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Title: How to implement integrated Project Management for Plant Constructors

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Abstract: Project management is a high complex business, whose success depends on the co-operation between the different partners. A concept to fulfil the high expectation is the use of the network. The next article introduces a model explaining how such a network could look like and the way out from the old competitive balance to a new collaborative balance. For that we introduce a new step concept, which is divided into different parts showing the high efficiency. The advantage of the step strategy shall be underlined and proved by means of objective parameters by comparing the step concept with other concepts. The speed and the efficiency are very important for the success of the concept. How to keep to the critical parameters is what to find out.

Title: How to implement integrated Project Management for Plant Constructors

Plant construction is characterized by high competitive pressure and low margins of profit. In order to remain competitive in this environment, it is necessary for the plant planner and the numerous subcontractors to work more closely together and to cooperate cross-company. The concept of Supply Chain Management offers solutions for that. These must be adapted to the typical ancillary constraints such as the large share of engineering to order processes.
Short-term collaboration and a prolonged and expensive tentative price phase and bid phase characterize the current situation in plant construction. Planning and control of the process chain is organized decentrally. Data exchange hardly takes place. Know-how about the progress of the project is tied to one location.

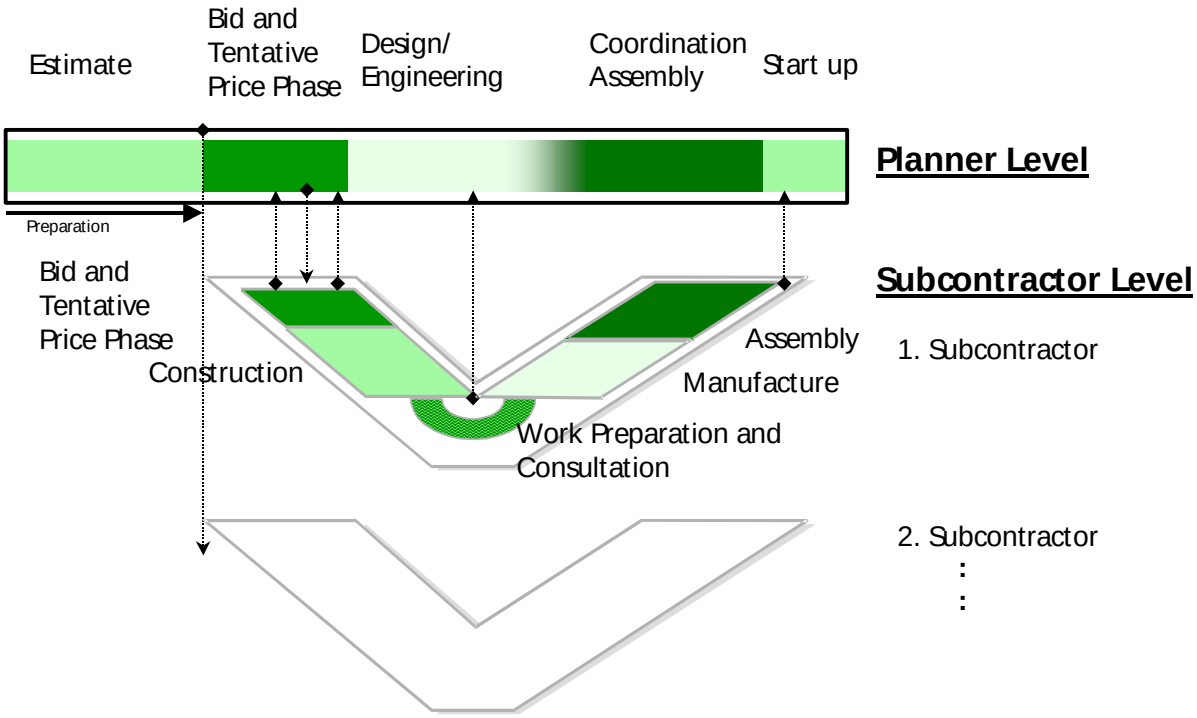

Illustration 1: Basic Processes in Plant Construction

Plant construction is characterized by its large share of engineering to order processes. This non-recurring character of products and processes leads to a form of project management which is strongly oriented toward networks. Three forms which serve as the basis of these networks can be observed today and hence appear to represent relatively stable states of equilibrium.

Possible Forms of Networks in Plant Construction

Competitive Networks (turbulent)
In competitive networks, the project partners each get together for the duration of exactly one project. In addition, there is an open invitation to bid on all aspects of subprojects, which are awarded in free competition. This condition is efficient in terms of incentive, since different companies compete for a contract and thus compete for a price without return. There are hardly barriers to and costs for leaving the network.

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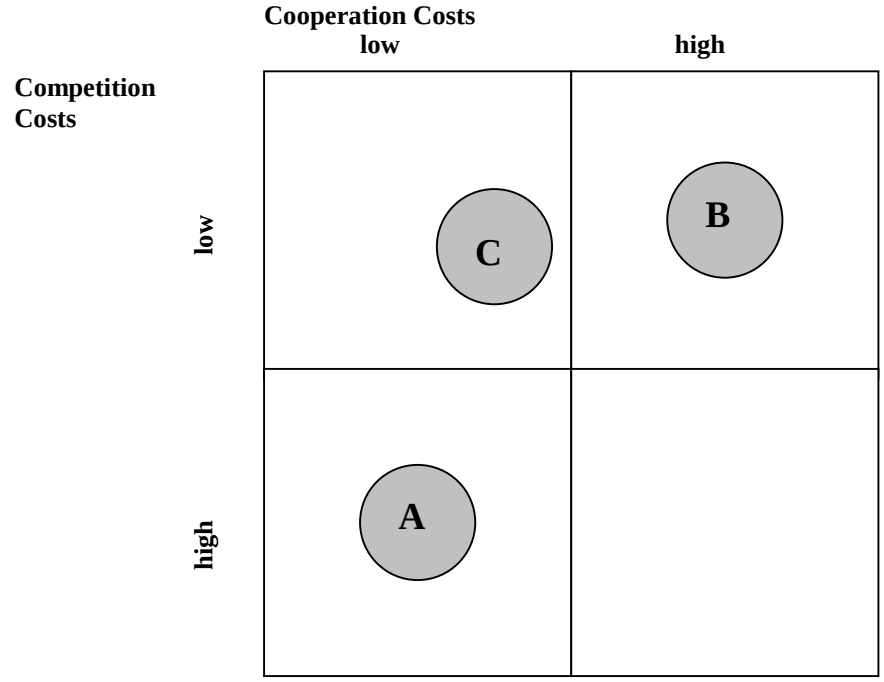
Network Company (rigid)
In large companies it can be worthwhile to create a network of legally and economically dependent subcontractors (divisions of companies), which are each specialized in a task and hence do not have to bear any costs of competition. When prepared accurately, such an (internal) network is efficient in terms of planning, i.e. definite communication structures are created and no resources are wasted on duplicated work. This especially applies to avoiding efforts of invitations to bid on projects. These are awarded with certainty. Thus there are hardly any barriers to and costs for entering the network. In contrast, high costs of cooperation must be reckoned with, which result from the high expenditure of planning (no value added) and from lacking incentive mechanisms.

Cooperation Networks (dynamic)
Cooperation networks should combine the advantages of network forms A) and B). To this end, two prerequisites are necessary.
C1) Organization which is efficient in terms of incentive and planning
Cooperation networks have to be designed in such a way that they create a competitive environment. At the same time, they have to be long-term enough in order to set up communication structures, which are the prerequisite for efficient planning.



C2) Introduction of the Cooperation Network
Cooperation networks do not arise in a natural way.
In contrast to hierarchically, centrally planned concepts for creating rigid network companies or for self-organizing, decentralized competitive networks, in a cooperation network there is a need for the collaboration of several independent companies with private objectives and incentives which often run counter to the objectives of the cooperation network.
Thus it is apparent that in plant construction two different interest groups exist, which each have a different interest in the form of the cooperation network
Thus the engineering partner is mainly interested in high ex post planing certainty (after awarding the contract), since s/he is responsible for seeing the entire project through. Simultaneously s/he favors ex

ante planning certainty produced by the competitive situation between the subcontractors, which guarantees him/her the desired price efficiency.
The subcontractors on the other hand would like to avoid precisely the competitive situation and thus the ex ante planning certainty. Ex post planning certainty does not matter to them at all, since the subcontractors generally earn a good deal of their money with the additional expenditure involved.
This contradiction in the objectives leads to a bilateral negotiating problem, in which it would be good for both parties to make a compromise since the overall benefit of the cooperation network is greater than the total of the partial costs which everyone has to bear. The actual problem of the negotiations is that only the form of cooperation and the assumption of implementation costs are contractually negotiable. By comparison, the benefit is produced indirectly only after fulfillment of the contract.
Thus the specific form of a cooperation network for plant construction is produced which is characterized by the following features.

- Vertical, lateral cooperative agreements between planner and subcontractors,
- Focal control of small and medium-sized enterprises of various stages of value added,
- Temporal limitation of the goal-oriented project work (non-recurring character through engineering to order),
- Dynamism and flexibility of the configuration.

The next figure shows a comparison between the forms of competition and cooperation networks. Also apparent is the vertical and lateral structure of the network with focal control by the planner.

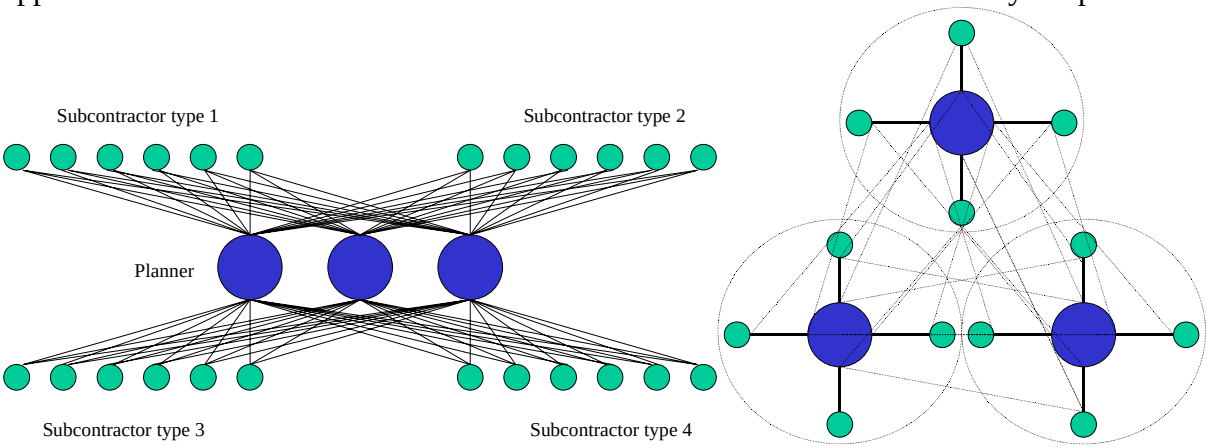


figure 1: From the competitive situation to the cooperation network: A structural comparison

The objective is a form of collaboration which is characterized by voluntary cooperation. Unfortunately, it very quickly and clearly turns out that, similar to a cartel, such a form of collaboration provides the individual additional benefit if he breaks free from the collaboration while all others continue cooperating. If everyone acts according to this motto, then this hinders the cooperation. A way to prevent this strategic behavior is to create incentives precisely not to leave the cooperation. This can, for example, be done through voluntary commitment that every partner then credibly affirms never to leave the cooperation. This succeeds if every cooperation partners has brought him/herself voluntarily ex ante into a position which harms him/her more if s/he leaves than it benefits him/her. In the simplest case, investment costs in the cooperation represent such barriers to leaving the cooperation, which are forfeited when leaving. Naturally, it depends considerably on how the voluntary commitment is effected by investment, because the voluntary commitment is already a strategic problem in itself. Thus the temporal components, which show the way from one of the peripheral strategies to the cooperation network, are absent in the following figure. Since a phase with low benefit must be gotten past on the

way from one strategy to another [1], it is important to resolve how a cooperation network should be implementated.

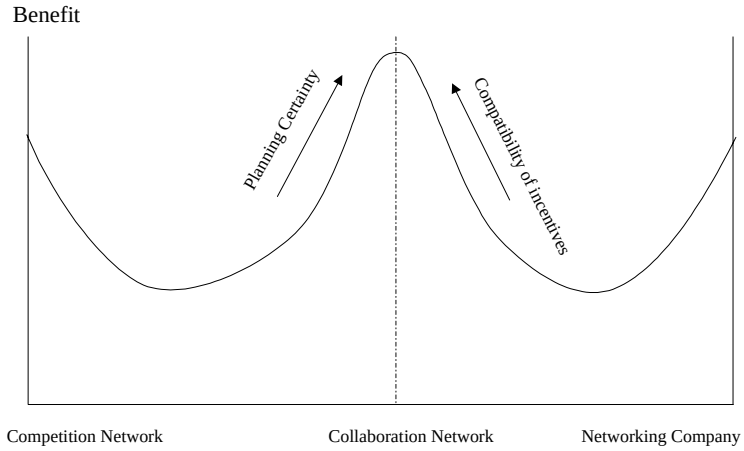


figure 2: how to get to a collaboration network

The following will be clarify the question, to what extent different strategies for introducing a cooperation network and the investment costs involved make a functioning voluntary commitment possible and what these concepts look like. In the process, it will be constantly assumed that the cooperation network is produced by competition.

Strategies of Dynamic Network Formation

The establishment of a cooperation network can be regarded as an investment. As such, it has a period of investment during which the organizational, structural and technological prerequisites must be created in order to enable a cooperation partner to collaborate.

organizational	technological	structural
determination of areas of authority and responsibilities	implementation of network technologies	adaptation of processes and products

The investment behavior has considerable impact on how quickly and at what costs and risks the capability to cooperate can be attained and a cooperation network installed.
In the process, various investment strategies are conceivable which will be briefly presented below without however laying claim to completeness.

A) Decree Principle
Cooperation per decree describes an implementation strategy which has the objective of changing into the state of the cooperation network as fast as possible in order to obtain a “solution from a unified whole”. To do this, it is necessary to entrust a central position with the creation of the prerequisites and the implementation.

B) Continuity Principle

[1] This results directly from the observation that cooperation networks do not originate independently.

Many cooperation efforts attempt to minimize the risk of failure. In order to accomplish this, the cooperation must be put into action as uniformly as possible. Further efforts are only undertaken when the first initial successes are seen.

C) Cascade Principle
The whole project's subdivision of the creation of a cooperation network into subprojects will bring about better clarity and lower risk from implementation. To do this, the whole project is subdivided into several self-enclosed subprojects which will be implemented successively.

The individual strategies differ mainly through the function of the implemented degree of cooperation over time. The figures which follow depict these forms of progress in principle. The progression is then subdivided in several phases which in principle retain their validity for all three strategies, however can differ greatly in the time progression and in their form.
These phases are:

- Finding Phase:
  This chronologically first step deals with the early phase of a cooperative alliance. Here the future partners will find each other and create an atmosphere of mutual trust and openness toward one another. The degree of cooperation grows only gradually. Only low costs are incurred and thus also only little benefit results.
- Implementation Phase:
  A cooperation network is actually created with the future partners evaluated in the finding phase. All partners make necessary investments in the network here and thus the necessary voluntary commitment is accepted.
- Learning Phase:
  Cooperation must be learned. During this process, the cooperation network already potentially possesses its full functional capability which however is not yet fully exploited. Only experience with the cooperation network brings additional knowledge about the potentials of the network. The degree of cooperation still grows marginally.
- Cooperation Phase
  The last phase is characterized by a stable degree of cooperation which constitutes a market equilibrium. The cooperation phase has a concrete benefit over the time which is relatively constant. Theoretically the phase is not limited as regards time.

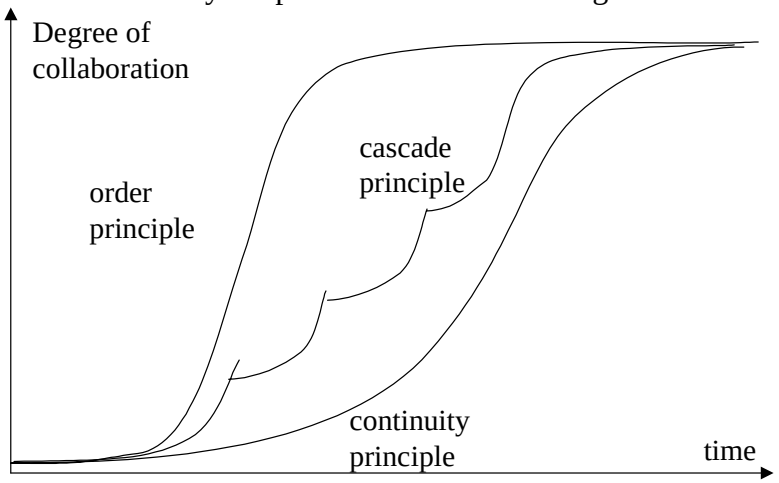


figure 3: degree of collaboration with different strategies

The following will more closely examine the individual strategies. To do this, the aspect of cost-benefit will above all be given priority over the time progression for the phases of the implementation of the alternative strategies, without however representing it more than qualitatively. The aspect of benefit is the obvious target criteria for all those involved and will be defined and discussed in even more detail further in this study.

Discussion about the Implementation Strategies

A) The introduction of cooperation per decree is only possible when there is a stronger network partner who is in the position to both motivate the weaker network members and to compel them to implement the cooperation network following a specific target. Plant construction can potentially produce such a strong network partner (focal leader). As already shown in the figure above, the planner assumes a central role, since s/he is both the client of all integrated subcontractors and bears most of the responsibility for the project.
   As a result, a possible approach emerges with which a cooperation network can be constructed.
   To do this, in a first step, the planner seeks partners capable of being in the network. In markets with strong crowding out s/he can then pass a major part of the costs for acquiring the network capabilities on to the subcontractors and simultaneously determine what constitutes the parameters of network capability.
   Thus the planner has a strategic advantage, since the rules of the cooperation can be fixed in the first step by selecting subcontractors capable of being in the network. At the same time however it is revealed that s/he frequently cannot full exploit this advantage, since the associated investments for fixing the network capability parameters are very risky, because the subcontractors possess private information about the benefit of the status of the network capability.
   In contrast to the approach presented here, a possibility to get around this disadvantage is to conclude cooperation contracts between the potential partners in the time before the necessary initial investments. These obligate the parties to mutual voluntary commitment through the initial investment. At the same time, it can however no longer be guaranteed that the most capable partner also really becomes the network partner since the selection process is omitted.
   The following figure attempts to graphically depict how such costs of the implementation of a cooperation and of the benefit, which result from the cooperation network, behave toward one another over the course of time. The graphs drawn are qualitative in nature and will be discussed individually in the following for all implementation strategies. Similar to the figure of the degree of cooperation, the time progression can also be differentiated in several phases here (finding, implementation, learning, cooperation phase). It then turns out that, after a finding phase without great cost, the decree principle strategy causes very high costs in the implementation phase in relatively short time. Clearly recognizable is also that the subcontractor will make his/her investment with a time delay, since s/he must reconcile these investments with those of the planner. This rather quick and large investment is offset by a benefit which is hardly measurable at first. On the other hand, a first benefit of cooperation is already apparent in the learning phase since the prerequisites of the cooperation are already fulfilled. Both for the planner and for the subcontractor, the benefit does not displays its greatest rise until in the cooperation phase, in which the cooperation is really lived.

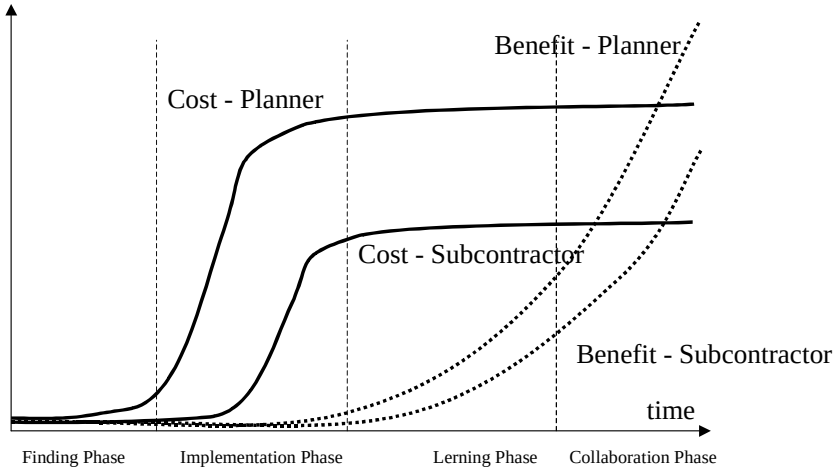


figure 4: decree principle: effort versus benefit

B) The introduction of cooperation following the continuity principle attempts to prevent the problems discussed above which arise from an introduction of cooperation per decree. The planner no longer obtains a strategic advantage here by deciding sequentially. Instead an approach is striven for which induces all partners to simultaneous make decisions. In order to accomplish this, the investment for implementing the cooperation must be subdivided into many small phases. If these phases are small enough, then a situation arises, in which all parties make their decisions simultaneously.
This slow evolution into the state of cooperation tries to get by without high initial investments. A very long phase of becoming acquainted will create an atmosphere of openness and of mutual trust, which then makes it possible for those involved to qualify possible partners to be network-capable partners. The investment in organization, technology and structure is only made when the partners are already selected and have proven themselves as capable partners by demonstrating openness and trust. What is more, the investments are divided into the smallest blocks possible in order to minimize the risk that one partner makes an initial investment and another partner does not follow suit. These very small investment steps make it never worthwhile to put the entire benefit of cooperation at risk for the small advantage of the investment saved.
The assumption of the divisibility of investment projects is however problematic. Admittedly it is possible to gradually increase the depth of the collaboration. In particular technological prerequisites of cooperation are however mostly associated with high investment costs, which are linked to the introduction of a concrete method or tool and consequently are not divisible. Leaps in investment can arise here which can no longer be shared by individuals.

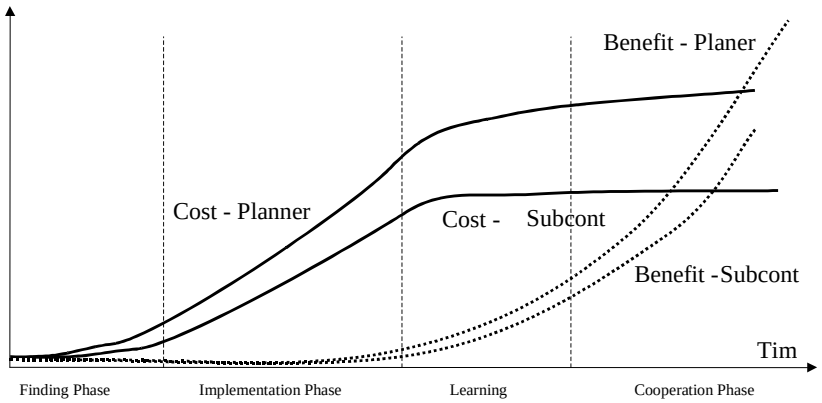


figure 5: continuity principle: effort versus benefit

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C) The ideas cited above result in expanding the continuity principle to a cascade principle, which attempts to include the advantages of the decree principle. Particularly the strategic dilemma and the great risk of the failure of the decree principle will be avoided. At the same time, when correctly introduced, the cascade principle results in the opportunity to obtain a holistic cooperation solution which can be implemented rapidly.
Correctly subdividing the entire project the entire project for implementing the cooperation network into individual steps of implementation produces the opportunity to subdivide an expensive and complex project into manageable subprojects. The figure which follows shows the cost-benefit curve and explains the fundamental functional mode of the cascade principle.
The subdivision of the implementation phase into many implementation steps turns out to generate a non-uniform progression of the cost-benefit curve. The S-shaped progression of the steps of implementation is a typical repetition of the entire progression.

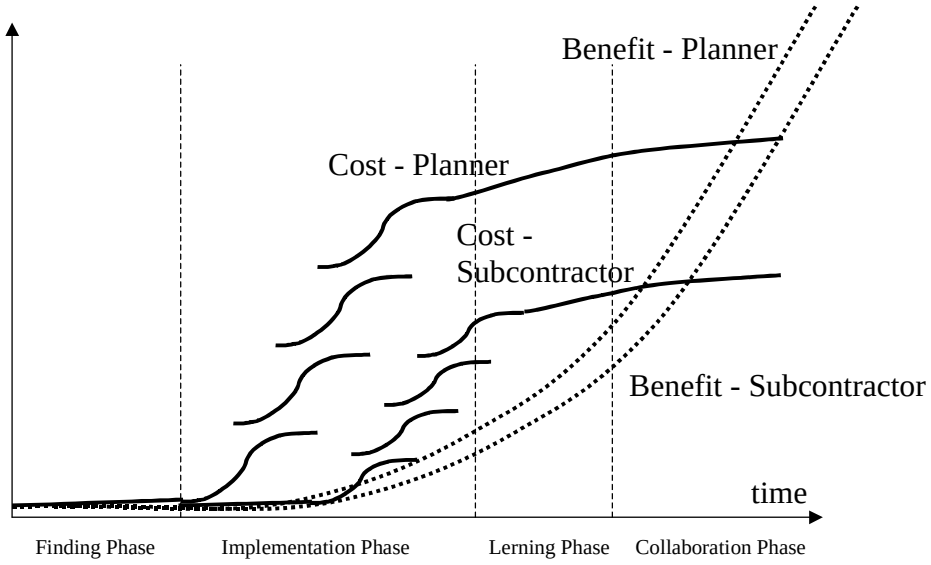
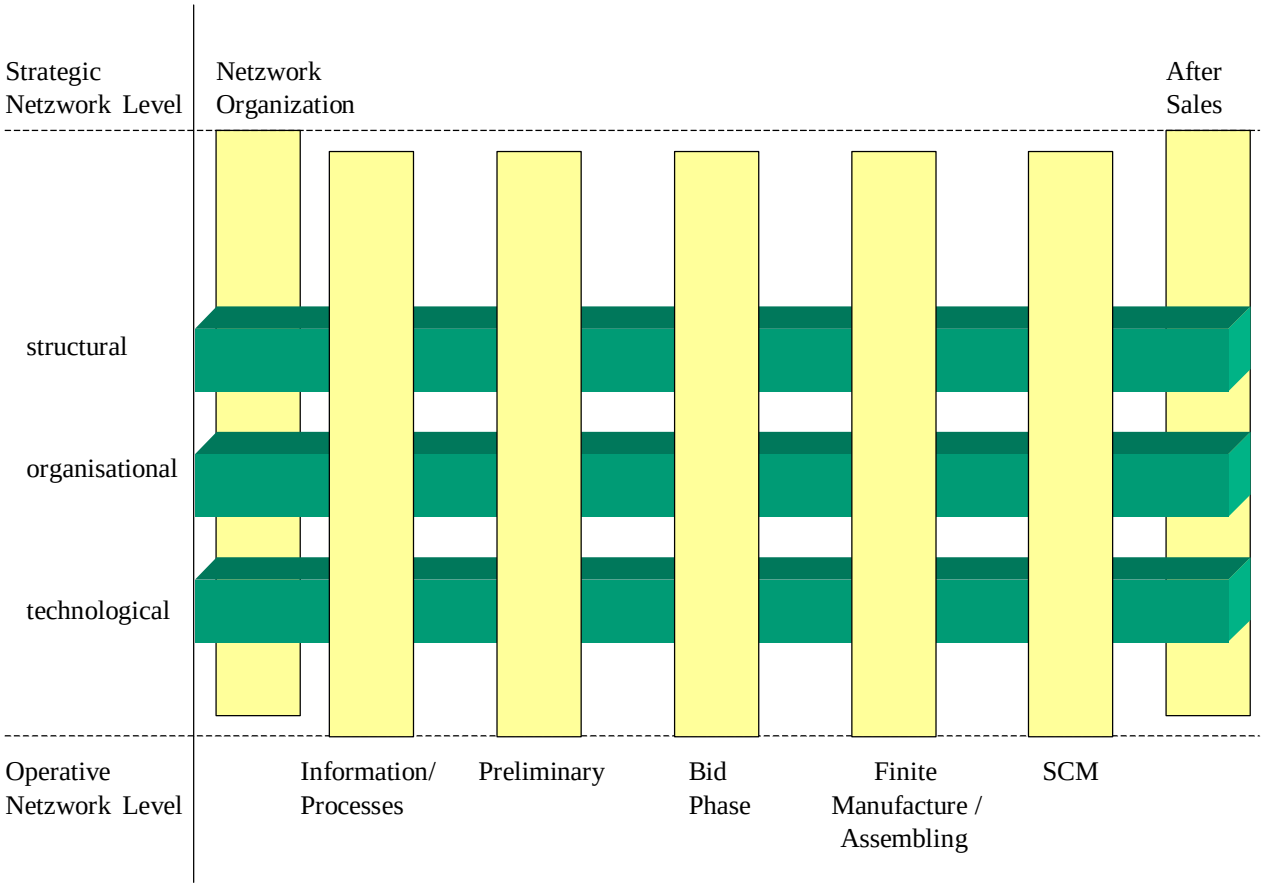


figure 6: cascade principle: effort versus benefit

The cascade principle represents a strategic alternative to the continuity principle and, in view of its advantageousness, will be more closely examined below. To do this, it is at first necessary to correctly differentiate the individual implementation steps from one another and to define the task areas resulting from this. The following section deals with this problem.

Identification of Steps of Implementation and Derivation of Task Fields

The problems already addressed of correctly differentiating the steps of implementation of the cascade principle can be solved with the help of the special features of plant construction. The project management of a plant construction project is subdivided into different phases (see the chapter on Fundamentals), which are sequentially run through in time and use quite different resources and have quite different tasks to fulfill. Hence, using these natural subdivisions of a plant construction project appears to be the thing to do to form the steps for implementing the cooperation network.



Step 5					
Step 4					
Step 3					
Step 2					
Step 1					
Phase	Information Processes	Preliminary Planing	Bid Phase	Finite Planning and Assembly	Start-Up, Documentation and Interfaces
Structural	Process Reengineering	Planning of Process Flow	e-Business Processes Acquiring Contracts	Execution and Controlling	Continuous Interface Management of Processes
Organizational	Introduction Process Manager	Process Planning	Purchasing and Sales	Feedback	Transparency of the Supply Chain
Technological	IM Systems 2-Level Model	Body of Knowledge	Market Place Risk Minimization	Sequence Plan and Network Plan	SCM in the Integrated Project Management

figure 7: Steps of implementation