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Austria

1.1 Introduction

In Austria, with the modernisation and expansion of the rail infrastructure network since around 1990, a structured cost and risk management has been carried out. This has taken account of the fact that with large transport infrastructure projects, due to the complexity, the long implementation period, and the multitude of project participants at the time of the project start, the project content is not fully known. The level of knowledge regarding the total content is developed only in the course of the project preparation, approval procedures, and detailed planning. The cost of such projects can also be quantified sufficiently only as the project develops. Nevertheless, to create and maintain a stable cost framework, the degree of uncertainty is taken into consideration by appropriate risk provisions.

These risk provisions have been classified as unknown (U) during the planning phase, since only part of them can be quantified by means of appropriate risk analyses. The establishment of the risk provisions for unknown elements is carried out on the basis of all previous project experience with the help of specific reference values, which take into account the respective project framework conditions.

The requirements for standardised project and cost management, as well as control and reporting, were originally established within Eisenbahn Hochleistungstrecken AG (HL AG) and later further developed within ÖBB Infra AG. For train station projects – such as the new Vienna Central Station and the projects of the Brenner base tunnel (50% owner), the Koralm Railway, and the Semmering base tunnel – the cost and risk management methods presented below will be used.

On the basis of the accumulated experience, a first guideline for the cost and risk determination for transportation infrastructure projects was carried out by the Austrian Society for Geomechanics (ÖGG) in 2005 [1] and the latest version was published in 2016 [2]. This chapter describes how costs, cost control, and risks have been managed within the Austrian Railway company ÖBB and how they are currently approached in Austria.

Sections 1.2–1.7 were written by Dr. Georg Vavrovsky (1.08.1950–16.02.2020) and Dr. Hubert Hager with respect to the ÖGG-Guideline 2006. Section 1.8 was written by Prof. Konrad Bergmeister with respect to the ÖGG-Guideline 2016.

The mentioned ÖBB manuals [3, 5, 9] have been actualized in the meantime and some of their contents have been adapted; although the essential basic statements still apply.

Models for financing, cost, and risk assessment: Major railway tunnel projects in Europe, First Edition.
Edited by Konrad Bergmeister.

1.2 Concept

ÖBB-Infrastruktur AG implements new and expansion projects for the modernisation and improvement of the rail network in Austria. The expansion investments are focused on route development and expansion along the main transport axes, such as the four-track expansion of the Westbahn and Südbahn railway lines, the Koralm Railway, and the Lower Inn Valley Railway, on the modernisation of the railway stations, on local transport projects in the metropolitan areas, and on freight terminals. With regard to content and expression, these projects include a wide range of rail transport projects, with a project portfolio of around 200 projects. In the past few years, the volume of investments has amounted to approximately €1.0–1.3 billion per year. In addition, extensive measures for the modernisation of the control and safety technology (global system for mobile communications – railway [GSM-R], European train control system [ETCS] L2, etc.) as well as for the renewal (reinvestment) of the rail network have been carried out.

The business process of handling investment projects in ÖBB-Infrastruktur AG stipulates that from the start of the planning phase through to handover to the operator, the project responsibility lies with specialised business areas of ÖBB-Infrastruktur AG.

The project responsibility for the planning and/or construction phase is determined on a case-by-case basis with a separate project order of the entire Board of ÖBB-Infrastruktur AG (project client or ÖBB-internal customer) and the project objectives and the time and cost tangents are determined accordingly. With the project order, the business area thus charged (project contractor or constructor) carries full responsibility for the operative building owner tasks, including all the duties of the project management.

1.3 Financing

The basis for the financing of ÖBB-Infrastruktur AG is § 47 of the Federal Railways Act (BBG), whereby the federal government must ensure that ÖBB-Infrastruktur AG has sufficient means available to perform its tasks and to maintain its liquidity and its own capital resources, to the extent of conducting the duties of the business plan in accordance with § 42 paragraph 6 of the BBG. This legally regulated commitment from the federal government is specifically implemented in the grant contracts in accordance with § 42 of the BBG.

In accordance with § 42 paragraph 2 of the BBG, the federal government provides grants for the planning, construction, and maintenance of the rail infrastructure. The grant contract to be agreed between the federal government and ÖBB is based on the business plan that is to be produced by ÖBB-Infrastruktur AG. Part of the business plan is the six-year framework plan to be drawn up by ÖBB-Infrastruktur AG, which includes the funds both for the expansion investments (new installation and development) and for maintenance (particularly repair and reinvestment).

The framework plan includes all expansion investments based on project progress. In the preparation of the framework plan, the strategic planning determinations (goal network 2025+) established by the Austrian federal government as a basis for the infrastructure investment must be taken into consideration. The framework plan must be supplemented each year by one further year and adapted with regard to the current project schedule for the new six-year period.

The framework plan must include all the decision-relevant information for the company, in particular:

- a detailed description of the projects, capacity analyses, and forecasts of the expected traffic growth
- a schedule with project-related planning and building progress
- a current cost estimation, a cost–benefit analysis, and an operating programme
- a description of the achievable quality of the rail infrastructure of the project.

The basis for the entitlement to federal subsidies is the approval of the annual framework plan by the Austrian federal government as well as the grant contract, which has been concluded and which is extended on a yearly basis.

According to the current grant contract, the share for expansion investments and reinvestments that is to be borne by the federal government (without the Brenner base tunnel) is 75% of the annual capital expenditure, for which, taking into account the average useful life, grants in the form of a 30-year annuity subsidy are provided. For the construction of the Brenner base tunnel, the federal government is responsible for 100% of the annual capital expenditure, for which grants in the form of a 50-year annuity subsidy are paid out. The cost contributions, Trans-European-Network (TEN) funds, cross-financing as applicable and, in individual cases, also real estate sales (e.g. for the main station in Vienna) will be deducted from the financing. In accordance with the grant contract, the federal government and ÖBB-Infrastruktur AG must ensure that long-term projects that go beyond the current framework plan period are also included in the following framework plans with the corresponding financial tranches.

The federal government has its long-term obligations arising from the approved framework plans up to the complete funding of investment projects secured in the form of preliminary approval for these financial obligations, prior to the budget. On the basis of the existing grant contract with the federal government, in accordance with the current financial requirements, ÖBB-Infrastruktur AG issues long-term investment bonds to finance ongoing projects.

1.4 Cost Calculation

1.4.1 Basic Principles of Cost Calculation

As well as high investment values, railway transport infrastructure projects usually involve high risks and involve particularly long-term project processing. The identification and presentation of the project costs must take into account these circumstances with an appropriate system on which to base the project cost control for accurate analyses and targeted control measures.

Within the framework of cost calculation, future developments and costs must be estimated based on the respective level of knowledge. In this context, the monetary valuation of the services to be provided, the development of price changes, and the project risks must be established with the involvement of the relevant project parameters, influencing variables and framework conditions.

Each project is caught between quality, cost, and time targets. The key features of this target triangle are defined by planning, and are used by the project processing as a reference for the monitoring and control measures. Cost assessments show the cost status of projects or parts of projects at regular intervals or after completion of certain phases. They accompany all project phases and form the basis for cost control and cost management. As the project progresses, the degree of detail of a cost assessment and its significance for cost stability increases.

The identification and presentation of the costs for expansion investments (new and expansion projects) of ÖBB-Infrastruktur AG are carried out in accordance with the 'ÖBB-Infrastruktur AG Cost Assessment Manual' [3].

This manual covers the basic structures needed for the systematic representation of project costs with a particular focus on project risks based on the 'Calculation of costs for transport infrastructure projects' [1] in the ÖGG guideline. It also refers to the RVS data sheet 02.01.14 'Determination of project costs for infrastructure projects' [4] in terms of cost classification. The scope of this data sheet covers the determination of project costs from the start of planning to the completion of the infrastructure projects, and, in particular, regulates the concepts of project costs for transport infrastructure projects. The main features of the cost classification of the specified rules and regulations are coordinated with each other.

The following shows the cost assessment system applied to new and expansion projects of ÖBB-Infrastruktur AG with reference to these rules and regulations.

The new guideline [2]: Calculation of costs for transport infrastructure while taking into consideration relevant project risks (2016) takes into account accumulated experience from the construction of major rail infrastructural projects and long tunnels (e.g. Lower Valley of the Inn [42 km], with Münsterer Tunnel [16 km], Terfner Tunnel [15.8 km], Wienerwald Tunnel [13.3 km], and Lainzer Tunnel [9.4 km]) of costs and risk management.

1.4.2 Cost Assessment System

From the perspective of project development, costs are defined as a monetarily valued use of services, supplies, and goods for project implementation. The project costs include the costs required to achieve the project objectives, such as costs for project management, planning, construction, project-related procedure costs, site supervision, construction site clearing, land acquisition, control, accounting, project information management, expert testimonials or fees for project implementation (regardless of whether they are provided internally or externally from the perspective of the project management), and the cost estimates for risks and development-related costs.

Strictly speaking, project costs do not include financing costs. Provided they also include financing costs, these should be shown explicitly.

Project costs can be specified with or without sales tax. When taking into account the sales tax, this should be shown explicitly.

The revenue allocated to the project phase, such as cost contributions, grants, subsidies or proceeds from material sales, should be shown separately (un-offset) from the project costs. This does not reduce the costs of the project.

With regard to the progress of an individual project, the following basic rule applies:

Planned costs = actual costs + forecast costs

The actual costs represent costs booked to the project (cost bearer) up to a certain date; the forecast costs include the estimated future costs from a certain date. The planned costs are calculated as the sum of actual and forecast costs. This structure applies for the entire duration of the project processing.

The planned costs are divided into the following cost components:

Basic costs (*B*)

+ cost coefficients for value adjustment and inflation (*G*)
+ cost coefficients for risk (*R*)

= BGR: Project costs on the price level per the defined reference date

+ cost coefficients for preliminary adjustment for inflation (*V*)

= BGRV: Project costs with preliminary adjustment for inflation

The project costs are the sum of the planned costs for all the project parts of a project. When listing project costs, the included cost components (e.g. *BGR* or *BGRV*) must be specified.

The planned costs generally have a spread width. With cost assessments for new and expansion projects, the median value must be stated. This is the value that has the same probability in terms of a cost overrun or underrun.

1.4.2.1 Basic Costs

Basic costs are the planned costs at a defined price basis with the defined acceptance of known project content, project deadlines, and the market situation. They form the foundation for any cost assessment and will serve as the basis for the application of cost coefficients for value adjustment and adaptation, risks, and preliminary adjustment for inflation.

Basic costs are based on an assessment of the price level on the construction market for a defined point in time. They are determined and represented separately for the individual parts of a project. As long as no service agreement has been signed to build a part of the project, this part of the project is known as a supply area. Upon commissioning the execution, the establishment of the part of the project is contractually fixed, and a purchase order or contract is provided.

Establishing the Basic Costs of Parts of a Project Prior to Conclusion of the Contract A prerequisite for this is the existence of a design for the respective part of the project. The project scope defined by this design is classified in individual cost elements, for which mass measurements must be carried out. Element costs are derived from the multiplication of element quantities and element unit costs.

Owing to the limited penetration of the cost assessment, there are parts of the basic costs that are not included in the element costs but do belong to the defined project scope. To fully represent the basic costs, with the merging of element costs into basic costs, it is therefore necessary to use a cost coefficient for unconsidered elements. Cost coefficients for unconsidered elements serve to establish, if possible, all of the cost variables that should already be known at the time of the cost establishment, such as:

- costs for expected main services, which, however, have not been recorded as cost elements (e.g. standstills and difficulties due to water in the tunnel)
- costs for expected small and ancillary services, which, however, have not been included in the element unit costs
- costs as a result of the adaptation of element unit costs from an element catalogue to the concrete framework conditions of the project.

Establishing the Basic Costs of Parts of a Project After Conclusion of the Contract This is always done on the basis of the agreement that has been made for the situation in question (contract). In construction projects, a list of services with positions and premises is usually provided. The basic costs after completion of the contract comprise:

- order amount of the main contract
- expected costs as of a certain date for expected quantity changes in the main contract
- order amount as of a certain date of the contractor's claimed and commissioned additional costs (additional contracts)
- expected costs as of a certain date for expected quantity changes in additional contracts
- expected costs as of a certain date for the contractor's claimed and non-commissioned additional costs (additional offers)
- expected costs as of a certain date based on known additional costs of the contractor but which have not yet been claimed.

Requirements on the Establishment of Basic Costs Because of the importance of the basic costs, when determining said costs at the project and project-part level, the following points must be considered:

- explicit project definition, together with the local, content, and time delimitation
- adequate planning documents on the project content and project execution, depending on the respective phase of the project, along with documentation for the planning status on which the cost determination is based
- complete and verifiable identification and representation of the costs, along with documentation of the sources
- complete structure of the project in elements
- systematically uniform forecast of the planned costs
- correct delineation of actual and forecast costs as of a certain date
- indication of the price basis for cost elements; uniform price basis of the basic costs for the cost establishment
- correct and verifiable mass establishment, including documentation.

1.4.2.2 Cost Coefficients for Value Adjustment and Inflation

Basic costs are determined from a specific price basis. This defines the time for which the prices on the construction market have been established. The portrayal of the market development from the original price level up to the more recent price basis of a specific date takes place by adding, to the basic costs, the cost coefficients for the value adjustment and inflation.

Cost coefficients for value adjustment and inflation are thus the methodical approach for taking into consideration the market price developments that have already occurred up to a reference date (date of the price basis). Cost coefficients for value adjustment are based on parts of projects prior to the conclusion of the contract. Cost coefficients for inflation are applied to assigned parts of the project (after conclusion of the contract).

1.4.2.3 Cost Coefficients for Risks

The implementation of infrastructure projects is subject to risk influences, which, even with careful planning, can cause fluctuations with respect to the known and considered basic costs. These fluctuations usually lead to cost increases and are not included in the basic costs. Nevertheless, to determine stable costs in the risk environment of projects, appropriate provision must be made for future planning cost changes.

This is carried out with cost coefficients for risks for the monetary consideration of quantifiable as well as still unknown or unpredictable influences. These are dealt with in a methodical manner in the course of risk management. The risk provisions must be adapted to the state of project knowledge as the project progresses.

1.4.2.4 Cost Coefficients for Preliminary Monetary Adjustment

The procurement of services does not take place on a set reference date but extends across longer periods into the future. Cost coefficients for preliminary monetary adjustment are the methodical approach to considering the assumed future market development after a reference date (date of the price basis) over the individual implementation periods and up to the end of the project. To determine this, a schedule of the services to be provided – divided into phases – is required. A postponement of projects or parts of projects will cause changes in preliminary monetary adjustment.

For rail projects in Austria, the cost coefficient for preliminary monetary adjustment is $P = 2.5\%$ per annum. The same approach is used for the nominalisation of risk costs.

$$C_{\text{nom.}} = (C_{\text{basic}} + C_{\text{risk}}) \times P^n$$

1.5 Cost Coefficients for Risks Corresponding to the Value of the ÖGG-Guideline 2005

The implementation of infrastructure projects is subject to risk influences that will cause variations, even with careful planning. Cost coefficients for risks (quantifiable and unpredictable influences) are the methodical approach for appropriately taking these into account (Figure 1.1) [1].

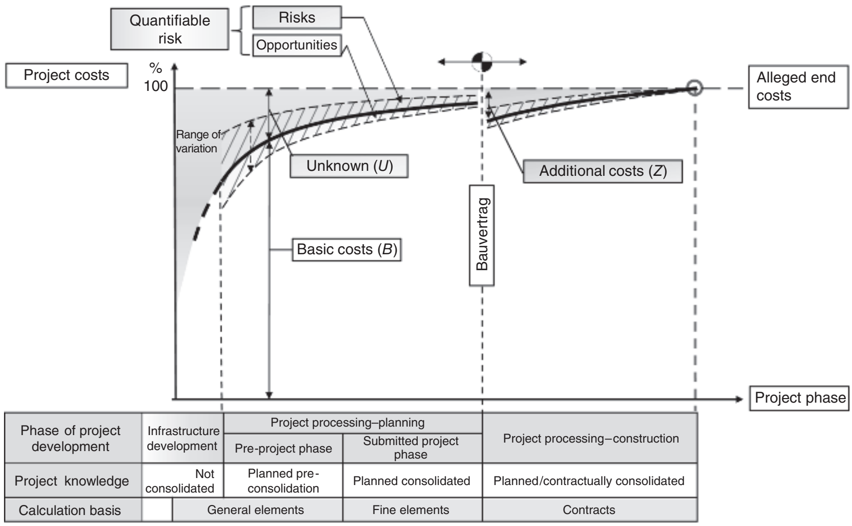

Figure 1.1 Schematic of the cost establishment.

1.5.1 Structure of the Cost Coefficients for Risks According to Project Phases

With the transition of a part of the project from the planning phase to the implementation phase, the structure of the basic costs changes. While cost assessments in the planning phase are based on element costs, in the execution phase there are specific orders (contracts), which usually include lists of services with unit prices.

Each pre-contractual planning status is characterised by the fact that the constructor is not yet aware of part of the project of the later construction. For the cost provision for the resulting planned costs, the basic costs for the as yet unassigned parts of the project are added as *cost coefficients for unknowns* (U).

With the conclusion of a (construction) contract, the construction for this part of the project is defined. Any still unknown deviations in construction execution, as compared to the contractual stipulations, will lead to additional contracts and therefore usually to additional costs in excess of the main contract amount. As cost provisions for the resulting planned costs, the basic *cost coefficients for additional services* (Z) *are added*. These cost coefficients are based on a definite contract between the installer and the contractor, and serve to cover additional planned costs due to changes in the nature of the agreed service, changes to the circumstances of the services to be provided, additional services, additional quantities, and other necessary changes to the contract.

For the aggregated representation: $R = U + Z$

1.5.2 Structure of the Cost Coefficients for Risks According to Risk Spheres

With regard to the responsibility for planned cost changes as a result of risks that have occurred, we differentiate between the constructor and the project customer.

The following are risks included in the *constructor's sphere*:

- *Planning risks*: Planned cost changes due to higher level of detail of the planning as the project progresses with unchanged service content.
- *Land acquisition risks*: Planned cost changes concerning land acquisition with unchanged service content.
- *Calculation risks*: Planned cost changes as a result of new estimates of the costs of services with unchanged service content. The cause for such planned cost changes includes, among others, services that were not taken into consideration in the original cost assessment, even though they must have actually been known from the start. A further reason is, for example, the deviation of a single contract result from the costs forecast.
- *Contract risks*: Planned cost changes, which may be due to the implementation of the contract under the concrete performance conditions.

The risks of the *customer sphere* include:

- *Order change risks*: Planned cost changes due to a change of objectives and framework conditions. This includes changes to the objective data (e.g. project requirements, state of the art), as well as changes in laws, regulations, directives, and implementation instructions (e.g. in the form of permit conditions).
- *Construction ground risks*: Planned cost changes as a result of unknown or insufficiently known geological and hydrogeological conditions.
- *Inventory risks*: Planned cost changes due to the unknown or insufficiently known scope or features of existing structures or parts of structures.
- *Approval risks*: Planned cost changes that are caused by the processing of approval procedures.
- *Financing risks*: Planned cost changes that are caused by the timing and method of the provision of financial means by the customer.
- *Market risks*: Planned cost changes, which are caused by the general development of the prices on the procurement markets of the constructor.
- *Risk of force majeure*: Planned cost changes caused by the effects of force majeure (earthquakes, floods, avalanches, extreme snow conditions, storms, environmental disasters, war, strikes, and similar occurrences, to the extent that such events occur over an unusual period of time).

1.5.3 Levels Used to Estimate the Cost Coefficients for Risks

The assessment of the cost coefficients for risks is carried out across several operative levels. In terms of predictability, influence, and responsibility, a distinction is made:

- *Level 1* (*part of a project*): This involves the assessment of the required risk provisions, where appropriate with the involvement of quantitative risk analyses carried out by the persons responsible for the individual parts of the project (supply areas and orders). The cost coefficients are shown in the cost structure of the respective part of the project.
- *Level 2* (*project*): This involves taking into account the risks that are not directly quantifiable by those responsible for the entire project. The cost coefficients for the second level are shown in the cost structure of the respective project.
- *Level 3* (*project portfolio*): Here, the project customer makes provisions for the remaining residual risks.

1.5.4 Reference Values for Cost Coefficients for Risks – Planning Phase

With cost assessments for parts of projects in the planning phase, the project constructor is not yet aware of part of the project to be constructed. For the cost provisions for the resulting planned costs, the basic *cost coefficients for unknowns* (U) *are added*.

The establishment of the cost coefficients U can usually be carried out with sufficient precision for both small and medium-sized projects based on reference values.

These reference values are used to estimate the cost coefficients U_E (constructor sphere) and U_B (customer sphere) and cover the risks that are estimated by the constructor.

Input parameters are:

- the forecast part of the basic costs for each part of the project (B)
- part of B, which is affected by the construction ground risk ($B^{\text{Constr. Ground}}$)
- the planning level (project knowledge)
- an assessment of the complexity of the project.

Results are:

- cost coefficients U_E per part of project (unknowns from the constructor sphere)
- cost coefficients U_B per part of project (unknowns from the customer sphere)

$$U = U_E + U_B$$

The percentages of the guide value procedure for risk provision represent just one reference point for establishing cost coefficients to cover the relevant risks. In individual cases, it can nevertheless be appropriate and necessary, owing to the given framework conditions, to use deviating cost coefficients for risks.

1.5.4.1 Cost Coefficient U_E

To determine the cost coefficient U_E per part of project, a u_E percentage (Table 1.1) is multiplied by the forecast part of the basic costs B of the part of the project: $U_E = u_E \times B$

Table 1.1 Percentages for u_E (corresponds to the value of the ÖGG-Guideline 2005 [1]).

		Complexity of the project (%)		
Percentage u_E	**Planning status**	**Easy**	**Moderate**	**Difficult**
Cost estimate for the Environmental Impact Study	Environmental Impact Statement	4	8	12
Cost calculation for the submitted project before the approvals	Submission planning	3	6	9
Cost calculation for the definitive project after the definitive approvals	Conclusion of the essential approval procedures	2	4	6

1.5.4.2 Cost Coefficient U_B

The cost coefficient U_B per part of project is formed from the sum of a cost coefficient for general project risks ($U_B^{General}$) and a cost coefficient for construction ground risks ($U_B^{Constr.Ground}$):

$$U_B = u_B^{General} + U_B^{Constr.Ground}$$

While the cost coefficient for general project risks depends on the total basic costs of the part of the project (B), the cost coefficient for the construction ground risks is calculated only from the forecast part of the basic costs that is affected by the construction ground risk ($B^{Constr.\ Ground}$). This results in the following formula for the calculation of U_B:

$$U_B = u_B^{General} \times B + u_B^{Constr.Ground} \times B^{Constr.Ground}$$

The percentages $u_B^{General}$ and $u_B^{Constr.Ground}$ – depending on the planning status while estimating the complexity of the part of the project – are determined using Tables 1.2 and 1.3, where an interpolation of intermediate values is possible.

Table 1.2 Percentages for $U_B^{General}$ (corresponds to the value of the ÖGG-Guideline 2005 [1]).

		Complexity of the project (%)		
Percentage of $U_B^{General}$	**Planning status**	**Easy**	**Moderate**	**Difficult**
Cost estimate for the Environmental Impact Study	Environmental Impact Statement	7.5	10	12.5
Cost calculation for the submitted project before the approvals	Submission planning	5	7.5	10
Cost calculation for the definitive project after the definitive approvals	Conclusion of the essential approval procedures	2.5	5	7.5

Table 1.3 Percentages for $U_B^{Constr.Ground}$ (corresponds to the value of the ÖGG-Guideline 2005 [1]).

		Construction ground conditions (%)		
Percentage of $U_B^{Constr.Ground}$	**Planning status**	**Easy**	**Moderate**	**Difficult**
Cost estimate for the Environmental Impact Study	Environmental Impact Statement	10	15	20
Cost calculation for the submitted project before the approvals	Submission planning	7.5	11.25	15
Cost calculation for the definitive project after the definitive approvals	Conclusion of the essential approval procedures	5	7.5	10

1.5.5 Reference Values for Cost Coefficients for Risks – Execution Phase

As risk provision for parts of projects in the execution phase, the cost coefficient for additional services (Z), which is the sum of the provisions for covering additional costs for the individual current contracts (Z_i), is used.

With easy construction ground conditions, the guide value for Z_i is around 5–10% of the respective order amount. However, as the amount of the necessary risk provisions Z_i very much depends on the framework conditions (e.g. complexity and prospecting required on the construction ground, construction processes, quality of the contract) of the individual contract, sometimes much higher Z_i cost coefficients are required. The risk provisions Z_i must be established for each individual contract, based on the given circumstances. In the course of construction, these are reduced to the contractual services that have not yet been rendered as a percentage, depending on the remaining risks.

1.6 Control

1.6.1 Project Cost Control

The long-term nature of infrastructure projects and the high-risk influences require the regular comparison of starting values and current status in accordance with control methodology. The key assumption of project cost control in ÖBB-Infrastruktur AG is thinking in terms of control loops for the purposes of periodically repeated activities. The formal and content-related basics are noted in ÖBB-Infrastruktur AG's manual for project cost control [5].

Project cost control is an integral part of the project. Based on the project cost control loop, the following processes will be carried out on a regular basis (Figure 1.2).

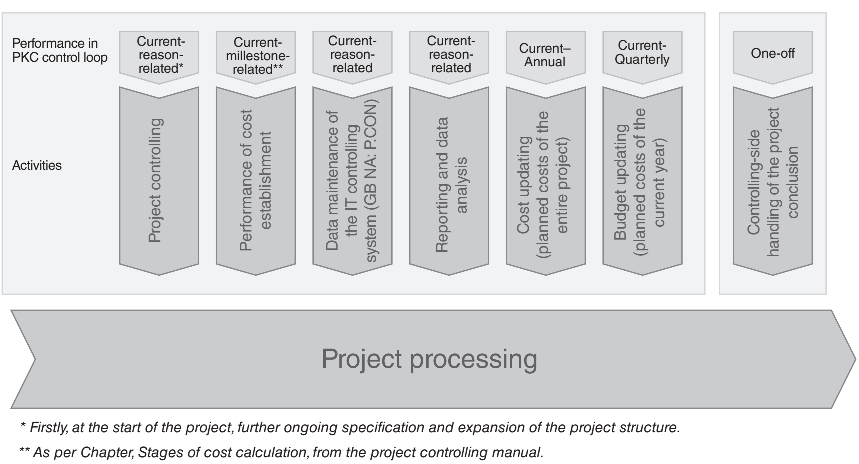

Figure 1.2 Project cost control in project management.

1.6.2 Project Cost Control in the Annual Control Loop

When applying the control concept to construction projects, the control loop is the main feature of the realisation phase of a construction project, where the individual project phases run from the planning through the construction phase and up to completion.

During the processing of the construction projects, control cycles are performed at regular intervals. To establish the plan value, periodically or after completion of certain project phases (e.g. route selection procedures, submitted project), cost establishments are carried out. The resulting plan value of a cost assessment after a specific realisation phase is subject to a comparison with the cost specification of the set value (set/plan comparison) during a cost control. The cost deviation represents the expected deviation from the cost specification.

The cost control processes the information from the target/plan comparison with control measures and must incorporate these in the realisation phase or adapt the provisions of the cost planning (set).

In the course of project processing, differentiation is made between a current (in the current financial year) and an annual (multiannual) control loop, as shown in Figure 1.3.

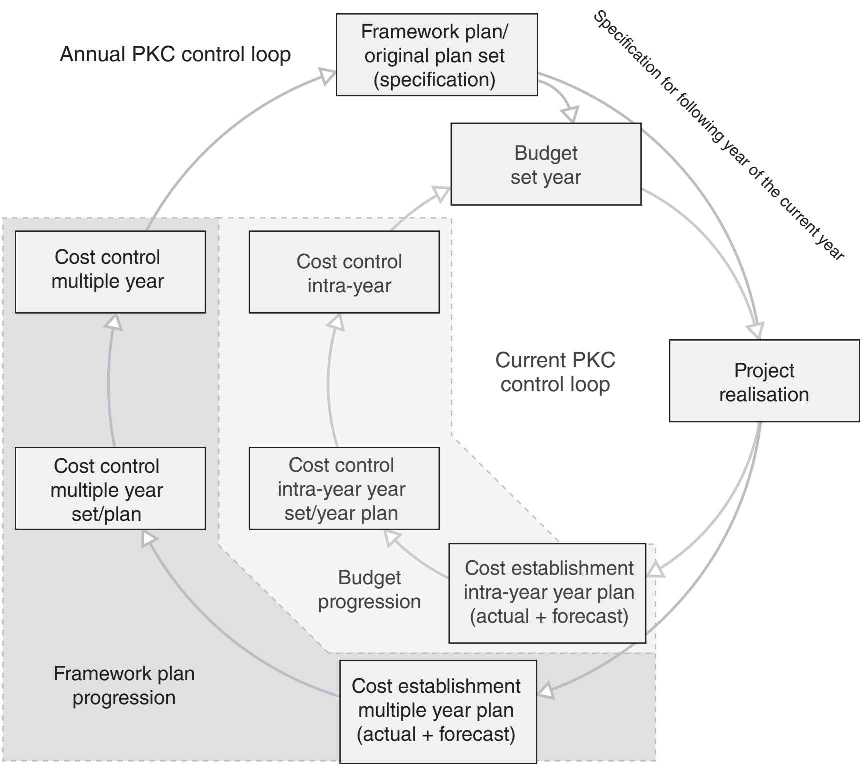

Figure 1.3 Annual and current project cost control loop.

A ‘current project cost control loop’ is the regularly repeated succession of budget allowances (annually set), project realisation, intra-year cost establishment (year-plan), intra-year cost control (set/plan comparison), intra-year cost control, and adaptation of the budget allowances. The current project cost control loop generally has a quarterly (new and expansion projects) periodicity.

An ‘annual project cost control loop’ is the regularly repeated succession of framework plan approvals (set), project realisation, several year cost establishment (plan), several year cost control (set/plan comparison), several year cost control, and adaptation of the framework plan. The annual project cost control loop has an annual periodicity.

1.6.3 Project Phases

Within the course of the project cost control, a clear temporal structure of the project process is of fundamental importance to match the activities of the cost planning to the project phases.

During the management of complex projects, a multi-stage phase structure has proven to be practical and necessary. The phase structure of complex infrastructure projects is carried out in three parts: conception phase (infrastructure development), planning phase, and implementation phase (construction phase).

In the conception phase, first a recognised need is clarified and formulated. Alternative actions for the fulfilment of the need must be defined and evaluated. The conclusion of the conception phase results in the solutions that are to be pursued.

The planning phase details the need and the solution that were formulated in the conception phase. The configuration of the solution and the carrying out of the essential official procedures are the main tasks of the planning phase. The conclusion of this phase is an (officially) approved project that can be implemented.

The implementation phase comprises the preparation of the tendering and execution planning, the structural implementation, and the handover to the subsequent operator (user). The implementation phase ends with the formal completion of the project.

1.6.4 Levels of Cost Planning

The individual phases of the project are allocated to the individual levels of the cost planning. Here, the requirements and the methods to be used to determine the cost planning are established, such as whether cost planning should be carried out on the basis of general or fine elements.

Railway infrastructure projects have five basic levels of cost assessment: general cost assumption, cost estimation, cost calculation, cost tracking, and cost determination. They are based on the increasing level of information from the project planning and serve as decision-making and control instruments for the assessment of compliance with the cost specification.

Table 1.4 shows the linking of the individual project phases with the levels of cost planning (cost establishment) as well as with date, risk assessment, and cost stability.

Table 1.4 Project phases/cost establishment, date, risk assessment, cost stability.

Phase	Infrastructure development	Project processing planning: Pre-project phase	Project processing planning: Submitted project phase	Project processing construction
Cost establishment subsoil (representation level)	**General cost assumption** (key values/general elements)	**Cost estimation** (general elements)	**Cost calculation** (fine elements)	**Cost tracking** (fine elements/LV)
Cost establishment detailed level	General cost assessment for development status xy	KS for route selection KS after route selection KS for UVE KS for pre-project	KB for submission project KB for UVP approval KB for project approval KB for planning conclusion	1. KV 2. KV … x. KV
Deadline information	Rough deadline acceptance	Rough deadline plan	General schedule	Execution deadline plan
Risk analysis	Rough risk acceptance	Rough risk analysis	Detailed risk analysis	Risk monitoring
Planning status	Project specification/rough planning	Pre-project planning	Approval planning	Execution planning/LV
Project knowledge	Not consolidated	Pre-consolidated in plan	Consolidated in plan	Consolidated in plan/contract
Quality of the cost calculation	Acceptance on basis of non-consolidated project knowledge	Rough estimation the basis of pre-consolidated project knowledge	Prognosis on the basis of project knowledge consolidated in plan	Prognosis on the basis of project knowledge consolidated in plan/contract
Cost stability	**(3) Low**	**(2b) Moderate**	**(2b) Moderate/(2a) High**	**(1) High**

KS, Cost estimation (in German: Kostenschätzung); UVE, Environmental Impact Statement (in German: Umweltverträglichkeitserklärung); KB, Cost calculation (in German: Kostenberechnung); UVP, Environmental Impact Assessment (in German: Umweltverträglichkeitsprüfung); LV, Tender specifications (in German: Leistungsverzeichnis).

1.6.5 Project Structuring

The figure of the individual project structure plan (PSP) elements in the project structure plan is crucial for orderly project cost control. An appropriate sustainable project structure must be drawn up at the start of the project process and expanded during the course of the project. The PSP serves as a continuous coordination and communication instrument for those involved in the project.

1.7 Change Management

During the management of infrastructure projects, changes are usually required with respect to the original assumptions. This can be caused by influences of the project itself (e.g. in-depth knowledge in the course of the project processing) or can come from outside the project (e.g. modified legal framework conditions or commissioned project changes). The changes can be in content (qualities), deadlines, or costs. Changes to the planned costs of a project are subject to specific approval conditions on the part of the companies (>3% or >€5.0 million).

In the control loop mentioned above, the changes must be represented periodically and form the basis for control measures. By doing so, a systematic change management enables both tracking of changes and transparent documentation of the project.

Change management is carried out both operationally within the project organisation of the executing business areas (constructor) and between the project client (customer) and the project contractor (constructor).

There is a differentiation between individual categories when recording and documenting the changes.

- Changes to content or qualities are referred to as content changes (cost changes in the responsibility sphere of the customer).
- Changes in the costs without changing the content or the qualities can be due to monetary adjustment related to causes independent of this adjustment (cost changes in the area of responsibility of the constructor).
- Changes to costs due only to a time delay of the project or adaptation of the indices for preliminary monetary adjustment are known as preliminary monetary adjustment changes.

1.8 Cost Coefficients for Risks Corresponding to the Value of the ÖGG-Guideline 2016

The cost coefficients for identifiable and quantifiable risks as well as still unknown or unpredictable influences have been re-evaluated in the 2016 version of the ÖGG-Guideline [2].

The 2005 version, used for previous cost updates, included fixed percentages, but the 2016 version of the Directive sets out bandwidths depending on the ‘complexity’ of the project.

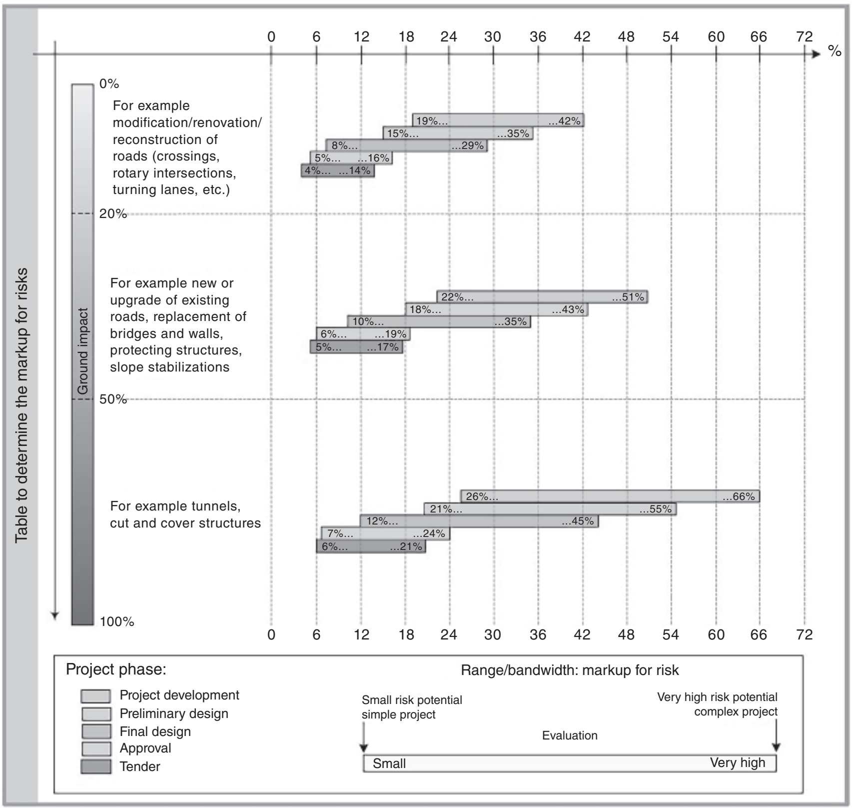

Figure 1.4 Calculation of the extra amount for risk provision (ÖGG Directive 2016).

For the calculation, the ‘complexity’ of the project was divided into three categories: ‘simple’, ‘medium’, and ‘difficult’. Based on this, the maximum, minimum, and medium values of the indicated bandwidth were applied to the calculation. In addition, the ÖGG-Guideline 2016 covers five project phases instead of three phases in the 2005 guideline.

The graph in Figure 1.4 shows the bandwidths based on the corresponding project phase and depending on the construction ground conditions (extract from the ÖGG Directive 2016 ‘*Cost calculation for transport infrastructure projects considering relevant project risks*’ [2]).

In Table 1.5, the lower and upper bounds of the cost coefficients for risks for tunnel projects are taken from Figure 1.4. The range between the lower and upper bound represents the possible impact of risks and the complexity of the project. For a simple project with a possible low impact the lower value can be taken, but for complex projects or projects with high impact the upper value should be chosen.

$$R = u \times B$$

Table 1.5 Calculation of the extra amount of risk provision for different project phases for projects with a high impact of construction ground conditions of 50–100% (e.g. tunnels and galleries) according to the ÖGG Guideline 2016.

Project phase	Lower bound (%)	Medium (%)	Upper bound (%)
Feasibility study	26	46	66
Preliminary project	21	38	55
Submission project for the environmental approvals	12	28.5	45
Definitive project after the definitive approvals (provisions set by the authorities)	7	15.5	24
Tender project	6	13.5	21

Abbreviations

B	basic costs
BBG	Federal Railway Act
ETCS	European Train Control System
G	monetary adjustment and inflation
GSM-R	Global System for Mobile Communications – Railway
ÖBB	Austrian Railway Company
ÖGG	Austrian Society for Geomechanics
R	cost for risks
RVS	Guidelines for the Mobility Infrastructures
TEN	Trans-European-Network
U	unknown risks
UVP	environmental impact assessment
UVS	environmental impact statement
V	preliminary monetary adjustment (prognosis) for inflation
Z	costs for additional service or work

References

1. ÖGG (Austrian Society for Geomechanics) guideline "Kostenermittlung für Projekte der Verkehrsinfrastruktur unter Berücksichtigung relevanter Projektrisiken." [Calculation of costs for transport infrastructure while taking into consideration relevant project risks] Salzburg, 2005.
2. ÖGG (Austrian Society for Geomechanics) guideline "Kostenermittlung für Projekte der Verkehrsinfrastruktur unter Berücksichtigung relevanter Projektrisiken" [Calculation of costs for transport infrastructure while taking into consideration relevant project risks] Salzburg, 2016.
3. "Manual to determine costs of ÖBB-Infrastructure AG." Vienna, 2011 (unpublished).
4. RVS data sheet 02.01.14 "Determination of project costs for infrastructure projects," Austrian Research Society Road, Rail, Transport, Vienna, 2012.
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