‘Quality construction’ –A few lessons for Young Engineers by Eng. Janaka Seneviratne

“Quality is never an accident; it is always the result of high intentions, sincere effort, intelligent direction and skilful execution; it represents the wise choice of many alternatives.”
William A Foster

The First Steps

I commenced my professional career as an engineer in a Sri Lankan semi-government engineering consultancy organisation. I was immediately assigned to a major hydro-power construction project of the accelerated Mahaweli Development Scheme. I directly reported to the senior staff of the Engineering Consultant which was a conglomerate of two German and a Swiss engineering consultancy firms. By the way, the international contractor for the project was also a construction consortium consisted of two German contractors who had been listed within the top five construction companies in Germany at that time. So, this opportunity was a seventh heaven for a graduate engineer. I still feel the sheer satisfaction of achieving high quality construction and project management experience. Also, it was a unique opportunity for me to witness the thought process applied by the expatriate consultant and the contractor to achieve a high quality end product.

Later I joined the Sri Lankan public sector with the intention of applying valuable experience to make a positive difference to their engineering affairs. However, I had a limited success. The professional public sector leaders whom I was associated with, just wanted me to maintain the status quo. This situation is not to be interpreted as a criticism of engineering competencies of my supervising engineers. It was due to their limited exposure to the 'quality' concept and the fear of leaving their own comfort zones. I believe that the organisational politics and the work culture played a detrimental part to make them ineffective in fusing the quality into their project outputs. So, the focus of this article is to recount a few lessons I learnt from the Germans, to inspire young engineers and construction personnel. Let me begin with a story.

One day, a local worker who worked for the German Contractor, mockingly asked his expatriate supervisor to explain what the 'S 1 finish' marked on a construction drawing. By the way, S 1, 2, 3 were the symbols used to indicate the hierarchy of surface finishes for concrete and the S1 was the smoothest. The German supervisor shot back aloud, "Pull your…. pants down and rub your …..bum on the concrete. If you get any scratches, it is not 'S 1'. The poor guy got his first lesson on surface finish quality and never wanted further lessons.

Quality

The definition of the term 'Quality' for a product or a service is dependent on one's perspective per se customer's perspective, specified standard perspective etc. The late Professor of the Harvard Business School, David A Garvin defined the quality under eight dimensions; Performance, Features, Reliability, Conformance, Durability, Serviceability, Aesthetics and Perceived. So, defining quality is not a straightforward affair and this is not a forum for that. Quality can simply be put as the 'conformance to the set product requirements'. (Crosby, 1979). The product requirements are set by the designer after taking into account the customer expectations. I believe that the young readers deserve a simple definition for 'quality' like, "meeting or exceeding the customer expectations" because that is what really matters, at the end.

Lesson learnt-1- Quality is a reflection of pride

The doer of an activity automatically owns the output as well. Hence, the pride of the doer is at stake on the quality of the output. If a poor quality output is delivered, it will tarnish doer's image and a stakeholder has a right to protest saying "this is not good enough".

There was a hundred metre span, uniquely designed concrete bridge to be built. I was the project engineer in charge, on behalf of the engineering consultant. The contractor completed the construction works within five months. Arrangements were finalised to remove the coffer dams built around the four massive piers. By the way, the coffer dams are built to divert the natural water course to allow construction works. Just before I signed off the authorisation papers, the contractor requested two more days to attend some finishing works on piers. I was puzzled as the piers were perfect for me. He took me to the site and showed me a few tiny holes scattered on concrete piers and also a few uneven concrete surfaces on piers due to the displacement of the formwork and the shuttering at joints. The defects were superficial and not structural defects. He wanted to rectify those by putting epoxy fillings and subsequent grinding. I explained him that these sections of the piers would be well under water later and also the defects were so minor. He looked at me sternly and waved the construction drawing. "Look at this paper, do you see a crooked line. All these are smooth lines and curves. I want to see the same at site as well.

This bridge is mine and also yours. My name is also written there even if it goes under water." I was speechless. It took two days for two workers to complete the job, sitting in a steel bucket hanging by a crane, under baking sun.

I never came across a construction supervisor who had such a passion and pride towards own construction work.

Lesson learnt-2- Quality cannot be achieved by just having money; it needs an attitude.

"Quality is not an act, it is a habit"- Aristotle

The contractor's job is to build the structure in accordance with the engineering specifications and the construction drawings. It is easy to maintain quality on construction documentation as the codes of practice dictate terms on that. However, the quality of these documents mean nothing, if the builder does not follow the specified construction details.

The German contractor imported formwork and shuttering material from Germany. The formwork was sturdy and the shuttering mounted on formwork had a special coating which makes the concrete surface very smooth. (Remember S1 !!!) The formwork and the shuttering for a huge concrete dam was a significant expenditure. The contractor could have saved a lot by selecting a cheaper local plywood material. There was a contract condition encouraging the use of local material as well. The problem for the contractor was quality of the local materials. If local materials had been used, Sri Lankan authorities and the politicians would have been happier. However, the German contractor refused to use local material. They pointed out the inferior quality of the shuttering material in the local market and the resulting rough finish.

By using such a high quality formworks and shuttering, the German contractor did not have to worry about repairing air pocket holes (honeycombs) on the concrete surface as the vibratory compaction of concrete along the highly smooth shuttering surface prevented the generation of airpockets. Otherwise, a high cost could have been incurred to repair massive areas of concrete surfaces, especially on the lengthy, curved spillway. So, the contractor made an informed decision to come up with quality material use and it eventually saved them money. The quality concept was in the veins of the German consultant and contractor.

Lesson learnt-3- Quality is about producing a product that lasts

This construction project had a concrete dam, a powerhouse, two large span bridges, a road network with over 100 culverts and a town water supply scheme. When the culverts were constructed, the inlets and outlets of the culverts were transformed into, at least, fifteen meter long channels. The sides and the bed of each channel were protected with boulders embedded in concrete. Local workers and also a few engineers whispered that the contractor was trying to maximise the project costs as this work came as a variation to the original project work. So, I confronted the site project manager and queried on this. He attentively listened to me and asked "What are the three main causes for a road failure?" I gave him a few engineering explanations which were perfectly right. He smiled and said "I agree but remember the three most common causes are water, water and water" Then only, I realised that he wanted to emphasis something else to me. He continued "You guys are very poor on maintenance. Given that, we make sure the road will last for a long time, without allowing water ingression to any part of the road. These drains will function for years. Also we build side drains for all these roads which are eventually connected to these channels. It does not matter for us these roads are located in

a virtual jungle. Otherwise, one day you guys would complain that the Germans did a poor quality job".

They proved me quality was to produce a product that will last long. By the way, the site project manager was absolutely correct on our maintenance practices. I drove on this road network after 20 years of the construction. I literally shed a tear or two, after seeing the road sides were overgrown due to poor maintenance. As a credit to the contractor's foresight and insight, the road structure itself was still intact due an excellent stormwater drainage system.

Lesson learnt-4- Quality is the attention to details

The most stressful period of my whole career was the four weeks period I covered the duties of the Section Engineer. I had to deal with the German Chief Project Manager (CPM) on a daily basis. On the third day of my acting assignment, I went to greet him as usual, when CPM visited the site early morning. He ignored me and did not even bother to shake my hand. I knew that this was not a good sign. He suddenly roared "The slope of this retaining wall is not right". That was it and he stormed out of the site. I got the gradient of the wall checked and found it was slightly wrong. This was corrected afterwards. I still don't know how he detected the error by his naked eye without taking any measurements. Two days later, he asked me join a ride on his luxury SUV and he drove it along the newly constructed road. While driving back and forth on each section of the road, he intermittently stopped and asked me to mark down a few sections on the road using spray paint. Finally, he stopped and called the German site supervisor and instructed him to remove 25 millimetre thick asphaltic concrete layer of each marked section of the completed road and reconstruct. Even the site supervisor was stunned. I noticed that the supervisor asked the reasons for this reconstruction although I could not understand more than a few words of German language. On the way back I politely asked the CPM, how he found out those sections were of poor quality. He replied "Look at this built-in gradient meter attached to the vehicle dashboard. When there are dips on the road, it oscillates". Again, I never met a Senior Project Manager in my professional career who was so attentive to the finer details. The contractor finally agreed and reconstructed the marked road sections at their cost.

Lesson learnt-5- Quality is a collective achievement

The concrete for the dam and powerhouse had to be of optimum quality. A special brand of low heat generation cement (blast furnace slag cement), was used and the concrete mixing was done using chilled water and ice produced from an ice plant, to control heat generation during concrete batch mixing. I was in charge of one of the night shift works of the powerhouse construction and I rejected a series of concrete trucks due to excessive concrete temperature. On that day, I rejected five concrete trucks and the local drivers were forced to take the trucks back to the disposal yard. However, I overheard the conversation between the drivers and the batching plant foreman, venting displeasure of my decision. I realised that they would be up to something sinister. Hence, I asked one of my technical officers to follow the trucks leaving the sites. The truckies were supposed to be driven to the dump yard or to another work site where the rejected concrete could be reused for less quality stringent, slope protection works. My officer reported me that the drivers stopped the trucks halfway, secretly added water to the concrete and were on the way back to the site pretending new concrete delivery. I rejected the trucks again even without testing as the adding of water would alter the strength of concrete. I had evidence to prove the act. There, the local batching plant foreman was only interested of covering his mistakes (to avoid the blame from his expatriate supervisor). By doing so, he was not interested about

maintaining quality of the end product. The point I want to make here is that if all in the construction team do not play their expected role, the quality of the outcome cannot be achieved. The local workers should have realised that this dam and the powerhouse will be a national asset for years to come and we must make sure the delivery of a quality asset.

Lesson learnt-6- Quality is an outcome of continuous improvement

At the end of the project, the Engineering Consultant prepared the final project report describing how the project was planned and implemented according to the designs and specifications. I had the privilege of writing one of the chapters of this report. While I was compiling my report I noticed that my expatriate Section Engineer was working on another report. To collect information for his report, he consulted me and the site project managers. When the time was right, I asked him about his report. He replied me that "The report we hand over to the client is the success story. It is not the one we are really interested in. This report is about the tragic events, where we failed, where we recovered and where we learnt our bitter lessons. You are not aware of many of those events. This report is a classified report. The copies of this report will go to the key project managers of our international branch offices and also to the principal contractor who happened to be from our country. We will, as a team, endeavour not to make same mistakes again and we are determined to do a better quality job next time. This is a matter of national interest". I had the privilege of reading this classified report. It enhanced the horizons of my project management knowledge. By the way, my Section Engineer politely declined my request for a copy to keep. No wonder the Germans are well known for their excellence in technology through their continuous improvement mindset.

It should be noted here that the German consultant and the German contractor only gave the leadership and the guidance and it was the local Sri Lankan engineers and workers who performed accordingly. They were competent enough to carry out the instructions. So, what local construction professionals need is the professional leaders of such calibre. I sincerely hope that the above few lessons would serve as a catalyst for the young professionals in the construction field to achieve excellence in quality construction.

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