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QA/QC IN CAPEX PROJECTS FOR THE CEMENT INDUSTRY

1. Risks at Stake

Some quality practitioners may disagree, but quality management falls under the larger umbrella of risk management.

Artists and scientists may seek quality for the pure sake of it, but industry managers strive for quality looking for a comparative advantage. Of course, no company can last at the bottom of the tail, but also at any other position of the scale the need to outperform, or at least stay aligned with the peers, is pervasive.

The risk for those at the bottom tail is marginality and disappearance; in any other position, the risk is loss of market presence against competitors. It does not need to be catastrophic, it is often a steady and slow disappearance.

Interestingly, a search of “cement industry quality” will yield almost anything that one can imagine related to the control of the cement manufacturing process, air emissions, alternative fuels and environmental assessments, laboratories, quality policies and managers, with also a big part dealing on concrete tests. Very few mention the customer, and even less care to occupy themselves with projects. The fact that this search does not show a direct link between clients and quality is indeed very odd but it is beyond our interest now.

Installed cement production capacity grows at few percentage points per year, overall, and therefore it is not surprising that Capex projects are a small niche for quality in the industry. But still, as a baseline reference: a yearly growth of capacity in the range of 3-4% at an average cost of 150 USD/t yields a global market of approx. 15 billion USD (15*10E9 USD). Big enough as to take a look at it.

> Estimate of the large Capex projects market size in the cement industry: ~15 bio USD per year.

2. Steps for Quality Management

There is a full range of approaches to quality management. Using as a reference the well-known PDCA model (Plan–Do-Check–Act), it is easy to identify the different possibilities.

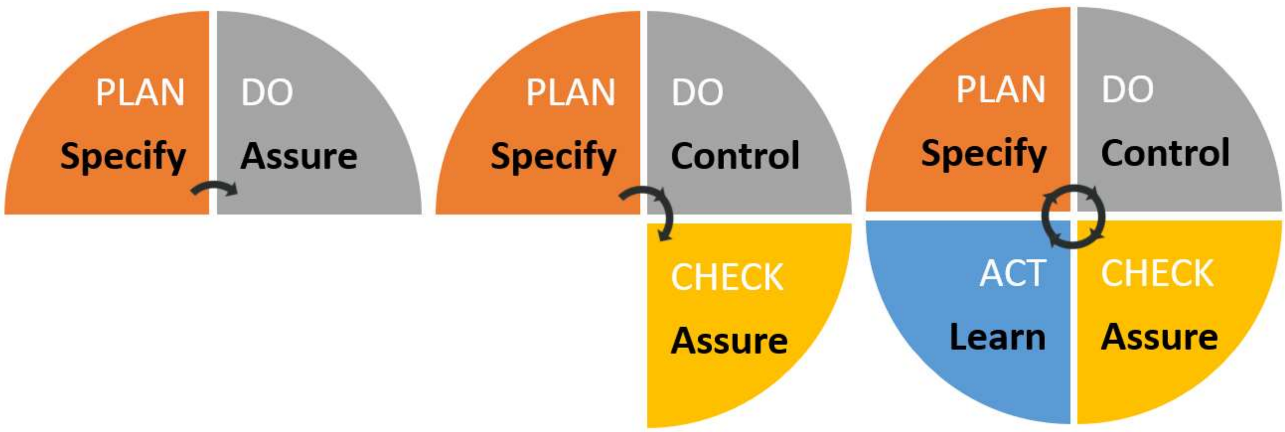

Figure 1: Different quality management approaches using the PDAC model

The selection of the option depends on the importance and nature of the task, but also on the culture and resources of the client.

The simpler way is to provide a specification (plan) and let the supplier manufacture (do & control) according to the specs. A further step would involve a verification (check, assure) that the execution has proceeded as expected. The final element would provide feedback into the specification in the form of experience gained (learn, act).

Let's see in some detail these main steps applied to Capex projects in the cement industry.

3. Specifications

Specifications are seen sometimes as useless paperwork, just a formality needed to proceed with "the real thing".

Of course, the larger the project the more clearly it is perceived that a good specification may be required, but still there is a surprisingly substantial number of odd cases.

And while we concur that there are bulky and useless specifications, our general point is that the attached engineers' jokes on specifications should not be disregarded without some serious reflection. That's our specification!

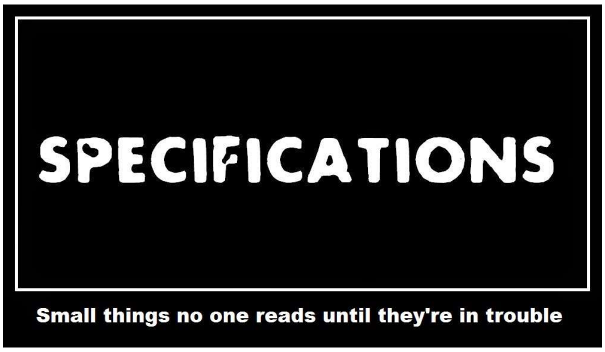

Figure 2: Specify prior to trouble

Too often, specifications are the result of a copy & paste exercise which ignores the particularities of the task, belong to a different project, or do not provide clear or complete rules on so basic aspects as f.eg. how to determine whether an item complies with the performance requirements or not; sometimes the different clauses of a specification are contradictory among themselves within a same contract, and links or references to wrong parts of the document are pervasive. The possibilities for the mess are indeed huge, and a compilation of such factual instances would show a real but hidden face of consultancy and engineering, not to be very proud of it! Copy & paste is a basic tool of standardization and efficiency - but it can also be a dangerous weapon.

This copy & paste practice has a secondary unexpected effect: the repeated utilization of a specification, in which every user introduces some changes, may end-up in a kitsch document. With good luck it may be funny to read; else, it can be a source of problems for the Client (starting with his tainted image as a competent party). Controlling the versions of specifications is important!

Standards like EN, ISO, DIN, BS, ASTM, etc. provide a superb base for a technical specification, but it is seldom the case that all the requirements can be referred to standards. It is also not unusual that the lists of standards are copied in bulk, without due understanding of the actual implications; including superseded standards is also too common.

A particularly dangerous situation can happen when different standards are mixed if their supporting basis are different. A typical example of wrong-doing is the utilization of design wind velocities from local codes or sources, with international building design codes (like the Eurocodes or ASCE-7) if the measuring conditions of the basic wind speed are not the same, which occurs frequently. Another usual problem is related to the design as per the EN concrete codes in countries where it is unfeasible to recreate the controls assumed required in the European ready-mix industry – controls which are implicit in the safety factors used in the structural design calculations of the Eurocode.

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There are many ways to write a bad specification, and much less to do it right. Four key features of a good one would be:

- Ground-based. This practicality involves aspects like the document size (specifications are not *bibles*, they have to be read), the supplier's features (perhaps it is not always necessary to provide a 5-year financial statement), the performance conditions (maybe the request of a 24-h continuous operation in a performance test is not suitable if there are 10 power shut-downs per day), or the insurance policy (a 2.5 mio EUR responsibility policy for a coal test seems quite odd).
- Simple & Complete. The general rule "as simple as possible, but not more" is applicable. A simple but complete specification would cover all the possibilities but entering in detail only for those which are deemed more likely to occur, while providing a general guidance for the rest. A specification that "kicks forward" all possible issues to the execution phase may be simple but is not complete; a specification that lists, say, all ASTM standards on cement may be complete (probably it won't), but it is definitely not simple.
- Coherent. The parts need to fit. This truism tends to be destroyed by the copy & paste approach, but also by the incompetence of the bad or careless specifier. If the maximum air-to-cloth ratio is fixed as 1.5 m/min, then a nuisance filter requiring an airflow of 24,000 m3/h cannot have 235 m2 of fabric; if the complete engineering is specified to last a given amount of time, including Client's revisions, then the total time the reviewers can take must also be capped and a clause for unsuitable engineering should be included (the usual specification of the maximum revision time per document batch is not ground-based).
- Procure. If you are in engineering, think in procurement; if you are in procurement, think in the engineer. You are not enemies! (At least not necessarily!). Too strict technical specifications may unnecessarily reduce the number of suppliers; but a focus on cost-cost-cost will likely cost dear in the long term.

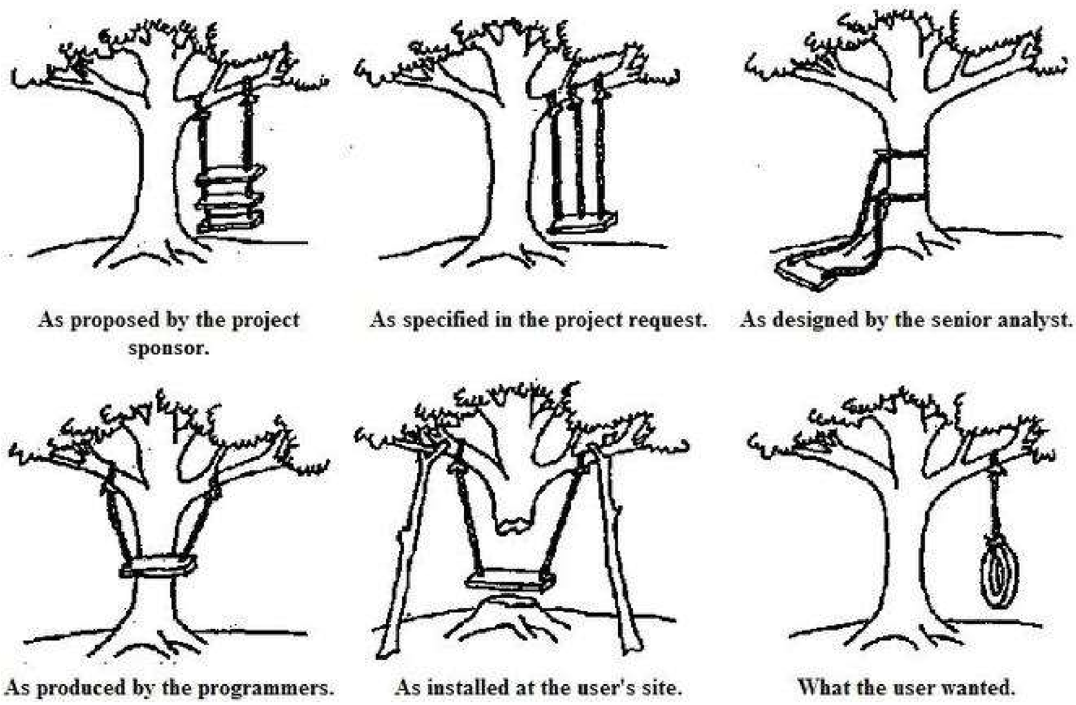

Figure 3: From a classic close-to-real case

4. Quality Assurance & Control (QA/QC)

Unfortunately, if one has to judge by the facts of projects and written documentation, there is some confusion with these two terms. It is worthy then to first clarify the terms.

ISO 9000 provides definitions which can be summed-up as follows:

- Quality: the degree to which requirements are fulfilled.
- Quality Management: the coordinated activities related to quality (documented in a Quality Management Plan, QMP).
- Quality Control: the means of achieving the requirements, in particular the monitoring (measuring).
- Quality Assurance: the means used to provide confidence that quality is being achieved.

Although the usual condensed expression is QA/QC or QAQC, there are cases where the terms are inverted as in a *Construction Quality Control / Quality Assurance Plan*. In fact, this inverted order (QC/QA) represents better the typical temporal sequence of quality-related activities in construction projects, although it is less euphonic than QA/QC. Here also confusion starts with the naming!

The usual practice in construction or erection projects splits the responsibilities in two parts:

- Contractor(s): is in charge of controlling the quality of his work. For that purpose, each contractor prepares and applies a Quality Control Plan (QCP) as a systematic implementation of a program of inspections, tests, and production controls.
- Client: can provide, independently of the Contractor, monitoring and inspection tasks aimed at verifying the effectiveness of the Contractor's QCP in order to obtain additional assurance that the contract requirements are met.

It is important to highlight that a Contractor's quality management plan must have a quality assurance part integrated within it. This assurance, however, is different from the QA provided by the Client. This multiplicity of functions is likely one of the reasons of the confusion mentioned above. In case of doubt it may be necessary, therefore, to specify the level at which the assurance function is provided.

The contract or specification can seldom enter into the details reached in a Quality Management Plan, which is typically prepared by the Contractor. However, what is good practice is that the specification includes at least the requirement of a QMP to be developed and approved by the Client, with the main points to be covered. A further step would be to specify the QA functions of the Client.

The extent of the Client's QA is a frequent topic of discussion. It requires resources which are normally not in the Client's scope of normal activities, it costs money, and, in some instances, it may even add some time to the overall schedule, although this is seldom a significant issue.

There are two extreme limits on this matter: 1) QA from the Client is absent and all the quality management is left to the Contractor; and 2) the Client's QA is actually doubling or substituting the Contractor's QA/QC.

There is no "best-solution for-all-cases" on this regard. The procedure for finding a reasonable position between these two extremes for the Client's QA follows principles of risk management:

- Contractor: QA can be increased if the reliability of the Contractor is low.
- Client: QA may be reduced if the Client has a good knowledge on the subject.
- Subject: the QA may be reduced if the implications of a non-conformity are small.

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A typical case of concern for the Client involves the manufacturing of critical parts in China.

In these cases, the Client is often in all respects "at the mercy" of the Contractor and its subcontractors acting as manufacturers. To the specific technical complexities of the manufacturing process, and the usual unawareness of the details from the Client's side, is added the language and cultural barriers, the convoluted subcontracting relationships, and the different technical standards and practices. In some cases, the size of the manufacturing company is very large, which is compounded with certain disregard for "simple customers" inquiring about their critical part.

If things go fine, which is in most cases, there is no trouble. But if there is a manufacturing issue, the quality controls of the manufacturer may be slightly relaxed, and then the Client may have a severe problem some years in the future, likely after the guarantees have expired.

Of course, the same can happen in a workshop located in India or a factory in Germany, but the reliability, transparency and cultural barriers are different, so different solutions may be required.

Our experience as consultants for the industry points to the following recommendations on this regard:

- Specifications: provide specifications which are sound (see above) for all critical parts (at least for them!).
- Scope: design a QA plan which is risk-based: apply its focus on main aspects of critical parts, leave secondary elements to the Contractor's QC with some eventual review.
- Manufacturers: prequalify them, at least those involved in critical parts.
- Site inspectors: engage local site inspectors, experienced with the local practices, well trained in the Client's specifications, and independent from the Contractor and manufacturers.

5. Learning

Although the position of Chief Knowledge Officer is not yet common, knowledge is likely the edge for companies. It is definitely a necessary practice to incorporate the learnings from experiences, share and spread the good and less-good results. This should be easy in the case of specifications and procedures which are related to operational aspects; large contracts occur less often, but still they are important enough as to become parts of a continuous improvement culture. Fact, however, is that experience gleaned from one project is in too many instances not adequately used for others: a possibility to improve is knocking in the door!

Figure 4: Defects in a casted girth gear: missed by the Contractor's QC and spotted by the Client's QA