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# ARCHITECTURAL EDUCATION IN THE AGE OF THE INTELLIGENT MACHINE

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**Abstract.** The alliance of Robotics and Artificial Intelligence hints at a decline in the demand for architectural services in the future. On the other hand, the need to accommodate the rapid population growth around the world will inevitably change the current methods of design and construction to smarter, faster, data-driven, automated, and sustainable processes. The radical shift that architectural practice will face in the not-so-distant future, as well as the demise in the value of post-secondary education suggests that the future of architectural pedagogy will be very different from the current model. Citing the urgency of the "unprecedented social, political and ecological challenges" many have demanded a full curricular restructuring of the disciplines related to the built environment. While there is no doubt that the "content" of our contemporary architectural education is failing our students, our environment, and the generations to come, this paper looks at how the "forms" of design education will be affected by rapid technological developments.

***Keywords:*** *Architecture, higher education, education, pedagogy, automation, artificial intelligence, elearning.*

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## 1. Introduction

The chances that a robot will take architects' jobs by 2024, according to willrobotstakemyjob.com, are only 2%. The site writes in bold letters that automation risk level for our profession is low and assures its human readership that they should feel "totally safe." Many others, including Nikos Salingaros, the editor of *On the Future of Architectural Education*, published on *ArchNewsNow.com*, appear to be skeptical of the numbers generated by this not-so-unbiased algorithm. Our profession, as Dr. Salingaros maintained in our correspondence, "will be replaced by AI" (see also Dickinson, 2019 on the challenge of AI published as part of the series). Sebastián Errázuriz, New York-based designer, who may have little in common with the architecture that Salingaros and his colleagues advocate, shares a similar view on the future of AI in our discipline. 90% of architects, Errázuriz (2019) argues, will lose their jobs to AI and machine learning.

According to the Royal Institute of British Architects' think tank, *Building Futures*, the demand for architectural services, which suffered a 40% reduction in the UK since 2008, will continue its demise. They argue that by 2025 mid-size firms will exponentially collapse and even the very word "architect" becomes outdated, if not obsolete (Jamieson *et al.*, 2011) What are architects to make out of such reports: ones like RIBA's speculation into the future, which has been reflected in the media as "the

death of architecture" (Merrick, 2011) or the more optimistic reports (e.g. Josal, 2017) that provide strategic advice for architects to remain relevant in the future market?

Such musings find more significance once situated in the landscape of higher education in general and architectural education in particular. To delay a serious conversation about the scope of (architectural) education and wishfully hope that our piecemeal integration of new technologies would allow us to somehow cope with the future market is often a result of misunderstanding the radical shift our discipline is facing and miscalculating the speed of this change.

## 2. Artificial Creativity

By replacing the body and mind of our means of production, Robotics and Artificial Intelligence (AI) are the determining factors of the future market. Based on a press release by PwC (2017a), by 2030 AI will increase the global GDP by 14%. They predicted in another report that by the same time automation plus AI could take away 38% of total jobs in the US (PwC, 2017b). And the remaining 62% of jobs will look nothing like the ones we know today. In fact, 85% of the jobs that will exist in 2030, according to Dell Technologies (2017), have not yet been invented.

With the rapid development of building information modelling along with further commodification of architecture, it is not hard to imagine online user-friendly interfaces in the future where clients could pick their land, input their preferences, choose from a list of images, templates, and styles, pick some final finishes, and download an energy-efficient, code-compliant, fully-buildable set of drawings (if such an output would still be relevant).

Many might argue that artificial or not, no computational machine, no matter how sophisticated, will be able to replicate the creative ingredient of architecture. But how did this argument work for web designers? A once-flourishing creative industry has been taken over by commoditized templates, so much that as of 2015, 25% of all websites worldwide were built through WordPress (Gelbmann, 2015). This pattern is by no means limited to the mundane world of mass-websites that are small in size, scope, and program and may not fully appreciate the value of design, because it turns out that almost 15% of the top 100 websites, including governmental pages and tech company sites, are similarly build through WordPress; and no doubt the numbers have increased since 2015.

To assume that creativity is an attribute exclusive to human mind seems rather naïve at this point. "As AI continues to improve," Yuval Noah Harari (2018) argues, "even jobs that demand high intelligence and creativity might gradually disappear." In his piece for the Atlantic, Harari, uses AI chess patterns to demonstrate the creative capabilities of machine:

> One of the ways to catch cheaters in chess tournaments today is to monitor the level of originality that players exhibit. If they play an exceptionally creative move, the judges will often suspect that it could not possibly be a human move—it must be a computer move. At least in chess, creativity is already considered to be the trademark of computers rather than humans!

## 3. Post-labor Construction

Having this not-so-comforting scope in mind, the question on what our graduates need to take away from school to succeed in an uncertain future market becomes further complicated. It is no secret that those involved in the practice have for long criticized architectural education for its inability to equip students with an applicable knowledge of construction, building codes, and architectural details.

But this view hardly takes into account the major shifts our profession is facing. To accommodate the 3.6 billion increase in world population by the end of this century, more than two billion new homes is needed in the next 80 years, that is 25 million homes per year (Smith, 2018). To put this number in perspective, imagine if every year, we built a new home for each Australian, regardless of their age, we would still remain unable to cope with the need for housing alone. It should therefore not come as a surprise that since the mid-1990s 100 new cities have been under construction worldwide, minus China, where in in just 12 of its 32 provinces, over 200 new towns under development (Shepard, 2017). The surprise comes when professionals dealing with construction and architectural services seem unaware that their current model of design, administration, and construction will become obsolete in the face of such demand.

If it was possible to 3D print 10 houses (in less than 24 hours) and a five-story apartment block back in 2014 (Stampler, 2015), the future of construction will indisputably involve even more automation — this may include a rapid development of the already-tested prototypes such as fast-brick robotics, autonomous robot tractors, humanoid robotic installations, flight-assembled construction, and robotically-3D-printed steel structures (TechStartups Team, 2019; Simon, 2017; Advanced Industrial Science, 2018; Gramazio & Kohler, 2011; Yalcinkaya, 2018). But, the scale and scope of the construction needed to accommodate the rapid change we face calls for not only a radical shift in architectural and construction process, but also a complete reevaluation of its pedagogy.

## 4. Academia in Demise?

While many of my colleagues are rightfully discussing the crisis that architectural education is facing in terms of its content and hinting at the “necessity” for change, we would like to discuss architectural education as part of a larger crisis affecting higher education, and emphasize the “inevitability” of such change. A change that is targeting the main product of our current higher education enterprise—degrees. A once luxurious commodity that would open the door to greater jobs, higher salaries, and better lifestyles is not selling as well in the current business model of college education.

Back in 2013, the Georgetown University Center on Education and the Workforce predicted that 65 percent of all jobs created by 2020 “will require some form of postsecondary education or training” (Smith & Strohl, 2013). Today however, I5 different companies, some of which are among the largest employers in the America, including Apple, Google, Netflix, and IBM, no longer require college degrees for employment (Glassdoor Team, 2018). According to Apple CEO Tim Cook about half of the company’s US employment in 2017 included people who did not have four-year

degrees (Eadicicco, 2019). Back in 2013, Google's senior vice president of people operations, Laszlo Bock, justified their position on disregarding college degrees by suggesting that "GPAs are worthless as a criteria [sic] for hiring, and test scores are worthless" (Bryant, 2013). This pattern that some of the most popular companies in the world do not require a college degree for employment is according to Akhtar (2019) "becoming a new industry norm."

And while 44% of recent college graduates (and more than one third of all college graduates) in the US are underemployed (U.S. Census Bureau, 2019), certain positions (e.g. electronic technicians and mechanical designer) are more likely to be filled by non-college graduates (Milord, 2019). This may in part explain why 58% of high-school sophomores chose not to earn a two-year or four-year degree (Akhtar, 2019). And among the ones who decide to start college, 75% either drop out or end up under- or unemployed (Dintersmith & Wagner, 2016).

It is not only Roger Waters and two other of the founding members of Pink Floyd, who felt "[they] don't need no education," and eventually left architecture school, because of their "disdain for critique" (MacLeod, 2015). Yes, the problem is much more widespread and therefore the emergent crisis in architectural pedagogy would make more sense if contextualized within the larger landscape of the growing futility of higher education.

The idea that higher education in general, and the Ivy League in particular, is a bubble that is overloaded, adds no value, and is doomed to fail is now shared by many including scholars (such as Joshua Spodek, faculty at NYU) and entrepreneurs (like Peter Thiel, the PayPal co-founder and venture capitalist) (Spodek, 2018; Lacy, 2011). Back in 2015, the U.S. Department of Education and Moody's Investors Service project predicted that in the coming years, closure rates of small colleges and universities will triple, and mergers will double (Woodhouse, 2015). Harvard Business School professor, Clayton Christensen (2017), foresees that "50 percent of the 4,000 colleges and universities in the U.S. will be bankrupt in 10 to 15 years."

## 5. Is Design e-Learnable?

The bankruptcy of universities however should not be equated with the demise of higher education. Yes, college degrees may not be the best indicator of knowledge, but knowledge itself has not lost its value — not yet. So, what, one may wonder, is filling the need for education? Let me give you a hint: while college enrollment in the U.S., according to the NSC Research Center (2019), has decreased for the eighth consecutive year, Southern New Hampshire University was able to grow its enrollment from 3,000 students in 2003 to around 132,000 students in 2019, and is pursuing an enrolment goal of 300,000 students by 2023 (McKenzie, 2019). What is the secret? Online education — the more accessible, flexible, and convenient means of learning, that according to Christensen and Eyring (2011), is disrupting/replacing the business model of traditional academic institutions.

But can the online education system be an effective substitute for studio instruction? Can the design sensitivity, criticality, and creativity that are acquired as a tacit knowledge through years of intensive collaborative studio environment be replaced by instructional tutorials that are often limited to teaching a specific narrow skillset?

Maybe not, but to think that this logic alone will single-handedly resist the online education wave is rather naïve. Regardless of the different opinions about the effectiveness of online education, its market is growing with an exponential pace.

The online education revenue of the Global E-Learning Market reached $107 Billion in 2015 (McCue, 2014) and will grow at a compound annual growth rate of around 7.2% over the next decade to reach approximately $325 billion by 2025 (Research and Markets, 2017). To put this in perspective, look no further than the already-beaten Gaming market that despite its 7.8% increase from the year before generated $108.9 billion in game revenues in 2017 (Newzoo, 2019).

## 6. Post-Degree Market of Architecture

So what does the forceful and seemingly-unstoppable growth of online education mean to architecture and architectural education? For one, design, in a post-digital era, should liberate its processes, methods, and tools from the authority of softwares. In the future, as a report by Dell Technologies (2017) suggests, "the ability to gain new knowledge will be more valuable than the knowledge itself." Once students are taught how to learn independently, many topics can be outsourced to online education.

The important task is to upgrade future architects from being a mere user of pre-developed softwares to creators of their own tools. This shift would require a proper mathematical education, if not coding/programming in its linguistic definition. Fortunately, the user-friendly environment of visual programming platforms (e.g. Grasshopper and Dynamo) allows architects to reclaim algorithmic thinking from the exclusive circle of coders, whose linguistic skills in talking with the machine had somehow legitimized their visions for the future.

If the rapid development of the build environment would require faster and smarter design strategies, design, for better or worse, may become more involved with systems and processes rather than formal outputs. The information-infused processes of BIM alone cannot produce design strategies that can address the need for architectural quality in a mass scale. A more systematic method, something like an evolved version of Alexandrian patterns (Alexander *et al.*, 1977; Mehaffy *et al.*, 2020), which have already been highly embraced by computer scientist (see object-oriented programming), can bring architectural meaning to the otherwise form-driven generative tools of design.

In addition to developing their own tools, architects should become an active participant in the creation of the future itself. By rethinking the socio-economic relations and institutions that dominate our world today, the next generation of architects should reinvest in design as a powerful form of activism and pick up the abandoned tasks of utopian speculations. Otherwise, the job will be left on the shoulder of politicians, corporations, and coders, who may lack the much-needed creativity, criticality, and comprehensive thinking that architects can bring to the table.

As educators, our primary role is thus to train individuals who are able to creatively tackle a much wider range of challenges through design thinking. This strategic reconceptualization of the scope of architecture is somewhat in line with the findings of RIBA's 2011 research cited earlier. "In order to compete against the cheaper workforces from the emerging markets," the report suggests, "architects must be able to see beyond 'building a building.'"

Aside from broadening its scope to other design disciplines, architectural education should resist the market-driven temptations to reduce its liberal arts and humanities components. In an age when "even the engineer needs to consider human interfaces, and even the programmer must learn to be a storyteller" (Aoun, 2018), architectural curricula should keep its humanities and liberal arts components tight. Architects' cross-disciplinary curiosity in history, theory, art, urbanism, and social sciences seems to be paying off after all. The future market, as unpredictable at it may seem, shows a consistent pattern of embracing those who could engage their technical skills with creative problem solving, critical thinking, and interdisciplinary dialogue—all of which have for long been the objectives of architectural pedagogy.

55 percent of the world's professional leaders, as UBC President, Santa Ono (2020) suggests, have backgrounds in social sciences and humanities. According to a study conducted on 318 employers with 25 or more employees, the Association of American Colleges & Universities (2013) concluded that, despite all differences, almost every one of these employers believed that the ability to "think critically, communicate clearly, and solve complex problems"—the very core values of architectural education—was more important than technical skills. The idea the "technology alone is not enough — that it's technology married with liberal arts, married with the humanities, that yields us the result that makes our hearts sing," is no longer seen as an exaggeration by designers to justify their value, it is reflection on the success of one of world's largest tech companies — what Steve Jobs calls, "Apple's DNA" (Lehrer, 2011).

## 7. Conclusion

In summary, the demand for rapid development is pushing for more automation in construction. This will affect architectural practice in two ways: 1) the outcome of a full architectural service will shift from conventional construction documents to a machine-oriented language and 2) the design process becomes faster and more intelligent to cope with the speed of development. More intelligent design process would require design decisions that are evidence-based, information-loaded, and parametrically adjustable.

A great chunk of the design process will thus be artificially conducted, while designers shall, at least for a while, maintain their role in the larger scale of strategic planning and the smaller scale of artistic and stylistic details and finishes. Design education will thus concentrate mostly on the enhancement of design tools, rather than design products. Speaking the language of the machine will become a norm for literacy in design disciplines but parts of the pedagogy that deals with computation will be outsourced to online education platforms. University education will adopt the architectural tradition of studio-based, hands-on, interdisciplinary learning, that emphasizes collaboration, criticality, and creativity.

So, how likely is the "death of architecture" after all? The knowledge we share shall stay relevant and even vital as long as we do not abandon our rightful seat in the discussion on the future of this planet and the wellbeing of its inhabitants and push to address a broader range of challenges through a mode of design thinking that encourages creative processes, interdisciplinary thinking, and critical reconceptualization of the problem. But unless a serious reassessment of our discipline

begins, the future of architectural education will remain a passive reaction to the shifts in automation, AI, and online education. This reassessment can begin by rethinking the scope, processes, and values of design.

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