STRATEGIC ANALYSIS

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explain how cement plant strategic analysis can give competitive advantage.

INTRODUCTION

In most cement companies, macro-strategy development is a corporate function. However, once the need for additional capacity has been identified, it is necessary to develop the micro strategy for the location where this new capacity is to be installed. This important step is often neglected and, in the drive to add new capacity, some basic plant strategic issues do not get addressed.

A plant strategic review carried out at a very early stage in the life of a project will save time and money, and will deliver a project that will be appropriate for the local circumstances. Areas to be considered include markets and products, raw materials, people skill levels, transportation and communications infrastructure, climatic conditions, spare parts availability, interface with existing plant and equipment, labour, fuel and power costs and availability, and environmental legislation.

Attention to all these issues at the beginning of any project will deliver additional capacity for the lowest capital and operating

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costs, and will result in a plant that will operate reliably for many years in the future.

WHAT IS STRATEGY?

There are, of course, many definitions, but the word derives from the Greek strategos, which referred to a 'military commander' during the age of Athenian democracy.

A strategy is a long-term plan of action designed to achieve a particular goal, as differentiated from tactics or immediate actions with resources at hand. Within a company, strategic planning should provide overall direction and give specific direction.

On a more practical basis, a good definition of strategy is that it is an umbrella plan encompassing a number of smaller plans to achieve the objective. Strategic planning therefore consists of the process of defining objectives and developing plans to reach those objectives. By labelling a piece of planning "strategic" we expect it to operate on the grand scale and to take in "the big picture" as opposed to "tactical" planning, which by definition has to focus more on the tactics of individual detailed activities.

This article will assume that a company has given the overall direction, and the decision has been made to build a new cement plant, either on a greenfield site, or located at an existing production facility. All too often at this stage strategic thinking ceases and instead other processes take over, such as a "wish list". One might be tempted to copy what was done on the last plant that was built, which by the time of the next project, will already be several years old. Alternatively, the priority might be building a better plant than one's competitors, or one might feel the need to have the latest technology.

It is precisely at this point in the evolution of the project that very clear and focused strategic thinking must happen. Wrong decisions taken at this stage are irreversible, will define the overall capital cost of the project and will ultimately determine whether the project is a success or whether it will underperform for the next 20 years. Unfortunately, in most organisations, strategy is seen as a head office function and its importance at lower levels is seldom recognised or encouraged.

The purpose of this article is to discuss the strategic decisions that need to be made at the initial stages of a project for a new cement plant and to give examples of typical issues that have arisen in practice and how they have been resolved.

WHAT DECISION-MAKING PROCESSES CAN BE USED?

When a company has decided to build a new kiln line or greenfield cement plant, what happens next? Before picking up the phone to call one of the major equipment suppliers, it is important to do some strategic planning.

Using the definition of strategy mentioned earlier - an umbrella plan encompassing a number of smaller plans – a strategic decision has been made to build a new kiln. The people responsible for delivering that project now have to embark on some strategic planning of their own to ensure that the plant is designed so that it delivers the local, or micro-strategic goals.

Strategic planning should do some or all of the following:

- Have the capability to obtain the desired objective.
- Fit well both with the external environment and with an organisation's resources and core competencies.

- Have the capability of providing an organisation with a sustainable competitive advantage.
- Prove dynamic, flexible, and able to adapt to changing future situations. In a capital intensive industry such as cement manufacture, this can save much future capital expenditure, for example if a new plant is designed to cope with a wide range of fuels and raw materials, including waste, and if it is future-proof in terms of environmental performance.

Most strategic planning methodologies depend on a three-step process (sometimes called the STP process).

- Situation - evaluate the current situation and how it came about.
- Target - define goals and/or objectives (sometimes called ideal state).
- Path - map a possible route to the goals/objectives.

For the information gathering and analysis stage, SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis may be used to assess those aspects of the organisation and the environment that are important to achieving the objective of the strategic plan (Table 1).

In developing the strategy one needs to answer these four questions:

- How can the strengths be used?
- How can the weaknesses be stopped?
- How can the opportunities be exploited?
- How can one defend against the threats in pursuit of the selected objective?

WHAT ARE THE KEY STRATEGIC DECISIONS?

The essential driver of any project must be the market, and those that made the decision to proceed with a project must have a clear view of what products are going to be manufactured and where these products are to be sold. Therefore, for the purposes of this article, it has been assumed that these aspects have already been fully analysed and decided.

It is also assumed that certain other basic decisions have already been taken at a corporate level. These will normally (but not always) include the plant capacity and the geographic location of the plant.

This leaves a number of significant issues that have to be decided. These include:

- The raw material sources and blending philosophy.
- The exact plant location and layout.
- The interface with existing facilities on the site.
- The fuels strategy.

All these areas will have a significant influence on the final plant design and how it will perform in the future.

There is, however, a very significant area that is often neglected when considering new plant design and this involves all the issues relating to people. The overall success of a project will depend on the people who are going to operate it, and cultural issues must be factored in at an early stage in the conceptual design of a project. These areas that require strategic analysis will now be considered in detail.

RAW MATERIALS SOURCING AND BLENDING

Raw materials are the life blood of a cement plant and it is essential that the materials to be used for making the cement are known in sufficient detail to enable the plant to be located in the optimum position (see later section on plant location) and for the equipment to be designed to be able to handle the materials.

Failure to perform this analysis in sufficient detail can lead to catastrophic consequences. Examples that CPI specialists have encountered include:

- Over-estimation of the limestone reserves at the planning stage limited the useful life of a plant to only 12 years.
- The raw materials evaluation failed to recognise the presence of chloride in the raw materials that necessitated the retrofit of a kiln gas bypass.
- Similarly, on another plant, the impact of alkalis in the raw materials was not recognised, leading to a significant reduction in output and increase in energy costs for a by-pass installation of 40% of the kiln gases.

Table 1. Definition of SWOTS

	Helpful to achieving objectives	Harmful to achieving objectives
Internal (attributes of the organisation)	Strengths	Weaknesses
External (attributes of the environment)	Opportunities	Threats

- In an arid region, it was not thought possible that a raw material could have a high moisture content when in fact it had 15% moisture, which resulted in a new crusher having to be installed.
- There are numerous examples where the raw materials handling systems are inadequate to handle the raw materials, necessitating extensive redesigns.
- There are several examples where the raw materials grinding plants were inadequately sized as the samples of raw materials sent to the equipment suppliers were not representative – typically, for a new quarry, only surface samples are sent, and these are often weathered and easier to grind than the bulk of the deposit.
- The free silica content of the raw materials was high and had not been recognised as an important factor in wear of the raw grinding plant and the impact on kiln performance and product quality.

Many more examples can be quoted, but the single most important factor in determining the success of a project is the assessment of raw materials. Some of the questions that have to be answered include:

- What is the life of the reserves?
- How much is known about the geology?
- What is the likely variability of the materials?
- What is the range of moisture contents?
- Have the materials been fully assessed for volatile minor components?
- What and where are the sources of the secondary raw materials?
- What is the life of the secondary materials?
- Are the raw materials owned by the company?
- Can representative samples be obtained of all materials?
- Can the quarry be developed to provide the average composition for the life of the deposit?
- How will the materials be transported to the plant site?

Only by knowing the answer to these questions can a plant design be developed that will achieve the overall objectives of a successful project.

Once the raw materials have been defined and characterised, the next important issue is how these materials are to be managed in terms of producing a kiln feed which has a chemistry at the targets defined and with a consistency necessary for efficient kiln operation and to meet the demands of the market.

Raw materials storage is expensive and potentially problematic, particularly in terms of ensuring a consistent and controlled feed to the raw mill. In order to minimise capital costs and ensure a trouble free operation in the future, the blending and storage strategy for the raw materials needs careful analysis. Typically, equipment suppliers are asked to quote for a "blending stockpile", but little thought is usually given to which materials need to be blended and at what stage these materials need to be blended. It is important to define what the blending philosophy is to be. The composition and variability of the individual components will determine the optimum solution.

For example, if a limestone quarry produces material with very little chemical variation, then it needs no blending, and the storage requirements are determined by quarry operation and transport logistics. A mistaken concept that is often seen is that a non-variable limestone is "blended" with another raw material component or components on a blending stockpile. However, this will inevitably produce a more variable material than if the components are stored and fed separately to the raw mill.

Another question to be asked is whether an automatic stacker and reclaimer is really needed for all the materials? If the raw materials are suitable, an ordinary stockpile and front end loader reclaim is an acceptable and economical solution that has been adopted successfully on some recent projects.

It is also important to decide whether the raw materials need to be covered, as this can also be expensive. It is usually a function of moisture content, rainfall and environmental issues, but significant capital cost savings can be made here.

It cannot be emphasised enough that during the commissioning phase of a new plant, most problems are caused by materials handling issues and not the main equipment such as mills and kilns.

PLANT LOCATION AND LAYOUT

Conventional wisdom is that a cement plant should be built adjacent to the supply of the principal source of calcium carbonate, usually limestone. The reason for this is that the cement manufacturing process removes the carbon dioxide from the limestone, so the cost of transporting limestone is higher than the cost of transporting cement as clinker. However, this is an over-simplistic view and the actual situation is more complex, with each situation needing to be analysed in more detail.

There are many examples of cement plants operating that are not following this general rule. Some of these are forced to separate the plant geographically from the principal raw material source. In general this relates to extreme topography in the area where the quarry is to be situated. Transport of limestone by overland conveyor is a very cost effective approach as it enables a plant to be situated in a location which is more advantageous in terms of product dispatch, power supplies, incoming raw materials etc.

There are examples, however, where plants have been located inappropriately, which have resulted in significantly increased costs in relation to their competitors resulting from the cost of raw materials transport, or in some cases have sterilised substantial quantities of raw materials reserves.

The optimum location is determined from a combination of factors, including:

- Location of principal raw materials reserves.
- Incoming power supply.
- Imported raw materials source.
- Fuel supply.
- Product dispatch infrastructure, considering:
  - road
  - rail
  - river
  - sea
- Topography.
- Drainage.
- Wind direction.
- Ground load-bearing conditions.
- Any interface with existing facilities and infrastructure (see later comments).

When the optimum location has been determined, the plant layout needs to be developed. The aim is to arrive at a layout which is economic yet uncomplicated, with good access to all plant for erection and maintenance, and which is a safe and clean plant with a road system allowing smooth traffic flow and which is suitable for easy extensions in the future.

INTERFACE WITH EXISTING INFRASTRUCTURE AND FACILITIES

If a new kiln line is to be built on the site of an existing plant, there must be a clear strategy developed over the potential interface. If the existing plant has old technology and a limited life, the new plant should have minimum interface because when the old plant shuts down, the new plant must be able to operate without any compromises being built in. For example, a common mistake is to operate the new plant from an existing control room. Subsequent closure will leave the new plant with the control room in a sub-optimal location, and any subsequent move would be very expensive. CPI has recently been involved in a plant design where this situation existed, and two options were considered. The first is to move the control of the existing plant to the new control room (expensive and not practical if the old plant has a short life) or to design the control system so it can be moved later quickly and without great expense. With today's computer and network technology, this latter option has become feasible.

A common solution is to use existing cement storage for the new plant. This is acceptable, as cement transport is flexible and can be switched at a later date to new facilities. However, traffic movement in and out of the plant needs to be mapped so that it is kept away from the manufacturing equipment; there needs to be sufficient parking for trucks waiting to load, incoming raw materials need to be separated from cement trucks, and positioning and functioning of weigh bridges has to be considered.

An important question is whether the existing road, rail, barge or ship infrastructure can cope. CPI was involved in the plant design for one major project that had to be abandoned because after the work had been done on the plant design, it was found that the mode of transport to be used (barge) could not be increased in capacity due to limitations on the dock facilities.

FUELS STRATEGY

The strategy relating to fuels must relate not only to what fuels are available now, but also what will be available in the future. In most first world countries, alternatives to coal and coke, such as tyres, solvents, animal meal, sewage sludge etc. are in common use. In developing countries, although these materials may not yet be readily available, they are likely to be so in the future and given the ever-increasing energy prices, in order to stay competitive, the potential use of some of these materials may have to be considered at an early stage in the plant design and layout.

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For example, if waste is to be used in the future (within the next 10 years), the precalciner should be over-sized and the plant layout adapted so that a kiln gas by-pass system can subsequently be added. Other examples of items of equipment for which space/layout allowance should be made could include tyre reception/transport systems and silos for storage of MBM that need to be located close to the firing floor. Measures such as these cost very little or nothing at the design stage, but can add substantial cost as a retrofit.

Coal grinding systems should be designed for a wide range of coals, the key parameters being hardness (Hardgrove index) and moisture content. An exception to this is if the available coal is very abrasive, where a ball mill will have to be used, and the design has to be based on a specific coal

CULTURAL ISSUES

When developing corporate strategies, analysis of the company and environment as it is at the moment and how it will be in the future, is recognised to be a basic part of the process. However, one aspect of internal analysis that has been consistently underestimated in developing corporate strategies is the field of corporate cultures. Consultants, when developing corporate strategies, are mostly focused on tangible internal and external factors when analysing the company and do not really take the cultural, often intangible and invisible, aspects into account.

This applies equally at a cement plant level. On a greenfield site, opportunities exist to develop a whole new company culture and a forward-looking company can use this as a golden opportunity to drive a whole new way of thinking throughout the whole of an organisation.

What is meant by culture? There are a number of well-known definitions, the following being very clear and concise.

"Culture is a series of values, standard interpretations, insights and ways of thinking that is shared by members of an organisation and is passed on to new members of this organisation." (Daft, 2002)

Why is company culture relevant to the design of a new cement plant? Without people to operate it, no cement will be produced. Without people to maintain it, it will soon grind to a halt. It follows that the calibre of the people available both to operate and maintain the plant, the quality of the management, both at the plant and the corporate level, and the quality of services outside the plant will have a significant impact on the project. If these issues are recognised at an early stage in the project, the design can be adapted in order to allow for local skill levels and infrastructure. A very common error is to always buy the "latest technology". Equipment suppliers are always eager to sell their new equipment designs but tend not to consider whether the technology is appropriate in some regions of the world. This does not always relate to just people issues. When equipment requires specialist spare parts that can only be imported, then import procedures and foreign currency restrictions can be a significant barrier to achieving high plant availabilities.

The safety culture that exists on a site is characterised by the levels of safety awareness and safe behaviours and attitudes in the workforce. Development of a strong safety culture begins at the plant design stage and should include due consideration of maintenance access, electrical and safety, correct equipment guarding. Later on in the project it should also include management systems and arrangements such as safe working procedures.

Some of the plant design issues that are impacted directly by cultural factors include:

- How sophisticated is the plant design?
- What level of automation is to be included?
- Is materials handling to be fully automated?
- Is manual cleaning acceptable?

In CPI's experience, with the correct procedures in place for selecting and training people, the company has yet to encounter any location in the world where educational or skill levels are likely to be a barrier to using state-of the-art technologies in cement manufacture. It is counter-productive to decide at the outset of a project that existing standards and practices on other plants in a company or other local cement plants must be adopted. Once this approach is taken, it becomes very difficult to change in the future.

The dilemma arises when, whether for social or union related reasons, it is necessary to employ many more people than are needed to run the cement plant. The approach recommended by CPI in this situation is to design the plant to be operated by a core group of well trained people, and if it is desirable to employ more people, then this should be in non-core areas, e.g. canteen, cleaning, packing plant labour, local transport, etc. This means that when conditions allow it, these can be outsourced and the plant headcount can be reduced to an acceptable level. Even when labour is cheap, and is likely to be so for the foreseeable future, it is still an error to use more people than necessary. With more people, more managers and supervisors are needed and it becomes much more difficult to locate sufficient people who can be trained.

The number of the core group should be based on world class and then adjusted for any features of plant design where more manual intervention is required (for instance if investment in automatic reclaim equipment is deferred). Maintenance headcount is determined by taking account of what services can be outsourced, for example, lubrication, bag filter replacement etc.

OTHER DECISIONS

There are many other decisions that need to be evaluated in the design of a new cement plant. Although these will have less impact than those already discussed, they are important in their own ways and a clear decision needs to be made based on a strategic analysis. Some examples of these follow.

An interesting decision that needs to be made (otherwise it will be made by the plant suppliers) is whether the plant is to be completely above ground level. This has considerable advantages in keeping the plant clean and for ease of maintenance, but will increase the capital cost, as many of the structures will have to be elevated. This is particularly relevant in the cooler and clinker transport area.

The situation with regards to spare parts availability needs careful consideration. The level of technology of the new plant should take into account the ease and cost of obtaining spare parts. CPI has had experience of plants that could not operate because an electronic component had failed and there were no spare parts available. The speed at which the plant can be restarted is then outside of the plant's control. Things to consider in developing a strategy regarding plant design and spare parts holding can include:

- Import duties.
- Import bureaucracy.
- Lead times.
- Local availability.
- Working capital policy.

A study of these factors will influence how sophisticated the plant should be. It is no good having the latest state-of-the-art technology if spares are difficult to obtain. In general, a plant should always be designed to maximise the supply of locally made spare parts.

CONCLUSIONS

Only when all the areas in this paper have been studied, and optimum solutions are achieved, is it time to contact the equipment suppliers and contracting companies. It is the job of those planning the project to specify what sort of plant is needed. It is important not to let anyone else sell a plant and design that they want.

If clear strategies are kept in mind when designing and building a plant, the process changes from a daunting or overwhelming prospect, to a situation that ensures that the resulting plant will be commissioned rapidly and will provide a profitable future for the company. EM