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## BENEFITS OF PROFESSIONAL CONSULTANCY & ENGINEERING FOR NEW AND EXISTING LARGE CEMENT PLANT CAPITAL PROJECTS

**CEMCON AG, International Consulting & Engineering in Cement – Environment - Minerals**

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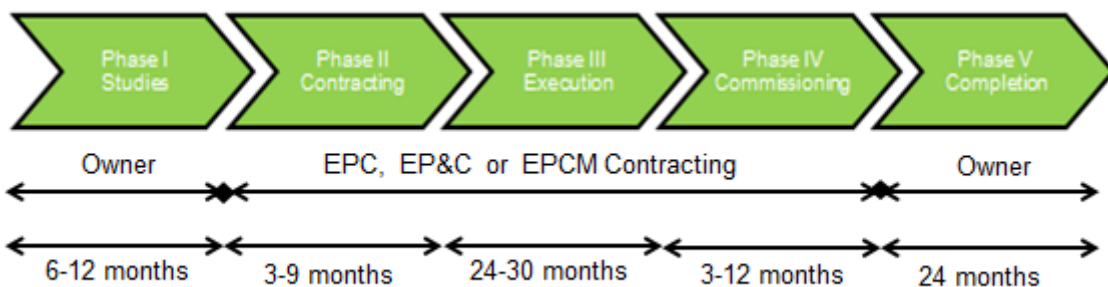
### Abstract

The cement industry has experienced a surge in large capital investment projects in recent years. This as a result of increased demand, aging technologies and a significant increase in production costs due, in particular to raw material and energy costs. The cement sector in Russia and the Commonwealth of Independent states (CIS) has benefitted positively from the expansion and renewal process with a significant number of large capital investment projects under execution in the planning and contracting phases.

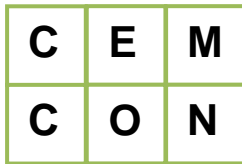
Globally, the deficit in the supply of new facilities, due to surging demand, has led to new entrants and an extremely competitive supplier landscape. New supplier entrants, predominantly from the Far East, have led the traditional sector suppliers to reevaluate their competitive position; aggressive outsourcing strategies, and a trend to mitigate project risks through supplier favorable contracting strategies, being the outcome.

The Owners awareness and understanding of the changing supplier landscape and the inherent increase exposure to the risks associated with large capital projects, has a direct impact the overall development – *Planning and Studies*, project structuring – *Contracting Strategies*, and the Owner's responsibilities – *Quality Assurance & Project Management*, throughout the lifecycle (refer figure 1) of large scale green field or expansion capital investment projects.

The Russian, and in part the CIS cement industry, presents key particularities where a high degree of expertise and know-how is required; from a technological perspective, extreme weather conditions and complex raw materials and from a project delivery perspective the intricacies of the construction industry and project approval processes.



**Fig. 1:** Large capital project development phases & typical time-line.



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In the current environment in Russia/CIS and the industry sector as a whole, it is essential that feasibility phase is utilized to critically evaluate the project specific situation with regard to the Owners financial, performance, time and operational targets; these targets not being mutually exclusive from Owners direct involvement and management, irrespective the contracting strategy. Irrespective of the overall contracting strategy, the particularities of the Russian market have resulted in the need for Owners to take a much greater, proactive role (and responsibility), in the overall development of their project from the initial planning at the feasibility phase through the plant commissioning and start of operations.

Projects in Russia and the CIS are often executed on an EP+C (Semi-turn-key) or on an EPCM (Multi package) project and contract strategy. This and the particularities to approve civil works by certified Russian Design Institutes creates project interfaces within the responsibility of the Owner which are qualified to cause significant influence on the project execution time and cost. Such interfaces require advanced and experienced project engineering, control and coordination. Working on behalf of the Owner, the expertise and knowledge of an international consultant, such as CEMCON AG, in the technological development and delivery of large capital projects in the Russian and CIS market are crucial.

This paper examines the sequential phases of large capital projects, the particularities within the Russian and CIS environment, and the benefits which can be realized through the use resources with global technological and project delivery capabilities & expertise.

#### Project Planning – The Feasibility Study

A comprehensive feasibility study for a capital investment project is, within the industry sector, a prerequisite for the interaction and discussions with Governmental Authorities, Financial Institutions and other project stakeholders: permitting and financing invariably being project drivers during this phase.

A project feasibility study summarizes the Owners activities in the development of a large capital investment project. Project thresholds such as the market potential, material sourcing and ownership and the financial drivers; investment, revenue, production costs and financing structure, are addressed as well as the following which are, in detail, within a project feasibility assessment:

- Cement Industry, **market assessment & potential** including a sales penetration strategies at a national and regional level;
- **Environmental assessment** of the project versus national and international benchmarks and often including an environmental & social impact assessment (ESIA) and a long term environmental sustainability strategy;
- Availability of **raw materials** for the production process, in terms of quality & quantity, classified in accordance with international standards; material reserves forming a significant part of the business units long term assets (proven reserves validated on an international basis being a basic requirement of financial institutions).
- Overall **technical concept** of the project including technology level employed, main machinery selection and a visualization of the proposed facility;
- Business unit, and plant, **organization and staffing**;

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- **Logistics** of inbound/outbound materials addressing, in particular, the cost effectiveness of sea-, rail- and road-bound transport modes;
  - Project implementation **schedule** and **contracting strategy**. The specific situation of the host country, such as Russia, of the Owner and of the project stakeholders are to be considered. This includes in particular the engineering, project control and site coordination capacities of the Owner; a major project risk if not implemented;
  - Project **financial viability** based on detailed **investment costs**, **production costs** (variable & fixed) and **revenue model**; project sensitivities including up- and down-side scenarios of EBITDA drivers and potential deviations in time and cost for the project.

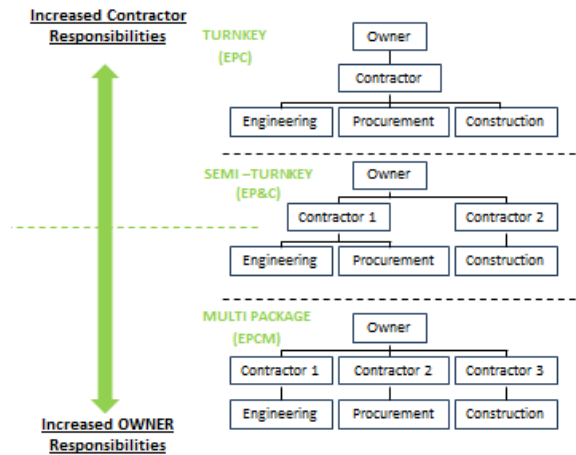
Project stakeholders assess the overall financial viability and technical merits of a capital investment project of on the basis of the Owner prepared feasibility study documentation. As a result of the 2009 financial crisis and the significant time and cost overruns of projects in the cement industry, a much more diligent pre-investment analysis by international present project stakeholders is being observed. Correspondingly the Owners time and resources investment in the preparation of project feasibility documentation have increased significantly. In many cases international expertise and know-how are utilized by the Owner at the feasibility stage to ensure state-of-the art facilities, under realistic financial conditions, while at the same time mitigating the inherent project risks. Internationally active stakeholders, in particular financial institutions, compare project metrics, as presented by the Owner, metrics against globally benchmarks available within their proprietary organizations and elsewhere. Such international comparison and benchmarking invariably results in the necessity of the Owner to align his project to international standard through the expertise and know-how of sector specialist, such as CEMCON AG, who have a vast experience in the development and planning of cement sector projects and whom are current with the industry sector globally.

In many cases, a comprehensive feasibility study can precluded by a more general and broad assessment of the market and project situation through a pre-feasibility evaluation; such a pre-feasibility providing a snapshot of the market, a principal technical determination and initial project financial viability analysis based on order of magnitude investment and operation costs for the project.

The lack of development of the key technical, environmental and financial metrics of a large scale capital project, by the Owner and the pre- and feasibility stage, invariably might lead to extensive delays in the overall approval and implementations.

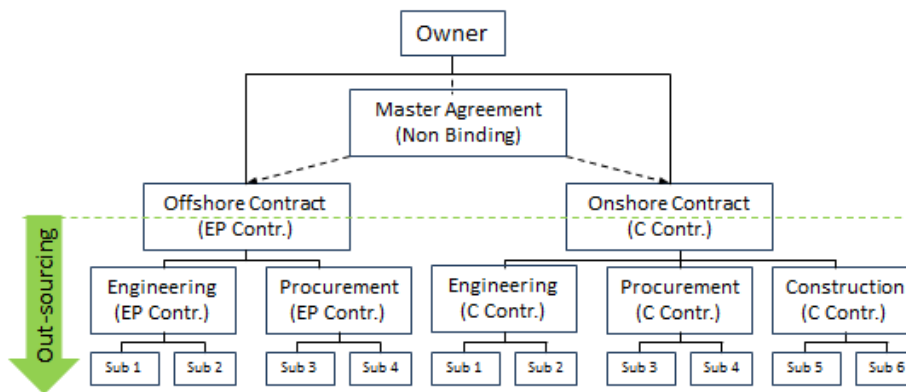
#### Tendering and Contracting – The Contracting Strategy

The desire of the project stakeholders, predominantly the financial institutions, to mitigate the risks associated with large capital investment projects has led to an industry preference for larger contractual packages; minimizing the Owner's contractual obligations to administer and coordinate the interfaces between contractual parties and carry the related project risk in terms of time and potential cost overruns. The extreme form of such a derogation of contractual responsibilities has resulted in the an EPC turnkey (Engineering, Procurement and Construction) contracting strategy for large capital investment projects with all engineering, procurement, construction and administration activities contractually assigned to a single party. This trend in emerging markets, markets that exhibit high growth rates and those markets with many new Owner entrants.



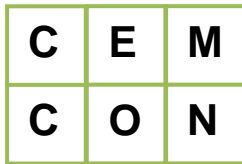
**Fig. 2.** Contracting Strategies vs. Owners Responsibilities/Risks.

Sector suppliers, on the other hand, tend to reduce their overall responsibilities, preferring discrete supply and service contracts under and multiple package (or EPCM – Owner controlled engineering , procurement and construction management) contracting strategy; such a contracting arrangement results in multiple contractual arrangement with the Owner, significantly increasing the Owners responsibilities for the project delivery and the management of contractual interfaces. In more mature markets, a balanced approach, EP&C or semi turnkey contracting strategy is frequently adopted; this primarily as a result of the unwillingness, or in-ability, of industry suppliers to assume the contractual risks associated with the on-site construction works component of the projects, this being the case in Russia/CIS. An EP&C, or semi-turnkey, contracting strategy, of which many variants exist, represents a balance of responsibilities and project risks between the Owner and the suppliers(s).



**Fig. 3:** Increased Contractual interfaces and “risk shedding” (trend EPCM) & Aggressive Supplier Outsourcing; the industry trend.

The entrance of new suppliers, predominantly from the far-east, has resulted in an extremely competitive supplier panorama with sector suppliers adjusting their value propositions utilizing a high degree outsourced engineering, fabrication, supply and construction activities in order to reduce the



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initial capital investment. This aggressive outsourcing strategy and the entrance of new supply and service providers at the “outsourced level”, two to three contractual levels removed from the Owner, result in increased of project quality time and cost risks and exposure; in most cases without the awareness of the Owner. Such aggressive outsourcing strategies directly influences the need for Owner oversight and involvement when EPC and EP&C contracting strategies are employed; under EPCM selection of contractual partners is under direct control of the Owner.

With the complexities of the Russian construction industry and a local certification process a trend towards an EP&C contracting strategy consisting of an imported (or offshore) component: engineering, services and imported supply, and an local (on-shore) component; engineering, local supply and construction activities has emerged (refer Figure 3). Supplier outsourcing has increased the complexity of this contracting strategy to include multiple contractual interfaces at the second and third tier levels between engineering, procurement and construction activities.

To successfully deliver large capital projects in Russia/CIS, the Owner must ensure that the border lines (Division of Responsibilities), between contractual partners and the Owner are clearly defined, that the consolidated project scope and content meets the Owners project targets and that the contractual documentation reflects international standards and best practices, protecting the Owners legal position and recourse (and not that of the suppliers). Often such expertise is not available within the Owners organization.

Throughout the tendering and contracting process the expertise and knowledge of international consultants, such as CEMCON AG, provide Owners with the technical, commercial and legal expertise to successfully structure and execute their project.

#### Project Execution/Delivery - Quality Assurance, Quality Control and Supervision

It is often misconstrued that the finalization of a capital projects contracting strategy, selection of contractual partners and the subsequent contractual commitments ensure that the Owners project targets are achieved.

It is however at this stage, in particular under EP&C semi-turnkey and EPC turnkey contracting modes that the greatest project benefits can be realized; the realization of these benefits are directly linked to the extent of the Owners’ involvement in assuring that suppliers’ contractual commitments are delivered or even exceeded I terms of quality of the project, the implementation time of the project and the overall adherence to the budget.

It is often overlooked that although engineering constitutes a minor component of the Owners initial capital investment, the impact of engineering on the overall quality, implementation schedule and final operational reliability of the facility are significant. It is in the Owners own best interest, irrespective of contracting strategy selected to provide expert oversight.

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Fig. 4: –Value Engineering – Slip-form (L) vs jump form (R) – Construction time savings 5-7 months

Value engineering (example refer figure 4) and quality assurance of civil, mechanical and electrical engineering (not design) phase, by the Owner, not only assure the quality of the end product, but also ensure that the critical path & workflow of the construction activities are achieved; both key drivers to achieving the Owners project targets.

Similarly Owner's oversight and quality assurance of fabrication is essential. In the past Owners have focused on quality assurance of main machinery components, ignoring the fact the predominant cause of, non-human caused, operational interruptions are associated with auxiliary mechanical and electrical machinery. As described previously suppliers have implemented aggressive outsourcing strategies with their quality assurance and quality control programs lagging well behind the pace of outsourcing. The entrance of unknown and often inexperienced new sub-suppliers in the industry and fact that supplier quality assurance activities themselves are outsourced further exasperate the quality risks. It is in the Owners best interest to have a proprietary quality assurance and quality control oversight for his project. Through operational experience and know-how, risk analyses identifying machinery that will negatively affect the operational reliability of the facility and a subsequent Owner quality assurance mechanism to mitigate the potential adverse impact of sub-standard material, fabrication or assembly, is recommended.

In the Russian context, with a predominant EP&C contracting strategy, the requirements of the Owners quality control and quality assurance activities are further amplified as a result of aggressive outsourcing implemented by suppliers. Owners must be prepared to allocate resources, whether proprietary or sourced on the international market, to directly control (in the case of EPCM) and provide in depth oversight and quality assurance of the engineering, fabrication and construction activities.

#### Project Execution/Delivery - Construction

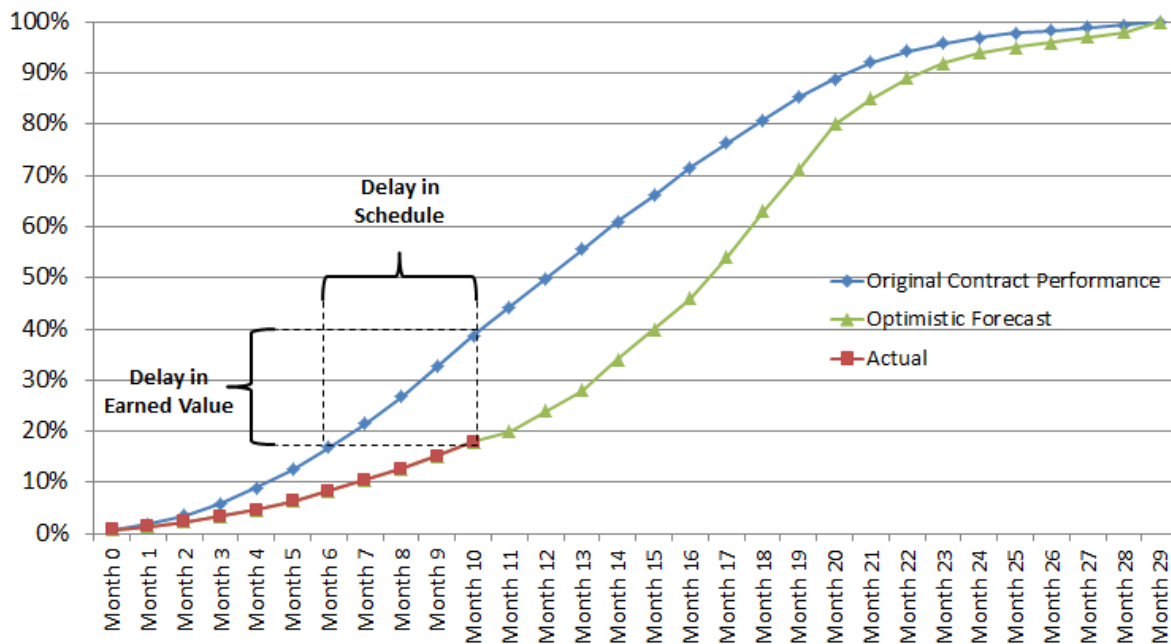
On site construction activities are preceded, and directly impacted by the on-time delivery of engineering, material and machinery; the Owners oversight for these activities are covered under previous sections of this article. For the Project execution a highly qualified, and experienced, Owners

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construction supervision team backed up by experienced international project execution experts, with multiple project delivery references is considered by CEMCON AG, to be a key success factor in the achieving the project quality, time and budget targets.

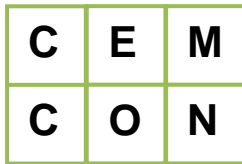
The satisfactory completion of construction activities are a direct result of two key drivers; first the integration of highly skilled, experienced, contractors & personnel and second through the systematic implementation of an integrated PMS (project management system) system with aligned and predefined procedures, processes and work tools; these procedures, process and work tools dealing with all aspects of the construction phase of the project including:

- Resource planning and allocation;
- Critical path scheduling and recovery planning;
- Progress monitoring;
- Project administration including payment and contractual change order mechanisms;
- Quality control of civil works, mechanical erection and electrical installation including certification and corrective measures for deficiencies;
- Occupational Health & Safety;



**Fig. 4:** EVM Project Evaluation – Early Identification of Time , Quality and Budget Deviations are key project success factor.

Under all contracting strategies the project delivery (execution) and monitoring team (Owner and Consultants, consisting of highly experienced managers, civil, mechanical & electrical engineers and administrators is required. Project monitoring and early identification of quality, time and/or budget deviations are the key activities of this team (refer figure 4). For large scale EPC turnkey capital investment projects, a site team of up-to 20 personnel is typically recommended; under EP&C and



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EPCM contracting strategies, and considering the Owners teams experience and capabilities, a significantly larger team is to be expected.

The construction supervision team is preferably Owner personnel with long standing project delivery references and experience. With the increase capital projects in the cement sector, the availability of experienced site personnel has become a critical issue. Experienced personnel is often recruited into other industry sectors, which similar to cement, are in experiencing an increase in project activity in Russia; industries such as mining & minerals and power generation & transmission. Similarly the availability of experienced resources is limited internationally; upfront resource planning with a lead time of 6 to 9 months, in conjunction with a globally active cement sector consultant, is considered essential for the Owner to assemble an expert and experienced site team in a timely manner.

#### Project Commissioning and Completion

Within the overall project implementation schedule, commissioning activities are always considered to be on the critical path. At this stage of the project key decision, including those associated with initial production, are typically made as a result of financial/contractual considerations or stakeholder pressure, and not necessarily based on the facility “readiness”. As a result plant commissioning activities are often initiated prior to completion, and certification of the construction activities; delays in achieving commercial production and expected performance levels with regard to output and/or reliability are the outcome.

Well trained plant management, production and maintenance personnel, as well as highly qualified and experienced engineers, with an excellent record of previous plant commissioning on an international basis, from the core of a successful plant commissioning and the subsequent performance optimization. Integrated teams composed of the Owners and Consultants operational and project personnel, supplier’s personnel and contractor’s personnel, dedicated solely to the check-out/certification, dry-run and commissioning are essential for a successful plant start-up

Systematic planning of commissioning activities, including plant check-out/certification and dry-run activities, results in a significant improvement in early plant operational performance and reliability; three to sixth month plant commissioning times being achieved with facilities utilizing a systematic commissioning plan and up to twelve months (or longer) for plants where commissioning activities were prematurely initiated.

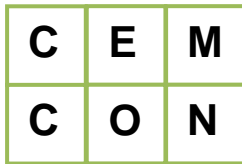
With typical plant capacities between 5000-10,000tpd clinker, and considering the seasonality of sales in Russia, a six to nine month improvement in plant commissioning and the corresponding achievement of commercial production is considered a significant contributor to the financial performance of the project.

#### Conclusion and key Messages

The Cement industry in Russia/CIS exhibit specific challenges that have to be overcome by Owners in the planning and execution of large capital investment projects.

Complex raw materials, extreme weather conditions and the industry trend towards an increased number of contractual stakeholders, in particular in the construction sector are being observed.





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In addition the following trends are being observed by CEMCON AG in the cement industry, each of which Owners should be aware, must consider in the planning and delivery of their large scale capital investment projects in Russia/CIS:

- As a result of the recent financial crisis and exposure to increased risks, project stakeholders have become much more stringent and diligent in the pre- and post- investment evaluation of capital expenditure projects. At the project planning, or feasibility stage, much greater emphasis is placed on the environmental, technical, commercial legal aspects and risks; a significant time and resources requirement by the Owner with expertise that is often not available “in house”.
- The reduced tolerance for cost financial related risks by suppliers, is resulting in an industry trend towards more diversified contractual structures; EP&C and also owner controlled multi package (EPCM) contracting strategies being observed. This together with supplier aggressive outsourcing strategies exposing Owners to greater project responsibilities. Owners project management capabilities to coordinate and take responsibility for the increasing contractual interfaces are a prerequisite for the successful delivery of projects resulting in the need of support by internationally experienced and competent consulting firms;
- To remain competitive in the cement sector, suppliers have adopted aggressive outsourcing strategies for engineering, services and fabrication. Supplier quality assurance and control lags behind the pace of outsourcing and is in itself an outsourced service; New entrants at all levels of fabrication and services, many with limited, to no, experience in heavy industry and the cement industry, are being utilized to deliver projects, often outsourced two to three levels removed from the Owner. Owner vigilance, irrespective of implemented contracting strategy, is essential;
- The financial success of a cement sector business unit is no longer as a result of increasing market growth and market share, nor solely capital investment. Rather business unit performance and profitability is as a result of the long term EBITDA generation potential; key drivers being the **Production Costs** - energy sustainability and energy reduction strategies, and **Revenue Generation** – long term sustainability of the Owners product portfolio(s), brand and corresponding pricing of a commodity product.

Irrespective of method of contracting strategy employed by Owners for their large capital project a direct involvement and intervention and oversight in the overall project development, meaning the cooperation with an international consultant is becoming more pronounced. Such direct involvement, consisting of project management, contractual interface coordination, quality assurance of engineering, fabrication/supply and construction activities throughout the project lifecycle, to ensure that project financial , performance, environmental and implementation time targets are achieved. With reduced (or no) involvement by the Owners in their projects, in particular in key markets such as Russia/CIS, significant exposure to deviations from these key project targets can be expected.

CEMCON AG, through its global experience in the Cement, Environment and Minerals industries is a committed partner to the Russian/CIS cement industry and is able to deliver an international level of technical, financial, commercial, operational and legal expertise to successfully develop cement sector business units and large capital investment projects and assist the Owners in mitigating project risks.