel.

We can now proceed to a cost analysis of a specific construction project, of a complex of similar projects or of the total construction in a specific geographic area or even of the construction sector as a whole.

1. The cost K_m depends upon the availability of construction materials. This availability depends upon the existence of relevant natural resources and their organised exploitation, which involves installations for processing the raw materials, and upon the development of the construction materials industry.

Improving the processing or the industrial production of materials, as well as the energy producing modes, we can decrease the cost K_m both absolutely and relatively to the other factors in S.

The use of new kinds of materials or new modes of construction or new designing styles may change the relative level of K_m compared with the level of the other partial costs. This is where low-cost housing comes in. However, before launching a new low-cost scheme, one should estimate the percentage of

savings against possible lowering in quality or in life duration or in aesthetics or any other matter that may be of importance to the users.

2. The cost K_o may be assumed to constitute a fixed percentage of the total cost. It should be estimated for each specific project. It may also be estimated for a specific type of construction in a specific country and for a specific time period. This estimation is sometimes not very easy, since this cost involves many unweighted factors.

3. The cost K_e is different absolutely and relatively for each kind of construction (buildings, highways, hydraulic works, ports, bridges, maintenance of old construction, etc). It may also vary according to locational factors, as foundation conditions, type of terrain, special characteristics of sea or river, etc. However, in each specific situation, we may have different relative values of K_e according to the degree of mechanisation.

While in industrialised countries the rate of mechanisation and the types of equipment used for specific types of construction are almost similar, in the developing ones there are considerable disparities in mechanisation even among similar projects constructed in the same country at the same time by different companies. This is due to many factors, among which the most important ones are the lack of adequate capital to invest in construction machinery and the overabundance of unskilled labor. There is also lack of skilled technicians for the operation and maintenance of equipment, lack of job shops for maintenance works and quite often inadequate stock of spare parts. As a consequence, there have been reported cases when mechanisation resulted in higher costs than if work had been done manually.

There is a considerable lack of statistical data on the relative values of K_e, therefore estimating the percentage of the total cost that may be attributed to the use of equipment during construction is not always easy. However, we can say that this cost is made up of depreciation costs, cost of operation and cost of maintenance of equipment. An analysis of each of these can be found in [16].

4. Finally, the portion of the total cost that may be attributed to the use of manpower during the construction stages is a function of the wages and salaries paid and it is influenced by the productivity of this manpower. This productivity may be considered a function of the attained education, general and specific, in conjunction with the effectiveness of education, as well as a function of the social and technological level of the country, in conjunction with the effect that the sociopolitical frame of the country may have on the efficiency of technical workers.

Such a cost analysis may help us to give relative weights to the different factors of construction. If we seek the development of the sector as a whole, we have to plan the development of each one factor and all of them in conjunction. For some factors, it may seem appropriate that their relative value becomes less, or else that they form a smaller percentage of S. However, this is not always possible in a rational way. As an example we should mention the portion due to equipment. Since equipment is a capital investment, which can not be liquidated out of the country, but only on rather costly and disadvantageous ways, the total amount of equipment used can not become less, except to the degree that some of it become obsolete and cannot be used. So,

assuming that we have the same amount of construction from year to year, if we decide to lower the degree of mechanisation, we can do it rationally only to the degree of obsolescence of equipment. Conversely, if we want to maintain a similar degree of mechanisation, we have to plan the total budget to be allocated to construction to be in line with the existing equipment, otherwise we will have underutilisation of this capital asset, which is also the most scarce of the construction factors in developing countries. A simulation model to facilitate such planning is proposed in [16].

To return to the micro level, construction firms of developing countries should try to develop themselves both technologically and managerially, keeping in mind an analysis similar to the previous one. To do so they have to search for the best possible utilisation of existing resources inside and outside the firm and develop appropriate techniques for this end.

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