

POSITION PAPER

Paradigm Shift in Architecture: Virtual and Physical Computing as Crafts

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Over the past couple of decades, a paradigm shift in architecture towards nonstandard, intelligent, and interactive architecture has emerged. With the emergence of powerful computational tools such as Rhinoceros and Grasshopper, the era of nonstandard architecture appears to be blossoming. As we are at the beginning of the age of digitalization, where computational logic has become integrated into the field of architecture, we need to clarify how and why these techniques and technologies, such as programmed architecture and robotic milling and printing, are to be incorporated in the design and build processes.

I am advocating for the paradigm shift in architecture towards a nonstandard architecture. Computers must be accepted as crafts, and architects must learn the crafts of computing.

I want to highlight the position of American writer, theorist and cultural philosopher Richard Sennett, who is also the Centennial Professor of Sociology at the LSE and University Professor of the Humanities at NYU. In his book, *The Craftsman* (2008), he advocates for the re-establishment of individual craftsmanship against the growing trend of capitalism. Sennett examines the link between traditional craft and technology. He refers to Kant's statement, the hand is the window on to the mind. The incorrect use of modern tools, such as CAD software, breaks the link between hand and mind. In Sennett's view, certain architectural learning cycles (scribbling, executing, understanding) are destroyed by the use of CAD software. He argues, Architects are no longer able to produce a meaningful product, because of working without consequences, not understanding proportions and relations, material properties, emotions and perception, and avoiding problems. Sennett wrote, "abuses of CAD illustrate how, when the head and the hand are separate, it is the head that suffers."¹

I agree with Sennett: the improper use of computers is one of the most problematic issues of our time. Digitalization refers to all sectors, not just the architectural. And we need to change how we deal with it.

If we place the terms mass customization and digitalization in a different context, namely media, our future shifts to a dystopian outlook. The pseudo-individuality and comfort the internet provides us by analyzing big data, embodies the enemy of our own, real independence and interests. Society needs to break free from mock values, represented as blatant materialism, egomania, consumption, amusement and Facebook likes. The reason behind this trend is the lacking will and ability to understand the logic behind computer technologies and algorithms. Humans are deciding to purchase pre-designed "easy-to-use" software, smart devices and computer controlled machines. However, the vast majority of them only know a couple of the included features of that software or device. The will to understand the underlying logic behind the program cannot be detected.

In this already extremely automated time, we need to accept, that we could not live our lives without computers, data, and robots. The industry, logistics, traffic, buying behavior, trade, politics, and everything else, is influenced and controlled by digital tools and analysis. This process is unstoppable. However, every problem creates an opportunity: we need to work with, and not against, the paradigm shift. Industry 4.0 provides us many opportunities that are a valuable good, and would develop the profession of architecture and its possibilities further. Referring back to Sennett, the Linux programmer, the dentist, and the mason - everybody executes a craft. We need to view the computer as a powerful tool in our architectural tool box. If we learn the language of computers, we are then able to express our ideas in reality.

¹ Sennett, Richard. *The Craftsman*. New Haven: Yale UP, 2008. Print. p. 44.

We need to act, and we need to act fast. Just recently, German Chancellor Angela Merkel acknowledged the paradigm shift and industry 4.0: *“Bitte sehen Sie nicht immer das Kritische im Zusammenhang mit der Digitalisierung, sondern sehen Sie das, was uns auch weiterbringt.”*² ³ Market researchers are observing a massive knowledge gap in informatics and believe that it is crucial for future job security. Their demand is to implement informatics in school curricula to prepare our future generations.⁴ England is an impressive example as well, because they are advocating for coding and computer science classes.⁵ This needs to be recognized as a wake up call for our profession. *Tempora mutantur, et nos in illis.*⁶

I want to provoke by stating that most architects are not satisfied with the outcome of their architecture. It is frozen proof of the limitations of human abilities and tools. Off course, nobody would agree that their structure is the result of compromises. We need to free our mind. We need to see what we want, and not what we cannot achieve. This era provides us with an opportunity to think freely and with tools that can help us get closer to our imaginations. Tools which might not be easy to learn and understand for everybody. But only if we learn the craft of computing, we can fully use the abilities and return to our main goal: designing what computers cannot design - spaces with emotions, human understanding, and perception: Architecture.

I am advocating for an intelligent combination of traditional tools and computer aided machines in craftsmanship.

As more and more unique examples of nonstandard architecture arise, the craftsmanship sectors are impacted. Eventually the masons, the foremen, the woodworkers and the metalworkers have to execute the data driven design ideas of the architects. Or don't they? Are we declaring those traditional jobs as extinct, and replacing them by robots and artificial intelligence to achieve a more efficient, more precise, and more complex product? Is there already a paradigm shift in craftsmanship, caused by ideas and the abuse of computational power of modern architects? Do we not need the long acquired and protected institutional knowledge of the traditional sectors anymore? Immediately, the fear of unemployment comes to worker's minds and the fear, of being replaced by a robot. A robot or computer, who is able to work more accurately, more efficiently, and faster. This fear sounds understandable: *“Durch die Digitalisierung geraten nun auch die Arbeitsplätze von durchschnittlich oder sogar hoch qualifizierten Berufstätigen unter Druck.”*⁷ ⁸ The employment rate for jobs with high automation in Germany is predicted to be at 42%.⁹

² [German] Please do not always view things concerning the digitalization skeptically, but rather, look at it as what brings us forwards (translation by author).

³ “Merkel Fordert CDU Auf, Sich Zum Technischen Fortschritt Zu Bekennen.” *Heise Online*. N.p., 26 Nov. 2016. Web. 02 Dec. 2016. <<https://www.heise.de/newsticker/meldung/Merkel-fordert-CDU-auf-sich-zum-technischen-Fortschritt-zu-bekennen-3505659.html>>.

⁴ “Industrie 4.0: Arbeitsmarktforscher Für Informatikunterricht an Allen Schulen.” *Heise Online*. N.p., 25 Nov. 2016. Web. 02 Dec. 2016. <<https://www.heise.de/newsticker/meldung/Industrie-4-0-Arbeitsmarktforscher-fuer-Informatikunterricht-an-allen-Schulen-3504513.html>>.

⁵ Dredge, Stuart. “Coding at School: A Parent's Guide to England's New Computing Curriculum.” *The Guardian*. Guardian News and Media, 04 Sept. 2014. Web. 02 Dec. 2016. <<https://www.theguardian.com/technology/2014/sep/04/coding-school-computing-children-programming>>.

⁶ [Latin] Times change, and we change with them.

⁷ [German] Due to digitalization, the job security of average or even highly qualified professionals has become endangered (translation by author).

⁸ Heißler, Julian. “Kollege Roboter.” *Tagesschau.de* (2016): n. pag. 25 Oct. 2016. Web. 20 Nov. 2016. p. 2.

⁹ Heißler, Julian. “Kollege Roboter.” *Tagesschau.de* (2016): n. pag. 25 Oct. 2016. Web. 20 Nov. 2016. p. 2.

I agree, that this is a high risk and imaginable for workers. But my position is not to replace every worker with a robotic machine, but to create the combined effort of both traditional craftsmanship and technologies, such as CNC machines, 6-axis industrial robots, and 3D printing. I am proposing two approaches: one for the architecture side, the other for the crafts sector.

To avoid job insecurity, craftsmen need to learn all the tools available and not distinguish between a hammer and a six-axis Kuka robot on rails with a chain-saw endeffector. Such as in the latter example, these machines must be seen as a tool in a toolbox. Only then the creative freedom on how to use each individual tool is promoted. As an example for this approach, I examined the dynamic at Bächer Bergmann GmbH, a woodworking firm from Cologne.

The vision of CEO Bächer is convincing, not only for the craftsman but also on the architecture side. The biggest problem can be described with the post-production of nonstandard structures. Through the lack of (traditional) knowledge, the outcome of robotic produced structures often needs a tremendous amount of post-production or interventions (e.g. for connections). Although, architects devoted their lives to the use of forms and spaces, they need to keep in mind the technical side. Therefore, I advocate for parallel education. One line represents the traditional approach, containing hand drawings, building techniques, general understanding of form and space on a emotional and perceptual basis. The other line gives the digital education, starting with learning scripting languages, computers programming, understanding electronics, and controlling computational controlled machines. In later phases, both sides can be merged, but the freedom is available for one to decide which tool to choose.

Through that freedom, a general robotization of our jobs will fail to appear. In that context, Kas Oosterhuis and Henriette Bier are proposing to “not attempt to optimize a traditional building design and building processes with human robotic processes”.¹⁰ The common sense and knowledge of choosing the right tool or machine on both sides will not cause an extinction of traditional craftsmanship. Actually, the opposite will happen: worker or, as Bächer’s case, carpenter can then focus again on planning and designing unique models and furniture: “*Wir müssen uns vor Augen führen, wo unser Beruf herkommt und das ist nicht das Zusägen von Spanplatten.*”^{11 12}

To conclude, I want to emphasize the most important proposition again. Nevertheless, if in a virtual or in a physical space, cutting-edge tools extend our tool box and do not replace any knowledge or proper applications. However, we need to further develop our profession and work with the paradigm shift in architecture. Additionally, architects need to learn the language and logic of computers, to seize the world of zeros and ones, and not become a slave of the digital world. Architects must seize the opportunities this shift provides us: powerful software and machines, in combination with traditional knowledge, finally give us the opportunity to create the opposite of the sterile and anonymous buildings we know today. These are the results of the inappropriate and limited use of CAD software, where the hand is cut from the mind. If we do not blindly follow the digitalization on all levels, but scrutinize and weigh the consequences, our generation can open the window again.

¹⁰ Oosterhuis, Kas, and Henriette Bier. *IA #5: Robotics in Architecture*. Heijningen: Jap Sam, 2013. Print. p. 15.

¹¹ [German] We need consider the origins of our profession, which is not the cutting of wood (translation by author).

¹² Heißler, Julian. “Kollege Roboter.” *Tagesschau.de* (2016): n. pag. 25 Oct. 2016. Web. 20 Nov. 2016. p. 3.