In a multiproject organization, the simultaneous management of the throughput times, resource allocations and costs of the projects is a complex process of balancing the (often conflicting) interests of multiple participants. Therefore, a new concept of portfolio management that is based on delegation and communication is required in the multiproject organization. The paper demonstrates how portfolio management can be put into practice by applying the planning and control cycle of individual projects to trade off the interests of project leaders and department heads in a team effort. By coupling the planning and control cycles for single projects and the portfolio of projects, an overall framework is built to meet the multiproject challenge. In this framework, the project-breakdown structure and organization-breakdown structure are linked. The paper concludes with the description of a practical application of the framework and the required supporting information system.

Keywords: portfolio management, matrix organization, project-based management, multiproject planning, planning cycle

Project management has become institutionalized in the past decades. Originally applied in the area of construction, engineering and data processing, project management has penetrated rapidly in R&D environments, manufacturing, administration etc. Gareis' points out that, in addition to construction and R&D projects, strategic planning, marketing and organizational development are also increasingly carried out using a project approach. Gareis defines 'management by projects' as the central strategy for the 'new' project-oriented company.

As the project orientation of organizations increases, multiple projects are carried out simultaneously. Gareis distinguishes the need to manage multiple projects simultaneously by defining the network of projects as an additional management consideration. Wheelwright and Clark state that, especially in R&D environments, managing the network of projects and focusing on resource allocation between projects is a crucial part of creating a sustainable development strategy.

As Turner and Speiser indicate, the vast majority of projects nowadays take place within portfolios of related, small-to-medium sized projects. In a portfolio, projects are interdependent in objectives, and make use of common resource pools (departments or expertise). The definition of a 'programme' by Speiser and Turner is equivalent to our definition of a portfolio, i.e. 'a set of projects which are managed in a coordinated way to deliver benefits which would not be possible if the projects were managed independently'.

In a multiproject organization, the simultaneous management of the throughput times, resource allocations and costs of the projects is a complex process of balancing the (often conflicting) interests of multiple participants. Platje and Seidel have demonstrated that a new concept of portfolio thinking is required in which all responsibilities are delegated to the lowest possible organizational levels and communication is improved. On the basis of this concept, this paper applies the planning and control cycle...
of individual projects to trade off the interests of project leaders and department heads in the portfolio-management (programme) situation. By coupling the planning and control cycles for single projects and the portfolio of projects, a framework is built for project-based management in the multiproject organization.

Project planning cycle

The classical planning and control cycle 'plan—do—check—action' (abbreviated to 'planning cycle') originated from the famous 'Deming wheel', and was described in literature focusing on Japanese management practices. The 'Deming wheel' describes self-regulating, continuous improvement processes. Applying this cycle to project management requires the basic notion that no project (or project team) is autonomous or self-regulating by itself. Therefore, the project leader responsible for the project should be added as the fifth, regulating element in the cycle. De Jonge has described the role and responsibilities of management in each element of the 'plan—do—check—action' cycle. Figure 1 shows an extension of the classical planning cycle for individual projects, combining 'management by projects' (according to Gareis and De Jonge) and 'management by exception'. This planning cycle encourages delegation and communication between the project leader (management, in the middle of the cycle), the team members, and solve potential bottlenecks. Thus, the conditions of Platje and Seidel (delegation to the lowest possible organizational level and communication between all parties involved) are fulfilled by this combination of 'management by projects' and 'management by exception'.

Portfolio planning cycle

The vast majority of projects nowadays take place within portfolios of related, small-to-medium sized projects. Often, a 'multiproject organization' is chosen as the organizational structure when multiple important activities (projects) are to be executed simultaneously, each requiring intensive crossfunctional cooperation of multiple expertise or departments. While flexibility in resource allocation is one of the advantages of the multiproject organization, a control problem may also arise: the more projects are executed simultaneously, the more communication and tradeoffs between projects (and departments) will have to take place for the 'portfolio of projects' to be defined and executed.

In a multiproject organization, three distinct parties play a role, each with their own responsibilities:

- **Project leaders (project managers):** These are responsible for the realization of the project goals, requiring the best allocation of scarce resources within a limited time window, to satisfy the needs and wants of their project owner (sponsor).
- **Department heads (resource managers):** These are responsible for the most efficient and effective use of their resources (department members) over different projects (continuous workload with minimal overlap). Also, they are responsible for the quality standards of the departmental expertise, limiting their available capacity (training programmes of their people).
• Management (programme directors): These are responsible for the realization of overall portfolio objectives (both overall organizational objectives and the needs and wants of different project owners, translated into priorities), with the most efficient and effective use of the limited amount of available resources (portfolio boundaries).

Since the projects in the portfolio are mutually dependent (because use is made of the same scarce resources), project leaders and department heads cannot only focus on their own project or department. Equally as important as individual project-team members jointly defining and executing mutually dependent activities in their project is teamwork at the portfolio level.

As Platje and Seidel indicate, a portfolio-management team (consisting of project leaders and department heads) is jointly responsible for

- the construction of feasible portfolios (satisfying the priorities of the projects within the boundaries set by management);
- the tradeoff (by negotiation) of (often conflicting) interests of the participants;
- the communication between management, project leaders and department heads.

By the application of the planning cycle described in the previous paragraph on portfolio management in a multiproject organization, a clear process of priority setting and resource allocation to different projects is provided, balancing the interests of all parties involved. Analogously to a project leader communicating with his/her project team by means of a project plan and a planning cycle, management communicates with a portfolio-management team (consisting of project leaders and department heads) on the basis of a portfolio plan and a portfolio planning cycle (see Figure 2).

The portfolio-planning process follows the same steps as in the second section, although the contents of the elements 'plan', 'do', 'check' and 'action' have a different interpretation:

- Action: Management sets the priorities (on the basis of the needs and wants of multiple project owners) and establishes boundaries for the project portfolio. For example, in an R&D organization, this will include objectives for the output of new product or process concepts, priorities over the different projects, and the total R&D budget.

- Plan: On the basis of the priorities and boundaries set by management, the portfolio-management team (project leaders and department heads) develops a feasible plan for the (re)allocation of resources and means over a number of projects. The inputs for this portfolio plan are the individual project plans as developed by project teams, and the resource availabilities of the departments. When the portfolio objectives (priorities) are feasible within the boundaries, management authorizes the portfolio plan, which provides the basis for the authorization of individual project plans and department schedules. When the priorities set by management cannot be met, an iterative process of negotiation and replanning should take place. In this process, the role of management is to negotiate the needs and wants of multiple project owners (reset priorities), and to reconsider the resource boundaries. The role of the portfolio-management team in the iterative process is to develop alternative feasible portfolios (replanning).

- Do: The members of the portfolio-management team (project leaders and department heads) support the execution of their individual project plans and department schedules. Management supports project leaders and department heads in resolving bottlenecks that cannot be handled at lower levels ('by exception').

- Check: On the request of the management, the progress of all individual projects is periodically aggregated into a portfolio progress report. The frequency of portfolio progress monitoring is lower than the monitoring frequency of individual projects.

- Action: Management will only take corrective action (i.e. reset objectives, boundaries and priorities for the portfolio) when changed needs and wants of project owners, external circumstances, or the portfolio progress ('check') requires it ('management by exception').

By means of this portfolio planning cycle, management, department heads and project leaders communicate on the basis of a clear and unambiguous portfolio plan (see Figure 3). Applying the planning and control cycle to portfolio

![Figure 2 Planning cycle for portfolio of projects (multiproject situation)](image)

![Figure 3 Planning process in multiproject organization (example)](image)
management, project responsibilities are delegated to the lowest possible organizational levels, and multilateral communication between project leaders and department heads is made explicit. The role of management is limited to setting objectives (priorities), establishing boundaries, authorizing the portfolio plan, resolving bottlenecks, and checking the portfolio progress. In the multiproject organization, management plays an explicit role in the owner (sponsor)—contractor (project leader) relationship by negotiating the needs and wants of multiple project owners (setting priorities over projects), which are then translated into an authorized portfolio plan by the portfolio-management team (project leaders and department heads).

**Coupled planning cycles**

Each planning cycle defines the communication between two succeeding organizational levels:

- from management to department heads and project leaders (portfolio planning cycle);
- from project leader to project team (project planning cycle);
- from department heads to department members (department planning cycle).

Project leaders and department heads are both team members in the higher (portfolio) planning cycle, and managers in the lower (project) planning cycles. Thus the planning cycles for individual projects and the portfolio of projects are hierarchically linked. The project leaders and department heads forming the portfolio management team serve as a link between project teams, departments and management.

In general, the frequencies of the project and portfolio planning cycles must necessarily be synchronized (i.e. coupled in phase). In many cases, the portfolio planning cycle time is longer than in underlying project planning and department cycles. For example, in large R&D organizations, the portfolio plan is usually developed once or (at most) twice a year. Management reviews and (re)sets the objectives, boundaries and priorities of the R&D programme on the basis of the needs and wants of their project owners (e.g. in contract research). On the basis of this, individual project plans and department schedules are created, executed and monitored.

The planning and control of these individual projects takes place on a more frequent (e.g. monthly) basis, within the boundaries set by the portfolio plan. The frequency of portfolio planning cycle is determined by the following:

- **Stability (steadiness) in the portfolio content**: When priorities are frequently changed by management, new projects are added or deleted regularly, or the individual project plans often change, and the portfolio content is subject to frequent variations. This requires frequent portfolio planning.
- **Stability (steadiness) in the portfolio process**: When the individual project plans are mostly executed according to plan, few (e.g. resource) bottlenecks will occur in the execution. When projects are frequently delayed or resource requirements change during the execution, more frequent portfolio planning is required to resolve bottlenecks.

The multiproject management concept of coupled planning cycles is in line with the principles of good project management, as defined by Turner. In particular, the portfolio of projects is split up into clear individual project and departmental plans, with single point responsibilities at each level. Both at the portfolio level and the individual project level, negotiation between all parties involved results in a contract (plan) that serves as a basis for a clear and simple reporting structure.

**Case study: project-based management in R&D organization**

In the R&D department of an industrial-equipment manufacturer, the portfolio-management concept of coupled planning cycles was successfully introduced.

The R&D department consisted of 200 experts, divided over six functional departments: research, predevelopment, software development, electronics development, and electrical and mechanical engineering. On average, ten projects were executed simultaneously, all owned and sponsored by the marketing department. The R&D director was responsible for setting the overall R&D objectives and priorities over the projects, taking into account the needs and wants of marketing. Although the principles of project-based management were highly developed throughout the whole organization, there was no structured planning process for managing the portfolio of projects. The R&D director aimed to steer all the projects directly by centralized procedures, while project leaders informally claimed overestimated amounts of resources at the departments, and department heads successfully hid redundant capacity for resource claims in projects. Planning and control resulted in bureaucracy and rigidity instead of improving communication and flexibility.

As a next step in project-based management, a portfolio-management team was introduced, consisting of all the department heads and project leaders, and acting as a link between project plans and department schedules on the one hand, and the objectives and priorities set by the R&D director on the other hand (coupled planning processes). In the portfolio-management team, project leaders and department heads were expected to jointly develop feasible portfolios and explicitly negotiate their (often conflicting) interests in a team effort. This required a major cultural change in the organization.

The required information system in this R&D department consisted of a set of modularly coupled systems that supported the planning cycles between succeeding organizational levels (see References 3, 9 and 10):

- a rough-cut capacity planner or resource-management system to support the portfolio planning cycle in making tradeoffs and analysing bottlenecks between alternative portfolios;
- traditional project-management systems (network planning) to support the project planning cycles;
- department schedulers to support the planning cycles between department heads and the department members.

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Figure 4 Interlinked planning cycles in multiproject organization
PORTFOLIO PLANNING CYCLE

MANAGEMENT

PORTFOLIO MANAGEMENT TEAM

PROJECT PLANNING CYCLE

PROJECT LEADER

PROJECT TEAM

Figure 5: Phase behaviour of portfolio planning and project planning
We define the information-breakdown structure (IBS) as a set of information systems to support the planning cycles between succeeding organizational levels. It being noted that each planning cycle requires its own information system, the IBS is coupled to the PBS and OBS in the multiproject organization (see Figure 4).

Since no standard tools are available to serve as a rough-cut capacity planner\textsuperscript{4}, a tailor-made tool was developed to support the portfolio-management process in a simplified and straightforward way.

By introducing the portfolio-management team and coupling the planning cycles at the portfolio level and the individual project and department levels, significant reductions in the throughput times of the projects were achieved. Portfolio planning and control initiated the communication and delegation of responsibilities to the lowest possible organizational levels. Furthermore, redundant capacity in the departments could effectively be allocated to high-priority projects, and management became able to oversee the consequences of adding new projects in a more realistic way.

Conclusions

Effectively addressing the multiproject challenge requires a new concept of portfolio thinking, as demonstrated by Platje and Seidel\textsuperscript{5}. This concept can be put into practice by describing the required planning processes in the multiproject organization. By extending the well known 'plan–do–check–action' cycle with 'management by exception', a planning cycle is defined that describes the communication between organizational levels on the basis of a clear and unambiguous plan, thus allowing for a large amount of delegation to team members.

This planning and control cycle for single projects proves to be equally applicable to planning and control at the portfolio level.

By linking the planning cycle at the individual-projects and portfolio level, a framework is built for project-based management in the multiproject organization. In this framework, the project-breakdown structure, organization-breakdown structure and information-breakdown structure are coupled.

A case study of an industrial development organization illustrates that, in multiproject organizations, significant improvements can be achieved by introducing this concept of portfolio thinking.

References