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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.

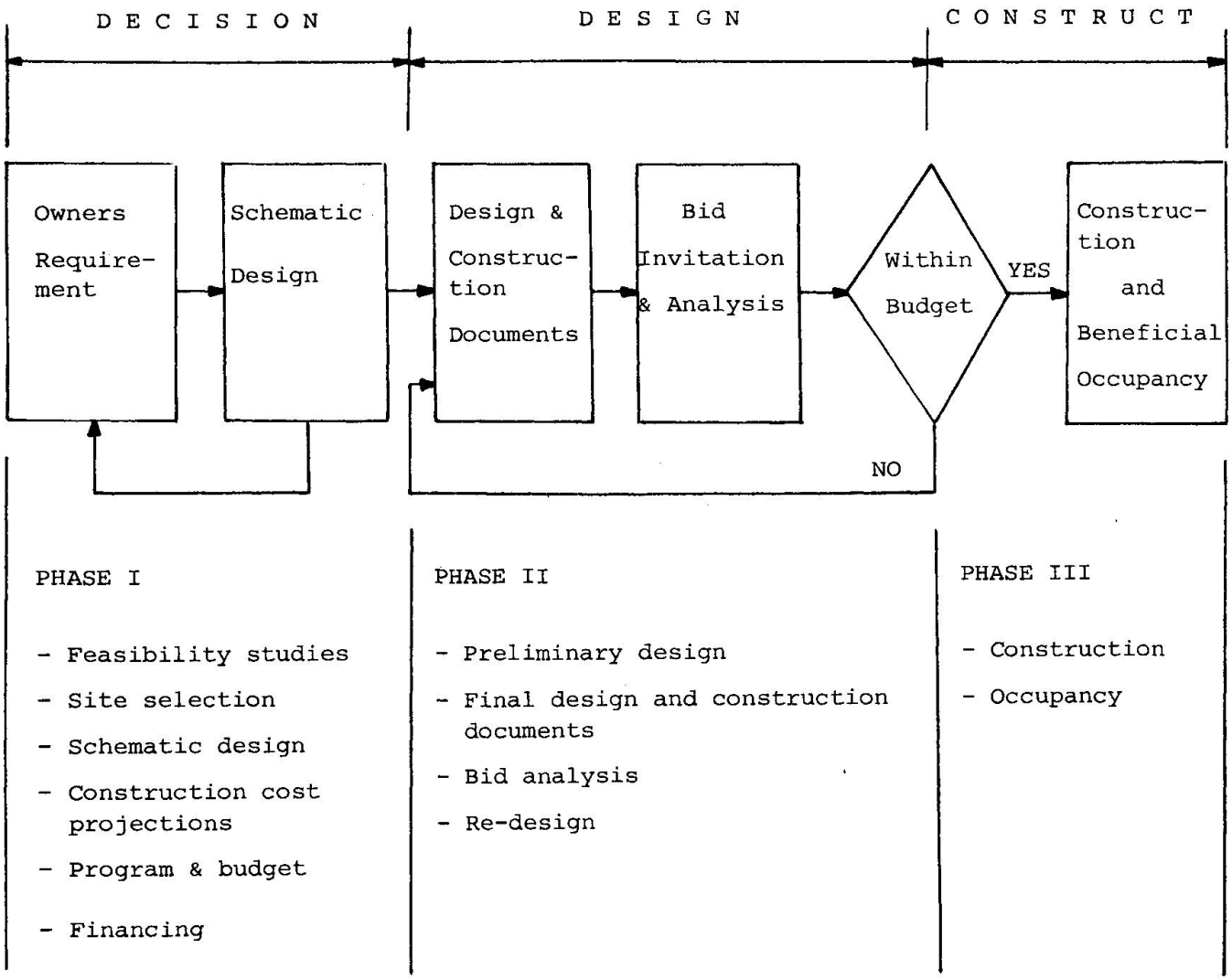
3. CONSTRUCTION MANAGEMENT PRINCIPLES

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

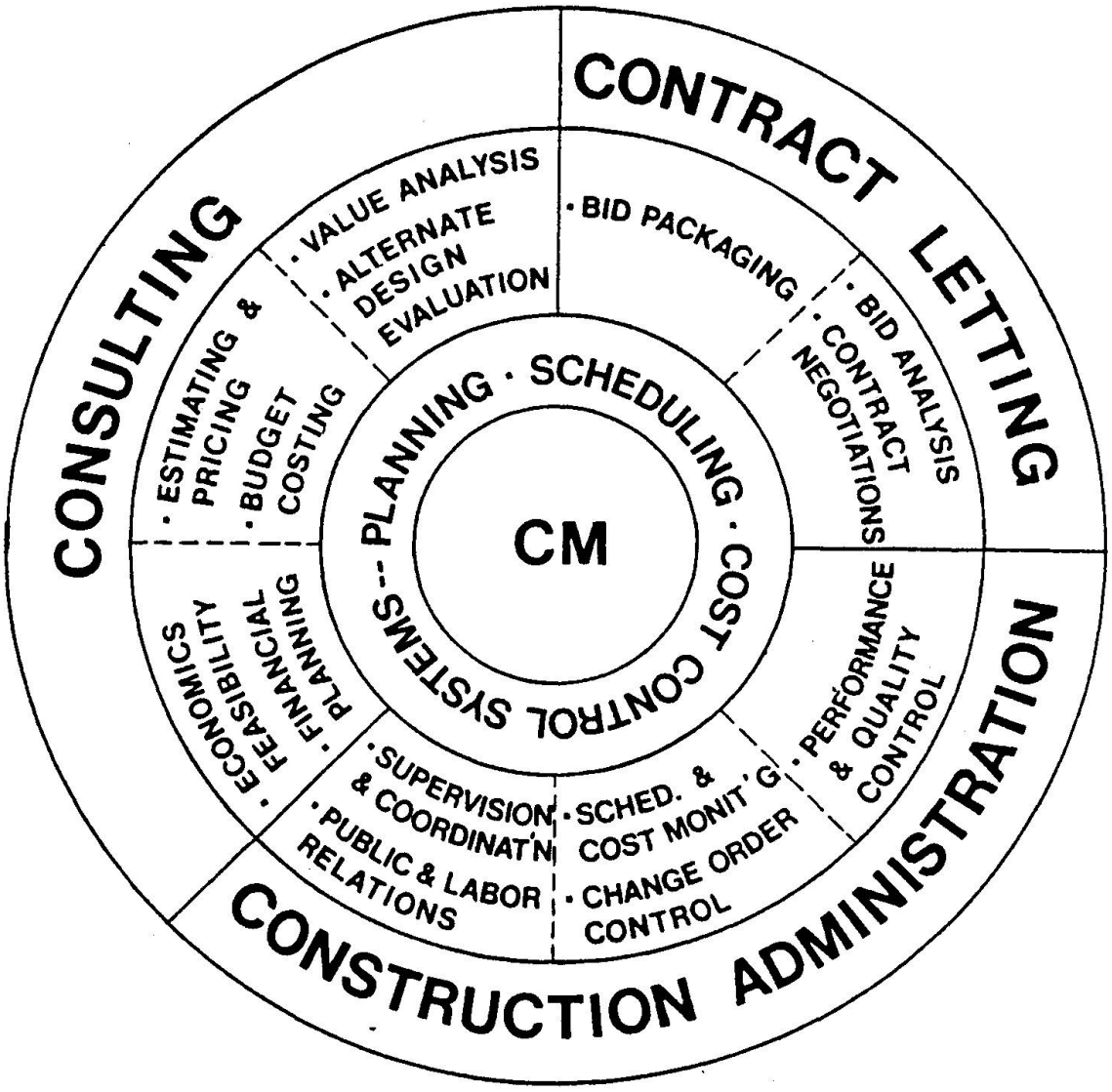


Figure 2

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.