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TASK PLANNING AS A PART OF PRODUCTION CONTROL

Juha-Matti Junnonen¹ and Olli Seppänen²

ABSTRACT

The execution of a construction project requires production planning and control to be performed with different levels of accuracy. In master plans, the overall progress of the whole construction project is planned and controlled. For practical implementation, site management requires more detailed plans. This can be achieved with the help of task planning, a method of planning which begins from what should be done and examines in detail how the time, cost, and quality objectives can be achieved. Task planning is related to look-ahead planning in the Last Planner System™.

Task planning is performed before the beginning of the task. The execution of the task is planned in detail and considered from six angles: analysing potential problems, scheduling, costs, quality requirements and quality assurance, the prerequisites for the task, and ensuring the progress of the task. The objective of task planning is to ensure that the task can be started on time, that the requirements of the owner can be met, and that the master schedule can be implemented as planned. Task planning also ensures that the supervisors and workers know the objectives and demands of the task and how the implementation of these objectives and demands has been planned. This requires the results of the task plan to be examined together with the workers who participate in the task, e.g. in quality circles. Task planning can also be utilised in the drafting of subcontracts and delivery contracts.

In this paper the connection between project master plans and task plans is described. The principles on which the making and use of task plans are based are described.

KEY WORDS

Task planning, scheduling

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INTRODUCTION

The purpose of this paper is to present the task planning method. The method has been developed in the 1990's (Junnonen 1998). It is a part of the comprehensive Line-of-Balance based schedule planning and control system (see e.g. Kankainen and Seppänen 2003). Currently the task planning method is widely used in Finland.

The scientific background of task planning is system thinking and goal-oriented management (e.g. Ballé 1994, Ackoff 1994). To simplify, the crucial factors are the division of production control into mutually-interacting parts and the fact that the execution of the task is secured from different aspects: scheduling, costs, quality, and safety (e.g. Rwelamila and Hall 1995).

The execution of a construction project requires production planning and control to be performed with different levels of accuracy, because plans are created in order to fulfil different purposes. In master plans the overall progress of the whole construction project is planned and controlled. But master plans are too rigid and general to be of use for the site manager and supervisors in planning and controlling individual project tasks. Plans can be made relevant for daily work with the help of task planning, a method of planning which begins from what should be done and examines in detail how the time, cost, and quality objectives for a scheduled task can be achieved. The reaching of the objectives and requirements of the master plan requires the examining of different alternatives, the identification of potential production risks, the concretisation of quality demands, and the choice of quality control procedures. Furthermore, the work must be planned so that it can be implemented safely, any disturbances and changes can be managed, and the necessary materials, equipment, and tools are available at the right time. Task planning differs from weekly or look-ahead planning in that the implementation of a whole task is planned as one entity (Figure 1).

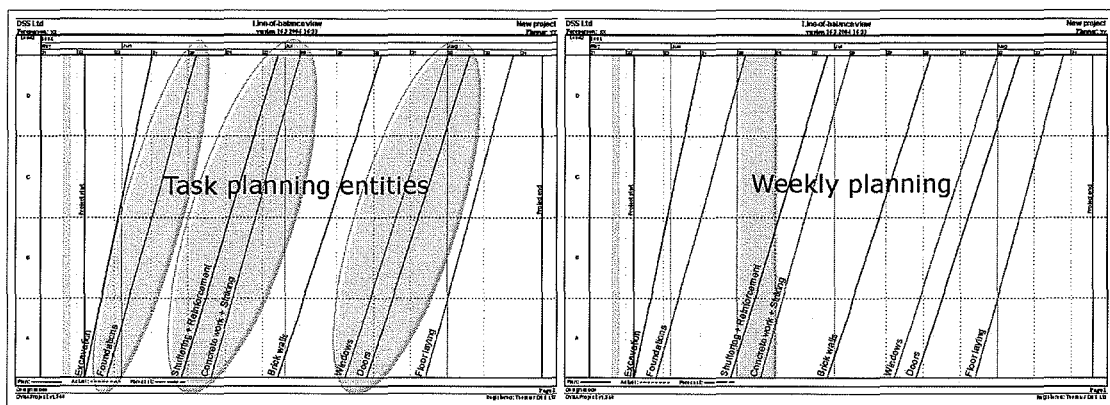


Figure 1. The difference between task planning and weekly planning

Production control is interpreted as a complex unity of decision functions and information-processing functions, which ensure that the construction process leads to a product which satisfies the requirements of the client (e.g. Melles and Wamelink 1997). An essential part of the production control process is production planning. In production planning the prerequisites for control are created, the future decisions that are related to the operation are prepared, and management is supported by scanning the future and reducing uncertainty (Hunt 1979). Production control consists of proactive and reactive control. The feasibility of production planning is secured with proactive control and endeavours to ensure that production does not deviate from what was planned. By means of reactive control, the original schedule can be implemented as planned. The need for reactive control and supervision is reduced by proactive control.

Detailed project plans are part of proactive control. With detailed plans the goal is to ensure that all the preconditions for the task exist when it is started and that it can be executed without disturbances. The detailed project plans include a material handling plan, a logistics plan, a site plan, and task plans.

Production is brought back to conformity with the plan by the use of reactive control. Reactive control involves the supervision of production and finding out how production deviates from the master plan (Kankainen and Sandvik 1999) (Figure 2).

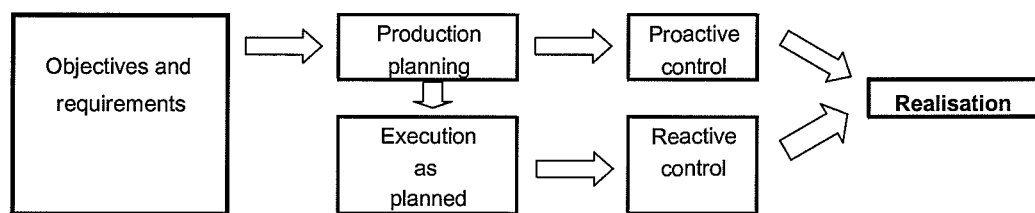


Figure 2. Proactive and reactive control

TASK PLANNING AS A PART OF PRODUCTION CONTROL

NEED FOR TASK PLANNING

Task planning is a tool for production management to ensure that:

- the individual task will reach the time and economic objectives and qualitative requirements laid down in the master schedule and budget
- the supervisor, subcontractors, and workers have a shared knowledge of the objectives and requirements of the work and how these objectives will be achieved (Junnonen. 1998, Kankainen and Junnonen 1999).

The responsibility for task planning is given to the supervisor who is responsible for the task. The responsible person should get acquainted with the task as early as possible in order to be

able to request changes to specifications and details. In the planning of an individual task, the main purpose is to ensure that all the prerequisites of the task can be met and the task can proceed with planned production rate. Prerequisites include:

- completion of the preceding task according to the schedule
- the readiness and constructability of product plans
- checking of technical details
- clarifying and timing the materials needed
- cataloguing and securing the equipment and tools needed

The task plan also serves as the realisation model of the task and is used for subcontracts, material contracts, deliveries of material, the reserving of equipment, and the clarification of the quality control procedures (Figure 3).

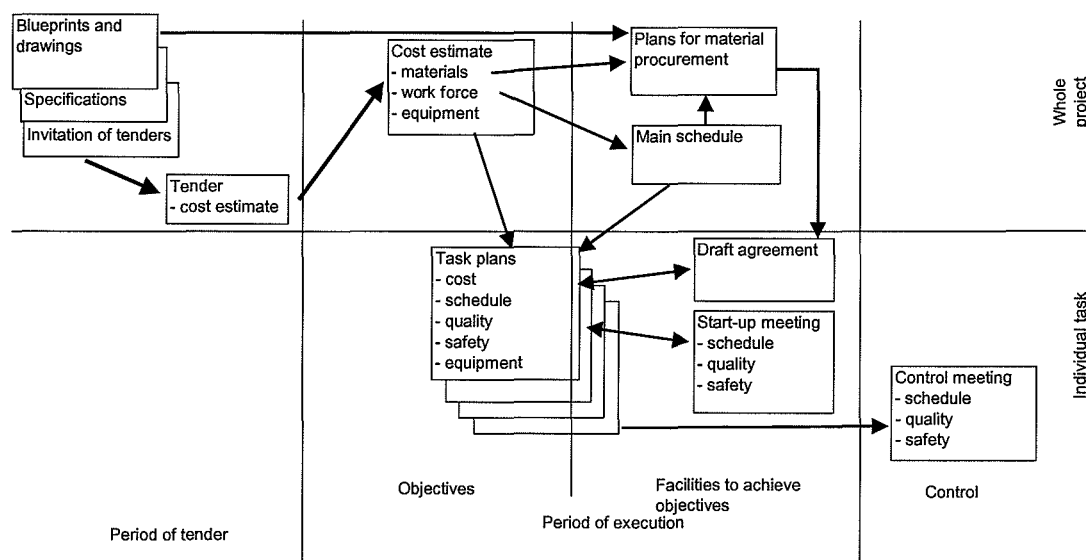


Figure 3. Principle of task plans and their connections with other production plans

CONTENTS OF THE TASK PLAN

With task planning, individual tasks are planned comprehensively so that the realisation of the task will fulfil the objectives and requirements. The objectives and requirements are found in contract documents, the contractor's overall plans, and safety regulations. The execution of the task is planned in detail from six angles: analysing potential problems, scheduling, costs, quality requirements and quality assurance, prerequisites for the task, and the securing of the progress of the task (e.g. Junnonen 1998, Koskenvesa and Pussinen 1999).

Schedule of the task

In the master schedule the project is divided into independent tasks, which are summaries of subtasks. The formation of tasks in the master schedule is often partly approximate, because the primary purpose of the master schedule is to ensure that the whole project and all of its milestones can be completed in time. The master schedule shows when tasks are going to start and end and how they proceed in terms of flow. Less important tasks of short duration are not scheduled in the master schedule or are included in the work content of other tasks (Kankainen and Sandvik 1999).

The purpose of the task schedule is (Figure 4):

- to ensure that the production rate of the task is compatible with the master plan
- to secure the beginning and completion of the task in the right time frame in each separate workplace
- to facilitate control by changing the objectives to measurable quantities

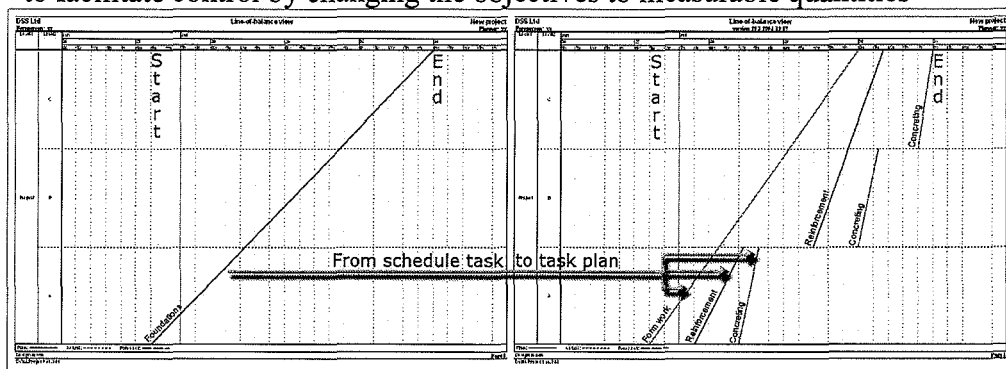


Figure 4. Principle of formatting the task from the schedule task

The work quantities and work consumption used in the master plan and the cost estimate must be checked and possible mistakes must be taken into consideration. Usually, if mistakes are noticed, the means by which their influences can be mitigated are quite limited. Changing resources or task contents, and improving work arrangements can influence the production rate.

General contractors have to determine the needed production rate and milestones of the subcontractors beforehand based on the master plans. Both the production rate and the milestones should be written into invitations for tenders and subcontracts. The general contractor must also clarify the required size of the subcontractor's team, so that it can be ensured that the subcontractor can achieve the desired production rate (Figure 5). To assess required crew size, productivity information based on historical data is needed. In Finland, this hasn't been a problem because the construction industry has developed a comprehensive productivity database as a joint effort (see e.g. Olenius, Koskenvesa & Mäki 2000).

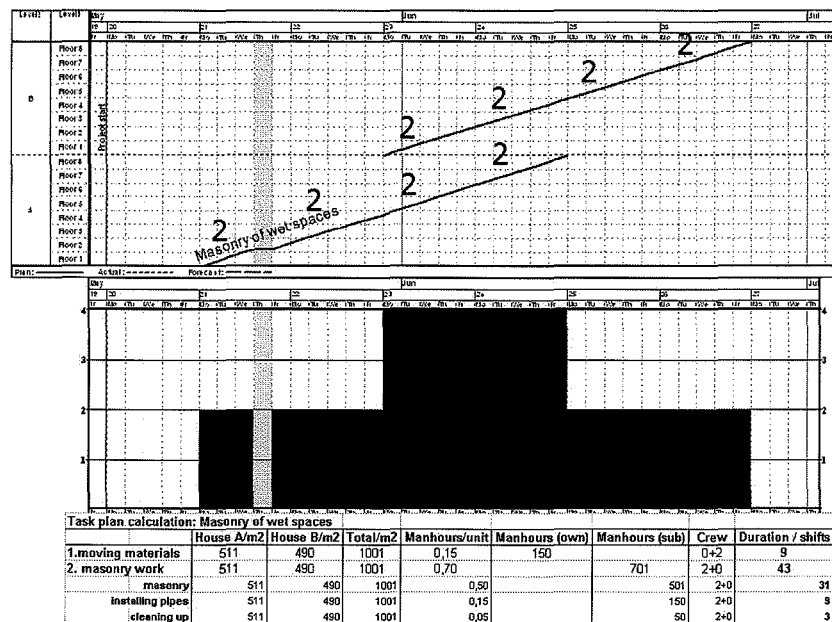


Figure 5. An example of a task schedule

Costs of the task

The cost objective of the task consists of two phases:

- collecting the cost objective of the task from the cost estimate of the project
- examination of quantity information, work consumption, and price level

The purpose of the collection is to ensure that the task can be carried out at the cost shown in the project's cost estimate. While the cost estimate is being made, assumptions are made about production solutions, logistics solutions, and about work methods. These assumptions have to be checked and specified before the task begins. The specifying of the obligations of subcontractors also affects work consumption (Figure 6).

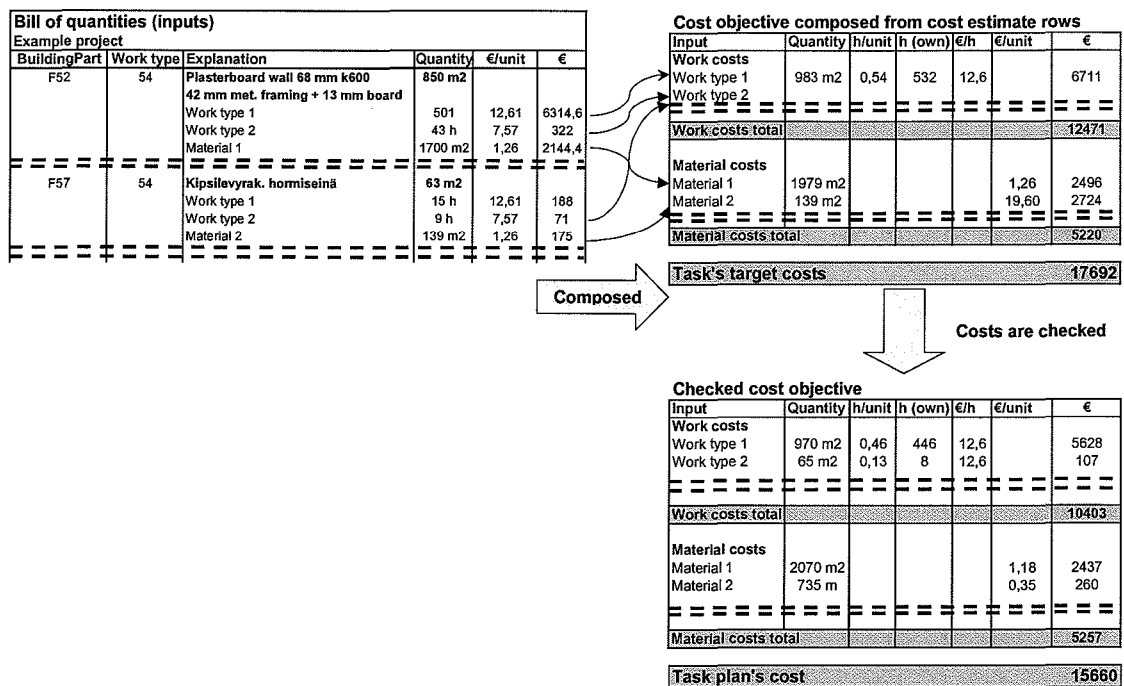


Figure 6. An example of a task's cost objectives

Quality requirements of the task

The purpose of the clarification of the quality requirements which are related to the task is to remedy mistakes and shortcomings in the work in advance. Additionally, possible faults and contradictions are noted and quality requirements which are unclear or illegible are redefined. The quality requirements are further converted, if necessary, into checklists that are given to workers.

The quality requirements for the task are presented in the specifications and in other contract documents. In these there can be references to general quality requirements and standards. The quality requirements of the task are collected and they are changed into work specifications and measurable values. At the same time, the technical details in the plans are specified and designed.

The quality requirements apply mainly to the tolerances and properties of the results of the work. They can also relate to performance or operation on the site, for example in connection with storage, safety, the handling of waste, or cleaning. For every quality requirement, how it is to be verified and documented must also be specified. In subcontracts the quality requirements are attached as an appendix to the agreement (Figure 7).

Inspection issue	Requirement	Checking / verification
Ground		
cleaning	no dust or dirt	brushing, visual checking
moisture	even moisture, if necessary moistening	measurement by hygrometer, notes in field log
Materials and tools		
mortar	compo mortar	producer's documents
water	temperature over +5°C	daily measurement 7 am., notes in field log
plastering mesh	hot galvanized, mesh size 19 mm clear cover 5 mm, stainless wire tie 4 no/m ²	producer's documents have to be checked during delivery
During the work		
layer thickness	rendering coat 2...3 mm browning coat 10...15 mm finishing coat 4...5 mm	measurement: * chance sample * otherwise visual checking
adherence	bond of the rendering coat 28 d: >1,5 MN/m ²	drawing test, notes in field log
plainness	browning coat ± 7 mm before finishing	darby float (l=2000)
drying time	rendering coat 2 d, browning coat 7 d, finishing coat 3 d	notes in field log

Figure 7. An example of a task's (plasterwork) quality requirements and quality proceedings

Analysis of the risks associated with the task

The factors that threaten the execution of the task are clarified in the task plan; in other words, an analysis of so-called potential problems is performed (e.g. Kepner and Tregoe 1976). The analysis of the problems must be based on the characteristics and details of the task, because the real problems cannot be identified at a level, which is too coarse and general.

It is possible to identify and prepare for most potential problems in advance to prevent the realisation of the problem or to prepare for its consequences. The identification of problems requires understanding of the chain of cause and effect. In the identification of problems, the craftsmanship and experience of the manager and supervisors and the workers are utilised. Additionally, different risk lists and quality problem lists can be utilised. The problems can be connected with the costs of the task, the schedule, or quality or safety issues. The mere identification of problems is not enough; the consequences must also be determined in order to estimate the seriousness of the problem. Knowing the reasons and consequences provides a chance to develop ways of action. Preventive action can concentrate on the cause, which reduces the probability of the problem occurring, or the consequences, which reduces the significance of the consequences.

For the analysis of problems, they are divided into technical, functional, procurement-related, safety, and environmental problems. A technical problem refers to performance that requires, for example, special technical know-how or technical solutions which are not ordinary or familiar. Functional problems have an indirect effect on the completion of the building, part of the building, or structure according to the plan. Problems of procurement are a subset of functional problems, but the probability of their appearance is more pronounced and the consequences are so significant that they form their own group (Kankainen and Junnonen 1999). Problems of procurement include the securing of the right source of

information for procurement, the contents of deliveries to the site, and the timing of the deliveries.

The identification of potential problems must always lead to preventive action, such as changes of plan, meetings and inspections between parties, improvement of work planning, or contractual changes.

Detailed planning of the performance of the task

The purpose of task planning is to ensure that the task can begin as scheduled, to look for new modes of action, or to find out details which are related to production when the chosen method is new. In detailed planning checklists are made of:

- machines, devices, and equipment
- hand tools
- bulk supplies

The detailed planning of the task also includes placing delivery orders for the materials which are related to the task and material logistics, such as the planning of transfers and storage and the reserving of storage areas and waste containers (Wegelius-Lehtonen et al. 1996). Furthermore, it is ensured that the workers have enough personal safety equipment on site and that the necessary safety plans have been made.

USE OF TASK PLANNING

IN DRAFTING SUBCONTRACT AGREEMENTS

With the help of the task plan, the terms of subcontracts are drawn up. The task plan is prepared in two stages. In the first stage, information concerning the task is collected and the cost and production targets of the subcontract are determined, the quality requirements of the work are clarified, and an analysis of the potential problems is carried out. In the second stage, the results of planning are utilised in the determination of the subcontract's terms and obligations. With the help of task plans, the following are obtained:

- cost objectives with which the subcontractor's bids are compared
- quality requirements
- quality control and quality assurance procedures
- schedule demands which are imposed on the subcontractor and apply to the beginning and termination of the task, and milestones and production rates

IN PREPARATION OF MATERIAL PROCUREMENT

The task plan for material procurement is made in a similar way as that for subcontracts, but in material procurement the primary focus is on determining the quantities of materials needed, the timing of deliveries, and logistical issues.

The task plan for the preparation of material procurement contains:

- costs
- delivery plans, lot sizes, and delivery times
- a logistical plan for transfers, storage, and waste management
- quality assurance procedures

With the help of the cost estimate it is ensured that the quantity of materials does not exceed the estimated quantity and that the procurement does not exceed the reserved costs. At the same time, the necessary materials and their quantities are specified.

IN ONE'S OWN WORK

In the task plan of one's own work the securing of the preconditions for the task is emphasised. The precondition for production control is that the supervisor and the workers know what the quality requirements and production rate and milestones for the task are. This requires the results of the task plan to be examined together with the workers participating in the task, e.g. in quality circles before the beginning of the task (Junnonen 1998). In quality circles the supervisor and workers go through the quality requirements and quality control, timing, and workplace safety aspects of the task and also plan other factors which are related to the task. Quality circles can also take place during the work if there are problems or the production rate is not what it should be.

CONCLUSIONS

With task planning, the individual task is planned comprehensively so that the realisation of the task will fulfil the objectives and requirements. The execution of the task is planned in detail from different angles: scheduling, costs, quality, the prerequisites of the task, and ensuring the progress of the task. Furthermore, an essential part of task planning is the analysis of so-called potential problems, in other words the factors that threaten the beginning or execution of the task.

The content of task planning and Last Planner are near to each other (e.g. Koskela and Koskenvesa 2003). In both, among other matters, the goal is to ensure that all the preconditions of a task exist when it is started, that the task can be executed without disturbances, and that it is completed according to the plan. Additionally, both methods are partly proactive and partly reactive. The methods have been developed independently from each other.

The reason why two short-term planning and control methods exist, and also that there are differences between them, is mainly because of differences in the planning of the main schedule and control systems. In Finnish practice the modified Line-of-Balance has been the dominant scheduling method since the 1980s, whereas Last Planner is based on the CPM method. However, Last Planner and task planning can both be seen as complementary methods which have the same goal.

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