How artificial intelligence contributes to competitiveness and workforce planning

AI & Competitiveness
Business Case #1
Company: Elea iC

Company profile

Year of foundation: 1991
Headquarters:
Ljubljana, Slovenia
Size: 101 employees
Sector: Architecture,
Engineering
and consulting (AEC)

Interdisciplinary consultants without geographical or technical boundaries. Since its inception in 1991, Elea has become one of the largest privately owned engineering and consulting companies in Slovenia. To facilitate access to international markets, Elea joined the interdisciplinary consulting group iC Group in 2002 and became Elea iC. With such mutual associations, Elea iC expanded the range of their services, which should lead to interdisciplinary cooperation without geographical or technical boundaries.

Utilising commercial AI platforms and in-house AI solutions tailored to the AEC industry for data extraction and structuring from past and current projects, as well as design exploration and optimisation under real-world constraints, the company's primary objectives are: a) to enhance internal operational efficiency and workflows, and b) to improve client solutions and deliverables across the AEC industry by creating new solutions and approaches for clients and enhancing their processes to find feasible and optimised outcomes.

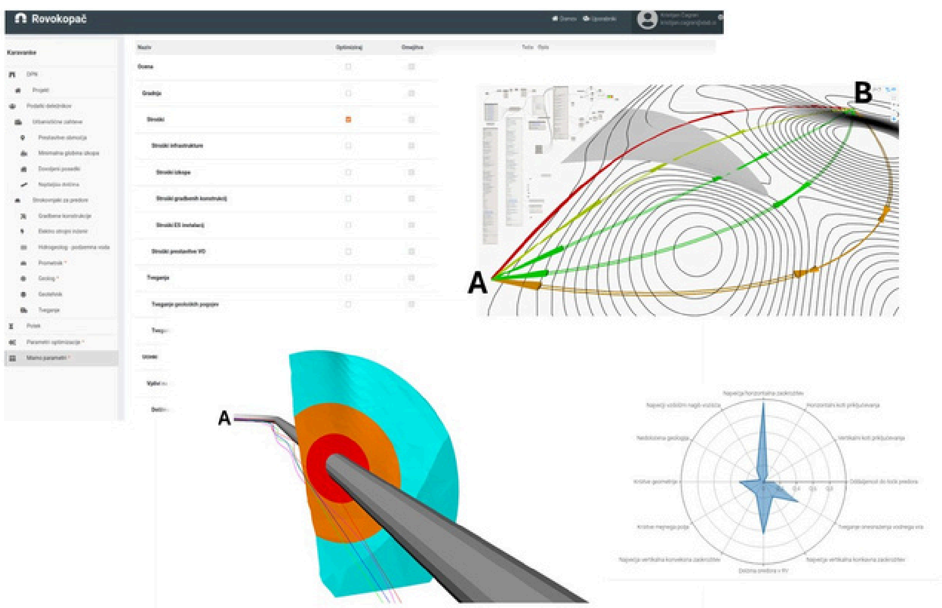
Interviewee

Miha Hafner
Research and
Development Engineer

Miha Hafner is a Research and Development Engineer at Elea iC. He is a senior civil engineer (University of Ljubljana) with a master's degree in Information and Communication Technologies from the Jožef Stefan International Postgraduate School. Active in the AEC industry since 2007, Miha combines deep domain expertise with advanced digital technologies and AI techniques to deliver practical, data-driven optimisation, support, and problem-solving solutions.

What are your AI use cases?

At Elea iC, we are experts in civil infrastructure design and operation, e.g. roads, sewage systems, tunnels, bridges and high-rise buildings. In collaboration with the Department of Intelligence Systems and Knowledge Technologies at the Jožef Stefan Institute and IT-solutions provider XLAB, both from Slovenia, we built Rouka. Rouka is an AI based Decision Support System (DSS), a web-based platform for **optimal tunnel alignment** search. In a complex environment - this means urban environments or similar - it considers multiple decision stakeholders. Usually, when we design the alignment between two locations - location A and location B - there are a lot of stakeholders involved in the decision-making and this is a very challenging task because there are a lot of public opinions, cultural heritage sites, etc. involved. It is really a challenge how to find the best alignment because there can be infinitely many alignments between two locations. So, the question we asked ourselves was what is the most cost-effective and environmentally accepted alignment and what can AI do for us in this relation?



The development of Rouka was part of the TOPP (Transparent design of optimal underground connections for smart cities using artificial intelligence technologies) project.

The first step in applying AI was to transform our thinking and workflows into a model that AI algorithms could process to do the heavy-duty work of finding the best possible alignment. The next step was to develop an algorithmic evaluation tool to assess the success of each possible tunnel alignment across multiple criteria. Some of the criteria can be mutually exclusive, so decision modelling is a very important step to define what is good, what is best, or what is better than some other solution. The algorithm does not know what is good or bad, so this needs to be defined. Since this is a multi-criteria decision model being used, one number, which represents the final score of each particular alignment, is obtained. This vastly reduces the number of viable solutions, which can be further refined using AI evolutionary computing.

Evolution is a natural process and the algorithm mimics this process by recombination and mutation. So, we recombine and mutate the genotype, which is a mathematical representation of our chosen alignment. After this model is set, the algorithm can improve or support, or search for better solutions. This algorithm self-learns and self-improves the final solution, and the result is better alignment according to our criteria including the different boundaries which we defined. Importantly, the AI cannot give us one solution. In the end, the human or responsible person needs to confirm the final solutions.

How did you introduce AI into the workplace?

I hear a lot that we have AI in almost a personalised form, but AI is merely a set of tools or technologies used within digital systems – it is just one part of a larger whole. There is much more necessary for a particular task, such as tunnel alignment, to be conducted. The multi-criteria decision model assesses different solutions, and the next step is to connect the parameters of each alignment to the AI algorithm. To make this process work, **human-machine interaction** is crucial.

> “Human machine interaction is a big challenge - when you speak with AI experts, what domain experts think is usually completely different from what the algorithms do.”

How do you define all the elements, all the requirements, all the boundaries, the fitness function? What is more important than the other? Or what are our goals? We humans, we experts, deal with these questions differently and at the end of the day this needs to be communicated and connected to the algorithm. This web-based platform - Rouka - was one part of this solution and also highlighted the need for interdisciplinary collaboration.

How important was collaboration?

We have different experts or stakeholders involved in the process and how to include their opinion or requirements into the system is something very important and also closely related to the way how things are managed in practice.

It is a challenge to connect architects and engineers with the same model. So, we started this process with the mechanical engineering experts, and then the next step was dealing with the parametric models. When we had the prototype model with the decision question and we met the people from Jožef Stefan Institute, it was like “love at first idea”. I said, “I don't want to change these parameters on my own. Do you have any technology that would find the best parameters?” and the reply was “Yes, of course, we have a lot of this”. The Department of Intelligent Systems and Knowledge Technologies does this a lot in other industries, but now we can manage to do this here. We are now applying AI methods and tools to other areas like tunnel operation or architecture, but those were the first steps.

At the end of the day, the main goal was to come out with a platform for public use, but in practice this transparency is not always appreciated. It is more common for stakeholders to say “Just give us a solution and we do not go into details. Just give us a solution [oriented] approach.” And this is challenging because we have great technology, on one hand, but in practice, people want solutions without much discussion. Architects, designers, engineers, construction companies, and at the end, infrastructure operators, are companies or stakeholders that are not connected very closely. Each of them is performing only their job and the main challenge is how to connect them into the pipeline and come out with a system which can much better support the AI on one hand and return better results on the other. But all these stakeholders are working in different locations, using various tools, and combining them is a challenge of our industry.

What benefits have you derived from using AI?

In tunnel alignment search, we define what is essential to decision-makers - this is neither AI nor decision theory; AI and decision theory are merely used to search for optimal alignment. With this approach, a few thousand different options are being checked. Humans cannot do this. I do not see anyone who would test 25,000 or more solutions with varying complex conditions.

> “We could also use brute force, but we wouldn't find feasible solutions.”

So, this is time-saving and improves the solution obtained. It is possible since the AI algorithm used is self-improving. That is, it starts somewhere, explores the space and then it focuses on the solutions which are more promising. I hear opinions from other colleagues, too, and the benefits they report are also in terms of the output - the outputs are much, much better. You can do some things very fast with digital technologies in general, but in relation to AI, you can improve the outputs. We can produce better solutions on a higher level. This is the simplest answer. So, it is not just time-saving, it also increases the level of service, performance, or the result as such.

Has AI affected the valuation of skills in your company?

The whole work process is different. Now we have user-friendly AI applications and tools that improve our services, as explained. Both, however, require fundamentally different understandings and workflows to exploit AI's potential fully. With these key technologies, non-experts in AI need to communicate with the systems available to them. For example, for engineers using AI algorithms, the coding and programming required for AI-based applications is challenging – it is not easy to master engineering and coding at the same time, and this creates unnecessary pressure. In the end, the questions that keep arising need to be addressed by experts across various fields. Clear evidence of this is found in the constantly evolving EU legislation and in the technologies and applications themselves.

> “The whole field is developing very fast and requires constant learning to stay in the game.”

As an expert in Engineering and ICT, I prefer cooperation with IT experts who are doing this 24/7. They are programming, developing digital systems and databases, data representations etc. They may not know much about the engineering domain, but through communication with them, they can deliver outstanding results and provide support. This collaboration is essential, as design experts cannot operate at the same level as professional coders or AI specialists, and vice versa. AI experts and coders rarely engage with engineering challenges and they are not allowed to take responsibility for engineering solutions. Naturally, the expertise, tools and approaches, as well as the requirements of each discipline differ.

Concluding remarks

Today, many people would like to benefit from AI, and some frustration is already emerging, as it is not easy to learn Python, code, and produce high-level AI results using the available applications. We need the support from IT experts and institutes – therefore, targeted and efficient investment in this field is required.

An inspiring example and clear evidence of this is the achievement of experts from the Jožef Stefan Institute's Department of Intelligent Systems, who won second place and shared a $500,000 prize in the XPRIZE Pandemic Response Challenge. Despite not possessing any medical expertise, these AI experts successfully identified the best measures for the coronavirus pandemic.

The collaboration on the optimal tunnel alignment search project (TOPP) was a powerful experience for me, and I would really like to see greater support from ministries and decision-makers for such applications and solution development - to back leading domain experts and promote stronger collaboration with the IT sector and research institutes.

"There is a need for a coordinated approach and communication with the IT sector and institutes because this topic is vast and it is important."

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https://www.elea.si/en/portfolio/underground-connections-for-smart-cities/

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