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Embracing today's Economic and Technological Reality: What It Means for Design Professionals

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ABSTRACT

History has shown that technological advancements alter the way we produce, exchange, protect, consume and save all kinds of goods. The First Industrial Revolution, for example, has been named as such since it indeed revolutionized everything related to daily living including art, culture, economy and politics. History has also showed that most cultural actors are reluctant to embrace advanced technology at first as they might see it as taking away something at the core of humanity. Arts and Crafts movement for example, grew out of a concern for the effects of industrialization on design, on traditional skills and on the lives of ordinary people. Today, economists, scientists and policy makers in developing countries are talking about the coming of the fourth industrial revolution and the Second Machine Age, that not only will redefine the way humans live their daily life but also the very definition of human beings. The aim of this study is to discuss the effects of these changes on theoretical and practical issues related to design professionals and education, including advanced technologies available and social and cultural implications of their use. The paper will argue that today's economic and technological reality will alter the design profession from its education to its implementation.

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1. Introduction

The rate of change in all areas of human life has been increasing ever since the First Industrial Revolution. Today not only the rate of change is drastic but also the number of changes that are taking place are numerous. It has been discussed that we are entering a new era in human history where digital technologies are creating new life practices altering our very way of life and revolutionizing everything related to art, culture, economy and politics. Today, economists, scientists and policy makers in developing countries are talking about the coming of the fourth industrial revolution, termed as Industry 4.0 in 2011 in the Science Fair in Hamburg, Germany, and the Second Machine Age, that not only will redefine the way humans live their daily life but also the very definition of human beings. Internet, the new renewable energies, and 3D-printing are the keys for the Third Industrial Revolution that was initiated after the 1970s which are increasing their effect on human lives.

History has also showed that most cultural actors are reluctant to embrace advanced

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technology at first as they might see it as taking away something at the core of humanity. Arts and Crafts movement for example, grew out of a concern for the effects of industrialization on design, on traditional skills and on the lives of ordinary people. However, their idea of art for the people could not be accomplished because their exquisitely made and decorated pieces could only be afforded by the very wealthy.

Today's technological advancements offer new perspectives and opportunities that already started to affect all areas from archeology to medicine, from construction to heritage. More importantly, the Industry 4.0 signals the end of capitalism as economist Jeremy Rifkin (2016) suggests, while a new economic paradigm is emerging which he calls collaborative commons which will transform our way of life. The aim of this study is to discuss the effects of these changes on theoretical and practical issues related to design professionals and education, including advanced technologies available and social and cultural implications of their use. The paper will argue that today's economic and technological reality will alter the design profession from its education to its implementation.

2. Literature Review

2.1. First Industrial Revolution and Architecture

At the time when James Watt invented steam engine in 1765, architects were almost unaware of its implications for architecture. Architects were more interested with finding the appropriate 'style' for emerging functions such as banks, libraries, hotels, museums, opera houses, train stations etc. due to social changes taking place. In this period known as Neo-Classism, architects' discussions were focused on finding 'the style' that would fit better into these new functions based on the ideals of their newly established nation states. Italian architects were considering Roman architecture more appropriate to them, for example, while Gothic was declared as the most British. America, on the other hand, decided Greek architecture more appropriate for their newly established democracy, while Baroque was found more appropriate for Paris Opera House by French architects as a place of human emotion and drama.

Technology, however, was already on its way to produce new materials and techniques that would alter architecture drastically. It would take some time for architects to accept and use these new technologies and materials available as representatives of the new age. It required not only the availability of these new materials and technologies but also acceptance of them by architects first and also by the society leading the way to consider technology as the "cultural manifestation of modern man."

One of the earliest examples of steel columns, for example, is in a public library in Paris, Bibliothèque Sainte-Geneviève (1843-1850). Designed by Henri Labrouste, the building (Figure 1) is a representative of how inexperienced and noncreative architects' of the period were. They were hesitant and non-imaginative in using new materials such as these slender cast-iron columns shaped as sort of Corinthian columns having set on stone pedestals. From the outside the library just looked like traditional stone and brick buildings without ever indicating the use of iron columns and beams inside.

Figure 1: Bibliothèque Sainte-Geneviève (1843-1850).

The architects' preoccupation with style and lack of interest with the technological developments are reflected most clearly in the story of the world's first temporary exhibition building, the Crystal Palace in London. The building's story starts when the world's first developed colonial power Britain wants in 1850 to organize the world's first expo to showcase the latest technologies and innovations from around the world titled 'The Great Exhibition of the Works of Industry of All Nations.' In January 1850 they announce a competition and form a committee to select the winning design. The structure had to be as economical as possible and be built before the exhibition was scheduled to open on May 1st, 1851. Within 3 weeks the committee receives 245 entries, all of which are rejected. None of the designs would satisfy the requirements until a gardener Joseph Paxton, who happened to be in London and heard about the difficulties, visits Hyde Park and quickly doodles his famous concept drawing of the Crystal Palace for the committee (Figure 2).

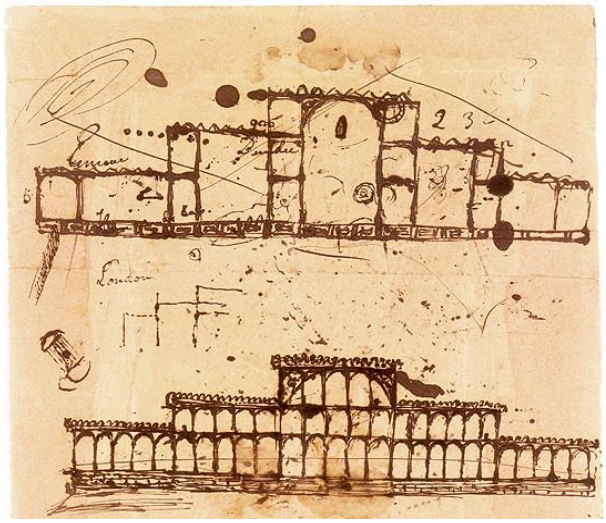

Figure 2: First sketch for the Great Exhibition Building by Sir Joseph Paxton (1850).

Paxton was just a gardener who started to work in 1823 at Chiswick Gardens, then in 1826 appointed by the Duke of Devonshire as head gardener at Chatsworth House. Here Paxton designed gardens, fountains, a model village and an arboretum. Paxton's interest of building greenhouses led him to be interested with the new technological developments as well. It is known that he was friends with engineers of the period such as Robert Stephenson. Using combinations of prefabricated cast iron, laminated word and standard sized glass sheets, he created the 'ridge-and-furrow' roof designs. In 1836 this system was used for the first time in the 'Great-Stove' the largest glass building at the time.

Paxton's experiments with glass and iron to build greenhouses were reflected in his concept drawing for the exhibition hall which included all the basic elements of the building. The design was a vastly magnified version of his lily house at Chatsworth. It was cheap, simple to erect and remove and could be ready quickly. Its novelty was its revolutionary, modular, prefabricated design and the extensive use of glass, and very low cost. The committee accepted Paxton's innovative plan.

Despite widespread cynicism amongst press and public of the period, when the Great Exhibition opened in May 1851 it was an enormous success. The satirical magazine Punch named the building as 'Crystal Palace.' Crystal Palace (Figure 3) resembles a giant greenhouse covering 77,268 sqm area. A total of 3350 cast-iron columns were used in the building, 1851 of which stood at the longer side representing its construction year. Its glass walls and roof cover an area of 83,700 sqm. Paxton's ingenious design created an unprecedented exhibition space. The construction, acting as a self-supporting shell, maximized interior space, and the glass cover enabled daylight. The method of construction was a breakthrough in technology and design, and paced the way for more sophisticated pre-fabricated design.

Figure 3: The Crystal Palace in Hyde Park for Grand International Exhibition of 1851.

Between May and October 1851 millions from across both the UK and the world visited the Crystal Palace. In October, Paxton was knighted by Queen Victoria when he got his Sir title was well as the title of architect. By the time exhibition closed its doors, much of the British public had grown exceptionally fond of their 'People's Palace' and there was great concern that the temporary structure was about to be lost forever. Thus, it was re-erected in Sydenham in south London in June 1854, where it remained until it burned down in 1936.

Starting with the second World Expo Paris 1889, we see architects and engineers designing together such as the 'Galerie des Machines' designed by architect Ferdinand Dutert in collaboration with engineer Victor Contamin. The marriage of architectural ideas with new materials made available by the new technologies had to wait until the pioneers of modern architecture put them into use. It required not only the availability of these new materials and technologies but also acceptance of them by architects first and also by the society leading the way to consider technology as the "cultural manifestation of modern man." Gropius's glass skyscraper and Le Courbusier's idea of undivided screens were among the first steps. The time gap between the demise of modern architecture and the technological innovations of first industrial revolution-mass production of glass and steel-is about sixty years.

2.2. Technology and Architecture Today

Today, economists, scientists and policy makers in developing countries are talking about the coming of the fourth industrial revolution, termed as Industry 4.0 in 2011 in the Science Fair

in Hamburg, Germany, and the Second Machine Age that not only will redefine the way humans live their daily life but also the very definition of human beings. Internet and the new renewable energies were the keys for the Third Industrial Revolution (TIR) that was initiated after the 1970s. Another major development in TIR is the 3D-printing. This new technology changed the manufacturing process from 'subtractive manufacturing' into 'additive' one that will cut down the materials used to produce goods as well as energy used during the process.

The development of new materials and technologies are at an unprecedented speed in contemporary period. Though there are some architects playing with the possibilities of emerging third industrial revolution much focus is needed within architectural discourse on the possible effects and interplays between architecture and the emerging new era with its new economic social and political agenda.

There are new avant-garde projects already experimenting with the application of the 3D printing technology. One of such as project is Amsterdam's 3D-printed steel pedestrian bridge that spans one of the city's old canals (Figure 4). The innovative Dutch construction company Heijman's Innovation Manager Jurre van der Ven suggests that we need to start looking at design in a completely different manner since in 3D printing design and construction operate hand-in-hand. Multi-axis industrial robots will construct the pedestrian bridge using cost effective and scalable technologies creating an automatic construction site.

Figure 4: Amsterdam's new 3D-printed steel bridge.

A new Ukrainian homebuilding startup company called PassivDom uses 3D printing robot that prints 20cm-thick walls, roof and floor of 380 square foot house in about 8 hours. The materials used include carbon fibers, polyurethane, resins, basalt fibers and fiberglass. The windows, doors, plumbing and electrical systems are for now added later on by a human worker. PassivDom's houses are now available for preorder online in Ukraine and US. Their designer Maria Sorokina adds that the homes also offer the possibility of living off-the-grid providing an opportunity to live in nature away from civilization but having the traditional house's comfortable conditions.

One of the world's largest architectural firms, Foster and Partners and a UK based 3D printing company called Monolite have teamed up with the European Space Agency to explore the possibility of using 3D printing to construct a permanent base on the moon. The buildings would be printed using lunar soil as the feedstock. The goal is to construct lunar habitats with locally sustainable materials found on the moon in order to avoid the logistic cost of shipping in materials from Earth.

The developments of Industry 4.0 are way on its way and it will alter many professions and similarly the way we live including the way we produce goods and the way we use them. Digital technologies available are also increasingly getting faster and more developed each day: Limits of image resizing and processing are increasing, new ways for image storage and retrieval lead to new image databases and faster access to images, many documents are digitized for public access including rare books and manuscripts, digital access to many photographic collections are made available each day.

3. Discussion and Conclusion

As discussed above, we have already entered what has been called 'The Second Machine Age.' The Industry 4.0 signals the end of capitalism as economist Rifkin (2016) suggests, while a new economic paradigm is emerging which he calls collaborative commons that will transform our way of life. Today we have more powerful computers, cheaper mass storage, higher band-with for internal and global networks, and more importantly soft-wares and file formats are becoming standardized thus enabling sharing.

The different historical layers of the city could be made available as cultural restitutions through digital surrogates. VU City project developed by Gordon Ingram and James Hotown Associates might be a good example for understanding these surrogates. They already digitally scanned and produced the city of London as a case for smart city data, i.e. large data readily available for live use. It is a case where city modelling is at a new level; you can see timeline of buildings in London as you desire for example

We need to evaluate theoretical and practical implications for many disciplines including art, architecture and heritage as well as education in all disciplines. Today, digital technologies such

as the 3D printing and 3D laser scanning might be in still developing, but their properties as well as usage will grow exponentially in the coming two decades as they becomes increasingly efficient and cheaper. Low cost techniques on 3D representation and 3D printing have already started to effect heritage preservation. Many European research projects are already completed such as VITRA (Veridical Imaging for Transmissive and Reflective Artefacts), VASARI, International Dunhuang Project, VU City and Collect Britain. British Library pronounced that the aim is to help people advance knowledge to enrich lives by aiding scientific advances, adding commercial value for businesses and contributing UK's 'knowledge economy' via innovatively exploiting it collections as a resource for the nation and the world. Some of the

To conclude, digital technologies are new tools that are providing new means for us in our work on cultural heritage as well as via internet platforms getting faster and better we have new ways to share our work with the rest of the world, and we may also have new educational tools soon using 3D virtual reality-VR, augmented reality-AR and mixed reality-MR technologies. We already started to have virtual collections available online. All together they can aid us in creating new ways of communicating to increase much needed intercultural dialogue that fosters understanding and peace among different cultures.

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