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# Session 4

# Cooperation in Solving Problems of Design and Construction
# Collaboration dans les phases de projet et d'exécution
# Zusammenarbeit bei der Planung und Ausführung

**Chairman/Président/Vorsitzender:**

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Ladies and Gentlemen,

I am very happy to be here on this occasion to preside over the 4th session of the IABSE Symposium, and I am grateful to the organisers for having given me this honour. The topic for discussion in this session is, as you all know, "Cooperation in solving problems relating to design and construction in developing countries". The basic paper on this topic, as appearing in the introductory report, is from Mr. Hans Habenicht. Four invited speakers who will present their papers on different topics relating to the theme, such as, major problems of design, construction and organisation to suit conditions in developing countries, adoption of the know-how of developed countries, and training and education for work in developing countries, as indicated in the invitation pamphlet of the IABSE. This will be followed by prepared discussions and later by free discussions.

Before we take up the introduction of the papers and discussion thereon, it may not be out of place for me to make a few passing observations on this subject. The title for this session presupposes that both the developed as well as the developing countries are currently facing some problems regarding design and construction in their developmental activities, and the same are sought to be solved by cooperation. At the outset, what is a developing country? A developing country, as defined by somebody elsewhere, is a country which lacks the industrial base to initiate mechanised construction methods and is not pressured by high labour costs to resort to labour - saving or time-saving techniques. This definition obviously does not cover the aspect of design. The term "developing country" indicates a country in the process of development, which is an ever-continuing process. The difference between

a developed and a developing country is only relative and such relative differences may exist even amongst the already developed countries, depending upon the level of sophistication in design and construction techniques. In the past, most of the countries situated in the third World had to depend completely on the advanced countries for design and construction techniques for any projects undertaken, and the local talent have practically remained undeveloped. Following the political changes that have taken place during the recent years, the need for an overall development covering the economic and social fields has given rise to the need for industrial and technological developments involving sophisticated designs and construction techniques. In some of the developing countries, there has been a marked development in that direction, and they are also now in a position to offer in some fields technical cooperation to the other, lesser developed countries. A recent survey, carried out by the UNDP during the last 18 months, has shown that about 900 organizations in 67 developing countries are in a position to offer technical cooperation in 16 economic and social sectors, which is expected to greatly facilitate inter-country cooperative exchanges. Viewed from this angle, the cooperation required in solving problems of design and construction need not necessarily come from only developed countries, and this forum may perhaps keep this aspect in view in formulating proposals in this regard. The designs and construction methods to be followed in any developing country should also take into account the country's resources in respect of finance, locally available materials, labour and technical skills. The cooperation sought or offered should not merely cater for a successful implementation of a project, but during the process, should also aim at imparting the necessary training to the local staff who should in due course be able to handle similar designs and to develop the required equipment from indigenous resources, without having to look for such help from outside for future building activities.

# Wichtigste Probleme bei der Planung, Ausführung und Organisation von Bauten in Entwicklungsgebieten

Major Problems of Design, Construction and Organisation to Suit Conditions in Developing Countries

Problèmes principaux lors du projet, de l'exécution et de l'organisation de constructions dans les pays en voie de développement

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## ZUSAMMENFASSUNG

Das Problem des Planens und Bauens in Entwicklungsländern birgt durch die extremen Verhältnisse, die weiten Entfernungen und dem daran gemessenen unentwickelten Arbeitsmarkt erheblich grössere Risiken, als dies in den Industrieländern der Fall ist. Sie lassen sich auf einige wenige Problemgruppen zurückführen. Nachträgliche Projektänderungen und verspätete Zeichnungslieferung gehören hierzu. Serieneffekte, Logistik, Training der einheimischen Arbeiter und ein gleichmässiger Leistungsverlauf über die ganze Bauzeit müssen eingesetzt werden. Für die Kooperation einheimischer Firmen mit international operierenden Unternehmen müssen neue Wege gefunden werden. Sie sollen die Zusammenarbeit junger einheimischer Bauorganisationen gerade auch mit mittleren Baufirmen der Industrienationen ermöglichen.

## SUMMARY

The problems of design and construction in developing countries due to the extreme circumstances, the large distances and the undeveloped work market contain greater risks than for equivalent projects in industrial countries. These problems allow themselves to be narrowed down into just a few groups. Supplementary project changes and delayed delivery of drawings belong to these. Standardisation, logistics, training of native workers and a uniform course of performance must be installed for the whole construction time. New ways must be found for the cooperation between native firms and internationally operating contractors. The collaboration between newer, native construction firms and medium-size construction firms of the industrial countries should be made possible.

## RESUME

Les problèmes de conception et de construction dans les pays en voie de développement — dûs aux conditions extrêmes, aux grandes distances et au marché du travail peu développé — contiennent de plus grands risques que pour des projets équivalents dans les pays industrialisés. Ces problèmes peuvent être classés en quelques groupes. Des changements ultérieurs du projet et la livraison tardive des plans en sont des exemples. Des questions de normalisation, d'intendance, de formation des ouvriers indigènes doivent être pris en considération pour toute la durée des travaux. De nouvelles solutions doivent être trouvées pour une coopération entre les entreprises indigènes et internationales. La collaboration entre de nouvelles entreprises indigènes et des entreprises de construction de moyenne importance des pays industrialisés doit être rendue possible.

Alle Probleme bei der Planung, Ausführung und Organisation von Bauten in Entwicklungsgebieten vorzustellen, wäre ein ausserordentliches Unterfangen. Das Deutsche Museum in München ist das grösste technische Museum der Welt. Das Gruselkabinett aller Probleme, Schwierigkeiten, Fehler und Pannen des Bauens im allgemeinen und in den Entwicklungsgebieten im besonderen müsste sicherlich grösser sein. Das erste, das Deutsche Museum, ist ein stolzer Triumph auf die technische Leistung. Das zweite, das Museum der Pannen, würde das Scheitern von Plänen und Vorstellungen, das Irren von Ingenieuren und Menschen darzustellen haben. Da man ja bekanntlich aus seinen Fehlern mehr lernen kann als aus seinen Erfolgen, will ich versuchen, aus diesen vielen Problemen einige wesentliche, immer wiederkehrende Gründe herauszudestillieren sowie ihre Folgen und ihre Abwendung zu diskutieren.

Die Probleme und Risiken der Bauausführung liegen sowohl im Projektentwurf als auch in den von aussen auf die Baudurchführung wirkenden Verhältnisse und Störungen und schliesslich in der Organisation des Bauablaufes durch das Unternehmen.

32 internationale Ausschreibungen zeigen, wie diese Risiken unterschiedlich eingeschätzt wurden. Jeder Balken zeigt die Bandbreite der abgegebenen Angebote mit dem jeweils niedrigsten und höchsten Angebot. In einigen Fällen haben die konkurrierenden Kalkulatoren die Kosten doppelt so hoch vorausgeschätzt wie die Kollegen der Konkurrenz. Dagegen lagen die Konkurrenzangebote der Bosporusbrücke nur um wenige Prozent auseinander. Der hohe Anteil der heimischen Fertigung, ein bis zum Detail durchgefeilter Entwurf und der Weltmarktpreis des Stahls hatten alle Angebote nivelliert.

Darüberhinaus signalisiert in einigen Fällen die grosse Abweichung selbst des jeweils niedrigsten Bieters von der Kostenvorschätzung des Consulting-Ingenieurs eine gewisse Unsicherheit der Entwerfenden, die Probleme der Bauausführung im voraus angemessen zu erfassen.

Es ist ein grosser Irrtum, Risiken allein durch Zuschläge erfassen zu wollen. Man kann ihnen meist nur durch die Wahl richtiger Bauverfahren und störungsunempfindlicher Bauabläufe angemessen begegnen. Derartige Massnahmen vermögen den Baubetrieb gegen Störungen weitgehend zu immunisieren; sie sind aber oft nicht billig. Der für diesen Baubetrieb erforderliche Aufwand wird kalkuliert und führt zum Baupreis. Bauverfahren und Bauablauf müssen aber auch vertraglich abgesichert sein. So stellen Baubetrieb, Bauvertrag und Baupreis ein ausgewogenes, stabiles Dreiecksystem dar. Jeder Eingriff in eines der Subsysteme stört das Gleichgewicht und führt zur Vertrags-, Preis- und Kostenunsicherheit.

Methodische Problemforschung kann den beteiligten Volkswirtschaften viel Geld sparen. Durch Nachdenken vorzubeugen ist auch hier billiger, als später die Nachforderungen der Unternehmen akzeptieren zu müssen, die meist noch nicht einmal ausreichen, den wirklichen Schaden abzudecken.

Wüssten doch immer die Consulting-Ingenieure, wie tief nachträgliche Projektänderungen und eine Verzögerung der Auslieferung der Zeichnungen in den Baubetrieb eingreifen! In Entwicklungsgebieten kann sich dieser nicht flexibel anpassen oder ausweichen. Die Bauleistung fällt ab. Dies führt zu Kettenreaktionen bei den folgenden Gewerken, Baugerät kann nicht umdisponiert, Material nicht mehr rechtzeitig beschafft werden. Das Personal ist nicht qualifiziert genug, sich umzustellen.

In einem Entwicklungsgebiet war eine Schwergewichtsmauer zu betonieren. Die rechtzeitige Fertigstellung hing davon ab, ob die Felssohle entsprechend der Soll-Leistung in massiertem Einsatz ausgeräumt werden konnte. Als 70% dieser Arbeit getan waren, stellte sich heraus, dass es zweckmässig sei, die Staumauer um wenige Meter zu verschieben und zu verschwenken. Anschliessend wurden die Aushubkoten fortwährend geändert. Dies erhöhte die abrechnungsfähigen Massen nur um 12%. Die Ist-Leistung jedoch fiel sofort ab. Der Grossgeräteeinsatz konnte sich nicht mehr entwikkeln. Produktivität und Bauzeit haben sich nicht mehr erholt. Der nachfolgende Betonbetrieb lief auf und konnte sich nicht mehr entfalten. - Der Baustelle war wirtschaftlich das Rückgrat gebrochen, weil das Entwerfen keinen "Redaktionsschluss" fand. - Hätte der Auftraggeber vor der Ausschreibung mehr Geld für Erschliessungsbohrungen ausgegeben, wäre diese Planungsunsicherheit ausgeschaltet gewesen. Die Baustelle hätte ihre bereitgestellte Kapazität voll ausnutzen sowie die Kalkulation und die Bauzeit einhalten können. Der beteiligten Volkswirtschaft wären die Nachforderungen des Unternehmens erspart geblieben und der Stausee wäre zwei Jahre früher fertiggestellt worden. Der Produktivitätsverlust vernichtet volkswirtschaftliche Resourcen.

Wir beklagen im Baubetrieb allgemein, dass es nicht genug Serien gibt. In Entwicklungsgebieten müssen in noch stärkerem Masse Grossserien gefordert werden, da das Anlernen auf der denkbar untersten Stufe beginnt. Können sich aber mittlere, angepasste oder aber hochmechanisierte Technologien genügend oft wiederholen, sind oft erstaunliche Leistungen erzielbar. Der Consulting-Ingenieur muss solche Serienmöglichkeiten bereits bei der Planung erkennen, selbst wenn sich dabei die Massen erhöhen sollten.

In einem Entwicklungsgebiet waren 5 nebeneinanderliegende Triebwasserstollen eines Wasserkraftwerkes nacheinander aufzufahren. Alle sind 500 m lang und haben gleichen Querschnitt. Der Vortrieb war voll mechanisiert. Beim ersten Stollen leistete die Mannschaft im Mittel 5,5 m je Tag, beim fünften Stollen 17,7 m je Arbeitstag. Die Leistung, und damit die Produktivität, hatte sich mehr als verdreifacht.

In einem anderen Land wurde bei sozialem Wohnungsbau nicht vorhandenes Bauhandwerk durch die Grosstafelbauweise kompensiert. Durch den Serieneinfluss in Vorfertigung und Montage konnte die angelernte einheimische Mannschaft sogar 30% mehr leisten als ihre Kollegen in Deutschland.

Ein anderes Problem ist die Logistik. Alle Stoffe, Geräte und Ersatzteile müssen in der geforderten Qualität, in ausreichender Menge und zur rechten Zeit auf der Baustelle sein. Die meisten Glieder in dieser Beschaffungskette haben keinen persönlichen, motivierenden Kontakt mit der Baustelle. Grosse, international operierende Baufirmen nehmen daher die Baustellenversorgung ausserordentlich ernst. Der Produktivitätsverlust unterversorgter Baustellen kann Millionen kosten.

Eine teure Methode des Nachschubs ist oft der billigeren aber unsicheren Methode vorzuziehen, vergleicht man diese Mehrkosten mit den Folgekosten des Baubetriebes.

Die sowjetischen Bau-Organisationen umgingen vor Jahren den verstopften Hafen Calcutta, als sie ein Stahlwerk in Bilai in Indien zu bauen hatten. Ihr eigener Baustellenhafen erwies sich trotz grösserer Entfernung als effizienter, als der besser ausgestattete Hafen Calcutta, über den die anderen Stahlwerke Durgapur und Rourkela eingeführt wurden. Dies brachte den Sowjetrussen einen beachtlichen Zeit-, Geld- und Achtungserfolg.

Ein weiteres typisches Problem des Bauens in Entwicklungsgebieten liegt im Arbeitsmarkt. Schon der Entwurf hat sich auf die Möglichkeiten und Grenzen einzustellen, einheimische Arbeiter kurzfristig zu trainieren. Für Entwicklungsgebiete müssen angepasste, mittlere Technologien entwickelt werden, sogenannte "intermediate technologies". Sie haben die besonderen Verhältnisse der Menschen, des Klimas und der Bauwerke zu berücksichtigen. Sie müssen auch "trainierbar" sein. Ein gutes Labour-Training reduziert die Fluktuation der Arbeiter, erhöht die Produktivität und verbessert die Arbeitsqualität. Meist wird die Ausbildung den Polieren, Meistern und Vorarbeitern der Bauproduktion allein überlassen. Die grossen US-Firmen dagegen haben sich bei Grossbaustellen für das "off-the-job-training" entschieden. Erst nach einem siebenden Interview werden die Bewerber eingestellt und in einer Art Lehrbaustelle ausserhalb der Produktion geschult. Erst dann werden sie in die Baustellenproduktion integriert.

So hatte die amerikanische Baugruppe des Mangla-Dammes in Pakistan ihren ausserordentlichen Erfolg ihrem konsequenten Labour-Training-Programm zu verdanken. Ohne vorgeschaltetem Training waren etwa 5-mal soviel Arbeiter während der Bauzeit durchgelaufen als langfristig verblieben waren. Bei vorgeschaltetem Training waren es nur 1/5.

Alle diese Probleme können Bauabläufe empfindlich stören. Sie führen zu Beginn der Bauarbeiten zu Verzögerungsperioden. Selten reicht dann die restliche Bauzeit aus, die angeschlagene Wirtschaftlichkeit bis zum Endtermin wieder zu sanieren und die Baustelle termingerecht fertigzustellen. Der unwirtschaftlichen Verzögerungsperiode folgt eine ebenfalls unwirtschaftliche Beschleunigungsperiode. Hinzu gesellt sich noch ein Verzug. In keiner Phase wird die kalkulierte Wirtschaftlichkeit erreicht. Verläuft dagegen die Bauleistung entsprechend der Soll-Leistungskurve, können auf dieser langen Regelstrecke alle Produktionsfaktoren harmonisch aufeinander abgestimmt werden.

Wird nun das kalkulierte Fertigstellungsdatum überschritten, so entstehen aus den zeitabhängigen Kostenelementen weitere Verluste. Die allgemeinen Baukosten - hierzu gehören z.B. auch die gesamten Gehälter der Angestellten - die Gerätekosten und die Kosten der Baustelleneinrichtung bedeuten eine fast ausschliesslich zeitabhängige Belastung. Selbst die Kosten der einheimischen Arbeiterschaft kann man als zeitabhängige Kosten auffassen. Man kann die Arbeiter ja nicht auf eine andere Baustelle transferieren. Sie wurden ja mühsam ausgewählt und trainiert. Man kann sie auch nicht vorübergehend entlassen. - In einem typischen Beispiel betrugen diese zeitabhängigen Kosten 43% der gesamten Vertragssumme.

Ein weiteres Problem ist die Entwicklung des Baumarktes in einem bestimmten Entwicklungsgebiet. Schnell entwickelt sich eine eigene einheimische Bauindustrie. Sie wird von der Regierung mit Recht in jeder Weise gefördert. Es werden Vorauszahlungen für das erforderliche Gerät gewährt. Präferenzen werden eingeräumt und Kalkulationsfehler durch Anerkennung von Nachforderungen kompensiert. Dagegen zu konkurrieren ist für international operierende Firmen zwecklos. So müssen sich mit zunehmender Entwicklung diese internationalen Firmen auf Gross- und Grösstprojekte zurückziehen und spezialisieren, die ausserhalb der Reichweite der einheimischen Firmen liegen.

Zwischen den beiden Märkten - für die internationalen und die einheimischen Unternehmungen - entsteht dann aber zunehmend ein Kooperationsbereich, in dem organisatorische und technologische Schwierigkeiten durch Zusammenarbeit beider Unternehmenstypen bewältigt werden sollen. Zuweilen wird eine solche Kooperation sogar von der auslobenden Regierung gefördert - ja verlangt. Schon 1927 bis 1934 hat die

Siemens-Bau-Union die jungen sowjetischen Baukonzerne bei dem Bau der Moskauer Untergrundbahn, der Baustelleneinrichtung von Dnjeprostroj - dem damals grössten Bauprojekt Europas - und bei grossen Industrieanlagen baubetrieblich beraten.

Für eine solche Kooperation und für das Weiterreichen des "know-how" stehen unterschiedlich intensive Formen zur Verfügung.

Am unverbindlichsten ist die Beratung der einheimischen Firma durch die internationale Unternehmung gegen ein Beratungshonorar.

Eine zusätzliche Gewinnbeteiligung mag auf die Beratungsfirma einen erhöhten Anreiz ausüben.

Oft verlangt aber schon der Auftraggeber ein stärkeres Engagement der internationalen Firma. Sie bildet mit der einheimischen Firma z.B. ein Konsortium mit Fachlosen. Den Spannbetonüberbau einer Brücke z.B. übernimmt eine erfahrene internationale Firma. Dabei macht jeder Partner unabhängig von seinem Partner Gewinn oder Verlust.

Stärker wird dagegen "know-how" in der horizontalen Arbeitsgemeinschaft übertragen. Wie in der vorigen Lösung haften beide Partner dem Auftraggeber gesamtschuldnerisch. Sie partizipieren aber jetzt - je nach ihrem Arbeitsgemeinschaftsanteil - gemeinsam an Gewinn oder Verlust der gemeinsamen Arbeit.

Die letzte Form der Kooperation ist die Gründung einer gemeinsamen neuen Tochterfirma. Viele Entwicklungsländer bevorzugen diese intensive Kooperation, die dann auch über ein einzelnes Projekt hinausgreift. Auftragnehmer ist dann nur die gemeinsame Tochterfirma.

Solche gemeinsamen Tochterfirmen - z.B. in Form einer GmbH - können recht problematisch sein. Man erwartet von ihnen einen höheren Standard, ohne dies durch eine Preis-Präferenz oder durch einen angemessenen Schutz der ausländischen Interessen honorieren zu wollen.

Bei all diesen Kooperationsformen entscheidet aber das menschliche Vertrauen und Verstehen - sowohl in der Führungsebene beider Partner als auch auf der Ebene der Poliere und Facharbeiter - über Gelingen oder Versagen der Kooperation.

Lassen Sie mich aber zum Schluss noch kurz ein sehr ernstes Problem beim Bauen in den Entwicklungsgebieten ansprechen; es ist dies die Arbeitssicherheit.

Zwar besitzen fast alle Länder entsprechende Invalidenversicherungen - sogenannte "workmen-compensation-insurances". Sie sind aber nicht mit unseren Berufsgenossenschaften vergleichbar. Sie übernehmen nach dem Gesetz nur die versicherungstechnische Seite des Arbeitsunfalles.

Sie sind aber nicht - wie unsere Berufsgenossenschaften - gezwungen, die Arbeitssicherheit durchzusetzen durch Ausbildung, durch Unfallverhütungsvorschriften und durch ständige Ueberwachung der Baustellen.

Während die Bauprojekte für die Menschen geschaffen werden, wird der Bauprozess von und mit Menschen durchgeführt. Es sollte in den Entwicklungsgebieten viel mehr dafür getan werden, dass diese uns Ingenieuren anvertrauten und uns Ingenieuren vertrauenden Arbeitskräfte nicht zu Schaden kommen. Das deutsche Modell der Bauberufsgenossenschaften könnte dabei vorbildlich Pate stehen.

Nachsatz

Erlauben Sie mir, dass ich noch einen Gedanken hinzufüge, der nicht nur über meinem Thema, sondern überragend über dem Thema dieses ganzen Symposiums liegen sollte.

Die Gesellschaftsbildung des Menschen fand in den grossen Stromgebieten statt; zunächst im Indusgebiet, später am Euphrat, Tigris und Nil. Nur durch die Gründung grösserer Gesellschaftsorganisatorien, der Stadtbildung, waren die Menschen vor 4000 bis 6000 Jahren in der Lage, die technischen Aufgaben der Wasserwirtschaft durch Arbeitsteilung zu lösen. Erst viel später sprang das aktuelle naturwissenschaftliche und technische Wissen hinüber über Griechenland nach Rom, nach Europa.

Während 6000 Jahre Baugeschichte waren wir die Nehmenden und die heutigen Entwicklungsländer die Gebenden.

Erst in den letzten 150 Jahren, nur wenigen Prozent der Baugeschichte, vertauschten sich die Rollen. Seien wir daher bescheiden, froh und dankbar, dieses Geschenk heute zurückgeben zu dürfen an die heutigen Entwicklungsgebiete, die die Grundlage zu unserem heutigen Wissen geschaffen haben.

**Construction Management Technology**

Technologie de la gestion de la construction

Technologie des Baubetriebs

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**SUMMARY**
Buildings constitute an essential part of the development and advancement of a country. The size, complexity and time required for the realization of construction projects call for the application of modern methods of planning and management. When attempts are made to export the construction management technologies of developed countries to developing ones, the terms „training" and „adaptation" take on great significance: training of the future users of a building as a prerequisite for its optimum completion, sensible utilization and proper maintenance, and adaptation of the technologies to be used during construction and utilization of the building to the local climatic, social and economic conditions.

**RESUME**
Construire est un aspect essentiel du développement et de l'avancement d'un pays. L'importance, la complexité et le temps nécessaire à la réalisation de projets de construction demandent l'application de méthodes modernes de planification et de „management". Lorsqu'on tente d'exporter les techniques de „management" de la construction, appliquées dans des pays développés, à des pays en développement, les termes „formation" et „adaptation" prennent une grande signification: formation des futurs utilisateurs d'un bâtiment comme condition pour une construction optimale, utilisation et entretien corrects et adaptation des technologies relatives à la construction et à l'exploitation du bâtiment au climat local et aux conditions sociales et économiques.

**ZUSAMMENFASSUNG**
Bauwerke sind wesentliche Bestandteile der Entwicklung und des Fortschrittes eines Landes. Die Grösse, die Komplexität und der Zeitbedarf für die Realisierung solcher Projekte rufen nach dem Einsatz moderner Planungs- und Managementmethoden. Versucht man, die Construction-Management-Technologien der Industrieländer in Entwicklungsgebiete zu exportieren, so sind die Begriffe „Ausbildung" und „Anpassung" von zentraler Bedeutung: Ausbildung der zukünftigen Benützer als Voraussetzung für die optimale Vollendung eines Bauwerkes, dessen sinnvolle Nutzung und dessen Unterhalt, Anpassung der anzuwendenden Technologien während des Bauens und der Nutzung an die örtlichen klimatischen, sozialen und wirtschaftlichen Verhältnisse.

## 1. INTRODUCTION

As people everywhere move from rural to urban areas, the need and demand for expansion in housing, schools, medical facilities, roads, commercial buildings, transportation, etc. increases tremendously. This in turn, creates a challenge and extraordinary demand on institutions and government agencies which much provide for this influx of people, in the way of services and opportunity.

Projects are the basic means of growth and development. In developing countries, however, a large proportion of the population is unskilled or semi-skilled which compounds the problem. How can these countries build the many needed varied types of large projects, all competing with one another in terms of urgency, financial resources, management skills and labour and material to build them.

There is, of course, no single answer or panacea which will magically cure all the troubles and ills facing the newly developing countries. Furthermore, each developing country has its own unique problems. However, one thing is clear. They must use the newest technologies available, adapted to their own situation if they are to meet their challenge.

Technologies of one sort or another have been used since ancient times to create a better environment and architectural "wonders of the world" such as the pyramids and the Taj Mahal. The very sight of these "wonders" leave us in awe, wondering at the immense management and coordination problems of those times. How did they do it?

For one thing, neither the Taj Mahal nor the pyramids were considered as investments and expected to bring in returns on capital invested. So, there was no need for a quick turn-around time. Secondly, there were no constraints either on time or financing. Labour and material costs which are present in today's construction were virtually absent from the project manager's consideration when he planned and built these architectural marvels.

Too, aside from the few artisans who designed these projects, the project manager was not dealing with specialized tradesmen. Therefore, if material or supplies were delayed, slippage did not necessarily occur, because the labour pool could be moved to work on another phase of construction.

In what might be called "the good old days" by today's harried project manager, all the project manager had to do then was deliver a unique architectural monument with all the necessary resources at his command.

Today, we are not so lucky. We not only need to meet the increasing demands of an exploding population, but the entire development and building process must be shortened to reduce financing costs and bring about an early return on investment through use of the facilities.

Development is normally a slow, tedious process that takes many years or even generations to accomplish allowing for a normal periodic rise in knowledge and achievement. Today, however, developing countries do not have generations in which to allow this normal process of development. To bridge or narrow the gap between developed and developing countries, the entire process must be shortened. Basic human needs demand it and enlightened governments are trying to comply.

In this climate of urgency, one thing is clear. Modern technology must be used. However, too often in the recent past, there has been the tendency to import Western technology on a wholesale basis and then finding out too late that it did not work. It was not that there was something wrong with the technology. Technology is a tool, and it can be used correctly or incorrectly. If technology is not applied correctly, by adapting it to conditions under which it will be used, it will not do the job.

Similarly, when a large project is contemplated, the technology available must be applied to that specific project, taking into consideration the many factors which affect the project's success. This is true whether the project is located in a highly technical society or in the most primitive circumstances, because the key is not technology, but its adaptation and application to specific project environments.

In developing countries, where time is of the essence, it is vital that new concepts and technology which lead to orderly and early completion be used.

Construction management, as it is known in the U.S., is a fairly new concept in meeting the dynamics of today's construction environment.

## 2. INHERENT FLAWS OF SEQUENTIAL DESIGN AND CONSTRUCTION

Before we discuss the construction management concepts, let us look into traditional methods of construction.

Figure 1 describes the basic building process in the sequential approach. This process has two basic characteristics. First, the process is, for all practical purposes, linear, like a relay race in which the project is handed to another carrier for each new phase. Second, throughout the process, the owner has little or no direct control over the process other than paying the individual carriers. The owner, A/E, contractor and suppliers each play a narrowly defined role.

The owner, in making decisions on the selections of alternates, basically relies on his A/E's cost projection and knowledge of construction methods. The owner has no reliable basis for judging the design for its practicality regarding the construction process, or for choosing an alternate process that could produce a cost savings without a decrease in functional quality.

Because of this, alternate solutions are known only after the bids are in. If the bids are high and over the budget, lengthy negotiations on design changes must be made. At that point, changes that could easily have been made during the early stages become costly and time-consuming.

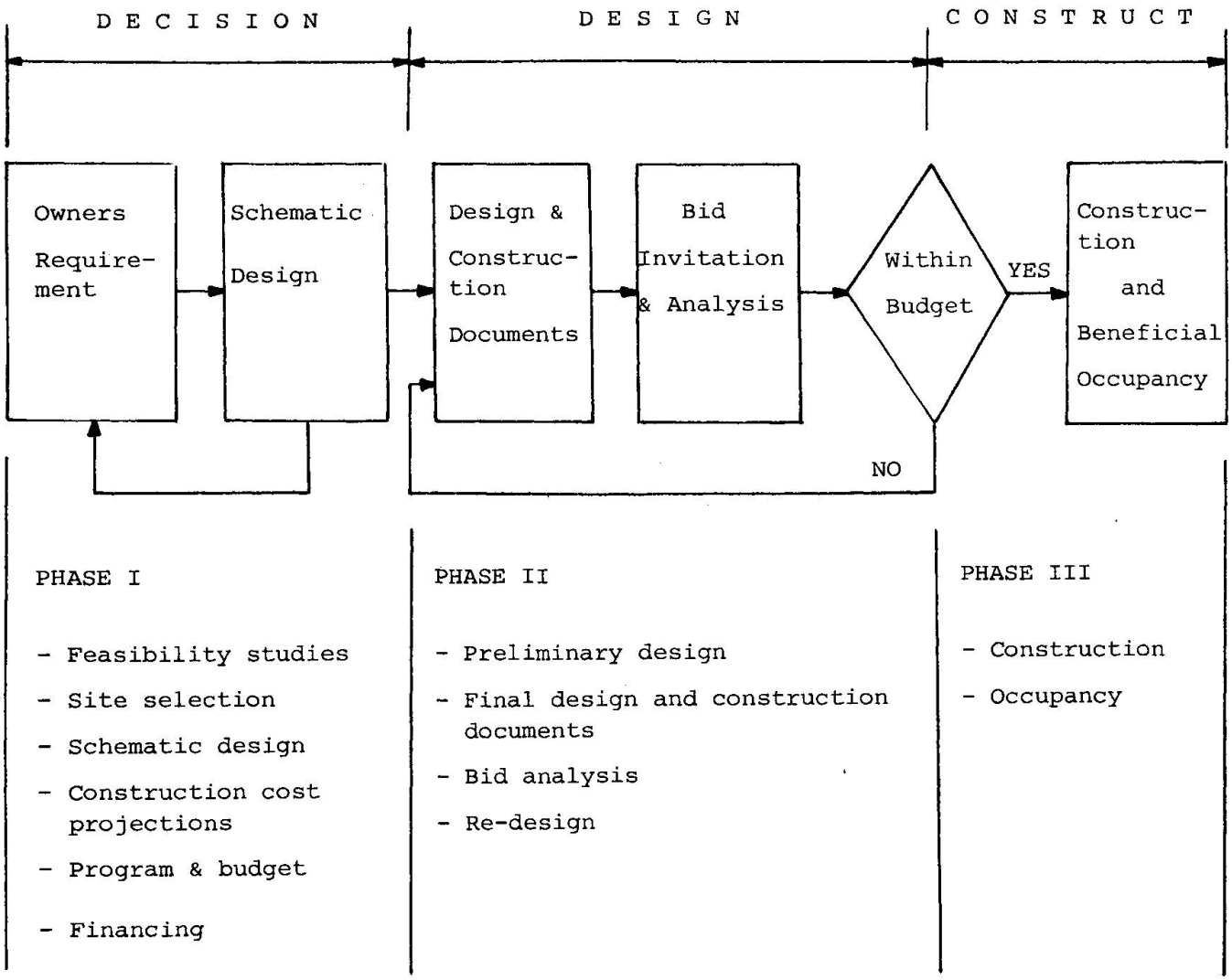
## 3. CONSTRUCTION MANAGEMENT PRINCIPLES

Time and cost of construction are the two key ingredients in determining the successful completion of a project. The final cost is not known until the project is substantially completed. The management challenge, then, is to use those principles that minimize the risk of not completing the project within time and budget. This challenge is met by applying the latest knowledge in construction techniques, methods and related cost in each of the following three phases: 1) the owner's decisions, 2) the A/E's design, and 3) the contractor's construction and delivery of

the project. See Figure 1.

Construction know-how can be applied successfully only when the development and delivery (decision, design, delivery and occupancy) of the project are regarded as a single process in which the efforts of all participants - planner, A/E, contractor, subcontractors, suppliers and so on - are effectively integrated. Therefore, construction management, or more descriptively, project management, is a set of professional management activities that must be carried out to minimize the risks of the uncertainties of time and cost, thereby enhancing the probability of a successful completion of the project.

Figure 1 : PROJECT DEVELOPMENT AND DELIVERY PROCESS
(Traditional G.C. Approach)



## 4. CONSTRUCTION MANAGEMENT FUNCTIONS

Figure 2 describes construction management functions which must be performed during the decision, design and delivery phases. Basically, the construction management functions are for the owner who must make, during the life of the project, innumerable business decisions related to interdependent design and construction problems. At every decision-making point, the owner's primary concern is whether his decision will meet his main project objectives of completing the project within time and budget and obtaining a fair return on his investment.

To meet the owner's need for making business decisions in a dynamic environment, there is no choice but to use well designed management information systems as a tool for analyzing and synthesizing information for decision-making purposes.

Although the A/E may be highly qualified in planning and designing buildings, he seldom has expertise in systems techniques for performing construction management functions. This critical gap must be bridged by some organization having the necessary knowledge of up-to-date construction methods, pricing, competitive market conditions, effective scheduling and cost control systems, as well as the ability to apply this knowledge to an actual project situation.

## 5. THE CONSTRUCTION MANAGEMENT APPROACH

Most experts agree that the construction management approach offers the best answer to the owner's need for bridging the gap of the A/E organization.

The construction management approach is basically a systems approach where overall time is saved through effective phasing between the decision, design and construction activities. In this approach, the phased design is started before the final schematic design has been completed. This allows construction to begin before the design is complete. Beneficial occupancy also is started before construction has been completed. This approach also allows the owner to delay his decisions concerning late delivery items, thereby using latest material alternates to achieve savings. Cost savings are realized through value analysis, design alternates, package bidding, which encourages competition among subcontractors, and by effective cost monitoring and cost control systems.

## 6. CONSTRUCTION MANAGEMENT TECHNOLOGY TRANSFER

A frequently raised question is whether this sophisticated construction management technology can be transferred to a less developed country without a supporting technical environment. On the surface, these doubts seem justifiable. But, once you delve deeper into the substance, you find no basis for such doubts. The apparent disadvantage of not having a long tradition of technological evolution may, in fact, turn out to be an advantage for rapid change if the tool is adapted to the environment.

Construction management technology can be basically divided into:

1. Techniques which analyze and create management information about:

   a) Construction methods and costs in relation to design, logistics, etc.

# CONSTRUCTION MANAGEMENT FUNCTIONS

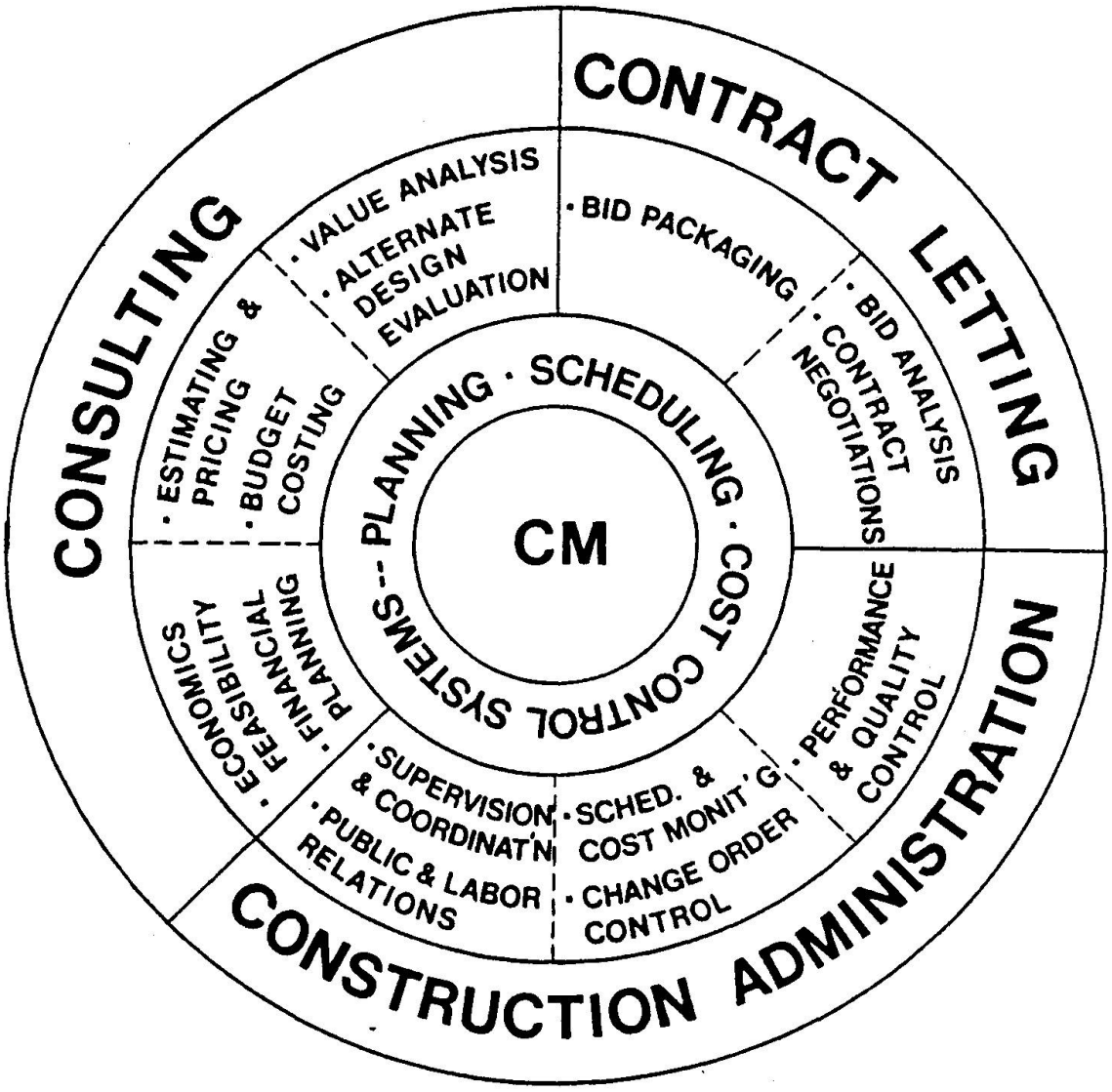



Figure 2

b) Scheduling

c) Cost control

2. Contracting methods

3. Management decisions

When considering this concept for the developing countries, one must approach it on several fronts: technological, environmental and the decision-makers. All of these are interfaced and interdependent and they must be responded to in order to succeed.

The techniques which develop and maintain management information on construction costs, schedules, conceptual estimating, etc. through the use of computer technology, can without question, be transferred. But it is essential that a planned training program be instituted where professionals from the developing countries can be trained to use this technology.

Experience, unlike knowledge, cannot be transmitted through the classroom exclusively. Therefore, for this training program to be effective, it must be well thought out and planned, and must include both a combination of formal lectures and "on-hand" training.

This "on-hand" training could be furnished through programs with construction management firms doing work in the country. Care must be taken though, to assure that the trainees work in a supervisory position on the project so that they are privy to information which formulates the background for decisions. This way, they gain first-hand knowledge in the application of technology and learn what pitfalls to avoid.

This training could be accomplished through a phased program between imported professionals and training staff for the project. This way, as the construction program and training progresses, the need for expatriates on the project, except for key individuals is reduced, and the newly trained professionals can gain valuable "on-the-job" experience in making technology work for them.

## 7. CONTRACTING METHODS

In the United States, the evolution of contracting methods has been primarily on two fronts - mechanization and specialty contractors. It is a well known fact that productivity is increased through mechanization wherever it is possible, and that the most efficient construction is done through the use of small specialty subcontractors. The general contractor, if there is one, acts as overseer and coordinator for the project.

In construction management methodology, bid packaging is used to increase competition and contract negotiation plays and important role in bringing about time and cost savings. In this method, there is no lump sum general contractor for the entire project. However, there are lump sum subcontractors on various phased portions of the work.

In most developing countries, transferrence of these exact methods would not work for two primary reasons: a) lack of specialty contractors, and b) the lack of mech-

anisation and skilled tradesmen. Also, many governments require a lump sum contract. Therefore, how can this concept be used in developing countries?

First, instead of packaging bids on specialty contract basis, one can phase design and construction for the total program into various logical phases which can bring about competition among local general contractors thereby reducing time and resulting in savings.

Second, if high mechanization must be brought in and/or the contractor is imported, then a facilities maintenance program with mechanics must be instituted, and also a training program for technicians must be provided. This should or can become a part of the contract of the contractor. Or, it can be planned and instituted separately and prior to the start of the construction.

Consequently, contracting methods will have to be adapted to the specific situations of the specific country. Even though there are many common technological and environmental problems associated with all developing countries, there are enough differences between countries to require that contracting methods be adapted to each specific situation.

## 8. MANAGEMENT DECISIONS

The decision-makers in government in most countries (there are exceptions) are not technically oriented, and yet, they need answers or options available to them for making decisions on information gained through sophisticated technology. Having relevant information is not enough. It must be presented in a format easily recognized and understood by the user. Therefore, information must be oriented toward the specific decision-makers' environment. One important way is to convert all information into graphical form for presentation.

Also, it is vital that procedures and a mechanism be planned and adopted which allows the decision-makers to react to the program and program changes.

## 9. CONCLUSION

When considering the transfer of construction management technology for use in developing countries, it comes down to two key words: training and adaptation.

Training is essential to successfully complete the project using the latest technology, and then later to administer or operate and maintain the facilities.

The second key word, adaptation, is especially important, because technology, if it is to be a useful tool to society, must be adapted to the local situation. Any suggestion for improvement that is made without being cognizant of needs, customs or basic understanding of the country is doomed to failure.

Above all, any improvement needs the wholehearted support and active participation of the decision-makers, who in the final analysis, know what can best be accomplished in their own country.

# How Developing Countries can Best use the Construction „Know-How" of Developed Countries and Apply it to Local Conditions

Engagement optimal du know-how des pays industriels dans les régions en développement

Optimaler Einsatz des Know-How der Industrieländer in Entwicklungsgebieten

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**SUMMARY**
This paper deals with the technical know-how of the developed countries in the field of planning, design and construction of buildings and how this know-how can be adapted to the technical level of the developing countries. The ability of a developing area to assimilate this know-how depends to a large extent on historical, religious, social, economic and climatic factors in that particular region.

**RESUME**
Cet article traite du know-how technique des pays développés dans le cadre de la conception, du projet, et de la construction de bâtiments et de l'adaptation de ce know-how au niveau technique des pays en développement. La capacité d'assimilation de ce „know-how" technique dans une région en développement, dépend dans une grande mesure des facteurs historiques, religieux, sociaux, économiques et du climat dans la région concernée.

**ZUSAMMENFASSUNG**
Dieser Beitrag befasst sich mit dem technischen Know-how der Industrieländer im Bereich der Vorbereitung, Projektierung und Ausführung von Bauwerken und dessen Anpassung an die technischen Möglichkeiten in Entwicklungsgebieten. Die Aufnahmefähigkeit der Entwicklungsgebiete in bezug auf den Transfer dieses Know-how der Industrieländer hängt wesentlich von den historischen, religiösen, sozialen, wirtschaftlichen und klimatischen Gegebenheiten einer bestimmten Region ab.

## 1. INTRODUCTION

Construction engineering has a long history not only as a science but also as an art in most countries of the world. There is no doubt that throughout history there have existed masterbuilders with great structural insight and enormous reserves of imagination. The first great structural engineer and builder of the stepped pyramid at Sakkara, Imhotep, was deified by the ancient Egyptians. Greek and Roman structures, the building of Moorish Spain, the Gothic cathedrals of Europe and the Islamic monuments of the Moguls and the Ottomans include works of construction that would be impossible to duplicate even today. Aesthetics, patronage and a high factor of safety appear to be the main basis of "design" and construction in all traditional structures. The application of the scientific process to design and construction took a long time even in countries that are developed in this field today. It had to emerge as the outcome of Industrial Revolution in Europe. The position of the neutral axis of a beam cross-section, as Heyman (1) has mentioned, was finally fixed only in the 19th century.

Over the last hundred years, developed countries have recognized and studied structural engineering as a science, have minimized the constraints of tradition and have begun to follow codified, rational procedures of design and construction. In developing countries, on the other hand, an overwhelming percentage of design and construction is still carried out empirically.

This paper describes the present-day techniques of design and construction of developed countries and discusses the uses and applications of these techniques and know-how in developing countries. The application of such know-how in a particular developing country will depend on the social, economic, religious and climatic conditions of that country. Attitudes in developing countries may be changed by the acquisition of wealth, by national aspirations, by suitability of geographical position or by cooperation with other countries. It is the contention of this paper that in the application of know-how, imitation of techniques can only be a first step; the logical approach is assimilation.

## 2. DESIGN AND CONSTRUCTION IN DEVELOPED COUNTRIES

The modern philosophy of design and construction is based on the three principal factors of economy, safety and aesthetics. The economic factor assumes the most importance in decision making, choice of structural system and selection of materials. Advancements in the fields of materials science, structural engineering and construction technology have led to a reduction in safety factors, while ensuring that the risk of structural failure is sufficiently small. Design and construction in developed countries are the result of a continuous process of research and development. Research is directed towards improvements in materials, analysis and design techniques, construction methods, education of engineers, codes and specifications.

Concrete and steel are the two main materials of construction in developed countries. It is now possible to obtain concrete with a compressive strength in the vicinity of 80 kN/mm$^2$ and steel with a yield stress of 520 kN/mm$^2$. By the year 2000, concretes with compressive strengths of over 400 kN/mm$^2$ might be obtainable (2) for special

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(1) Heyman, J., Coulomb's Memoir on Statics - An essay in the history of civil engineering, Cambridge University Press, Cambridge, 1972.

(2) ACI Ad Hoc Board Committee, "Concrete - Year 2000", Journal of the American Concrete Institute, No. 8, Proceedings V.68, August 1971, p. 581.

purposes. It will therefore be apparently feasible, using concrete as a construction material, to construct buildings having heights of 600 m to 900 m, bridges having spans of 500 m to 600 m, floating cities, underground or submarine cities.

Besides steel and concrete, research is also in progress on timber, aluminium, bituminous materials, plastics, articifial lightweight aggregates and waste products as sources of construction materials.

Rapid industrialization in the early 20th century and the demands for housing and work space in the cities have given a big impetus towards high-rise construction in developed countries. Tall buildings for offices, commercial and residential purposes have also created many problems of structural and construction engineering, transportation, city planning and the environment, and attempts have been made to solve these problems over the years. New structural systems and design concepts have been developed for tall buildings. Improved construction methods in the form of lift slab construction, slip forming, prefabrication and industrialized construction have been utilized. Transportation and parking facilities within and outside tall buildings have been designed. Effective water supply, waste water disposal and fire protection measures have been devised. A new concept of "city within the city" has also been started in the planning of tall buildings. In fact, tall buildings are regarded as symbols of national development in most countries.

Besides improvements in living and work spaces, the means of transportation have also been modernized in developed countries. Motorways, freeways, autoroutes and autobahns are frequently referred to as indicators of progress and development.

## 3. APPLICATION OF KNOW-HOW TO DEVELOPING COUNTRIES

Just as civil engineering in the world of today has ceased to be a national field of study and has acquired a universal character, the inevitable result of the application of engineering and technology to human problems, termed Development, has also become an international issue that calls for a healthy dialogue, a workable partnership and, above all, an absence of polemics.

In developing countries, the exploitation of national resources, economic growth and increases in agricultural output have intensified demands for improvements of housing, work space and recreational facilities in urban and rural areas.

Developing countries can use the know-how of developed countries in the preparation of codes, standards and specifications for design and construction. However, these codes should be prepared taking into account the socio-economic and climatic conditions of each country, local construction materials and methods.

Urban construction in developping countries is primarily carried out by using cast in-situ concrete. The present-day techniques of developed countries should be adopted to improve the manufacture and properties of concrete. Use of ready-mixed concrete should be encouraged. The facilities for testing of concrete and other materials are usually not available near the construction sites. In such cases, the use of non-destructive methods for proper quality control as specified in developed countries should be introduced. Recommended procedures and specifications for hot-weather and cold-weather concreting should be enforced.

As the pace of construction increases in developing countries, the demand for materials of construction will also increase. Investigations should be carried out on

local materials and wastes for utilization as constructional materials. A start has already been made in this direction. Research is in progress on the use of rice-husk ash as a cementing material. Bamboo has been used as reinforcement to form "bamboo reinforced concrete" in several countries. Stone dust from quarries is being tested as a fine aggregate in making concrete. Similar studies should be carried out on other waste materials.

Know-how in developing countries may also be inculcated by encouraging the use of small computers operating with the Basic and Fortran languages for the solution of design and construction problems. Large computers should be employed only if efficient use of remote terminals and time-sharing facilities is feasible.

The application of construction know-how of developed countries is urgently needed in the specific areas of low cost housing, large public works and continuing education, which are separately discussed below.

### 3.1 Low Cost Housing

The basic techniques of industrialized construction must be adopted by developing countries, in all of which the problem of shelter is acute. Of the three basic approaches, the post and beam system, the panel system and the box system, the first is specially applicable to countries where only simple machinery for manufacture and erection is available. Light and heavy panel systems may be envisaged in urban areas of developing countries. Box systems need special trailers for the carrying of units and excellent roads, and their application in developing countries is likely to be limited. Large cranes are also required in the erection of structures with box modules.

Developing countries should concentrate on evolving prefabrication systems using reinforced concrete or prestressed concrete, possibly in conjunction with local available materials. As steel is imported by most developing countries, steel structures cannot be used extensively. Wood is also scarce in many such countries. However, masonry is an important building material for houses of up to 4 storeys. Research on masonry is not at a very advanced stage even in developed countries, where masonry is either employed for small residential buildings or as an infill. Research institutions in developing countries have an opportunity to apply scientific methods to the study of load bearing masonry and to assess the role of masonry construction in the field of labour-intensive construction which is an economic necessity in poor countries with large unemployed populations. Similar considerations apply to adobe construction, which in some form accounts for over half of all rural dwellings in developing countries. While research information on adobe construction from developed countries may be limited, the application of the technical know-how of developed countries with its emphasis on analysis, experimentation, systems approach and innovation can result in the creation of a local know-how in the area of adobe construction.

### 3.2 Large Public Works

It is not anticipated that over the next two decades more than a few developing countries will be able to apply the construction technology of developed countries in the field of large public works like dams, bridges, airports and harbours without the active cooperation of developed countries. Apart from know-how aspects, this situation is also brought about by the inability of many developing countries to finance large projects from their own resources. A start has to be made in the rational design of small dams and small bridges.

Care has also to be taken to ensure that in construction work a proper sequence of activities is planned and executed. For example, in road construction, underground pipes and ducts for utilities should be laid before the actual construction is undertaken.

In many cases, it may not be feasible to construct concrete roads in developing countries due to scarcity of cement, poor techniques of construction and lack of adequate maintenance.

### 3.3 Continuing Education

Continuing education is an extremely important aspect in the process of the application of construction know-how to developing countries. This is not to suggest that know-how can formally be taught, but rather that continuing education can help in bringing about the right environment for the application of know-how. Courses in computer applications, systems analysis, construction management, mass transit systems and new materials will stimulate interest in students as well as practising engineers. An engineering hour on television should be instituted in developing countries to discuss topical items and new developments in engineering. Stress should be laid on fields where available know-how could be applied immediately. Thus, rationalization of the design and construction of rural structures to resist earthquakes and other natural disasters, the building of a large number of temporary shelters for displaced persons, rapid construction and assembly of utilitarian structures like sheds, silos and storage tanks, modular design of structures and practical techniques of prestressing would evoke a positive response from all people in the construction industry.

## 4. LOCAL COORDINATION

While stressing the cooperative aspects of the flow of know-how from developed to developing countries, attention must also be paid to individuals and organizations on the spot whose job it is to effect this transfer. In this respect, the report by Wolak (3) on the role of a developer sensitively analyses the subtle interaction between a developer and his environment. Wolak has grouped some representatives of developed countries into "paternal pied-noirs", "desperate do-gooders" and "mercenaries", and has also mentioned the technical, administrative and political difficulties faced by developers in the countries which they seek to develop.

In developing countries, experts who possess and can apply technical know-how are rarely given representation in high-level decision making, which is treated as the exclusive domain of a few privileged civil servants. Fledgling industries, which might provide an alternative medium for the application of technical know-how are all too often geared only to earning quick profits. Industries could support and sponsor research in technical universities that whould not only help the solution of such problems but also raise the level of know-how in the country. Universities in developing countries are sometimes the last ivory towers. They do not often rise to the task of applying the know-how they possess to local conditions.

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(3) Wolak, Z.M., "The role of a developer in the low-cost housing programmes for developing countries", UNIDO Joint Consultation on Prefabrication for Industrial Construction, Warsaw, 1975.

An organic relationship between the government, industry and technical universities is an absolute necessity for the transmutation of theoretical know-how into tangible applied know-how. It is only after such a relationship is genuinely underway that the efforts of countries abroad can be channelled into the country in a productive fashion.

As an example, the provision of large scale low cost housing in developing countries may be considered. Attempts by various governments to deal with this problem within the official framework have not succeeded in developing countries, because it has not been realized that the problem is essentially an industrial problem and needs to be tackled in exactly the same manner as a large dam or steel mill project is handled. Furthermore, it is the job of technical universities to inform the government, industry and the public that the problem of mass shelter has fundamental research aspects and that industrial production may be preferable to rationalization of traditional construction methods alone.

The speedy development of the developing countries of the world is both a necessity and a challenge because in the ultimate analysis the development of the world is the sum total of the development of all the countries in it. Developed countries must share in this urgent task by providing technical expertise not merely to exploit developing countries as potential markets. Development should cease to be a basis of relative economic comparison between countries and should instead provide common minimum absolute standards throughout the world.

# Un cas de transfert de technologie

Beispiel eines Technologietransfers

A Case of Technology Transfer

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**RESUME**
L'auteur démontre dans cet article quels sont les façons et les méthodes utilisées aujourd'hui par Eurequip afin d'introduire la technologie des pays industrialisés dans les pays en voie de développement. C'est surtout dans la soi-disante méthode T que les interdépendances entre l'homme, l'organisation et la formation/éducation sont pris en considération. Ainsi cela permet de rendre possible une adaptation presque sans restriction aux conditions et coutumes locales.

**ZUSAMMENFASSUNG**
Der Verfasser zeigt in diesem Beitrag, welche Wege und Methoden von der EUREQUIP heute angewendet werden, um die modernen Technologien der Industrieländer in Entwicklungsgebieten einzuführen und anzuwenden. Im besonderen die sogenannte „T"-Methode berücksichtigt die vielfältigen Interdependenzen zwischen Mensch, Organisation und Ausbildung und ermöglicht dadurch eine beinahe unbeschränkte Anpassung an spezifische, lokale Bedingungen und Gewohnheiten.

**SUMMARY**
The author shows, in this article which ways and methods EUREQUIP uses today in order to introduce the modern technology of industrial countries to developing countries. Particularly in the so called T-method the many-fold interdependences between man, organisation and training/education are considered. Thereby it makes an almost unrestricted adaption to specific local conditions and customs possible.

## 1. LA SITUATION

### 1.1 Les conditions géographiques

L'exemple de transfert de technologie décrit ici s'est déroulé dans la Répulique du Niger. La capitale de ce pays est Niamey située sur le fleuve Niger.

La Société des Mines de l'Air (SOMAIR) se compose d'une mine et d'une usine de traitement d'uranium situées à Arlit sur la frontière sud du Sahara, dans la région nord-ouest du Niger. La zone minière d'Arlit se trouve à 250 km (150 miles) d'Agadès, et à 2000 km (1200 miles) de la mer, dans une région pratiquement inhabitée.

Le gisement d'uranium a été découvert en 1966, par le Commissariat à l'Energie Atomique français à la suite d'une importante action de prospection dans tout le vaste bassin sédimentaire qui s'étend à l'Ouest des massifs montagneux de l'Air. Cette région du désert saharien est l'une des plus chaudes d'Afrique.

### 1.2 Quelques faits concernant la Compagnie

Elle a été fondée le ler Février 1968. Aujourd'hui les actionnaires sont les suivants:

L'Organisation Nigérienne ONAREM (33 %), la Compangie Française des Minerais d'Uranium (11,8 %), COGEMA (27 %), Mokta (7,6 %), Minatome, (7,6 %), l'"Urangesellschaft" (6,5 %), et Agip Nucleare (6,5 %). Le capital s'élève à 17,2 millions de dollars.

L'exploitation comprend l'extraction du minerai à ciel ouvert et son traitement dans une usine chimique. La carrière à une profondeur de 60 m environ, la couche minéralisée étant recouverte d'environ 40 m de morts terrains.

En 1976, les tonnages bruts extraits atteignaient approximativement 12 millions de tonnes dont 3 millions de tonnes de minerai.

Le traitement comporte une attaque par l'acide sulfurique du minerai broyé. Les liqueurs recueillies par lavage sont ensuite filtrées et purifiées. L'uranium est enfin précipité sous forme d'uranate de soude titrant 70 % environ.

L'usine dont la production a commencé en Janvier 1971, pouvait traiter 350'000 tonnes de minerai par an et produire 750 tonnes d'uranium dans les concentrés, en 1972. La capacité de production atteignait 1'500 tonnes en 1975.

La conception et la construction de ce complexe requéraient une infrastructure industrielle. Il nécessitait également la construction d'une cité minière, incluant les logements du personnel, les centres de loisirs et de terrains de jeux, une école et un hôpital, correspondant à des investissements atteignant la somme de 72 millions de dollars.

### 1.3 Les conditions sociologiques et économiques

La République du Niger est encore un pays ayant un faible niveau d'industrialisation, les usines étant essentiellement implantées le long du fleuve Niger dans la partie sud du pays.

Les ressources en personnel qualifié du Niger sont très limitées. En 1970, il y avait une seule école technique de haut niveau à Maradi, avec moins de 200 personnes étudiant les techniques commerciales et industrielles. Jusqu'à présent à peine 10 % de la population a reçu un minimum d'instruction. La population totale est estimée à 4,5 millions de personnes, 50 % ayant moins de 20 ans.

La part d'uranium concentré dans le commerce extérieur du Niger est très importante; en 1976, les exportations d'uranium devraient couvrir en valeur les importations.

## 2. APPROCHE GLOBALE

### 2.1 Les acteurs principaux du transfert de technologie

Il y a transfert de technologie lorsqu'un groupe d'hommes devient capable d'assumer, une ou plusieurs fonctions attachées à une technique particulière de manière satisfaisante.

Par "transfert" on entend "transmission de quelque chose d'une personne à une autre". Il existe un émetteur qui détient une technologie et un receveur qui désire l'utiliser. En fait, il serait plus correct d'utiliser le terme de transfert de "compétence technique" ou encore "compétence industrielle". Suivant la complexité de l'opération de transfert de technologie (d'émetteur à receveur) un certain nombre d'acteurs peut intervenir, deux à trois ou plus.

Dès le moment, où l'émetteur et le receveur vont plus loin qu'un transfert par simple copie, un troisième acteur devient nécessaire. Ce troisième acteur est le spécialiste du transfert de technologie.

Dans le cas SOMAIR, le Commissariat à l'Energie Atomique français est l'émetteur des techniques minières; la Compagnie Ugine Kuhlmann responsable de la conception de l'usine, est l'émetteur de la technologie de fabrication. Le deuxième acteur, le receveur, est SOMAIR. Plus spécifiquement, il s'agit en fait des individus et des groupes au sein de cette organisation.

Le troisième acteur est Euréquip, en tant que spécialiste du transfert de technologie. Ce troisième acteur est rarement un individu seul, car il y a plusieurs techniques spécialisées à transférer qui nécessitent l'effort d'une équipe structurée. Il s'agit là d'ailleurs du mode d'intervention habituel d'Euréquip.

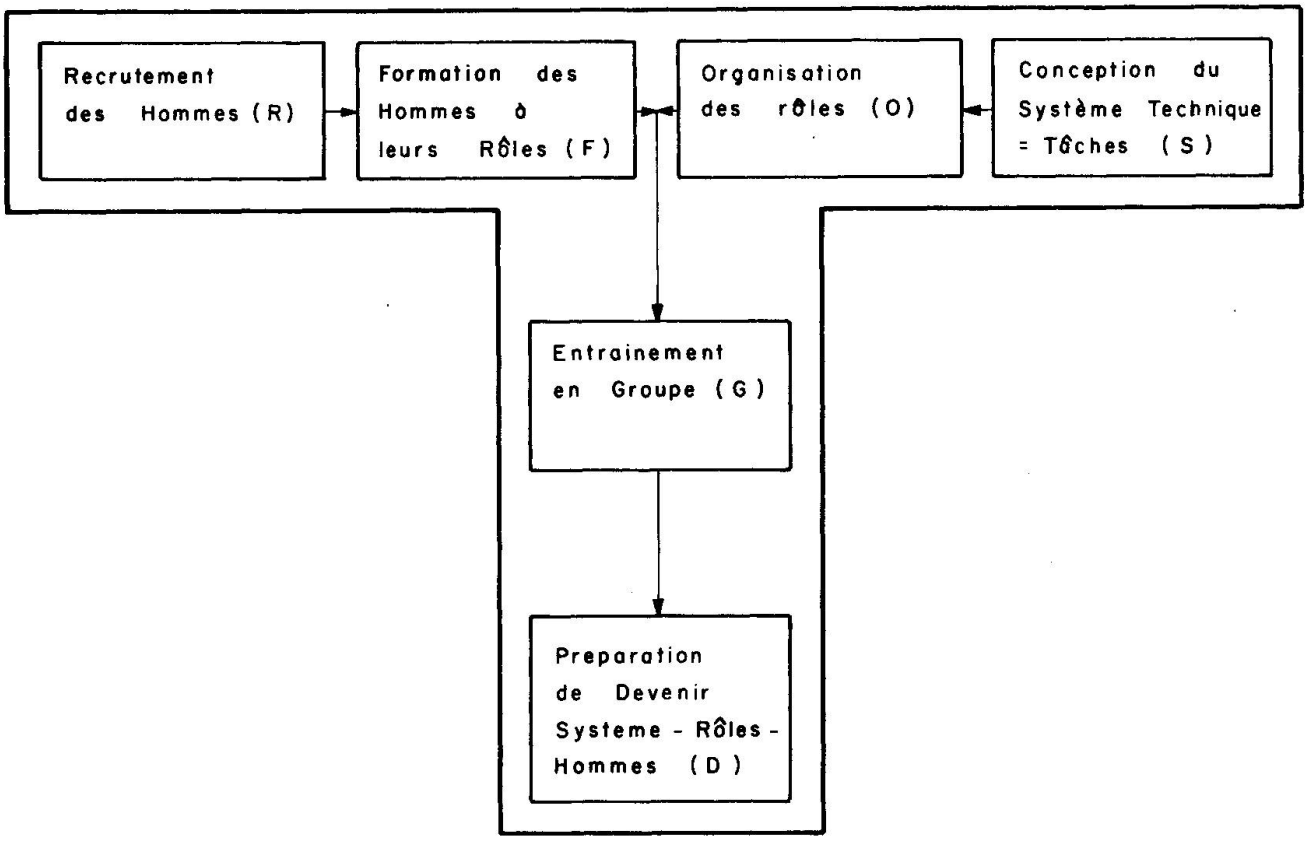
### 2.2 La méthode "T" proposée par Euréquip

Le transfert de technologie peut être divisé en six opérations-clés:

1. Elaboration du système (S), qui indique ce qui doit être fait
2. Organisation des tâches individuelles (O) à l'intérieur de la structure générale et des structures spécifiques
3. Recrutement (R) à l'extérieur ou à l'intérieur de l'entreprise de personnel qualifié
4. Formation (F) de chaque personne à son rôle
5. Entraînement en groupe (G) en structure réelle
6. Préparation des systèmes et évolution des rôles (E) en relation avec la plan de personnel.

Le transfert doit s'étendre à ces six opérations, soit en les reconduisant depuis l'émetteur par copie conforme, soit en les concevant au carrefour de l'impératif industriel et de la réalité socio-culturelle du récepteur.

La figure ci-dessous montre, par sa forme, pourquoi Euréquip a baptisé cette méthode "T".




***Opérations - clefs d'accès à la maitrise technique, donc de transfert de technologie.***

Le spécialiste de transfert de technologie doit être capable d'apprécier:

- l'environnement socio-culturel de l'émetteur et du receveur
- la structure d'ensemble de l'entreprise y compris les systèmes de gestion qui l'innervent et les hommes qui l'animent
- le degré de pénétration de la technologie intéressée

de manière à évaluer le chemin à parcourir et à en déduire les actions détaillées des opérations-clés permettant de réussir le transfert de technologie.

## 3. LA MISE EN PLACE DE LA METHODE "T" DANS LE CAS SOMAIR

Bien que cette méthode ait été formalisée après le démarrage de l'expérience SOMAIR, nous verrons que la plupart de ses différents aspects ont été pris en compte pour SOMAIR.

### 3.1 Etudes préliminaires et rôle de l'équipe projet

Dans un premier temps une équipe projet a été créée, composée d'ingénieurs appartenant à des entreprises minières tant françaises que nigériennes. La présence de cette équipe fut une aide considérable pour adapter le modèle occidental retenu pour l'opération.

Une deuxième étape préliminaire consista en une étude du "receveur" qui fournit des informations complètes sur le marché du travail local, les caractéristiques de la population locale (niveau d'instruction, intelligence, stabilité, coutumes, etc...) et les possibilités de formation existantes.

### 3.2 Définition du système

Un compromis fut atteint entre la tendance à opter pour un équipement hautement automatisé et le désir d'employer la main d'oeuvre locale.

De plus, une grande attention a été apportée aux conséquences d'une production en continu (en termes de quantité et qualité). Ces conséquences impliquent la mise en place de règles d'entretien (en particulier, d'entretien préventif) ainsi que des modifications de comportements du personnel.

### 3.3 Organisation

- Pour l'exploitation, les postes de travail habituels sont apparus difficiles à remplir, car le personnel n'avait pratiquement aucune culture industrielle. Aussi, la responsabilité de la chaîne de traitement du minerai a été répartie entre plusieurs sections.

  Par exemple: la section chimique a été divisée en deux secteurs: Solution et Concentré. Dans chaque secteur le nombre de postes a été augmenté de trois (en France) à cinq.

- Dans la section Entretien mécanique, qui n'est pas subdivisée en France, trois sous-secteurs ont été créés à partir des types d'équipement: Entretien des véhicules légers, Entretien des dumpers, Entretien des bulldozers.

### 3.4 Recrutement

Celui-ci a été grandement facilité par l'étude mentionnée ci-dessus (Etude du Receveur).

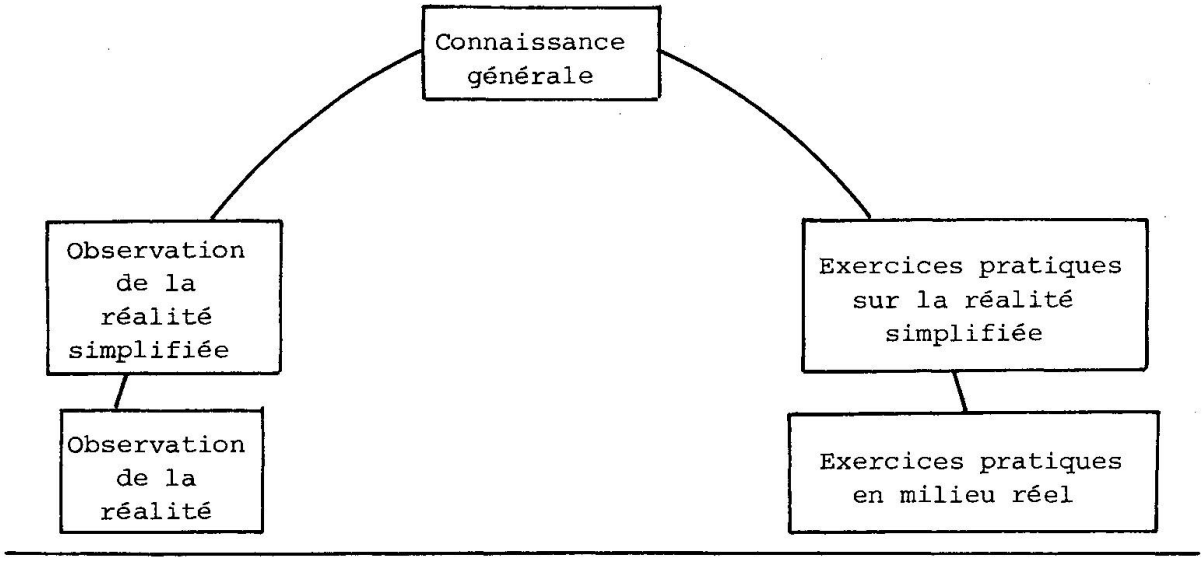
Un agent a été formé à l'utilisation des tests psychotechniques afin d'être capable d'appliquer au recrutement une approche scientifique.

Du point de vue quantitatif, il fut décidé de limiter le nombre de manoeuvres dans l'usine. Aussi le volume de recrutement était-il lié à la capacité de production du centre de formation.

### 3.5 Formation

L'idée de base a été la formation "en cascade", les agents de maîtrise et non les instructeurs professionnels, forment les ouvriers. Ces agents de maîtrise reçoivent bien sûr une formation pédagogique adaptée, avant de former eux-mêmes les conducteurs de camions, de bulldozers....

La deuxième idée fondamentale a été de maintenir une liaison étroite entre la formation et les tâches du poste de travail. C'est la méthode de l'arche:




Pour les opérateurs, on a fait appel à l'utilisation intensive de simulateurs.

Il est à noter que cette formation n'a pas été faite dans la seule optique de répondre aux besoins immédiats de la nigériennisation, mais aussi pour faire face au "turnover" et aux besoins indirects de la nigériennisation (remplacement des personnes qui ont été promues, par exemple).

### 3.6 Formation en groupe

Ce type de formation n'a pas été utilisé de manière systématique. Cependant, il faut noter que le fait que ce
été les formateurs a grandement facilité leurs relations avec leurs subordonnés, et les a aidé à créer un esprit d'équipe.

### 3.7 Evolution

Il est intéressant de noter l'évolution qui s'est produite dans le secteur Entretien:

- Au départ, l'entretien, tant pour la mine que pour l'usine, était centralisé;
- La première étape d'une évolution a été de créer une section Entretien par secteur: (mine, usine, centrale, etc...);
- Une section Méthode a été créée dans chaque section Entretien;

- Le résultat de cette évolution a été le suivant:

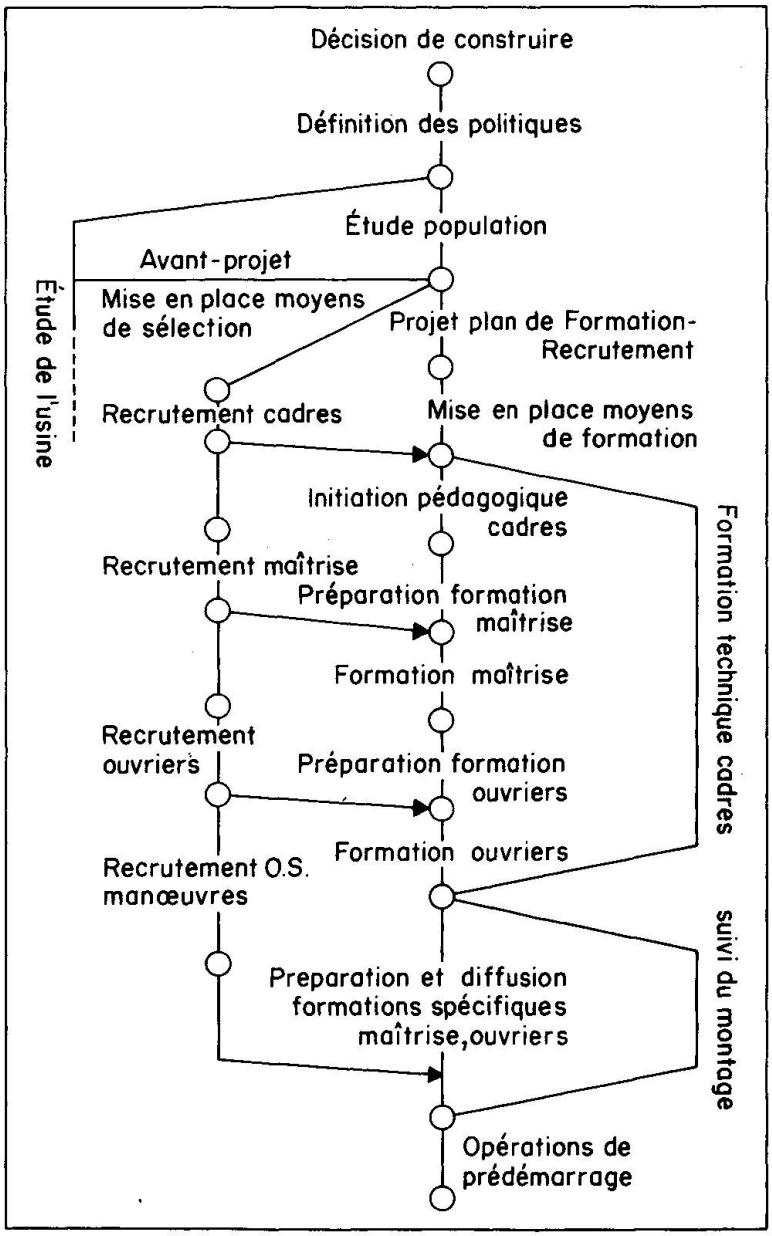
  1. Toutes les opérations Entretien ont été décentralisées,

  2. Les plannings de fabrication pour des travaux spéciaux, et la fabrication des pièces de rechange, dans un atelier central équipé en machines-outils, ont été centralisés.

3.8 Programme de formation global

Le diagramme suivant présente le processus global qui a été suivi pour la formation. Pour faciliter la compréhension de ce diagramme, nous avons omis, à dessein, les nombreux liens qui existent entre la formation, la construction et la définition des procédures de travail. La longueur des traits n'est pas proportionnelle au temps nécessaire aux opérations.

Le processus suivi est basé sur l'idée qu'une usine est un système global où le hardware, le manpower et le software sont étroitement liés.



## 4. CONCLUSION

Le cas SOMAIR, ainsi que d'autres expériences qu'EUREQUIP a mené dans divers pays en voie de développement et divers types d'industries, montre que la méthode "T" offre un très bon cadre de travail pour l'implantation d'un transfert de technologie.

Cette méthode souligne une manière pratique de prendre en compte les liens constants qui existent entre les hommes, l'organisation et la formation. Elle propose une approche qui permet de trouver la solution la mieux adaptée à chaque cas.
En effet, la copie conforme ne peut être une réelle solution, les modèles traditionnels non plus. Aussi, le succès du transfert de technologie dépendra toujours très largement de la créativité des équipes de lancement.

# The Role of the Social Scientist

Le rôle de l'expert en socio-économie

Die Rolle des Sozialwissenschaftlers

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**SUMMARY**
The role of the social scientist is to evaluate those aspects of the social, economic and cultural organization of the local environment for which a particular construction project is to be designed. This is to ensure that the project is appropriate not only for the physical, technological and ecological conditions, but also for the 'host' populations involvement and the defined social objectives. This function is most urgent when consultants and contractors are working in countries whose social organization, economic and political systems and cultures differ greatly from their own.

**RESUME**
Le rôle de l'expert en socio-économie est d'analyser l'ensemble des structures sociales, économiques et culturelles constituant l'environnement d'un projet de construction. Une série d'enquêtes est faite afin d'assurer que la conception du projet réponde aux conditions physiques, technologiques et écologiques et soit en harmonie avec les infrastructures existantes. Ces enquêtes préliminaires deviennent particulièrement cruciales lorsqu'il s'agit d'un projet devant être implanté dans un pays dont la culture, ainsi que les infrastructures sont extrêmement différentes de celles du pays du consultant ou de l'entreprise de construction.

**ZUSAMMENFASSUNG**
Die Rolle des Sozialwissenschaftlers besteht darin, jene Aspekte der sozialen, wirtschaftlichen und kulturellen Organisationen der örtlichen Umgebung zu bewerten, für welche ein bestimmtes Bauprojekt entworfen werden soll. Das heisst, er muss versichern, dass das Projekt nicht nur für die physikalischen, technologischen und ökologischen Bedingungen geeignet ist, sondern auch in Bezug auf die einheimische Bevölkerung und die definierten gesellschaftlichen Endziele. Diese Aufgabe ist sehr wichtig, wenn Berater und Unternehmer in Ländern arbeiten, deren gesellschaftliche Ordnung und wirtschaftlichen und politischen Systeme sich von den eigenen wesentlich unterscheiden.

## 1. INTRODUCTION

I wish to start with the assumption that we are all agreed on the need to design construction projects to be appropriate for a specific location and to fulfil a specific function, whether we choose to judge the project on the basis of economic rates of return, technical efficiency or political and social benefits. Within this context, I will focus on the socio-economic and cultural factors that are relevant to a design strategy in developing countries. Plainly it is always necessary to evaluate the physical, ecological and technical aspects of a project, but this is especially critical when assessing the feasibility, appropriate design specifications and potential effects of construction projects in developing countries where foreign expertise is introduced into an unfamiliar non-western environment. Furthermore, a special category of socio-economic and cultural variables requires scrutiny in evaluating the inherent problems of this transfer of expertise or technology to a host environment that is of a different social, economic and cultural character, and in examining the pontential social impact of such a project. It is this area that is of concern to the social scientist within a wider evaluation of the host environment - namely the human, economic and political implications of development construction projects, whether bridges, agricultural projects or industrial plants.

## 2. THE SCOPE OF THE SOCIAL SCIENTIST'S CONTRIBUTION

### 2.1 The Aims of Social Analysis of Construction Projects

There are two main reasons for the involvement of the anthropologist or sociologist in project feasibility evaluation or design. Firstly, it is important to identify constraints of a socio-economic or cultural nature that may impede the implementation of a project or jeopardise its success (however defined); secondly the responsibilities of consultants working in developing countries are rapidly widening to include an evaluation of the effects or impact of the projects they undertake, both to minimise undesirable social or cultural disruption and to ensure that the well-defined objectives of social and economic development are realised. Unfortunately, the consequences of not following such an approach include both wasted money and social dis-benefits for the developing countries, and a damaged reputation for the consultants themselves. However, these issues are highly complex, since the interests or objectives of governments, commercial or economic institutions and the often unwitting recipients of these projects can diverge greatly. It is quite clear though, that there is no justification for complacency of this issue.

### 2.2 General Strategy for Social Impact Studies

A general strategy for conducting studies of this nature in the many different situations that might require them entails:

- setting up effective communication with local counterparts or associates who have access to local data sources or key informants.

- following a systematic methodology of data gathering and analysis on social factors that would not be often undertaken in developed countries where the social organisation and culture is broadly similar to those of the consultants. This may not necessarily require a complete field study, but should be tightly focused on the extent to which the proposed project will directly or

indirectly affect the local population, and what involvement would be expected of them in terms of construction, operation, maintenance, administration or training requirements.

- lastly, adopting a more patient and accomodating attitude towards infrastructural, organisational or bureaucratic standards than would be tolerated in his home environment. It is unrealistic to expect standards and style of organisation and professionalism in developing countries of the same type as those in the industrialised world.

## 2.3 Data Collection

Typically, the baseline data necessary for the most demanding of projects would include:

- demographic data: size, structure and characteristics of the local population

- socio-economic practices and organisation; economic activity, employment, use of land, distribution of income, experience of western economic practices

- social organisation: kinship structure, family size and organisation, settlement patterns

- cultural characteristics: customs, religion, political organisation

Further data specific to a particular project may include such factors as agricultural practices, management of natural resources, amenability to and familiarity with the work practices and administrative structure imported by the consulting engineers or their contractors. Also it is often necessary to evaluate the different interests or aspirations of socio-economic or ethnic groups likely to be involved in different ways with the project.

## 2.4 Data Analysis

In order to predict or make an assessment of the social impact of the project, which logically follows the use of the base-line data in the initial feasibility work and project design, more tightly focused, and often more qualitative information is required. This is an indeterminate area, somewhat vulnerable to the cynical critic, since prediction of human response or reaction to intrusion is not a precise science. Here the critical variables are the perceptions and attitudes of the local population relating to their participation in the project or their rational evaluation of the benefits to be expected. It often surprises western consultants that local populations resist intervention, do not always see projects as beneficial, and are not prepared to change their way of life to suit the requirements of a plan they either have not been given the opportunity to understand or which they perceive from within their own value systems or experience as being without benefit. Further to this is the attempt to forecast any undesirable secondary effects of a project that take effect after the project is completed and the experts or consultants have departed. It is crucial that the responsibilities for ensuring administrative or social continuity and harmony are not ignored, especially at the design and construction phase.

## 3. CONCLUSION

I would like to make two final points. Firstly, the practice of subdividing or packaging parts of a construction project, while no doubt necessary, increases the problem of ensuring a constant or consistent approach to the social and cultural impact of projects through from the consultant down to the sub-contractor on the site, especially where significant involvement with the local community is required, or where the project has important social and political objectives. Secondly, it must be emphasised that, although they are often taken for granted, the socio-economic factors must be systematically and thoroughly analysed, and cannot realistically be isolated from the technical or ecological factors. An understanding of the interrelationships of these factors is crucial to the effective, economically viable and socially beneficial design of construction projects and their subsequent implementation by foreign consultants or contractors working in developing countries. Although time does not permit the discussion of case histories, my own experience of the socio-economic effects of design and construction projects ranges from fast suspension bridges in Fiji to the importation of lare work forces in Saudi Arabia, or the development of a vast copper mine in Bougainville, Papua New Guinea.

# An Investigation of the Design and Construction Problems in Nigeria

Problèmes de projet et de construction au Nigéria

Entwurfs- und Ausführungsprobleme in Nigeria

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**SUMMARY**
As with Nigeria, the author presents the particular problems of an oil exporting developing country, in the face of a gigantic construction programme. The problems of delay in construction following an insufficient infrastructure and the explosion of construction costs caused by inflation are also considered.

**RESUME**
A l'exemple du Nigéria, l'auteur cherche à présenter les problèmes particuliers d'un pays en voie de développement, exportateur de pétrole, face à un gigantesque programme de construction. Les problèmes de retard dans les délais d'exécution, à la suite d'une infrastructure insuffisante sont évoqués, de même que l'explosion des coûts de construction occasionnée par l'inflation.

**ZUSAMMENFASSUNG**
Am Beispiel von Nigeria versucht der Verfasser, die besonderen Probleme eines ölexportierenden Entwicklungslandes bei der Bewältigung der zahlreichen, grossen Bauaufgaben darzustellen. Besondere Beachtung werden dabei den Problemen der zeitlichen Verzögerung der Bauzeit infolge ungenügender Infrastruktur und der Explosion der Baukosten infolge Inflation geschenkt.

## 1. INTRODUCTION

Before discussing the problems of the building industry in Nigeria, it is necessary to mention some of the fundamental geographical features which may have a direct or indirect influence on this subject matter.

With an area of around 92 million ha., the Federal Republic of Nigeria, Fig. 1, is the largest country on the west coast of Africa. Based on the 1963 census figure, the projected population of about 80 million in 1976 makes it the most populated country in Africa. There are three areas of high population density.

It lies between longitudes $2^{\circ}$ and $15^{\circ}$ east of the meridian and latitudes $4^{\circ}$ and $14^{\circ}$ north of the equator. Owing to its latitudinal extent, Nigeria has varied physical conditions, human types and economy. In general, rainfall diminishes from the south-east and south, towards the north and north-east. In the south-east there is an excess of rainfall all the year; in the north there is adequate rain only in two or three months of the year. There is also a corresponding vegetational range.

There is a great variety in human outlook and organisation. This is evident between the four main groups - Hausa and Fulani in the north, Yoruba in the south-west and Ibo in the south-east. The size and variety of the Federation is likewise reflected in its varied economic resources. She is one of the few large timber exporting countries of West Africa, and is rich in mineral resources.

## 2. BOOM IN THE CONSTRUCTION INDUSTRY AND PRESENT PROBLEMS

As the world's eighth largest exporter of crude petroleum, Nigeria as well as other members of OPEC benefited from the recent increases in world oil prices. The so-called "oil-money" has reflected in the economic strength of this fast developing country. With the large revenue available in the country, the need for its inhabitants to acquire improved housing and living conditions are growing rapidly. The Federal Government has recognised these needs and is making every attempt to improve the present situation. As a result of this, the Third National Development Plan, 1975-1980 (Table 1), has called for a total investment of about £20 billion. Almost half of this will be spent on construction.

Naturally, the sudden boom in the construction industry of Nigeria is creating various problems. Although these problems[1] are numerous and diverse in nature, the most serious ones are discussed in this section.

### 2.1 Demand for Foreign Expertise

Although Nigeria has numerous highly qualified indigenous Contractors, Engineers, Architects, Quantity Surveyors and other allied professionals, the present construction boom calls for additional foreign expertise. As stated in the Plan, "while serious effort will be made to assist indigenous contractors to improve their skill, it will be necessary during the Plan period to continue to attract a good number of reputable foreign contractors into the country to augment the overall construction capacity". The shortage of indigenous expertise could also be illustrated by a keynote address to the Commonwealth Association of Architects' Conference held in Accra in 1976. Speaking at this occasion, the Nigerian president of this Association, Mister Oluwole Olumuyiwa, said that the quality of

African architectural expertise was as good as anywhere else in the world, but pointed out that, while it is true that there is acute shortage of architects in Africa, it might not be correct in respect of quality. Although his reference was to Architects, the situation is the same for most Nigerian construction and design expertise.

The principal problem in employing foreign expertise is their lack of previous knowledge of the social, climatic and economic conditions[2] of Nigeria. These problems range from small projects, where foreign staffs are employed as supervisors, to multi-million Naira (N) complex projects, where foreign firms or consortia are engaged as main consultants or contractors. Basically, the lack of tropical design experience and construction methodology seems to be a major handicap to most foreign personnel and firms. As a result of this, buildings which portray European or other western culture and outlook are gaining ground. The adaption of unsuitable design technique and the choice of wrong materials give rise to the design and construction of buildings which may be found unsuitable in the foreseeable years.

These problems could be alleviated by the training of more Nigerian professional and technical staff, and financial support to able indigenous firms. Where foreign consultants are engaged for massive projects, at least a two-man team of Nigerian professional experts (either from the industry or from the University) should be appointed by the Government to oversee the general concept of the project and also to provide necessary guidelines at the design and construction stages. The Nigerian professional institutes, such as the Nigerian Institute of Architects, the Nigerian Institute of Building and others, should run "induction" courses for new foreign staff joining the construction industry. These courses should provide participants with sufficient materials for tackling the differing climatic, social and economic conditions in Nigeria as compared to their country of origin.

## 2.2 Construction Delays and Inflation of Building Cost

There is a great shortage of building materials in most parts of the country. This gives rise to hoarding, inflation and the use of inferior alternatives. The Plan recognises the shortage of building materials and aims at minimising existing bottlenecks. Effort is being made to increase investment in domestic production of cement and other essential building materials. The use of local materials such as burnt bricks will be vigorously promoted under the Plan to minimise dependence on imported substitutes.

However, as the industry depends heavily on imported materials, the delay in supply and scarcity of certain materials hinders progress on most sites. From Table 2 it can be seen that a large proportion of the materials needed in the industry for implementing the 5-year development Plan, will be imported. The summary of a recent survey[3] of building material prices in selected towns in Nigeria is shown in Table 3. It is clear from this Table that there is a wide fluctuation in material prices. The causes of these variations in prices were attributed to the following six main factors:

- Location of the local building material manufacturing industries
- Transport costs from sources of supply and sites
- Untarred and bad roads to hinterland
- Fuel shortages
- Degree of supply and demand at each location
- Excessive profit margins of the building material merchants.

These problems have been recognised by the Federal Commissioner for Housing Urban Development and Environment, Wing Commander Mouktar Mohammed. Further serious attempts are therefore being made to increase the use of local materials. It is hoped that the extensive use of Nigerian local materials will not only provide more cheap materials, but may lead to the production and development of more suitable building components.

### 2.3 Inadequate Statutory and Scientific Guidelines

As Nigeria was previously a British colony, there has been a tendency to rely on most standards and practices which were handed down during the colonial administration. These techniques inherited by the Nigerian construction industry are not generally suited to its climatic conditions. Although the British Standards Institute's publications (Codes of Practices and British Standards) are still widely used, the recent construction failures in Nigeria have shown that the behaviour of some materials, such as concrete, in temperate countries differs in some peculiar ways from its behaviour in tropical countries.

The need for adequate statutory and scientific guidelines to suit the conditions in Nigeria has been widely recognised. For example, a symposium on a new code of practice on the structural use of concrete in building was held in Lagos in April 1976. Speaking on the occasion, the Director of the Nigerian Standards Organisation, Mr. D. O. Ogun, stressed that the boom in the construction industries in the country has prompted the organisation to establish a building and construction technical committee of experts to provide guidelines on various building materials. After considerable research, a new code of practice for concrete structures has been produced by the committee. Research work is also continuing in most Nigerian Universities and other Government agencies to produce more relevant guidelines for the construction industry.

Although the growing catalogue of building failures, now reaching serious proportions, could be seen as symptomatic of fundamental problems in the construction industry, the blame for such failure does not lie within one sector only. In Nigeria, the Building Contractor is generally blamed for most of these failures, whereas the Architect, or Engineer, could have been responsible. It is therefore essential that a thorough scientific investigation be carried out before the cause of any failure could be established.

## 3. CONCLUSIONS

As the boom in the Nigerian construction industry has created a situation where local personnel and materials are unable to meet with the demand, it is essential that foreign expertise and materials are attracted into the country. The Government should, however, increase its efforts towards the training of local technical staff, and the use of local materials should be exploited.

## 4. ACKNOWLEDGEMENT

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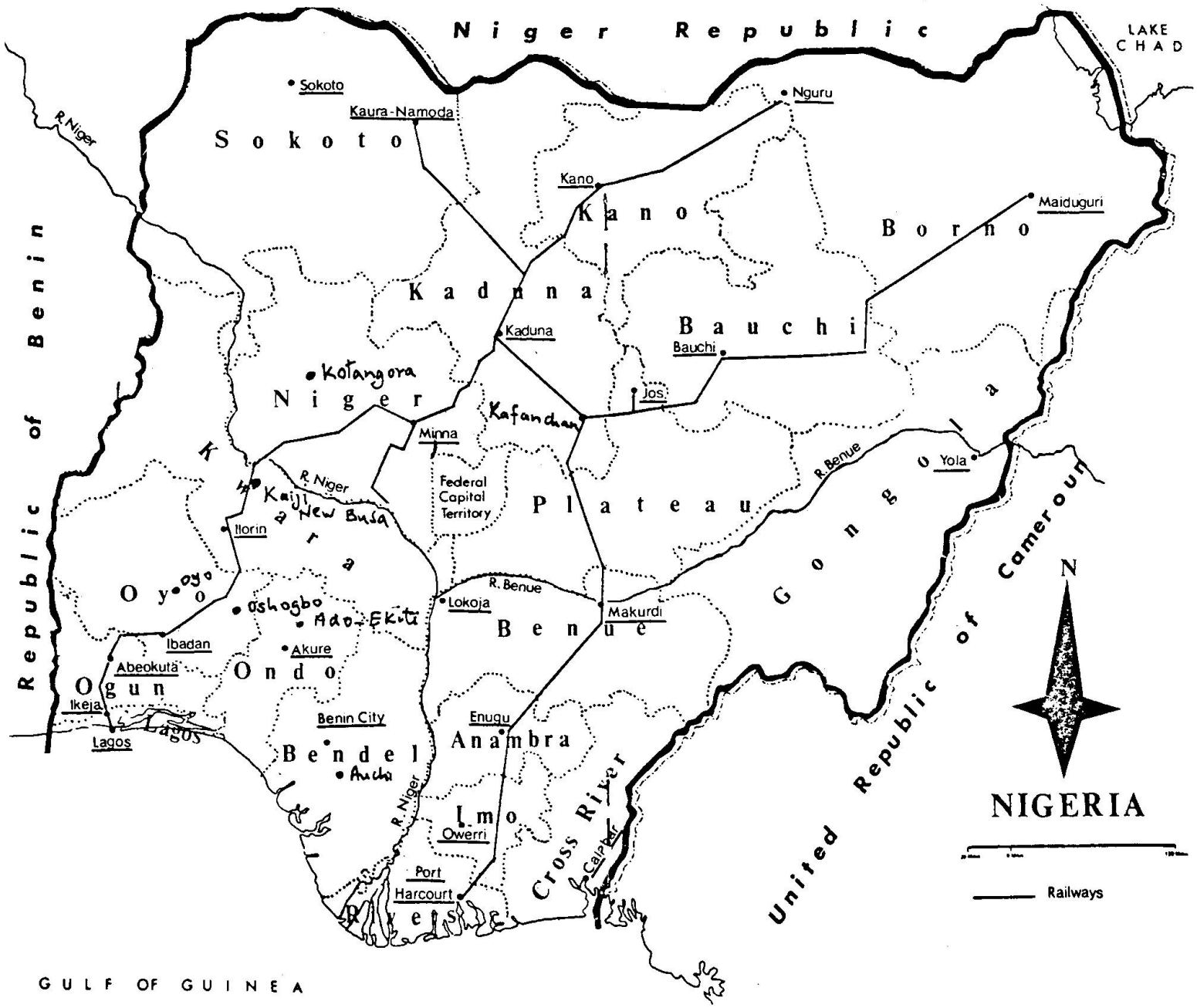


FIGURE 1: FEDERAL REPUBLIC OF NIGERIA

SUMMARY OF PUBLIC SECTOR CAPITAL PROGRAMMES: 1975-80

Nmillion

| *Sector* (1) | *Total all Govts.* (2) | *Federal Govt.* (3) | *Total all States* (4) | *Benue-Plateau* (5) | *East-Central* (6) | *Kano* (7) | *Kwara* (8) | *Lagos* (9) | *Mid-Western* (10) | *North-Central* (11) | *North-Eastern* (12) | *North-Western* (13) | *Rivers* (14) | *South-Eastern* (15) | *Western* (16) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A: ECONOMIC | | | | | | | | | | | | | | | |
| 1. Agriculture | 1,645.852 | 750.845 | 895.007 | 64.768 | 95.408 | 142.556 | 66.303 | 14.824 | 63.521 | 68.139 | 73.754 | 65.441 | 48.150 | 63.526 | 128.617 |
| 2. Livestock | 344.046 | 173.176 | 170.869 | 10.314 | 15.227 | 24.682 | 7.299 | 17.090 | 8.383 | 12.280 | 20.801 | 20.080 | 5.700 | 10.648 | 18.365 |
| 3. Forestry | 109.730 | 30.014 | 79.716 | 9.055 | 5.355 | 4.610 | 9.300 | 0.500 | 4.975 | 5.826 | 8.438 | 4.530 | 2.000 | 12.701 | 12.426 |
| 4. Fishery | 101.554 | 58.561 | 42.993 | 3.367 | 1.398 | 1.600 | 1.700 | 15.451 | 2.289 | 0.100 | 1.397 | 0.751 | 5.538 | 5.639 | 3.763 |
| 5. Minings and Quarrying | 2,680.425 | 2,680.425 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6. Manufacturing and Craft | 5,315.871 | 4,907.227 | 408.644 | 28.938 | 69.271 | 23.966 | 37.804 | 32.246 | 43.500 | 21.289 | 22.463 | 8.200 | 36.228 | 39.419 | 45.320 |
| 7. Power | 1,075.238 | 932.038 | 143.200 | 12.000 | 10.000 | 8.000 | 15.000 | 0.200 | 10.000 | 10.000 | 20.000 | 20.000 | 8.000 | 10.000 | 20.000 |
| 8. Commerce and Finance | 559.355 | 323.433 | 235.922 | 16.900 | 25.700 | 16.086 | 28.650 | 15.500 | 12.180 | 14.175 | 19.600 | 10.305 | 43.100 | 23.573 | 10.153 |
| 9. Transport | 7,303.068 | 6.274.342 | 1,028.726 | 98.990 | 88.728 | 55.340 | 63.990 | 36.265 | 200.000 | 59.723 | 119.956 | 108.180 | 51.650 | 69.184 | 76.720 |
| 10. Communications | 1,338.944 | 1,338.944 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| Sub-Total | 20,474.082 | 17,469.005 | 3,005.077 | 244.332 | 311.087 | 276.840 | 230.046 | 132.076 | 344.848 | 191.532 | 286.409 | 237.487 | 200.366 | 234.690 | 315.364 |
| B: SOCIAL | | | | | | | | | | | | | | | |
| 11. Education | 2,463.822 | 1,656.193 | 807.629 | 71.702 | 78.239 | 68.647 | 46.129 | 30.642 | 60.807 | 75.600 | 90.511 | 63.264 | 74.300 | 65.931 | 81.857 |
| 12. Health | 759.928 | 314.160 | 455.768 | 30.670 | 62.621 | 32.430 | 28.500 | 53.901 | 39.690 | 23.810 | 42.900 | 30.550 | 34.805 | 22.850 | 43.041 |
| 13. Information | 380.225 | 234.341 | 145.884 | 9.415 | 19.837 | 6.500 | 15.900 | 5.300 | 5.900 | 6.193 | 16.137 | 16.170 | 12.310 | 15.110 | 17.112 |
| 14. Labour | 43.187 | 43.187 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 15. Social Development and Sports | 139.603 | 24.950 | 114.653 | 8.148 | 22.592 | 6.203 | 5.760 | 19.266 | 3.920 | 3.770 | 11.501 | 6.751 | 9.350 | 8.778 | 8.614 |
| Sub-Total | 3,786.765 | 2,272.831 | 1,513.934 | 119.935 | 183.289 | 113.780 | 96.289 | 109.109 | 110.317 | 109.373 | 161.049 | 116.735 | 130.765 | 112.669 | 150.624 |
| C: REG. DEVELOPMENT | | | | | | | | | | | | | | | |
| 16. Water Supply | 930.038 | 317.413 | 612.625 | 58.120 | 57.540 | 40.000 | 45.500 | 44.400 | 73.975 | 41.100 | 42.201 | 43.489 | 7.600 | 31.200 | 127.500 |
| 17. Sewerage, Drainage, and Ref. Disposal | 428.495 | 154.499 | 273.996 | 9.706 | 28.000 | 13.240 | 6.000 | 70.000 | 58.000 | 9.200 | 7.500 | 4.500 | 26.000 | 4.600 | 37.250 |
| 18. Housing | 1,837.430 | 1,650.000 | 187.430 | 5.000 | 20.500 | 30.930 | 8.000 | 11.000 | 30.000 | 10.000 | 18.000 | 10.000 | 10.000 | 10.000 | 24.000 |
| 19. Town and Country Planning | 754.867 | 250.453 | 504.414 | 24.299 | 70.706 | 21.243 | 9.200 | 117.525 | 31.007 | 23.102 | 31.087 | 38.730 | 55.500 | 35.009 | 47.006 |
| 20. Co-operative and Community Development | 193.294 | 16.187 | 177.107 | 12.782 | 17.000 | 17.773 | 6.500 | 35.344 | 11.851 | 10.548 | 23.516 | 16.644 | 1.200 | 13.655 | 10.294 |
| Sub-Total | 4,144.124 | 2,388.552 | 1,755.572 | 109.907 | 193.746 | 123.186 | 75.200 | 278.269 | 204.833 | 93.950 | 122.304 | 113.363 | 100.300 | 94.464 | 246.050 |
| D: ADMINISTRATION | | | | | | | | | | | | | | | |
| 21. Defence and Security | 3,325.517 | 3,325.717 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 22 General Administration | 1,124.128 | 709.210 | 414.918 | 24.809 | 35.955 | 46.421 | 25.250 | 34.960 | 27.092 | 36.617 | 39.866 | 50.472 | 40.877 | 34.160 | 18.439 |
| Sub-Total | 4,449.645 | 4,034.727 | 414.918 | 24.809 | 35.955 | 46.421 | 25.250 | 34.960 | 27.092 | 36.617 | 39.866 | 50.472 | 40.877 | 34.160 | 18.439 |
| Nominal Total | 32,854.616 | 26,165.115 | 6.689.501 | 498.983 | 724.077 | 560.227 | 426.785 | 554.414 | 687.090 | 431.472 | 609.628 | 518.057 | 472.308 | 475.983 | 73.477 |

TABLE 1

SOURCE: FEDERAL REPUBLIC OF NIGERIA
THIRD NATIONAL DEVELOPMENT PLAN 1975-80

ESTIMATES OF MATERIAL INPUTS REQUIRED FOR IMPLEMENTING THE PLAN

| (1) | Unit (2) | Quantities, Public Sector: Housing Barracks Prisons (3) | Offices Hotels etc. (4) | Stores Warehouse (5) | Factories Shops (6) | Schools (7) | Hospitals (8) | Health Centres Clinics (9) | Roads Bridges Tarmac (10) | Water and Sewerage (11) | Miscellaneous (12) | Public Sector Total (13) | QUANTITIES Private Sector Total (14) | QUANTITIES Total Plan (15) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Cement | million tons | 3.48 | 1.19 | .38 | .67 | 4.68 | .42 | .28 | 6.71 | .85 | .95 | 19.61 | 3.46 | 23.07 |
| 2. Reimbursement | million tons | .92 | .86 | .01 | .05 | 1.19 | .11 | .05 | 1.36 | .24 | .17 | 4.96 | .92 | 5.89 |
| 3. Construction Timber | million cu. ft. | 42.89 | 10.88 | .28 | .70 | 32.23 | 26.80 | 1.42 | — | — | 11.59 | 126.79 | 21.73 | 148.52 |
| 4. Joinery Timber | million cu. ft. | 14.38 | 2.15 | .03 | .28 | 16.49 | .80 | 2.03 | — | — | .02 | 36.18 | 5.74 | 41.92 |
| 5. Structural Steelwork | thousand tons | — | — | — | 80.5 | .1 | — | — | 460.0 | 45.0 | .. | 585.6 | 195.0 | 780.6 |
| 6. Galvanised Pipes | thousand tons | 45.8 | 8.9 | — | 1.1 | 38.0 | 5.1 | .7 | — | — | — | 99.6 | 23.0 | 122.6 |
| 7. Copper Pipes | thousand tons | — | 2.9 | — | — | — | 2.0 | 1.3 | — | — | — | 6.2 | 1.9 | 8.1 |
| 8. Extruded Aluminium Section | thousand tons | .8 | 8.9 | — | — | — | 1.0 | 1.5 | — | — | — | 12.2 | 7.0 | 19.2 |
| 9. Rolled Steel Section | thousand tons | 179.2 | 2.9 | — | 2.5 | 68.0 | 2.0 | — | — | — | — | 254.6 | 34.2 | 288.8 |
| 10. Asbestos Cement Pipes | thousand tons | 144.6 | 2.9 | — | 1.8 | 33.1 | 1.0 | — | — | — | — | 183.4 | 29.5 | 212.9 |
| 11. Pipes (Cast Iron) | thousand tons | — | — | — | — | — | — | — | — | 81 | — | 81 | — | 81 |
| 12. Pipes (Steel) | thousand tons | — | — | — | — | — | — | — | — | 63 | — | 63 | — | 63 |
| 13. Roofing | | | | | | | | | | | | | | |
| (i) Felt | thousand tons | 35 | 3 | — | — | 38 | 2 | 2 | — | — | — | 80 | 6 | 86 |
| (ii) Asbestos Cement Sheets | thousand tons | 42 | — | — | 7 | 233 | 5 | 7 | — | — | — | 294 | 16 | 310 |
| (iii) Aluminium Sheet | thousand tons | 7 | 18 | — | 70 | 15 | 3 | — | — | — | — | 113 | 235 | 348 |
| 14. Air-conditioning | thousand refr. tons | 15 | 193 | — | — | 51 | 20 | 15 | — | — | — | 294 | 147 | 441 |
| 15. Electrical Installation | Megawatts | 308 | 357 | — | 70 | 322 | 268 | 41 | — | — | 4 | 1,370 | 435 | 1,805 |
| 16. Flexible Floor and Wall cov. | thousand sq. yds. | 6,877 | 709 | — | .. | 338 | 201 | 308 | — | — | 7 | 8,440 | 2,903 | 11,343 |
| 17. Ceramic Floor Tiles | thousand sq. yds. | 12,500 | 5,679 | 41 | 910 | 3,354 | 1,005 | 5,848 | — | — | 53 | 29,390 | 8,046 | 37,436 |
| 18. Ceramic Wall Tiles | thousand sq. yds. | 8,223 | 7,967 | 85 | 210 | 4,120 | 623 | 446 | — | — | 74 | 21,748 | 6,885 | 28,633 |
| 19. Fibre Ceiling Sheets | thousand sq. yds. | 6,216 | 3,433 | — | — | 17,996 | 482 | 1,047 | — | — | 33 | 29,207 | 4,980 | 34,187 |
| 20. Glass | thousand sq. ft. | 36,830 | 17,279 | 28 | 1,575 | 60,434 | 3,752 | 2,430 | — | — | 156 | 122,484 | 25,118 | 147,602 |
| 21. Paint | thousand gallons | 1,639 | 310 | 46 | 210 | 2,658 | 181 | 122 | — | — | 3 | 5,169 | 1,068 | 6,237 |
| 22. Sanitary Wares | | | | | | | | | | | | | | |
| (i) Lavatory Basins (Clay Ware) | thousands | 165 | 57 | 2 | 14 | 398 | 5 | 18 | — | — | 1 | 660 | 108 | 768 |
| (ii) Sink (Clay Ware) | thousands | 64 | 5 | — | 7 | 8 | 21 | 3 | — | — | — | 108 | 19 | 127 |
| (iii) Water Closet (Clay Ware) | thousands | 105 | 54 | 3 | 14 | 349 | 5 | 11 | — | — | — | 602 | 109 | 711 |
| (iv) Urinal Bowls (Clay Ware) | thousands | — | 12 | 2 | 2 | 190 | 1 | 2 | — | — | — | 209 | 16 | 225 |
| (v) Shower Tray (Clay Ware) | thousands | — | — | — | — | — | 1 | 1 | — | — | — | 2 | — | 2 |
| (vi) Steel Sink | thousands | 88 | 1 | — | — | 5,478 | 1 | — | — | — | — | 5,568 | 21 | 5,589 |
| (vii) Steel or Cast Iron Bath | thousands | 85 | 3 | — | — | 4,895 | 1 | — | — | — | — | 4,984 | 32 | 5,016 |
| 23. Bitumen | million tons | — | — | — | — | — | — | — | 3.96 | - | — | 3.96 | — | 3.96 |
| 24. Aggregates | million cub. yds. | 10.4 | 3.6 | 1.1 | 2.0 | 12.6 | 1.3 | .8 | 144.2 | 4.9 | 5.5 | 186.4 | 10.3 | 196.7 |

TABLE 2 SOURCE: FEDERAL REPUBLIC OF NIGERIA
THIRD NATIONAL DEVELOPMENT PLAN 1975-80

| | Materials | Unit/ Size/ Quantity | LOCATION AND PRICES (prices quoted in Naira) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lagos State | | | | Oyo State | | | Ondo State | | | Anambra State | Rivers State | Bendel State | | Niger State | | Kaduna State | Kwara State |
| | | | Surulere | Igbobi | Ebute Metta | Ikega | Ibadan | Onogbo | Oyo | Akure | Ado-Ekiti | Owo | Enugu | Port Harcourt | Benin | Auchi | Minna | Kontagora | Kafanchan | Kainji New Bussa |
| 1 | Load of sand | 1 tipper | 34.00 | | 34.00 | 23.00 | 20.00 | 12.00 | 12.00 | 11.00 | | 12.00 | | | 25.00 | | 12.00 | 12.00 | | |
| 2 | Load of gravel | 1 tipper | | | | 75.00 | 40.00 | 17.00 | 18.00 | 28.00 | | 30.00 | | | 70.00 | | 34.00 | 34.00 | | |
| 3 | Ton of cement | 1 ton | 60.00 | 47.00 | 70.00 | 50.00 | 56.00 | 58.00 | 80.00 | 85.00 | 66.00 | 90.00 | 69.00 | 72.00 | 70.00 | 80.00 | 70.00 | 84.00 | 84.00 | 57.00 |
| 4 | Roofing timber | cu. ft. | | | | | 5.35 | 3.70 | 6.00 | 2.80 | | 3.00 | 5.50 | 4.00 | | | 3.40 | 3.50 | 3.50 | |
| 5 | Asbestos roofing | 6′ long | 5.00 | 3.00 | 4.60 | 5.00 | 4.40 | 2.65 | 4.00 | 5.50 | | | 6.85 | | 6.80 | | | 6.50 | | |
| 6 | Asbestos ceiling | 4′ × 4′ | 3.00 | 1.50 | 2.60 | 4.50 | 2.10 | 3.00 | | 7.00 | | 3.00 | | | 2.30 | 2.70 | | | | |
| 7 | Flush door | | | 11.00 | 18.00 | 15.70 | 13.65 | 13.00 | 15.00 | 14.00 | | | 15.00 | 16.00 | | 15.00 | | 18.00 | | |
| 8 | Bath tub | 5′ 6″ | 85.50 | 80.00 | 70.00 | | 90.00 | 25.00 | | | 72.00 | 80.00 | 88.00 | 60.00 | 64.00 | | | 115.00 | | |
| 9 | W/C | 1 No | 44.50 | 45.00 | 42.00 | 45.00 | 50.00 | 54.00 | 45.00 | 45.00 | 52.00 | 58.00 | 52.00 | 40.00 | | 48.00 | | 55.00 | | |
| 10 | Kitchen sink | 1 No | 46.00 | 48.00 | | | 46.00 | | | | 42.00 | 40.00 | 45.00 | | 50.00 | | | | | 50.00 |
| 11 | Emulsion paint | 1 gallon | 6.50 | 10.45 | 7.50 | 5.50 | 9.95 | 9.90 | 8.00 | 9.50 | 8.00 | 11.00 | 5.50 | 9.50 | 7.50 | 6.50 | 8.00 | 8.00 | 8.00 | 10.50 |
| 12 | Gloss paint | 1 gallon | 7.50 | 12.60 | 9.50 | 6.50 | 12.00 | 12.00 | 7.00 | 11.40 | 7.00 | 12.00 | 8.50 | 10.50 | 9.00 | 7.50 | 9.00 | 10.00 | 11.50 | 12.00 |
| 13 | M.S. Iron rod | Ton | | 360.00 | | 350.00 | 300.00 | 370.00 | 360.00 | 360.00 | 390.00 | 380.00 | 356.00 | | | 358.00 | | 504.00 | | 380.00 |
| 14 | Iron nails | Cwt. | | | | 27.00 | 32.20 | | | | | | 38.00 | 32.00 | 32.00 | 32.00 | 16.50 | 16.50 | 32.00 | 27.00 |
| 15 | Chubb mortice lock | 1 No | | 6.00 | | 5.20 | | | | | | | 7.30 | 7.50 | | | 2.50 | | | 6.50 |
| 16 | 12-in. Gal. steel pipe | 3 m. | 6.00 | 5.00 | 4.50 | 6.00 | 6.00 | 6.00 | 7.00 | 7.00 | | 6.00 | | | | | | 5.50 | | 5.50 |
| 17 | Plain louvre blades | 150 mm. | 0.97 | 0.80 | | 1.22 | 1.25 | 1.06 | 1.25 | 1.16 | 1.50 | 0.90 | 1.22 | | | 1.22 | | 1.30 | | 0.95 |

TABLE 3 BUILDING MATERIAL PRICES IN SELECTED LOCATIONS IN NIGERIA

# Problems of Construction Industry in Nigeria

Problèmes de l'entreprise de la construction au Nigéria

Probleme der Bauindustrie in Nigeria

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**SUMMARY**
The paper reviews the problems of the Construction Industry in Nigeria: it discusses the major role being played by expatriate construction companies and also the limitations and problems of the indigenous contractors. An assessment is made of the effect of Government policy on the Construction Industry.

**RESUME**
Cet article résume les problèmes de l'industrie de la construction au Nigéria: le rôle prépondérant joué par les entreprises de construction étrangères et les limitations et problèmes des entrepreneurs locaux. Une appréciation est faite sur l'effet de la politique du gouvernement face à l'industrie de la construction.

**ZUSAMMENFASSUNG**
Der Vortrag beleuchtet Probleme der Bauindustrie in Nigeria: er behandelt die führende Rolle, die ausländische Baufirmen spielen sowie die Begrenztheit und Probleme der einheimischen Kontraktoren. Es wird eine Einschätzung über den Effekt der Regierungspolitik bezüglich der Bauindustrie gemacht.

The Construction Industry is of crucial importance in the economy and in national development particularly in developing countries. There cannot be much progress in national development without the provision of basic infrastructure, a network of good communication systems, rail and road network for movement of goods and people, water supply, housing and urban development.

In economic terms, the importance can be assessed by the rate of investment. In Nigeria's third national development plan, the planned expenditure on construction activities accounts for about 40 % of the ₦ 30 billion earmarked for the whole plan period. This is by far the largest share of any single sector of the economy. Apart from having the largest rate of expansion, the Construction Industry indirectly influences the economy in many other ways. It provides employment for about a quarter of the labour force; it has necessitated improvements in transport facilities and has led directly to the establishment of local industries for manufacture of cement, roofing materials, metal frames for windows and doors and terrazzo flooring.

## 1. THE STATE OF THE CONSTRUCTION INDUSTRY

The Building and Construction Industry has had a rapid and steady growth over the past two decades and it also has one of the highest rates of expansion in any sector of the Nigerian economy.

The Nigerian Construction Industry is dominated by a few large expatriate firms who carry out about 90 % of the work. There are many small Nigerian contracting firms which account for the rest of the work. These are mainly in the area of building construction, though recently one or two are embarking on civil engineering works. Even in the area of small building works and commercial and industrial buildings, only a few are able to compete successfully with expatriate firms.

The indigenous contractor is faced with the problems of working capital, poor management and lack of good organisation.

### 1.1 Finance

Finance is very important in the Building and Construction Industry. The contractor has to invest on plant which is expensive in the case of civil engineering jobs, and requires cash for payment of workers salaries, purchase of materials, etc. Inadequate finance can severely limit the scope of activities of a contractor.

In recent years the problem of finance has become soluble. The commercial banks are under considerable pressure from the Government to assist indigenous companies and any contractor who has demonstrated a good sense of responsibility and shows some creditable construction record should not have much problem in attracting funds from the banks.

### 1.2 Personnel

Nigerian labour is extensively used by both expatriate and indigenous construction companies even though the industry is capital intensive. By European standards, the output of labour on building and civil engineering sites is very low. Labour wages are relatively low and for civil engineering projects, the overall labour cost is small in relation to the total output. One interesting point is that expatriate contractors always get better productivity out of Nigerian workers, this can only be ascribed to better supervision.

1.3 Management

The question of organisation is rather more serious. The most common complaint against Nigerian contractors is that they do not complete jobs on schedule. Most of the problems that arise come from bad planning and inefficient organisation. It is the efficient organisation of men and equipment that makes for good results in terms of job quality, completion time and profit margin. People often assumed that labour is cheap and they put workers on site without proper supervision that ensures productivity. This is wasteful; when one talks of cheap labour, it is in relation to labour costs elsewhere.

The lesson here for the indigenous construction company is that contracting is not a field in which one-man enterprise can succeed. Contractors should form proper companies with trained technical personnel and managers.

## 2. GOVERNMENT POLICY ON CONSTRUCTION

Government policiy efforts to encourage Nigerian Contractors have taken several forms. One form was to reserve projects costing ₦ 100'000 or less for only Nigerian Contractors and another was to encourage partnership with expatriate firms. In spite of these efforts, participation of Nigerian Contractors in the construction industry has been relatively small.

The position has improved somewhat during the execution of the Second National Development Plan. By this time, some engineers had entered the Construction Industry as contractors and their record so far has been encouraging.

A new innovation is the Government decision to participate in the construction industry by forming joint construction companies with some expatriate firms. The original intention which presumably is to try to reduce cost, is a good one. Construction cost has been rising steadily and it has reached a stage where it is difficult or well nigh impossible to estimate the cost of a project accurately. There are two major factors responsible for this. Apart from the rising cost of construction materials and equipment, there is a great deal of work (some would say too much work) available and the contractors do not have the executive capacity to do all the work. Quite often, advertisements calling for tenders are ignored by contractors.

However, in trying to solve one set of problems, one hopes that new ones are not created. A government construction company that does not compete for government jobs has a virtual monopoly will not be an economic proposition nor will it lead to reduction in costs. The idea of sharing in the profits can also prove to bé illusory, as any Accountant knows well, profit is a question of definition. A Government joint venture should also provide its share of Nigerian manpower. A Government construction could be useful if it provides an opportunity for Nigerian Engineers to take part in the construction industry in the country but this will not be achieved by simply acquiring shares in an expatriate firm and giving the firm a monopoly of government projects.
This is perhaps a convenient point to mention the question of Indigenisation. The Indigenisation Decree puts the Construction Insutry in Schedule II. This means 60 % Nigerian Ownership of Construction Companies and 40 % expatriate. The aims of the Federal Military Government are laudable and one should congratulate it on a major piece of legislation. The ultimate objective must be that Nigerians run their own affairs either in the construction industry or in other fields of endeavour. However, the nation needs to emphasise and re-define its objectives.

The most essential objective to be achieved with this policy is a transfer of technology such that in future, Nigerians will be able to build bridges, flyovers and skyscrapers all by themselves. There is a distinction between this and a share in or transfer of profits. What do we mean then when we say that Nigerians must own 60 % of an industry? Do we mean that Nigerians only take 60 % of the profit or do we mean that Nigerians must also contribute as much as 60 % of the expertise required in carrying out a construction project? There is no doubt that we have to aim for a transfer of technology, so as to ensure that we can execute our development projects ourselves but the present acute shortage of manpower makes it unlikely that we can achieve this immediately.

## 3. CONSULTING SERVICES

The profession of consulting engineers was rather slow in starting in Nigeria. A few took the plunge in the early 1950's and concentrated on buildings. These firms were invariably one-man operations and were in no position to cope with major civil engineering projects.

The Federal Ministry of Works actively encouraged participation of Consulting Engineers in the development projects of the 1970-74 Plan. The strategy was to encourage larger combines or association with foreign firms. This has, to a large extent, proved to be a successful experiment. Several firms of Consulting Engineers have sprung up in the last five years and in association with foreign firms have taken part in some of the complex and major development programs. They have also taken up the challenge of modernisation and some have been able to use the new sophisticated tools of computers, etc. However, the practice of distributing work equally between firms has led to fragmentation which could hamper the development of indigenous expertise. Patronage should reflect expertise: well established firms with several competent engineers are likely to perform better than single individuals. Council of Registered Engineers of Nigeria which has been set up to regulate the practice of engineering profession in Nigeria is now attempting to control the establishment of consultancy firms.

Consulting Engineers profession differs from other business in several respects: it is not, strictly speaking, a business concern, it is service in a specialised ability and the duty of the Consulting Engineer is to seek the best interests of clients at all times. This is why the tradition has been to invite the best consultant in a field to advise or protect the client's interest in a particular project. There is however, a growing trend among clients particularly State Governments, which request Consultants to quote or tender for a job. The disadvantages of the procedure however outweigh any apparent economic gains. It is not the cheapest advice that the Client needs but the best and since there is a fixed scale of fees, it is better to select Consultants on the basis of competence.

The shortage of experienced manpower in the Ministries of Works, creates a serious problem in the implementation of projects. This often means that a proper assessment or comment on the Consulting Engineers reports is not possible. The few officials that are available are far too busy to be able to read each report in detail. This means that there are considerable delays in obtaining approval for preliminary projects and in a Military Regime where the emphasis is on achievement, the Consulting Engineer could be blamed for the delay. This situation also makes it imperative that the best Consultant be retained for a particular job so that even if his advice is implemented, it could not lead to disastrous results.

## Factors to be Taken into Account in Designs and Constructions in Developing Countries

Facteurs à prendre en considération pour des projets et des constructions dans les pays en voie de développement

Was in Entwicklungsländern beim Entwerfen von Bauten und deren Ausführung beachtet werden muss

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Since 1967, Indonesia has opened its doors to foreign capital and foreign expertise. Before that, in the period of 1945 to 1967, it can be said that Indonesia has isolated itself. In this period, the domestic difficulties have created an unfavourable situation to conduct economic planning. However, we should not forget that before 1945 Indonesia was colonized by the Netherlands and at that time Indonesia already had a regular Dutch administration. This means that in Indonesia a generation already existed which worked according to an administration which at that time could be regarded as up-to-date.

At present, 35 years later, there are still some left of this generation who are still active and involved in construction activities, naturally not a great number anymore.

Between 1941 - 1960, the education of young people was rather erratic and this has caused a generation gap, so that the consequences are still felt at present. However, it would be quite wrong to regard Indonesia as a country which is 100 % "illeterate" in all respects. An example: East-Java in the Dutch colonial era was the most advanced province, and at that time it was already very progressive in irrigation matters and at present it can still manage irrigation conducted for 100 % by Indonesians.

In various disciplines, including Civil Engineering, Indonesian technicians have already rendered many services. Hereunder we list the disciplines which can be conducted for 100 % by Indonesian consultants:

1. Structural engineering on buildings, bridges, highways.
2. Soil mechanics, foundation calculations, road-building.

3. Earthquake engineering control, dynamic analysis calculations.

4. Town planning and habitat affairs.

5. Drinking water provision.

The above are disciplines included in engineering.

In the sectors of consultancy, feasibility studies, industrial-, banking-, hotel management and computerization, it should be admitted that our experience is still insufficient. At present, Associations of Professionals have already been established:

a) In the Engineering sector: The Indonesian Construction Techniques Consultants Association (P.K.T.P.I.)

b) In the General Consultancy sector: The Indonesian Consultants Association (IKINDO).

These two associations will merge within short and we shall strive to achieve progress and to obtain as many projects as possible.

The question arises whether there is still a place for foreign consultants. The answer is positively: yes. We need consultants in disciplines which are still vacuum, but there is a requirement/condition, and this requirement/condition is the transfer of know-how.

There is another matter that we wish to stress: Do not send manpower fresh from the universities who wish to learn in our country; likewise, do not send adventurers and brokers. Within a relatively short period, namely since 1967, we have had bitter experiences in consultancy and contracting matters. The Indonesian people have become critical and in a young and developing country there are still many aspirations toward Nationalism.

I, as Chairman of the Association of Consultants, am always prepared to extend information for mutual benefit. In a developing country which is still lacking in research laboratories, experiences in various sectors are not adequate, and we, as Indonesian consultants, are sufficiently realistic.

## Observations in Asian Countries

Observations dans des pays asiatiques

Beobachtungen in asiatischen Ländern

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### 1. INTRODUCTION

The paper on cooperation presented in the introductory report was interesting and it would be appropriate to make some observations based on experience gathered in Asian countries from a base in an Asian institution (the Asian Institute of Technology).

Taking the points in the order used in the paper:

### 2. LOCAL EXPERTISE

In many developing countries of Asia there are engineers with excellent qualifications and experience who can give valuable assistance to foreign companies. A considerable number of these engineers have been trained and have gained practical experience in developed countries but unfortunately, many of them have adopted the standards and methods used in these countries (normally capital intensive, machine based technologies) and are not willing to adapt the procedures to suit their own countries.

This institute is based in Thailand but it is an international institution and has students from 20 countries in the Asian region. The training given at AIT is designed to produce Asian engineers equipped to tackle the problems of Asia. They are not only given a firm grounding in the theoretical aspects of their profession but they are also taught how to handle problems of engineering practice, processes and management which they will meet when they enter practice in their own countries. This aspect of training is extremely important for young engineers who will find themselves in positions of great responsibility much earlier than their counterparts from developed countries.

## 3. LABOUR INTENSIVE METHODS

### 3.1 Use of Labour Intensive Technique

The use of labour intensive techniques is often considered by developing countries in the initial planning stages of large projects. In most cases financial assistance is needed and is sought, either from a single country as bilateral aid, or as a loan from an international agency. Although the pattern may have changed a little recently the donor agencies have always tended to either specify methods of construction (with advice from foreign consultants who normally favour capital intensive methods) or they provide only the foreign exchange element of the finance (labour intensive work is almost entirely dependent on internal funding). Not only is there no encouragement for developing countries to adopt labour intensive methods but in this way they are actively discouraged. Governments and international agencies giving aid should re-examine their criteria for selection and support of projects and consultants and international contracting companies must be willing to review their methods and approach to projects in developing countries before any significant progress can be made in the use of labour intensive methods.

### 3.2 Information on Labour Intensive Methods

There is a dearth of information concerning labour intensive methods. Although several trial projects have been monitored and documented by the International Labour Organisation the amount of technical data available is pitiful when compared with the libraries of books devoted to machine orientated construction. So long as this paucity of information exists it will be difficult, even for its advocates, to justify the labour intensive approach.

## 4. MATERIALS, TOOLS AND EQUIPMENT

### 4.1 Use of Locally Manufactured Materials and Equipment

The comments concerning the risks of importing materials also apply to tools and equipment. Locally produced tools are not always of good quality or design. Tools and equipment have been adapted and developed on several labour intensive projects but there is still great scope for development. When hand tools are to be used in large numbers the additional problem of supplying sufficient good quality tools must be considered. Local industry is not normally able to produce on a large scale without assistance and forward planning.

### 4.2 Development of Suitable Tools and Materials

A great deal of research on alternative materials is being carried out in developing countries. At AIT investigations are continuing into the use of local materials in the construction industry (e.g., bamboo as concrete reinforcement, burnt rice husk in cement production, the us of local waste products int the production of construction materials). At the same time as developing new tools and equipment it is necessary to reconsider the specifications for the quality of work or product produced. The specifications should be consistent with local conditions and the work to be done using the tools and materials.

## 5. LINKS WITH DEVELOPING COUNTRIES

Human relations and cultural considerations are extremely important when dealing with large numbers of workers. No foreign engineer can expect to cope with all of the local problems which are bound to occur. There is much to be said in favour of long term relationships (formal or informal) between foreign engineering companies and their local counterparts.

## 6. MAINTENANCE

Although maintenance has always been regarded as the poor relation of construction, it is essential. It is mainly labour intensive (even in developed countries) and developing countries have adequate manpower to maintain civil engineering works provided this is not made difficult by sophisticated design or maintenance specifications. Governments throughout the world have a reluctance to spend money on maintenance when it can be spent elsewhere and this is a major obstacle to providing adequate maintenance especially in developing countries where there is great pressure to put as much money as possible into new projects. In addition, improper use of the works (e.g., weight limit abuse on roads) in some developing countries makes more maintenance necessary.

## 7. CONCLUSIONS

The major problems of design and construction in the developing world will only be overcome when a concerted effort is made to tackle the problems of

a) Providing adequate numbers of proficient, locally trained engineers

b) Gathering and desseminating knowledge of alternative techniques and materials

c) Convincing foreign engineers that the methods used in their countries may not be appropriate in other situations

d) Donor agencies need to make a critical reappraisal of their methods and criteria for allocating loans and aid.

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# Bau von Transportobjekten in den Entwicklungsländern

Construction of Transport Projects in Developing Countries

Construction de projets de transport dans les pays en développement

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Die Sowjetunion verfolgt einen Kurs der Ausweitung der internationalen Wirtschaftszusammenarbeit auf der Grundlage der Prinzipien der friedlichen Koexistenz von Staaten mit unterschiedlicher Gesellschaftsordnung. Bei der Durchführung dieses Kurses hat die allseitige technische und wirtschaftliche Hilfe für die Entwicklungsländer wichtige Bedeutung. Die Hilfeleistungen bestehen in der Ausarbeitung von Bauprojekten durch sowjetische Organisationen, in der Uebergabe von Typen-Projekt-Dokumentation, Lieferungen von Ausrüstungen und Materialien, Einsatz von sowjetischen Fachleuten auf Bauobjekten im Ausland und Hilfe in der Ausbildung nationaler Fachkräfte.
Die technische und wirtschaftliche Zusammenarbeit der Sowjetunion mit den Entwicklungsländern Asiens, Afrikas und des Nahen Ostens bei der Projektierung und dem Bau von Eisenbahnstrecken und Autostrassen, Brücken, Anlegestellen in Seehäfen und anderen Transportobjekten wird immer umfassender.
Unter den mit Beistand der Sowjetunion errichteten oder noch im Bau befindlichen Transportobjekten in diesen Ländern kann man die Eisenbahnlinie Kamishliye - Haleb - El Ladhaqiye in der Syrischen Arabischen Republik, die Eisenbahnlinie Conakry - Prigyaybe in der Republik Guinea, die Seehäfen in der Volksdemokratischen Republik Jemen und eine Reihe von Brücken in der Volksdemokratischen Republik Laos nennen.
Die Hilfe der Sowjetunion fördert die Schaffung und Festigung des staatlichen Wirtschaftssektors der Entwicklungsländer. Das ist wichtig für die Beschleunigung ihrer wirtschaftlichen Entwicklung und die Festigung ihrer Selbständigkeit.

Eine wichtige Seite der Hilfe für die Entwicklungsländer ist die Ausbildung nationaler Kader. Bei der Projektierung und dem Bau von Transportobjekten werden die Bürger dieser Länder in den für sie neuen Bauberuten ausgebildet und sie durchlaufen ein Praktikum in den Betrieben, Bauplätzen und Lehranstalten der Sowjetunion. Allein in den letzten Jahren wurden in Irak, Syrien, Somalia, Afghanistan und Guinea mit unserem Beistand über 10'000 Fachkräfte für die Bedienung von Baumechanismen und den Betrieb der Ausrüstungen ausgebildet. Hunderte ausländischer Spezialisten haben ihre Qualifikation in der UdSSR verbessert.

Die Projektierung und der Bau von Objekten in Entwicklungsländern wickeln sich auf einem modernen Entwicklungsniveau der Bautechnik und unter Berücksichtigung der Errungenschaften des wissenschaftlich-technischen Fortschritts ab. Grosse Bedeutung hat die Vorforschung der Natur- und Klimabedingungen des Baugebietes, die Festlegung der Möglichkeiten für die Nutzung der örtlichen Materialien und die Vorbereitung der notwendigen Transportkommunikationen. Eine gründliche und den örtlichen Bedingungen entsprechende Vorbereitung auf die wichtigsten Bauarbeiten ist das Unterpfand für ihren erfolgreichen Verlauf.

**Closing Remarks**
**Remarques finales**
**Schlussbemerkungen**

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Closing this session, the Chairman thanked all speakers for their contributions, which were followed with much interest. Sophisticated methods and processes in the design and construction of developmental activities, specially to cover social and economic needs, should not be the domain of industrialized societies only. They should also belong to the developing section of the world which is perhaps even in a greater need of these up-to-date methods in view of their limited resources.

To use these methods for the developing countries, we must modify and update our thinking on the methods of design for these countries. The attitude of the technical participants towards their counterparts in the developing countries must not be one of condescension. They must consider their contribution a challenge to better the lot of the developing countries and their efforts a joint-venture with their local counterparts towards these common goals.

The following will provide some guide-lines in this direction:

- Investigate local conditions thoroughly to ascertain the true-needs, constraints as well as possibilities of the countries concerned,
- Tailor the design as far as possible to existing local construction practices in conjunction with the imported advanced construction techniques. In other words: thorough planning of the design to take into consideration local bidding and construction practice is essential,
- Involvement with construction planning, execution and inspection is essential,
- Simplicity in design and in the choice of construction methods and procedures is important for the successful application of these methods. This means that the components and methods should be simple, but not the product itself.