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## Interaction in the Design of Buildings

### Planification d'ouvrages complexes

### Planung von komplexen Bauwerken

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#### **SUMMARY**

The planning of complex construction projects with particular regard to short design periods and limited fees, requires precise work preparation of the individual stages of the design and an exact definition of the work scope. The matrix organisation of the planning team has proved to be the most reliable tool for controlling the planning procedure. Both work preparation and matrix organisation will be discussed in detail.

#### **RÉSUMÉ**

Du fait d'une phase de planification généralement courte et d'honoraires limités, la planification d'ouvrages complexes nécessite une préparation précise de chaque phase du planning, avec une définition exacte des prestations à exécuter. La matrice organisation a fait ses preuves lors de la procédure de planification de l'équipe. La matrice organisation, ainsi que la préparation des travaux sont présentées individuellement.

#### **ZUSAMMENFASSUNG**

Die Planung komplexer Bauwerke fordert im Hinblick auf die meist kurze Planungszeit und das begrenzte Honorar eine besonders gute Vorbereitung der einzelnen Planungsschritte mit genauer Definition der auszuführenden Leistungen. Für die Planung Procedure hat sich die Matrix-Organisation der Planungsteams sehr bewährt. Sowohl Arbeitsvorbereitung als auch Matrix-Organisation werden im einzelnen beschrieben.



### Interaction in the Design of Buildings

Nowadays the planning and design of complex buildings can only be performed satisfactorily by closest co-operation between architects and engineers of various disciplines. There is a strong mutual interdependence of the individual disciplines, demanding carefully developed planning systems in order to achieve an optimal design and planning concept for the project as a whole. It would be quite inadmissible to optimize only one or a few disciplines on their own, without regard to the overall project. It is for this reason that close collaboration and the development of broad-based decisions are essential.

On the other hand, consulting fees and scheduled planning items are normally rather limited, necessitating tight planning procedures and precise definitions of the planning depth and design detail.

These considerations lead us in principle to two subjects with which I want to deal with now, viz.

1. the preparation of planning work, and
2. the planning procedure.

The principle is shown in Fig. 1.

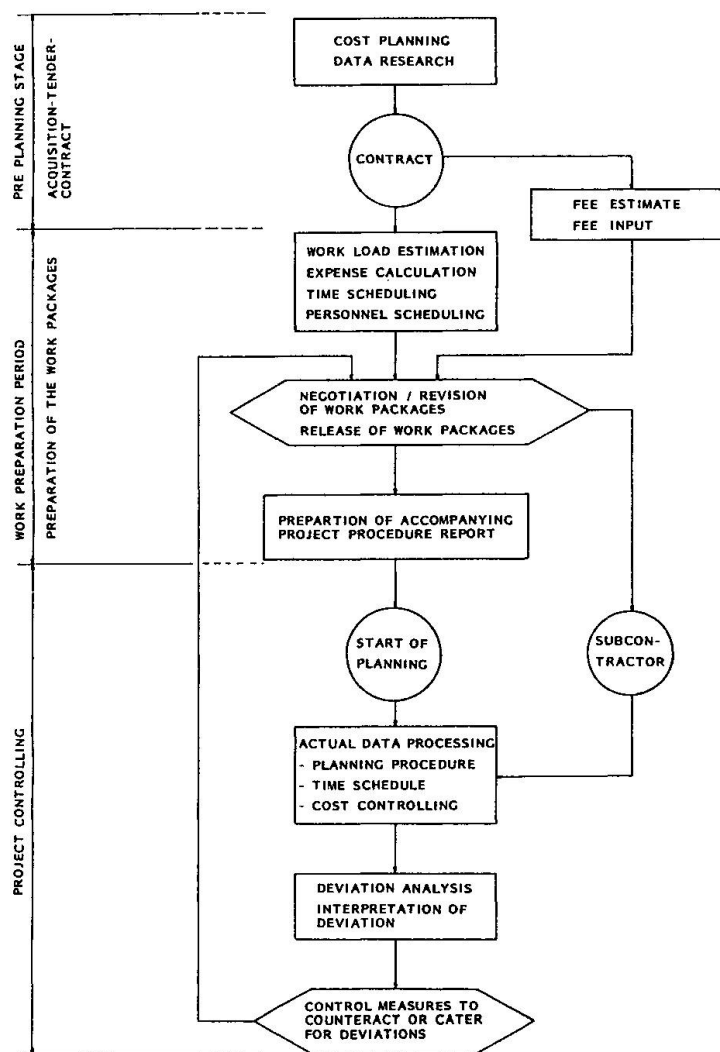


Fig. 1 Planning Preparation and Project Controlling



## 1. Planning Preparation

Good planning preparation is the key to the success of a project. It requires, though, very experienced planning experts with plenty of imagination and - at the same time - a sound conception for economical aspects. The planning preparation structures the overall planning procedure for the whole project from beginning to end, and subdivides the different planning stages. In this connection, each discipline engaged on the project is treated individually.

It will be clearly specified as to which drawings have to be made in the different design stages, also which reports have to be prepared, with an indication in respect to their contents. This goes right through to the Final Design and the Working Drawings, including Tender Documents.

Should the project start at zero, this scheduling will initially, of course, only go as far as the Preliminary Design; after its approval the further design stages will be structured.

The planning preparation also provides the future planning team with an indication as to related projects already designed, as to which details could possibly be used for this project from a computerized schedule of details, including the system to be chosen for Specifications and Bills of Quantities, and finally as to which similarity can be found with projects already completed.

The various design drawings, calculations and reports are then time-scheduled so that an overall picture can be obtained for the individual stages in respect of design work, in order to fulfill the envisaged task. The calculated man-days, man-weeks, or man-months are then multiplied by the appropriate cost factors so that the total planning expenditure is determined quite accurately. If this estimated expenditure agrees with the available fee, the project can be realized in this way. In case the fee is insufficient, the schedules have to be revised with the aim to reduce the design volume.

The final schedule and calculations form the basis for the future continuous work supervision and for the control of the progressing consumption of the consulting fees.

In addition, the planning preparation phase forms the basis for the composition of the planning team, and for the dates at which the individual disciplines have to get into action with their design work.

After completion of this preparatory phase, we now come to the

## 2. Planning Procedure

The Matrix Organization System has proved itself most suitable for the planning procedure. A matrix for various projects are shown in Fig. 2.

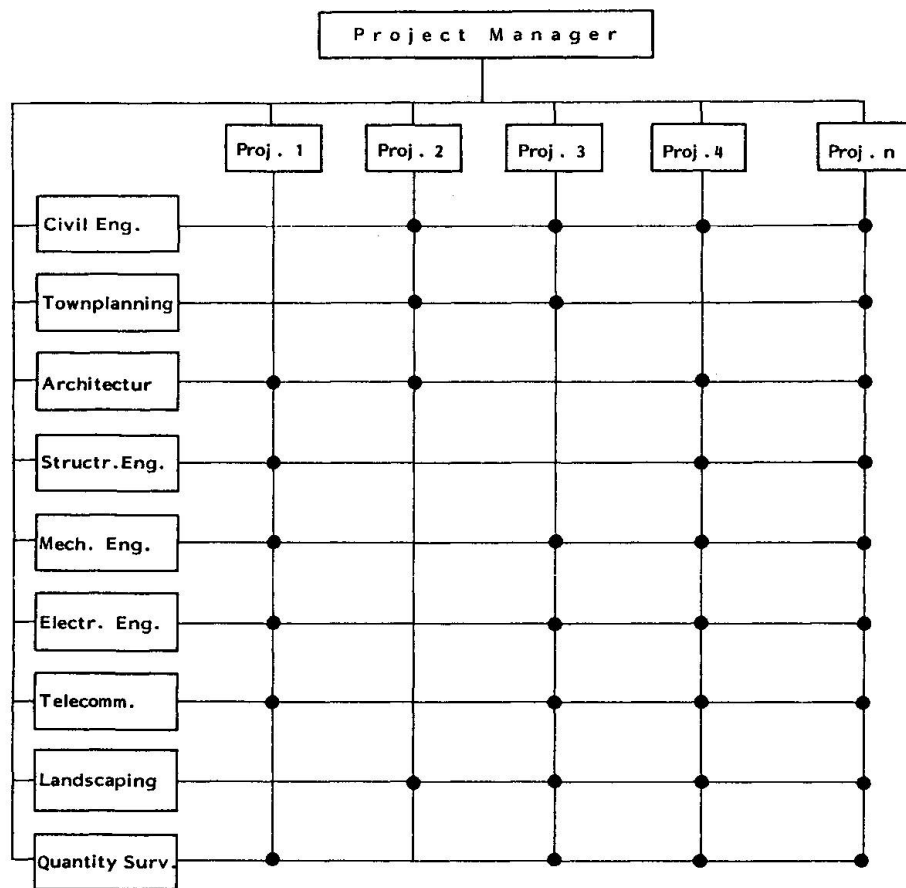


Fig. 2 Matrix - Organisation System

The Project Manager is appointed by the Company Management. The Departmental Heads in turn nominate the respective team members assigned to the Project Manager who also has a vote in their selection.

The Project Manager is responsible for the vertical axis of the matrix system, thus for the co-ordination, for the observance of the scheduled planning volume, for negotiations with the various disciplines, for adherence to the time schedules, and for keeping within the frame of consulting fees. The Project Manager is in charge of and controls the complete planning work process.

The Departmental Heads are situated in the horizontal axis of the matrix. They are responsible for the technical aspects of the project performance, and for the quality of the design work carried out by their team members. During the whole planning performance, they support the members of their own discipline in respect of both expertise and engineering standards, provide the appropriate design groundwork, and assist in the search for good technical solutions.

This method entails that each team member receives directions from two different sides, a situation to which they must get accustomed. Experience has shown that very rarely conflicts arise; on the contrary, that this dual control does lead to an efficient work procedure. It must be stressed, though, that the last decision always rests with the Project Manager.



The Project Manager represents the project vis-à-vis the Client and conducts all essential negotiations within the scope of the contract.

For each project, the Project Manager reports to one particular member of the Company Management who accompanies and controls the project from start to final completion, supporting the Project Manager in every respect. The Company Management will always be involved whenever contractual questions or serious decisions are concerned.

Each person engaged on the project records his working hours daily. At the end of the month he or she submits this record, approved by the Project Manager, to the Project Controlling Department for computer input. The Project Controlling Department supervises all projects throughout their complete planning period, and determines their progress on a monthly basis by means of drawing lists and time schedules. The computer calculations of man-hours and other expenditures in relation to work progress then yield a monthly progress report on the financial status of the project, and also on the realization of the project target at that stage.

If major discrepancies occur, steps must be taken, jointly with the Project Manager, to avoid losses. During the progress of the project, only limited possibilities exist for achieving any significant savings. It is therefore most essential to know exactly each month the financial status of the project, as counter-measures can then already be taken at the occurrence of minor deviations. If the discrepancies become too large, it is generally impossible to avoid losses effectively.

The planning procedure is affected quite appreciably by the increasing application of computers for design and draughting work. This is most obvious in such cases where a particular discipline has to refer back to information on computer stored drawings and data of other disciplines.

The matrix system remains equally effective with the use of CAD, although the work preparation has to be adapted to the employed computer operation. Here it is most essential for all participating disciplines to have recourse to the appropriate computer-stored drawings. By superposition the floor plans can be used conveniently also for the other disciplines, such as for instance Mechanical and Electrical Engineering. In case of any alterations it must be observed, of course, that such amendments are transmitted to all relevant disciplines.

During planning preparation the input times for the computer drawings have to be observed most carefully; also the appropriate steps to be taken so as to minimize future alterations. Furthermore, the time scheduling for the planning work must be prepared extremely accurately, if for no other reason than to allow for the availability of the computer.

A combination of meticulous Work Preparation and the employment of the Matrix System is a highly recommendable method for the planning and design of complex buildings.

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