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## **Rates of Diffusion of Network Applications among Construction Firms**

La diffusion des techniques de l'analyse du chemin critique dans les entreprises de construction

Über die Verbreitung von Netzplantechniken in Bauindustriefirmen

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### **SUMMARY**

Network analysis techniques are widely used nowadays for planning purposes by construction companies in industrialized countries. However the same cannot be said to be true for developing countries. According to Mansfield, the diffusion of innovation among firms follows a certain pattern. In this paper, the diffusion of network analysis techniques among construction firms in industrialized and developing countries has been examined within an analytical framework developed by using Mansfield's findings. Conclusions are made in the light of the findings.

### **RESUME**

Les techniques de l'analyse du chemin critique sont actuellement beaucoup utilisées pour la planification dans les entreprises de construction des pays industrialisés. Toutefois il n'en est pas de même dans les pays en voie de développement. Selon Mansfield, la diffusion d'innovations parmi les entreprises suit un certain schéma. Dans cet ouvrage, la diffusion de techniques de l'analyse du chemin critique dans les pays industrialisés et en voie de développement a été examinée sous forme analytique, utilisant les découvertes de Mansfield. Des conclusions sont présentées à ce sujet.

### **ZUSAMMENFASSUNG**

Die Netzplantechnik wird heutzutage von Bauunternehmungen in Industrieländern bei der Planung häufig angewendet. In Entwicklungsländern ist dies jedoch nicht der Fall. Nach Mansfield erfolgt die Verbreitung von Neuerungen innerhalb der Unternehmungen nach einem gewissen Schema. In diesem Bericht wurde die Verbreitung der Netzplantechnik in Industrieländern wie auch in Entwicklungsländern analytisch geprüft, indem die Erfindungen von Mansfield angewendet wurden. Diesbezüglich werden Schlussfolgerungen aufgezeigt.



## 1. THE PROBLEM

It is the opinion of the great majority of practitioners of network analysis that the use of such modern management techniques greatly enhances productivity, efficiency, communication, coordination, planning, control and profitability. That is why network analysis techniques are used extensively by most construction companies in industrialized countries. However, developing countries are only in the early stages of introducing such techniques. How did this diffusion among firms in industrialized countries take place? What is the speed of response of construction firms in developing countries? This paper attempts to answer these questions by examining the phenomenon within a well defined analytical framework.

## 2. THE ANALYTICAL FRAMEWORK

In his elaborate study of technical innovation and imitation, Mansfield puts forward a number of hypotheses and then tests their validity by statistical methods applied to data collected from a large number of companies in various industries (1). Among other things, the results indicate that:

- The length of time a firm waits before using a new technique, tends to be inversely proportional to its size;
- The length of time a firm waits before using a new technique, tends to be inversely proportional to the profitability of its investment in the innovation;
- The personality attributes, interests, training, and other characteristics of top and middle management may play an important role in determining how quickly a firm introduces an innovation.

## 3. THE STUDY

The use of network analysis techniques by American construction companies started in the early 1960's. The process of diffusion continued until the early 1970's when it reached a peak and a plateau. The diffusion of these techniques in the British construction industry followed approximately the same pattern with a delay of 3 to 4 years. However, the first CPM applications were observed to take place in Turkey only as late as in 1969-1970 and the use of such techniques has not yet reached a stable level of application. Furthermore, the rate of diffusion appears to be lower than what it was 8 to 10 years ago in industrialized countries.

This study involves the examination of the past and present use of network analysis techniques in the construction industries of industrialized and developing countries, within an analytical framework constructed by using Mansfield's findings.

### 3.1 The size of the firm

Mansfield's finding that innovation first spreads among larger firms seems to be valid in the case of network analysis. Davis's study of network applications among American construction companies (2), and the author's personal impressions of the evolution in Britain tend to strengthen the validity of this argument. This phenomenon can be explained in various ways:

- The cost of applying network analysis and the spending necessary for the introduction and adaptation of the technique can only be afforded by larger companies.

- The risk involved in starting using network analysis in a single project is larger for smaller firms.
- According to certain commentators the technical and scientific quality of managers is higher in larger firms resulting in prompter action towards a novelty with proven advantages.
- It is generally assumed by users that network applications in relatively larger construction projects - built naturally by large companies - are more useful and successful.

The fact that firms in developing countries are late in introducing network analysis can therefore be partly explained by the limited number of large local construction firms in these countries.

### 3.2 The profitability of the investment in the innovation

The measurement of the cost of implementing network analysis in a project is not a difficult task. A literature survey indicates that the cost of using network analysis seems to vary between 0.10 % and 1.00 % of the total project cost (3). However, when a manager is about to decide whether to replace the existing conventional planning system by network analysis, the vital information that is necessary is not cost, but rather a cost/benefit analysis of the new technique. What does the technique cost to install and to operate? What does it offer in return? Do the returns justify the cost?

There have been no systematic attempts to determine the contribution of network analysis to the profitability of a company. Nonetheless the literature is full of speculations and rumors that network analysis produces considerable savings. Furthermore, many authors accept explicitly that the size of intangible benefits such as improved communications, higher efficiency, higher confidence, etc., very much warrant the use of such techniques. The truth of the matter is that it is an extremely difficult task to determine the extent to which network analysis contributes to the profitability of a company. Accountants state that the results of such an exercise would be most unreliable because of the multitude of factors influencing overall profitability, and their complex interrelationships.

Despite the fact that the most important question cannot be answered, it is observed that construction firms in industrialized countries were not deterred by this inaccuracy and that on the contrary, the technique spread among companies with high speed. Construction industries in developing countries are, however, characterized by conventional and conservative technologies, organization and mentality. It is not therefore surprising to see construction companies in developing countries to resist the introduction of a new technique whose contribution to profitability or whose intangible advantages have not been proven by concrete examples in their own country.

### 3.3 Attitudes of managerial staff

Construction people in industrialized countries realize nowadays that bar charts are not adequate any more for large and complex jobs that are built today: hence the need for a newer, more flexible, more accurate, and more efficient technique. Indeed, it has been observed in western countries that network analysis can successfully be introduced into a company if, among other factors, there exists a need for such techniques in the firm (4).



The need for more advanced planning techniques is generally initiated by the planning department. However, this in itself is not sufficient for a successful start. It is important that this need be felt at all levels of the managerial hierarchy, including site staff and senior management. Companies conscious of this fact, tend to educate their staff by organizing internal courses, by sending key personnel to external courses, or by providing them with the relevant literature.

The situation in developing countries is rather different. The first applications in Turkey were the result of an unconscious imposition on contracting companies by client organizations. In such cases a network is prepared and hung on the wall of the site manager's office and is never implemented.

#### 4. CONCLUSION

The situation in Turkey, as in most developing countries, indicates that these countries are not only 8 to 10 years late to introduce network analysis techniques in their construction industry, but also that the rate of diffusion is slower than what it was 8 to 10 years ago in industrialized countries. This finding can be explained as follows:

- The diffusion of network analysis techniques takes place initially among larger construction companies. However, the number of ambitiously expansive large local companies in developing countries is limited.
- The rate of diffusion is higher in instances where the intangible benefits are readily apparent. However, there is a strong reaction in developing countries to the fact that the contribution of these techniques to company profitability cannot be determined and that concrete examples showing intangible benefits are non-existent in their own country.
- And finally, these techniques must be introduced as a response to a well-shaped need towards more efficient planning techniques. However, the initiation of such techniques in developing countries tend to have a character of imposition to an organization that has not yet felt the need for a more advanced technique.

It is apparent from the few factors that were taken into consideration in this paper that prevailing conditions in developing countries are quite different from those in industrialized countries. Further extensive local research is therefore necessary in developing countries to diagnose and solve introduction and implementation problems associated with network analysis techniques.

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