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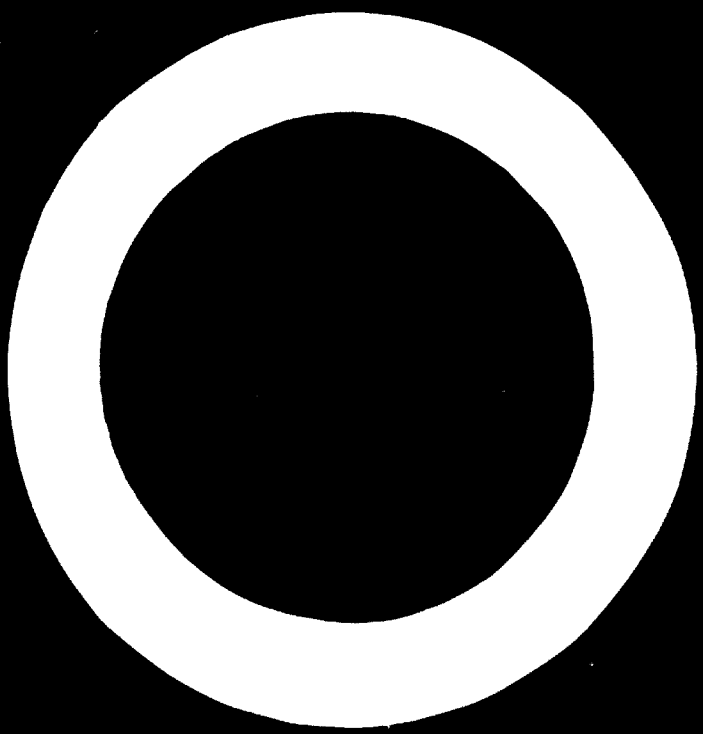
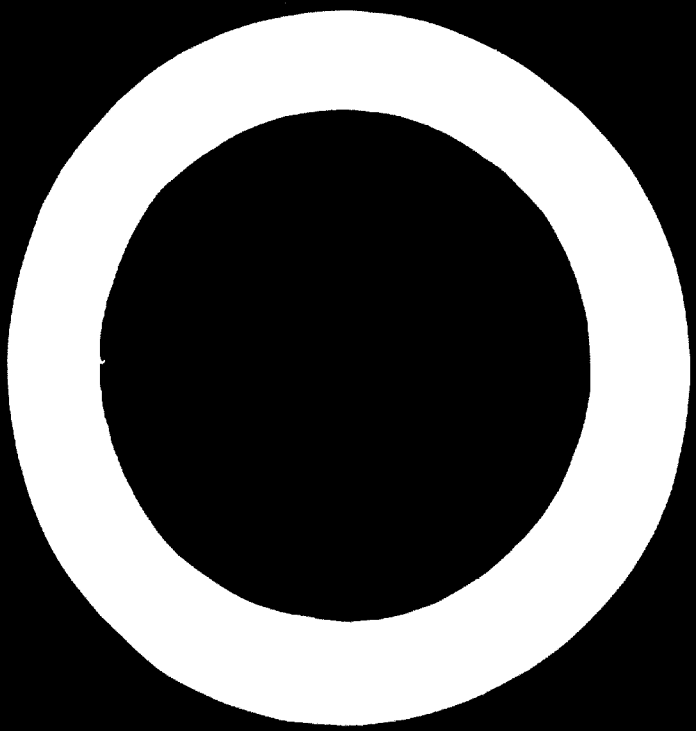
UNIDO MONOGRAPHS ON INDUSTRIAL DEVELOPMENT

Industrialization of Developing Countries: Problems and Prospects

CONSTRUCTION INDUSTRY

UNITED NATIONS





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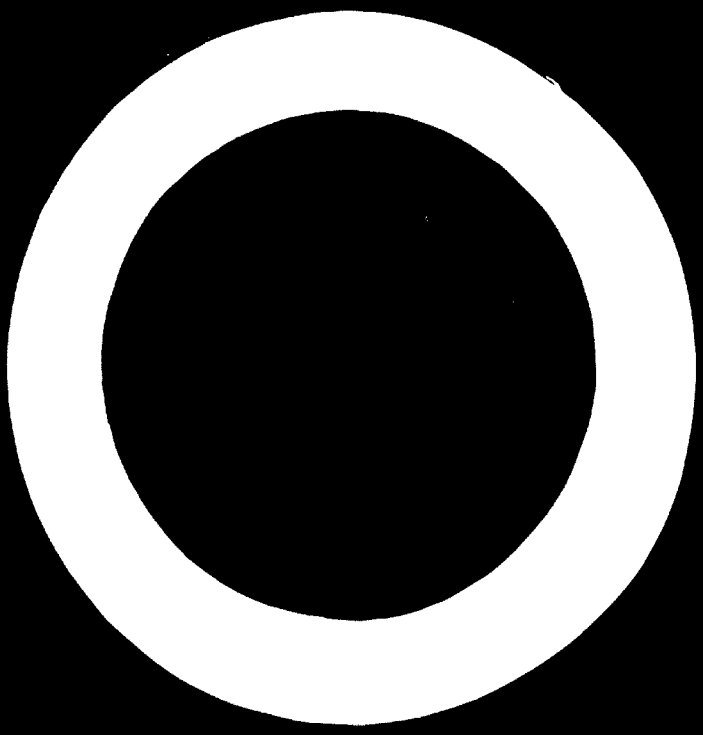

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
VIENNA

UNIDO MONOGRAPHS ON INDUSTRIAL DEVELOPMENT

Industrialization of Developing Countries:
Problems and Prospects

MONOGRAPH NO. 2

CONSTRUCTION INDUSTRY

Based on the Proceedings of the International Symposium on Industrial Development (Athens, ~~November–December~~ 1967)

UNITED NATIONS
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Foreword

The International Symposium on Industrial Development, convened by UNIDO in Athens in 1967, was the first major international meeting devoted exclusively to the problems of industrialization of the developing countries. It followed a series of regional symposia on problems of industrialization held in Cairo, Manila and Santiago in 1965—1966 under the sponsorship of UNIDO and the United Nations regional economic commissions, and a similar symposium held in Kuwait in 1966 under the sponsorship of UNIDO and the Government of Kuwait.

The Athens Symposium was attended by some 600 delegates from 78 countries and by representatives of various United Nations bodies, international organizations and other interested institutions in the public and private sectors. It provided a forum for discussion and exchange of views on the problems and prospects of the developing countries which are engaged in promoting accelerated industrial development.

The Symposium devoted special attention to possibilities for international action and for co-operative efforts among the developing countries themselves, and explored the scope, means and channels for such efforts.

Studies and papers on a wide range of problems relating to industrialization were presented to the Symposium—by the UNIDO secretariat and by participating Governments, international organizations and observers. An official report, adopted at the Symposium, has been published by UNIDO.[1] Based on this documentation and the discussions in the meeting, the present series of monographs is devoted to the 21 main issues which comprised the agenda of the Symposium. Each monograph includes a chapter on the issues presented, the discussion of the issues,

[1] *Report of the International Symposium on Industrial Development, Athens 1967* (ID/11) (United Nations publication, Sales No.: E.69.II.B.7).

and the recommendations approved by the Symposium. Some of the monographs deal with specific industrial sectors; some with matters of general industrial policy; and others with various aspects of international economic co-operation. An effort has been made to make the monographs comprehensive and self-contained, while the various economic, technological and institutional aspects of the subject matter are treated within the context of the conditions generally prevailing in the developing countries.

Since economic, technological and institutional aspects are described with particular reference to the needs of the developing countries, it is felt that the monographs will make a distinct contribution in their respective areas. They are intended as a source of general information and reference for persons and institutions in developing countries concerned with problems of industrialization, and particularly with problems and issues of international co-operation in the field of industrialization. With this in view it was considered that an unduly detailed technical presentation should be avoided while at the same time enough substantive material should be offered to be of value to the prospective reader. For a more elaborate treatment of the subject, the reader is referred to the selected list of documents and publications annexed to each monograph.

The annexes also contain information on the areas in which UNIDO can provide technical assistance to the developing countries on request; a selected list of major UNIDO projects in the respective fields; and a list of meetings recently organized by the United Nations.

It is hoped that the monographs will be particularly useful to Governments in connexion with the technical assistance activities of UNIDO and other United Nations bodies in the field of industrial development.

This monograph has been prepared by the secretariat of UNIDO on the basis of material submitted by Professor D. A. Turin, University College, London.

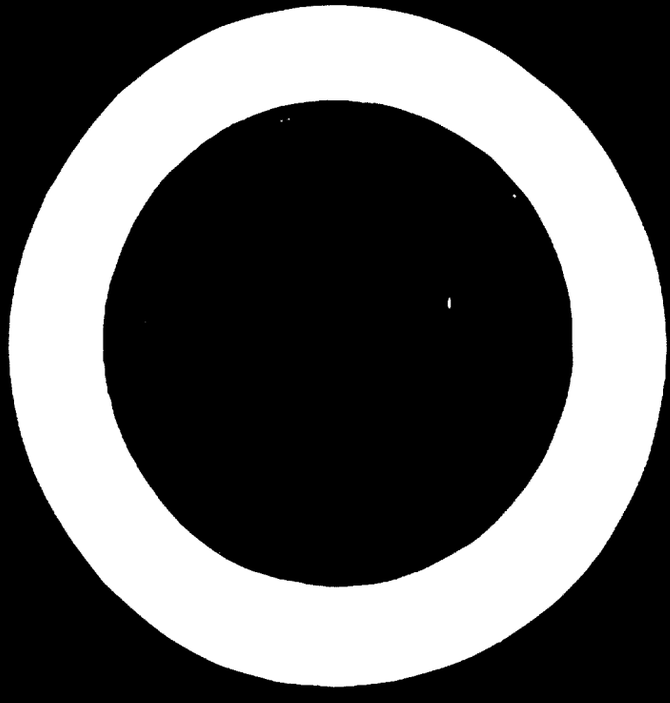
CONTENTS

Explanatory notes

Dollar ($) refers to US dollar unless otherwise specified.
Billion signifies thousand million.

The following abbreviations are used in this monograph:

CIB	International Council for Building Research and Documentation
ECA	Economic Commission for Africa
ECAFE	Economic Commission for Asia and the Far East
ECE	Economic Commission for Europe
EEC	European Economic Community
EPA	European Productivity Agency
FAO	Food and Agriculture Organization of the United Nations
GDCF	gross domestic capital formation
GDP	gross domestic product
GNP	gross national product
ILO	International Labour Organisation
OECD	Organisation for Economic Co-operation and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
WHO	World Health Organization



INTRODUCTION

The present monograph is concerned with the construction industry and its role in economic development. By its very nature the study is broad in character and covers only the salient features of the industry, with particular reference to the problems of developing countries. It should be read in conjunction with Monograph 3 in this series, on the Building Materials Industry.

Chapter 1 deals with the place of construction in the national economy and relates the main aggregates of construction activity to the level of economic development. The first comparison is made between construction and the gross domestic product (GDP). Statistical analysis shows a strong correlation between the *per capita* value added by construction and the *per capita* GDP. The rate of growth of the value added by construction is slightly greater than the rate of growth of the GDP; as a general rule construction accounts for 3 to 5 per cent of the GDP in most developing countries and 5 to 9 per cent in most industrialized countries.

The same pattern applies to the part of construction that contributes to gross domestic capital formation (GDCF); capital formation in construction (valued gross) accounts for 7 to 13 per cent of the GDP in most developing countries as compared with 10 to 16 per cent in more than half the industrialized countries. In most countries construction also represents between 45 and 60 per cent of all fixed capital formation. Although fixed capital formation increases with *per capita* GDP, the percentage of this investment going into construction does not appear to be related to the level of economic development. On the other hand, annual fluctuations in construction investment are considerably greater in developing than in industrialized countries, which makes short- and long-term planning for the construction industry more difficult.

The construction industry employs between 2 and 6 per cent of the labour force in developing countries and between 6 and 10 per cent in industrialized countries.

The casual nature of construction employment is revealed by the high incidence of unemployment. The percentage of unemployed construction workers is between two and three times greater than the average rate of unemployment for the economy as a whole. There are also some indications that wages in construction in developing countries tend to be lower than manufacturing wages; the relationship is reversed as the economy becomes more industrialized.

If the patterns of construction inputs and outputs in an industrialized and a developing country are compared, it will be seen that developing countries are heavily dependent on direct and indirect imports not only of materials and components and of plant and equipment but also of skilled manpower and managerial staff.

The comparison also shows that whereas in a typical industrialized country as much as one third of the total output of construction goes into maintenance and repair work, in most developing countries maintenance and repair account for a significantly smaller share of total resources, because maintenance standards are lower and because there is less construction and it is of more recent date.

Construction as an industry should be given adequate consideration in planning economic strategy; in most national plans this is not the case at present.

It may be seen from a world survey of the main indicators of construction activity that construction resources are very unequally distributed among regions. Although countries in the upper range of *per capita* income have less than one third of world population, they account for five sixths of the world product and seven eighths of total construction output.

Chapter 2 discusses some qualitative aspects of the construction process. The main participants in the construction process are the user, the client, the design team, the manufacturer of building materials and components, the contractor and subcontractors and the building materials merchant. The special features of the contractual relationships linking the participants are described, as well as the conflicts arising from divided responsibilities and the inadequacies of the traditional forms of contracts. The most important external constraints on construction are reviewed. Recently, there have been promising developments regarding the statutory requirements that govern the construction process and the quality of its output. Chapter 2 also contains an analysis of the construction process by its main stages and relates such stages to the

roles played by the participants and to the contractual relationships between them.

The role of the Governments in relation to construction is described. It ranges from concern with the economic and social welfare of the community as a whole to direct involvement by central and local government as clients.

Chapter 3 describes several ways of analysing construction output in developing and industrialized countries, particularly as regards the relationship between new work and maintenance and repairs. Both activities must be integrated into an over-all plan in order to make the best use of national resources. The main components of construction output are analysed by type of work, namely dwellings, non-residential building, and other construction works, as defined in national accounts. The analysis shows that the relative share of these types of construction differs significantly between developed and developing countries. Dwellings represent between 30 and 50 per cent of construction output in industrialized countries, as compared with between 20 and 45 per cent in developing countries, whereas the share of civil engineering in construction output is between 35 and 59 per cent in developing countries as compared with between 20 and 40 per cent in industrialized countries.

Chapter 3 also considers briefly the relative importance of the public and private sectors of construction and the way in which the public sector can be utilized by Governments to regulate demand and to encourage the private sector to develop in particular directions.

Construction is further classified by level of technology. The four main categories of construction are defined as international-modern, national-modern, national-conventional and traditional. They are in turn related to the various construction units operating in developing countries; an attempt is made to quantify their relative share in the total output.

Chapter 4 deals with manpower, equipment and finance. The labour content of construction is high; and there are many different construction skills, some of them traditional, such as those associated with masonry, and some modern, such as those connected with the use of concrete. There is a trend towards employing a higher proportion of professionally qualified staff in modern construction. Plant in construction is used mainly for the handling and transport of bulky materials and tends to displace unskilled workers. Its use is not, therefore, a main factor in reducing costs unless it is accompanied by an improvement in the

organization of building operations. It should be possible for developing countries to manufacture locally simple building plant and spares to service imported plant.

Chapter 4 also analyses the financial relationships of client, contractor and building-materials merchant. The construction industry has a relatively low capital intensity, since investment in this sector accounts for under 4 per cent of the total GDCF in most countries. The factors that enter into a comparison of the unit cost of construction are described. In making a cost analysis, it is useful to divide construction into functional elements and to take into account, in addition to the initial capital cost, the discounted value of future recurrent expenditure on maintenance.

Chapter 5 deals with the main issues discussed at the Athens Symposium. Technical development and rationalization, the use of prefabricated parts and structures, standardization, the role of research and development institutions and the lack of qualified personnel and skilled labour were the main issues discussed at the Symposium. The elements of government policy and the appropriate areas for international technical assistance were considered in the light of these issues. The recommendations adopted at the Symposium indicated the need for national and international action to strengthen planning, to establish appropriate institutions and to develop suitable training schemes, particularly for supervisors and technicians. The desirability of promoting exchanges of experience between developed and developing countries and among developing countries themselves was stressed.

Chapter 6 describes the existing activities of UNIDO and the aspects of the work programme of the Committee for Housing, Building and Planning of the Economic and Social Council that relate to the construction industry. Some additional lines of international action are then indicated for future consideration. They include surveys of resources, analysis of the contractual relationships between the participants in construction activity, reviews of construction codes and regulations, advice on adapting governmental policy to changes in the structure of demand, research into the financing of construction, technical assistance to improve the standard of cost accounting in construction enterprises and application of modern technology, modified where appropriate, in developing countries.

Chapter 1

THE PLACE OF CONSTRUCTION IN THE NATIONAL ECONOMY

International organizations have attempted to bring consistency into the definition and presentation of national accounts statistics,[1] but many divergencies from the standardized international system are still apparent in the data reported by individual countries. Many of the conclusions about the construction industry that are drawn in this chapter are therefore indicative only of broad trends and of orders of magnitude. The coverage and quality of statistics improve as development proceeds; conclusions based on data from less developed countries are merely tentative.

Table 1 gives the world estimate of value added by construction and of gross domestic capital formation in construction in 1965. Data covering seventy-five countries are consolidated into subtotals for five income groups according to *per capita* gross national product (GNP) and for eight continents and sub-continents that are ranked in decreasing order of average *per capita* GNP. The table shows that, out of a total of approximately $230 billion invested in construction in 1965, 88 per cent was in countries in the two upper income groups, a proportion even higher than the over-all share of these countries in the world GNP, which was 83 per cent. If the data are considered on a regional basis, it will be seen that North America had approximately 40 per cent of the world GDCF in construction, Western Europe 25 per cent and Eastern Europe 20 per cent, whereas the whole of Asia (excluding Japan) accounted for just over 5 per cent. It is true that official parity rates are open to well-founded criticism and that the contribution of the non-monetary sector of construction in developing countries is substantially underestimated in aggregates such as those used in table 1; nevertheless, the fact remains that the world resources for construction are very unevenly distributed among countries at different economic levels.

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[1] *A System of National Accounts and Supporting Tables;* for full reference see annex 3 under "United Nations".

TABLE 1: 1965 WORLD ESTIMATES[a] BY INCOME GROUPS AND BY REGIONS OF: (a) VALUE ADDED IN CONSTRUCTION, AND (b) GROSS DOMESTIC CAPITAL FORMATION IN CONSTRUCTION

(billion dollars)

Income groups by range of per capita GNP in $	*Region*																		*Percentage of world total*	
	North America		*Oceania*		*Western Europe*		*Eastern Europe*		*Latin America*		*Middle East*		*Asia*		*Africa*		*Total all regions*			
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
I 2,000+	34.2	90.7			2.2	5.1					0.1*	0.2*					36.5	96.0	33.4	41.8
II 700—2,000			1.8	3.2	27.4	48.8	23.9*	41.8*	1.2	2.7	0.3	0.6	4.8	8.9			59.4	106.0	54.3	46.1
III 400—700					1.3	3.1	1.3*	2.4*	1.0	2.1	—	0.1*	0.1*	0.2*	0.7	1.2	4.4	9.1	4.0	4.0
IV 120—400					0.6	1.1	—	—	1.2	2.5	0.2*	0.3*	0.8	1.6	0.6	1.3	3.4	6.8	3.1	3.0
V under 120.....									—	—	—	—	5.2*	10.9*	0.5	1.0*	5.7	11.9	5.2	5.2
TOTAL ALL GROUPS	34.2	90.7	1.8	3.2	31.5	58.1	25.2	44.2	3.4	7.3	0.6	1.2	10.9	21.6	1.8	3.5	109.4	229.8	100.0	100.0
Percentage of world total	31.3	39.5	1.6	1.4	28.8	25.3	23.0	19.2	3.1	3.2	0.6	0.5	10.0	9.4	1.6	1.5	100.0	100.0		

KEY: — less than 0.05.

* crude estimate.

SOURCE: *UN Yearbook of National Accounts Statistics* and national sources.

[a] Data relate to 75 countries.

CONSTRUCTION AND MACROECONOMIC INDICATORS

Construction as a component of the GDP

The contribution of the construction industry to the GDP includes new work and maintenance and repairs. In less developed countries, a large part of this value has to be imputed from the subsistence sector as mentioned above, and the amount is difficult to estimate owing to the lack of common definition and of adequate statistics. For further discussion of this point, see the section in this chapter on construction in national economic development plans.

In order to make comparisons between countries and to assess trends in the contribution of construction to the GDP, it is also desirable to remove the distortion caused by wide annual fluctuations that are a particular feature of construction activity, especially in developing countries.

Appropriately adjusted data for the two five-year periods, 1955—1960 and 1960—1965, show a strong linear correlation between the logarithm of *per capita* value added by construction and that of *per capita* GDP. The regression equations (where x = *per capita* GDP and y = *per capita* value added in construction) are:

1955—1960: $\log y = 1.18 \log x - 1.72$

number of observations = 62

percentage of variance accounted for = 88 per cent

1960—1965: $\log y = 1.25 \log x - 1.94$

number of observations = 76

percentage of variance accounted for = 93 per cent

The adjusted data for the period 1960—1965 are shown on a double logarithmic scale in figure 1.

These equations indicate that the share of construction in the GDP tends to increase with increasing *per capita* GDP. Countries in the three highest *per capita* income groups given in table 1 show a very consistent pattern of growth between the two five-year periods, with value added by construction increasing faster than *per capita* GDP. For less developed countries there is no consistent pattern: in some countries in the lower income groups, the share of construction actually decreased over the period under review, whereas in other countries it increased, sometimes fairly rapidly.

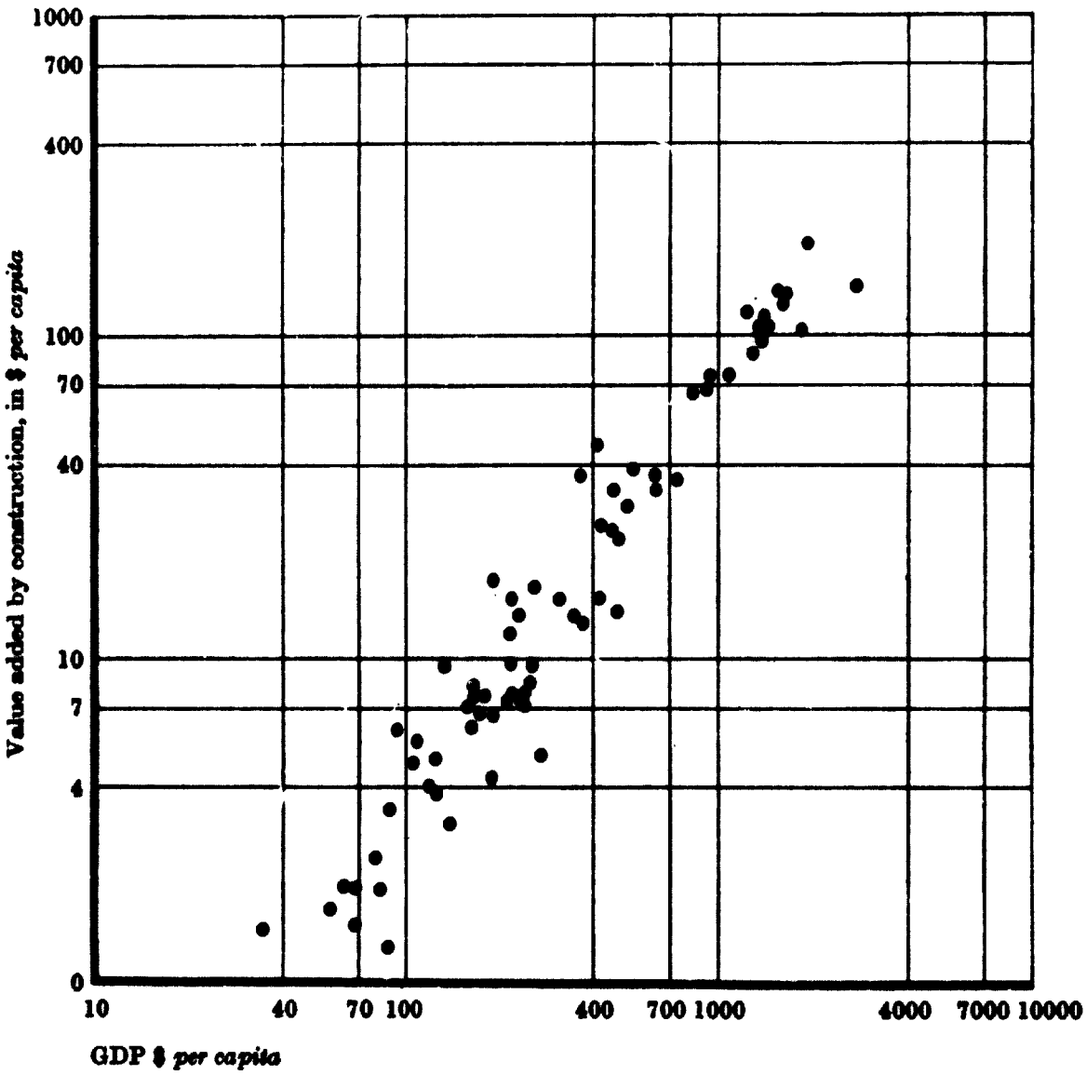

Figure 1. Per capita *value added by construction and GDP, 1963 (Average percentage contribution of construction to GDP 1960—1965 multiplied by* per capita *GDP in 1963.)*

SOURCE: *Yearbook of National Accounts Statistics*, 1963, United Nations publication, Sales No.: 64.XVII.4; other sources.

To sum up, it may be said that value added in construction may represent between 2 and 10 per cent of the GDP; for most developing countries it represents between 3 and 5 per cent and for most developed countries between 5 and 9 per cent.

Construction as part of GDCF

In so far as construction forms part of GDCF, most repair and maintenance work is excluded because it does not accrue to the formation of new capital, the exact definition of which varies somewhat in different countries.

If the data available on GDCF are analysed in the same way and for the same periods as those relating to the GDP, they also show that there is a strong linear correlation between the logarithms of *per capita* GDCF in construction and *per capita* GDP. The regression equations (where x = *per capita* GDP and y = *per capita* GDCF in construction) are:

1955—1960: $\log y = 1.12 \log x - 1.26$
number of observations = 53
percentage of variance accounted for = 91 per cent

1960—1965: $\log y = 1.20 \log x - 1.50$
number of observations = 64
percentage of variance accounted for = 95 per cent

The data for the period 1960—1965 are shown on a double logarithmic scale in figure 2.

It is again apparent from statistical analysis that the share of GDCF in construction in the GDP increases with the *per capita* GDP. In more than half the industrialized countries GDCF in construction is between 10 and 16 per cent of the GDP, whereas in three fourths of the developing countries it is between 7 and 13 per cent of the GDP.

Some changes occurred between the late 1950s and the early 1960s. As in the case of value added by construction, the rate of growth of GDCF in construction for the more developed countries has been at least equal to, and often greater than, that of the *per capita* GDP, whereas among less developed countries, a number of African and Latin American countries are exceptions to this general trend. Construction activity is sensitive to political and economic uncertainty; furthermore, such countries tend to carry out single, large projects that fail to provide continuity of demand for the services of the industry. The average share of construction in the total GDCF does not appear, however, to be related significantly to the level of economic development. Over a short period a country may concentrate on plant and machinery or on infrastructure with a high construction component; over long periods a relative balance is maintained in capital formation between these two sectors.

The percentage of the GDP devoted to capital formation increases with the *per capita* GDP, although there are great individual variations. For most industrialized countries from 20 to 25 per cent of the GDP is devoted to capital formation; this is significantly higher than the range for developing countries (12 to 16 per cent).

Wide annual fluctuations tend to obscure the general picture in developing countries, but over the last decade the rate of growth of

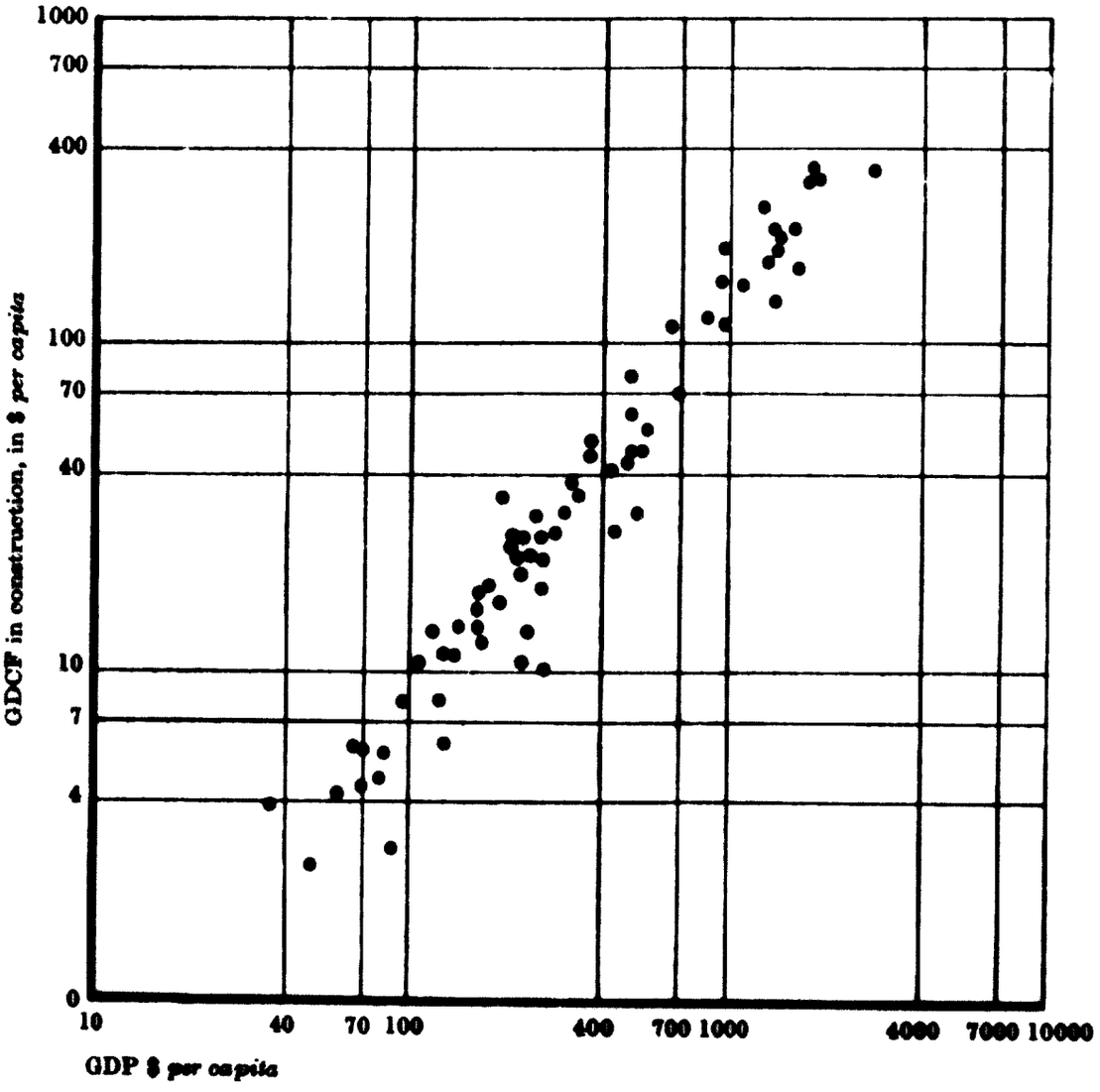

Figure 2. Per capita *GDCF in construction and GDP, 1963. (Average percentage contribution of capital formation in construction to GDP 1960—1965 multiplied by* per capita *GDP in 1963.)*

SOURCE: *Yearbook of National Accounts Statistics*, 1963. United Nations publication, Sales No.: 64.XVII.4; other sources.

investment in construction has been consistently higher than that of the economy as a whole in most industrialized and also in some developing countries; in other developing countries, however, sharp decreases have occurred.

EMPLOYMENT IN THE CONSTRUCTION INDUSTRY

The construction industry employs a large proportion of the civilian labour force in countries at all levels of economic and social development.

The main source of information on labour statistics is the *Yearbook of Labour Statistics* produced by the International Labour Organisation

(ILO). Although constant progress is being made as regards the coverage and comparability of information reported by member countries, caution should be exercised in making comparisons between different countries.

The two most striking features of employment in the construction industry are the widely differing percentages of total employment that are reported by countries with a similar *per capita* natural income, as well as between more advanced and less developed countries. In countries with a *per capita* GNP of $400 and above in 1965, construction provided between 3 and 12 per cent of total employment over the period 1958—1966 or 1967. In countries with a *per capita* GNP of about $400 in 1965, employment in construction ranged from under 0.5 to nearly 12 per cent of total employment.

Statistics for less developed countries are less accurate than those for industrialized countries; furthermore, they are not likely to cover the considerable construction activity that occurs in the subsistence sector of the economy. There are no reliable estimates of the numbers of self-employed and "do-it-yourself" builders. Even in industrialized countries much construction work is carried out in this way. Thus, in the United Kingdom it has been estimated that as much as 10 per cent of total construction output and approximately 30 per cent of all maintenance work, particularly of current maintenance and repairs, take place outside the construction industry.

After allowance has been made for such factors, it seems likely that construction provides from 6 to 10 per cent of total employment in most of the industrialized countries and from 2 to 6 per cent in less developed countries. Employment in the building materials and components industry, in transport, stock and distribution of building materials and other ancillary operations connected with construction is not identified separately in ILO statistics, but evidence derived from censuses of industrial production shows that such related sectors of construction activity may provide an additional 4 to 6 per cent of total employment in developed countries and probably 2 to 4 per cent in less developed countries. Construction as a whole, including the production and delivery of material inputs, may therefore account for as much as 15 per cent of total employment in some of the industrialized countries and for as much as 10 per cent in less developed countries.

A comparison of the ratio value added in construction to GDP with the share of construction in total employment shows that in most economically developed countries, i.e. those in Europe, North America

and Oceania, construction provides a larger percentage of employment than of GDP. In other words, the net output or value added per man-year in construction is significantly lower than in the economy as a whole.

Another socio-economic feature of the construction industry is seen from an analysis of the incidence of unemployment in different countries over the same period. In most of the countries for which this index can be calculated, the incidence of unemployment in construction was from two or three times higher than the national average. This is owing to a number of factors, including the seasonal nature of construction activity, which slows down during winter in countries with cold or temperate climates, and during a prolonged or intense rainy season in tropical countries. Other reasons for high unemployment in construction are that the construction labour force is composed of casual workers, that a significant part of construction activity is subjected to cyclical fluctuations and, most importantly, that a high proportion of workers employed in construction are unskilled and can be laid off at short notice. Many Governments in developed countries have taken steps to reduce and even eliminate seasonal fluctuations in employment, to introduce guaranteed wages for building workers, and other measures to reduce structural unemployment. No similar attempts appear to have been made in developing countries, although the problems such countries face are as great as or greater than those in developed countries.

Another important feature of employment in the construction industry is that in countries with a high *per capita* national income, wages in this industry tend to be higher than wages in manufacturing. This is because in these countries actual earnings in construction work are considerably higher than statutory wages, owing to piecework, overtime payments and above all to the bargaining power of the construction trade unions. In most developing countries manufacturing wages are higher than wages paid to construction workers. It also appears that where wages in construction are significantly lower than in manufacturing, they increase in the course of economic development at a faster rate, so that the differential between them tends to narrow. It may be postulated that the higher the level of development, the higher the ratio of wages in construction to manufacturing wages, as the construction industry has to compete with other sectors of the economy for skilled workers and finds difficulty in attracting them to jobs where working conditions are particularly hard.

THE ECONOMIC STRUCTURE OF CONSTRUCTION

It is not possible to compare trends between different countries by the method used in preceding sections. Work carried out by independent research organizations has shown, however, that it is possible to build up profiles summarizing the main features of construction output that may be taken as representative of a group of countries that have reached approximately the same level of social and economic development.[2] Table 2 shows the profile of construction output in the early 1960s in a typical Western European country falling into group II according to *per capita* GNP (Country A). The structure of the profile may be summarized as follows:

Maintenance and repair of existing assets amounts to 50 per cent, in money terms, of the construction output going into new work; this average proportion, however, conceals sectoral variations between a minimum of 20 per cent in the case of commercial and educational buildings and a maximum of 40 per cent in the case of transport, communications and other public services.

The new work is divided almost equally between the public and the private sectors; the private sector is, however, the more important in maintenance and repair work, a fourth of which is assumed to be carried out by the property owners themselves, with or without paid assistance.

Dwellings account for two fifths of the grand total and a slightly higher proportion of maintenance and repair; this is because the stock of dwellings is relatively old and the annual additions are approximately 2 per cent of the stock.

Manufacturing, transport, roads and other public services and commercial and other private services each account for approximately one eighth of total new work; their respective contributions to the maintenance and repair total, however, differ considerably.

Health and education together account for 8 per cent of the grand total, for nearly 10 per cent of new work, but for less than 5 per cent of maintenance and repair; this is partly because the number of buildings connected with education and health has rapidly increased since the Second World War and many are of relatively recent date.

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[2] Fredriksen, pp. 27—30; for full reference see annex 3 under "Other sources"; and "The Interrelations between Social and Economic Development", *Research Notes* No. 1, pp. 1—32; for full reference see annex 3 under "United Nations".

TABLE 2: PROFILE OF CONSTRUCTION OUTPUT IN INDUSTRIALIZED COUNTRY A—TYPICAL WESTERN EUROPEAN COUNTRY WITH *per capita* GNP ABOUT $1,200
(total output equals 100 units)

Sector acquiring output	*Total of new work and repair and maintenance*	*New work*			*Repair and maintenance*		
		Public	*Private*	*Total*	*Public*	*Private*	*Total*
Agriculture, fishing, forestry, mining, quarrying	3	0.6	1.7	2.3	0.1	0.6	0.7
Manufacturing, including construction	14	—	8.0	8.0	—	6.0	6.0
Trade, commerce and other private services	12	—	9.7	9.7	—	2.3	2.3
Transport, communications, roads and other public services	17	9.5	0.5	10.0	6.7	0.3	7.0
Utilities—gas, electricity, water	6	3.6	0.4	4.0	1.9	0.1	2.0
Dwellings	40	13.0	13.0	26.0	3.0	11.0	14.0
Education	5	3.7	0.3	4.0	0.9	0.1	1.0
Health and welfare	3	2.2	0.1	2.3	0.7	—	0.7
TOTALS	100	32.6	33.7	66.3	13.3	20.4	33.7

SOURCE: Professor D. A. Turin, based on research material.

TABLE 3: PROFILE OF CONSTRUCTION OUTPUT IN DEVELOPING COUNTRY B—TYPICAL OF A LESS DEVELOPED COUNTRY IN AFRICA OR ASIA WITH *per capita* GNP ABOUT $100
(total output equals 100 units)

Sector acquiring output	*Total of new work and repair and maintenance*	*New work*			*Repair and maintenance*		
		Public	*Private*	*Total*	*Public*	*Private*	*Total*
Agriculture, fishing, forestry, mining, quarrying	11	2.2	8.0	10.2	0.1	0.7	0.8
Manufacturing, including construction	12	2.4	9.0	11.4	0.1	0.5	0.6
Trade, commerce and other private services	5	0.5	4.0	4.5	—	0.5	0.5
Transport, communications, roads and other public services	24	16.0	—	16.0	8.0	—	8.0
Utilities—gas, electricity, water	7	6.6	—	6.6	0.4	—	0.4
Dwellings	35	0.3	31.5	31.8	—	3.2	3.2
Education	3	2.1	0.7	2.8	0.2	—	0.2
Health and welfare	3	2.3	0.5	2.8	0.2	—	0.2
TOTALS	100	32.4	53.7	86.1	9.0	4.9	13.9

SOURCE: Professor D. A. Turin, based on research material.

Table 3 shows a second country (Country B) falling in group V according to *per capita* GNP. It may be taken as typical of some of the less developed countries in Africa and Asia that have recently become independent and have benefited from some external financial assistance, especially with infrastructure and, to some extent, with health and education. The construction industry consists of a few foreign firms handling large civil engineering contracts in the public sector; a few indigenous firms, mostly small and starved of capital and plant, and working on small to medium building contracts including some current maintenance; and a large number of self-employed artisans among whom only those operating in urban areas belong to the monetary sector.

The profile has the following characteristics:

New work accounts for 86 per cent of total construction output. The proportion of maintenance and repair is much smaller than in Country A, partly because the modern buildings are fewer and of more recent date. (The value of construction output does not include work in the subsistence sector. Estimates of this sector have been made for a few developing countries and show that its share may range from 10 to 30 per cent of the total. Much of it goes into current repairs and maintenance, owing to the short life of most traditional buildings and infrastructure.)

The private sector accounts for more than 62 per cent of the new work; approximately 60 per cent of this amount relates to the construction of "conventional" dwellings in urban and periurban areas, i.e. dwellings incorporating a fair amount of modern materials (such as roofing sheets, windows, doors etc.) but relying on traditional techniques for the superstructure and many of the finishes.

The proportion of the grand total devoted to construction for agriculture, forestry and mining is naturally higher than in Country A owing to the general orientation of the economy. On the other hand, it is clear from the large share of the grand total contributed by transport and communications that there is a vigorous development programme in this economic sector.

Educational buildings account for only 3 per cent of the grand total; the private sector contributes one fourth of the new work in this area, owing to the importance of private schools in the country.

As already stated, maintenance accounts for a much smaller percentage of total work than in Country A; 57 per cent of maintenance

work is devoted to transport, communications and other public services, a pattern typical of the early stages of investment in infrastructure. Airports, harbour facilities, trunk roads and other communication networks are given priority and absorb most modern construction resources.

The comparison between these two profiles may be summarized as follows: A country in the early stages of development devotes a greater share of its resources to new work and, within this, to basic infrastructure in agriculture and mining, transport and communications. A smaller proportion of construction resources is absorbed by building for social purposes (dwellings, education and health and welfare) and commercial buildings. A relatively small share is also devoted to construction for manufacturing industries.

Similar profiles may be built up for construction inputs as shown in tables 4 and 5. Country A is to a large extent self-supporting in terms of material inputs; direct imports of building materials are partly offset by exports, depending on the local availability of primary products such as timber, iron ore etc. Inputs of goods and services account for slightly over two fifths of total output; wages and salaries account for a similar proportion; and the rest goes into taxes less subsidies, amortization of plant and equipment, profit and other trading income. Direct and indirect imports amount to 10 per cent of total output of construction, but more than half of these imports are offset by visible or invisible exports, including the contribution to balance of payments made by consultants and contractors working abroad.

Country B presents an altogether different picture. Inputs represent more than half of the total output owing to the high cost of transport and of building materials, 60 per cent of which are imported, directly or indirectly. Inputs of goods and services account for 55 per cent of total output, whereas wages and salaries amount to less than one third of the total, and even this includes a component for skilled foreign workers. Plant and equipment, although less frequently used than in Country A, are relatively expensive, being wholly imported from abroad: profit and other trading income also incorporates an "import" item in the form of profits that are repatriated by foreign contractors. The grand total reveals the heavy dependence of the construction industry in Country B on direct imports (24 per cent) and indirect imports (13 per cent); most indirect imports consist of primary products and transport equipment.

Throughout this comparison, reference has been made to percentages and relative values. To put the problem in perspective, it should be

TABLE 4: PROFILE OF CONSTRUCTION INPUTS IN INDUSTRIALIZED COUNTRY A—TYPICAL WESTERN EUROPEAN COUNTRY WITH *per capita* GNP ABOUT $1,200
(gross value of production equals 100 units)

	Domestic	*Indirect imports*	*Direct imports*	*Total*	*Exports, including invisible exports*
Inputs from agriculture, forestry, mining, quarrying and manufacturing	25	3	5	33	3 Building materials and components
Fuel, power, electricity, gas, water	1	—	—	1	
Other service inputs, including transport	7	1	—	8	1 Professional fees of consultants working abroad
TOTAL VALUE OF INTERMEDIATE INPUTS	33	4	5	42	4
Wages and salaries and associated expenditure	43	—	—	43	
Amortization of plant and equipment and rentals paid	2	—	1	3	1 Sales of plant and equipment abroad
Indirect taxes less subsidies	2	—	—	2	
Other gross business income	10	—	—	10	1 Repatriation of profits from contractors working abroad
TOTAL GROSS VALUE OF PRODUCTION	90	4	6	100	6 Total contribution to balance of payments

TABLE 5: PROFILE OF CONSTRUCTION INPUTS IN DEVELOPING COUNTRY B—TYPICAL OF A LESS DEVELOPED COUNTRY IN AFRICA OR ASIA WITH *per capita* GNP ABOUT $100
(gross value of production equals 100 units)

	Domestic	*Indirect imports*	*Direct imports*	*Total*
Inputs from agriculture, forestry, mining, quarrying and manufacturing ...	16	8	16	40
Fuel, power, electricity, gas, water	1	1	—	2
Other service inputs, including transport	8	4	1	13
TOTAL VALUE OF INTERMEDIATE INPUTS	25	13	17	55
Wages and salaries and associated expenditure	28	—	3	31
Amortization of plant and equipment and rentals paid	—	—	2	2
Indirect taxes less subsidies	2	—	—	2
Other gross business income	8	—	2	10
TOTAL GROSS VALUE OF PRODUCTION	63	13	24	100

pointed out that *per capita* value of construction of modern buildings in Country B is one twentieth of that in Country A. Within the total, *per capita* expenditure on dwellings in the less developed country is only one fifteenth of that in an industrialized country; *per capita* expenditure on school construction is one thirtieth and so on.

Differences between Country A and Country B in construction costs per unit of accommodation and in quality standards are much less striking: the ratio is probably between one half and one fifth for the lower grades of building. Although allowance should be made for the effect of such differences and for the contribution of the subsistence sector of the economy, it must also be borne in mind that for many major civil engineering works and for buildings such as hospitals, universities, airport terminals and government offices, building costs are actually higher in developing countries. It is then possible to appreciate the size of the gap between an industrialized and a developing country in terms of real *per capita* construction investment.

In fact, in many developing countries the inadequate volume of building and civil engineering activity is one of the constraints on more rapid and more equitable social and economic progress; but since as much as one third of the total value of modern construction may be dependent on imports, economic planners face a difficult task in building up this vital sector of the economy.

Construction in national economic development plans

Most economic planners must be aware of the importance of construction to balanced economic and social development. Yet an examination of more than 40 development plans current in the mid-1960s in countries at various levels of economic development reveals only limited attention devoted to construction by most of them. Few define targets for construction or examine in detail the relationship of construction to other sectors of the economy.

There are a number of reasons for this apparent neglect. The first, which applies particularly in countries in early stages of development, is that construction is difficult to identify; its boundaries are not easily defined, as even in the more industrialized countries it is fragmented among a large number of small production units inadequately covered by national and regional statistics. The unit on which national construction statistics are based may be the building site (where actual assembly

operations take place) or the firm or establishment from which such operations are co-ordinated. In either case the collection of statistics is difficult. A further complication is the practice of subcontracting (see chapter 2), with the accompanying risk of double counting or serious omissions. Since construction output in developing countries may fluctuate widely from year to year, it is not easy for economic planners to recognize trends or identify meaningful averages.

Furthermore, a large sector of construction activity in developing countries occurs outside the monetary sector. Methods for assessing this component of the subsistence economy are crude and have not received sufficient attention from development economists.[3] Most of these methods are based on an estimate of the number of traditional dwellings at a given point of time, a rough guess as to their expected life and an even rougher guess at their nominal value. Discrepancies in the assessment of how long such structures will last or in the density of occupation of traditional dwellings can greatly distort the estimates of total output in the subsistence sector.

It is also difficult to measure inputs into construction. International standard classifications of industries and trade do not give a convenient separate heading for the materials used in construction, partly because construction uses outputs from many other industries. It is not easy to use input/output analysis for developing countries, and the few input/output tables available for construction relate only to the monetary sector.

An attempt to base planning on value added in construction encounters similar problems. Wages and salaries are not easy to assess because of the casual and, in some cases, seasonal pattern of construction employment. Payment by piecework is the traditional method of remuneration in many countries, and contractors do not keep full records of such transactions. Plant and equipment are moved from one building site to another, and it is difficult, if not impossible, to allocate their amortization to an individual operation. The same applies to overheads and profits that fluctuate widely from year to year and between contracts; they can be assessed only approximately even if the contractor has some figures available.

If the problem is tackled by considering the expenditure by economic

[3] See: *L'équipement physique en constructions traditionelles dans les pays africains de la zone franc: essai d'évaluation*, Institut d'Etude du Développement Economique et Social, Université de Paris, Paris, 1963. Examples of similar methods can be found in some national development plans and in the notes accompanying national accounts in some African and Asian countries.

sectors on construction, it becomes clear that construction expenditure straddles the capital and current accounts and cannot be readily identified under either heading. It is seldom possible to distinguish, within an investment programme, the component of new work in construction from that of new plant and equipment. In the current account, maintenance and repair work forms part of items such as fuel, heating, transport, management etc. Construction is nevertheless an important component of all sectors of economic activity.

Development plans in some countries are confined to the public sector, with emphasis on public investment; few distinguish between investment in construction and other forms of capital formation. In some cases the development plan is little more than a catalogue of individual projects, mostly in the public sector. Only a few such projects can be clearly identified as construction. On the other hand, most plans have separate chapters on social programmes, covering education, health, social welfare and, less frequently, housing and community development. But the emphasis is on targets: increase in elementary school places, number of hospital beds etc., and not on the construction required to achieve them. Even major multilateral and bilateral agencies providing capital assistance in these areas do not generally break down their capital aid in terms of construction and other equipment. Similarly, many plans devote a separate chapter to transport, communications or infrastructure in general, but few of them show construction as a separate item in these economic sectors.

All development plans devote much attention to industry, but this term is generally interpreted in a limited sense and covers only a part of manufacturing. Thus, although building materials and components account for such a substantial part of total construction output, usually the only construction material mentioned separately in a development plan is cement, because the cement industry, being capital-intensive, consists of a limited number of plants; in some countries, there is only one. Cement can also be identified in trade statistics, and it is therefore fairly easy to calculate the apparent consumption. There is a tendency to regard cement as representative of all construction materials. Because of the close correlation between *per capita* cement consumption and construction output, or even GDP, revealed by a number of national and international studies, economic planners have even been tempted to use cement as an indirect measurement of construction output. The large variety of building materials and components, imported under different headings or produced locally by a large number of small manufacturers,

escapes the attention of planners and is neither recorded nor mentioned. The structure of construction inputs is explicity estimated in development plans only in exceptional cases. Even in such cases the estimate is based on a few, selected building types unrepresentative of the total output of construction in the country concerned. Furthermore, in the few plans that assess employment in construction separately, estimates are confined to the monetary sector. The result is that there is no official calculation of the effect that the various phases of the development plan will have on construction, and consequently no basis is available on which to assess future construction output. But the problem is not insoluble; with the collaboration of the technical departments of government agencies and of national and foreign contractors and professional offices, it is often possible to build up a picture of construction activity in a developing country by extracting the construction component from the different sections into which the development plan is divided.

Reference should also be made to two organizational problems of the construction industry that appear in some development plans. One is the recommendation to use "local" materials. The term is often employed ambiguously to refer either to genuine traditional materials (such as adobe, mud and wattle, bamboo, thatch) or to the local production of modern materials, or to both. The two types of materials have, however, little in common.

Traditional materials, the use of which is prevalent and justified in rural areas within the framework of the co-operative arrangements and barter economy of traditional society, have seldom proved suitable in rapidly growing urban areas. When they are brought up to quality standards acceptable to town-dwellers, traditional materials are unable to compete with the more efficient "modern" ones, however crude the latter may be.

In most cases, however, the local production of modern materials and components is a problem that should be tackled in terms of effective demand and commercial outlets, investment in plant, financial credit, better management etc.

The second organizational problem is the stress laid on construction as a labour-intensive operation to be used as a convenient means of absorbing endemic unemployment or underemployment. The fact is that it is seldom possible to reconcile efficiency, speed and productivity—all important targets in general economic development—with the rather questionable social objective of providing temporary jobs for unskilled workers.

A DEVELOPMENT PROFILE FOR THE CONSTRUCTION INDUSTRY

Economic and social development cannot be dissociated from each other, as is generally recognized in industrialized and developing countries alike. Considerable attention is therefore devoted by national and international agencies to the contents and measurement of development, in order to define significant indicators and to assess their complex interrelations, with the ultimate aim of building up development profiles that bring out the relationships between various social and economic criteria.

Since construction forms an integral part of the general economy, many of the indicators of its development are simply particular facets of more general phenomena, varying according to local conditions.

The first indicator of development in construction might be the share of the monetary sector in total construction output—a share that may be assumed to increase with economic development. Another indicator might be the percentage of locally produced building materials or, more precisely, the degree to which construction was supplied by local industries producing modern building materials and components. Most developing countries follow the pattern of construction technology adopted by industrialized countries.

The introduction of modern technologies has another consequence, namely that in the early stages of development foreign expertise is required to handle them. The share of foreign firms in the monetary sector of construction output is therefore suggested as a negative indicator of development, at least when such a share is very large.

The public sector of construction acts as a valuable agent of modernization. It is so important that the share of the public sector in modern construction output might be singled out as a distinctive feature of the early stages of development. Another factor that might be considered is the composition of the labour force, since construction traditionally serves as a transitional stage between unskilled, rural agricultural employment and skilled, urban industrial occupations. It would therefore appear justified to use the percentage of skilled operatives employed in construction as an indicator of construction development. The narrowing of the gap between wages in construction and in manufacturing is an indicator of national development.

The degree of mechanization of building operations might also be taken as a measurement of modernization; it is closely related to the

share of depreciation of plant and equipment in the total cost of construction.

Other features of construction activity might contribute to defining a development profile of the industry, such as the quality and quantity of technicians and technologists employed; the sophistication of the management tools used; the share of services and equipment in the total cost of buildings (this does not apply to civil engineering); the quality standards attained in the various categories of construction output etc. It would however, be difficult to make even a rough measurement of such factors.

The indicators listed above are highly correlated and may therefore be replaced by a single index, for example, the share of the monetary sector in total construction output. This index can be used to show in graphic form a typical profile of construction development, as in figure 3. The horizontal scale on the graph represents the time dimension, the actual duration of each phase depending on local circumstances. On the vertical axis, three curves have been plotted, each expressed as a percentage of total construction output. Curve A represents the share of the monetary sector in construction output; curve B represents the

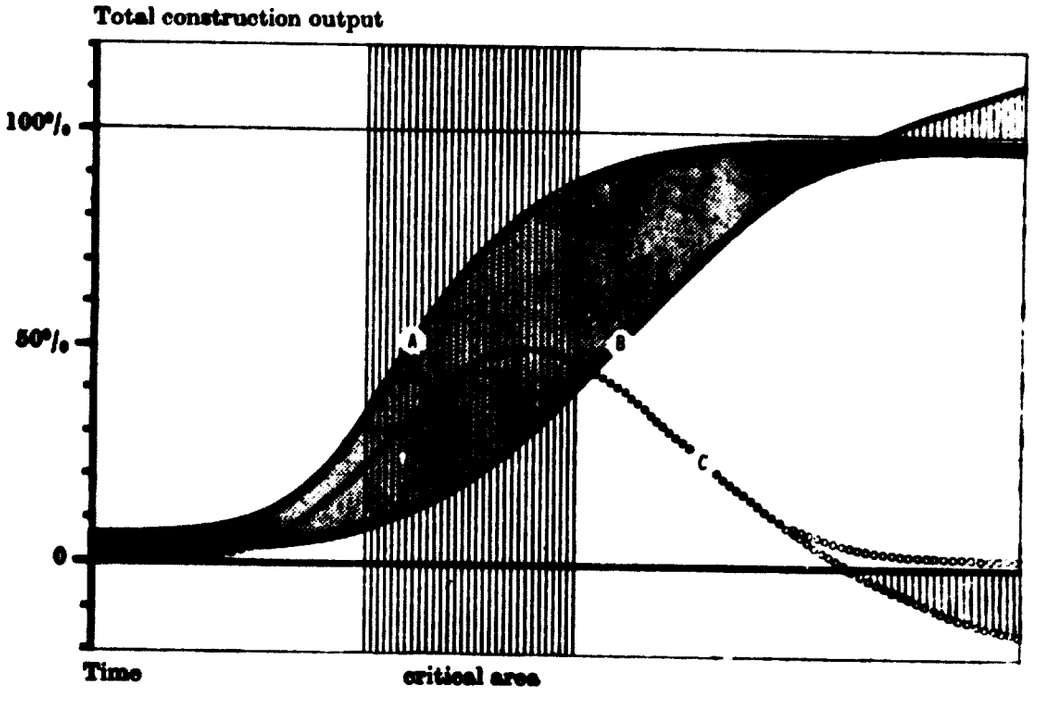

Figure 3. A development profile for the construction industry

Key

A Output of construction in the monetary sector
B Local supply of modern factors of production
C Imports

local supply of modern factors of production; curve C represents imports and is the difference between A and B. Two alternatives are depicted for the final phase, in one of which the local supply exceeds local requirements and some exports take place. For the sake of clarity and simplification, it is assumed that the requirements of the non-monetary sector are met locally without resorting to imports.

The development profile of the construction industry is characterized in its early stages by a sharp increase in the demand for modern techniques that are mostly alien to local traditions and require a rapid expansion of local resources of all kinds, including skilled labour. When local resources fail to match demand, construction must compete with other sectors of the economy for scarce foreign exchange in order to import essential inputs. Most countries, however, could produce many of the material inputs locally. The development of skills, especially at professional levels, is a slower process; although the ultimate goal of training all skills locally should not be forgotten, the recruitment of highly qualified foreign personnel is often justified as a temporary expedient. Plant and equipment will continue to be imported until the local engineering industry has reached an adequate level, but the production of simple tools and the replacement of parts could be initiated at an early stage.

THE CONSTRUCTION PROCESS: A QUALITATIVE ASSESSMENT

Construction is a complex process, not for technological reasons but because of the great number of participants involved and the conflicts arising out of their differing requirements and attitudes.

The main participants and their contractual relationships

The participants

The process of construction involves some of the following participants:

The user;
The client;
The design team;
The contractor and the subcontractors;
The manufacturer of building materials and components;
The building-materials merchant.

Other participants might be added to the list: the authorities that under statutory requirements must approve the structure; the banking and financing institutions that advance some of the capital required during and after the construction, and the public undertakings that in some countries act as contractors for the supply of basic services such as electricity, water, sewerage etc.

All types of construction are intended for use by somebody: a private individual, a group of individuals, a firm, a government department or society as a whole. In an increasing number of cases, however, the user is different from the client, the latter being the person or organization putting up the money for construction. In the public sector, for example, the user may be the community at large or a particular section of the

community composed of individuals not known in advance to the client, although he must nevertheless attempt to assess their needs.

Many of the mistakes that have occurred in the provision of publicly owned housing, schools and hospitals may be attributed to the fact that insufficient attention was paid by the authorities acting as clients to the actual requirements of the ultimate users of the building. The same applies in the private sector when a firm commissions new premises for its headquarters office or when a manufacturing enterprise builds a new plant. Systematic studies of user requirements covering the major types of building have only recently been undertaken in a few industrialized countries. This is also true of the major infrastructural works that are used intensively by the community and require considerable recurrent expenditure for maintenance and repairs over their lifetime. In many cases, the organization or public authority responsible for the initial capital outlay is different from that responsible for maintenance. It is not yet the general practice to take the concept of cost-in-use into account during the early stages of planning by the client.

As regards clients, the important distinction is between collective and individual clients, because collective clients, as explained above, have only an indirect relationship to the user. The distinction between public and private clients is less significant, although the organization pattern of one category differs considerably from that of the other and both vary from country to country. The public client will be considered later in this chapter under the section dealing with the varied role of the Government in construction. In developing countries, there are a few corporate private clients in industry and commerce (large manufacturing concerns, banks, insurance companies, chains of distributive stores etc.) that are large enough to support their own technical construction staff. They use private contracting firms to carry out their work, although sometimes they have their own maintenance and repair teams.

In housing, private collective clients (as opposed to public authorities, central or local) are still the exception in developing countries. Considerable efforts have been devoted at the national level, often with foreign assistance, to setting up housing co-operatives and housing associations. Such institutions have to struggle with the problems of underdevelopment, in particular lack of capital, discontinuity of programmes and shortages of professional manpower. Few of them have their own technical departments; they rely mainly on the private sector for the design and execution of their building programmes.

Similar considerations apply to the private sector of education and health, which in many developing countries provides, on a voluntary or charitable basis, many of the facilities offered to the population. It would thus seem that appropriate guidance from central and local government would be of particular value to the private collective client, and the matter should receive greater attention in future construction plans.

The private individual client seldom, if ever, uses professional services and is at the mercy of the local artisan or contractor. He is difficult to reach directly, although the potential benefit of improving his knowledge of building matters is great. He should be one of the main beneficiaries of the intermediate technology described in chapter 3 and might become a powerful agent of modernization if his initiative and motivation were properly channelled.

The client plays an essential role in construction, since he initiates the whole operation, appoints advisers, commissions the contractor to carry out the work, and, throughout the process, advances most of the capital necessary to keep the operation going. The client may also be the user, in which case some of the problems mentioned above are reduced, although they are seldom completely eliminated. One of the first tasks of the client is to brief the design team, i.e. to define clearly what he expects from the final output. The client is responsible for assessing and approving the activities of all the other participants. He may delegate some of this work to the professional advisers he has appointed.

The design team may include, depending on the circumstances, architects, engineers of several kinds, specialist consultants, estimators and quantity surveyors and others. Such teams are employed on a considerable proportion of construction work in developed countries, but only on a relatively small amount in developing countries, where much building and civil engineering work is carried out without a professional designer, or at least without a separate individual acting in that capacity.

The function of design exists, however, and may be identified in practically all construction processes, no matter how simple or primitive they may appear. In even the simplest building in rural areas there is a certain degree of specialization, and an embryonic design function is exercised by the client himself or by the artisans carrying out the operation. Better design is the most efficient method available to developing countries of obtaining a higher output by making a more rational use of local resources. One of the principal functions of the design team is to prepare a set of instructions for the contractor.

The contractor is the person or organization responsible for the assembly on site of the materials and components required to produce the building. He must be given instructions sufficiently clear and precise to enable him to quote a firm price for his services. A number of procedures have been evolved in various countries to ensure that the rights of the client are safeguarded. In most building work, and sometimes even in civil engineering, the main contractor handles only the bulkiest operations connected with the infrastructure (excavation, earth-moving, foundation etc.) and the superstructure of the building. He delegates the more specialized activities connected with finishes and equipment to separate firms acting as subcontractors.

The amount of work subcontracted can vary from nothing at all to almost the entire operation, depending on the type of work and local custom. In many European countries, it is now the general practice for the main contractor to subcontract up to 50 per cent of the total value of work to specialist firms. In some cases, the main contractor may act as co-ordinator of the various subcontractors, who are responsible for all the work. In other countries, there is no main contractor, and separate contracts are made with each trade group, the main responsibility for co-ordinating and supervising the work resting with the client and/or the design team.

In all countries, the basic unit of the building and civil engineering industries is the individual firm, whether it is composed of an artisan working in isolation or of a large national or international contractor employing thousands of operatives.

Few statistics on the size of firm are available in developing countries, but summary evidence suggests that the fragmentation of the industry, so often regretted in industrialized countries, is even more marked. A special feature in developing countries is that firms have a limited capacity to move from one category of building to another. The four categories of building in developing countries, namely, the international-modern, the national-modern, the national-conventional and the traditional, which are further discussed in chapter 3, operate in different areas and cater for different resources. Each presents its own development problems. Increased construction output would call for greater mobility between one category and another.

It should not be the aim in developing countries to reproduce the pattern of the construction industry found in industrialized countries. But some general trends, such as greater concentration of units with accompanying greater specialization, will occur in most countries.

Much will depend on changes in the structure of demand and in methods of awarding and managing contracts and on the ability of the industry to adapt itself to such changes.

The trade associations in developing countries, although often rather weak, may prove important as instruments of change. They tend, even more than in industrialized countries, to be dominated by the larger firms with headquarters in the capital cities. In some cases, such firms have considerable political influence that they can bring to bear on public clients and on the Government in general. Contractors' associations are generally no less conservative than professional institutions in many developing countries; they are seldom open to small firms, and they are particularly zealous in safeguarding the position of their more influential members in relation to public clients.

One of their main objectives is the maintenance of lists of recognized contractors suitable for particular kinds or sizes of projects in the public sector, or the establishment of such lists where they do not exist. This protectionist attitude is not conducive to the best utilization of resources at a national level, although its supporters often claim that it contributes to maintaining a higher standard of work than would otherwise be observed. There is, however, little evidence even from industrialized countries to support such a contention.

Trade associations are the most suitable channel for transmitting knowledge to the individual firm, especially as regards methods and procedures: costing, estimating, resource scheduling, on-site management etc. They should be encouraged to do so, and they should obtain adequate support from public sources if they show willingness to perform this role. But their membership must be broadened, their structure made more flexible, and their regional and local associations strengthened.

The manufacturers of building materials and components provide many of the material inputs that are produced away from the building site. It is not easy to define the building materials industry because construction uses many different products, some of which are manufactured by industries outside the construction sector. On the other hand, some contractors also manufacture simple building materials and components, on the building site itself or in a separate establishment.

The dividing line between contractor and manufacturer is thus far from clear. Construction is in the main an assembly operation; there is a general trend away from on-site production by the contractor and towards the increasing use of material from manufacturers of building components. This development is variously referred to as "prefabrication",

"industrialization" and "system building". In addition, as the components and fittings used in building become increasingly complex, some manufacturers have begun to act as subcontractors, offering supply-and-fix services.[4]

The building-materials merchant is another important participant. He acts as intermediary between the manufacturing industry and the contractors and subcontractors. He stocks a large number of building materials, components and fittings; he provides the small builder with valuable technical and commercial information; most importantly of all, he gives short-term credit to the contractor.

The main justification for his role lies in the discrepancy between continuous production processes, which characterize modern manufacturing industry, and the discontinuous requirements of material inputs, which are a special feature of traditional construction work.

One of the problems of the construction industry in all countries is the difficulty of co-ordinating the activities of the main participants and ensuring that their energies are channelled towards a common goal.

The contractual relationships between participants

To understand better the complexities of the contractual relationship linking some of the participants, it should be borne in mind that in all bulky assembly industries, such as the construction, shipbuilding and aircraft industries, the product—a building, a freighter or a new type of aeroplane—is normally sold before it is made, whereas in manufacturing industries the product is generally made first and sold afterwards.

This characteristic is at the origin of the complicated contractual obligations associated with construction in countries at all levels of economic and social development. It also explains the elaborate written documents (scale drawings, bills of quantities, general and particular specification etc.), required to communicate information from the client to the design team and from the design team to the production team.

According to prevailing custom, all the characteristics of the final product must be described in unequivocal terms and quantified to enable the contractors to offer a firm price. It is therefore understandable that this stage of the process should receive so much attention and occupy

[4] For further discussion of this subject, see Monograph 3 "Building Materials Industry" in this series.

so much time. But it could be considerably improved and speeded up if all the participants made concerted efforts. Developing countries could learn much from the inefficient practices current in industrialized countries and could improve on such methods in order to make the best use of scarce resources and skills.

The scope, quality and quantity of the information exchanged among the participants is largely dependent on the form of contract linking them, and this in turn depends on how far the production team participates in the design process. It is traditional in many countries that most contracts be awarded by competitive tender; it follows that the description of the product must be exhaustive, sometimes down to details of the operations necessary to produce it.

The only legal obligation of the contractor towards the client is to produce satisfactorily what has been described in the contract. This means that any alteration in the characteristics of the product as so described implies a departure from the contract and requires the consent of all the participants. The problem of "variation orders" in the construction industry has confounded many specialists and led to innumerable complaints, disputes and legal proceedings, in industrialized and developing countries.

Competitive tendering, whether open or selective, is practically universal in the public sector of construction in market economies. Some degree of competition exists even in centrally planned economies. The main objective is held to be the safeguard of the public interest and the prevention of favouritism or corruption; it is also claimed that competitive tendering gives the client the best value for his money.

A disadvantage of competitive tendering is that it may neglect the contribution the production team might make to design and may ignore the skills, plant and equipment that such a team might have available. It may have the effect of freezing technological progress, since competitive tendering works satisfactorily only with generally accepted, and therefore conventional, procedures and techniques.

Alternatively, contractual relationships may fall under the heading of negotiated contracts. A number of procedures have been developed to enable the client and the design team to bring in contractors, and in some cases manufacturers of building materials and components, at the early stages of planning. Negotiated contracts are frequent in the private sector and are generally used in all countries for maintenance and repair work, which cannot be prescribed and quantified with sufficient precision

in advance, and for some highly specialized operations where competition is non-existent.

Between the two poles of open competitive tender and negotiated contract, there are a number of hybrid procedures, some of which have been used for many years, while others are still at an experimental stage. One of the well-tried procedures is the design-and-build type of competitive tendering applied to public and civil engineering work in some American and European countries. Joint teams of designers and contractors are invited to submit proposals for a given piece of work and at a given price, and the client defines only in general terms the main features of the work to be undertaken. It is for the team to satisfy the client that its design meets the requirements laid down in the invitation to tender and that its resources are adequate to carry out the work within the price and time limits specified in the contract.

A procedure of recent origin and used only for specific projects in a few highly industrialized countries is to invite manufacturers of components to tender for the supply of known quantities of a product described only in terms of the performance expected from it, i.e. on the basis of performance specifications.

With few exceptions, developing countries have copied the most traditional and somewhat inhibiting contractural procedures evolved in Europe and North America. Unfortunately, some of these procedures presuppose a level of administrative and technical competence seldom available in developing countries outside a few privileged sectors. Inefficient contractual relationships are among the obstacles to a better use of resources in the construction industry. Other equally important external constraints in developing countries are briefly reviewed in a following section.

The stages of the construction process

Although it is difficult to generalize, it may be useful to describe the conventional way in which construction is handled in order to give a better understanding of the complex relationship between the participants. A characteristic of the conventional process is the sequential intervention of the participants.

The first stage is the assessment of the demand for construction and the study of user requirements. In the case of buildings of a repetitive nature, such as housing, schools, hospitals, offices, laboratories, the study

of user requirements has become a sophisticated tool in developed countries, drawing on a number of social and physical sciences as they apply to construction.

In the case of a collective or public client, the body of knowledge built up over years of experience may be drawn upon at the beginning of every new building venture. For individual building or individual clients, however, many aspects of user requirements have to be studied afresh on every occasion. In some cases, user requirements are expressed in the form of standards concerning the amount and quality of finishes and services, the interrelationship between the spaces and so on.

User requirements are the basis on which the client formulates his brief to the designer. The more the brief is defined in terms of performance, the greater the scope for the designer to use his skills and those of his associated consultants to optimize the use of resources and maximize value for money. Very often the brief states limits of expenditure, either for the building as a whole or for its main parts; sometimes these targets are expressed in terms of ceiling prices per unit of floor space or per place provided.

In the second stage, the designer undertakes a complex series of operations whereby, by successive approximations, he attempts to define the work to be done in accordance with his professional standards and the local social conventions, but in the last resort with a view to satisfying the client. Increasingly precise proposals are elaborated, submitted to the scrutiny of specialists and cleared with the client, until a set of documents is obtained on which consultations can be held with the production team, including, as applicable, contractors, subcontractors and manufacturers of building materials and components. Whatever the type of contractual arrangement, a point is reached in the process when it is possible to estimate the price to be paid to suppliers and assemblers, and contracts are signed binding the parties concerned.

Simultaneously with the stage described above, the proposals must be cleared with the public authorities responsible for planning approval, building regulations, safety requirements, building licensing, financial sanction, insurance etc. Not all the constraints mentioned above apply in every country or to all buildings, although most of them are enforced in a majority of urban areas throughout the world. The need to secure official approval on a number of different aspects has often been blamed for delaying the construction process unnecessarily, and in many countries considerable efforts have been made to streamline procedures and co-ordinate the actions of the various authorities concerned.

When all the necessary clearances have been obtained, the building site is handed over to the contractors, who initiate the production and assembly stage. But not all the technical information required from the design team in order to complete the project is available from the beginning; it is indeed customary for the design team to continue producing such information throughout the process and almost to its very end.

This practice has caused friction between clients and designers on the one side and manufacturers and assemblers on the other. It has often been claimed that all production information should be available before work starts on site, or in some cases before the contractor is appointed, as a necessary step to ensure that building operations proceed smoothly. On the other hand, it is obvious that if the design were completed in all its details before the contractor was appointed, he would be deprived of the opportunity to make a valuable contribution to the process from his knowledge of the organizational, managerial and technical problems involved.

A number of compromises are possible to harmonize these conflicting interests; their relative success or failure depends, in the last resort, on the professional competence of the participants and on their willingness and ability to work together towards a common goal. Intimate collaboration among client, designer and contractor is sometimes prevented by contract practices (especially in the public sector) or by codes of professional conduct. Since the Second World War, concerted efforts have been made in many industrialized countries to improve collaboration among participants at various stages.

Contrary to what is commonly believed, construction operations on the building site take up a relatively small proportion of the total time, in some cases as little as one third, although more commonly about one half. Whereas a good deal of attention has traditionally been paid to improving the organization of assembly operations on site and to improving production techniques in manufacturing building materials and components, it is only recently that similar efforts have been devoted to the stages preceding actual construction.

From the viewpoint of the economy as a whole, however, and in some cases from that of the individual public or private client, delays in the pre-construction stage can add considerably to the social cost of construction. It may be necessary to commit resources for a long time before the construction begins to benefit the individual or the community.

Throughout the construction period the activities of the contractor and subcontractors are followed and supervised by the client or his

professional advisers. To safeguard the interest of the client against defects or malpractice, it is almost universal practice to defer payment for a certain proportion of the work done as a guarantee. This balance is paid to the contractor after a specific period of time, which varies in different countries.

Once the work has been completed to the satisfaction of the client, it is handed over to the client or the user, and its life as a valuable asset begins; this in turn has implications in terms of management and of operational and maintenance costs. A considerable part of construction activity is devoted to maintaining, repairing, altering or converting existing buildings.

With minor local variations, developing countries follow the general procedure outlined above for modern construction and encounter similar constraints and difficulties; the position may indeed be worse, since the administrative and contractual machinery is often less efficient. Many ambitious economic development plans have lagged behind their targets or been diverted from their course by a failure to appreciate such problems when investment programmes were formulated.

THE DIFFERENT PATTERNS OF THE BUILDING PROCESS

The diversity of local conditions and traditions makes it impossible to describe in general terms technological trends in construction. From the experience of countries at different levels of economic and social development, an attempt may be made to define certain features common not to the materials used nor to the skills required nor to the contractual procedures adopted, but to the nature of the relationships between the participants and the roles they play at each stage of the building process. The possible patterns may be reduced to four basic types, which are briefly examined below. The discussion is concerned mainly with building activity as distinct from civil engineering.

The "one-off" approach

The "one-off" approach is usually associated with conventional building procedures, underlying the descriptions of the roles of the participants and the stages of the building process described in preceding sections.

The main characteristic is the sequential intervention of the main participants: at each stage, a single participant carries the main responsibility and is *de facto* the co-ordinator of the building team. The word team, however, is misleading in this context, since the principal feature of the "one-off" approach is that each new project requires the establishment of an entirely new team that is dispersed once the building cycle is completed.

Because the team functions once only, the description "one-off" is justified. The buildings and their component parts may be highly repetitive, and the technologies used may vary from the more traditional and artisan type to the more advanced forms of mass production and rationalized assembly.

The "component" approach

The component approach is favoured by many industrialized countries in Europe, Eastern and Western.[5] Its objective is to combine the economic advantages obtainable from the mass production of a limited number of components with the greatest possible variety in combining such components in order to meet the requirements of users and the specifications of clients.

Such apparently contradictory aims may be reconciled only if all the participants are willing to adopt a number of standards conventions relating to the dimensional co-ordination of the components, the limits of production assembly, position tolerances and the geometrical and performance characteristics of the joints between components. In many European countries, considerable efforts are devoted to drawing up and implementing such agreements.

The public sector is the most convenient area for introducing standards conventions and, more specifically, that part of the sector in which the Government acts as both client and designer.

The advocates of the component approach hope that, when fully developed, this method will succeed in matching an almost unlimited variety of building with an increasingly restricted number of mass-produced interchangeable components. This would obviate the need to

[5] *Report on the Proceedings of the Second ECE Seminar on the Building Industry*, Paris, 24—29 April 1967; for full reference see annex 3 under "Economic Commission for Europe".

control demand itself, as is the case at present in the public sector of several countries where the various public authorities have to form consortia and pool their building programmes in order to guarantee industry the minimum demand required to produce long runs of standardized components.

Model approach

The problem of reducing variety in building may be solved in a completely different way if instead of standardizing components efforts are devoted to standardizing the whole building. This is the "model" approach. Buildings become similar to other industrial products; they may be described in catalogues specifying their main features and offering them for a firm price.

In this sense model buildings are made before they are sold: the manufacturer or the contractor (in some countries he is called a developer or a home builder) is the real initiator of the process, takes most of the risk involved in producing the object that is then placed on the market, and carries the over-all responsibility throughout the process. The buyer of a model building knows what he is getting for his money; but he is offered only a limited choice, or none at all.

The model approach can therefore succeed only in areas where a highly repetitive product is acceptable to society; according to economic, social and political conditions, this may apply to private and public house buildings, to typical classrooms (or even schools), model clinics, standard factories or agricultural buildings.

It is an approach highly attractive to both the Government and the construction industry whenever the Government feels in a position to impose standard buildings or the industry is confident that the demand exists or may be created for its products.

It is not surprising, therefore, that model buildings are equally favoured by some of the most rigid of the centrally planned economies and by the staunchest supporters of a free market economy. The model approach does not depend on the actual technologies used and may be applied equally well to traditional buildings and to construction on the most advanced and mechanized production and assembly lines.

If the whole production process is geared to manufacture a limited number of unchanging models, there is no need for the component parts of each model to be compatible with those of other models, provided they

are compatible with each other. The fundamental distinction between the model approach and the component approach becomes apparent whenever a client or a manufacturer who has satisfactorily developed a particular model is asked to modify it in order to make its parts interchangeable with those used in the model of another client or manufacturer.

Furthermore, there are limits to the cost reductions obtainable from longer production runs, from continuous rather than batch production, from decreasing the number of types, or from any combination of these processes, because raw materials, which are not much affected by variety of models, account for such a high proportion of total production costs and because current production technologies are already geared to short runs and frequent changes in the dimensions and characteristics of the product. The economic benefits of standardization within present technologies are therefore limited, whereas the disadvantages to the client or the user of reducing variety are considerable.

Process approach

In many countries, a fourth approach is used that, for lack of a better term, may be called the "process" approach. It is more difficult to describe; it is characterized by a pattern of relationships between participants cutting across many of the traditional boundaries between client, professions and industry.

A common variant of the process approach, called a "package deal", offers to the client a comprehensive service by a mixed team of designers, producers and assemblers. Another variant is the "serial contract", which enables the client to renew with an existing team an on-going contract, subject to negotiating a new price.

In both cases the essential feature is the cohesion of the building team, and this requires that the contractor be brought in at an early stage and the members of the team know each other well. To secure the second prerequisite, the group must be established on a more or less permanent basis; the continuity of the team thus becomes the key to success in this approach.

A particular structure of demand for buildings and a given level of technology may be more or less favourable to any given approach, although the relationship may be complex. Thus, for example, some of the most successful systems of prefabrication based on heavy concrete panels are not based on the component approach, since their parts are

seldom interchangeable between systems, nor on the model approach, since few manufacturers succeed in persuading the client to accept standard buildings, especially if the client realizes that the system is far more flexible than the production manager cares to admit. They are based on the process approach, i.e. the provision of a comprehensive design-and-build service. The essence of mass production is not, as was once remarked, that "you can have any colour provided it is black" but rather that "you can have any colour provided it is a Ford".

The technology used is relatively unimportant; the dividing lines between traditional, neo-traditional, rationalized traditional, *traditionnel évolué*, industrialized building and so on, may be arbitrary and bear little relationship to the materials used and to the production and assembly sequences adopted.

Any of the four approaches may be adapted to conditions prevailing in developing countries. The lack of firmly established national standards may facilitate the introduction of the standards conventions required for the component approach, although the low quality of local production and the scarcity of professional skills may prove a serious obstacle. The model approach is already in use especially in the public sector, although in many cases a complete product is not offered but merely a set of standard plans and specifications. The "one-off" approach dominates the private sector and the more prestigious of public buildings and large civil engineering works. The process approach is often offered by international consulting firms, especially when they are in a position to provide, in addition to a professional and industrial service, part or all of the finance for the project in the form of bilateral aid or private investment.

The varied role of the Government in construction

The role of the Government in relation to the construction industry is complex and varied in all countries, whatever their level of economic and social development. The Government acts as the legislative authority imposing external constraints on construction and as participant at different levels in the building process.

In the most general terms, the primary role of the Government is the welfare of the people. At this level, construction is a sector of the economy that contributes to the national product and accounts for a large proportion of investment.

Although, as already mentioned, few national economic development plans give separate consideration to construction, it is obvious that all

Governments are concerned with construction inputs, in particular materials and manpower, and with its outputs, since practically all human activities take place in, on or around the products of construction.

The Government and the external constraints on construction

It is not surprising to find that the location, dimensions and qualities of buildings and civil engineering works are subject to elaborate statutory requirements. Even relatively small urban or semi-urban centres in developing countries operate a system of building permits, building regulations and inspectorates of works, however crude it may be.

Historically, statutory requirements for building originated during the nineteenth century as a result of public concern for health and sanitation. In many countries building regulations are still issued and administered by the Public Health Departments of central and local government. Safety was next included in building regulations, although in some countries fire regulations had been introduced at an earlier stage as a result of disastrous city fires. Safety requirements relating to earthquakes evolved in a similar way; each disaster led to a review of the existing regulations and generally resulted in the imposition of stricter or more apposite structural requirements.

Gradually the collection of basic health and safety regulations developed into quality standards for buildings as a whole (stability, natural light, sound insulation etc.), or for their parts (durability, resistance to natural deterioration, weather-proofing etc.). In the absence of a rigorous and systematic body of knowledge on the performance of building materials, building components or complete buildings, it was natural that such regulations should specify as acceptable standards only those materials and techniques that had proved their suitability over long periods of time.

In many industrialized countries, and in practically all developing countries up to this date, building regulations are still couched in the form of statements laying down precisely what type of material or mode of construction is acceptable. It is possible to suggest an alternative method of construction in only a few cases and even then the proposal is authorized or rejected by strict comparison with the more traditional building techniques.

The problem is particularly acute in developing countries, where modern building technology and criteria have been transplanted without substantial modification from Europe or North America. The strict

enforcement of descriptive and therefore restrictive building regulations originating under different climatic, social, economic or organizational conditions has often stifled the development of new materials and techniques and has added an unnecessary burden to construction costs in developing countries.

The retention of outdated building regulations is one aspect of a general tendency for professional staff and administrators in developing countries to insist on the same requirements as their counterparts in industrialized countries. Although lip service is paid to the idea of adaptation to local circumstances, it is often interpreted as a half-hearted scaling down of European or North American standards. There is an urgent need for a thorough reappraisal of performance requirements in terms of local conditions and for a general overhaul of statutory regulations in developing countries on the basis of the more advanced criteria elaborated in many industrialized countries of Europe and North America, suitably adapted to local conditions and to local standards of taste.

The Government as a participant in the construction industry

The following paragraphs deal with the ways in which public authorities, both at the central and local government level, participate in construction activity. They are based on the practice of market economies and do not apply to countries with centrally planned economies.

Governments may be committed to providing finance for the construction process without necessarily acting as clients; it is common, for example, for central and local government or for public agencies funded by the Government to encourage private construction, especially in housing, by providing capital at reasonable rates of interest and over long periods. Public authorities do, however, often act as clients; central and local government programmes in all countries include a variable but in general a large proportion of total construction output. The departments most directly concerned are those responsible for transport and communications, defence, public buildings for education, health and social welfare, housing, and, in some cases, the nationalized sector of the economy (energy, railways etc.). The relative importance of such sectors varies from country to country according to the political, social and economic system, local traditions and the particular programme concerned. The different public authorities may also vary considerably in their attitudes as clients.

All countries have a central government department responsible for what are usually called public works. This covers parts or the whole of the central government building programme and very often the main network of public infrastructure (roads, bridges, harbours, canals, airports etc.). In some cases, separate public authorities are set up to cover specific sectors among those listed above, and such authorities are sometimes granted a considerable degree of independence, although they derive most of their funds from the central government budget.

In most developing countries, central government departments concerned with building and construction are relatively well staffed and technically sophisticated. They tend to be over-centralized, which is natural in view of the scarcity of professional manpower, and rather conservative as regards design and the administration and supervision of construction projects. They use an approach to construction matters similar to that adopted in industrialized countries, although the similarity is often limited to matters of procedure. As a result, the over-strict attitude of many central government departments, in particular of ministries of works or public works departments, while intended to maintain a high professional and technical standard, often imposes an unnecessary constraint on innovations in the building process. Regional offices of central government departments, when properly staffed (which is rarely the case) may sometimes be more flexible, since they are in closer contact with local conditions and the requirements of users.

Local authorities are in an even more difficult position than central government departments even in countries with a long tradition of local government at the municipal, provincial or regional level. The technical departments concerned with construction are embryonic, under-staffed and out of touch with what is going on elsewhere. Local government suffers even more than central government from lack of continuity in construction programmes, making it difficult to plan operations properly and to recruit qualified staff.

Professional staff in local government employment may suffer from lack of adequate career prospects and tend to regard the technical departments of the central government as the goal of a successful professional career. This is unfortunate, since a major part of the contribution that construction can make to economic and social development in most developing countries will occur outside the capital city or major conurbations. The adequate staffing of local government building and civil engineering departments should therefore receive a high priority in planning skilled manpower resources for construction.

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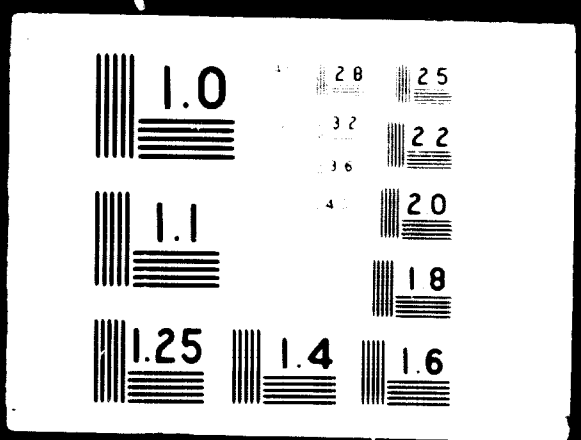


The central or local government acts in the capacity of client by providing funds for, and commissioning works from, the private construction industry. It should be borne in mind that the role of client generally includes defining acceptable standards and issuing an adequate brief to the design team.

It is necessary to distinguish between the general responsibility of the Government for enforcing compliance of all construction activities with statutory requirements as described in the preceding section, and the specific responsibility of government departments as clients of the construction industry. A clear line can also be drawn between public authorities that simply buy the services of the construction industry and those that participate in actually designing their own construction programme.

Ministries of education of many countries have their own architects and engineering departments, which prepare plans, bills of quantities and specifications for educational buildings for which the construction industry is invited to tender in open or restricted public competition. Similarly, ministries of public health may be responsible for the design of hospitals, clinics, health centres etc. Highways, railways or airport authorities may have their own design staff, and so on. Since they are in closer touch with local conditions and the ultimate users, such departments often show more initiative and imagination than ministries of public works.

The nationalized sector of industry and the major public utilities (water, electricity, gas, railways, transport etc.) are frequently modern and sometimes technologically advanced in matters of construction. They compete successfully with central government departments in recruiting professional staff, to whom they offer a career structure more flexible, although sometimes less secure, than that of the civil service. Depending on the institutional framework, they may be less conservative in their method of awarding contracts, and they are jealous of their autonomy, an attitude that sometimes leads to open conflict with central government departments. They may also be less restricted in financial matters particularly as regards capital investment; in many cases they therefore use more capital-intensive methods of construction.

In a few cases, the public sector gives a lead to the rest of the industry by being in the forefront of innovations as regards studies of user requirements, types of building, technological processes and building techniques, contractual relationships and other procedures. These are

exceptional cases demonstrating the positive role that the public sector might play if it were willing and competent to formulate a reasoned technical policy in construction matters.

In many developing countries, the public sector is the principal or even the sole employer of highly skilled or professional manpower in construction. Government departments may also be involved in actual building and employ operatives directly to carry out part of their own construction programmes. This applies mainly to the maintenance and repairs of publicly owned buildings and civil engineering works, although in some cases public authorities may undertake with their own labour force new construction, mostly of a specialized kind. (Even when they do not, they usually procure centrally their own materials and plant and enter into "labour only" contracts with private firms; it is often claimed that the economies thus obtained more than offset the overheads.)

It will be noticed that the participation of the Government in the construction process may range from an interest that is diffused, general and indirect to a participation that is intensive, particular and direct. It would be wrong to assume, however, that these different degrees of involvement are necessarily sequential.

A government department is frequently involved in the production stage, while failing to co-ordinate the construction industry at the level of the national economy or to develop a reasoned technical policy even for the sector in which it acts as client or designer. Few Governments in the market-economy countries have adopted a clear technical policy in construction matters.

There is no doubt that the Government should include construction in its general economic policy and should take steps to develop and implement a technical policy for the industry as a whole. The obstacles to the formulation of a technical policy are, to a large extent, the vested interests of the spending departments (housing, health, education, public works etc.), making them reluctant to surrender some of their autonomy for the sake of a common long-term policy.

The role of the Government merely as a client of the construction industry is clearly insufficient in itself to promote future technical and organizational development; Governments should be prepared to formulate an explicit and consistent policy and to use the public sector as a pioneer for introducing desirable changes in the structure and attitudes of the industry as a whole.

THE OUTPUT OF CONSTRUCTION

There are several ways in which the product of the construction industry may be broken down for the purpose of analysis. Those most usually accepted are:

New work and maintenance and repairs;

Residential building, non-residential building and other construction works;

Public sector and private sector;

Modern and traditional categories.

Few countries compile sufficient statistics to provide a detailed breakdown of construction according to all these categories, although in most countries the order of magnitude of some of the main aggregates is known. Knowledge of the relative importance of the various categories of construction output is a prerequisite for formulating short- or long-term policies for the construction industry in any country, particularly developing countries.

It is seldom possible to consider construction output globally. Different categories of construction consume different inputs, follow different patterns of financing, grow at different rates, utilize different technologies, and are handled by different professions or contractors. A separate analysis is therefore required.

New work and maintenance and repairs

The first method of breaking down construction output distinguishes between new work and maintenance and repairs. The distinction is not as obvious as it may appear, partly owing to the way in which accounts are kept by industrial, commercial or public establishments and in which capital and current expenditure are interpreted. Individual organizations may draw different dividing lines between the two categories of

expenditure, and their definitions may not coincide with those adopted for fiscal purposes.

National accounts may tackle the problem in yet another way and thus add to the confusion. Although it is possible to identify clearly items at the opposite extremes of the range covered by construction activity (for example, a completely new school or hospital building, as compared with the periodic replacement of paint or electric bulbs), there is a large area in the middle, variously described as conversions, alterations, additions, major repairs etc., which, according to the method of reporting, may be attributed either to new work or to maintenance and repairs.

The problem is not of purely theoretical interest, since maintenance and repairs may account for as much as one third of the total annual output of construction in industrialized countries and absorb up to 40 per cent of construction manpower. Furthermore, as shown in tables 2 and 3, the allocation of total output between new work and maintenance and repairs varies considerably in different categories of construction.

Experience also shows that the two types of activity are closely interrelated. The volume of maintenance work depends on the number of buildings to be maintained, their age and quality, on acceptable standards—either imposed by statute or by what is socially considered as tolerable, on the availability of labour and material resources and on aspects of fiscal policy that may act as an incentive or a disincentive.

A vigorous programme of new housing or new school construction, if sustained over a number of years, will reduce the average age of buildings and also, if old buildings are scrapped, the immediate over-all need for maintenance. The reverse is also true: a policy of maintaining, renovating or improving the existing stock of dwellings, schools or roads will reduce, to some extent, the need for replacement and therefore will affect the level of new construction.

Maintenance work is often treated as a residual. When the capacity of the construction industry is limited, especially in terms of availability of skilled labour, maintenance expands or contracts in inverse proportion to fluctuations in new work. The relationship between the two categories is not a simple one, and it is only beginning to be understood in a few industrialized countries.

Accounting techniques such as discounted cash flow, or calculating the equivalent annual cost of a once-for-all capital investment, have only recently been applied to construction programmes on any significant

scale. Although the concepts are familiar enough, the dichotomy between the organization providing the initial capital for construction and those responsible for maintaining the building over its lifetime has proved an obstacle to taking both aspects of construction activity into account in planning programmes.

In developing countries, at least in the early stages of modernization and urbanization, the stock of capital assets in building and civil engineering work tends to be of more recent date than in industrialized countries. Although statistics on maintenance are practically non-existent in developing countries, there are indications that maintenance work accounts for a small proportion of total construction activity, probably not more than 10 to 15 per cent as opposed to 25 to 35 per cent in industrialized countries. (See tables 2 and 3.) The lower standard of maintenance tolerated in developing countries for a large part of the stock also serves to diminish the proportion of work in this category. But the problem is simply postponed: since the product of construction is long-lasting, present day decisions to skimp the qualitly of new work or the level of maintenance of existing stock implicitly commit future generations to spending a good deal on maintenance and repairs.

This may be observed in major infrastructural works (roads, airports, irrigation canals etc.), where the neglect of adequate maintenance in the early stages has led to rapid deterioration and to mounting expenditure on repairs, for which sufficient provision has not been made in the budget. Public works departments in developing countries are reluctant to plan and organize maintenance operations, as opposed to the more challenging and prestigious task of undertaking new civil engineering works.

Building maintenance, as distinct from civil engineering maintenance, is a labour-intensive operation, requiring a large number of skilled operatives in the finishing trades (painters, plasterers, roofers etc.). In industrialized countries it is traditionally handled by small firms; in developing countries, it is mostly carried out by self-employed artisans whose numbers are often limited. This raises important problems of training and organization, which have not so far received adequate attention.

In civil engineering work, some of the maintenance operations may be mechanized, although this is seldom done in developing countries. Handling the large unskilled labour force in the direct employment of public authorities presents a special problem of organization, management

and supervision in which the critical factor is the availability of trained foremen and supervisors.

Developing countries must take into account the intimate and complex relationship between the allocation of resources to new work and to maintenance and repairs. Experience in the industrialized countries may serve as a guide, and statistical information, although difficult to obtain, may be collected at least in the public sector of construction. What is needed is a clear realization of the problem and the formulation of an explicit policy. In the public sector, the clients, since they are the authorities themselves, already possess the means for implementing such a policy; in the private sector, more indirect measures will have to be introduced, including the use of fiscal incentives and the adoption of long-term programmes to educate clients and to train skilled workers, so that the necessary maintenance work is carried out.

Residential building, non-residential building, and other construction and works

Countries using the United Nations system of national accounts report the breakdown of GDCF in construction under the summary headings of residential building, non-residential building, and other construction and works. They do not all report under the three headings separately; but sufficient information is available to give a general indication of the orders of magnitude involved.

The breakdown is useful in so far as it distinguishes between building proper and civil engineering. Different countries interpret these terms in different ways; sometimes it is even impossible, within a single project, to separate unequivocally the two categories. Many firms carry out both building and civil engineering work, although it is often organized by separate departments; in some countries, however, these two activities are carried out by separate firms, frequently belonging to different trade or professional associations and in some cases negotiating contracts or wages on a separate basis. The nature of new civil engineering work tends to favour the larger firms, since it consists mostly of large "one-off" contracts, often requiring the use of expensive and highly specialized plant.

Data over the ten-year period 1955—1965 from 53 countries reporting residential building (dwellings) separately and from 40 countries reporting other construction and works separately are summarized in

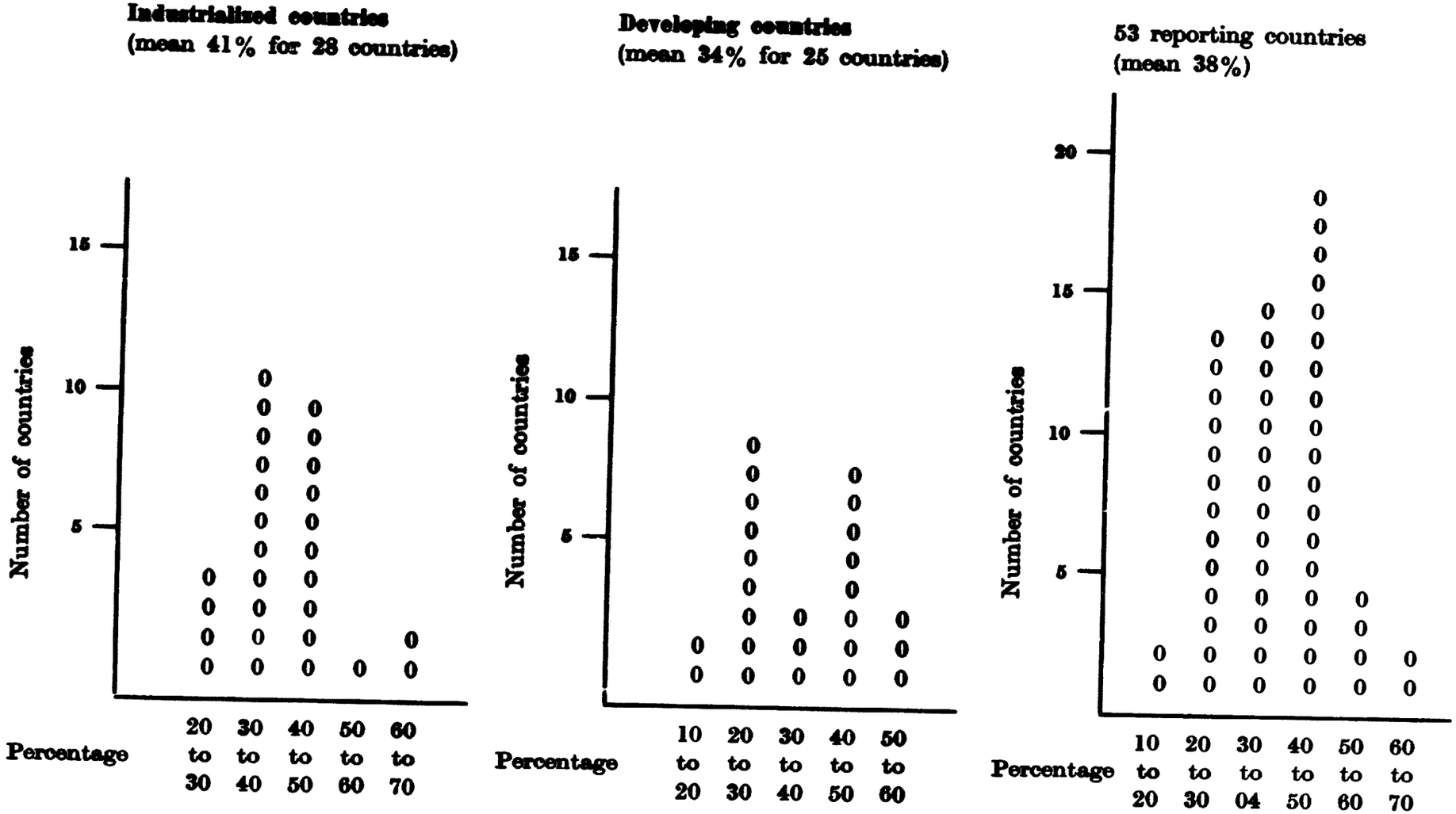


Figure 4. Dwellings as a percentage of GDCF in construction, 1955 to 1965 (frequency distribution)

SOURCE: *Yearbook of National Accounts Statistics, 1966*, United Nations publication, Sales No.: 67. XVII. 14.

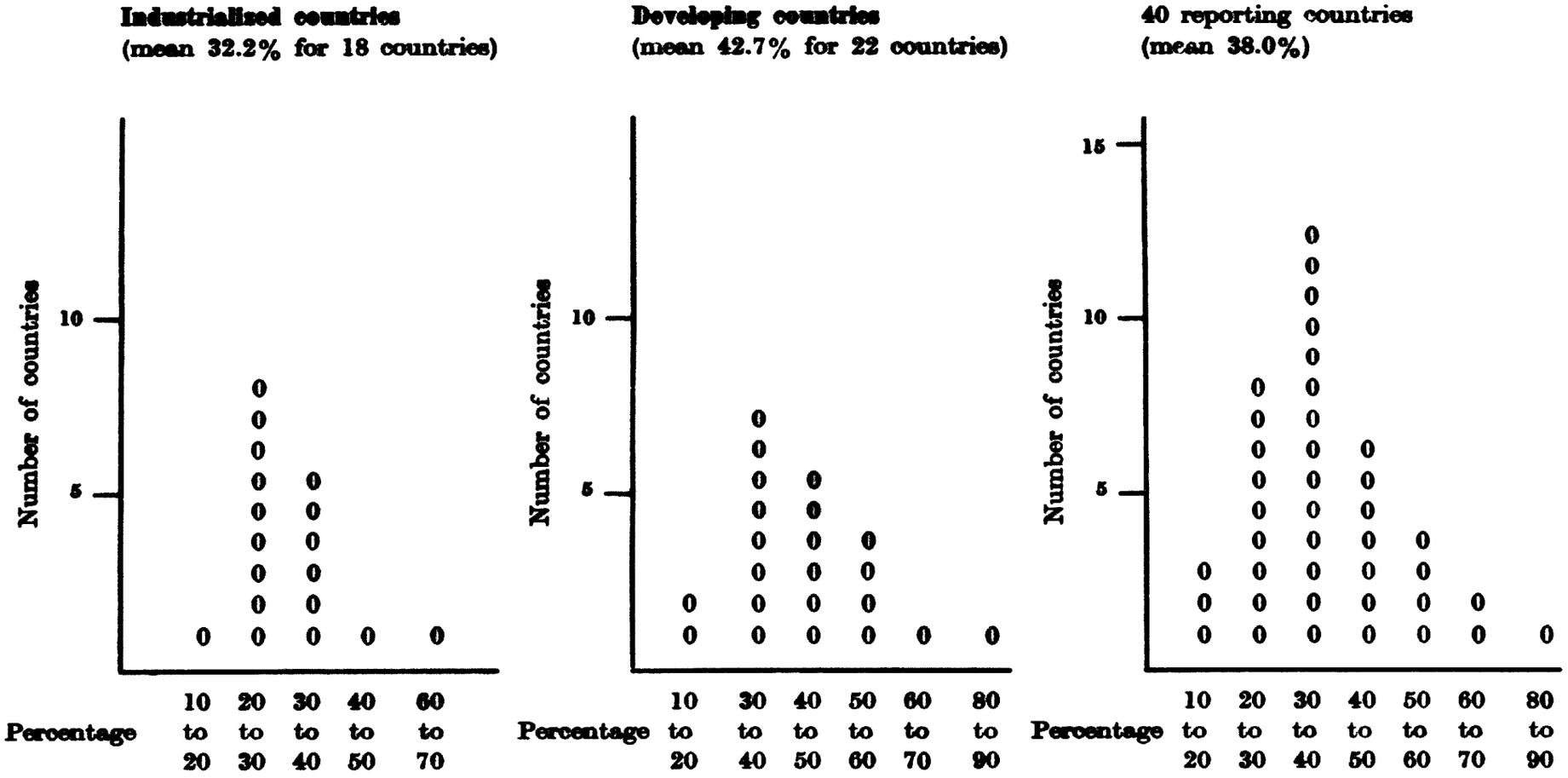


Figure 5. Other construction and works as a percentage of GDCF in construction, 1955 to 1965 (frequency distribution)

SOURCE: *Yearbook of National Accounts Statistics, 1966*, United Nations publication, Sales No.: 67. XVII. 14.

figures 4 and 5. It will be seen that in most countries each of these categories accounts for between 25 and 50 per cent of total fixed capital formation in construction, with a simple mean of 38 per cent. There are, however, significant differences between industrialized and developing countries.

In industrialized countries dwellings absorb from 25 to 60 per cent of GDCF in construction, the proportion for most countries falling within the narrow range of 35 to 45 per cent. The share of other construction and works (civil engineering) varies from less than 20 to nearly 70 per cent, with the figure for half the countries lying in the 25 to 35 per cent range.

The pattern is not so clear in developing countries, where great differences in the share of each category may be observed. It should also be noted that averages are less meaningful in developing countries, since they hide great fluctuations from year to year. Furthermore, it should be remembered that in many developing countries statistics of GDCF refer mostly to the monetary sector and only rough estimates are made of capital formation in the subsistence sector.

Dwellings appear to account for a smaller percentage of GDCF in construction in developing countries. In most countries the proportion is between 30 and 40 per cent, with the figure for individual countries scattered more widely, from a minimum of 10 per cent to a maximum of nearly 60 per cent. The share contributed by civil engineering also varies considerably—from 10 to 80 per cent—but in most countries it is between 35 and 50 per cent, a range significantly higher than that recorded for the industrialized countries.

The share of each of the three categories in GDCF in construction is to a large extent dictated by the needs of the economy and the aspirations of the community. In this sense, construction is a "service industry" and the level of activity is subject to the demands of the other sectors of the economy. Construction seldom creates its own market, although it has proved to be very adaptable to rapid changes in demand.

This fact is expressed more controversially in the phrase "a country has the construction industry it deserves", i.e. changes in the structure of the industry tend to follow, rather than precede, changes in the structure of demand. The level and characteristics of the demand for buildings and civil engineering works may be changed, at least over short periods, by deliberate acts of policy. This is partly because the public sector in construction is very important in most countries.

Over long periods, however, a relative balance is re-established between residential building, non-residential building and civil engineering works, reflecting the particular pattern society requires. Factories cannot be built without houses; houses cannot be built without schools; factories, houses and schools cannot be built without roads, and so on. Social requirements are similar in countries at a similar level of economic development, and this is reflected in the breakdown of construction activity into the three categories considered in this section.

Changes of emphasis between categories of building output are facilitated by the fact that residential and non-residential building utilize approximately the same mix of factors of production and may be tackled by the same labour force and, up to a point, by the same contracting organizations. But there is no real interchangeability between building and civil engineering work for various reasons, including the differences in size of firms and in the contractual arrangements.

On the other hand, although few building firms can successfully enter the civil engineering field, the converse is fairly easy. A significant development in Western Europe since the Second World War has been the entry into building construction of large civil engineering contractors, who brought with them their managerial skills, their financial resources and their familiarity with the deployment and efficient use of an expensive array of plant and equipment. Attempts have also been made in developing countries to utilize international civil engineering contractors for building purposes, but the limited scale of operations and the low prices offered for the construction of conventional housing have often defeated the promoters.

A factor of considerable importance in all countries is how the effective demand is shared out among contractors. Economies of scale must be considered, although there is some tendency to exaggerate their importance. If continuity of output were guaranteed over longer periods, this would probably contribute to making the industry function more smoothly; but it is difficult to reconcile such a guarantee with the principle of competition, which dominates a good deal of construction activity in both public and private sectors. Certain types of repetitive building—for example, public housing or primary schools—are more likely to provide continuity of output than other, more individual types. Political and economic uncertainties, however, often make it impossible to rely on repetitive building to provide the steady demand that would enable the construction industry to make more efficient use of its resources.

Public sector and private sector

Construction output may also be classified according to whether the client is a public authority or a private body, individual or collective. Unfortunately, statistics on the relative importance of these two sectors are available only in a few industrialized countries.

In many developing countries, public expenditure on construction (including both new work and maintenance and repairs) is the only expenditure known with any degree of accuracy, at least as far as the central or provincial government is concerned. It is difficult to generalize from the scattered data available, but it is reasonable to assume that the public sector dominates in civil engineering works, where it may account for more than 90 per cent of the total annual output, and that the private sector is the more important in housing, building for industry and commerce and—in developing countries with a long tradition of religious or missionary institutions—in building for education and health.

In a majority of industrialized countries, including most European countries and Israel and Japan, a considerable volume of housing is financed, directly or indirectly, by central or local government. The same applies to building for education (primary, secondary and higher), for health and for other social welfare services. In countries where large sectors of industry and services are nationalized, the share of the public sector is considerably more than 50 per cent.

In view of the size of public investment in building, it is surprising how reluctant most Governments have been to make use of their powers except in purely financial matters. Until recently, few Western European countries laid down a clear technical policy for the buildings they helped to finance. This is not the case in the centrally planned economies in Eastern Europe, however, where technical policies have often preceded administrative or economic measures.

The situation began to change at the beginning of the 1950s, when it was realized that the gap between the demand and the supply of building, hitherto regarded as an emergency following the disruption and destruction of the Second World War, was in fact a long-term problem to be solved only by long-term changes in the structure of demand and the way in which this demand was allocated to the construction industry.

At the same time, owing partly to improved communications and a greater awareness of the problem in other countries, and partly to the

action of international agencies and organizations [such as the United Nations Economic Commission for Europe (ECE), the Organisation for Economic Co-operation and Development (OECD) and its affiliated European Productivity Agency (EPA), the European Economic Community (EEC) and the International Council for Building Research and Documentation (CIB)], Governments and other public institutions started work on reviewing existing regulations, introducing more flexible methods of awarding contracts and formulating conventions for the dimensional co-ordination and standardization of building materials and components that might be internationally accepted. There was also a move to reassess the purpose and scope of training for employment at all levels in the construction industry, and in general to sponsor, encourage and support what became known as the "industrialization of building".

The public sector played an essential role in this. It may be regretted that the professions associated with the industry (architects, engineers etc.) did not, at least until recently, sufficiently associate themselves with it. At the risk of oversimplifying the position, it might be said that the converse was true in the centrally planned economies, where the publicly owned construction industry took the lead in introducing changes and securing the support of the higher policy-making bodies.

It was natural that the public sector should be prominent in the move towards industrialized building. Only the public sector had a sufficient volume of demand for building to justify the research and development work necessary to launch new techniques or to create new products. Only the public sector was able to plan its requirements in advance and ensure the continuity of demand, universally regarded as a *sine qua non* for industrialized building. The drawback was that the public sector was exposed to changes in policy and to political control. Governments were tempted to use the public sector as an indirect regulator of demand, which sometimes had unfortunate effects on the construction industry.

Few Governments seemed to appreciate that credit restrictions, licensing systems and similar indirect means of modifying demand did not have an immediate effect on production. Since new construction is a form of capital investment, the construction industry and its related professions are sensitive to changes in mood or confidence. But, since construction is also a complex assembly operation, the repercussion of such changes on the various sectors supplying inputs is much delayed. The time lag has been variously estimated at from eighteen months to three years, and the consequence is that government measures often

have the opposite effect from what was intended, if indeed they have any effect at all.

Such considerations are relevant to developing countries, where the public sector often dominates modern construction activities in the urban areas. Furthermore, construction is usually heavily dependent on imports of building materials, components, plant and skills. Sudden changes in the construction policy of the Government, or in the way it is financed, or the introduction of restrictions on imports or quotas, affect the output and the organization of the industry more rapidly than in industrialized countries.

Large fluctuations in the aggregate figures for construction output conceal even larger variations in individual categories of construction, with regional or local repercussions that may prove disastrous for emerging national contractors who lack the financial resources to ride out the peaks and troughs of demand.

The large international concerns, which in many developing countries have a near monopoly of major civil engineering projects, protect themselves by increasing their profit margin and by writing off over short periods the expensive plant and equipment they use in highly specialized work. These practices lead to higher prices and are largely responsible for the high building costs in developing countries, as compared with those for similar kinds of work in industrialized countries.

The responsibility of public authorities is therefore greater in developing than in industrialized countries. When it is borne in mind that the public sector is often the principal employer of highly skilled manpower, the importance of a consistent construction policy by central and local government hardly needs stressing.

Outside the centrally planned economies, however, private clients also account for a sizable proportion of the total demand, and the production side of the industry is almost entirely in the hands of private industrial concerns, including a large number of self-employed artisans.

As an exception to this rule, it is customary for public departments to employ their own labour to carry out a substantial part of maintenance and repair work on publicly owned construction. This is because maintenance work is made up of a large number of small operations that are not easy to describe in unequivocal and binding terms in a legal agreement, which would be a prerequisite for farming it out to a contractor.

The technical policies and contractual arrangements in force in the public sector affect the private sector as well, although with a considerable time lag. In only a few countries in the upper range of economic and social development could it be claimed that the private sector is ahead of the public sector as regards contractual procedures or the use of advanced technologies. One of the main problems in the remaining countries is how to increase the influence that the public sector exercises over the private sector and how to spread the know-how accumulated in a few central places throughout an industry that, by its very structure, tends to resist change.

Modern and traditional categories

The three preceding sections of the present chapter have analysed the output of construction by type of work and by sector of use. As far as developing countries are concerned, an even more important distinction is based on the different levels of technology used by the construction industry. Four separate categories may be identified in most developing countries; they are:

The international-modern;

The national-modern;

The national-conventional;

The traditional.

The international-modern category is the easiest to define and the term is largely self-explanatory. It includes major civil engineering works, public buildings in a prestige class, and high-quality private buildings in the large urban centres of developing countries. It is international in that it employs technologies borrowed from the most advanced countries and that it is largely—sometimes exclusively—in the hands of expatriate firms. It depends heavily on imports of expensive materials and components, of sophisticated plant and machinery, and of professional, managerial and supervisory skills. It conforms with international quality standards; it is based on internationally accepted contractual documents and practices, and so on.

The national-modern category may be regarded as a scaled-down version of the international sector. It caters to both public and private demand in major urban centres. Although it is based on technologies imported from industrialized countries, the quality standards have been scaled down to local conditions. It requires a large number of skilled operatives in various building trades. It employs the simpler mechanical

aids and plant (concrete mixers, block-making machines, hoists scaffolding etc.). It is handled mainly by national firms whose organizational pattern and technical competence is often a pale copy of the middle-range construction firms in industrialized countries. The national-modern category includes a large proportion of minor public buildings, (schools, health centres, police stations etc.), private commercial and industrial buildings, secondary roads and other minor civil engineering works. In some developing countries the national-modern category uses almost exclusively locally produced building materials and components, although a small proportion of imported fittings and equipment may be employed. In the less developed countries of Africa, Central America and Southeast Asia, however, imports of building materials and components may contribute from 20 to 30 per cent of the output value.

The national-conventional category is not easy to define. It is in essence transitional and the term "intermediate technology" is often used to describe it. It is characterized by a mixture of traditional materials and techniques and a few selected modern inputs, such as cement for floors and wall blocks, corrugated iron or asbestos-cement sheets for roofing, hardwood for joinery, glass, paint and other finishes. Such materials are used in varying amounts according to the sophistication of the client. For a number of technical and administrative reasons, the public authorities do not generally finance building in this category, but it covers a large proportion of privately built dwellings in urban and semi-urban centres, as well as a good deal of rural infrastructure and community development. Most of the work is carried out by local artisans and by small, emerging indigenous contractors who are starved of working capital, simple plant and tools and basic management skills. The national-conventional category of building provides an ideal training ground for local artisans to acquire the necessary experience to undertake modern construction.

The traditional category of building predominates in rural areas and, in some cases, in the areas between rural and urban settlements. It lies almost entirely outside the monetary sector, and the labour is mostly unskilled men carrying out "do-it-yourself" jobs. Traditional building is greatly influenced by the national-conventional category as soon as transport facilities improve communications between urban and rural centres, or the rural dweller has migrated to the town.[6]

[6] An interesting example is described by Crooke in *International Labour Review;* for full reference see annex 3 under "International Labour Organisation".

TABLE 6: EXAMPLE OF CONSTRUCTION OUTPUT BY TECHNOLOGICAL LEVEL, CATEGORY OF CONSTRUCTION AND BRANCH OF INDUSTRY, IN A DEVELOPING COUNTRY AROUND 1965

(percentage breakdown: 100% = total construction output)

Branch of industry	*Technological level and category of construction* *																*Total, according to branch of industry*
	Very high level				*High level*				*Medium level*				*Low level*				
	IM	*NM*	*NC*	*T*	*IM*	*NM*	*NC*	*T*	*IM*	*NM*	*NC*	*T*	*IM*	*NM*	*NC*	*T*	
Civil engineering	11	3	—	—	2	5	—	—	—	3	1	—	—	—	1	2	28
Building	3	2	—	—	2	12	1	—	—	5	15	—	—	—	4	13	57
Maintenance and repairs	2	2	—	—	—	2	1	—	—	—	3	—	—	—	—	5	15
TOTAL, ALL BRANCHES OF INDUSTRY	16	7	—	—	4	19	2	—	—	8	19	—	—	—	5	20	100
TOTAL, ACCORDING TO CATEGORY OF CONSTRUCTION		23				25				27				25			100

SUMMARY BY CATEGORY OF CONSTRUCTION AND TECHNOLOGICAL LEVEL

	Very high	*High*	*Medium*	*Low*	*Total*
International-modern	16	4	0	0	20
National-modern	7	19	8	0	34
National-conventional	0	2	19	5	26
Traditional	0	0	0	20	20

* IM—International-modern; NM—National-modern; NC—National-conventional; T—Traditional.

It will be observed that the four categories have been described both in terms of the technological features of construction and of the branches of the construction industry that carry it out. The two aspects are closely connected, but the relationship is not a direct one. The relative importance in output of each category of construction and the contribution of each branch of the industry may be better understood from table 6, which is based on the experience of a developing country in the mid-1960s. The table exemplifies construction output by:

Branch of industry; civil engineering, building and maintenance and repairs;

Category of construction: international-modern (IM), national-modern (NM), national-conventional (NC), and traditional (T);

Technological level (very high, high, medium and low).

Of the four technological levels—very high, high, medium and low—each accounts for approximately one fourth of the total output, with high and very high technology predominating in new civil engineering construction, whereas new building construction is equally distributed between high, medium and low technology. At each technological level, the output is shown also by category of construction. Construction in the national-modern category is seen in this example to account for 34 per cent of the total output (19 per cent at the high technological level, 7 per cent at the very high level and 8 per cent at the medium level). At the "very high" technological level, reading vertically, it is seen that construction in the national-modern category is divided almost equally between civil engineering, building and maintenance, whereas at the "high" technological level, the national-modern category is concentrated largely on new building.

Without some estimate of the breakdown of output by technological level and by category of construction, it is impossible to formulate a coherent policy for the development of the construction industry. The different categories respond differently to changes in technological level of demand. Resources released by one category cannot necessarily be used by another; the situation may occur, for instance, where idle capacity in the national-modern category may coexist with excessive demand for construction in the national-conventional category or *vice versa*. There may also be a lack of effective demand for a category of construction, for example, when pilot projects for social housing (improperly called low-cost housing) are carried out in the national-modern category at prices well above the means of the social class for which they were originally intended.

Planning for the future of the construction industry in a developing country must be based on a reasonable quantitative assessment of the present structure of construction output and the construction industry and on consistent assumptions about the probable rates at which each category will grow. Targets may then be set, based on past experience and on the growth potential of individual categories. The desired volume and technological level of demand may be influenced by direct policy action, especially in the public sector; estimates of resources required to achieve these targets may be made for each category. Finally, specific constraints may be eliminated by concerted short- and long-term action. In brief, the lines along which construction output evolves may be directed by conscious decisions on the part of the Government.

MANPOWER, EQUIPMENT AND FINANCE

MANPOWER[7]

The quantitative aspects of employment in the construction industry were discussed in chapter 2. The present section is concerned with some qualitative aspects of manpower engaged in construction.

The construction process consists in the main of the assembly on site of a large number and variety of building materials and components. The labour content is high, as in other similar large-scale assembly operations. Furthermore, the variety of materials and components used in construction implies a corresponding variety of techniques and procedures for their assembly. This is reflected in the number of different construction skills, some of which have evolved over centuries, while others have been introduced more recently as a result of innovations in building materials.

The evaluation of data for 1960/1961, collected by the Directorate for Scientific Affairs of OECD and relating to all economic activities in eleven industrialized countries, showed that employment in construction accounted for 5 to 10 per cent of total employment. But analysis of the labour force by occupational groups as defined by the ILO showed that, except in Greece and Portugal, the group comprising craftsmen, production-process workers and labourers accounted for only 30 to 40 per cent of the *total* labour force, whereas it constituted 75 to 85 per cent of the construction labour force. These proportions underline the labour-intensive character of construction activities.

National aggregates for the construction industry conceal considerable differences within the industry itself. In any country, construction units differ greatly when analysed by size of firm, by skills of workers and by trade. For example, construction firms specializing in civil engineering works are generally large or very large and employ a high proportion of concretors, machine operators and labourers,

[7] Monograph 14 in this series deals with the general subject of manpower in industry.

whereas contractors devoted mainly to the traditional finishing trades and services (painters, plumbers, roofers etc.) are generally small or very small and employ few labourers but a large proportion of workmen specialized in their respective skills.

Changes in the structure of demand have a great effect on the structure of employment. Thus, a switch from maintenance to new work or from building to civil engineering will place different demands on firms of different trades and different size. The construction industry in all countries shows a certain flexibility in adjusting itself to new conditions. When changes are too sweeping or rapid, however, shortages occur of skilled manpower with the right qualifications, and targets are not met. It is clear that better short- and long-term planning would be possible but would require a degree of sophistication and comprehensiveness rarely attained even in highly industrialized countries.

Skilled workmen

The traditional operative skills involved in construction are mostly those concerned with masonry (stone, bricks etc.), carpentry and joinery, flooring, tiling, plastering and rendering and painting. With the development of environmental control and mechanical services in building that began towards the middle of the nineteenth century, entirely new skills had to be introduced to handle plumbing and sanitation, electrical installations, mechanical services and, more recently, heating, ventilating and air conditioning.

The other major innovation in building technology has been the replacement of massive load-bearing construction by framed structures with relatively light infill and cladding. The main materials used for frames are currently steel and reinforced concrete. Thus, steel erecting emerged as a new skill in the United States towards the second half of the nineteenth century.

The relative share of different skills in the construction labour force has changed rapidly in industrialized countries, following technological changes. The employment of masonry skills has generally decreased owing to the use of concreting, either plain or reinforced, which since its introduction towards the end of the last century has spread more rapidly than any other building technique.

In situ concreting requires considerable skill in shuttering, and this has become a specialized branch of the construction carpentry trade. The use of reinforced concrete also involves the introduction of the new

skill of preparing and placing steel reinforcement, both at the factory and on site. Traditional finishing trades, such as plastering and painting, have become the scarcest skills in building; the desire to reduce such operations, or to eliminate them altogether, is one of the reasons behind the introduction and large-scale development of pre-cast concrete construction that has constituted the main technological trend in Europe over the last fifteen to twenty years.

Carpentry and joinery skills have evolved differently and in ways that vary from country to country. The relative decrease in the use of timber as a structural element in many industrialized countries has often been offset by a corresponding increase in fittings and equipment involving timber. In other countries new timber technologies (wood-based panels, gluing, laminating etc.) have been developed that require new and more sophisticated skills. A number of other new trades have emerged over the last forty or fifty years, with the introduction of asphalt and bitumen products, asbestos cement, insulating materials, new types of flooring and other finishes, sheet glass and, more recently, aluminium and plastics.

The situation is not static; construction is no more dominated by traditional skills than any other assembling industry. Nevertheless, the training of some of the more traditional skilled workers has not changed sufficiently and is still based, as it was several centuries ago, on apprenticeship.

Accelerated training schemes for both traditional and non-traditional skills have been tried with some success. For example, one of the advantages of the assembly on site of large pre-cast concrete units is that specialized labour can be trained considerably faster for this job than for the more traditional masonry skills. The same is true of the manpower required in the factories producing concrete elements, where advanced mechanization has reduced significantly the skilled labour content of production.

Methods of payment have also changed considerably. Between the extremes of fixed-time wages and straight piecework payment, a number of different systems have been evolved using bonuses, premiums and incentive schemes, some of which have been successful in increasing the productivity of the construction labour force. The definition and measurement of the quality of the final product still remain a weak point in labour relations and one that has received insufficient attention even in industrialized countries.

A promising trend has been the reduction in the number of trades involved in assembly operations, accompanied by better planning and

organization of the sequence of individual operations on site. New management tools have been developed to reduce the overlap between gangs of workmen performing repetitive operations, thus ensuring a better use of labour. In some countries this has led to an expansion of subcontracting as described in chapter 2.

Similar general trends may be observed in modern construction in many developing countries. A large proportion of the construction output, however, is still based on relatively simple construction techniques involving unskilled labour or traditional local skills. Nevertheless, it would be wrong to assume that with the rapid process of urbanization, shortages of skilled labour will not occur even in less developed countries. Such shortages have already been experienced in many urban areas where massive unemployment or underemployment is accompanied by a scarcity of bricklayers or blocklayers, carpenters, plasterers etc. In developing countries, apprenticeship and vocational training schemes for the construction trades are still completely inadequate in terms of the numbers produced and the types of skill imparted.

Trade unions have an important role to play in construction development. Their structure and strength varies considerably in countries at different levels of economic and social development. Even where trade unions have established themselves in a strong political position, however, they have failed so far to make a significant contribution to the innovations so badly needed in the construction industry. This is true even of more advanced countries, where, with few exceptions, building trade unions have adopted a rather conservative attitude to the introduction of new technologies and, sometimes, of new management tools. A great effort is required to bring trade unions in developing countries to realize their potential contribution to the evolution of construction within the framework of long-term social and economic development.

The building professions

The problem of highly skilled manpower employed in construction is quite different from that of skilled and unskilled workmen. At the upper end, there are a number of professions such as architects, civil engineers, structural engineers, mechanical and electrical engineers, and, in Commonwealth countries and former British colonies, quantity surveyors.

The OECD data, mentioned in the previous section, showed that the groups comprising professional, technical and clerical workers contributed a relatively low proportion of the construction labour force as compared with the total labour force. As in the case of skilled and unskilled workmen, the proportion of administrative, professional, technical and clerical staff varies in different types of enterprise and in different trades, but it tends to grow steadily with the size of firm. There is a slow but significant change towards employing a higher percentage of professionally qualified staff in construction. This is owing partly to the trend towards concentration in the industry and the correspondingly increased share of larger firms in the total output of construction.

The organization of the main building professions varies considerably from country to country according to their level of economic and social development. In general, local practices of architects and engineers are small, professionally weak, starved of working capital, uncertain of future employment, without adequate subordinate staff and often unable to apply the codes of professional conduct and the structure of fees laid down by their respective institutions.

Expatriate firms, often very specialized, tend to act as consultants and to cream off the best professional skills available locally. They are often introduced into a country in connexion with a major project; once it is completed they sometimes find it difficult to secure sufficient work to maintain an adequate staff. Some of them become wholly local firms after a few years; others maintain only a skeleton staff locally and transfer most of their operations back to their country of origin.

Professional institutions of architects and engineers devote themselves mainly to the interests of their members and are only marginally concerned with training, although there are some notable exceptions. Few of them display a progressive attitude towards construction procedures, although their potential contribution to innovation and development is great. They should also play a more dynamic role in initiating original research and in encouraging their members to apply the results. This assumes that they are strengthened, both legally and financially, and that they are prepared to give a lead to the development of construction.

Such institutions generally adopt a protectionist attitude towards local professional standards and are unwilling to recognize foreign qualifications, except those obtained in the countries of the former colonial powers. A greater mobility of professional manpower among the developing countries, and among industrialized and developing countries,

would, however, be a great step forward. Institutional barriers to such mobility should be removed by concerted action through the machinery of the professional institutions at national and international levels.

Plant

Practically all assembly operations carried out on site use some tools or equipment; it is therefore difficult to measure the degree of mechanization of building operations if simple hand tools are included under this term. Hand tools are in use all over the world and few of them have been improved for generations. If, however, mechanization is taken to mean the use of power-driven machines, an indirect index of mechanization might be based on the horsepower per operative or per unit of output—a measurement used in some centrally planned economies. But the nature of assembly operations on site is such that even the most flexible machines are actually utilized for only a fraction of the available time. An accurate measurement of the contribution of mechanization to the efficiency of building operations should take this factor into account.

Varieties of building plant

Almost all the machines utilized on building and civil engineering works have been designed to perform relatively simple and repetitive operations. In this sense they mostly replace unskilled labour. Up to the present, mechanization has not been much used for sophisticated operations requiring more highly skilled workers, who are scarce in practically every country. This was perhaps inevitable in view of the low technological level of assembly operations required for a building or a major item of infrastructure as compared with many more advanced manufacturing processes. But it is an important factor in relation to the introduction of plant and machinery in developing countries. An exhaustive discussion on labour-intensive and capital-intensive methods in building and civil engineering work may be found in ILO publications.

It should be borne in mind that buildings and civil engineering involve the movement, transport and placing of masses of bulky materials. Indeed, the output of construction is the heaviest product made by man; buildings may weigh between 100 and 1,000 kg/m² of floor area, depending on the materials used. The lightest types of uninsulated, single-storey

structures are made from timber, bamboo or other organic materials. If thermal insulation is added to external walls and ceilings, the weight of such buildings is 150 to 200 kg/m².

Multi-storey buildings with light frames, light suspended external walls (curtain walls) but solid floors, used as office blocks and for other administrative purposes in urban areas throughout the world, weigh between 400 and 600 kg/m². Buildings with heavy, load-bearing walls (brick, stone or concrete) but light structural floors and roofs, which constitute most single- and double-storey dwellings in the Northern hemisphere, weigh about the same.

A combination of heavy walls and solid floors, generally made of reinforced concrete, is characteristic of traditional construction and of most of the heavy panel systems of prefabrication developed in Eastern and Western Europe in the last fifteen years; buildings of this type weigh between 800 and 1,000 kg/m² of floor area.

Such figures give an idea of the mass of materials to be handled in constructing even the simplest buildings. In many countries, a dwelling for a family of four persons weighs between 50 and 100 tons. Indeed, physical mass may be an advantage from the viewpoint of sound insulation and of thermal capacity, which is desirable in climates with hot days and cool nights. The prevailing trend in building technology, however, is towards weight reduction, although at present buildings throughout the world are still very heavy. For this reason, the first operation to be transferred to machines is usually the mixing of the aggregates (gravel, crushed stone, sand etc.), binders (cement, lime etc.) and water which go into making mortars and concrete. Power-operated mixers of different sizes, with or without mechanical hoppers and dosing devices, have been adopted by builders in developed countries all over the world and are increasingly used in modern construction in developing countries. Such machines are simple and sturdy; they have a regular output and, if they are properly used, the product is of uniform and prescribed quality. The same applies to stone crushers and other machines required to produce and grade aggregates used in concrete.

The next operation to be mechanized is the vertical movement of materials and components. Although primitive cranes have been used since mediaeval times in Europe, the introduction of vertical lifting devices operated by electricity or internal combustion engines is relatively recent in most industrialized countries.

Wheelbarrows and similar tools are used extensively all over the world to transport materials, although they have still to be introduced

into many developing countries, but horizontal transport by mechanical devices is somewhat more complicated because a building site generally presents many obstacles, including uneven ground, that simple machines cannot easily deal with.

Civil engineering is more highly mechanized than building. Earth-moving in bulk and excavation have been mechanized to a large degree, especially since the introduction of the bulldozer during the Second World War. Digging equipment has been employed for decades in major civil engineering works (canals, harbours, dams etc.), although machines appropriate to the smaller sites used for building are of relatively recent introduction.

The final step in the mechanization of bulk operations is the introduction of the tower crane or the travelling crane, combining vertical and horizontal movement. In many European countries, tower cranes on building sites were practically unknown ten or fifteen years ago, although they are already beginning to be used in urban areas in developing countries. Their use is linked with the trend towards high building in densely urbanized areas.

The tower crane represents a turning point in building technology. Since it is expensive, it is justified economically only if it is used intensively. Although it is impossible to determine which of the two evolved first, there is no doubt that tower cranes and prefabrication of large concrete components are closely associated. In some centrally planned economies, the maximum weight of components that could be handled by a range of standardized cranes has been used as a criterion for classifying building techniques by levels of technology.

It will be noticed that the operations described so far deal with the handling and movement of bulky and heavy materials and components. The next step is more difficult since it concerns more sophisticated operations, considerably more diversified and traditionally handled by skilled workmen.

In countries where "wet" systems of construction are generally used, attempts have been made to mechanize operations such as bricklaying and plastering, but with only limited success. An alternative has been to suppress these operations altogether by changes in design, materials and technology. In many European countries, non-traditional methods of construction based on the use of large load-bearing reinforced concrete panels for floors and walls were originally introduced as a means of overcoming the shortage of skilled masons, bricklayers or plasterers. Such methods are efficient when they succeed in eliminating completely the

need for a particular trade. When, however, some finishing operation is necessary, involving a specialized trade, the economic advantages of prefabrication are greatly reduced, if not lost completely.

This is the main lesson to be learned from the experience of industrialized countries, but it might also be claimed that the major contribution of mechanization to construction lies in the fact that machines have a regular output and are relatively expensive. Their use therefore is an incentive for the contractor to organize the whole construction operation (and not only that part directly affected by machines) in a proper sequence and at a prescribed pace.

As a result, there should be an improvement in the operations on building sites, similar to that which has already taken place in major civil engineering operations. Such an innovation would probably have a greater effect than the actual saving in terms of manpower replaced by machines, since the manpower concerned is usually unskilled and therefore relatively cheap. If, however, the introduction of machines is not accompanied by better management and more rational organization of work, it will fail to produce the expected economic results. This has often been the case in developing countries.

The use of building plant in developing countries

At present, developing countries import a great number of the construction machines used, although many of them are of relatively simple design and might be manufactured, or at least assembled, locally. The production of simple building plant may be a promising line for the emerging engineering industries in many developing countries, if changing conditions make it possible to use such plant more extensively in construction.

Most machines used on construction sites are designed to perform only a limited number of operations. The more specialized they become (and thus potentially the more efficient at a particular operation), the more discontinuous their use is likely to be. The choice between specialized, high performance and low utilization machines on the one hand, and multipurpose, low performance and high utilization machines on the other, must be made whenever mechanization is applied to complex assembly operations.

In the industrialized countries, it is possible for a construction project to make use of a particular machine when it is needed, through

plant pools operated jointly by groups of contractors, through extensive plant hire services or, in the case or large contractors, through the activities of a separate but affiliated company, hiring plant on a cost or profit basis to the remainder of the firm.

Arrangements of this kind are rare in most developing countries, except in some of the large towns in Latin America, North Africa and parts of Southeast Asia. The lack of continuity of demand and the irregular rate at which construction operations, apart from major civil engineering works, proceed deter local contractors from acquiring even simple site machinery. Scarcity of finance is another factor limiting the introduction of mechanized plant by local contractors. A co-ordinated government policy might easily break the vicious circle of low utilization and high cost, and the experience of industrialized countries in the establishment and operation of plant pools might usefully be adapted to the conditions prevailing in the urban areas of the developing world.

Developing countries should also explore the possibility of using imported second-hand machines; there is already a lively trade in used plant. It would be necessary to establish an adequate organization for the maintenance and repair of such equipment. To function efficiently, the organization would need stocks of spare parts, either imported (which would present problems, owing to the lack of international standardization) or manufactured locally as part of the development of minor engineering industries.

Financing the building process

There are several possible conceptual models of the building process. In one section of chapter 2, for example, the process was discussed in terms of the participants, their respective roles and their contractual relationships, whereas another section has described it in terms of the flow of information. The building process may also be considered in terms of the flow of financial resources among the participants. This concept is particularly useful to developing countries, where capital resources are always in short supply.

In chapter 2, it was pointed out that the client provides the financial priming for the initiation of the process. In order to do so, he must command sufficient capital resources to bridge the period between the inception of the project and the time when it begins to yield its social or economic benefit.

When the Government is the client, the problem is often masked by the budgetary conventions obtaining in the public sector and by the fact that market interest rates are seldom charged during the bridge period. But the private developer investing his capital in a project is interested in shortening the time during which his investment is unproductive. It has been variously estimated that the interest paid during the bridge period can add, according to prevailing interest rates, financial arrangements and fiscal conventions, from 5 to 10 per cent to the capital cost of many building projects.

It is therefore reasonable for all the participants, in their own interests, to attempt to cut down the time spent on the construction process. It is, however, seldom appreciated that actual construction time on site accounts for only a part (often less than one half) of the total building time-table. The delays encountered in the preliminary stages of the process, including those attendant upon securing approval from the competent authorities, may add considerably to the cost of the project.

The problem has become increasingly acute with the growing complexity of large-scale building projects, and attention is being devoted to it in several industrialized countries. There is little evidence, however, that any action is being taken in developing countries, where problems of financing modern construction are difficult.

The remuneration of the contractor and subcontractors is the next problem in the flow of financial resources. They are almost universally paid by instalments on the basis of work done. The work is subdivided into clearly identifiable operations, and the instalments are paid over the period of construction.

The intervals between such payments vary from country to country and between different types of work; they may also vary as a consequence of special contractual arrangements or of many other factors unrelated to the building operations. The basic pattern, however, is that contractors and subcontractors, but more particularly contractors, pay their labour on a weekly (sometimes even daily) basis, whereas they receive payment from the client in arrear. Throughout the project they therefore need to have available as working capital a sum variously estimated at between 2 and 10 per cent of annual turnover.

An unusual feature of the financing of building operations is the almost universal custom of withholding a portion of the payments due to contractors as a guarantee against bad workmanship, hidden defects

or other faults that may be observed only after the project has been completed. Various percentages are withheld in different countries and for different types of contract, and the client (especially the Government) is always under pressure from contractors to reduce the amount so withheld, the interest on which adds to the total price eventually paid by the user.

Payment for building materials and components is also made in arrear in developed countries where building-materials merchants have organized an efficient network of distribution and storage of supplies. The merchants perform an important function by providing, in addition to technical advice, short-term credit to the contractors, who pay several weeks after delivery. This service is essential to smaller contractors, but it is important to larger firms as well. In some countries, the building-materials merchant provides credit even for the heavy, bulky materials that are delivered direct from the stores of the manufacturer to the building site without passing through the merchant's yard.

The problem of financing plant and tools is a different one. It is often remarked that building is a labour-intensive activity. The percentage of total cost attributable to the operating costs and depreciation of plant is between 2 and 5 per cent on most building projects, depending on the level of mechanization, the category of building, or the actual operation.

This percentage is not significantly higher in the case of industrialized building in most industrialized countries, at least within the limits of current technology. The main difference between traditional and non-traditional operations is that the non-traditional requires a considerably higher fixed capital investment in plant off the site and sometimes in transport and handling equipment, but ensures that better use is made of the investment. Capacity utilization has become essential to the successful operator of non-traditional building techniques; if it is achieved, such techniques do not add to the final cost a significantly higher percentage for depreciation of plant and equipment than traditional building methods.

It is customary for the main contractor, when such exists, to supply the general plant, including scaffolding and temporary structures, required by specialist subcontractors to perform their operations. Complex arrangements regulate the allocation of responsibilities and financial liability between contractors and subcontractors for the use of plant on site.

In many developing countries, small contractors exercise their calling under very bad conditions; short-term credit is not available; materials have to be paid for on delivery; payment from the client is often subject to unreasonable delays, especially in the public sector; plant is expensive and breakdowns frequent; labour is unreliable; cash flow is unpredictable so that forward planning is difficult; and management techniques are embryonic or non-existent. This is an area where further studies of the conditions under which local contractors operate in the developing countries might lead to suggestions for removing some of these obstacles and thus ensure higher productivity in the building industry.

Small firms are also more exposed than their larger competitors to fluctuations in local demand, since they operate only in one locality. Owing to the general atmosphere of uncertainty, they have little incentive to tie up their scarce capital resources in fixed investment of any kind. On the other hand, since they command few permanent assets, they are less likely to obtain credit from banks and other financial institutions. This is a vicious circle that can be broken only by a conscious effort on the part of the public authorities; they might either guarantee a regular flow of orders, to small firms or provide easier credit facilities or, preferably, consider a combination of both measures.

Investment by the construction industry is comparatively low, expressed either as a percentage of total fixed capital formation or of turnover. Data for thirty-nine countries, covering the period 1960 to 1965, showed that in thirty-three cases, capital formation by the construction industry accounted for less than 4 per cent of GDCF.[8] This percentage is significantly lower than its contribution to GDP. Land and buildings do not play an important part in the capital formation of the typical construction firm, especially in developing countries.

Cost and price

Next to physical units, cost and price are the most convenient and universal criteria for measuring the inputs and outputs of construction. The distinction is important. The nature of the building process is such that, whereas the prices of inputs and outputs are readily ascertainable, costs are not easy to assess.

[8] *A System of National Accounts and Supporting Tables*; for full reference see annex 3 under "United Nations".

The analysis of unit costs

Most industrialized countries collect and publish indices of wholesale prices that cover the main building materials. The indices reported by the countries of Western Europe and the United States show that over the last ten years the prices of bricks and tiles have risen considerably faster than those of cement. Expressed as an index with 1958 prices as 100, the prices of bricks and tiles now stand in the range of 120 to 150, whereas cement has either decreased or increased at most to 110. There has been no international trend in the prices of sawn wood; different countries have shown different trends.

The relative stability of cement prices as compared with those of ceramic products and sawn wood explains the general trend towards the substitution of brick and timber by cement-based types of construction.

Many European countries collect data on price movements for inputs and outputs of housing construction, which accounts for up to 40 per cent of total construction output and up to two thirds of all new building. Over the ten-year period 1958—1966, in all countries for which data are available, with the exception of Sweden, the index of wages has increased considerably faster than the index of materials.

This shows clearly the pressure of an increasing demand for house building on the labour market when it is not matched by a corresponding increase in the supply of skilled labour. It may also be taken as an indirect measurement of lower productivity in the construction industry as compared with manufacturing industries; it shows in addition the gradual closing of the gap between building and manufacturing wages. These trends are probably world-wide, although there is little statistical evidence from developing countries to confirm them.

Another world-wide trend is that prices for house building are increasing faster than the prices of consumer or other durable goods. In most industrialized countries, the relationship between the price of a dwelling and the income of the household occupying it has remained unchanged over a long period. In many developing countries, however, the gap between the price of urban dwellings of a minimum acceptable standard and household incomes has increased with the process of rapid urbanization.

Whereas in the industrialized countries the capital value of so-called "low-cost" housing is equivalent to between one and one half and two and one half years' income of a skilled manual worker, in developing

countries the capital value of a house is more likely to represent between three and eight years' income in spite of the fact that quality and space standards in developing countries are considerably lower.

To express costs per dwelling in this way, it is necessary to assume that the unit taken for comparison is defined in precise terms. This is far from being the case, since the relationship between building costs and building standards is very complex. Nevertheless, there is sufficient evidence to show that for most building types total cost increases with area, but not in direct proportion, i.e. the marginal cost of the additional unit area is considerably less than the average cost.

This relationship, which is true whatever the absolute cost of the building, arises from the fact that in practically all buildings there is a part of the cost that remains constant and is independent of the size of the building; the greater this part, the smaller the marginal cost will be. In the case of residential construction, the constant part comprises the cost of the staircase, the kitchen and bathroom, the front door, the garage, the meters, the boiler etc.; in the case of office buildings, it might include the cost of lifts, entrance hall, sanitary installations and so on.

Data compiled from a number of sources in developed and developing countries show that the marginal cost per square metre is between 0.4 and 0.6 of the average cost per square metre, which means that extra space (provided it is useful space) is among the cheapest ways of providing better standards of accommodation—a fact that is only just gaining recognition in some industrialized countries.

For the purpose of economic and social planning, unit costs may be more significantly expressed in terms of user units. Thus, the cost of housing is expressed in terms of bed space or inhabitants, the cost of schools in terms of students to be accommodated, the cost of hospitals in terms of beds for patients and so on. Standards formulated in this way provide a powerful incentive for the client and the designers to improve the design of the building itself and to obtain a more efficient utilization of building space.

One of the best examples of this is the evolution of school building costs in the United Kingdom over the last fifteen years; the cost per pupil in secondary schools has increased less rapidly than the general index of building costs, owing to the reduction of the area per pupil which was achieved in the early 1950s. During this period, however, school building standards actually rose in terms of the quality and spatial arrangement of the accommodation provided.

There is no doubt that better studies of user requirements, more flexible briefs and more intensive research—all related aspects of the design process—might yield economies at least as high as those derived from reducing the cost of inputs.

Costs for building and civil engineering works, expressed per unit of output, vary not only over periods of time but between regions, even within small countries. Such variations in industrialized countries are due mainly to local market conditions and to pressures of demand on local resources of skilled manpower; they are much greater in the developing countries, where they tend to reflect the high cost of transport of building materials and components—whether manufactured at a domestic centre or of foreign origin—and the scarcity of managerial and professional skills outside the main urban areas.

This applies even to simple construction work. As an illustration, it has been estimated that transport costs of material added as much as 50 per cent to the cost of primary classroom units built in an African country where the network of trunk roads was not particularly poor. It is suggested that most developing countries could derive great benefit from making studies of regional variations in construction costs, possibly in the form of contour lines similar to the isochrones used in transport studies.

Functional elements and cost analysis

Another method of analysing building costs consists of dividing the building into functional elements, i.e. groups of materials, components and assemblies which, taken together and independently of their physical characteristics or the way in which they are assembled, fulfil a definite function. Thus, external walls constitute one element that includes the structural part of the wall and all the finishes and accessories necessary to make it perform the multiple uses for which it is designed; a roof is another element, internal partitions a third and so on.

The concept of functional elements is not more than twenty years old and was developed to serve as a fair basis for comparing the costs of non-traditional methods of house construction. Analysis of costs according to functional elements is now common practice in many countries and is beginning to be adopted by the most progressive Governments in a few developing countries. Such analysis reveals the relative importance of the various parts of the building and enables

clients, designers and manufacturers to concentrate their efforts on the elements that really matter.

It can be shown, for example, that in industrialized countries internal finishes and services may account for between 50 and 60 per cent of the total cost of building, depending on the sophistication of such installations as heating, ventilation, air conditioning, lighting and other services. The growing cost of internal finishes and services has led to the rationalization of the design and to the integration of engineering and mechanical services as buildings become increasingly complex.

In developing countries, on the other hand, the roof is often the most expensive element in one-storey buildings. It can account for up to 30 per cent of the total cost; walling materials of local origin are relatively easy to find practically anywhere in the world, and the lower standards of finishes are reflected in the fact that for much conventional building they contribute a smaller part to the total building cost.

Corrugated iron sheets are popular as roofing material, although their poor performance in terms of thermal and sound insulation makes it clear that there is scope for the development of a new, permanent, impervious, strong and light material to provide roofing for the two thirds of the world population that inhabit the less developed areas in Africa, Asia and Latin America.

Reference was made in chapter 2 to the concept of cost-in-use, according to which the discounted values of future periodic maintenance costs are added to the initial capital cost. The same technique can be used in reverse, i.e. to express the combined capital cost and recurrent expenditure in equivalent expenditure of equal annual sums over the expected life of the asset.

Assuming that records exist of maintenance and repairs expenditure for individual parts of the building or, better still, for functional elements of different nature, the application of the cost-in-use technique may be an invaluable tool to assist the client and the designer in choosing the technical solution offering the minimum over-all cost. Good results may be obtained even from scanty or inaccurate data.

The concept of functional element combined with that of cost-in-use makes cost planning a reality at design stage. In fact, it becomes possible to assign limits to the cost of different parts of the building and, to modify preliminary design decisions if they exceed such limits. Cost planning is impossible without cost analysis; cost analysis presupposes cost control.

It is regrettable that the view should be held that these decision-making tools are too sophisticated for developing countries. In fact, experience has shown that, once suitably adapted to local conditions, such design methods may be applied at any level of complexity with relatively little demand on highly specialized skills. The benefits of using them in developing countries might be far-reaching and long-lasting.

Non-building costs

So far this chapter has confined itself to the cost of the building. This is, however, only a part of the over-all picture. Buildings stand on land and land has to be serviced: the site requires drainage, water supply, sewerage, gas, electricity, roads etc. The proportion that buildings represent of the total cost varies considerably from country to country and, within a country, according to the type of building, to the accepted standards, to densities of occupation, land use and a number of other factors. Comparative figures, which are available only for housing, show that non-building costs, excluding the cost of land, can represent as much as one third of the total. It is particularly valuable to apply to this important component of the total cost the method of cost analysis described in the preceding paragraphs.

Chapter 5

THE INTERNATIONAL SYMPOSIUM ON INDUSTRIAL DEVELOPMENT: ISSUES, DISCUSSION AND RECOMMENDATIONS

The issues, the discussion, and the recommendations approved by the Symposium are presented in this chapter.

THE ISSUES[9]

A country's economic and social aims cannot be fulfilled unless supported by a construction industry capable of meeting the demands they impose upon it. For this reason, development of the construction industry deserves the full attention of Governments over a prolonged period. In all countries, construction is one of the largest sectors of economic activity, second only to agriculture in the developing countries and to manufacturing in the industrialized countries. The construction industry, as measured by the value of new work and major capital repairs, accounts for more than half of the gross domestic fixed capital formation in practically all countries, whatever their level of economic development. Further expansion of the construction industry and the raising of its technical level are of particular significance for the industrialization process in developing countries.

Programming of investment

Construction, instead of being a haphazard operation, must be the subject of conscious rational programming, in respect to both demand and supply, within the framework of the economic plans of the developing countries. Public investment (dams, irrigation schemes, transport systems, large industrial and residential projects etc.) must be carried out on the basis of long-term programming. Construction objectives should be co-ordinated with the planning of the supply of materials. Public investment has to be carefully dovetailed with private investment, not only to

[9] UNIDO, Issues for Discussion: The Construction Industry, 1967 (ID/CONF. 1. A/12) (mimeo.).

ensure continuous activity within the construction industry itself, but also to ensure harmony with the desired levels of regional and national economic activity.

Technical development and rationalisation

The general trend towards industrialization of the construction processes must be carefully examined by developing countries in the light of their national resources and the capacity of the construction industry to absorb new techniques. The factors to be considered include availability of capital, the possibility of manufacture of the necessary materials, the foreign exchange situation, projections of demand and supply, including the technical capacity of construction firms and the general employment situation.

While technical developments need to be carefully weighed, it would undoubtedly be advantageous to rationalize site operations to eliminate from traditional methods of construction the organizational and technical defects which impede the economical use of more productive methods. In some developing countries, rationalization would provide the only way of increasing efficiency over the short term. In these cases, any technical or organizational changes which seem likely to lead to improvement should be investigated. There is a wide range of construction activities in which a close examination would bear fruitful results, such as improving construction techniques, developing simpler equipment, improving equipment in use and setting up temporary site plants to produce simple building components.

Use of prefabricated parts and structures

National and international measures should be identified to promote investment in prefabrication works and contractors' plant in order to increase the capacity of the industry. Large-scale application of prefabrication methods rather than on-site construction may prove to be the key not only to a rapid increase in building output but to increased employment of labour without impairing the quality of the end product. Analysis and evaluation of relevant experience might be of particular interest to developing countries and could help in developing suitable policies for promoting these branches of the industry. Several alternative schemes should be prepared for comparison and the determination of the best solution. The preparation and proper evaluation of these schemes are complex and difficult tasks, and a wrong decision may be very costly.

Standardization, modular co-ordination and typified (model) designs

The lack of uniformity in standardization and modular co-ordination, both at the national and the international level, inhibits the development of the construction industry and reduces its productivity. It is essential that the quality and dimensions of commonly used building materials and components be standardized at the national level. This is also highly useful at the international, and particularly the regional, level, since it allows for interchangeability of building materials and their use by the construction industry without the difficulties generally associated with using on the same structure various materials that have been standardized on different bases. International unification of standards and standardization should therefore be explored and supported to the fullest possible extent. The wider use of typified (model) designs would improve both the functional quality of buildings and the productivity and economy of the construction industry. It is in the interest of Governments to entrust the development of typified designs only to appropriately qualified design firms or institutes and to provide support to them. Co-operation among investors (private or public) to obtain and use suitable typified designs should be encouraged.

Research and development institutes

In formulating policies for the technical development of and increased investment in the construction industry, Governments should be assisted by research and development institutes. Appropriate forms of international action might be considered to help interested developing countries in the establishment and development of such institutions. The requirements in this connexion will vary in individual countries, depending on the level and size of the industry and its locational pattern, and there is also the danger of dispersing existing facilities and skills. Therefore, in developing countries, especially in those at earlier stages of industrialization and where there is a lack of qualified personnel, the establishment of a single central institution should be envisaged. It should be responsible for collecting, evaluating and disseminating technical information, preparing building standards and supplementing the collected information with its own research if necessary.

Training

The lack of qualified personnel and skilled labour is one of the main factors impeding progress in the construction industry in developing countries. Therefore, a programme for education and training at all levels

will constitute the most important part of any plan for technical development of the construction industry for a long time to come. It is suggested that developing countries use less conventional forms of education in addition to the conventional methods based on schooling. A good example is training on the site, which has proved to be an efficient method for training illiterate labour. The programme for education and training should cover at least some of the large number of small firms in rural areas, which are not generally familiar with conventional design and contractual procedures. Governments may consider the employment of a certain number of small firms jointly on a suitable project, so as to provide an opportunity to train the foremen gradually in the use of more rational methods of construction, as well as in the use of drawings and specifications.

THE DISCUSSION[10]

There was general agreement on the economic importance of the construction industry in all countries, whatever their level of economic development, and the central role the industry might play in long-term social and economic development. The volume of construction output, accounting for more than half the total capital formation in most industrialized and developing countries, was in itself proof of the central place of the industry in economic growth and underlined the need for improving its efficiency.

In the course of the discussion, speakers raised several important issues concerning the development of the construction industry and illustrated them from the experience of industrialized and developing countries taking part in the Symposium.

The important role of the Government in promoting the development of the industry was mentioned repeatedly. Particular emphasis was laid on the need for low-cost housing suitable for the lower income groups in developing countries and on the means at the disposal of the Government to elaborate and implement such programmes. The improvement of the housing situation, especially in rapidly urbanizing areas of the developing world, was an important objective of social policy. But the provision of buildings for education, health, administration and other services, as well as the establishment of an adequate infrastructure, was of equal concern to the Governments in all countries.

Reference was made to the close links between the construction industry and other branches of the economy. Construction absorbed a

[10] *Report of the International Symposium on Industrial Development, Athens 1967* (ID/11) (United Nations publication, Sales No.: 69. II. B. 7).

large proportion of the output of many industrial sectors, on which it depended for the supply of its material inputs (building materials and components, fuel, energy etc.) and for a number of services (professional, transport and marketing).

Some of these manufacturing sectors depended entirely on the construction industry as an outlet for their products; they were therefore greatly affected by fluctuations in construction output, only part of which could be absorbed by changes in stock level. The important role that Governments might play in ensuring continuity of demand for construction activities was discussed and illustrated by examples drawn from the experience of several countries.

Stress was laid on the need to expand the local production of modern building materials and components and to develop the use of improved traditional materials. The dependence of many developing countries on imported building materials should be reduced as rapidly as possible by making use of local resources and by long-term programmes aimed at developing local modern industries.

In this connexion, the problems of standards and quality control were considered, especially the importance of relating such standards realistically to local conditions and requirements. It was stated that reliability of quality in locally produced materials and components was an essential step towards a better utilization of resources, improved designs and reduction of waste.

A discussion on the possibility of the increased use of certain building materials, such as clay, cement, wood, steel, plastics etc., showed that local conditions played an important part in determining how far such materials might contribute to the development of construction.

Manpower, described as a second major factor in construction activity, received special attention. The role of construction as employer of skilled and unskilled labour was illustrated and the problem of training was discussed at length. It was pointed out that on-the-job training of apprentices should be integrated with more formal training in vocational or trade schools. The two approaches should be regarded as complementing each other, with the common objective of raising the over-all level of skills in the construction labour force.

Considerable attention was devoted to the relative advantages and disadvantages of labour-intensive methods in construction. Examples were cited of the successful introduction of mechanical equipment into construction operations as a means of improving productivity and

therefore reducing construction time. Emphasis was also laid, however, on the social and economic benefit of using labour-intensive methods as a means of absorbing structural unemployment.

A discussion on changes in technology demonstrated the relationship between the increased production of modern materials and components, the introduction of new materials, the use of mechanical plant and the general raising of skills in the construction industry.

The view was advanced that developing countries should achieve "industrialization of construction" in stages: the improvement of handicraft methods; the rationalization of traditional site operations, together with increased use of on-site prefabrication and improved methods of assembly; increasing use of building components of growing complexity that were factory-made and assembled, leaving only relatively simple operations to be carried out on site; finally, the almost complete prefabrication of buildings through advanced methods of industrial production.

The discussion of such stages brought to light problems relating to design, continuity of demand, transport, quality control and training of semi-skilled labour that were illustrated by examples from the experience of countries at different levels of economic and technological development.

There was considerable discussion on the problems of statutory requirements, specification, performance standards and contractual relationships and on the contribution that improved methods might make to raising productivity in construction. Among the means recommended to achieve such improvements were the use of standard forms of contract, the development of type designs by public and private design offices and the introduction of standard specifications and procedures that commanded general acceptance.

Several delegations pointed out that foreign firms of consultants and contractors should play an active part in the long-term development of the local construction industry, referring to their role as agents of modernization and as teachers of more advanced skills that might be applied to the remainder of the local construction industry.

Two major themes recurred throughout the discussion. The first was the need for more concerted efforts in research and development, particularly as regards making better use of local resources and skills and paying appropriate attention to local climatic and social conditions.

The second concerned the necessity of including the whole of the construction industry, including its material inputs, within the

frame-work of an over-all development plan, in view of its vital links with other sectors of the economy and its central role in the formation of new capital assets.

Recommendations approved[11]

Construction, especially as part of public investment (dams, roads, irrigation schemes, large industrial residential projects) should be the subject of planning in respect of both demand and supply within the framework of the economic plans of the developing country.

UNIDO, in co-operation with other international organizations, should advise developing countries regarding the organizational, administrative and contractual set-up in their construction industries in order to improve performance and efficiency and to promote standardization.

UNIDO should, on request, assist developing countries in the establishment of design organizations, in setting up working groups to promote designing activities in accordance with local conditions.

In all fields of construction activities UNIDO should promote the exchange of experience between the developed and developing countries and among developing countries themselves in order to avoid duplication of effort.

UNIDO should assist in the establishment of institutes responsible for collecting, evaluating and disseminating technical information, and, as required, supplementing compiled information with research. These institutes should also draft bylaws and regulations valid, as far as possible, for the country as a whole, and prepare standards for performance specifications, tender documents and contractual procedures.

UNIDO should collect and disseminate information as well as promote studies on the economics of competitive building methods, in particular prefabrication methods suitable for use under the conditions prevailing in developing countries.

UNIDO, in co-operation with FAO and other appropriate United Nations bodies, should organize a study group to evaluate the role of wood-based products as building materials under the specific conditions prevailing in developing countries.

UNIDO should assist developing countries in the training of supervisors and technicians for the construction industry in co-operation with the ILO.

[11] *Report of the International Symposium on Industrial Development, Athens 1967* (ID/11) (United Nations publication, Sales No.: 69. II. B. 7).

UNITED NATIONS ACTION TO ASSIST THE CONSTRUCTION INDUSTRY IN DEVELOPING COUNTRIES

This chapter discusses the scope for international action to promote the development of the construction industry and the role of UNIDO, in association with other United Nations bodies, in a work programme designed to assist the developing countries in this sector. There is, inevitably, some overlap with the parallel discussion of the building materials industry in a companion monograph of the present series. The development of prefabricated items to replace on-site production by contractors requires detailed study of the factors involved in both industrial sectors, which it may be desirable to organize within a single project. The characteristics which construction industries in various countries have in common are far more numerous than those which differ. Information and experience obtained in one country can in most cases prove of great value in many other countries. The prospects are therefore encouraging for assisting the developing countries by international study and research.

Field activities

Annex 1 indicates the areas in which UNIDO can provide technical assistance. The emphasis in field projects has been initially on product standardization and research into techniques. The United Nations regional economic commissions have committees that are concerned with housing, construction and planning, and UNIDO collaborates in the work undertaken at the regional level. FAO also has an interest in housing, which derives from its activities in the field of forestry. The aim of these activities is to make wood and wood products more readily available and to promote their use for low-cost housing in developing countries. All the above organizations, and other United Nations bodies

and Specialized Agencies—for example, the ILO, WHO and UNESCO—participate in the work programme of the Committee for Housing, Building and Planning of the Economic and Social Council.

UNIDO is interested in three projects which the executive unit of this Committee, the United Nations Centre for Housing, Building and Planning, expects to organize during the period 1970—1975. One project concerns the improvement and development of building technologies based on locally available materials. The second project concerns the adoption of industrialized processes for the production of housing units and components, and the degree of applicability of these processes to the conditions prevailing in developing countries. In the context of this project, the term "industrialization" includes the production of components in factory or on site, construction with prefabricated forms and line production on site using industrial techniques.

UNIDO is interested in the third project—measures for the improvement of the building industry as a tool for human settlement development—to the extent that it will be concerned with formulating guidelines for priority measures to be taken by governments of developing countries on such subjects as: modular co-ordination, construction standards, typification, the rational production and use of building materials, the industrialization of building.

Supporting activities

Field activities are supported by meetings of expert groups, workshops and seminars. In this way, those actively engaged in the construction industry in developing countries can meet each other and their counterparts from developed countries, to exchange experience and learn from each other's successes and failures in dealing with common problems. This part of UNIDO's activities may be expected to grow in phase with the expansion of field work. An Expert Group Meeting was held in November 1969, with the collaboration of FAO, on Production Techniques for Wooden Houses under Conditions Prevailing in Developing Countries. In 1970, a Regional Seminar is planned in Africa in co-operation with ECA and the United Nations Centre for Housing, Building and Planning, on Prefabrication in the Building Industries in Africa. There are three further seminars proposed for 1971, 1973 and 1974 in the draft programme of the Centre, in which UNIDO would expect to participate. They concern, respectively, low-cost earthquake and

hurricane resistant construction, uses of industrial and agricultural wastes in construction, and technology of cement products and their use in low-cost housing construction.

New areas for UNIDO activity

On the basis of the analysis in previous chapters of the structure of the construction industry, it is possible to suggest some additional lines of action that UNIDO might take in the future to assist this industrial sector.

Surveys

In many countries, some fact-finding is desirable as the first step towards developing the construction industry. Resources need to be surveyed in terms of labour, plant and equipment, capital, as well as the materials employed. Even when natural resources have been surveyed in connexion with a national development plan, it is rare that the inputs required for construction have received sufficient attention. There is also a tendency in feasibility and pre-investment studies to take account of the relatively large enterprises producing cement, steel and so forth, but to omit (because it is much harder to collect the information) the many small enterprises, some of them at artisan level, that make collectively an important contribution to construction.

It will often be impractical to attempt to compile accurate statistics in this sector, but planners should aim at assessing trends and orders of magnitude because such estimates are far better than no estimates at all for the purposes of national planning.

Contractual relationships in construction

The second step is to acquire a greater knowledge of the contractual relationships between the participants in construction activity. Since the client, the design team and the contracting firm play leading roles, their attitudes and problems must be studied and probable future changes taken into account, especially if some of these changes are brought about by deliberate government policies. The most carefully planned programmes fail if they do not take into account the requirements

and contributions of those responsible for implementing them. The roles of client, designer and contractor are complementary; conditions must be created in which they act in a concerted way towards a common goal.

Construction codes and regulations

The statutory framework is also an essential element of the over-all picture. Although they are less complex than in industrialized countries, the codes, regulations and administrative and technical controls imposed on construction activity in developing countries are quite considerable. Some of them may be more justified than others; in any case, it would be unrealistic to ignore them or to replace them without assessing first their relevance or their limitations. UNIDO, in collaboration with the United Nations Centre for Housing, Building and Planning might organize technical assistance aimed at strengthening the organizational, administrative and contractual machinery in the construction industry.

Adapting to structural change

Without prejudging the impact on demand of new materials and technologies, it seems probable that another important area for assistance is in adapting to a structural change in demand. It is generally assumed that if such changes are fed back to the construction industry, they will go some way to stimulate corresponding changes in the structure and operation of the industry itself. Direct technical assistance in this area has been limited and mostly related to housing policy. The whole complex of planning regulations and incentives to construction exerts an important influence on the structure of demand and the development of the construction industry. Major issues of policy are involved which, at the request of Governments, might be tackled at national or subregional levels.

Flow of funds in the construction sector

The flow of finance through the construction process is another area where more information would make it possible to formulate more reasoned policies. It is not an easy field to survey, but it cannot be neglected, since construction requires a considerable amount of working

capital, and construction output is the most durable of man-made assets. In particular, attention should be paid to small and medium-sized contractors and manufacturers who cannot obtain credits, partly because they have few assets to offer as security and partly because their operations fluctuate considerably from year to year.

Cost accounting

Standards of cost accounting in the construction industry generally leave much to be desired except in the case of large enterprises working in the international-modern sector. Without good cost records and adequate management tools, it is unrealistic to expect that the quality-to-cost ratio can be assessed, much less improved. Better accounting by construction enterprises of all sizes, adapted to their individual needs and capability, but sufficient to achieve improved standards of quality for the benefit of society as a whole, is without doubt one of the most promising areas for international and bilateral technical assistance.

Research and development

Research and development is another area where developing countries might benefit from the experience accumulated by industrialized countries, provided that the application of such knowledge is geared closely to local conditions. There must be two-way communication in order to produce satisfactory results, and this requires more careful organization than is sometimes thought. In the last analysis, the success of any venture of international assistance will depend on all concerned being aware of the specific nature of the problem to be tackled and of its close relationship to other issues of social, economic and technological development.

Annex 1

UNIDO ASSISTANCE IN DEVELOPING THE CONSTRUCTION INDUSTRY

A. Areas relating to the development of the construction industry in which UNIDO is in a position to provide technical assistance

Standardization of products and dimensions, including prefabricated and re-assembled construction parts;

Development and functioning of construction enterprises;

Development and application of techniques, especially for non-housing construction;

Testing and research institutions in the above field;

Pre-investment projects, pilot and demonstration plants and improvement of existing plants producing novel building materials and components required as part of new construction techniques.

B. Selected major technical assistance projects

The projects listed below relate to the activities of the United Nations Industrial Development Organization since its establishment in 1967. The list excludes projects carried out under the predecessor organizations of UNIDO (the former Division of Industrial Development up to 1962 and the Centre for Industrial Development up to 1967). Since the projects are listed for illustrative purposes, the names of countries have been omitted.

The respective programmes under which the projects are implemented are shown as:

SIS	Special Industrial Services of UNIDO
UNDP/TA	United Nations Development Programme, Technical Assistance Component
UNDP/SF	United Nations Development Programme, Special Fund Component
RP	Regular Programme

(1) *Projects implemented or under implementation by UNIDO in areas related to the development of the construction industry*

THE AMERICAS

Technical Standard Institute (construction materials) (UNDP/SF)
Construction technology—thermic control (UNDP/TA)

ASIA AND THE FAR EAST

Technological Research Institute, construction materials assistant (UNDP/SF)
Feasibility of manufacture of pre-cast concrete products (UNDP/TA)
Building and construction materials expert (UNDP/TA)

EUROPE AND THE MIDDLE EAST

Assistance to the Building Research Institute (SIS)

(2) *Projects in preparation or under discussion with Governments in areas related to the development of the construction industry*

AFRICA

Use of plastics in conjunction with local raw materials in building (UNDP/TA)

THE AMERICAS

Prefabrication in the building industry (UNDP/TA)
Assistance to the National Institute of Industrial Technology—thermic control (UNDP/TA)

ASIA AND THE FAR EAST

Pilot plant for building and construction materials (UNDP/SF)
Pilot plant for production of plastic/wood structure by irradiation techniques (UNDP/SF)
Prefabrication in the building industry (UNDP/TA)

EUROPE AND THE MIDDLE EAST

Centre for Development of Housing and Construction (UNDP/SF)
Assistance to the construction and building materials industry (UNDP/TA)

Annex 2

MEETINGS, SYMPOSIA AND WORKING GROUPS ORGANIZED BY UNIDO

	Location	*Dates of meeting*
Expert Group Meeting on Production Techniques for Wooden Houses under Conditions Prevailing in Developing Countries (in collaboration with FAO)	Vienna	November 1969
		Proposed dates
Regional Seminar on Prefabrication in the Building Industries in Africa (in co-operation with ECA and the UN Centre for Housing, Building and Planning)	Denmark or Africa	1970
Meeting of the Heads of Building Materials Research and Development Organizations of the ECAFE region (in collaboration with ECAFE)	Bangkok	1970

Annex 3

SELECTED LIST OF DOCUMENTS AND PUBLICATIONS ON THE CONSTRUCTION INDUSTRY[1]

UNITED NATIONS

A System of National Accounts and Supporting Tables (Sales No.: 64.XVII.5).

"The Interrelations between Social and Economic Development", *Research Notes* No. 1, 1968 (UNRISD/68/C.22).

Department of Economic and Social Affairs

Soil-Cement: Its Use in Building (Sales No.: 64.IV.6).

Modular Co-ordination in Building, Asia, Europe and the Americas (Sales No.: 66.IV.4).

Construction Statistics (Sales No.: 66.XVII.4).

International Social Development Review. No. 1. Urbanization: Development Policies and Planning (Sales No.: 68.IV.1).

Finance for Housing and Community Facilities in Developing Countries (Sales No.: 68.IV.4).

International Recommendations for Construction Statistics (Sales No.: 68.XVII.11).

Industrialization of Building, 1965 (E/C.6/36) (mimeo.).

Social Aspects of Housing and Urban Development, 1967 (E/C.6/67/Add. 1) (mimeo.).

United Nations Industrial Development Organization

Sectoral Studies Prepared for the Symposium: Construction Industries, 1967 (ID/CONF. 1/24) (mimeo.).

[1] Symbols and Sales Numbers of United Nations documents and publications are given in parentheses after the titles.

Economic Commission for Africa

Housing in Africa (Sales No.: 66.II.K.4).

The Construction Industry in Development Programmes: A Techno-Economic Review in the West African Subregion, 1966 (E/CN.14/INR/107 and Corr. 1) (mimeo.).

Report of the East African Training Courses for Building Contractors, held in Ethiopia, Kenya, Uganda and Zambia, from April to June 1968 (E/CN.14/417) (mimeo.).

Economic Commission for Asia and the Far East

Study on Building Costs in Asia and the Far East (Sales No.: 61.II.F.9).

Economic Commission for Europe

Annual Bulletin of Housing and Building Statistics for Europe: Government Policies and the Cost of Building (Sales No.: 59.II.E.3).

Economic Commission for Europe

Cost, Repetition, Maintenance. Related Aspects of Building Prices (Sales No.: 63.II.E.4).

Housing Costs in European Countries (Sales No.: 63.II.E/Mim.7).

The Use of Steel in Construction (Sales No.: 64.II.E/Mim.24).

Proceedings of the Seminar on Changes in the Structure of the Building Industry Necessary to Improve Its Efficiency and to Increase Its Output (Sales No.: 65.II.E/Mim.16).

Effect of Repetition on Building Operations and Processes on Site (Sales No.: 65.II.E/Mim. 23).

Report on the Proceedings of the Second ECE Seminar on the Building Industry, Paris, France, 24—29 April 1967 (Sales No.: 69.II.E/Mim.12).

Economic Commission for Latin America

Housing and Building Materials Industry, Central American Economic Integration Programme, 1960 (ST/SOA/41).

Report of the Latin American Seminar on Housing Statistics and Programmes, held in Copenhagen from 2 to 25 September 1962 (Sales No.: 63.II.G.14).

Report of the Interregional Seminar on Rural Housing and Community Facilities, held in Maracay, Venezuela, from 2 to 19 April 1967 (ST/TAO/SER.C/103) (mimeo.).

INTERNATIONAL LABOUR ORGANISATION

"Rural Settlement and Housing Trends in a Developing Country: An Example in Nigeria", by P. Crooke, *International Labour Review*, Vol. 96, Nr. 3.

International Migration of Labour in the Construction Industry, 1959 (IC/C/6/II) (mimeo.).

Young Workers in the Construction Industry: Their Situation and Prospects, 1959 (IC/C/6/III) mimeo.).

Technological Changes in the Construction Industry and their Socio-Economic Consequences, 1964 (IC/C/7/II) (mimeo.).

Practical Measures for the Regularisation of Employment in the Construction Industry, 1964 (IC/C/7/III) (mimeo.).

Social Aspects of Prefabrication in the Construction Industry, 1968 (IC/C/8/II) (mimeo.).

Social Problems in the Construction Industry Arising out of the Industrialisation of Developing Countries, 1968 (IC/C/8/III) (mimeo.).

OTHER SOURCES

American Institute of Timber Construction, *Timber Construction Manual*, Wiley, New York, 1966.

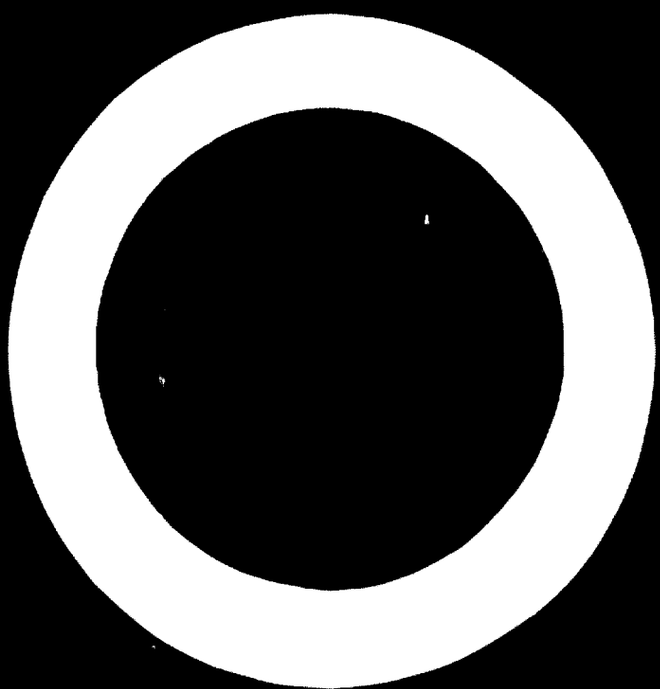
Bentley, H., *Building Construction Information Services*, United States Research Co., Detroit, Mich., 1964.

Fredriksen, H., "Profiles of Relative Development", *International Development Review*, Vol. 9, No. 4 (1967).

Peurifoy, R. L., *Construction, Planning, Equipment and Methods*, McGraw-Hill, New York, 1968.

United States Housing and Home Finance Agency Library, *Bibliography on Housing, Building and Planning for Use of Overseas Missions of the US Agency for International Development*, revised ed., May 1964.

Vittrock, J., *Reducing Seasonal Unemployment in the Construction Industry*, OECD, Paris, 1967.



UNIDO MONOGRAPHS ON INDUSTRIALIZATION OF DEVELOPING COUNTRIES: PROBLEMS AND PROSPECTS

No. 1. Non-ferrous metals industry
No. 2. Construction industry
No. 3. Building materials industry
No. 4. Engineering industry
No. 5. Iron and steel industry
No. 6. Fertiliser industry
No. 7. Textile industry
No. 8. Chemical industry
No. 9. Food-processing industry
No. 10. Industrial research
No. 11. Small-scale industry
No. 12. Standardization
No. 13. Industrial information
No. 14. Manpower for industry
No. 15. Administrative machinery
No. 16. Domestic and external financing
No. 17. Industrial planning
No. 18. Regional co-operation in industry
No. 19. Promotion of export-oriented industries
No. 20. General issues of industrial policy
No. 21. Technical co-operation in industry

Printed in Austria

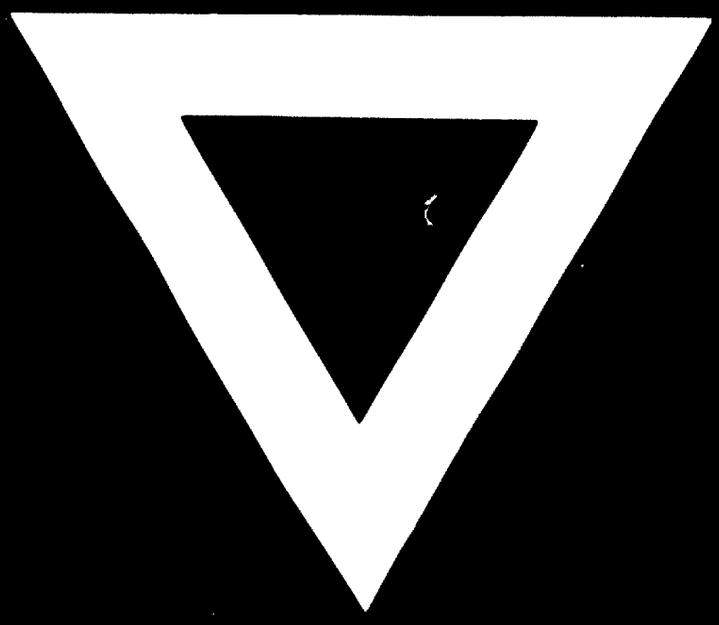
Price: $U.S. 0.50 (or equivalent in other currencies)

United Nations publication

69-3428 – April 1970 – 4,300

Sales No.: E. 69. II. B. 39, Vol. 2

ID/40/2



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