The Art and Science of Project Management

Metal Bulletin Monthly, September 2002
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1. Introduction.

In the modern world, manufacturers of industrial systems and services providers are working together on a worldwide scale. A flexible and reliable General EPC Contractor must be qualified to offer comprehensive solutions to the customer specific problems and needs. Based on a wide range of activities, all of them supported by engineering capabilities and innovative problem solving techniques, a General EPC Contractor shall provide the base for stable volume and earnings growth. Successful projects are the challenge, through innovative, efficient, safe and high quality systems. A flexible and reliable General EPC Contractor offers (and fulfills) on-going support from the planning and financing stage to full-scale operation. A responsible General EPC Contractor must also pursue a policy of sustained yield, ensuring that all products and manufacturing processes comply with the requirements of sustainable development.

2. Project Phases.

Since some years ago, the industrial sector has dramatically decreased their internal planning and project management resources, due in general to down sizing and cost reduction initiatives. This has clearly resulted in an increased requirement for the General EPC Contractor not only to design and source technology and equipment, but also to undertake, manage and coordinate complete projects. Under this scheme, an efficient project structure has to be developed, wherein contracted relationships between parties must be clearly documented and understood. Responsibilities and interfaces between the General EPC Contractor and supporting contractors have to be clearly defined too. In general, large scale-industrial projects are normally carried out through the following phases of evolution:

- <u>Development</u>. In this phase the following activities must be carried out: Feasibility study, market study, budget/business plan, environmental impact study and legal requirements study. Support from the General EPC Contractor at this stage includes consultancy/feasibility services, technology selection, plant concept development, selection of equipment suppliers, selection of local construction and service partners, project planning, and implementation procedures. Once the project has proven feasible, a bankable study must be prepared, including risk analysis, financial projections, preliminary information memorandum and selection of financing sources. In this phase, the financial capabilities of the General EPC Contractor are extremely important for a successful realization of this critical project step. A preliminary investment figure (± 15%) is enough at this stage, enabling the project partners not to spend time and efforts in expensive detailed activities (Figure 1).

- <u>EPC Contract</u>. In order to sign the Engineering, Procurement and Construction (EPC) Contract, the following activities must be concluded. Bank due diligence, final information memorandum, loan negotiations/documentation and syndication. During this phase, the General EPC Contractor must provide a definitive investment figure (Figure 1). Under a turnkey project scheme (Figure 2), the general EPC contractor must take full responsibility for the project time schedule, as well as for any variation in the plant investment up to the final plant acceptance by the customer.

However, in case of other project schemes, i.e. in house shopping around, open-book with target price, functional turnkey, technology package, this responsibility has to be clearly defined between the different project partners, depending on commercial terms and the corresponding scope of each partner.

- Implementation. In this phase the following activities must be carried out: Full EPC contract execution, project management and coordination, scope specification and procurement services, engineering management and coordination, equipment installation, plant construction, plant commissioning, and quality management and assurance. During this phase, the project investment is fined tuned, well detailed and completed by the General EPC Contractor (Figure 1).

  The typical risk level for the different activities in the implementation of industrial projects is presented in Figure 3. This is a very important factor to be considered by the customer, in order to define the best project scheme according to his own capabilities and to those of the different partners involved.

- Operation. A flexible and reliable General EPC Contractor does not leave the customer alone when the guarantee tests have been fulfilled and the plant has been accepted. It is always desirable to support the project during the operational phase, including activities such as: Operation management, production scheduling, quality/cost control, personnel training, techno-economic assistance, product buy-back and take-off arrangements, outsourcing services, etc. Indeed, a General EPC Contractor with these capabilities will give an added value to the plant owner.

3. Capability of a General EPC Contractor for Industrial Projects.

Based on the above mentioned phases and requirements of industrial projects, the capability of an EPC contractor, to be considered a reliable partner should comprise at least the following:

- A reputed company.
- Solid financial standing.
- Global presence.
- Global sourcing capability.
- Extensive experience in large scale-turnkey projects.
- Tailored financial support/concepts for the customer.
- Extensive project management capability.

4. Financing: An Essential Service in Large-Scale Projects.

Project financing has always been one of the essential services provided by a General EPC Contractor involved in large-scale plant projects. However, when facing low foreign currency reserves and heavy debts, this area takes increased importance. Companies developing new projects are now demanding from their General EPC Contractors not only an optimum cost/price ratio, but also a long-term financing package with adequate conditions of loan repayment and cash liquidity. Therefore, a flexible and reliable General EPC Contractor must support the customer to achieve the following tasks:

- Negotiation with international lenders.
- Negotiation with multi-lateral lenders.
- Negotiation with local lenders.
- Funding lowest all-in costs.
- Minimum equity commitment.
- Minimum loan repayment guarantees.
- Minimum currency risk exposure.
- Adequate loan terms (grace & repayment).

In some cases, the customers require also from their General EPC Contractor to undertake barter transactions with products from the plants to be built or from some existing plants, with the aim of decreasing or securing the debt service of the project under development. A General EPC Contractor with this capability will give an added value to the project financing conditions.

5. Project Management in the Steel Industry: From Iron Ore to Steel Slabs.

A practical example for this type of project is presented in Figure 4. In this case, it is considered that iron ore (pellet feed), natural gas, oxygen, electricity and some other consumables are available at the site (supplied by others at the plant battery limits, normally under a Build-Own-Operate (BOO) scheme). Therefore, the following units would be included in an EPC contract for the production of steel slabs:

- Pelletizing Plant.
- Direct Reduction Plant.
- Electric Arc Furnace.
- Ladle Furnace.
- Slab Caster.
- Interplant Services.

The pelletizing plant constitutes the process area, in which the beneficiated iron ores (pellet feed) from the iron ore mine concentrator (outside battery limits) are converted into pellets, in accordance with the specifications of the integrated steel mill for the downstream direct reduction plant.

The direct reduction plant is designed for the conversion of iron ore pellets into metallic iron, by the use of reducing gases in a solid-gas moving bed reactor. Oxygen is removed from the iron ore by chemical reactions based on hydrogen (H_2) and carbon monoxide (CO), both reducing gases generated from natural gas, for the production of highly metallized Direct Reduced Iron (DRI). In the reduction reactor, iron carbide (Fe_3C) is also formed by the combination of carbon (from natural gas) with metallic iron from the reduced product.

The optimum DRI/scrap ratio to be used as metallic charge in the electric arc furnace is defined by the raw material price structure, its performance during melting, as well as the steel quality that is required for the final product. The use of DRI in the electric arc furnace permits the manufacture of steel grades that would be difficult to produce from 100% available scrap. The main reason is that DRI provides virgin iron units, free of the various tramp elements and impurities that are normally present in steel scrap. This is particularly important for high quality flat products, which require excellent formability and aging characteristics.

The ladle furnace is basically a secondary metallurgy station, where the liquid steel quality is refined before casting, by means of dissolved gas purging, wire injection and alloy additions.

Treated steel is fed to the continuous caster for the production of the final product (steel slabs).

The typical operating cost components for the production of slabs in this type of plant are presented in Table I. The feasibility of the project will depend mainly on the slab sales price (CIF), the total slab production cost, the project time schedule, and the production start up curve. Except for the slab sales price (market conditions), all other feasibility aspects are highly influenced by the flexibility and reliability of the technologies utilized, as well as by the proven capability of the General EPC Contractor and all other partners involved.

Under a turnkey EPC contract, the scope of supply and services by the General EPC Contractor covers normally the following (inside battery limits):

- Project management.
- Engineering.
- Process equipment.
- Civil works.
- Buildings/Structural works.
- Electrics & Automation.
- Utilities & Media.
- Material handling.
- Logistics.
- Storage facilities.
- Commissioning.
- Plant start-up.

Depending on the infrastructure available at the site, some other services could have to be considered either in the investment or in the operating cost (outsourcing), such as:

- Site development.
- Port.
- Transport media.
- Housing.
- General services.

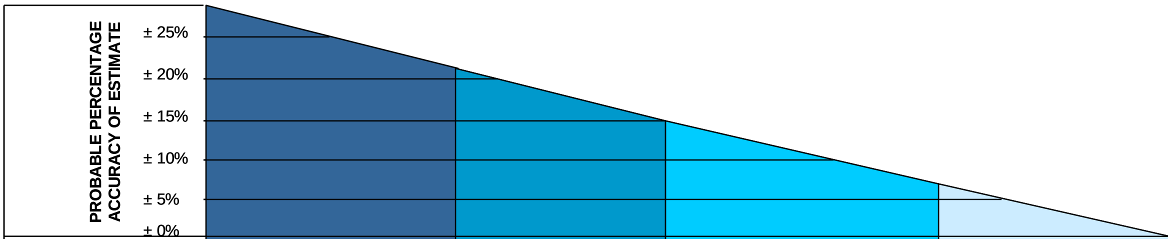
A typical project schedule for this type of projects is presented in Figure 5. The strict monitoring and control of the project schedule and milestones are, indeed, the sub-schedules where all detail activity is maintained and controlled. The payment schedules and cash flow would clearly relate to this, being independently monitored by the Commercial Project Manager. A clearly defined communication matrix has to be established, both internally within the project team, and externally with the client and the nominated subcontractors. One of the early essential milestones is the timely provision of conceptual layout, drawings and data, relating to the process flow, plant equipment, its location and loading, battery limits, points of access, and all piping, cabling and service requirements.

Quality and delivery are obviously key issues and have to be strictly monitored and controlled by in-house specialists to the respective shops- from material sourcing and throughout the manufacturing phase. The interfacing with the building, civil and service contractors is also a key area, in order to ensure the accurate and timely provision of building structures, foundations and services, aligned with the core plant requirements. Finally, the process of plant installation and commissioning is an area where extensive planning and scheduling is required. The detail scheduling of the installation process and the allocation of adequate resources–supervisory management and labor is obviously critical to the project success.

6. Conclusions.

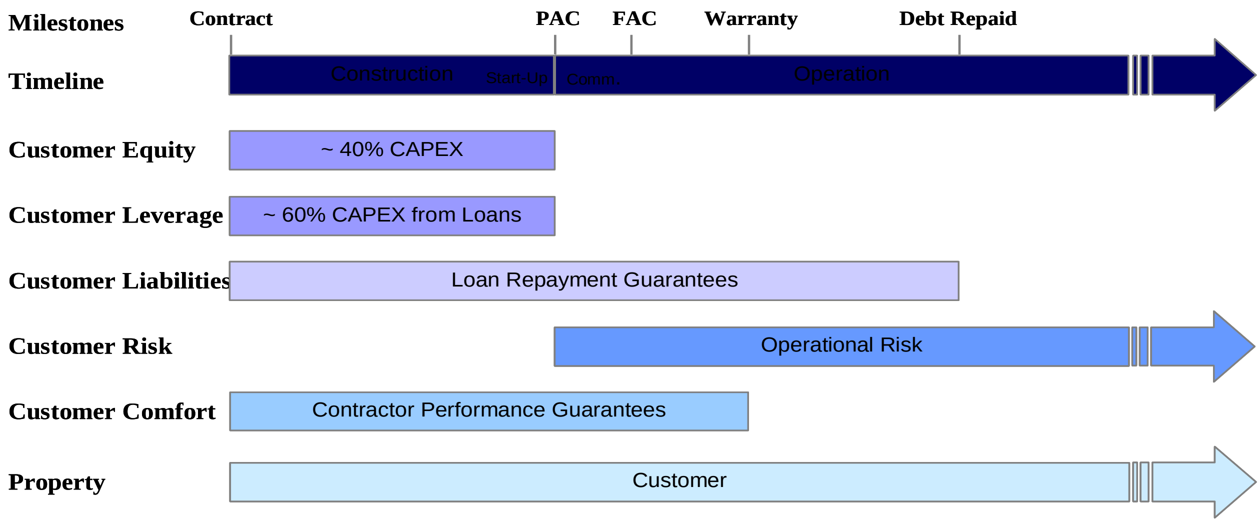
Project management is both a science and an art. Especially in large-scale industrial projects, where diverse disciplines are normally involved, the selection of a flexible and reliable General EPC Contractor is vital for a successful project development. Technical, commercial and financial capabilities are fundamental for properly realizing the different phases in this type of projects. The proven experience of the General EPC Contractor in the execution of large scale-turnkey projects is also of prime importance. When several hundred or even thousand million US Dollars are to be invested, why not to take enough time and gather enough information for the proper selection of a flexible and reliable General EPC Contractor?

Figure 1
Project Investment Estimates



TYPE OF ESTIMATE	ORDER OF MAGNITUDE	PRELIMINARY	DEFINITIVE	DETAILED
DATA REQUIRED	• Product Capacity & Location • Cost Data on Similar Projects • Major Equipment List	• Complete Equipment List • Process Flow Diagrams • Plant Layout & Sections • Motor List	• Equipment Specifications • Vendor Quotations • Construction Schedule • Electrical Lines • Piping & Instrumentation • Final Flow Diagrams • Soil & Architecture Data • Site Survey & Labor Analysis	• Bulk Material Specifications • Vendor Quotations • Construction Specifications • Sub-Contractor Quotations • Engineering Advanced Approximately 10%
DEFINITION OF SCOPE OF WORK	VAGUE, NON DEFINITIVE	SOMEWHAT VAGUE	CLEARLY DESCRIBED ESSENTIALLY COMPLETE	COMPLETE WELL DETAILED
ESTIMATING PROCEDURE	FACTORING	COMBINATION OF FACTORING AND QUANTITY TAKE-OFF	MOSTLY QUANTITY TAKE-OFF VERY LITTLE FACTORING	COMPLETE QUANTITY TAKE-OFF

Figure 2
Turnkey EPC Contract



Buyer Credit CAPEX: Fixed

Figure 3
Risk Structure in Industrial Projects

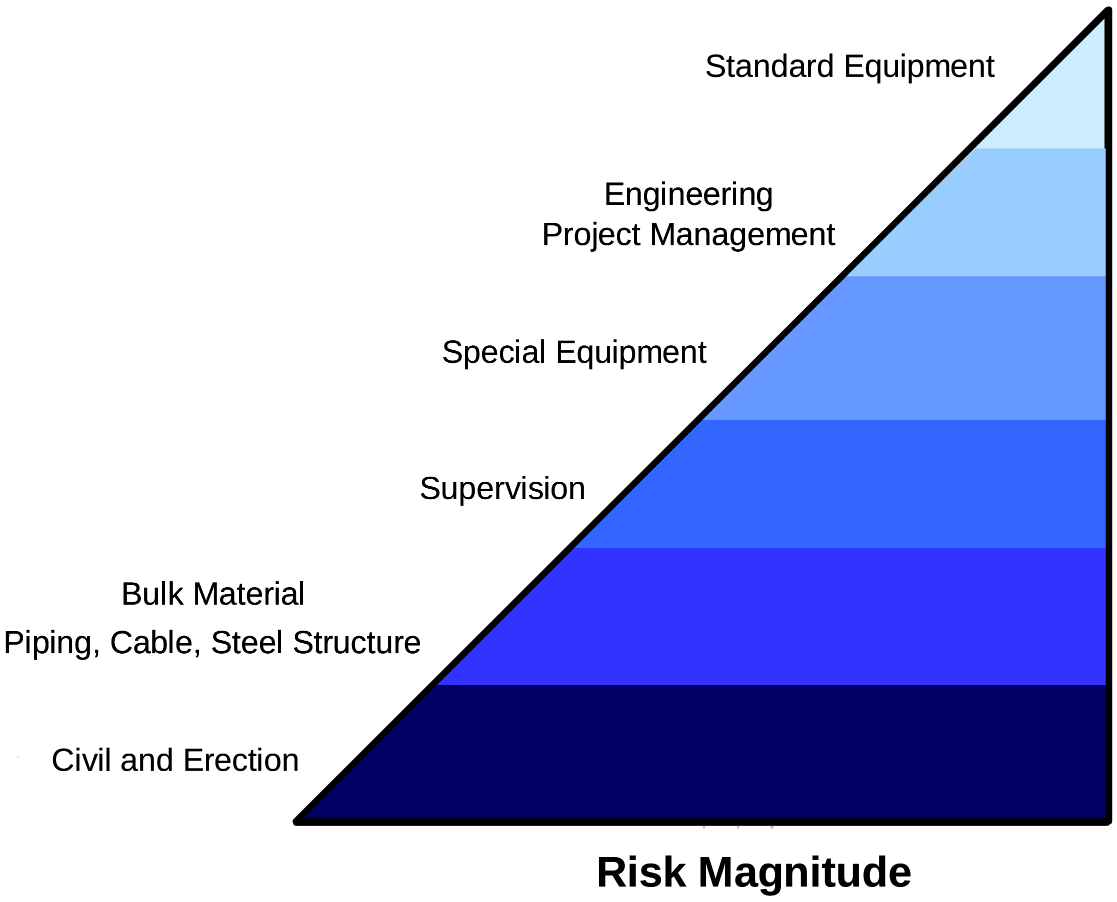


Figure 4
Steel Industry Project
From Iron Ore to Steel Slabs

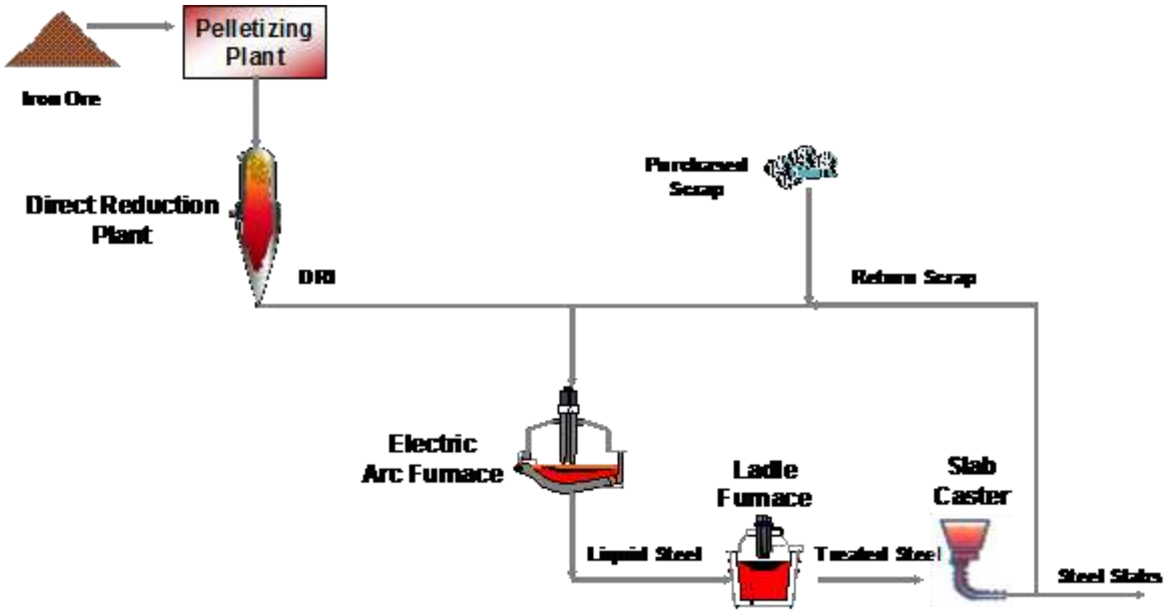


Figure 5
From Iron Ore to Steel Slabs
Typical Project Schedule

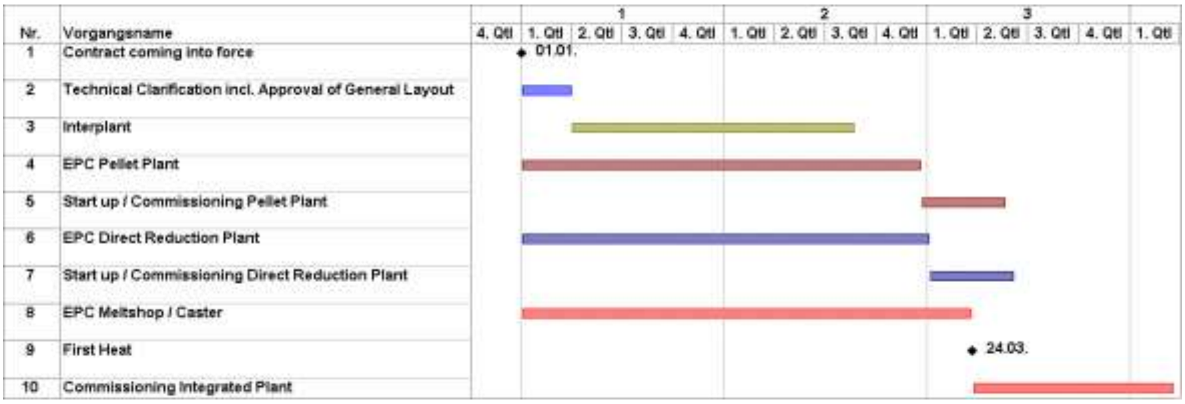


Table I
Components of Direct Production Cost

Pelletizing (Pellets)		Direct Reduction (DRI)		Electric Arc Furnace (Liquid Steel)		Ladle Furnace (Treated Liquid Steel)		Slab Caster (Slabs)	
Pellet Feed	ton	Pellets	ton	DRI	ton	Liquid Steel	ton	Treated Liquid Steel	ton
Natural Gas	Nm^3	Natural Gas	Nm^3	Scrap	ton	Natural Gas	Nm^3	Natural Gas	Nm^3
Electricity	kWh	Oxygen	Nm^3	Electricity	kWh	Electricity	kWh	Electricity	kWh
Water	m^3	Nitrogen	Nm^3	Magnesite	kg	Argon	Nm^3	Oxygen	Nm^3
Bentonite	kg	Electricity	kWh	Graphite	kg	Synthetic Slag	kg	Nitrogen	Nm^3
Dolomite	kg	Water	m^3	Lime	kg	Graphite	kg	Argon	Nm^3
Other Materials	$	Other Materials	$	Dolo-Lime	kg	Al	kg	Water	m^3
Labor	m-h	Labor	m-h	Oxygen	Nm^3	FeMn HC	kg	Covering Powder	kg
Maintenance	$	Maintenance	$	Electrodes	kg	FeMn LC	kg	Casting Powder	kg
				Water	m^3	FeSi	kg	Other Materials	$
				Shell WCP	$	Other Alloys	kg	Tundish Refractories	kg
				Roof WCP	$	Other Materials	$	Rolls	kg
				Roof Refractories	kg	LMF Electrodes	kg	Copper Mould	kg
				Shell Refractories	kg	Ladle Refractories	kg	Scrap Reverts	kg
				Labor	m-h	Labor	m-h	Labor	m-h
				Maintenance	$	Maintenance	$	Maintenance	$