

DPC Project Management Technology in Russia
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Summary

Construction management technology in Russia differs from that described in *A Guideline to the PMBOK™*. Differences concern all phases of project lifecycle including design, procurement and construction. Construction planning and management in Russia is based on the industry and company norms defining cost and material requirements per unit of volume for different activity types, resource usage and resource productivity for the different types of assignment. Hence the approach to project scheduling and budgeting based usually on the volume of planned work and assigned resources' productivity (not on activity duration as described in *A Guideline to the PMBOK™*). This approach and other aspects necessary for construction management are discussed in this presentation and realized in a project management software package Spider Project developed and widely used in Russia.

Design

At the phase of Design, construction budget and duration are estimated basing on the Russian industrial norms. These norms contained in the special reference books define expected cost components (manpower, material and equipment costs) and resource usage per one unit of activity volume (meter, kg, cubic meter, etc.). Estimated cost and duration of project activities are calculated using activity volume, standard productivity and the quantity of assigned resources. The Russian project management package Spider Project calculates activity duration automatically during project scheduling. Due to high inflation rate construction cost estimates change at least once every quarter, which calls for recalculation of project budget and adjusting project baseline.

Usage of the above-mentioned reference books in all construction projects guarantees the same approach to project cost and schedule planning. Besides it permits to introduce global changes in the project data should the norms be changed.

Spider Project users may create any number of different project databases. Usually the following four (at least) are necessary:

- database A: material usage norms per one unit of volume for different activity types,
- database B: cost (by components) per one unit of volume for different activity types,
- database C: resource productivity for different types of assignments,
- database D: resource usage (expressed as percentage of work time) for different types of resource assignment.

In some projects the following databases are also needed:

- database E: material usage norms per one unit of work volume for different assignment types,
- database F: material usage norms per one work hour for different resource types,

If a given type of project activity or assignment is contained in a database, its characteristics are taken from the database and the cost and material requirement norms therefrom are multiplied by activity volume.

The libraries of the fragments of typical projects are also widely used when creating project computer models. A typical project fragment is the computer simulation of a standard part or a phase of a larger project. An example of such fragment is the construction of a linear portion (100 m) of the road of some kind on a certain ground. When Spider Project users add the typical fragment to the project they input the volume of the fragment (for example, 245 meters of the road). The program includes the fragment (as project phase) to the project model multiplying the cost, material requirements and volume of the fragment activities by respective coefficient (in our case $k=2.45$).

The risk analysis is also different. The usual PERT approach with the estimation of optimistic, pessimistic and expected activity duration transforms into respective estimation of resource productivity. Besides, in construction projects it is natural to simulate risk events (for example, delays in resource work, bad weather, etc.) using exceptions in resource and project calendars. As a result classical PERT analysis is inapplicable in this case and we should use other methods including Monte Carlo simulation.

Large Russian construction companies have units manufacturing construction materials. Spider Project also performs the simulation of resources' manufacturing and delivery permitting to optimize resource supply and respective contracts. Including project financing in the project computer model you can not only obtain reports on project cash flow but also calculate project schedule basing on the schedules of material supply and financing. Unfortunately in Russia this side of project management is unpredictable now.

Construction

Resource management is the most important part of construction management. Optimal use of project resources is the main factor of project success. It means that the resource constrained scheduling algorithms should minimize project duration. The schedules produced by Spider Project are usually much shorter than the schedules produced for the same projects by other PM packages. But resource management places certain specific constraints on DPC project management software apart from producing the best resource-constrained schedules. In particular it is usually necessary to simulate work staggered in two or three shifts, to use partial resource assignment and skill scheduling with different resource productivity on assignment. There are also specific requirements for project data organization and reports. Usually we employ several WBS, OBS, Contract Breakdown Structure, responsibility structure, as well as hierarchical cost and material centers in a single construction project.

The monitoring of work results differs significantly from the usual timesheet approach. In the real projects it is not only the time spent on each activity that matters but also the volumes of work done (which are not necessarily proportional). If we know the remaining volumes of work then using Spider Project we can easily schedule the rest of the project. Comparing the time spent and the volumes of work done we can adjust resource productivity in project database, which permits to forecast the future project performance more accurately then using Earned Value Analysis.

When we implement project management in a Russian construction company we usually create the Analytical Center - analogue of Project Office. The functions of the staff of this Center include helping construction managers with project scheduling, cost and resource analysis, forecasting, database updating and preparing project performance reports. From our experience it follows that one project analyzer can successfully serve in three project management teams.

In such a short paper we can't describe all processes of construction management. So we shall concentrate on construction project scheduling and budgeting – the technological processes which show the difference in approaches most.

Construction Planning Processes Step by Step

- 1) *Project purpose is usually defined by the construction contract or invitation to bid. Define deliverables that should be controlled.*
- 2) *Define core WBS basing on the existing library of typical project fragments. Project fragments are usually the small projects that are repeatedly used as phases in different projects. These fragments will automatically become project phases if they would be included in project computer model. Project fragment is usually prepared for some typical volume of work (like 1000 meters, 100 square meters, etc.). When included all volumes of work and material requirements of project fragment activities are multiplied by coefficient defined by the actual volume of work in the current phase.*

- 3) *Define project resources.* At this stage you should decide which resources contained in resource database will be used in the current project. Usually resource database contains information on all resources that could be used, including potential subcontractors.
- 4) *Check, update or add cost and material requirements per resource work hour.* Some resources in the process of their work require materials (car needs petrol, crane needs electricity, etc.). These data are stored in the resource database and should be checked and updated regularly.
- 5) *Check and update the necessary project fragments.* Pay attention to the project resources and materials. Make necessary substitutions. Check assignment type codes especially if resources were changed. Assignment type defines standard productivity of resource measured in physical volume of work per work hour.
- 6) *For new assignment types define resource productivity and workloads (resource percent allocated). Put these data in assignment productivity and resource percent allocation databases.*
- 7) *Create project fragments that are typical though absent in the library, put them into the library of fragments.*
- 8) *Define sequence and physical volumes of project fragments that should be included in the project computer model.*
- 9) *Create project computer model using typical fragments.* Creating project computer model using project fragments you will automatically create project WBS. It doesn't mean that this WBS will be single. Users of Spider Project can create and simultaneously use any number of different WBS in one project model.
- 10) *Add phases and activities that are specific for the project and absent in the library of fragments.* Project phases that will not be repeated don't need to be kept in the typical fragment library.
- 11) *Define project risks.* Usually we divide risks to external and internal. External risks should be included in the contracts as forth major events or insured. Internal risks should be considered in the process of planning project duration and cost.
- 12) *Define and include in the project computer model risk mitigation phases and activities.*
- 13) *Link project activities.* Project fragments include links between fragment activities but it is necessary to link activities belonging to different fragments and new activities.
- 14) *Define volume of work to be done or fixed duration for all new activities.* Activity duration can be defined as fixed (resource independent) or calculated. In last case activity volume should be defined and its duration will depend on productivity of assigned resources.
- 15) *Assign types to new activities.* Type of activity is used for connection with the databases of activity cost and material requirements per unit of volume.
- 16) *For new activity types define cost and material requirements per unit of volume and put these data in corresponding databases.* On some project activities materials can be produced. In this case material requirements mean production of material per one unit of activity volume.
- 17) *Assign resources to new activities.* There are several types of assignments. The first one – *team assignment* when resources should work together. If one of them is not available then all team doesn't work. The second one – *independent assignments* of several resource teams. In that case all teams work independently and activity can be finished if its volume have been done by any group of assigned teams. Independent assignments are very useful for simulating work shifts. The third one – *resource pools*. Resources or teams belong to resource pool if there is a choice which of them to use. You should define the number of resources or teams to be used or their total productivity. Each resource has its own productivity on the considered assignment and Spider Project will choose those who are free at the moment when activity can be included in the project schedule and whose total quantity or combined productivity is as defined. Example: trucks with the different capacities can be used on some activity. You can define their total number or productivity and leave the rest to the program. Using resource pools you need not worry that resources are not used properly because you assigned to some activity the wrong ones. You can define priorities for assignment of pool resources. Without them Spider Project assigns first those resources whose cost per unit of volume is less. Activity duration is calculated after resource assignment during project scheduling.
- 18) *For new assignments add assignment type codes.* Assignment type codes serve for connection of project data with the databases of assignment productivity, resource percent allocation, cost and material requirements per unit of work volume.
- 19) *Define productivity for new assignment types.* Productivity of assignment type should be stored in the corresponding database. It is much easier to change the data in the database and apply the new data to any project than to find and correct the data in the long list of project assignments. Besides the standard database we usually create optimistic and pessimistic versions of resource productivity database which are used for risk simulation.
- 20) *Update databases.* New data should be included in project databases.

- 21) *Define project activity and resource calendars.* These calendars should include expected non-working and part-time working periods.
- 22) *Check and update unit cost by components for project materials.* Russia suffers from the high inflation rate. The cost of materials and resources changes constantly. The same with the ruble exchange rate. We not only need to update these data frequently but also to calculate separately expenses in different currencies. We also need to compare expenses with the state norms. Thus we need to calculate not only total cost but also the cost by components and their groups.
- 23) *Check and update work hour cost of project resources.*
- 24) *Check and update resource independent costs of activities and assignments.* The cost of activity is the sum of costs of resource usage on activity resource assignments (which is proportional to the duration of resource work), materials utilized on activity (proportional to their quantities), and resource independent costs which are assigned directly to activities and assignments. For an example the cost of subcontractor work is defined by contract and is assigned directly to subcontractor assignment.
- 25) *Calculate the initial resource constrained schedule.* The process of the draft project schedule development is illustrated by Exhibit 1. The natural criterion for schedule optimization is project cost. Usually optimizing project cost means minimizing project duration. Minimal duration indicates that resources are used most efficiently, management has larger time reserves, products are faster to market. Russian managers always try to optimize project schedules and are not quite happy with the results produced by known American packages.
- 26) *Check target dates and optimize project resource quantities.* Analyzing resource loads and playing “what if” scenarios project planner should define the optimal set of project resources. Optimal means the set of resources with minimal operating cost that is sufficient for meeting contract target dates.
- 27) *Calculate project budget.* Project budget includes not only time and phase distribution of planned cost, but also of all other project cost characteristics – cost components, spending and income, cashflow. Spider Project users can also create and use unlimited number of project cost centers. This step concludes deterministic part of schedule development. If received estimates show that the project can be profitable then comes time for estimating uncertainties.
- 28) *Check and update optimistic and pessimistic versions of project databases.* Company databases usually include optimistic and pessimistic versions of project data. These data include assignment productivity, workloads, material requirements, cost estimates and should be regularly updated.
- 29) *Create optimistic and pessimistic estimates for duration driven activities.*
- 30) *Create optimistic and pessimistic calendars.* Risk events can be successfully simulated through activity and resource calendars. The simplest way – to add exceptions to the regular calendars. These exceptions can include additional non-working days, unusual work weeks, etc. Optimistic and pessimistic estimates of the number and duration of such exceptions should be made and applied to corresponding (optimistic and pessimistic) computer models.
- 31) *Calculate optimistic and pessimistic resource constrained schedules.* Optimistic and pessimistic schedules are usually stored as the separate project versions.
- 32) *Optimize necessary resource quantities for optimistic and pessimistic scenarios.* Optimistic and pessimistic schedules were calculated for the same resource quantities as the expected one. Actually the quantities of necessary resources should be adjusted to the new schedule data.
- 33) *Update optimistic and pessimistic resource constrained schedules.* Calculate corresponding schedules with new sets of resources. It is useful to keep optimized schedules as the separate versions. Spider Project permits to create, keep and compare any number of project versions. It helps not only for what if analysis but also for project performance analysis. We usually keep project history as the sequence of project versions. It permits easily estimate performance for any time period, helps to organize project archives.
- 34) *Calculate optimistic and pessimistic project budget.*
- 35) *Calculate optimistic, expected and pessimistic duration and costs for the controlled project deliverables.*
- 36) *Define target probabilities.* The target probabilities of project product deliveries on time and within the planned cost can be different for different project deliverables.
- 37) *Calculate target dates and costs.* There are different ways for this calculation. The most precise is Monte Carlo simulation but this method is also most time and effort consuming. Usually the accuracy of the initial information is not very high and simulation can be replaced by the usual PERT estimates for total phase and project duration and costs. Our experience shows that such estimations are quite reliable.
- 38) *Create additional WBS.* One WBS is not enough for most projects. Usually we use at least deliverables, process, contract and responsibility structures. These structures are useful not only for reporting but also for

project control. It is not necessary for every WBS to contain all project activities. We call WBS every activity hierarchical structure with every activity belonging only to one parent (phase).

- 39) *Create OBS.* As WBS Organizational Breakdown Structures should not include all project resources. OBS is any resource hierarchical structure with each resource belonging only to one parent. OBS are very helpful for project resource management and reporting.
- 40) *Produce reports for cumulative optimistic, expected, target and pessimistic cost and materials.*
- 41) *Negotiate project financing and material supply.* Project financing and material supply should be negotiated because there is constant shortage of money in Russia and some materials should be ordered in advance or specially produced.
- 42) *Create the material supply schedule.* Material supply schedule is the result of negotiating and/or corresponding contracts.
- 43) *Create project financing schedule if necessary.* If the project owner can't afford calculated financing schedule then alternative schedule is developed. The project financing model can be rather complicated including other projects intended to gain necessary money.
- 44) *Include both schedules in the project computer models.* Material supply schedule should be included in one of the WBS of the project computer model. Usually material supply activities are included in the separate project phase. Project financing is also represented by separate project phase.
- 45) *Recalculate project schedules.* With material supply and project financing included in the project computer model project should be rescheduled. This new schedule postpones activities that can't be included in the project schedule because of material or financial shortages (material and cost leveling).
- 46) *Create cost, resource and material centers.* We also use cost, material and resource centers primarily for plan and performance analyzing and reporting. Cost centers can include chosen cost components, material and resource costs. Material and resource centers can include groups of materials or resources. Project reports can include all necessary information on these centers – total cost and amounts per any project element and time interval.
- 47) *Recalculate target dates and costs for all centers, WBS and OBS elements.* Target dates should be adjusted to project financing and material supply schedules.
- 48) *Negotiate target dates and costs.* Negotiate target data with subcontractors and receive their official approval.
- 49) *Prepare bids or contracts.*

These processes are typical for all construction projects.

Conclusions

Russian construction companies use the approach to construction management that is not supported by the traditional project management technique and software. The core difference – Russian construction managers plan, control and monitor volumes of work. Assigned resources define activity duration. Duration calculations are usually based on resource productivity defined by state norms or company standards.

Russian managers are used to intensive use of construction databases defining standard resource productivity, resource workloads, material requirements, costs, etc.

Resource shortages make Russian managers to pay much attention to resource and cost management. They need to simulate material production and supply, project financing. Resource leveling should include material and cost leveling and produce best possible results.

Risk management is also different. Original schedule information is usually not activity duration but resource productivity. Risks are primarily simulated not through estimated activity duration but through estimated resource productivity, amounts and calendars.

Suggested approach seems to be quite natural for construction management.