3 The 0 + 5 + X Planning Model

The 0 + 5 + X planning model (fig. 3.1) is the outcome of a multitude of projects in different sectors together with many years of practical experience.

![Diagram of the 0 + 5 + X Planning Model](image)

**Fig. 3.1 Complexes of the 0 + 5 + X planning model (abbreviated version)**

It contains complexes that cover a range of areas from the processing of the problem and task definition to acquisition of the customer order and the project definition, project development and the project implementation and execution. The results of the complexes can be developed either individually or in their totality as engineering planning services for customers, clients or investors. At the same time, the complexes define fundamental decision-making levels for complet-

ing or continuing the planning work from the task definition to the realization of
the production facility.

The customer order is a prerequisite for project development and implementa-
tion. It must lead to the project definition (complex I) agreed upon between the
customer and the contractor (manufacturer/supplier).

The planning project should be implemented in three stages (complexes) based
on a planning model.

Complex I: five specifications (01 – 05) to qualify the definition of the pro-
ject.

Complex II: five project design steps (5/1 – 5/5) for the development of the
project.

Complex III: five specifications (x6 – x10) for the implementation of the pro-
ject.

The three complexes are implemented in a loop or spiral process that reevalu-
ates every upstream and downstream project design activity whenever changes are
made and verifies their effect on the overall project.

In this manual checklists and comments such as “NB” and “note” support the
implementation of a planning project employing the 0 + 5 + X planning model.
The checklists are used to provide a logical sequence for the selection and review
of project design activities and are assigned to complexes I - III.

The planning model is only a rough guideline beginning with the identification
of objectives and the design of a solution. A methodical approach must provide for
adaptability in the planning process and the design of production facilities.

The approach is demonstrated by means of a complex planning project of sys-
tematic production facility planning for the production of worm gears (cf. 3.2.5).

3.1 Project Definition (Complex I)

This includes the five specifications in figure 3.2, which are derived from the cus-
tomer order.

The customer order is the outcome of intensive collaboration, consultation and
influence exerted by the potential planner as contractor - CO - (planning engineer,
supplier) with the potential client - CL - (investor, operator). Compiling details of
the problems and objectives relevant to the project necessitates preparatory work
(e.g. project studies and analyses) on new developments and specifications.

Examples of preparatory work relevant to development include research find-
ings (products, processes/technologies, machinery and plant), patents, inventions,
technical developments, forecasts, innovations, reference designs, technologies,
plants and projects, conceptual designs, reports and inspections.
3.1 Project Definition (Complex I)  

Fig. 3.2 Complex I of the 0 + 5 + X planning model: project definition

Examples of preparatory work relevant to specifications are production and sales programs, products (design, features), technology, quantities, times, quality, costs, restrictions and permits, partners (general contractors, subcontractors, contractors for equipment, facilities, construction and trades); deadlines, work and decision stages and investments.

In order to prepare the content of the project definition (complex I), the questionnaire (checklist) in Table 3.1 should be completed.

Table 3.1 Checklist – 0 + 5 + X Planning Model - Customer Order/Project Definition (Complex I)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>Customer Order</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Requirements specification: Definition of customer’s task (problem) – what has to be done and why to achieve the scope of service demanded</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical specifications: Project engineer/supplier’s implementation concept – how and by what means is customer’s task (problem) to be resolved?</td>
</tr>
<tr>
<td></td>
<td>01</td>
<td>Project definition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specification of input variables</td>
</tr>
<tr>
<td></td>
<td>a) Actual status</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data available</td>
</tr>
<tr>
<td></td>
<td>b) Target status</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Redevelopment</td>
</tr>
<tr>
<td></td>
<td>02</td>
<td>Analysis Phases/Corporate Objectives</td>
</tr>
<tr>
<td></td>
<td>a) Corporate objectives</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Market position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prestige</td>
</tr>
<tr>
<td></td>
<td>b) Concepts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sales, marketing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profitability</td>
</tr>
</tbody>
</table>
3 The 0 + 5 + X Planning Model

<table>
<thead>
<tr>
<th>03 Basic Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>New building</td>
</tr>
<tr>
<td>Remodeling/rationalization</td>
</tr>
<tr>
<td>Extension</td>
</tr>
<tr>
<td>Decommissioning</td>
</tr>
<tr>
<td>Revitalization</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>04 Planning Phases, Objects and Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Planning phase</td>
</tr>
<tr>
<td>Development/planning</td>
</tr>
<tr>
<td>Start-up</td>
</tr>
<tr>
<td>Dismantling</td>
</tr>
<tr>
<td>Main/conceptual planning</td>
</tr>
<tr>
<td>Execution planning</td>
</tr>
<tr>
<td>b) Planning objects</td>
</tr>
<tr>
<td>Personnel</td>
</tr>
<tr>
<td>Equipment/plants</td>
</tr>
<tr>
<td>c) Planning instruments</td>
</tr>
<tr>
<td>Models</td>
</tr>
<tr>
<td>Tools</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>05 Project design principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
</tr>
<tr>
<td>Top down</td>
</tr>
<tr>
<td>Variants</td>
</tr>
<tr>
<td>Improvement</td>
</tr>
<tr>
<td>Synergy</td>
</tr>
</tbody>
</table>

The purpose of order acquisition is to negotiate the most important requirements and specifications to which the production facility must respond, as well as the scope of supply and services. A detailed request for quotation or offer (technical and commercial part) can then be drawn up based on these preliminary negotiations and preparations. The following documents have proved valuable in this respect:

Requirement specifications (DIN 69905): client’s (CL) definition – what has to be done and why to fulfill the scope of performance required?

Technical specifications: project engineer/supplier’s (CO) implementation concept – how and by what means is customer’s task to be accomplished (task definition and solution)?

Table 3.2 shows the functions of the requirement and technical specifications.

<table>
<thead>
<tr>
<th>Table 3.2 Functions of the requirement and technical specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functions of the requirement specifications</td>
</tr>
<tr>
<td>Description of the required scope of performance</td>
</tr>
<tr>
<td>including the basic conditions (from the client’s perspective)</td>
</tr>
<tr>
<td>Description of requirements regarding the scope</td>
</tr>
</tbody>
</table>
The feasibility in terms of content, time and financing of the scope of performance set out in the requirement specification is coordinated and reviewed by the CO (planner, supplier) in conjunction with the CL, and the technical specification is drawn up by the CO as its implementation concept.

The implementation concept includes the scope of performance required, the implementation of the requirements in economically efficient supply chains with technical solutions, the auxiliary equipment in support of project execution, the coordinated implementation of planning activities, stages and steps and decision and control measures with specific target dates.

The cycle: together with the CL and CO’s joint specifications in the project definition stage (complex I), the request for quotation/order to the CO by the CL, the drawing up of the offer by the CO, the commissioning of the scope of services by the CL and the joint conclusion of the contract all form the basis for the project development (complex II) and project implementation (complex III). This process must be managed and this is known as project management.

In principle there are two separate stages to defining the content of the requirement and technical specifications:

a) Project development (complex II)
for the complex production facility planning as the planning-side basis for the execution/implementation project. This includes, among other things, all essential resources and items (machinery/plant/facilities/trades) based on non-binding (indicative) offers. The equipment list equates to a “bill of materials” for the entire project.

b) Project implementation (complex III)
has the objective of implementing all resources and items (machinery/plant/facilities/trades) based on “binding” orders and contracts for all items in the equipment list. For this reason from this point forward binding quotations and agreements must be obtained / concluded for every single item right up until the
material and technical execution. The approaches to and special features of planning and execution are discussed separately in “Project Implementation (complex III)”. The project definition comprises important specifications regarding the customer’s (general) aims. A network should be set up between the customer and project team and the participating partners to evaluate short-term changes and their consequences and derive inferences for the subsequent work. In the process, decisions need to be made in the following five areas of project design activity:

(01) **Specification of input variables**

The input variables are configured according to the target status. In the case of existing production facilities that are to be “redeveloped,” the actual status needs to be analyzed (actual status analyses). To do this, existing inventory data (documents, drawings, products, production quantities, technologies, processes, location and structure of the production and logistics systems and building plans) should be used. A comparison between the target and actual status should make any shortfalls apparent. This applies for the client’s specifications for construction, technology, demand progression, level of technology, floor space/rooms, times, restrictions and profitability.

**NB: Input variables**

a) General input variables

- corporate objectives
- production program, products, product groups (quantity, quality, times, costs) taking market developments into account
- materials (commodities, raw materials, semi-finished products), origin, quality and quantity for core and by-products
- production technologies and processes
- resources and capacities for core, auxiliary and subordinate processes
- manufacturing information: manufacturing/assembly, lot sizes per unit of time; make-to-order, small batch and series production, manufacturing stages, vertical integration
- logistical processes
- plant and equipment information: main systems, mechanization and automation, procurement possibilities
- logistical organization and technology
- working time, remuneration systems, workforce capabilities
- organization (structure, processes, functional units)
- profitability including target costs (target costing, target pricing), performance and revenue statistics, capital spending
- health, labor and environmental protection including resource consumption
- timetable for planning and execution
3.1 Project Definition (Complex I)

- basic conditions (selected laws, ordinances, etc.)

b) Input variables in the case of existing production facilities

The assessment of the situation and potential based on existing data constitute a necessary prerequisite.

Situation analyses incorporate all data about the product, process and plants including building elements and employees, and a check of all inventory data. The assessment of potential incorporates the determination of capabilities together with an evaluation of strengths, weaknesses and opportunities.

c) Evaluation by assessing potential

*Objectives of the assessment of potential*

- creation of initial data for the subsequent planning process
- obtaining of detailed knowledge about the planning object, discovery of technical, operational and organizational weaknesses

*Fundamentals*

- clear definition of aims, contents and scope of the analysis
- use of suitable employees
- application of special methods and auxiliary equipment
- determination of basic conditions

*Approach*

- specification of areas to be examined when assessing potential
- specification of investigative effort and the methods employed to carry out the production facility analysis

*Information obtained from*

- product quantity analysis (e.g. ABC analysis)
- manufacturing process analysis
- material, energy and information flow analysis
- order processing analysis
- plant and equipment analysis
- cost analysis
- workflow and organizational structure analysis

**Note:** the outcome of a well-founded assessment of potential forms the basis for ascertaining the planning task, providing a detailed definition of the initial position and targets and evaluating solution principles. Input variables must be examined for possible changes and adaptability. Target and actual data need to be determined for production and order program planning.
(02) Specification of the scope of analysis and corporate objectives
This is based on the anticipated value-added and supply chains and corporate objectives. Decisions must be made regarding the basic corporate objectives in accordance with fig. 3.4 and planning concepts.

**NB:** For the corporate objectives take note of the aim categories.

<table>
<thead>
<tr>
<th>Differentiate and prioritize</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic corporate objectives</strong></td>
<td>(according to MEFFERT)</td>
</tr>
<tr>
<td><strong>Aim category</strong></td>
<td><strong>Aims</strong></td>
</tr>
</tbody>
</table>
| Market position aims | - Increase in market share  
- Opening up of new markets  
- Increase in turnover |
| Profitability aims | - Profit  
- Turnover  
- Return on capital (equity, total capital) |
| Financial aims | - Safeguarding of liquidity  
- Minimization of outside capital  
- Profit |
| Social aims | - Job satisfaction  
- Income and social security  
- Personal development |
| Prestige aims | - Autonomy  
- Societal and political influence  
- Image |

The following factors underlie the different aims

| - Concentration | - Utilization of potential synergies |
| - Development of strengths | - Adaptation of the organization to the strategy |
| - Utilization of opportunities | - Compensation for risks |
| - Targeted innovation (Product, process, structure, social) | - Transparency of strategy  
- Consistent values |

**Fig. 3.4** Strategic principles and aims of the manufacturing enterprise (adapted from Meffert and Wiendahl)

**NB:** for the planning concepts

a) Sales and marketing concept

**Table 3.3** Questions regarding the sales and marketing concept

| Enterprise related questions, including about the product’s share of turnover and profit the fixed and variable costs associated with the product | Sales market related questions, including about the absolute and relative market share of the product |
b) Product concept
This contains all information on economically-marketable products (quantity, form, costs). Sub-concepts need to be developed in accordance with the product life cycle. Sub-concepts include: product development, use and recycling.

c) Production concept
This is based directly on the product concept and determines the product manufacturing processes (technologies) in terms of their technical, technological and organizational form. Table 3.4 shows the decision-making principles.

<table>
<thead>
<tr>
<th>Influences</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>• Quality</td>
</tr>
<tr>
<td></td>
<td>• Quantity per unit of time</td>
</tr>
<tr>
<td></td>
<td>• Availability</td>
</tr>
<tr>
<td></td>
<td>⇒ need-/customer-based</td>
</tr>
<tr>
<td>Business enterprise/</td>
<td>Manufacturing costs ⇒ profit oriented</td>
</tr>
<tr>
<td>Profitability</td>
<td>Process reliability, operating and occupati-</td>
</tr>
<tr>
<td></td>
<td>onal safety ⇒ compliant with the law</td>
</tr>
<tr>
<td></td>
<td>Employees (number, skills) ⇒ • need-based</td>
</tr>
<tr>
<td></td>
<td>• socially acceptable</td>
</tr>
<tr>
<td></td>
<td>• profitable</td>
</tr>
<tr>
<td>Environ-</td>
<td>Flexibility (adaptation of processes to</td>
</tr>
<tr>
<td>mental precautions</td>
<td>product life cycle, product changes) ⇒</td>
</tr>
<tr>
<td></td>
<td>market/sales-based</td>
</tr>
<tr>
<td></td>
<td>Resources (materials, energy, information) ⇒</td>
</tr>
<tr>
<td></td>
<td>economical, minimum-cost, re-source and</td>
</tr>
<tr>
<td></td>
<td>energy efficient</td>
</tr>
<tr>
<td></td>
<td>Emissions ⇒ environmentally compatible</td>
</tr>
<tr>
<td></td>
<td>Waste ⇒ environmentally friendly/ recycling-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personnel concept</th>
<th>Sub-sectors of personnel planning are</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• personnel requirements, future personnel</td>
</tr>
<tr>
<td></td>
<td>requirements and workforce</td>
</tr>
<tr>
<td></td>
<td>• recruitment, planned/future recruitment in</td>
</tr>
<tr>
<td></td>
<td>the event of shortages</td>
</tr>
<tr>
<td></td>
<td>• personnel deployment, optimum allocation of</td>
</tr>
<tr>
<td></td>
<td>staff to jobs (a) medium to long term and</td>
</tr>
<tr>
<td></td>
<td>(b) short term/operational</td>
</tr>
<tr>
<td></td>
<td>• personnel development (qualitative personnel</td>
</tr>
<tr>
<td></td>
<td>planning), qualification of workforce in</td>
</tr>
<tr>
<td></td>
<td>accordance with job requirements as a signi-</td>
</tr>
<tr>
<td></td>
<td>ficant contribution to supply of personnel</td>
</tr>
</tbody>
</table>
e) Profitability concept (assessment)
All of an enterprise’s business processes influence its profitability in that they either drive value creation directly and/or indirectly, and consequently result in costs.

The profitability concept should be regarded as the definition of concrete return on investment targets and financial goals to be achieved by the enterprise as well as the corresponding basic implementation measures (cost reduction, investment and pricing, among others).

Each assessment and manipulation of the profitability of a business enterprise is based on monetary values. These values obtain their regulating effect from the markets. The corporate accounting department connects the monetary values to in-house processes. Key and in-process tasks (bookkeeping, financial accounting) include

- cost accounting – pricing (process-oriented cost accounting and pricing)
- investments - financing
- financial accounting – benchmarking (financial accounting process and benchmarking)

**Note:** variants of possible changes should be taken into account in the concepts. In the process, the targets, benefits, costs and risk also need to be evaluated (cf. evaluation methods tab. 2.3)

(03) Specification of basic planning cases
These form the basis of the reason for formulating a project. Decisions must be made regarding the project function based on the four basic cases.

**NB:** Selection of basic planning cases

Basic case A – New development of production facilities
- significant preliminary planning period in terms of time and content
- global specifications for production program and development
- determination of optimal location incl. infrastructural integration
- targeting of optimal process solutions based on high degrees of freedom

Basic case B – Reconfiguration of existing production facilities
- aims are rationalization or modernization of existing production complexes
- relatively precise specifications for production program and development
- continuous adaptation of the production complexes to production program changes (market) or to cost-effective process and plant innovations.

Basic case C – Expansion of existing production facilities
- leads to increased floor space and room utilization in the existing location
can be combined with identification of location for additional capacities (cf. basic case A)
• can call the existing location into question and lead to relocation to a new site

Basic case D – Decommissioning (revitalization) of existing production facilities
• leads to reduction in floor space and room utilization in the existing location
• can lead to complete closure of the site
• floor space that is freed up can be assigned to new uses

Note: flexibility and adaptability in particular must be taken into account for each of the basic cases.

(04) Specification of the planning phases, objects and instruments
In the case of the planning of production facilities, the planning phases must be related to the life cycle, planning objects and planning instruments. The scope of consideration of the planning cube thus consists of x-y-z axes, by means of which the different planning tasks are to be developed (see fig. 3.5).

![Fig. 3.5 Scope of planning consideration (Schenk, Wirth 2004, p. 107)](image)

Each planning task is different and complex. It must be executed so that the planning phase, object and instrument are given equal consideration and aligned to the practical realities.

The planning phases form a closed loop. There is positive feedback between the individual phases, and the ways in which they interconnect and interact must be taken into account. In practice only the development (I) in the form of the plan-
ning phase, setup (II) in the form of the execution phase and startup (III) and operation (IV) in the form of the commissioning phase are integrated. Work contents and results that are generated by service providers (planning agencies) and in-house planning departments are:

**Planning phase**
Studies, concepts, analyses, projects (variants), task definitions, function descriptions, layout depictions, functional models

**Execution phase**
Assessment and selection of offers, construction sequence plans, relocation plans, project management plans (trades and schedule flows), capacity allocations, coordination processes), commissioning stages

**Commissioning phase**
Commissioning and acceptance protocols, quality and protection certificates, proof of performance in the startup phase

**NB:** Selection of planning phases, objects and instruments

a) Planning phases (x axis)
- development/planning
- target planning
- core/conceptual planning
- detail/system planning
- execution planning

b) Planning objects (y axis)
- personnel (number, skills, motivation)
- structures (workstation, section, division)
- moveable objects (machinery, plant, workstations, equipment, logistics)
- property (buildings, infrastructure, land)

c) Planning instruments (z axis)
- theories
- models
- methods/procedures
- tools and instruments

**Note:** the scope of planning consideration allows for a multitude of possible combinations, so that for each planning task specific planning methods and the corresponding models and tools may be selected and utilized.
(05) Specification of project design principles

Principles and rules that are based on experience have become established for managing projects. Decisions must be made as to which specific principles will apply to the project development.


1. **Totality Principle**
   Global design of the planning process (phases and stages), interdisciplinary composition of teams, participative forms of procedure and cooperation. First analyze, then systematize.

2. **Phase Principle**
   For each phase in the life cycle of products, processes, plants and buildings, it is necessary to execute a separate project (e.g. for planning, implementation, commissioning).

3. **Stage principle**
   Progressive execution of definable, logically-ordered planning stages and steps within the project design process according to the TOP DOWN and BOTTOM UP principles. The approach that proceeds from the aggregate to the individual is also designated as the TOP DOWN principle, or as the analytical approach. The inverse is the BOTTOM UP principle, or synthetic approach. Fig. 3.6 shows both options.

<table>
<thead>
<tr>
<th>Analytical approach</th>
<th>Synthetic approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Planning “from the outside in” or “top down”</td>
<td>- Planning “from the inside out” or “bottom up”</td>
</tr>
<tr>
<td>- starts with the whole and gradually works towards</td>
<td>- starts from the smallest element (e.g. workstation) and by</td>
</tr>
<tr>
<td>detailed solutions</td>
<td>combining (or synthesizing) the elements</td>
</tr>
<tr>
<td>follows the order used in construction: “plan the</td>
<td>calculates the next largest area until the overall result</td>
</tr>
<tr>
<td>whole and then the details”</td>
<td>- the main focus is on production-related requirements</td>
</tr>
</tbody>
</table>

*Fig. 3.6* Fundamental approaches in planning

4. **Variant principle**
The generation of variables and variant decisions leads to preferred solutions based on evaluations (vary and optimize).

5. **Profitability principle**
   Applies to the planning (project development) as well as to the execution and operation of the production plants taking time factors into account.
6. Project constancy principle
Safeguarding of the project’s aims, adherence to schedules and costs as well as contract-driven service provision.

7. Order principle
Prerequisite for systematic work and the application of existing solutions, building blocks and modules.

8. Flexibility principle
Flexibility and adaptability in planning, execution and operation of the objects.

9. Improvement principle
Continuous process of constantly monitoring the project for problems that might hinder the timely, cost-effective and quality-compliant completion of the task, and their systematic logging and resolution. Fig. 3.7 shows the permanent process of refinement as a PDCA cycle.

10. Situation principle
Planning, execution and operation subject to situational changes in terms of content and/or time.

11. Synergy principle
Cooperation through joint and efficient utilization of resources for value creation.

**NB: Rules**

From the general to the detailed

→ First as a whole, then subdivided
→ First centralized, then decentralized
→ First general, then individual
→ First aggregated, then detailed
→ First global, then in concrete terms
→ First general verification, then detailed verification
→ First the meters, then the millimeters
From the individual to the typical → First quality, then quantity
    → First analyze, then systematize
    → First individual processes, then standard processes

From the individual to the integrated → First individual, then integrated solutions
    → First integrate functions, then automate

From the ideal to the real → First legality, then profitability

From trust to control → First control, then delegation

From the refinement process to the decision process → First determine processes, then make decisions

Note: the planning of production facilities and plants is a process of refinement with different decision-making stages. The Customer Order/Project Definition checklist (fig. 3.1) is recommended to help you determine the focal areas for project definition. It is subject to a process of continuous improvement. From the principles listed, the “improvement principle” (PDCA cycle) is of primary importance for situation-driven planning (fig. 3.7)

References

Rockstroh W (1973) Technologische Betriebsprojektierung. Technik, Berlin, Band 1 - 4

3.2 Project Development (complex II)

In order to develop a project (planning activities 5/1 to 5/5) it is necessary to complete the project design steps based on the project definition. Fig. 3.8 (Wirth 2000) shows the project design steps and what they entail.
Factory Planning Manual
Schenk, M.; Wirth, S.; Müller, E.
2010, XII, 410 p., Hardcover
ISBN: 978-3-642-03634-7