

## Dual-Use Skills - Securing Talent for emerging and disruptive technologies

Everybody knows that emerging and disruptive technologies (EDT) includes artificial intelligence, autonomous systems, quantum technologies, biotechnology and human enhancement technologies, space, hypersonic systems, novel materials and manufacturing, energy and propulsion, and next-generation communications networks [1]. However, which one of you knows what are the new sub-domains of AI that are up-trending in mid term future, but can not be seen now in tech investments, nor business? Furthermore, do you know what skills, competences, knowledges or tools are required for each sub-domain? Most likely not, because that is the level of details we usually trust someone else, e.g. universities, to figure out.

Nevertheless, this is the level of details we need to know to ensure we have enough human resources to run operations related to EDTs, not forgetting the cognitive warfare dimensions. The technology is evolving fast and the race is already here [2]. We should understand that we might also have huge emerging blind spots: Emerging technologies are capability agnostic, in many cases privately developed, and multi-domain. And so are the skills, competences, knowledges and tools required.

Technology ad skills foresights are nothing new. They have been done in military and business domains for centuries. New technologies have enabled to do those in scale. When old-school foresight was based on labelling content, taxonomies and statistics, modern methods applies data spaces, high performance computing and language models. The difference in both quality and delay is remarkable: while skills foresight just few years ago was 1-2 years late and based on taxonomies of 15000 skills (from which 5000 was outdated), modern skills foresight is real-time and based on normalized language (phrases) that are used in real world, just now [3].

Since 2015 Headai, a Finnish deeptech company, has built a decision intelligence products based on openly available data. The core feature of Headai's technology is turning any text into detailed and normalized knowledge graph. The knowledge graph construction is done by small, domain specific, language models and algorithms applying the idea of Self Organizing Maps. The technology enables building measurable and comparable scenarios from different data sets.

For example job ads and job descriptions tells what skills and competencies companies are looking right now. When putting 2022, 2023 and 2024 skills demand in timeline we have a trend lines about skills demand. Selected tech and economical news as well as investment decisions tells something about technologies that is expected to be in use in 1-5 years. Research papers and patents tells longer horizon, what will be here in 3-10 years. All these can be naturally converted to trend lines.

Curriculums and course descriptions tells not only what education providers are offering, but also connection between tech topic and skills. B.Sc and M.Sc theses (publicly available data in most EU countries) tells very detailed picture about skills supply. Also the graduate person have the skills provided by the curriculum, so that data enables good estimates for skills supply in general.

Investment decisions, patents and research papers do have interesting dimensions, authors. This tells us which (individuals, companies, universities, countries) have demanded skills and competences, and how big the supply is. Also absence of the skills is a finding.

All this naturally requires carefully sourced big data. Headai has built the data pipelines by connecting the data to computing environment. In other words, the data is always in it's original location. It is just read, not scraped, not saved into a new collection. This is done in order to ensure real-time data (or notice the absence of real time data) and enable traceability of the results. Now every piece of the analysis can be pointed back to the original source. Everything is done according to AI Act, Data Act and GDPR.

Because all the scenarios are comparable, we can analyse e.g. what are the EDT sub domains that are most likely up-trending in next 3-5 years and what is the exact skills demand behind the domains. Furthermore, we can analyse do we have companies, patents and research activities in that domain, and who they are. Next, do we have enough education for the future skills demand

and if not, which universities can help us boosting up the education. Thanks to this capability, several national and EU level competitiveness actions, e.g. LEADSx2030 [4] as well as international organizations, e.g. The World Bank [5], are trusting this technology. In fact this is about EU's competitiveness, in economy and business. Very soon also in defence.

In my talk, I'll deep dive into few scenarios about EDT skills demand and supply, and investments that might be needed in order make sure we have enough talent in the future.

Finally, the rough estimation of expenses. In business, AI alone will change 60% of work known today in advanced economies [6][7]. The job loss is not all the cases dramatical, in fact in half of the cases AI just improves the productivity and only in half of the cases the work changes remarkably. If we use this as a baseline for all the EDTs, we won't at least overestimate the change. If we need a completely new person for the task, it might take 60000€ and 3 years to train such person. If a short training is enough, the costs might be just 10000€ and 3 months. In most of the cases just a course might be enough, and the costs will be few days and few thousand euros.

So, let's assume that 30% needs course or two, 27% needs short training and 3% of the jobs needs a new person. In an army of 250 000 people, this brings up to 1 000 000 000 euros extra costs. Worse than the costs is, that if we start late, we have to wait 3 years for the most critical talent.

[1] Online: [https://www.nato.int/cps/da/natohq/topics\\_184303.htm](https://www.nato.int/cps/da/natohq/topics_184303.htm)

[2] Online: <https://digital-commons.usnwc.edu/cgi/viewcontent.cgi?article=8417&context=nwc-review>

[3] Online: <https://www.headai.com/2024/04/04/the-data-economy-is-already-here-lets-make-it-fair/>

[4] Online: <https://advancedskills.eu/>

[5] Online: <https://blogs.worldbank.org/education/jobs-skills-and-potential-ai-kenya>

[6] Online: <https://www.imf.org/en/Blogs/Articles/2024/01/14/ai-will-transform-the-global-economy-lets-make-sure-it-benefits-humanity>

[7] Online: <https://www.weforum.org/stories/2024/02/artificial-intelligence-ai-jobs-future/>