ALICE's adventures overground

ALICE (ArtificiaL Intelligence Construction Engineering) is being used to supplement the 'optioneering' of planners and project managers working on the most complex projects

Construction projects are getting larger and more complex, and the range of factors that have to be addressed to improve their efficiency, save money and shorten schedules, etc. have also increased over the last few years. Whereas earlier projects had to potentially contend with difficult site locations, specialised equipment and construction technologies, local building constraints and even historical preservation requirements, current issues that have to be taken into account include global labour and material shortages, constrained resource supply chains, increasingly stringent construction requirements regarding health and safety and, of course, sustainability.

This is especially relevant in heavy civil construction projects, which often encompass large or linear footprints, above and subsurface construction, and which may span many miles - a typical example is HS2. These challenges also apply to industrial projects, which typically involve complex engineering and procurement challenges.

Even more straightforward large commercial, residential, or mixed-used projects in high-density environments have problems to work around, especially when it comes to access to sites, which can be constrained by traffic, space, or other factors, and some geographic locations are also weather-constrained.

CONSTRUCTION OPTIONEERING

Exploring the vast number of options that could be assessed both prior to construction in the pre-planning phase and the preparation of bids, and in the construction management phase as well, are beyond the resources of any surveyor or project manager without the assistance of specialised software.

I use the word 'could' advisedly, for those involved in considering the broad range of potential solutions, alternatives, and options that ensure a given solution aligns with project objectives and makes the best use of resources, only have limited capacity to do this task. And tools like an Excel spreadsheet or Gantt Chart would hardly touch the interaction or interdependency of the issues involved.

Optioneering, however - a technique used in other industries - is able to streamline the process. That is where ALICE Technologies (ArtificiaL Intelligence Construction Engineering) comes in, with AI capabilities developed specifically for construction optioneering.

ALICE TECHNOLOGIES

ALICE is the brainchild of civil engineer, René Morkos, who followed his father and grew up in the construction industry working as a project manager in Afghanistan, building an underwater pipeline in Beirut, driving automation-led engineering on a $350 million gas refinery expansion project in Abu Dhabi, and leading the development of a virtual design and construction model for Amsterdam's cruise ship terminal.

Recognising the inefficiencies on construction projects, with very poor labour, material resources and space usage (typically only around 3% of the average construction site was worked on at any time), he used his experiences for his PhD at Stanford University to find an algorithm for the link between space usage on a construction site and sequencing schedules. The result is ALICE, which can be used during pre-construction and as a live management tool during construction, enabling costs to be reduced on most projects by an average of 11% and build time by 17%.

ALICE is at its most powerful when being used on major infrastructure projects, as the savings that can be made are in billions and years when it comes to cost and timescales. And with the UK planning to use infrastructure as a way of driving the post-pandemic recovery, now is the perfect time for a tool like this to be introduced to the market.

PRE-PLANNING AND BIDDING

ALICE helps construction companies to bid more accurately and with more confidence. Using ALICE Preconstruction they can plan design/build or alternative delivery projects, calculating the thousands of options available to create the detailed, resource-loaded schedules that they need to manage complex projects, reduce costs and build faster. Users start by

uploading a 3D model of the project, or logic diagram to ALICE before adding key pieces of information, such as labour, rates, materials, equipment and construction methodology.

They then build a 'recipe' - essentially, a list of core tasks to deliver a certain element of the build. These are specific to the organisation and can be ordered and arranged to fit the user's needs. They can also be reused or adapted for future projects. Each time a user plans with ALICE, the work therefore becomes quicker and easier.

When complete, ALICE automatically creates a 4D construction schedule that includes every key milestone for the project, fully resourced - telling you how long it will take, what it will cost and what is needed to deliver it. Used for feasibility studies, production planning or scheduling, ALICE enables users to quantify the impact of different scenarios, helping them to make informed decisions and get to the best plan, optimising resources such as labour, equipment and materials, and ensuring that all major contingencies have been accurately modelled to assess the feasibility of the bid schedule and reduce risk.

Users can also see the effects of changes to the design visually by connecting the design to schedules and estimates to visualise all aspects of the construction project - creating, in effect, a variable 4D modelling environment.

Because these 'recipes' are built in, any changes to the project can be input easily and a new schedule will be prepared with the updated information, using ALICE to help mitigate delays by generating corrective schedules automatically. No need to spend weeks modifying your schedule when circumstances change - ALICE can update plans and schedules in a few clicks to instantly get projects back on track.

THE AI ASPECT OF ALICE

Because construction scheduling is so complex with many variables involved, each of which has a ripple effect on others and ultimately the schedule, it is very difficult for humans to predict the exact effects of purchasing more equipment, adding an extra crane, or hiring another crew, and we base our decisions on imperfect assumptions and information. It's small wonder that projects end up over budget and behind schedule.

Artificial intelligence has already proven itself in answering complex questions, and ALICE was created to help produce construction schedules that are much more efficient and have more due diligence than ever before. Supplemented by your existing construction knowledge, you can set up simple rules for your projects, and then use ALICE's scheduling engine to analyse millions of simulations, looking for the best schedules according to your rules. This takes about 10 minutes.

For example, informing ALICE which tasks require which crews and equipment, ALICE can easily process countless options and calculate the effect that hiring an extra crew or adding a second crane will impact a schedule.

ALICE was designed to be a tool to assist planners and project managers, who make the rules and create the "what if" scenarios to be analysed, using their experience in the field to tell ALICE what's possible and what isn't. Once created in ALICE, then can be reused elsewhere in the same project, or future projects.

ALICE TECHNOLOGIES FOR HS2

ALICE Technologies was used for the Align Project, part of HS2. Together with Align JV (a joint venture of Bouygues Travaux Publics, Sir Robert McAlpine, and VolkerFitzpatrick) they worked on an innovation project for HS2.

Align is delivering the C1 package of the high-speed railway, which comprises a 21.6km stretch of railway in a rural environment that includes a 3.37km viaduct, and 16.04km twin-bored tunnel, with five ventilation shafts. Able to simulate millions of scheduling options in minutes, the Align team ran a pilot with ALICE to test their programme for the viaduct substructure and look for improvements.

The team spent four weeks getting up to speed with ALICE and building 17 'Recipes' to analyse (ALICE's instructions which break down elements including the specific construction tasks that are required.) These recipes included 642 separate operational factors that would need to be considered for scheduling purposes. ALICE generated six million potential options in ten minutes.

The remaining two weeks of the trial was spent analysing the simulations and exploring the "what if" scenarios. Examples included testing the optimal mix of teams required on the substructure in order to increase the utilisation of their crews and minimise downtime for labour and equipment.

PLANNING FOR THE NEXT GENERATION OF BUILDERS

In addition to serving as CEO of ALICE Technologies, René Morkos is an adjunct professor at Stanford University, working with the construction engineering department and teaching the next generation of construction talent a whole new approach to scheduling complex projects - leveraging, I would assume, the latest techniques and opportunities emerging with Artificial Intelligence.

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