

Finance accounting and cost control for long-term construction contracts supported by the integrated management and information system Aristoteles

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Hochtief AG Germany has developed a comprehensive management and information system for the construction industry named Aristoteles. This system is an efficient supporting tool to manage a variety of construction sites as well as operating business units with required economic targets. As such, Aristoteles offers wide-ranging control of complex economic processes in construction in a consistent manner.

In this paper the process oriented functions of the system will be described with special emphasis on finance accounting and cost control. The basic elements in this respect are tender estimation, creation of initial project budgets and running budgets, regular determination of work done and result forecast to the end of the project. Further, cost accounting, monthly reporting, and all balance-related postings are included.

On the basis of the extensive reporting (targeted/actual cost comparison, cost manager, project report, actual/targeted hours worked comparison, overhead cost report, amendment report or project (result) lists of all projects realized by one business unit), the responsible managers can make justified project evaluations, project controls and variance analyses during the project period and derive appropriate management measures. Thus, Aristoteles includes all substantial elements for the risk management of the operational business.

In big construction joint-stock companies it is of crucial importance to satisfy the information requirements of the investors. In this respect the system provides a transparent presentation of the financial, investment and profitability situation of the company. In the international construction industry the balancing rules according to IAS (International Accounting Standards) have already been used to a larger extent. In accordance with these rules the partial profits of the work during execution can be shown as realized even before completion of a long-term contract.

The validity of Aristoteles will be outlined briefly. Major advantages using the system are highly enhanced accuracy of project controlling, systematic overhead allocation to projects, change of attitude of the project personnel due to increased cost consciousness and improved flow of information within the company.

Introduction

High profitability is a long-term guarantee for future company existence. In order to achieve this aim objectives like project execution within defined time frames and cost limits, providing the agreed performance and client satisfaction must be realized. To achieve efficient project and business control in order to match the above-mentioned key objectives, it is necessary to enter and reproduce business data with high performance information systems.

With Aristoteles, Hochtief AG of Germany has developed a complex management and information system for construction and related industry. The tool provides all information needed for project management for large and unique projects—and that way also management of the related business units. In this way it functions as an universal tool for planning, risk management, project and company result control. It also secures use of unified terminology and reporting. All relevant business unit and subsidiaries of Hochtief are equipped with this system. This paper focuses on the implementation of the system in the Czech subsidiary Hochtief VSB, Prague.

The system comprises three parts: Kubus as estimation and controlling system for all sizes of construction projects, RenuS/SAP R3 as an accounting system which supports balancing, activity based costing, material purchasing, invoicing, etc., and Probet/Diva as superordinate management and information system for top management.

Estimation

Cost structure

KUBUS as a process-oriented estimating and controlling software is designed to assist especially project management for large and complex projects, e.g. like mining tunnelling, shaft sinking, etc. As such, it can be used from the very first information up to the last statement of accounts. Technically, Kubus is a modern windows software and permits working in both centralized and local data bases.

Before the project cost estimation in Kubus can start, cost structure must be created. In this cost structure all cost types like wages, salaries, materials, machine costs, subcontractor

cost, etc. are described. This cost structure corresponds with the accounting plan of the company via cost type keys (CTK). During project estimation unit prices e.g. for standard hourly wages and/or for bulk items, like concrete, steel bricks, etc. may be defined for each cost type, resp. cost type key. Changes of those prices can be made here centrally in a very efficient manner. For efficient project controlling during the execution phase of the project cost control comparisons with bookkeeping can be made on the basis of each cost type key.

Principles of bid estimation

Projects start to take shape when inquiries are selectively processed and bids are prepared. The aim—always taking the risk potential into account—is to acquire new contracts.

The tender estimate is always calculated with quantities for direct costs and indirect costs to determine the job costs net. The job costs gross are calculated by adding the overhead costs. The bid price results from adding the job costs gross, the entrepreneurial risk and the computed profit. In other words, the tender estimate ends with the budgeted profit fixed for the bid phase.

- *Direct Costs of Partial Services (DC)* are shares of costs, which the client requires directly by performance description (e.g. bill of quantities). Parts included are e.g. excavations, concrete and steel construction, technical equipment as heating or air-conditioning systems.
- *Indirect costs (IC)* are estimated costs, which are not inquired in the items of individual unit costs of the bill of quantities (e.g. salaries of site management, site equipment, office space, telephone, etc.).
- *Overhead costs (OHDS)* consist of e.g. costs of commercial management, administration costs, also costs for fleet of cars and building rental of the superordinated business unit and headquarters. This item is applied as a percentage rate. The value is derived by dividing planned administration costs and planned earned value of all projects in the current business year. In case the company wins the project this value is charged monthly on the basis of earned value on site. The value will not be changed during the life of a project.
- *Job costs gross (JCG)* are determined by summing up job costs net + overhead costs. In order to secure future life of a company it is fundamental to cover these costs fully in a long-term perspective.
- *Risk (R) and profit (P)* represent the difference between job cost net and bid price. Business risks and certain unforeseen cost should be covered by this. The amount of the percentage rates depends mainly on the market situation and competitors. Risk and profit are calculated similar to administration expenses—according to the turnover.

During the creation of the tender, one or several bills of quantities (BoQ) can be created. The direct costs contain all work items of the project. The direct costs can be recorded in more detail by using sub-items. The indirect costs of the project can be estimated in the work items indirect costs. This estimate is also based on the cost types used by accounting.

The costs of contractual and bid risks are evaluated and incorporated in the bid price. Entrepreneurial and project related risks can be calculated either as surcharges in the top sheet or in a special indirect costs BoQ. This BoQ allows the identified risks to be recorded and tracked within

the indirect costs of the bid and contract. Only the general project—related risk is estimated as a surcharge.

The top sheet contains all parts of the tender estimate which are needed for calculation of unit and total prices of the bid. The costs estimated in one or more direct and indirect costs BoQs are merged there. For this purpose, the necessary BoQs are allocated to the top sheet.

Special advantage of this method is that individual unit prices are item-wise described by the portion of direct cost and relevant surcharge for indirect cost, administration overhead and profit. In turn, unit prices derived on subcontractor bid show directly the limit value for later subcontractor's placement.

Realization of projects

Initial project set-up, which on the one hand serves to represent the contract in Aristoteles and on the other hand establishes the basis for future project controlling has to be done prior to the execution of the project.

After the contract has been signed and all corresponding documents are in hand, all documentation must be checked. Particular attention must be paid to any discrepancies that have arisen between the inquiry which was the basis for the tender and the contract.

Estimate after contract award

After a contract is received, the estimate after contract award is created in Kubus. It represents the contractual scope of work including indirect costs. The estimate after contract award is, like the tender, structured by items. The storage by cost type keys applied in the tender estimate as defined by Accounting is maintained. The estimate after contract award reflects the result of the contract negotiations on the basis of the tender estimate.

Creation of original budget

Immediately after the estimate after contract award, but in general before the award of the subcontractor's work, the original budget is created in Kubus. That is where the planned profit is stated. The planned profit is the entrepreneurial goal of the project and simultaneously the

Bid	
Direct costs of partial services	DC
+ Indirect costs	IC
= Job costs net	JCN
+ Overhead costs	OHDS
= Job costs gross	JCG
+ Risk and profit	P
= Bid price	

Figure 1. Bid price breakdown

basis for performance-oriented remuneration (POR). The original budget contains the award limits for subcontractor work. The project risk is represented as estimated costs in a special cost type. The project manager makes decisions about the usage and allocation of this risk reserve. The estimate after contract award and the original budget are fixed in Kubus.

Project management and project controlling

Project controlling provides a current tracking of the economic project flow and enables countermeasures to be taken in good time; particularly by identifying potential sources of loss, this makes prompt intervention possible.

Current budget

Current budget is updated according to the reporting dates. This represents the updating of the original budget periodically during the project life in which all interim modifications are incorporated.

The monthly cost control at the reporting date is the basis of the early warning system. In the cost control, earned value, target and actual costs as well as profit are shown in relation to the reporting dates. For this purpose, executed performance quantities are recorded monthly in Kubus and target costs and earned value are evaluated using the award limits for subcontractor work. The analysis of the cost control constitutes the basis for the projection and forecast within Kubus up to project completion.

Earned value

The earned value is the sum of the target costs (nominal job costs net) and of surcharges (overhead costs + profit of the current budget). The percentage of completion is the relation between earned value and the current contract value.

Target actual/comparison

Within the target/actual comparison, the target costs are compared with actual costs including accruals. The difference shows deviations. Thus providing initial indications within the early warning system.

Invoicing

It is important to keep the client informed about project progress. Especially in 'open book' contract types like the 'Guaranteed Maximum Price' (GMP), this can also include details concerning the cost control including projection and forecast. The invoices are charged to the client according to the contract. The invoice amount should at least correspond to the performance amount. If this is not possible as planned, corresponding imputed interest has to be estimated during the bid phase. In any event the project is charged with the actual interest costs or credited with interest earning.

Interim applications for payment for the project are created in Renus, the enclosure to invoice is added from Kubus. All modifications to the contractual scope of work are introduced in the current budget in Kubus.

Sub-contractor work award

In the bid phase and in the contract phase, tendering of subcontractor work is created via Kubus and the work sections are sent out for tender.

After the tenders have been received, the subcontractor work can be compared and evaluated in a tender evaluation

table. Information from Renus can be used to create subcontractor lists. In this way, systematic selection of appropriate subcontractors is supported. The contract prices of the contracted subcontractors are introduced as award values in the current budget after the work has been contracted. They are identical to the contract values of the subcontractors managed in Renus.

Controlling of the subcontractors is carried out within Kubus via the cost manager or detailed via subcontractor controlling. It is possible to see if the award cost was covered by comparing the award limit with the actually achieved award value. Achieved award profits or losses are shown via the award factor (Awd-F). It represents the relationship between award costs and the award limit. The award value and the award profit always represent the current status, because the award values are adapted in later modifications, via quantity modifications or subcontractors variation orders.

A subcontractor appraisal is made in Renus at the latest after the conclusion of subcontractors' work. These data can be evaluated for future subcontractor inquiries.

Monthly Project Report (MPR)

The most important project information is summarized at the reporting date and placed at the disposal of executive management. The Monthly Project Report (MPR) in Probet contains important details about performance and profit, invoicing and payments at the reporting date as well as the forecast values for earned value, profit, and payments at completion date.

Continuous forecasting (Figure 2) is an important part of MPR. Result of Probet forecast represents the basis of balance project evaluation. A lot of entries are carried out in accounting on the basis of MPR (e.g. accounting entry of earned value and forecast, booking of invoice, balance state accounting etc.).

Regular supervision of project status with Probet reports allows the creation of an important communication tool, which should serve to all economically responsible employees. It is possible to assess the quality of continuous forecasting and ability of estimate of the project team by consistent monitoring and supervision of forecasted results. Economically unfavourable projects are often distinguished by unrealistic values of earned value and costs, which are however taken into account at the end of the project.

Methodology of forecasting with respect to the balancing

Result forecasting describes economical project result per stated day, as it is expected from the point of view of the project manager at the end of the project. It is necessary to see the forecast as realistic evaluation and that way also as business estimate of future development.

Extrapolation is a step towards the creation of monthly forecast. Extrapolation of all costs till the end of the project can be created from the sum of actual costs and expected residual costs. It is conservatively focused with view to the company's balance rules and it follows the *principle of business cautiousness*. This means, while the revenues are taken into account by the order award, all expected costs till the end of project are covered against it. Then the chances and risk assessment is carried out. All extrapolation, chances and risks are summarized for the result forecast till the project end.

Figure 3 shows typical result development of anticipated

Project Status
Monthly Project Report 03/2001
BE00725—Administration Building Prague

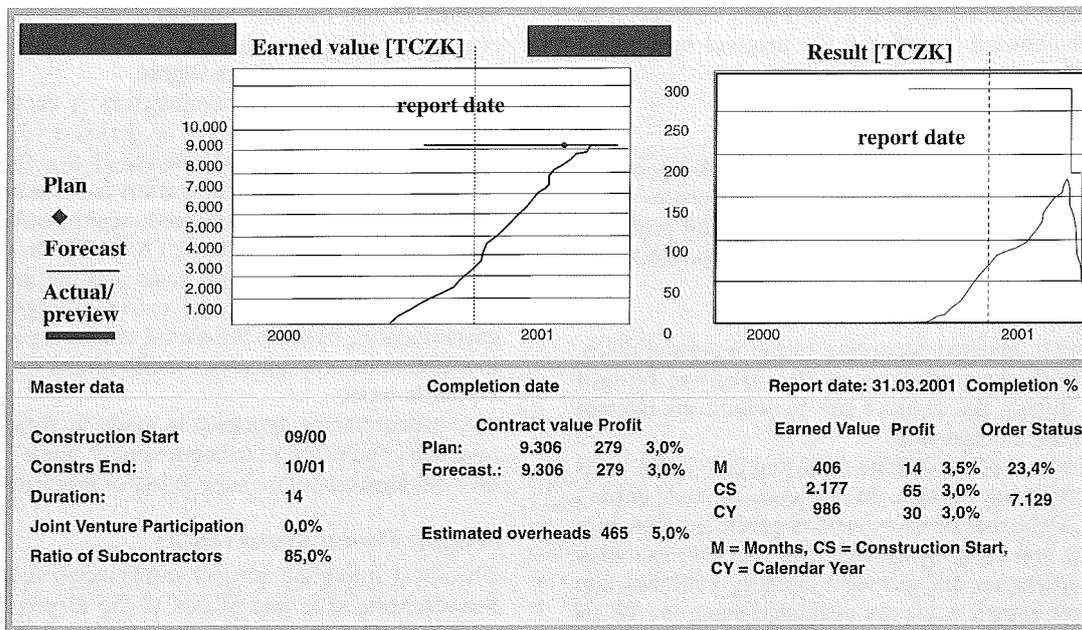


Figure 2. Example—project status with data from Probet

positive final result. Here no balance result can be shown according to the Czech Commercial Code. Partial profit is shown economically according to the rules of International Accounting Standards (IAS).

However, in the balance negative project result is shown by the project with negative final result (also according to the rules of IAS). In the company's balance a provision must be created in the volume of expected total loss, that means that loss must be displayed in the balance sheet according to the local Commercial code and IAS in the full.

This praxis has its basis in the 'principle of imparity'. According to this principle, it is necessary to present the loss as soon as it appears. Profit is treated differently, and it can be shown only after it is realized. The principle of imparity is based on the 'principle of business cautiousness'.

Reporting in Renus

Project Report PR0—Individual cost items—actual

Based on the entries and cost types of accounting, this report provides an overview of earned value and costs and that way also composition of project result. The information is presented according to Figure 5.

Special attention has to be drawn to the correct values of subcontractor accruals, i.e. the estimate of actual value of performed services of each subcontractor firm on site. This value usually deviates from the status of invoice of subcontractor. This information is created as proposed value in Kubus (during monthly performance evaluation) and then transferred to Renus. It is very important to verify each value when carrying out forecasting procedure.

All projects of the business are presented in list form in the Report ER345—project status. Items shown are administration expenses, interest result and result of single projects. Horizontally, there are displayed information from

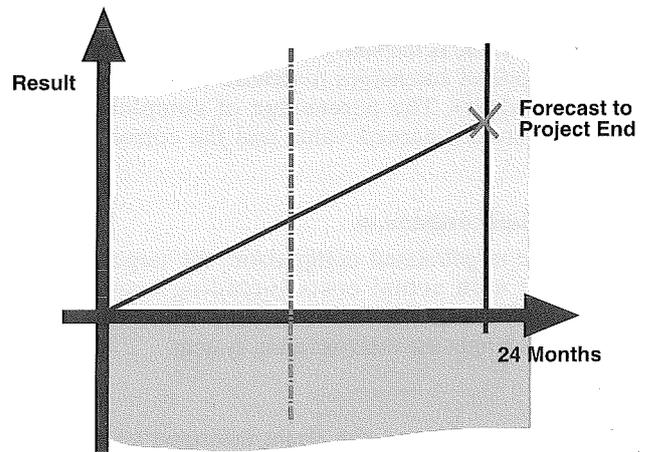


Figure 3. Presentation of positive project result

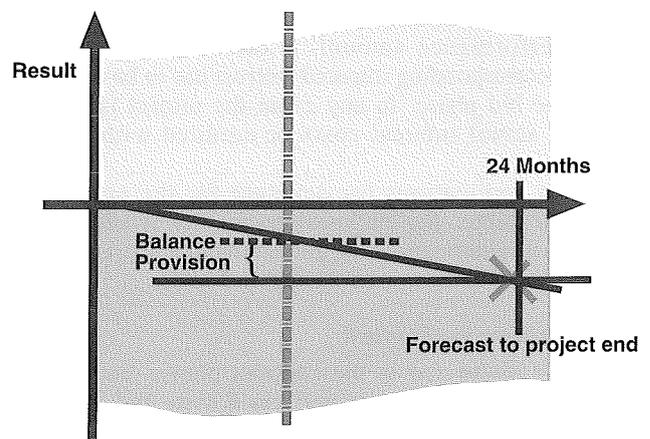


Figure 4. Presentation of negative project result

running calendar year, values from the beginning of the site (cumulated) and values of plan and forecast of Probet.

Cost Centers Report CC0 for administration expenses

Administration expenses of administrative levels in headquarters and divisions are managed over a variety of cost centres (e.g. company management, finances and accounting, controlling, marketing). Special cost centres are created for project management of site operations.

In Aristoteles the following system of overhead cost allocation is implemented.

- *Area of settlement*—Complete recharging of incurred costs, e.g. house and property costs, insurance costs to

other cost centres or projects. In this meaning, costs in this area are not part of administration expenses.

- *Area of overhead cost, respectively 'pure' administration expenses*—'Net' administration expenses of commercial management, finances and accounting, controlling etc. on division and headquarters.
- *Area of services*—These cost centres deliver special services and work as profit centres. Clearing directed to the receiver is mainly done according to quantities (e.g. hours of service times price). These costs are not the part of administration expenses.
- *Area of administration expenses settlement*—Settlement of administration expenses to the projects is done here according to the percentage key. The rate is charged monthly in a consistent manner to the projects.

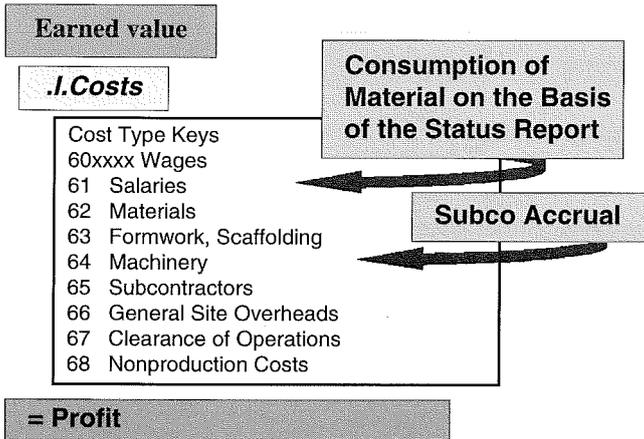


Figure 5. Scheme of project report PR10

Result of the business unit

This report displays the earned value of the business unit and their result before and after the settlement of administration expenses. Administration expenses are shown separately according to single areas. Additionally there is shown the neutral result (Figure 6).

Figure 7 gives an overview of the monthly reporting system with interdependencies.

Balancing in construction industry—problem of profit realization for long-term construction contracts

Construction industry is a long-term concern—measured according to the periods for completion and sales in many industrial branches. Progress of construction order often exceeds one or more balance terms. This results in

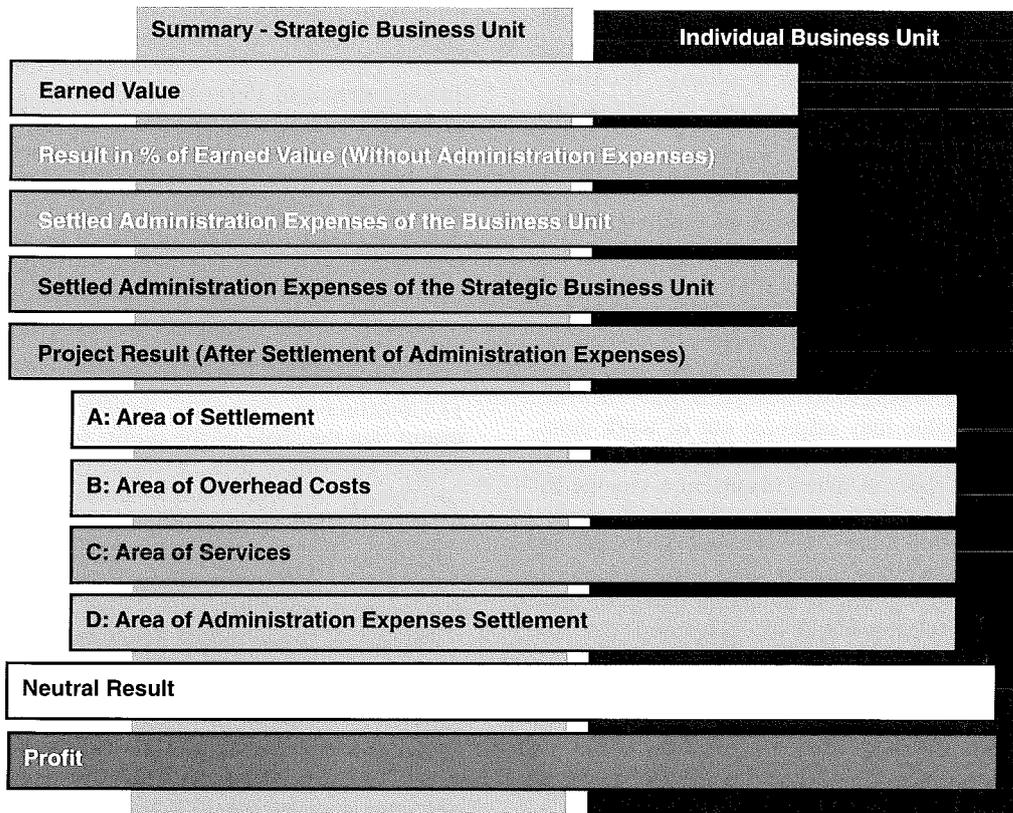


Figure 6. Result of the business unit

by completion process is determined in Kubus with *orientation to the output* from the ratio of already carried out earned value and total planned earned value. Revenues and costs of the order are concurrently shown in the profit and loss account, and the partial profit added to one production period is determined as a sum of difference between both after deduction of previous periods with realized partial profits. Earned values, which were not charged to the investor, must be activated by the company as a subject of property with the characteristics of account receivable. Total loss must be immediately taken into the account.

Validity of Aristoteles implementation

Major advantages using the system are highly enhanced accuracy of project controlling, systematic overheads allocation, systematic business-economic-training of the project staff with related change of attitude towards higher cost consciousness and economic decision-making, improved flow of information among individual departments, and to elaborate a year-end closing according to IAS Gaap.

Unified evaluation scheme is used as a basis

Project actual and forecasted results can be evaluated according to the uniform economic proceedings applied.

Before the implementation of Aristoteles the project cost accounting was carried out in point of fact individually — according to the qualification of the project management. The non-transparency was partially even conditioned by the system—(keyword: transformation society).

On the base of the Aristoteles reporting there is realized systematic auditing of all construction sites.

Systematic overheads allocation

Before the implementation of Aristoteles the overheads were allocated to the projects according to the 'acceptable-burden-principle'. That means: higher allocation percentages were assigned to projects with good positive results. Generally the project results according to the Accounting Department were not transparent and meaningful enough. With Aristoteles the overheads allocation is being managed centrally.

Systematic determination of award limits for the subcontractors' works is another advantage of the uniform allocation. This, in turn, improves negotiations with subcontractors and may lead to further procurement cost reduction.

All cost types—all projects

We intend to monitor all cost types of a project (including all overheads, risks, results, etc.) and all projects within the operational unit with Aristoteles. In this way we are able to avoid point analyses with limiting conditions. Further, the complete construction process over the full time duration is monitored.

Systematic business-economic-training of the project staff

We have achieved significant improvement in the sense of the business-economic-problem analysis and understanding. This was reached by consequent application of the economic-model of Aristoteles (e.g. overheads costing, unit prices determination and project controlling according to

the cost types with the determination of work done) and by relevant intensive training measures.

Aristoteles has tremendously changed the attitude of the project personnel towards higher cost consciousness and economic decision-making

Higher cost awareness has been reached by consistent questioning project results on the basis cost control reports and further consequent project auditing. Thus managerial qualification within a branch which requires above all engineering skills was improved substantially.

Improved flow of information among individual departments

On the base of the Aristoteles reporting (Renus accounting and Kubus project control) the information deficiencies—arising particularly from the interfaces among individual departments—were reduced considerably. This concerns especially improved cooperation within the procurement of subcontractors' works and materials, information flow regarding the estimation of work done and costs (estimating departments). Also improvement of project realization by systematic project budget updating and reconciliation with the work-scheduling department with a focus on costs, quality, and time relations.

Information about costs in the sphere of the claim management is available quickly. It is possible to identify potential claims in more qualified manner by systematic budget updating in Kubus.

Degree of accuracy in the presentation of project results was increased considerably

Construction industry achieves (under high risks) generally low margins (1–3% project profit). That's why it is necessary to create forecasts during the project duration with a corresponding degree of accuracy. Thus the application of sufficiently accurate controlling systems is indispensable.

Year-end closing according to IAS

With Kubus controlling system we are able to determine (focusing on the output) the percentage of completion of individual projects accurately. This is a substantial factor for the certification of the year-end close according to IAS—Gaap.

Summary and conclusions

The Aristoteles system is an effective tool for extensive business efficiency control of the construction sites and superordinate operative units. It offers the chance to continuously monitoring and questioning complex processes typical for construction companies with large and unique projects. It is meant to serve primarily project management and the management of the related business units.

Aristoteles also provides the following advantages:

- Accounting guidelines are binding for all users in the business
- The evidence and display of operationally economic processes will be more transparent by common use of the same database and by use of unified terminology
- Aristoteles supports procurement, personal management, business planning and control
- It is possible to develop qualified databases for estimation with Kubus.

- On the basis of extensive reporting (comparison of plan and actual, cost manager, project report, comparison of planned and actual terms, amendment reports or project list from Probet), it is possible to carry out qualified accruals, respectively performance determination, project checks, and deviation analysis within the project
- Aristoteles includes all important elements for risk management of operative businesses.

Increased transparency intended by the system contributes to the long-term success and existence of the company. Here is seen an important advantage towards the competitors on the Czech construction market.

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