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Construction Management and Technology in the Digital Age

Gestão e Tecnologia da Construção Civil na Era Digital

Gestión de la Construcción y Tecnología en la Era Digital

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Abstract: *This article is based on research carried out over the years by a professor and the research work of an undergraduate student at the Faculty of Technology of São Paulo (FATEC-SP), both from the Buildings course at the same institution. It should be noted that the text deals with the area of civil construction, but can be transposed to other economic segments, where changes in information technology present a new reality in the way people work, both with a focus on management and new executive technologies. Focusing on technology and civil engineering, but with a perception of the reality and challenges of technical and engineering areas in general, that is, an analysis of the current digital era that surrounds us. Through research and the academic experiences of both authors, the text moves towards concluding what the main actions would be for possible improvements in higher technological education to face this new reality.*

Keywords: *Management;, Construction technology; Digital era.*

Resumo: Este artigo é baseado em pesquisas realizadas ao longo dos anos de uma docente e o trabalho de pesquisa de um aluno de graduação da Faculdade de Tecnologia de São Paulo (FATEC-SP), ambos do curso de Edifícios da mesma instituição. Salienta-se que, o texto trata da área de construção civil, mas pode-se transpor para outros segmentos econômicos, onde as mudanças da tecnologia da informação apresentam uma nova realidade no modo de trabalhar das pessoas, tanto com foco na gestão, como nas novas tecnologias executivas. Foco na tecnologia e na engenharia civil, porém com uma percepção da realidade e dos desafios das áreas técnicas e de engenharia de forma geral, ou seja, uma análise sobre a atual era digital que nos cerca. Através de pesquisas e das experiências acadêmicas de ambos os autores, o texto caminha para a conclusão de quais seriam as principais ações para possíveis melhorias do ensino tecnológico superior para enfrentar essa nova realidade.

Palavras-chave: Gestão; Tecnologia construtiva; Era digital.

Resumen: Este artículo se basa en una investigación realizada a lo largo de los años por un profesor y en el trabajo de investigación de un estudiante de graduación de la Facultad de Tecnología de São Paulo (FATEC-SP), ambos del curso de Edificios de la misma institución. Cabe destacar que el texto aborda el área de la construcción civil, pero puede ser trasladable a otros segmentos económicos, donde los cambios en las tecnologías de la información presentan una nueva realidad en la forma de trabajar de las personas, tanto con un enfoque en la gestión como en las nuevas tecnologías ejecutivas. Foco en la tecnología y la ingeniería civil, pero con una percepción de la realidad y retos de las áreas técnicas y de ingeniería en general, es decir, un análisis de la era digital actual que nos rodea. A través de la investigación y las experiencias académicas de ambos autores, el texto avanza hacia la conclusión de cuáles serían

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las principales acciones de posible mejora en la educación tecnológica superior para enfrentar esta nueva realidad.

Palabras clave: *Administración; Tecnología de la construcción; Era digital.*

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1. INTRODUCTION

The direction of higher education in a world undergoing digital transformation, therefore, involves teaching technological and sustainable innovations in a post-pandemic world, where the development of a country depends on the application of the quality of education offered to young people.

In a digital world, construction must implement new information systems, software, and applications, in addition to using hardware, namely computers, tablets, and cell phones, that walk through the construction sites, managing them alongside human beings.

Moreover, robotics, through autonomous vehicles, robots, and drones, has begun to reshape the construction workforce. This trend is not limited to construction, as other economic sectors are also experiencing similar shifts. This raises the question of what the future of work will look like, underscoring the need for adaptation and preparation.

2. FUNDAMENTAÇÃO TEÓRICA

TOFFLER et. al., 1977), is not just to equip students with knowledge for the present, but to prepare them for the future. A future that is rapidly approaching, bringing with it exciting news of new advancements every day. It is clear that this future will not be a mere extension of the present, but a radically different environment that we must be ready to navigate.

As per the FIA (2020), technology in construction is not just a set of tools and techniques, but a transformative force. It is the study and application of methods and tools in the construction industry, with the aim of enhancing productivity, increasing profit, and reducing waste.

According to Eder Santin in an interview for the website, Belgobekaert (2022, our translation) says that:

> "Civil construction, as an engineering activity, is inseparable from technological innovation. Let us consider that technology involves studying and mastering processes, methods, materials, equipment, and professional training for human activity. Innovation is a natural and necessary characteristic of civil construction, being responsible for its constant evolution. It was a technological innovation that allowed the construction of increasingly taller, more complex, and safer buildings.".

The same website lists the vectors of technological development, namely, rationalization in search of productivity and the industrialization of civil construction with the specialization of labor, transforming construction sites into assembly centers.

The same website also reminds us that, to prepare for new technologies in construction, we must:

- Make an effort in education;
- Observe the work strategically, analyzing aspects involving logistics, the

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flow of materials within the construction site, technological evolution, and technical standards, among other points related to new construction methods that require a greater degree of planning;
- Become professionals focused on management for the demands of production planning, process, and cost control, and also people management;
- Participate in technical and academic events, attend sector fairs, and do benchmarking.

For Prata (2022), the construction process's industrialization and the construction site's digitalization also drive the emergence of new material technologies in civil construction. Today, buildings do not require water; energy is generated from roofs and walls.

Prata (2022) and FIA (2020) have introduced a range of material technologies that are revolutionizing civil construction. These include bioconcrete, concrete photovoltaic tiles, solar paint, ecologic brick, Pet bottle wool, self-compacting concrete, artificial sand, lightweight concrete panels, concrete cooled with liquid nitrogen, welded mesh for composite slabs, panels made from EPS Expanded Polystyrene, and high-performance microconcrete. Each of these innovations plays a crucial role in advancing the industry and underscores the importance for professionals to stay abreast of these developments.

According to Ferreira (2021a), another new trend and requirement for construction professionals is knowing how to work and communicate from remote locations, requiring digital skills due to the recent pandemic. It is, therefore, a new reality of globalization of parts of the functions performed by professionals in the field. Projects, budgets, schedules, various plans, and meetings can be carried out remotely, which will soon become required for young professionals entering the job market. In other words, the pandemic brought knowledge of software and educational communication systems to teaching.

In the publication of the European Union Scientific Center (n.d.), the “Digital Competence Framework for Educators” (DigCompEdu – Digital Competence Framework for Educators), teaching professions face rapidly changing demands, which require new, broader, and more sophisticated than before. The ubiquity of digital devices and applications, in particular, requires educators to develop their digital competence. As such, DigCompEdu is a scientifically sound framework that describes what it means for educators to be digitally competent. Provides a general reference framework to support the development of specific digital skills for educators at all levels of education in Europe, including general and vocational education and training, special educational needs, and non-formal learning contexts, detailed in 22 skills organized into six areas, aiming to detail how digital technologies can be used to improve and innovate education and training.

For Ferreira (2021a), in addition to these trends, we have “retrofit” in an environmental preservation movement through the renovation of existing buildings, mainly with the use of part of the constructed building, the reformulation, and maintenance of facilities that reduce, for example, the energy required for use, or reducing the use of natural resources such as drinking water

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and the use of new, more sustainable materials.

In addition to these trends, construction professionals are adapting to new hardware and software technologies, which will impact everyone in the construction production chain.

Therefore, digital technology entities in construction are essential in this context, highlighting the National Center of Competence in Digital Manufacturing Research of Switzerland, ConstruLiga (2019), the Institute of Advanced Industrial Science and Technology (ICTIA) of Japan, Silva (2018), the International Association of Automation and Robotics in Construction (IAARC), technology developer Omer Haciomeroglu and the Umea Institute of Design – both Swedish and computer scientists from the Harvard School of Engineering (Gonçalves et al., 2016).

Regarding robotics in construction, the following stand out: the SAM 100 robot that lays 3,000 bricks per day, Atflaw (2018), the HRP-5P humanoid robot capable of installing plasterboard alone Silva (2018), the ERO robot that performs demolitions in concrete structures, allowing the reinforced steel to be immaculate and reused, in addition to separating the cement from the aggregate, Gonçalves et al. (2016), remote civil construction sensors such as GPS, GIS, RFID (Radio Frequency Identification), for resource management, non-invasive and non-destructive assessment of structures, construction planning, computer simulation and visualization, and computer-assisted structural rehabilitation software, Gonçalves et al. (2016), robot inspired by ants and termites, self-controlled machines were made to create structures from foam blocks. Called TERMES, the robots can create towers, pyramids, and other more complex structures made up of small bricks, Gonçalves et al. (2016), drones or uncrewed aerial vehicles (UAVs), had excellent adherence to Brazilian construction sites, monitoring the construction site to monitor the progress of work, 3D mapping, assessment of terrain and site conditions, monitoring employees and check whether they are using mandatory PPE, in addition to on-site inspection and monitoring of pathologies, INBEC, n.d. and Cecílio et al. (2020) and the robot “the guardian XO” is a full-body exoskeleton, which allows construction workers to carry masses of up to 90 kg for long periods, in order to reduce physical stress (Cecílio et al., 2020).

In the digital era, the evolution of construction management has been greatly facilitated by software and applications. Notable examples include Artia, Revit, Navisworks, Autodoc, Construct app, MS-project, Gestor 90, Crystal ball, Volare, Primavera, Sienge, RM solum and the Tron-orc. These tools have significantly streamlined various aspects of civil construction management, leading to increased efficiency and productivity.

According to INBEC (n.d.), Machine Learning is a part of artificial intelligence that allows machines to learn. Thus, the idea is to make software capable of developing activities without specific programming, such as Smartvid.io, which developed a platform that aggregates visual data from the construction site to analyze it. This idea generates insights into safety, quality, equipment usage, and progress tracking. In this way, the innovation makes it possible to carry out digital

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inspections without the presence of a professional in the field. Augmented reality is an extension of virtual reality. This innovation allows users to walk through 3D environments. Preparing a project allows it to visualize it in the environment to check aspects such as size and compatibility. Additionally, AR is a valuable resource when showcasing architectural designs to clients. Numerous applications and software based on augmented reality have been developed for Civil Construction, such as MeasureKit, Arki, SmartReality, and Augment.

Examples of management methodologies and techniques in the digital era are **Big Data Analytics**, which is the manipulation of enormous amounts of information capable of composing analyses, optimizing business decisions, reducing costs, and increasing efficiency. Whether structured or not, information can come from people, computers, machines, sensors, or other devices. It is considered one of the new developments due to its potential impact on business in the sector. The startup NETResiduos, for example, uses Big Data to manage waste and avoid fines intelligently. Another startup, ZeroDistrato, combines Big Data and Artificial Intelligence to predict cancellations. Thus, the greater availability of information Big Data provides makes decision-making more assertive. Tecnisa and Mac are Brazilian companies that already apply Big Data solutions to uncover consumer behavior Instituto INBEC (n.d.). Therefore, the best benefits of Big Data in construction are project optimization, increasing sustainability, more efficient service (the systems use technologies such as Artificial Intelligence, Machine Learning, and Deep Learning), and cost reduction, SantoDigital (2018). Big Data Analytics should also facilitate project management, budgeting, and planning the work, and collaborate in the analysis of indicators and the crossing of MOBUSS data (2018), allowing the management and analysis of a large amount of data, making the sector, the consumer and the unexplored public understood, analyzing risk prevention; problem-solving; data security; the prevention of equipment failure; project optimization; increasing sustainability; improving customer service efficiency and reducing costs, Oliveira (n.d.). The challenge for construction managers is to know how to deal with all this volume of information and translate numbers, texts and images into strategic information that helps to bring more efficiency and productivity to project management – from the office to the construction site, therefore, the benefits of extensive data analysis in construction management, in addition to preparing your company to accommodate the leading technologies that are revolutionizing the engineering and construction market, the process of collecting and using information related to your business in a strategic way can bring other great benefits , namely: more assertive predictions; identification of problems at early stages; more information in the decision process; better use of accumulated knowledge; approaching customers and proactive management, Celere (2018), the **Internet of Things** (IoT) can increase the safety and productivity of workers on the construction site as wearable sensors, allowing to monitor workers' fatigue and reduce the possibility of accidents on the construction site, or in monitoring the structure, in the manufacture of concrete, it is possible to insert wireless sensors to monitor the incidence of load and events in the structure institute INBEC (n.d.), **Cloud Computing** taking advantage of its connections in four distinct service categories: SaaS - software as a service: applications provided via the WEB to end

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users; PaaS - platform as a service: tools and services used to provide applications; IaaS - infrastructure as a service: hardware and software to run servers, storage, networks and operating systems; and ITaaS – IT as a service: assistance from IT professionals in resources such as applications, platforms and infrastructure (Ferreira, 2021), **Information Systems Management** (ISM) deals with planning and development, management and use of technology tools of information to help people carry out all tasks related to processing and managing information. **Information Technology** (IT) refers to any computer-based tool people use to work with information and support an organization's information and information processing needs. Managers must possess the two most essential skills that constitute the DNA of digital mastery: digital capacity and leadership capacity, Rainer Jr. and Cegielski (2011). BI is the abbreviation for **Business Intelligence**, and through it, it is possible to manage, map, model, and automate business processes, optimizing task time. BI is an almost mandatory tool for planning, and with this tool, the following steps of a project are defined more assertively and efficiently. Furthermore, BI provides valuable information in other areas of the company. The main ones are employee performance, profits, expenses, metrics, and indicators. Lima (n.d.), AI (**Artificial Intelligence**) is an area of computer science formed by systems that simulate the human ability to think rationally and intelligently; therefore, it also influences management. It is when a machine imitates human brain functions, such as learning and solving problems, and this concept of artificial intelligence is quite broad and is nothing new—the volume of data and the ability of computers to interpret digital information. One of the sub-areas of artificial intelligence that has enabled the expansion of this technology is **machine learning – a field of computer science that uses algorithms and statistics to "teach" computers**. The growth in the availability of digital data and the computational capacity to store and process this data are why it has become easier for computers to learn to "think" the way we think. The McKinsey Global Institute surveyed more than a thousand engineering and construction software startups worldwide to identify how companies in this market have adopted digital technologies in their processes. This study revealed how artificial intelligence has been incorporated into civil construction. According to the consultancy's analysis, adopting this technology is still timid, and few companies have the professionals, tools, and processes necessary to implement AI. However, the study indicates that it is starting to make a difference and bring practical results to the market in the following ways: **Systems that optimize project schedules** can consider thousands of alternatives for delivering the work and continually improve overall project planning, **recognition, and image classification allows the person to evaluate video data, collected in the construction field**, to identify possible behaviors of professionals that pose risks and use this information to train the workforce, and **analytical platforms that can collect and analyze sensor data**, allowing create and drive real-time solutions to cut costs, prioritize preventative maintenance, and avoid unplanned downtime. Research by the McKinsey Institute indicates that this timid scenario of using **artificial intelligence in the engineering and construction market** should change in the coming years, thanks to the expansion of technology in the sector and complementary areas. Discover some possibilities mentioned

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in the study: refining the quality of projects, increasing the efficiency of project management, talent retention and development, and constant design optimization (CELERE, 2018a).

Data Science refers to the analysis and study of data so that it is possible to generate insights and make decisions based on the information analyzed in a predictive way, for example, in the performance of works with more than one block, predicting likely difficulties that can arise in the field, preventing possible accidents, delays, and expenses. It is an essential trend for the construction sector, as companies that adopt these solutions improve their projects and results, ensuring more assertiveness, a fundamental point to compete in this market. Construa Negócios magazine (2018), **Lens** combines Big Data and BIM (Building Information Modeling). It is a 3D platform that allows modeling and simulations based on historical data. It allows changes to be made with greater awareness of the possible consequences and without significant scares. The system's objective is to be a more efficient tool for planning construction, making global management and decision-making more effective. It uses an extensive database with information about the project combined with BIM, and this combination is used to carry out simulations. It is a very complex but exciting application of Data Science in Civil Engineering (CONSTRUA NEGÓCIOS, 2018).

BIM, or Building Information Modeling, is a game-changer in the construction industry. It brings together various project aspects, from electrical and hydraulic systems to room layout and construction architecture, streamlining the construction site preparation process. This digital tool not only enhances information accessibility and process agility but also fosters a safer construction environment. The concept of 'Digital Twins' is a direct result of BIM's capabilities (FIA Business School, 2020).

For Salviano (2019), **BIM** (Construction Information Modeling) is a technological trend already paving the way for digital transformation in civil construction. A digitalization and standardization methodology can make projects lean and profitable. Collaboratively, BIM creates an information model of a project in three dimensions and covers all the information necessary for its management, becoming more than just software.

According to data from ABDI Brazilian Agency for Industrial Development (2020), the impacts of BIM on civil construction would be 20% reduction in input costs, 4% increase in costs with ICTs (information and communication technologies), design, architecture, and engineering; and 10% reduction in the total cost of the work.

According to Celere (2019), technology has significantly changed the role of the construction manager and the skills needed for this role. It is about understanding the movements that drive innovations and technological advances and, from there, having a clearer vision of how the work and business can benefit from these transformations. Thanks to recent transformations in the engineering and construction market, project managers have been taking on new and challenging roles requiring new skills. In this sense, the construction manager needs, for example, to know how to use technology to his advantage, collaborate

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and integrate different areas, be analytical, base himself on data to make decisions, and always follow market developments. Therefore, we have new manager profiles: HIGH-TECH CONSTRUCTION MANAGER (open vision about adopting technologies) and integrative CONSTRUCTION MANAGER (facilitate integration and collaboration between the different areas involved in projects. Although technology favors integration, the construction manager still has a crucial role in cooperation between different sectors to happen) ANALYTICAL CONSTRUCTION MANAGER (when building and managing real estate projects, your company is not just creating walls, columns, and roofs; it is also accumulating a pile of information. How you organize and use this data can make all the difference to the success of the projects and be an important strategic differentiator for the organization. With the increase in computer storage and processing power and the evolution of technologies that collect data in time (such as the Internet of Things and mobile devices), this volume of information has grown increasingly. By adopting a more analytical and data-based stance, managers can better control projects and make better decisions); TRENDHUNTER CONSTRUCTION MANAGER (the speed of digital transformations also influences the necessary skills and profile of the current and the future. It is because, as market changes and technological advances occur increasingly quickly, more than just preparing to use new tools, construction managers need to adapt to the speed of transformations to remain relevant and remain. In constant learning mode, they are looking for new ways to differentiate themselves and increase business efficiency; therefore, construction managers who want to remain relevant in the market must be trend hunters.

Salviano (2019) highlights the pivotal role of technology in the modernization of the civil construction industry in Brazil. Companies like BASF, Cyrela, Deca, Eztec, Gafisa, MRV, Saint-Gobain, Schneider, and Thyssen Krupp have formed an innovation and market relationship nucleus with the aim of disseminating digital transformation in civil construction. The key challenge of this transformation is to integrate new processes, digital mindset, and technologies into the daily routines of all professionals, irrespective of their field. The democratization of this vision poses a challenge for companies striving to innovate in civil construction, primarily due to the scarcity of skilled labor capable of utilizing the currently applied technologies.

However, according to the Combuluz website (2021), Brazil still needs to be one of the industry's innovative powers concerning technology use. In a list of 63 countries on the Global Innovation Index made by the World Health Organization, Intellectual Property, the country is in 57th. However, the construction sector can help Brazil to rise in the ranking, not just because it is one of the most important for the country's economy, accounting for almost 8% of GDP, but also because it is an area under pressure to produce with increasing quality and sustainability, facing one of its biggest problems, waste. Technology helps save costs and contributes to the time spent carrying out work.

It helps accelerate the completion of work so that it can be delivered on time. There is also the issue of pressure from more demanding consumers and increased competition. It increasingly requires improving the quality of the work

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and being increasingly innovative to stand out in the market.

According to the same website, investment in technology makes it possible to improve the development of projects, making them modern, innovative, and fast; increase safety on the construction site due to the use of appropriate and innovative individual and collective protection equipment; improve the communication process, since there is an information record where data is collected and stored automatically; and record information on all processes carried out during the works, helping to make decisions so that there are no errors in the execution of the work.

3. Method

The purpose of this article is to describe and explain academic, teaching, and student experiences over the years; therefore, it is descriptive-explanatory research that was preceded by a relevant bibliographic review.

Also presented are the questionnaire via Google sent at the time of the pandemic in 2021 and the visit to hubIC-USP to see the 3D printing laboratory.

4. Results and Discussion

Amid the pandemic, 21 professionals responded to the survey, with almost 40% working in companies providing services and consultancy in the construction industry, 24% working in construction companies, and 14.3% in civil construction project companies.

Among these professionals, 33.3% are engineers, 23.8% are construction coordinators, and 9.5% are architects. However, we have technologists, construction managers, project managers, and consultants among the respondents. Regarding working time in the construction sector, most respondents have 0 to 5 years of experience, that is, 61.9%; 14.3% have worked in the sector for 5 to 10 years, and 23.8% have worked in construction for more than ten years.

When asked about the software infrastructure, a significant 66.7% of the respondents reported using spreadsheets, 61.9% use text editors and specific software for work scheduling, 57.1% use software for project development (graphic pieces), and 52.4% use specific software for project budgeting. It's worth noting that these professionals also utilize information technology for communication, such as intranet and video conferencing. The use of other software options was less prevalent, with the understanding that respondents could choose multiple options.

The fifth question asked to the interviewees was about the company's hardware infrastructure. 76.2% say they use a notebook to carry out their work in construction design and management, 57.1% say they use a computer, and 52.5% say they use mobile devices or cell phones. Unlike other countries, where many would say they use tablets and 3D printers, these items were the least voted for.

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When it comes to the use of robotic technology on site, 42.9% of the respondents reported using safety equipment like the smart turnstile, 28.6% use infrastructure machines, and 23.8% use drones in their work. It's important to note that some respondents admitted to not using any robotic technology, indicating a potential area for growth and innovation in the industry.

The 7th question is about the degree of use of databases in project management software. Unfortunately, 52.4% admit that their databases are not updated periodically, 33.3% admit that their databases are updated periodically, and only 14.3% admit that their databases are continuously updated, which shows that the minority works in a place that has already realized the advantage of keeping their databases updated, computerizing the lessons learned and depending on the system dealing with data, if it can getting too big analytical data and the machine that learns, we get to what we call artificial intelligence.

The 8th question is about applying the "Internet of All Things" on the construction site in the interviewees' companies. 66.7% say they do not apply it on the construction site, 19% say they apply it sometimes, and only 14.3 % responded that they always apply. The same 14.3% admit that their databases are constantly updated.

In the 9th question, we inquired about the incorporation of the 'Internet of All Things' in the design of construction projects, a technology with immense potential for future building. Surprisingly, 66.7% of the companies do not currently apply it, 19% use it occasionally, and only 9.5% utilize it consistently. This data suggests a significant opportunity for future adoption and growth in this area.

The 10th question asks whether printing buildings with a 3D printer is already a reality in Brazil. 42.9% believe that it will be a reality in the future, 38.1% believe that this innovation will occur quickly, and 19% believe that this technology is unlikely to occur in Brazil.

The 11th question concerns the use of virtual and augmented reality in the design phase of civil construction projects. 57.1% say they do not use these technologies, 28.6% say they sometimes, in some projects or launches, and 14.3% always use these technologies.

In the 12th question, the interviewee was asked to leave a comment or suggestion, and in short, according to our interpretation, we have the technology has to be available to everyone; only then will it be viable. There are advances in developing new materials, but more needs to be done to improve artistry. Therefore, to advance in information technologies, it is necessary to quickly train employees and outsource workers, technicians, technologists, engineers, and architects. We need to be prepared for this new demand; for innovative projects, those who need to point the way are government development companies. Some technologies, such as virtual and augmented reality and BIM, are in the implementation phase. The implementation of integrated management software at the construction company will also begin next month, and our company is now learning about these technologies and is starting to implement them. It is already a reality in the Brazilian market.

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During a visit to hubIC-USP's 3D printing laboratory in October of this year, we learned about the entity's initiatives and proposals, mainly related to technological innovations in civil construction, including research focused on 3D printing in concrete (printer in Figure 1).

Figure 1 –3D printer

Source: The authors (2023)

Currently, they are developing and executing a completely 3D-printed kitchen, from its walls to its utensils, as shown in Figure 2.

Figure 2 – Kitchen walls and construction of utensils using a 3D printer

Source: The authors (2023)

Educational institutions must be prepared for a new reality of technological innovations in construction. Students cry out for this attitude. What initiatives should be considered regarding the training and qualification of the construction workforce, and what new skills will be needed? Are we prepared for the imminent future of work?

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5. Conclusion

With the increasing acceleration of technological evolution and the demand for increasingly qualified professionals in the face of these changes, we conclude that for civil construction professionals, it is necessary to have a plural career, not limited to just one specific training, but seek subsidies to understand the whole production chain, ranging from the conception of implementation to the final delivery of the product. Furthermore, there should be a change in the teaching plan of institutions that offer courses focused on engineering and architecture, enabling the implementation of physical and technological structures to meet market demand, not only but in organizational cultures, modify processes to the applicability of innovative solutions in project development, compatibility of information, making more assertive decisions, reducing rework and reducing noise in communication, among others.

It is evident that the need for a diverse skill set is not limited to professionals in the construction industry. The impact of technological advancements will be felt by everyone, and professionals will bear the responsibility of constantly updating their skills, whether they are theoretical, technological, or executive. Those who fail to adapt to this new reality risk being left behind, with job opportunities slipping away.

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