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STRUCTURE AND FUNCTION OF THE CONSTRUCTION INDUSTRY
WITH EMPHASIS ON THE DEVELOPING COUNTRIES*

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* The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of the United Nations Industrial Development Organization (UNIDO). Mention of firm names and commercial products does not imply the endorsement of UNIDO. This document has not been edited.

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1. History of the subject

During the First Consultation on the Building Materials Industry (UNIDO-HABITAT, Athens, 1985, [1], point 78), several participants indicated that "since building materials were not end-products and are used by the construction industry, the building materials industry could not be considered separately from the construction industry". Similarly, during the Second Consultation on the Building Materials Industry (UNIDO-HABITAT, Athens, 1991, [2], p.10), the following general consideration was adopted: "The strategy for the low-cost building materials sector should reflect the forward and backward linkage with other sectors of the economy, and with the construction sector in particular".

The Director-General of UNIDO, within the frame of the Consultations Programme for the biennium 1992-93, proposed to the Industrial Development Board (1990) that the First Consultation on the Construction Industry in the Developing Countries be convened during the biennium 1992-93. The proposal was approved by the Board. Subsequently, UNIDO decided to organize the First Consultation on the Construction Industry which is scheduled to held in Tunis, 3-7 May 1993. This study-report is a background paper for the Consultation.

2. Significance of the subject

2.1. There is a basic moral requirement, i.e. human rights for shelter, under acceptable health conditions, are included in the concept of any "development". In additon, in many cases development itself does create new needs for low-cost houses. It is at least the case of abrupt industrial development: for a certain period of time, cheap labour inevitably means "homeless labour" coming from less developed areas and, to a certain extent, finding shelter in urban slums.

Under this light, the building industry proves to be a key sector for development.

On the other hand, the role of civil engineering infrastructure works in broader development cannot be overemphasized.

Consequently, the entire construction industry (building and infrastructure) is understandably considered as a fundamental instrument for development.

2.2. In addition, the directly economic importance of the construction sector has to be pointed out:

a) The construction industry per se, constitutes a huge economical activity, contributing to the GDP by 10% in the European Community ([4], p.4) or by 3% to 9% in developing countries ([3], p.2); thus, the construction industry (C.I.) proves to be one of the biggest industries in purely production terms. There is a clear tendency towards increasing contribution of this industry to the GDP as development continues:

$$\text{Contr.C.I. [\%]} = 2 \cdot \log \text{GDP [doll.]} \pm 3$$

(based on data of [5], p.35)

b) Another economic index in which the construction industry shows its advantages, is its contribution to the gross fixed capital formation (GFCF) as a percentage of the total GFCF of the country; this index ranged from 35% to 81% for ten developing countries during the seventies ([3], p.6). This remarkably dominant role of the construction sector in capital formation has to be borne in mind in policy making.

c) If correctly conceived, the construction industry contributes to the reduction of import dependency of a country. However, appropriate construction technology has to be selected to this purpose (see para. I. 2.6.c of Part Two of this Report).

d) The beneficial backward and forward linkages of the construction industry with other industries cannot be overemphasized; its stimulation for other economical sectors has been recognised.

2.3. In addition to these direct economical benefits, developing countries should take into account some further socio-economic benefits which are due to the construction industry:

a) Employment generation: this well-known potential in the construction industry is frequently used by Governments to warm-up economy; this fact has to be remembered more generally in policy making.

b) Income redistribution: employment generation, skill upgrading (see below para. c), favourable financing for low-income housing, capital spending for large-scale civil engineering works, all contribute to a redistribution of national products downwards (social justice component).

c) Skill generation: on-the-job skill acquisition frequently leads to further specialization, both in the construction sector and in serving other industrial sectors.

d) Higher productivity: the low-income population, after the provision of shelter and civil infrastructure, feel morally upgraded (direct contribution to labour productivity). It has also been observed that improved dwellings are frequently transformed into some sort of informal economic production units; improved road systems also make the commodity outputs of such small units more easily accessible.

2.4. In conclusion, several moral, political, economic and socio-economic arguments underline the significance of the subject of this Consultation. The recommendations of the Second Consultation on Building Materials ([2], p.7, para. 15) invited Governments to "take into account the long-term benefits to be derived from investments in this sector".

Yet, as pointed out in a study by HABITAT ([6], p.3), there is still a certain "inability to convey to policy-makers the national economic development implications of low-income shelter and infrastructure construction".

That is why "efforts to identify the issues confronting the overall construction industry and to devise ways to promote the development of indigenous industries" should be considerably broader than mere effort "in the areas of building materials, industrialized construction and labour-capital substitution" ([3], p.39). This broader target is also aimed at by the First Consultation on the Construction Industry.

3. The character of this document

This Report is a recompilation of previously formulated ideas. It is interesting to note how many times those ideas have been forwarded during the last ten years; but it is equally interesting to observe how disproportionately little consideration is given by some planners to the construction industry (the European Community included, see [7]). That is why this report has inevitably repeated those ideas, however within its own framework.

The framework used here attempts to be as broad as possible. Its disadvantage is apparent; due to its broadness, it cannot go deeply enough into each of its topics. It has, however, the possible merit of underlining the vital synergy between the very many components of the system construction industry, following the recommendation of the Second Consultation ([2], p.6, 10): "The situation calls for new policy initiatives [...] as an integral part of national socioeconomic development policy". That is why a system's approach was adopted in this report. To quote again HABITAT'S view ([8], p.3), "planning in the construction sector (needs) a clear understanding of the structure of the sector".

In elaborating the structure and the function of the construction industry, this report always puts the emphasis on developing countries. However, the description of the system (Fig. 1) is as general as possible; it could be equally valid for industrialized countries. Thus, it also offers the possibility to describe tomorrow's situation in a developing country; the level of development does change in time, and the corresponding complications for the construction industry system should be taken into account.

I. P O L I C Y

1.1. GENERAL POLICY

The construction industry, by its very nature, is bound to a disproportionately large number of influences, related both to the demand for construction goods and to the supply capacity of the industry. Consequently, several general policy components may directly or indirectly affect the construction industry. An inventory of such policy components is presented hereafter, without however any detailed analysis.

1.1.1. Planning for endogenous development

There is always an optimum amount of foreign technology to be immediately used in a developing country: short-term high-priority plans may call for such a solution, making its cost and other side-effects affordable. This may be more frequently the case when a relatively higher level of technology is needed, whereas in other cases it is accepted that a certain delay and/or relatively higher costs may be preferable if an endogenous solution is to be developed.

Policy-making in this respect is based first on economical considerations and, above all, on priorities of values democratically assessed. In this connection, the construction industry is an activity with a remarkable "vertical" variability of technological levels: from locally-made simple shelters, to the most sophisticated airport, the construction industry offers itself for diversified decisions regarding the endogenous/exogenous issue (see also para. I. 2.6c).

1.1.2. Broader background policies

There is a multitude of other policies affecting demand and supply of the construction industry such as:

a) Family programming (since overpopulation dramatically accentuates housing needs): the unprecedented growth of population in India is considered as the first reason for the housing shortage to continue to be acute, despite an exhaustive package of governmental measures ([11], p.131);

b) Income generation strategies;

c) Fiscal incentives (both for the enhancement of demand for construction works and for the encouragement of endogenous contracting firms);

d) Salaries and pricing policy (since the construction sector is a high labour-consumer; as an example, in several African countries ([3], Table 17), house-building activities contain 30% of labour participation.

e) Health and safety of workers, bearing in mind the disproportionately high number and seriousness of accidents on construction sites; as an example, [9] in Greece during the seventies, the death probability in the construction industry was 225% higher than in all industries in general.

1.1.3. Energy and environment policies

a) Binders (cement, lime, ashes etc.), the most important of the building materials, are high energy consuming products. Thus, during the Second Consultation on Building Materials ([2], p.22, point 77), many participants expressed concern regarding high production costs derived from i.a. imports of fuel (the main source of energy in many countries). In this connection, two strategies should be examined: (i) the first is related to the use of low-cost and less polluting energy alternative resources; this is for instance the case of the use of biomass in small-scale energy production units (see i.a. [10], Session 10: "Biomass in Developing Countries"). and (ii) the possibility of modified production technologies, as in the case of the elimination of the oven and drier in fabrication of hollow (stabilised clay/cement) bricks (see also [13], para. 42).

b) The environment protection issue is also an understandable concern in a general policy regarding the construction industry. Lower energy technologies result in lower pollution levels. However, there are other more direct risks related to the construction sector, such as the case of a disproportionate and uncontrolled extraction of aggregates from small rivers. Similarly, irreversible destruction of timber forests for conversion into building products, is another example of an uneconomic solution.

Nevertheless, the environment issue in developing countries should not be tackled the way it is in industrialized countries: the priority of needs in developing countries may lead to somewhat higher rates of polluting agents over other more pressing needs for low-cost production, provided that there is a preconceived policy of gradual reduction of these rates, as economic and social development goes on.

c) The Second Consultation on Building Materials concluded that: "creating a policy environment conducive to the growth of the sector should be given urgent priority at the national level. This should be fostered through national dialogue, with the participation of government representatives, professional bodies, the industry and non-governmental organizations active in the sector. A national-level apex coordination body, with representatives of all the parties concerned, should be set up for this purpose. This body should promote the sector through intersectoral coordination, reviews and, where possible, reforms of sectoral policies, institutional arrangements and the mobilization of resources for the sector".

1.2. SPECIFIC POLICY

In addition to the general aspects of national policies directly or indirectly affecting the construction sector (see para. 1.1., part two of this Report), a series of more specific measures is offered in policy-making addressing the construction industry issue. The following inventory is somehow more detailed that the one related to the general policy. However, this is not complete; some cross references to more special publications may partly fill this lacuna.

1.2.1. Evaluation of the demand

It is understandable that, both in market and centrally-planned economies, demand assessment is needed for any pragmatic policy making. Thus, in the Second Consultation of Building Materials ([2], p.9) the following basic recommendation (para. 30) was formulated: "While promoting the building materials industry, due consideration should be given to the nature and extent of demand in order to ensure optimal utilisation of the resources invested and affordability of products and components. In respect to housing, demand assessment would be based primarily on purchasing power, socio-economic preferences, climatic conditions and the disaster-proneness of the region. The imbalance between supply capacity and demand for construction, is the fundamental constraint of the construction industry" ([8], p.3). In this respect, it is customary to consider separately the private and the public sector.

a) The estimation of housing and related urban infrastructure demands in the private sector, is not easy. The range of incomes, priority of preferences of the population,and other not easily quantifiable data may lead to several rather diverging scenaria. Several formal techniques used in industrialized countries (see i.a. [5], p.13) cannot be adopted to developing countries. However, in this field, a more normative technique is frequently followed in developing countries (since the needs in low-cost housing are extremely high).

b) The construction demands in the public sector can be better estimated. Educational or military buildings or hospitals, may be planned within each of the respective special sectors and summed-up. Besides, the demand in civil engineering works is dictated by broader socio-economic development factors.

In both cases, subsequent steps in policy-making may be highly dependent on a more detailed description of the total construction demand; materials, equipment, education etc., needed to serve the purpose, will be the corresponding (more detailed) targets of policy.

1.2.2. Land-use and town-planning policy

This is a major-issue; it seems that in African and Asian developing countries, land costs constitute 20% to 60% of the total cost of a building or of a construction project ([12], p.80).

The study of this specific topic goes far beyond the scope of the present papert. It should be said, however, that in a housing policy, a long-range programme is needed in order to:

(i) avoid land speculation in the future (early acquisition is recommended);
(ii) minimize urban infrastructure costs (selection of "easy" subsoil conditions);
(iii) optimize transportation costs;
(iv) secure low-hazards sites versus accidental events (such as innundations, landslides, earthquakes, pollution or fire);

There are a few successful examples of low-cost land acquisition for future housing projects, both by private companies or by public organizations.

1.2.3. Financing

For some analysts, this is a basic issue, both for housing and engineering works. By its nature, the construction industry is a capital absorber: it needs advance purchase of materials and epuipment, as well as cash availability for wage-payments. Thus, a day-by-day collecting of little money, may easily lead to double costs...

In addition, the aleatoric mechanisms governing the construction market may induce further need for capital. That is why a financing policy of the construction sector is needed in every country. A short inventory of such financing is given below:

a) Credit assistance to individuals for shelter. Depending on the level of economic and technical development, the following forms of credit assistance are used:

   - Savings and credit systems directly connected to low-income housing;

   - Loans in cash. However, in some developing countries two risks may be run, undermining the effectiveness of those loans: the eventual scarcity of materials or, in the other extreme, the possible spending of some of this ready-made money to cover other pressing needs of the individual...

   - Loans in kind, such as building materials, mainly for simple and traditionally known building techniques;

   - Loans in "construction-work hours" of skilled builders, paid by the lender himself;

   - Allotment of services of "building brigades", whenever this is practicable (preferably within small communities).

b) Financial policy versus contractors: unlike other industry-owners, an entrepreneur in the construction industry is bound by some rather unfavourable financial conditions (encountered in all countries).

   - He is paid by installments, long after the delivery of the "product", although he frequently pays cash for his purchases;

   - In order to make a new site ready for production, a contractor needs time for preparatory activities; no payments are made during these periods of re-assembling the "nomadic factory" which is a job-site;

   - He is exposed to the consequences of the quality of a multitude of unskilled or semi-skilled workers: his performance bonds and defect guarantees may be lossed accordingly;

   - In addition to these unfavourable conditions (which may call for a working capital more than 5% of the annual turnover), in some developing countries payments may be delayed for a long time, and banking facilities are not always available.

These are the reasons for which a special policy for "contractors' financing" may be needed; such a policy may i.a. include (i) reduction of bureaucracy, (ii) generous advance payments, (iii) risk guarantees for private banks lending to construction firms ([3], p. 56) or to small-scale material producers and building products manufacturers.

c) Last but not least, in view of the financing difficulties of the construction industry in developing countries, foreign donors or lenders will continue to be extremely important. In this respect, it is worth mentioning that half of the loans given by the World Bank during the 1980's were for construction works.

1.2.4. Optimization of resources between infrastructure and dwelling construction

This issue has a double aspect.

a) Civil engineering works are so important for the national economy at large, that some governments show a preference in spending for such works rather than for drastic interventions in the market of dwellings (despite the fact that little of the know-how remains in the country, and a lot of materials and equipment are imported for the construction of large engineering works). There are no simple rules for the optimization needed: level of development, priority of values, technical capacities and other parameters may play a role. It would therefore, be interesting to collect information on relevant case studies.

An important alleviation of such dilemmas in planning, may be achieved in some countries by invigorating the private real-estate sector specialized in low-cost housing. This is, after all, a commercial affair; except that it entails such a number of counterincentives that it may necessitate the same State-assistance as individual shelter beneficiaries (except, of course, direct loans).

b) Local infrastructure at an urban scale is another important issue. Here, organization is easier; there is always a minimum of streets, electricity supply, water supply and some sewerage system needed in addition to the dwellings built, provided that possibilities have been left for future gradual completion of such infrastructure. The successful examples of a "shallow sewerage/block sewer" scheme in scattered settlements in Natal (Brazil) and the technically-sound pit-latrines developed in Mozambique should be mentioned in this connection. Yet, another example illustrates the problems still faced in several countries in relation with infrastructure: 8% of families in the Dominican Republic have no electric light ([14], Table 3).

1.2.5. Technical incentives

In the special case of developing countries (or of non-developed areas in industrialized countries), low-cost housing or massive reconstruction of dwellings after a natural disaster, may need further assistance other than a financial one. Shortage in technical information or goods may jeopardize such a housing programme. The following actions should be briefly mentioned here:

- Simple practical posters or short technical guidelines for self-builders may be of a paramount importance;
- Ready-made drawings for simple houses may be made available to low-income inhabitants;
- Housing cooperatives may be encouraged and eventually be somehow endowed (at least in terms of technical assistance);

Finally, in some developing countries, building materials may be missing in some areas; a regional or national emergency plan to overcome such deadlocks should be established.

1.2.6. Linkages with other economic activities

Here we should highlight the essentials regarding a policy for building materials, equipment and appropriate technology in general.

a) Building materials: this basic issue has been sufficiently covered by the two global consultations organised by UNIDO and HABITAT in Athens, 1985 and 1991 (see [1], [2]). The importance of the subject (50% of total costs of a dwelling are for building materials, in African countries) cannot be overemphasized. Large or medium capital expenditures necessary for establishing big material-factories, are inevitably accompanied by adequate market studies, at least in cases where a major political decision is made in favour of such an investment (para. c, here below). In developing countries with low technological level, limited foreign credits and inadequate internal transportation systems, more flexible small-scale production units were proved very efficient, especially for local traditional materials. In this connection, governments have an interest to publicize information regarding the nature, location and accessibility of local available raw materials, as well as their possible use as building materials: geographical and geological mapping, concessionary rights and basic technological information are needed for potential investors. To serve the purpose, additional roads and additional legal measures against bureaucratic tendencies may be needed.

Thus, the approach of cheap/local materials and small-scale production units, wide-spread in the territory, will be enhanced. Indeed, this is a fully complementary policy, compatible with the use of more industrial high performance materials: if not, there will be a tendency to waste expensive materials in low-performance uses. The example of portland cement used in masonry works, foundations or in plasterings, is both technically and economically wrong. In this respect, in several developing countries, special "masonry cements" were successfully developed (puzzolimes, locally-blended cements, etc.), leading to cost reduction as high as 30% (Tanzania, Botswana, etc.) or even 50% (Rwanda, Philippines etc.), see [6] p.20.

Nevertheless, it has to be emphasized that assistance in only developing traditional materials (be it with their modern modifications and improvements) entails the risk of impeding progress; it is difficult to exclude that development may follow a route similar to that of today's industrializ countries. Thus, a second approach has also followed parallelly, i.e. the development of new materials and building products (via international assistance and/or local research), provided that these developments are compatible with: the actual cost of energy in the country as well as the prevailing policy on the capital/labour substitutability issue.

b) Building equipment: Building materials part of a construction product at any level, whereas the participation of building equipment may differ very much (from almost nil in case of traditional small rural shelters, up to almost fifty per cent in a prefabricated high-rise tower). But this should not lead to an underestimation of the significance of tools, instruments, machines and transportation means, increasingly part of the construction process. To say that abundance of available labour in some developing countries favours certain simpler technologies is understandable. However, it would be a mistake to ignore the benefits gained from a certain level of mechanisation (quality, efficiency and rapidity).

In conclusion, a combined construction equipment scheme should be sought, including locally-produced tools and simple machines, locally-assembled more complex equipment, temporary use of borrowed sophisticated foreign machinery and, finally, imported special equipment whenever needed (provided that its future maintenance has been fully secured).

c) Appropriate technology and its selection, is a long debated issue which also has consequences on the construction. Below is a brief list of the angles from which appropriate construction technology can be seen:

(i) Because of the high diversification of the construction industry, there is more than one appropriate technology for a building product: if we consider the subsector of dwellings, a financially-sound housing programme in a large urban agglomeration may need semi-industrialized technologies, whereas smaller urban or any rural settlement may call for local traditional (though preferably modified) building materials and techniques;

(ii) Similarly, the geograghical character of targeted building products ("concentrated" or "spread accross the country", a country having a satisfactory or a deficient transportation network) influences the selection of the technology;

(iii) In all cases however, the basic performance rule should be "no more than needed, no less than possible";

(iv) An adopted foreign technology should be "vertically stable", i.e. be technically feasible at all levels, such as ([13], p. 34):

- installation
- operation
- maintenance
- production process
- repair

by means of locally-available or easily imported skills, services and materials. This aspect is well illustrated by the example of a rudimentary fibre-concrete roofing-sheets vibrator: to make it available at remote sites, away from electricity networks, the vibrator was purposely modified using electrical batteries. However, in very many cases, there was no access to battery charging equipment; thus, a seemingly "appropriate" project failed;

(v) The criterion of "naturaliseability" has to do with:

- a trial run and in-job training
- minimal dependence on imported goods or services in order to sustain the selected technology
- some possibilities for replication, modification, etc.

(vi) The basic criterion, however, is of a purely economic nature. The "national cost" of each technology examined, should be calculated on the basis of real costs, i.e. the real (not the artificially low) rate of exchange of foreign currency, the real capital interest rates (not those offered to animate specific national sectors), and the real labour wages (not those imposed by the State as if unemployment were inexistent). Such an approach seems to justify a liberal economy philosophy; it may also explain some wrong decisions made in the past, based on cost/benefit calculations in which unrealistic prices were used.

On the other hand, true social costs should also be taken into account which may not coincide with the actual (be it free) market prices; the cost of the environment, the renewability of resources or the economic consequences of abrupt increases in unemployment, belong to this category of "hidden" costs. From this point of view, even within liberal economies, appropriate interventions may be needed.

1.2.7. Policy versus entreprises

For a certain period in the past, Governments in some developing countries had the tendency to underestimate the importance of specialised construction enterprises. At the best, state-enterprises were mainly used in implementing housing and civil engineering works programmes. Nowadays, a considerably more flexible policy is followed in this respect. The Second Consultation On the Building Materials Industry was very clear about this (p. 10, [2], para. 8): "Entrepreneurs are the central actors in and the driving force behind the growth of the sector. A national strategy should therefore strive to involve the entrepreneurs in all decision-making processes". Below is a brief analysis of the various aspects of such a policy.

a) State or private: State construction enterprises have offered good services in several cases when know-how and mobilisation capacity in a country were limited. However, in view of the remarkable instability of the construction market, high inelastic costs in a state-enterprise may make economic efficiency doubtful. Besides, the frequently aleatoric nature of the construction process (many unforeseable circumstances) does not suit the possible rigidity for which the public sector is characterised. That is why the flexible, "multi-sized", geographically spread, private construction companies are recognised as powerful instruments in policy-implementation.

b) Foreign or local: It has been repeatedly said that the "easiness" of immediate solution of problems by means of foreign contractors, may lead local construction industry to a permanent atrophy - although on the other hand, waiting for the maturity of the esogenous forces may sometimes be harmful to national development.

Here again, optimisation is sought and multilevel action recommended:

(i) Construction goods necessitating an admittedly higher technology than available in the country, may be entrusted to foreign enterprises, provided however that those goods are:

- indeed urgently needed
- rather concentrated in time and in space
- designed and constructed with the maximum possible participation of local engineering firms.

(ii) At the same time, a "ransom" technique may be profitably tried: for each construction work entrusted to a foreign company, a fixed small percentage of the budget should be "donated" to those projects which aim at heightening the technological level of the corresponding esogenous sector (technical education, technical centres, techno-economical studies etc.).

Besides, a specific policy versus local contractors (see i.a. 2.3) will be studied and implemented.

c) Large or small: The importance of small, low-cost, flexible and geographically-spread construction firms, cannot be overemphasized especially in the housing construction sector. Nevertheless, viable private companies in this sector need working capital; its importance goes up with the level of the investments such a company needs, in order to adapt itself to up-to-date production processes. Thus, again, a pluralistic solution is sought, with several medium-size and even big companies needed as well; a policy facilitating the promotion of local firms from small to medium and from medium to large size, should also be established. In this connection, big construction companies working abroad are an interesting issue; several rapidly developing countries have followed this trend. However, together with very successful examples, some failures (including a disproportionate dumping from the "exporting" country) have occasionally created trouble regarding the suitability of such a policy for developing countries.

d) Formal or informal: So far for the formal sector of the construction industry; an important, reliable and relatively constant instrument for development.

However, a long tradition of extremely important informal construction activities, calls for a systematic analysis of the related phenomena. Available incomplete data confirm the high capacity of the informal construction sector at least as an employment-generator; in the example of a case-study in Nairobi ([6] p.16), ten times more jobs have been generated through the informal (as compared to the formal) sector, for an equal amount of capital invested.

Rural areas and periphery of towns are the fields of the "informal" builders, i.e.

- Inhabitants, building their own shelters
- Artisans hired by small owners
- Groups of associated artisans.

Part of these may gradually advance into the formal sector.

The importance of the informal sector may be indirectly shown by statistics describing the percentage distribution of residential buildings constructed in rural areas, as compared to the total buildings' construction. Based on [15], p. 59, we observe that this percentage B_r % in rapidly developing countries, was in direct connection with the percentage P_r % of the population living in rural areas:

$$B_r\% = (0,7 : 1,4) \cdot P_r\%$$

Obvious as this relationship may seem, it does deny the opinion that most construction of dwellings takes place in urban areas.

In Kenya and Côte d'Ivoire during the 1970's, the informal sector covered almost one third of the total value of the construction sector ([3], p. 26), however with a much larger percentage (60%) of shelters produced or workers employed.

A lot of informal building activities also take place in urban slums.

Nevertheless, three serious problems should be considered:

- The apparently low quality of construction outputs of the informal sector;
- The tendency to facilitate "illegal" housing (frequently in appropriated lands);
- A considerable inertia in using modern materials and/or techniques, even if they were nominal and performant.

Appropriate means of an intervention policy in this respect (educational, legal and financial), are discussed elsewhere in this report.

1.2.8. Regulatory, educational and research policy

The specific components of a policy related to the construction industry, should be completed by a series of more fundamental measures related to:

- Regulatory documents (Standards and Codes);
- Education (formal schooling and know-how transfer in particular), and
- Research (mainly of an applied character, related to materials and construction process).

These topics are discussed in more detail in the following chapters.

II. REGULATORY DOCUMENTS

The socio-economic importance of the construction sector in every country is so high, that its extensive and multifold regulation is much needed: habitability of the built environment, performance of civil engineering works, durability of construction outputs, and above all safety versus all kind of actions (loads, imposed deformations, environmental influences, fire and natural disasters), are fundamental public issues which call for legal action.

Unlike some contrary opinions, the need for regulatory documents and their enforcement in developing countries should be emphasised; it is precisely the scarcity of resources and skills that makes the duration and performance of products more desirable. Hence the significance of the subject of this chapter. However, only a short inventory of regulatory documents will be presented, emphasizing their function within the entire "construction system", rather than offering detailed descriptions and recommendations.

2.1. Legislation on land-use

Several basic issues have to be addressed here, such as:

- Expropriation principles for public construction;
- Concession of lands containing raw materials related to the construction industry;
- Landscape protection rules;
- Principles for selection of industrial, residential or recreational areas and public utilities' location.

2.2. Urban regulation

The contents of such a typical document will not be described here; its importance for orderly community development and towns is well known. Two points, however, should be made in this connection.

a) This document is an appropriate tool to encourage architectural solutions and forms, as well as infrastructure schemes which are compatible with the aesthetic traditions of the country, as well as with the available materials and skills; such guidance to the designers and users is of a paramount importance. Obviously, the conditions for the use of other solutions will be equally described, so that progress is not hindered.

b) The means for the enforcement of all regulatory documents relating to buildings' design and construction are normally described within an Urban Regulation: obtaining a building permit which encompasses several controls of prerequisites, is one of the basic means in this respect; possible control during construction is another desirable provision.

However, an equilibrium should be sought between requirements and feasible control services: if the first prevails over the second, bureaucracy and/or corruption can occur.

2.3. Contracts negotiations rules

This can be an important document, frequently used in industrialised countries, to regulate the relationships between the owner, the consultant and the contractor especially in large civil engineering works.

2.4. Essential requirements

This is a "pre-normative" fundamental regulatory document, describing in rather general terms the targeted final functions of construction goods.

According to the recent European "Buildings Products Directive", the following definitions may be useful.

The products must be suitable for construction works which (as a whole and in their separate parts) are fit for their intended use, account being taken of economy, and in this connection satisfying the following essential requirements where the works are subject to regulations containing such requirements. Such requirements must, subject to normal maintenance, be satisfied for an economically reasonable working life. The requirements generally concern actions which are foreseeable.

Essential requirements in terms of objectives, concern:

- mechanical resistance and stability;
- safety in case of fire;
- hygiene, health and the environment;
- safety in use;
- protection against noise;
- energy economy and heat retention.

2.5. Standards for materials, building products and installations

a) This is the most basic technical regulatory document for the construction industry. Standards are the tool for implementation of essential requirements; composition, fabrication, quality assurance, handling and use of building materials or products are described only as means for desired performances to be finally achieved.

b) In the particular case of developing countries, standards also offer the best way to induce the use of affordable local low-cost materials, previous research and experience having shown their feasibility and adequacy. Thus, one may counterbalance some snob tendencies enhancing the indiscriminate use of costly "modern" materials.

c) Thus, the importance of standards is broadly recognised; however, the extensive national effort needed for their drafting and enforcement is underestimated; preparation of a standard regarding a specific material or product, necessitates:

- Previous extensive experience of raw materials;
- Scientific-technical knowledge on physical and chemical processes of fabrication;
- Experience on constraints related to available technology and skills;
- Feeding back information on the use and behaviour of the material or product within the final construction.

Most of these prerequisites are not fulfilled in some developing countries, at least for some materials (and there are so many in construction). Besides, the level and number of specialists and representatives needed for drafting a standard, as well as the duration of the respective deliberations, are so costly that they can hardly be afforded by one country alone. As a consequence of these multiple difficulties, several developing countries merely adopt the standards of some industrialized countries, giving up the basic regulatory potentialities a really esogenous standard offers, i.e.:

- Pragmatically desirable and feasible performance levels.
- Encouragement for the use of local low-cost materials.

If the construction industry in developing countries is to be enhanced, it is important that this situation be drastically changed.

d) In this connection, it is worth elaborating further on the performance concept, i.e. the final in-work behaviour of a given material or product; a behaviour described in terms of functional (useful) properties. Thus, the basic requirement will NOT be described in terms of composition, intermediate test-results or particular fabrication modes, but rather in terms of final properties within the structural system (*).

Obviously, composition and fabrication modes will be mentioned as an alternative possibility to meet the basic requirements; composition and fabrication affect a lot of final properties (hence, the "performance" of the product). However, a standard basically aiming at a fundamental output (performance), has the following advantages:

- any alternative composition or fabrication, leading to the same final performance, is left open;

- offers the possibility of individually describing the level of performance needed.

If, on the other hand, a foreign standard is copied (especiallly a non-performance oriented one) one is bound to two respective restrictions:

- Locally-available raw materials may not fall within the limits of the descriptive foreign standard (empirically inspired by the materials available there);
- One is obliged to impose the performance level implicitly hidden in the foreign standard.

In some cases a standard which is copied can be as harmful as no-standards at all.

(*) A good example of this philosophy is an Indian standard for soil-cement blocks which does not impose a unique cement percentage; instead, it leaves it to the in-situ strength class needed.

An explanation is needed here regarding the modified performance level a country may choose to better serve its particular socio-economic and technical conditions: the level of action or influences against which "resistance" (a performance) is needed, is a function of the intended time-life (L_t) of the product, and an indication of the socio-economically acceptable probability of failure (P_f):

$$S_d = S(L_t, P_f) \quad (**)$$

From country to country (or, in the same country, from period to period of its history of development), both the intended time-life and the acceptable probability of failure may be different: the actual conjecture may dictate optimum lower values of L_t and P_f, if the present generation should be entitled of some profits.

In more practical terms, the following recommendations should be retained:

(i) Standards of construction material, product or installation, are basic instruments for the enhancement of the construction industry and the national development at large. Efforts and expenses for establishing national standards are therefore highly justified;

(ii) Foreign standards, especially when they are performance-oriented, constitute a good basis for drafting national standards. However, different performance levels and different descriptive means may be used, depending on local economic and technical peculiarities;

(iii) Similarly, a policy is needed for the enforcement of standards for local material producers and contractors. To this end, scarcity of means and experience in quality assurance should be faced in a pragmatic way, avoiding unnecessary bureaucracy; simplification in procedures and possible special retentions uniquely destined for quality control, are some of the suggested means to this purpose;

(iv) National drafting groups should be composed of a wide range of representatives (planners, producers, designers, contractors, users) and not just research centres' representatives;

(v) Standards, like all Regulatory Documents, should be formulated in precise unambiguous scientific and legal language. Subsequently, some of these documents need to be re-formulated (tech.guides, Manuals) in a language and style readily understandable by less-educated construction people.

(**) As an example, in the case of seismic actions, the resistance needed is a function of

$$\exp\left[b.\log\left(-\frac{L_t}{\ln(1-P_f)}\right) + c\right]$$

2.6. Codes of practice

a) As is known (see para. III), a final engineering good is produced and exploited via a series of actions, such as design, construction and maintenance, which also need to be regulated.

Codes of practice are the respective regulatory documents for design, construction or maintenance. Unlike standards, these Codes have to do with:

(i) a multitude of materials and products,
(ii) calculation procedures directly related to the educational level and social attitude versus safety issues,
(iii) a non-factory production-environment (i.e. an open air site) and numerous non-skilled workers, both contributing to lots of uncertainties.

It is precisely because of these (rather dangerous) peculiarities, that Codes are more needed than any other regulatory document, especially in developing countries; even in the absence of Standards, a comprehensive Code may cover the gap within its holistic contents.

b) Here again, the drafting of a national Code in a specific field of the construction industry, is a difficult task (see para. 2.5.6). To alleviate these difficulties, appropriate foreign Codes are useful technical documents, at least as starting predrafts. However, several modifications are frequently introduced:

- Simplifications dictated both by a pragmatic recognition of the average technical/scientific and educational level, and the scarcity of quality-control facilities;

- Reliability differentiations imposed by possible differences in (i) intended lifetimes L_t, (ii) acceptable probabilities of damage P_{dam}, (iii) maintenance policies (fig. 2, all three policies leading to possible decrease of the design values of the actions, or reductions of partial safety factors $\ddot{U}_F$ regarding actions), and (iv) quality control levels (possible increases in partial safety factors $\ddot{U}_M$ regarding materials).

c) Differentiations of Code requirements may also be foreseen within the country: it might be for instance the case of low-income settlements, as in many rural areas of developing countries and/or urban squatter settlements. Both intended lifetimes and damage probability levels may be purposefully reduced, in order to reach a rational and legitimate construction mode. Otherwise, the "impossible" provisions of an official (foreign-inspired) Code, may easily lead to the other extreme of totally illegal and uncontrolled construction.

d) Last but not least, there is a great need nowadays for "Maintenance and Repair" Codes in every country. Improved economic models and better understanding of durability, explain this necessity.

For developing countries, such Codes and, above all, respective Guides on Maintenance and Repair, seem to be more valuable, especially if accompanied by a relevant national policy regarding existing construction goods.

2.7. Technical Approvals

These are documents regulating the study, testing and acceptance of modern or complex construction methods or products, which are not covered by a national Code or Standards. Specific applied research is needed to this end. The conditions of submission, investigation, acceptance and follow-up for such "technical approvals" are described in a relevant national document. Thus, specific cases of technical innovation are covered and progress is not hindered.

2.8. Quality Assurance Schemes and Certification

a) Quality of construction goods is a controversial subject of great economic and social importance. Even in industrialized countries, it is claimed that gross errors in the building industry generate costs many times higher than the initial cost. This could be greatly avoided if design and construction were adequately checked and monitored. The construction industry, by its nature, is exposed to highest quality uncertainties ("nomadic" character, uncontrolled skills of several of its workers, encounter many different materials and products, etc.).

b) On the occasion of enforcement of Standards and Codes, some possible means to improve quality assurance schemes in developing countries have been mentioned:

- Simplification of regulatory documents to a level of feasibility;
- Adoption of the performance concept which, in addition to its importance already analysed, offers the possibility of making quality control more comprehensive (main checks for basic final properties);
- Application of a small retention fee, directly destined to finance quality assurance schemes to the budgets of all construction works. Alternatively, oblige any professional associations of manufacturers and contractors to pay for the entire quality assurance scheme. Fiscal incentives may accompany such measures;
- Intensify educational and demonstration means highlighting quality;
- Whenever possible, mobilise consumer organizations to implement quality assurance schemes.

c) Whenever complete and continuous control is feasible, offer the possibility for a national certification with a "quality mark" stamped on the product. Accompany it with better financing conditions (e.g. additional State guarantees to banks).

2.9. Liability and Insurance

Responsibilities of a producer or a contractor towards the purchaser or owner, are normally described in Specifications, and covered via surety bonds in case of non-performance by the producer or the contractor. However the corresponding amount of money may be disproportionately high, especially for professionals in developing countries. Thus, insurance in the construction industry becomes an important instrument for stability and development. From this point of view, the extension of banking systems in developing countries may have favourable effects.

III. PRODUCTION

This chapter is presented for the sake of completeness in the description of the Construction System, rather than because any substantial elaboration could be offered within this report.

3.1. Planning

a) Project's description
b) Land acquisition documents
c) Feasibility report
d) Financial conditions
e) Programme.

In the case of a large engineering work, the above mentioned planning stages are accompanied by relevant documents prepared by specialists. At the other end of the scale of construction outputs, the making of a simple shelter also goes through such planning procedure, without however any formal procedure.

Nevertheless, in every case the ties of the construction industry with economics and management again become clear.

3.2. Design

a) Know-how needed.
b) Design file (calculations, drawings, specifications).

This is a fundamental step in the entire construction process. In essence, the established programme of an engineering "product" has to be developed into construction drawings and specifications.

Normally the basic mental process of design follows the subsequent stages:

(i) Conceptual design (by experience and intuition).
(ii) Selection of materials (technical and economical knowledge needed; available standards are considered).
(iii) Actions and infuences to be accounted for, are inventorised (relevant design codes are considered).
(iv) Analysis, dimensions and verifications follow. Simple or sophisticated calculations are needed for this purpose (computer-aided design nowadays becomes a daily procedure).
(v) Detailed drawings are prepared, readable by the contractor and his labour force, together with relevant specifications (construction codes are considered).
(vi) A detailed quantities-estimation of all materials and works is prepared; respective unit prices allow for the final calculation of the total budget needed.

The construction stage itself has been recognised as a "capital-intensive" procedure; similarly, the design stage is a process based on accumulated capital of knowledge: long formal education, apprenticeship, experience and feed-back of information are needed to make a good designer in architecture and civil engineering. His responsibilities for the final work are disproportionately large. It is, therefore, not a surprise to observe the scarcity of good designers in some fields of the construction industry in some developing countries. A strategy to cope with this situation may comprise:

- A long range forecasting of national demand in construction outputs; relevant (be it very rough) estimation of qualified engineers and architects for various design-levels, may be made. Timely modifications are however needed.

- A formal education plan may be prepared for university-level studies abroad or in the country. A follow-up is necessary.

- For those design projects entrusted to foreign firms, provide for a minimum number of young qualified engineers from the country, to follow some parts of the design as apprentices.

- For some intermediate levels of design sophistication, provide for mandatory design joint ventures of foreign and local design firms.

3.3. Selection of Contractor

This report will not elaborate on this stage of the construction-production process; its importance however is made clear if the subject is connected to:

- the financial issue (para. 1.2.3., Part Two)
- the national policy versus entrepreneurs (para. 2.8., Part Two)
- the quality assurance issue (para. 1.2.7., Part Two)

In any case, the procedures for the selection of contractor call for another optimisation between a) transparency and impartiality, and b) efficiency and speed.

3.4. Construction

a) Every programme, design and call-for-bids, ends with the final and most essential stage, i.e. the construction itself.

This stage is implemented only if an equilibrated blend of the following components is feasible:

(i) Adequate financing.
(ii) Experienced personnel, such as:

- Managers
- Engineers
- Craftsmen
- Unskilled workers

(iii) Materials and products available.
(iv) Selected, well-known, construction techniques.
(v) Equipment compatible with the personnel, materials and techniques selected.

The highly diversified character of the agents contributing to the production of the final construction goods, cannot be overemphasised. Especially if the "open-air" and "non-permanent" factory of this industry is considered (the nomadic job-site). That is why in the beginning of this section, equilibrium was mentioned.

A comment should be made here on the managerial capacities of the leading personnel involved in construction. The most diverging component of the overall costs of house building in ten African countries, was the "overhead and profit" component: Around its mean value of 20% of the total cost, the standard deviation observed was more than double compared to the standard deviations of material or on-site labour costs ([3], Table 17).

b) Financing has been discussed in Part Two, para. 1.2.3.

Regarding the necessary personnel in a contractor's firm, the first component which needs special attention is the managerial one; organisational capacities, devotion and creative coping with unforeseen circumstances, are the sine qua non conditions for leading personnel on site. An extra difficulty is that formal education does not help much in this respect; moral capacities, apprenticeship and long experience is the only way out. Although market mechanisms do gradually produce this category of personnel, developing countries may occasionally feel a relative scarcity. The only strategy one could possibly recommend in this connection, is broader support a government could offer to the local entrepreneurial profession (see Part Two, para. 1.2.7)

It must be reminded here that labour's participation in the total cost of buildings in some developing countries, ranges between 20% and 35%; half of this personnel is unskilled. In addition, the seasonal and the migratory characteristics of construction labour should be pointed out. It is obvious that relevant statistics on these phenomena are extremely valuable prerequisites for any policy-making.

c) Problems related to building materials have been discussed in para. 1.2.6a and para. 2.5. of Part Two of this report.

Here we should comment on some particular aspects regarding construction techniques.

- Firstly, it has to be reminded that the ratio in the building sector,

$$\lambda \quad . = \frac{\text{Cost of Structural elements}}{\text{Cost of Finishes and Installations}}$$

seems to reflect availability of resources and level of development: in ten African countries ([3], p. 41) it was found ó 1:1; in rapidly developing areas (Greece in the sixties) ó 1:2; in industrialized areas, ó 1:4.

Consequently, the importance of "non-structural" materials and products should not be underestimated.

- In the other extreme (ó > 1), the concept of "perishable" structures has certain merits in order to better serve a rational planning of development: purposely limited lifetime spans (if included in a longer framework of future drasticly improved policy) may lead to the selection of very cheap traditional construction techniques.

- Within the issue of appropriate technology, low-cost housing may call for well-studied labour-intensive techniques in foundations, walling, dooring, roofing, finishing and installations. Good examples are offered in this respect by the Indian CBRI ([11], pp. 145 to 155).

- Industrialisation (or merely serial production in dispersed centres) of some components like doors, windows, light partition elements, cheap tubes etc., may be profitable on a regional scale (its extent depending on the transportation facilities available).

- The selection of appropriate construction techniques becomes a more challenging issue in case of a relatively higher economical/technical level of development: optimization of number of storeys (mainly in urban areas), type and extent of prefabrication of structural elements, degree of mechanisation of in-situ construction methods, insulation level adopted, selection of hybrid solutions of locally-produced and imported materials, etc., may constitute profitable alternatives.

- In the case of developing countries however, several of these issues should be addressed by technical research centres in a collective way rather than by isolated medium-size contractors.

d) Equipment to be used in construction is the last but not least component in this stage of production. Here again, optimisation is needed between cheap rudimentary tools handled by a numerous supposedly cheap (mainly unskilled) labour, and sophisticated mechanisation. Relevant decision-making depends on:

- type and urgency of construction work
- level of mechanical maintenance available
- availability of spare parts
- conditions of financing

It has however to be pointed out that besides the purely economical considerations, a quality assurance component should also be taken into account: mechanisation tends to minimise the risks of gross error in the construction industry. That is why governments may have an interest in offering incentives to groups of local contractors to establish their own factories for tools and simple machines if basic materials and know-how are available.

3.5. Use

As previously stated, the "production" of engineering goods should be looked at as including maintenance and repair as well. The difference here is that the user himself (and not the contractor) should organize this economically and socially-important stage. Depending on the level of development, the following means may enhance maintenance and repair efforts:

- Posters for self-maintainers
- Exhibitions in Communities
- Financial and/or insurance incentives
- Package schemes: a construction company sells flats together with a long-term obligation of maintenance.

Last, but not least, this issue also needs an educational re-orientation in universities and technical schools: there is a rather one-sided tendency to teach subjects mainly referring to new structures; existing structures' assessment, redesign and repair are more complicated but very much needed topics.

4. ACTORS

For the sake of completeness, we should again list the human agents of the construction industry.

a) The owner
b) Owner's adviser
c) The design consultant (architects, engineers, economists)
d) Materials producer
e) Equipment producer
f) The contractor
g) The user

This enumeration may also be useful as a reminder of the respective strategical means to enhance the construction industry, i.e.:

- Information
- Education
- Fiscal incentives, and
- Finance

related to each of the above mentioned actors.

5. KNOW-HOW

The importance of the "capital of knowledge" contributing to the construction industry may occasionally be underestimated; economic aspects as well as production and availability of materials, tend to monopolise the interests of policy makers. Besides, education and research inevitably have a long-term character, which also discourages relevant planning. This chapter is an attempt to remind the several know-how generating components which may in principle contribute to the development and better productivity of the construction sector.

5.1. Dissemination of information to interested groups, such as the population at large; the workers or contractors and the potential investors in the sector, may prove helpful even if the normal media is used (newspapers, radio, television); a relevant plan is however needed to the purpose.

5.2. Experience and tradition

Modern formal educational subjects are not the only means for technical education; informal training through apprenticeship is a sound way to the purpose. Some moral and economic incentives may intensify this procedure.

5.3. Formal education

Technical education, even at its lowest level, can be enhanced in a favourable environment of general education; efficient elementary schooling seems to be a prerequisite for any vocational educational system

- Craft-training schemes
- Vocational schools

Statistics regarding the follow-up of technical staff in industry are needed in order to evaluate the efficiency of the system.

At the higher level of technical education, the first thing one may deplore is the rare opportunity for contacts with the construction industry itself. In some cases, a double stream of teaching staff should be profitably secured: normal academic personnel for fundamentals, and highly experienced (local or foreign) staff members of design firms or contractor companies. should be adequately remunerated. In addition, higher technical education institutes need a continuous assessment and modification of their curricula; rapid developments in socio-economic and technical terms, impose rearrangement in formal education more frequently in developing than in industrialized countries.

5.4. Continuing education

Precisely because of the above mentioned developments, formal education (with its understandable inertia) may not respond to new educational demands. This objective may be covered in a more flexible way by a (preferably formalised) continuing education scheme. Such a broad scheme may serve the entire technical hierarchy:

- To engineers (refreshment lectures and specialisation courses).
- To technicians (upgrading in construction techniques, training in special branches).
- To unskilled workers (stages in real job-sites).

The efficiency of these flexible schemes will largely depend on the possibilities of:

(i) paying normal salaries to the trainees during their continuing education time, and
(ii) ensuring the participation of well-paid and creative teachers at the relevant level; the lower the level, the more difficult it will be to hire efficient and enthusiastic trainers.

5.5. Standards and Codes

These regulatory documents (see para. 2, Part Two) possess a considerable educational potential: being a synthesis of scrutinised knowledge, Standards and Codes (for design, contruction or maintenance) constitute excellent teaching material.

Obviously, depending on the level of "students", a transcription of these documents in another style may be needed.

5.6. Technical centres

Such centres offering backing services to the construction sector in general, create the best opportunities for direct or indirect educational services. Training in the centre, preparation and publicising of technical guides and manuals, and contribution to the drafting of regulatory documents, are some of the services contributing to the dissemination of know-how (see i.a. [17]).

5.7. Transnational transfer of know-how

This may be an extremely efficient means for technical education, independent of the level of development of the country concerned:

- Technical exchanges: a profitable way for a North-South or South-South transfer of knowledge. Even the migration of technical labour constitutes such a means.

- Foreign contractors working in a country, or foreign manufacturers selling their technology, give locally-hired personnel the opportunity to acquire new knowledge, management being one of the fields for which developing countries may have greater need. To maximise this mechanism, the recommendation of the Second Consultation on the Building Materials Industry ([2], p.& 22) may be followed whenever possible: "Complete technological packages are negotiated, encompassing adequate provisions for training, engineering, know-how, maintenance and subsequent technical back-up support".

5.8. Research

Besides its direct contribution to development, applied research in the constuction sector plays a basic educational role. Being obliged to establish contact with the font of knowledge on the subject, a researcher should subsequently offer this knowledge to non-specialists in his environment.

Incidentally, research groups in this sector may maximise their efficiency if they:

- Establish linkages with real local problems.

- Start by a complete literature and documentation survey.

- Carry out research in close collaboration with higher education institutes (direct offer of newly acquired knowledge).

- Produce extension services in order to translate research outputs into economically-viable activities.

III. PROVISIONAL CONCLUSIONS

1. CONSTRAINTS

An attempt was made in this report to highlight the multiple inter-relationships between the various components of the construction industry on the one hand, and parts of governmental policy and social issues, on the other; Fig. 3 illustrates some of these relationships. In some internal loops of the entire system, the inter-dependency is so strong that the impression may be given that any external intervention is impossible. Fortunately, experience shows that a lot of progress has been made in several developing countries, thanks to such interventions.

Yet, a lot of bottle-necks (malfunctions of the system) remain; they may be different from country to country or, in a given country, different in time.

In what follows, some of these malfunctions ("constraints" for the development of the construction industry) are selectively presented; several others might have been chosen as well out of those mentioned in the previous chapters of this report.

1.1. Land-use policy

In some congested urban areas of rapidly expanding cities, lands available for low-income housing programmes are rather scarce and inappropriate. Reference is made here to Part Two, para. 1.2.2.

1.2. Urban and house infrastructure

Even in the case of sufficient shelters, the general condition of sanitary installations is so poor that a rapid deterioration, both in moral and health terms, is taking place. Considerable upgrading of the importance given to these infrastructures is needed.

1.3. Imported construction techniques

Exception made of the urgently needed basic civil engineering works, in a lot of other less stringest cases, there is a tendency to use unnecessary "modern" construction techniques, imported from foreign countries as packages of:

- foreign-made materials, which may not be compatible with local climatic conditions and maintenance possibilities,
- sophisticated equipment, which is frequently difficult to back-up by sustainable spare parts and repair schemes;
- disadvantageous economical conditions, such as loans, unfavourable markets for labour-intensive local techniques, etc.

Notwithstanding the contribution of some modern techniques to the progress, the aforementioned situation may be a serious constraint to the development of the construction industry.

1.4. Low level of regulatory documents

The key role of Standards, Codes and other regulatory documents in enhancing the construction industry was discussed in Part Two, para. 2. together with the rather unfavourable situations encountered in some countries; industrialised countries do not always make an exception. Considerably more intensive efforts and resources should be given towards improving such situations.

1.5. Inadequate financing

It has been recognised that the construction industry (and especially its contractors' sector) is a rapid capital-absorber. Besides, the discouraging conditions of continuous dismantling of job-sites, and the need for timely payments, before any installment is approved, makes the situation of entrepreneurs much more difficult. This is a considerable malfunction of the system and it is unlikely that it will be remedied without a relevant policy and follow-up.

1.6. Limitations of the informal construction sector

The importance of the informal sector has been recognised (see Part Two, para. 1. 2.7.d), together with its limitations such as:

- Low quality
- Instability
- Resistance to progress

Precisely because of its importance, this sector can be (profitably) alleviated of its limitations.

1.7. Low level of available know-how

Human actors in the entire construction system play an understandably focal role (see Part Two, para. 4). Their actual educational level, however, is not always adequate; this has a fundamentally negative influence on the development of the construction industry. Selectively, more acute insufficiencies were observed in the following areas:

- Managerial capacities
- Modern design methods
- Technical skills, e.g. in mechanical engineering.

Multifold and long-term educational efforts are needed, although fruitful results are not expected to be very clear for a time; this causes difficulties in solving the problem.

1.8. Shortage in building materials

Refer to the First and Second Consultations on the Building Materials Industry.

1.9. Unstable working conditions

This is an international problem in the construction industry; developing countries being more vulnerable. Because of this instability, both the public and the private construction sectors are confronted with expenses which disproportionately increase the final costs.

A multiple as well as flexible policy is needed in this connection: fewer state-entreprises, a major role of the informal sector, broader economic improvement to keep construction demands high enough, timely uniformity obtained via appropriately programmed demands for bids, possibilities of south-to-south bilateral agreements for construction schemes, etc.

1.10. From central planning to market systems

This general issue (see [18]) may more heavily affect the construction industry at the beginning, both because of the deflation of the public sector and the expected temporary economic deterioration. It may however subsequently play a positive role, if more flexible medium-sized construction companies take the lead, backed-up by a freshly generated banking system.

Each of the aforementioned constraints, needs a strategy. It is however hoped that when relevant measures are taken, the system's approach advocated in this report will be helpful in weighing the importance and the repercussions of each of these measures.

2. ALTERNATIVE STRATEGIES

It is not within the scope, and indeed within the possibilities of this report, to build up a concrete strategy for tackling the above-mentioned constraints; the picture of the malfunction of the system may vary so much, that no preconceived strategy plans are feasible; a sufficiently broad recommendation to this end may however be found in [8], p.26. Besides, the contents of chapter 1 of Part Two of this report may profitably serve the same purpose. Nevertheless, a more flexible and inevitably less-detailed scheme will be described here; it is composed of two components as follows.

2.1. Constant components

Select some of the constraints which seem to be the most important, and make them permanent objectives of a strategy. An example for such a selection of five points is given hereafter:

a) The lack of basic statistical data regarding the construction industry has to be remedied; no policy can be made without a comprehensive set of information regarding the various aspects of this industry (see Part Two, para. 1.2.1. and 1.2.7.). Thus, at least, inventories of existing forces, as well as more pragmatic estimations of construction demand are needed.

b) Although bureaucracy may sometimes be part of the problem, it is nowadays recognised (see i.a. [2], p.10) that a national coordinating body for the construction industry ("COBO-CONI") is needed; it would undertake global responsibilities matching the holistic characteristics ("system's approach") of this industry.

This body will identify responsible and/or influential agencies, institutes and associations, and will subsequently try to apply an overall coordinating plan and a complete follow up. It is essential that entrepreneurs in the entire sector are adequately represented in this body.

c) Intensify the production of innovative low-cost construction techniques and materials which are:

- correctly adapted to real technical requirements and economic resources available;

- based, as much as possible, on local raw materials and skills;

- scientifically conceived and tested.

Optimise the distribution of available resources between such R+D and direct expenses in the construction sector.

d) Create a decisive impact on systematic maintenance and repair of existing construction goods, especially of the most vulnerable between them (e.g. water supply and sanitary infrastructure in low-cost housing): advertise its importance, distribute relevant technical guidelines, encourage demonstrations, provide for partial financing of communities, etc.

e) Select some of the educational means (see Part Two, para. 5.) for the enhancement of the construction industry, and establish a long-term plan (together with its follow-up).

2.2. Short-term components

Identify further weak mechanisms ("malfunctions") of the system of the construction industry, and make them short-term objectives in the strategy. The degree of effectiveness of the measures to be taken and the "responsiveness" of the system to each of the mechanisms chosen, are not well known. Thus, trial-and-error methodology will be used, possibly on a biennial basis.

The First Global Consultation on the Construction Industry will offer the most qualified opinions on how such a national strategy should be made and with which appropriate components.

3. REQUIRED INITIATIVES OF INTERNATIONAL AGENCIES

In this report, the role of international assistance to developing countries on subjects related to the construction industry, has been repeatedly mentioned. Especially that of UNIDO and HABITAT within the United Nations System. Similarly, the positive role of lending organizations and donors has been mentioned. The efforts made by scientific international associations, such as RILEM and CIB, for technical assistance regarding low-cost housing should also be mentioned.

A list of some further initiatives is given below, favouring the welfare and development of the construction industry in developing countries.

a) Opportunities should be offered to countries to share information and experience of common interest. Thus, optimisation of North-South and South-South technical assistance and cooperation will be encouraged.

b) Give financial assistance to undertake case studies on missing statistical data related to the construction sector at large, and/or its educational aspects.

c) Assist governments of developing countries in creating national coordinating bodies for construction industry ("COBO-CONI"). Offer the possibility of a network for information exchange on global planning of national construction industries.

d) Encourage the creation of North-South and South-South joint-ventures in the construction sector. Previous economically-successful cases of west entrepreneurs and capital investors should be publicised.

e) Advise governments and international lending organizations on the appropriate forms of foreign financing of national construction industries.

f) Continue support of national efforts towards creating technical centres for construction, as well as in establishing regional networks of such centres. Intensify their activities on construction techniques and design, in addition of their endeavours related to materials.

Here again, the First Global Consultation on the Construction Industry will discuss the needs related to international assistance, and make recommendations.

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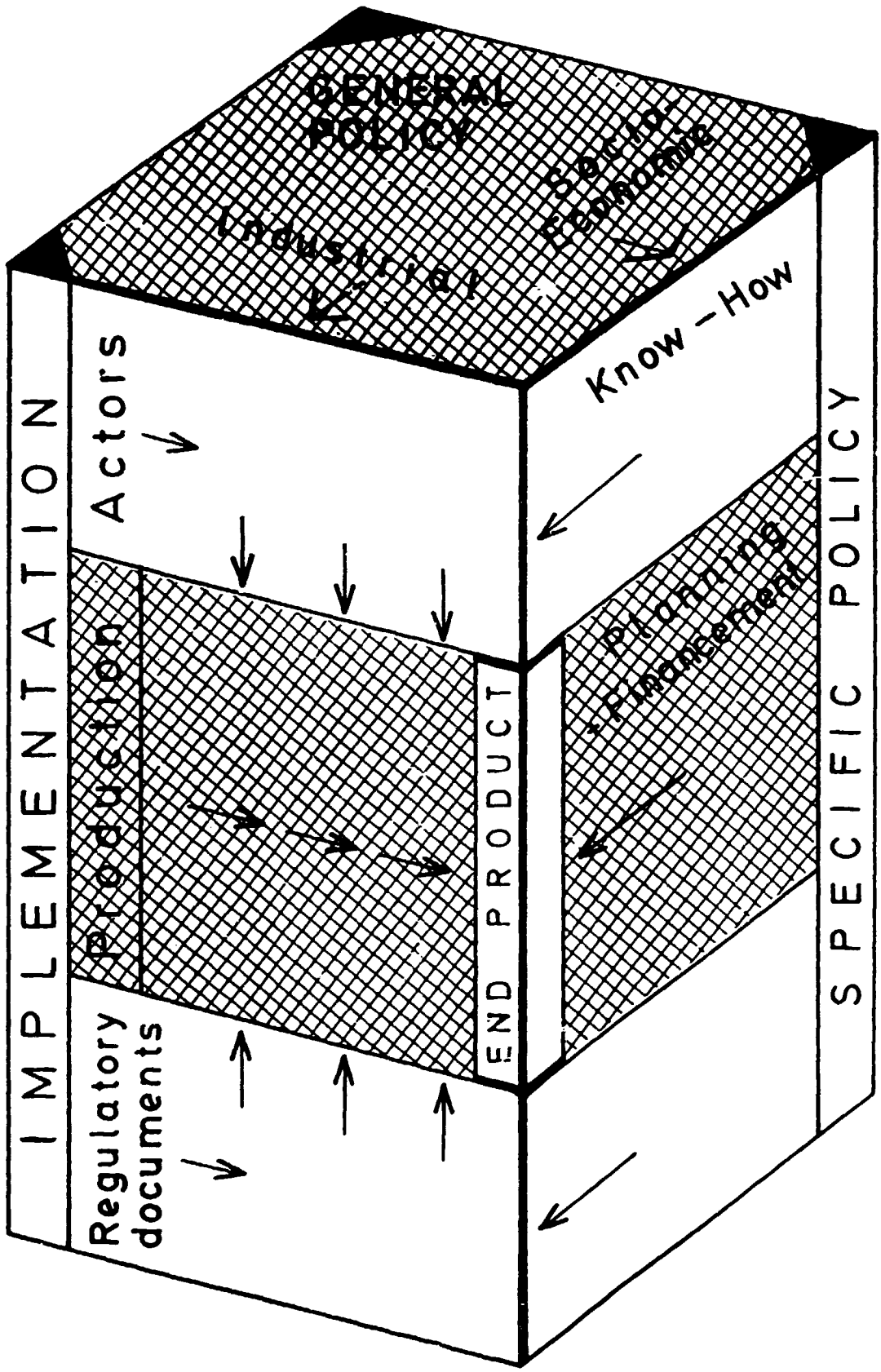

Fig. 1: Structure and function of the construction industry

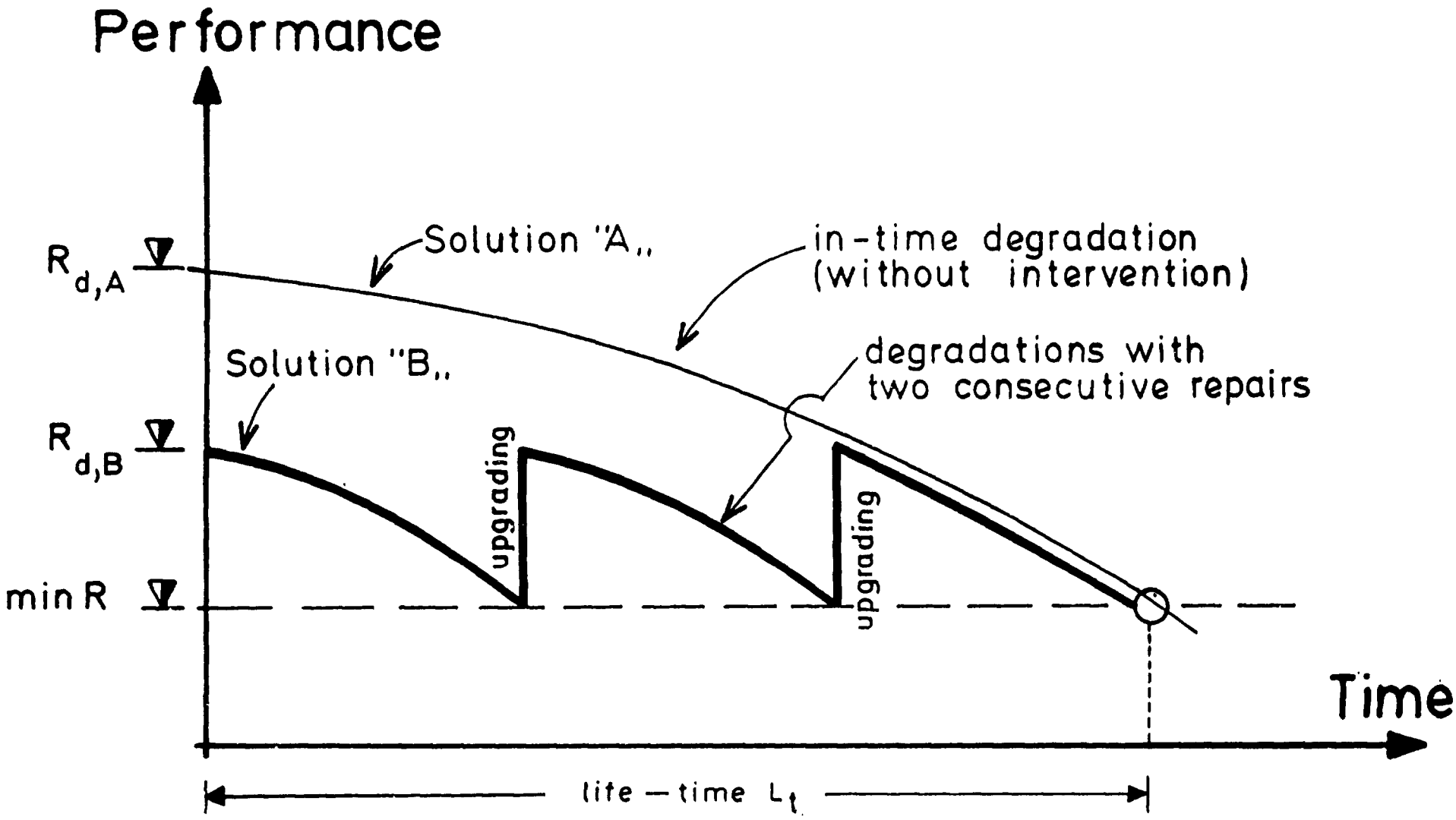

Fig. 2: For the same intended lifetime, and the same acceptable minimal performance min R, two different initial "design performances" R_{dA} and R_{dB} may be imposed, depending on the planned intermediate repair policy.

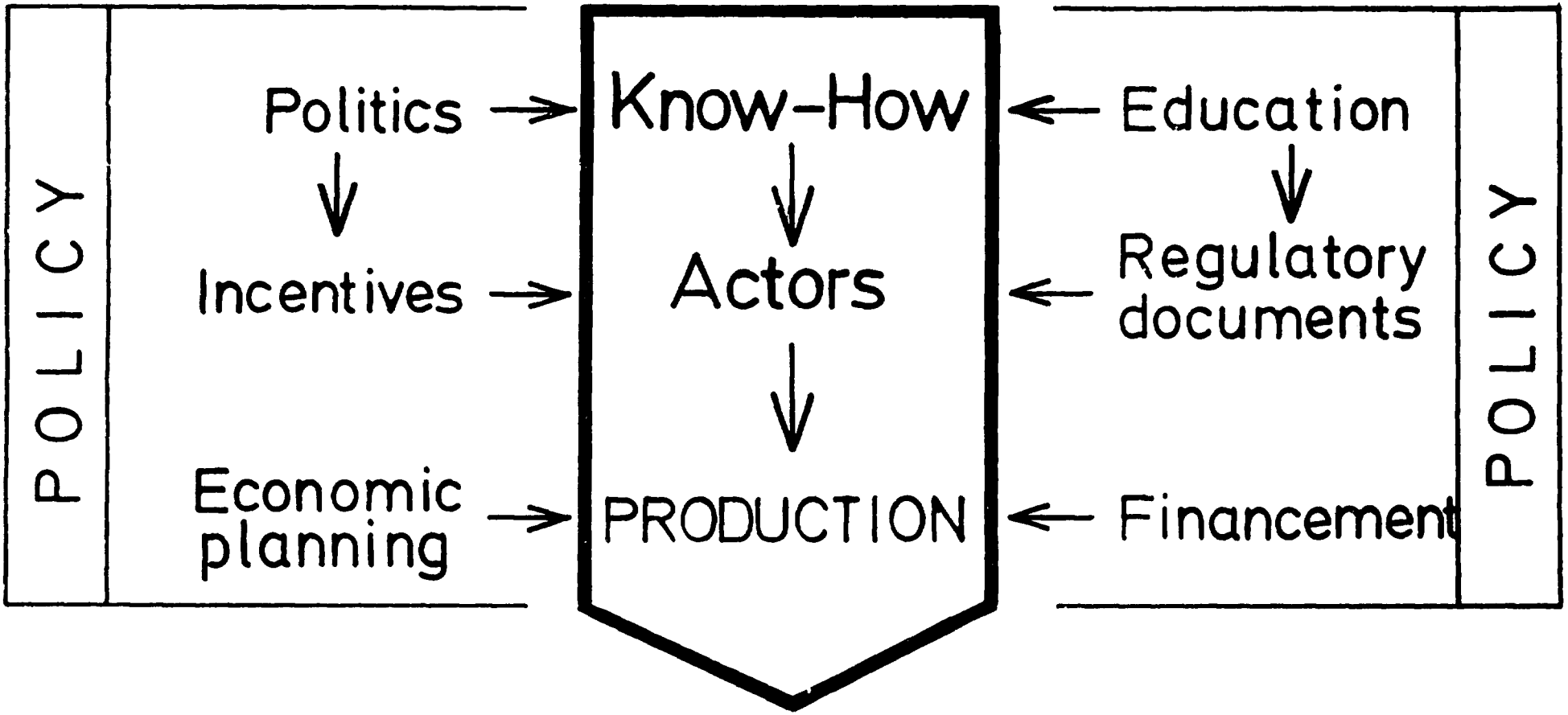

Fig. 3: The construction industry stream and transverse influences of socio-economic nature