

## Nut and Bolts of Engineering and Construction

by Robert Prieto

In developing a project execution strategy for the owner of a large project, his current design and construction practices were reviewed as part of the familiarization process. The existing work as well as the new program he was going to undertake were sited in a remote, costly, labor constrained, and environmentally harsh setting, so getting it right was extremely important.

During a visit to one of the existing construction sites, we repeatedly passed one operation as we traveled back and forth to different work locations. This operation involved a two-man crew bolting up a large hopper. Over the course of the day we would see one of the men walking a kilometer down the road to a warehouse to retrieve additional nuts, bolts, and



replacement tools. It became evident that what was taking place was less than optimal so we stopped to watch the operation.

What we saw were two men with eight differently sized sets of nuts and bolts and eight sets of tools working at low productivity rates because of the harsh environmental conditions. Despite their best efforts, they would periodically encounter a defective nut or bolt and, since the bolting operation had a defined sequence, they would have to obtain good parts from the warehouse when they ran short of a particular size.

Each nut and bolt combination had a different tool set and periodically a tool would fail in use and need to be replaced. Progress on the operation was slow and, given the scale of the operation, it was likely that this crew would be at this one particular operation for a good part of the month. In discussions with the construction manager we could identify no good reason for different sized nuts and bolts so we decided to ask the designers upon our return to the engineering office.

At the principle design office we identified the designer of this particular hopper and asked him a simple question, namely, “What are you trying to optimize?” His answer was quick and straight forward: “Design.” As he pointed out, stresses were less towards the outside of the flange and as such he could use smaller bolts; smaller bolts cost less. So we requested that he estimate the cost savings of this versus using one size of bolt. He came back the next day and told us \$157.

Our next call was to the construction manager, who similarly didn’t understand why multiple bolt sizes were needed. Our question for him was “If all bolts are the same size, what would his direct construction labor cost savings be (unskilled labor was about \$1,000 per day at

this remote site and retaining labor was still a challenge). The following day he called back and told us that with the likely efficiency improvements he could have taken 10 work days out of this operation or \$10,000 in direct labor cost. We started to thank him, but he said he wasn't done. He then went on to point out that for every dollar of direct labor cost he had two dollars of indirect labor costs associated with maintaining a construction camp, taking care of meals, laundry, and doctors, and transporting labor back and forth for periodic leave.

Again, we started to thank him but he interrupted and said he wasn't done. He continued, pointing out that he now had a larger warehouse to house eight sets of nut, bolts, and tools versus one size; that he had to track eight times as many items in the supply chain; had eight different sets of cost codes for the benefit of the accountants; and that, given the remoteness of the site, they had to over-order eight sets of parts and tools versus just one since the cost of delay was huge. Finally, he flagged that he would now have eight sets of waste streams versus just one.

Throughout this process he was highlighting the cost of that \$157 savings, and the results were staggering. On the new program, there were going to be close to 50 of these same hoppers spread out at five remote site locations. Clearly a different philosophy was required, namely one that recognized the scaling effects of a "giga" program and more importantly one that recognized that the inefficiency one might encounter in the "nuts and bolts" of such a program were unacceptable.

Equally important was putting in place a strategy and change process that provided a path forward and a mechanism to constantly assess whether we were keeping the appropriate outcomes focus—one sensitive to the scaling effects and opportunities present.

Sweat the details! The nuts and bolts of construction really do matter.

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