Future Directions in Architectural Practice[1]

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The period since the middle of the second decade of the 21st century has seen dramatic changes in the global scientific and socio-economic environment: while the COVID-19 pandemic might have had the biggest impact on what our futures might look like, there are other changes such as the war in Ukraine, rapid developments taking place in the spheres of communication and information technology with the onset of the so-called 'Fourth Industrial Revolution' which will have an impact on how architects practise their profession. In addition, globalisation and new liberalism have suffered some form of (temporary?) setback and we see large-scale human migration towards wealthy countries – Western Europe in particular. At the same time the balance of economic power is shifting. And then there is the threat of global warming and the urgent need to change the way we live and do things. The future direction of architectural practice has been a topic in the professional conversation for some time, with architectural professional bodies such as the Royal Institute of British Architects (RIBA) commissioning a study on the future of the profession, focusing on the questions: "Who will design our built environment in 2025; what roles might those trained in architecture have then and how might architectural practice have changed as a result?"[2] Much has changed since then and the 2025 concerns suggested by the RIBA's study are looming on the horizon. Hence, this study aimed to identify some of the possible directions into which the practice of architects could possibly develop in the next five to ten years and the opportunities that may well arise from the previously mentioned developments. Practitioners might thus be enabled to prepare themselves for possible future opportunities while educators develop and adapt education programmes in order to ensure that their graduates are empowered to flourish amidst the unfolding opportunities.

Introduction

The end of the Plague in the 17th century brought a labour shortage that forced landlords in Western Europe to accede to demands for better treatment of their labourers. After 20 million Indians died as a result of the influenza pandemic, the resultant misery helped kick-start Mahatma Gandhi's campaign to end British rule in India:[3] Pandemics can result in political and socio-economic changes in society and economic systems. How will the COVID-19 pandemic influence society?

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1. Disclaimer: This paper was completed in middle May 2022 and is based on the situation as it existed at that point in time.

2. C. Jamieson, *The future for architects?* (London: Royal Institute of Architects: Building futures, 2010), 6.

3. R. Guest, *The aftermath of the pandemic will make politics more turbulent: Political unrest tends to peak two years after an outbreak starts* (The Economist, 8 November 2021), 2.

Across the world, civil unrest rose by 10% in 2020 despite the restrictions on movement and public gatherings that were in place.[4] The disparity in vaccination rates between rich and poor countries will mean that income levels in poorer countries will remain low, leading to higher rates of sickness and death in these countries.[5] In addition, medical experts warn that we should learn how to adapt and learn to live with the virus,[6] and it appears that society could be in for an extended period of upheaval. Arundhati Roy, Indian author,[7] argues: "Historically, pandemics have forced humans to break with the past and imagine their world anew. This one is no different." Manyika[8] believes that the world beyond the COVID-19 crisis will not return to what it was before the pandemic. Russia's invasion of Ukraine on 24 February[9] and the continuing war between the two countries have proven these predictions correct, and as will be shown later, this aspect alone will result in long-term changes in global affairs, the economy and socio-political relationships.

It follows that the architectural profession, like our urban environment and lifestyle, cannot remain unaffected and must actively form part of the process to "imagine their world anew" as foreseen by Roy.

Nature – or to be more precise, humankind's mistreatment and mismanagement thereof – has also reached a point where drastic changes are required to restrict the negative impact of climate change. The recent 26th Conference of the Parties (COP26) summit agreed that countries will meet again in 2022 to promise additional cuts to their emissions of carbon dioxide (CO_2) in an effort to try to restrict temperature rises to less than the 1.5 degrees Celsius required to prevent a "climate catastrophe". Pledges made at this year's summit, if met, will only limit global warming to about 2.4 degrees Celsius.[10] Buildings generate about 40% of all emissions and carbonised carbon generated by the manufacture and transportation of construction materials is responsible for approximately 11% of emissions.[11] "In a post-pandemic world, concern for our health and the health of the planet has grown …"[12] Undoubtedly, the architectural profession has a major role to play, and the buildings architects design have to change dramatically.

Equally, developments in communication systems, mobile connectivity, computing, sensors, robotics, artificial intelligence, three-dimensional printing and advanced materials are drastically changing manufacturing and production

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4. Ibid.

5. N. Loder, *What to expect in year three of the pandemic: New antibody and antiviral treatments, and better vaccines, are on the way* (The Economist, 8 November 2021), 1-2.

6. S. Mahdi, *Omicron is new Covid kid on the block: five steps to avoid, ten to take immediately* (News 24, 30 November 2021).

7. Cited by D. Susskind, J. Manyika, J. Saldanha, J. Burrow, S. Rebelo, and I. Bremmer, "Life Post–COVID-19," *Finance & Development* 57, no. 2 (2020): 3.

8. In Ibid.

9. J. Psaropoulos, *Timeline: A month of Russia's war in Ukraine* (Aljazeera, 2022), 1.

10. British Broadcasting Corporation, *COP26: What was agreed at the Glasgow climate conference?* (BBC News, 15 November 2021), 1.

11. A. Cohen, "Green the supply chain with better building materials," *Architect; The Journal of the American Institute of Architects* (2021), 1.

12. Nissenbaum in C. Parker, *Twenty views on how to rebuild better after the pandemic* (World Economic Forum, 13 November 2020), 4.

systems. The Fourth Industrial Revolution has thrown up the requirement for new business models. New models, based on systems and platforms, will result in businesses developing the ability to offer new services that will change the ways in which organisations operate.[13] Due to these changes, there is a growing need to change how infrastructure, buildings included, are designed, realised and managed as urbanisation, digitalisation and climate change increasingly change the world. To build better, the World Economic Forum suggests that the building and construction industry will have to adopt digitalisation, develop new working practices, and increase collaboration with among others, the public sector.[14]

All the while, the architectural profession is under pressure and change is forced upon its members continuously. This is also true for all the statutory professions. Davis cites the Susskinds' belief that technology is slowly dismantling the traditional professions, including architecture.[15] TMD Studio agrees by stating that architectural practice as we know it is set to change or disappear and that the future role of architects may be dramatically different to what it is at present.[16]

After stating the research methodology employed, this paper considered and analysed predicted socio-economic and socio-political changes, predicted changes to the business environment, predicted technological developments, predicted environmental changes and changes predicted for the built environment and architectural industry and profession. This is followed by an analysis, discussion and statement of findings followed by conclusions and recommendations. The study aimed to determine how these changes will affect the profession and where architects might find new business opportunities and roles in our changing society.

Research Methodology

Boote and Beile and others contend that "[a] thorough, sophisticated literature review is the foundation and inspiration for substantial, useful research".[17]

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13. Zurich, *Advanced Manufacturing and Production* (World Economic Forum), 1.

14. P. Delorme, and M. Haigh, *Why the world needs a fresh take on smart and sustainable infrastructure* (World Economic Forum, 2021), 1.

15. D. Davis, *What 'The Future of the Professions' reveals about the future of architecture* (2019), 1.

16. TMD Studio: Architecture and Visualisations, *Emerging trends that will shape the future of architecture* (TMD Studio, 2017), 2.

17. D. N. Boote, and P. Beile, "Scholars before researchers: On the centrality of the dissertation literature review in research preparation," *Educational Researcher*, 34 no. 6 (2005): 3-15; including J. Combs, R. Bustamante, and A. Onwuegbuzie, "An interactive model for facilitating development of literature reviews," *International Journal of Multiple Research Approaches* 4 (2010): 159-182; A. J. Onwuegbuzie, K. M. T. Collins, N. L. Leech, A. B. Dellinger, and Q. G. Jiao, "A meta-framework for conducting mixed research syntheses for stress and coping researchers and beyond," in *Toward a broader understanding of stress and coping: Mixed methods approaches*, edited by G. S. Gates, W. H. Gmelch, and M. Wolverton (Series Eds.) & K. M. T. Collins, A. J. Onwuegbuzie, and Q. G. Jiao (Vol. Eds.), *The Research on Stress and Coping in Education Series* (Vol. 5) (Charlotte, NC: Information Age, 2010), 169-211.

Thus a qualitative approach comprising a desktop or literature review was used. Since the nature of the topic is strategic with a strong focus on future developments, the research mostly considered current views, knowledge, and future changes. Therefore, the literature reviewed was mostly internet-based research and professional portals since these types of resources best reflect the latest thinking and the ongoing discourse.

The literature was analysed, and themes were identified and synthesised into mega-themes which were combined with the results of the desktop review. This was done in order to draw conclusions and make recommendations regarding suggested changes to the business strategies employed by practices and changes in architectural programmes at schools of architecture.

Research Aim

The study aimed to identify some of the possible directions into which the practice of architects might develop in the next five to ten years and the opportunities that might come about as a consequence of the previously mentioned developments.

Research Questions

The primary research question was aimed at determining what some of the possible directions are into which the practice of architects might develop in the next five to ten years and what the opportunities are that might arise as a consequence of the previously mentioned developments.

In order to answer this question, the following research questions were pursued:

1. How will changes in the socio-economic and socio-political environments affect architectural practice?
2. How will the Fourth Industrial Revolution change the way we practise?
3. How will the need for more climatically appropriate cities change the way we practise?
4. How will developments in building and construction technologies change the way we build?
5. What will the identified changes mean for architectural practice during the next five to ten years?

Literature Review

This review contains predictions regarding foreseeable socio-economic and socio-political changes that are anticipated in the next five to ten years.

Socio-Economic Changes Predicted due to the COVID-19 Pandemic

The current COVID-19 pandemic has drawn the injustices and inequalities that exist throughout the world into sharp focus.[18] While the pandemic might still be a factor for some time, many of the challenges we will have to deal with after the pandemic phase, will be exacerbated versions of the problems that existed before the pandemic. The most prominent of these challenges are to reconcile efficiency and resilience, humanise capitalism, and densify economic activity and living areas while adjusting to climate change.[19] Bremmer[20] regards the main trends that existed before COVID-19 as de-globalisation, a growing nationalism ('my nation first') and China's geopolitical rise.

In the post-pandemic phase, when COVID-19 will hopefully no longer pose a significant threat to human life[21] and we enter the endemic phase, the world will not return to what it was before.[22] One example of how things have changed since the start of the pandemic is how many existing trends such as the transition to a cashless society, the increase in remote work, the decline of brick and mortar retail businesses and the move to online retail[23] have been accelerated. While Neeley[24] believes that levels of remote work are unlikely to rise to the extent of mid-2020, this phenomenon is here to stay and might even increase. Sneader and Singhal[25] foresee that it will develop into what they call "hybrid work" where employees are expected to work from the office on a regular basis and from home for the rest of the time. One change that has been speeded up is the Fourth Industrial Revolution.

Consequently, the power imbalances as manifested in global institutions must be re-balanced.[26] The world will have to become more inclusive, resilient and sustainable.[27] Asonye[28] asserts that what was 'normal' has not worked for the majority of the world's population and that we should instead use our current discomfort to forge a new paradigm. Nissenbaum[29] points out that during the pandemic, concern about the health, not only of humans but also that of the planet, has grown and with it a willingness to support sustainable ways of doing and the use of materials that support nature and natural systems. Rossiello[30] believes that

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18. Suskind *et al.* (2020), 2.
19. Manyika in Susskind *et al.* (2020), 3.
20. In Susskind *et al.* (2020), 5.
21. J. Guzman, *Top health expert declares 'the end of the pandemic' now in sight; The pandemic could come to an end in the U.S. by early next year* (Changing America, 5 November 2021), 1.
22. Manyika in Susskind *et al.* (2020), 3.
23. A. Powell, *What will the new post-pandemic normal look like? Outbreak forced changes big and small, some of which are here to stay* (The Harvard Gazette, 24 November 2020), 2.
24. cited by Parker (2020), 4.
25. K. Sneader, and S. Singhal, *Trends that will define 2021 and beyond: Six months on* (McKinsey & Company, 2021), 8.
26. Saldanha in Susskind *et al.* (2020), 4.
27. Burrow in Susskind *et al.* (2020), 4.
28. C. Asonye, *There's nothing new about the 'new normal'. Here's why* (World Economic Forum-My Forum, 2020), 1.
29. cited in Parker (2020), 4.
30. cited by Parker (2020), 2.

those who are innovative, flexible and energetic while being persistent will emerge strongest after the pandemic

In January 2021 Sneader and Singhal[31] projected the following trends to emerge beyond 2021:

How the COVID-19 crisis and the subsequent recovery are shaping the global economy:

- The return of confidence unleashes a consumer rebound.
- Leisure travel bounces back, but business travel lags behind.
- The crisis sparks a wave of innovation and launches a generation of entrepreneurs.
- Digitally enabled productivity gains accelerate the Fourth Industrial Revolution.

How businesses are adjusting to the changes prompted by the COVID-19 crisis:

- Pandemic-induced changes in shopping behaviour forever alter consumer businesses.
- Supply chains rebalance and shift.
- The future of work arrives ahead of schedule.
- The biopharma revolution takes hold.

The authors reviewed their prediction in July 2021[32] and found that, at that time, indications were that they were fairly accurate in providing us with a fairly clear indication of what we might expect going forward. Unfortunately, they did not include environmental concerns in their predictions.

Najam's interviews[33] identified the following additional characteristics: disruption will accelerate, politics will become more turbulent, habits acquired will persist and each new crisis will bring new opportunities,

Another useful prediction of socio-economic changes to be anticipated is provided by Dondi, Klier, Panier and Schubert who, after a survey of 18 000 people, found that there will be a reduction in the need for manual and physical skills, that the need for basic cognitive skills will decrease, while the demand for technological, social, emotional and higher cognitive skills will increase.[34] These authors further identified 56 foundational skills (or Deltas) that could assist people in functioning well in the future economy. These are illustrated in Figure 1.

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31. Sneader and Singhal (2021), 2.
32. Ibid.
33. A. Najam, *I spoke to 99 big thinkers about what our 'world after cronavirus' might look like-this is what I learned* (The Conversation, 12 January 2021), 2.
34. M. Dondi, J. Klier, F. Panier, and J. Schubert, *Defining the skills citizens will need in the future world of work* (McKinsey & Company, 2021), 2.

Figure 1. *Foundational Skills Required by the Future Economy*[35]

Following research, the Pew Research Centre found that many experts believe that the changes we face will make life worse for the majority due to rising inequality, authoritarianism and the spread of misinformation.[36] However, they also found that a minority believe that the new 'tele-everything' society will have many advantages relating to improved family time, health care and social activity.

The demise of the pandemic will bring with it a societal challenge that might be far greater than the pandemic: Sternfels, Francis, Madgavar and Smit[37] believe that to counter this challenge, a strategy that is inclusive, sustainable and growth-based is non-negotiable. They argue that growth will bring economic opportunity and prosperity while inclusion will spread the advantage created across society. They further state that sustainability is a prerequisite if the advantages gained are to be carried over to the next generation.

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35. Source: Dondi *et al.* (2021), 4.

36. Pew Research Center, *Experts say the 'new normal' in 2025 will be far more tech-driven, presenting more big challenges* (Pew Research Center, 2021), 1.

37. B. Sternfels, T. Francis, A. Madgavkar, and S. Smit, *Our future lives and livelyhoods: Sustainable and inclusive and growing* (McKinsey & Company, 2021); Najam (2021), 2.

Changes Predicted due to the Ukrainian-Russian Conflict

Commentators predict that the Ukrainian war could end by the end of 2022 or early 2023.[38] While it remains to be seen how and when this terrible war will end, it is predicted that it will influence future developments across the globe, but to varying degrees depending on region.[39] The main changes that will flow from this conflict are as follows: economic growth will slow down while inflation will rise due to higher food and energy costs.[40] Neighbouring countries will be particularly hard hit because of disrupted supply chains, trade routes and refugee-related pressures.[41] It is most likely that the war will bring an end to globalisation as we knew it: The global economic and geopolitical order could be fundamentally altered. This could be a turning point for the world's security system[42] because Russia's integration into the international economic fraternity will end, and large-scale sanctions could remain in place.[43] Furthermore, an overview will reveal that the shape and timing of energy reform have already been changed while the prices of commodities are likely to remain high[44] while energy policies move towards secure access and source diversification.[45] The foregoing could have an impact on sustainability targets. In addition, the competition for scarce but essential materials, equipment and other commodities will increase.[46] This will add to pressures for greater efficiency and localisation. The reconfiguration of security relations, continued sanctions and localisation could also result in the separation of global technology standards and independent development of technologies.[47]

The massive humanitarian crisis that has resulted from the war will require massive humanitarian spending[48] while massive defence spending and military aid will mean that funding will be diverted from pre-war targets, resulting in a slowdown of socio-economic spending. As always, it is the poor and the vulnerable who will suffer the most.[49] Ultimately, greater volatility and uncertainty will be the order of the day.[50]

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38. TimesNow World Desk, *When will Ukraine-Russia war end? Here's what US officials have to say* (TimesNow World Desk, 2022).

39. M. Antelme, *The eye of the storm: The economic repercussions of the war in Ukraine are likely to be unevenly distributed across economies* (Coronation Fund Managers, 2022), 2.

40. A. Krammer, J. Azour, A. S. Selassie, I. Goldfajn, and C. Rhee, *How war in Ukraine is reverberating across world's regions* (IMF Blog, 2022), 1.

41. Ibid.

42. Ibid, 3; N. Katser-Buchkovska, *The consequences of the war in Ukraine will be far-reaching* (World Economic Forum, 2022), 3.

43. Antelme (2022), 1.

44. Ibid, 2.

45. S. Smit, M. Hirt, K. Buehler, O. White, E. Greenberg, M. Mysore, et al., *War in Ukraine: Lives and livelihoods, lost and disrupted* (McKinsey & Company, 2022), 3.

46. Ibid.

47. Ibid.

48. Ibid.

49. Ibid.

50. Ibid, 4.

Technological Changes Predicted

"The pandemic highlighted the power of technology and digitalisation." Paredes[51] points to the reality that companies that had previously invested heavily in technology and digital transformation dealt with the pandemic and associated lockdowns much more effectively than those who did not. She highlights that the earlier than anticipated onset of the Fourth Industrial Revolution and its reliance on digitalisation has the potential to change our world for the better by bringing diversity and creativity to the process, if it is driven by a broad range of innovators.

The Fourth Industrial Revolution, while primarily a technological revolution, will dramatically alter our socio-economic context. Some describe the change as a transformation. Sneader and Singhal[52] see this move as one that starts transformation throughout all business ecosystems, placing people in the centre of innovation by creating an empowered workforce while boosting productivity in the midst of an overarching concern for environmental sustainability. This implies drastic change and continuous upskilling, with those who are not doing so falling behind.

Fleming cites McKinsey's view that there will be more technological progress in the next 10 years than in the preceding 100 and suggests that 10 technological trends will play the major role in this transformation. They are process automation and virtualisation, advances in connectivity, distributed infrastructure, advances in computing (enhanced analytic and other capabilities), applied artificial intelligence, enhanced programming, enhanced data safety, advances in biological science, the development of new and superior materials, and a strong drive towards cleaner technologies. In the building environment, new materials such as carbon-reinforced concrete and other products that utilise waste materials are coming into use.

Environmental concerns and the need to restrict climate change will spur its own technological advances: Taylor[53] refers to developments such as the replacement of concrete heavy infrastructure with alternatives such as mangrove forests, and lists the following advantages for nature-based infrastructural alternatives:

- They bring about initial cost savings and infrastructure that is cheaper to maintain.
- These activities result in an improvement in the conservation and management of natural areas such as parks and oceans.
- They safeguard the ecosystems humankind depends on, thus limiting global warming and change.

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51. D. Paredes, "Better support for innovation and creativity," in *20 views on how to rebuild better after the pandemic* (2020).

52. Sneader and Singhal (2021), 2.

53. M. Taylor, *Turning infrastructure green offers huge savings on top of climate benefits* (Reuters, 25 October 2021).

The architectural profession cannot remain unaffected by these changes. The way we think and work cannot remain unchanged: we will have to adapt and develop ways of working with these changes, and benefitting from them.

In summary: people will benefit from being able to add value over and above what automated systems and intelligent machines can do, being able to operate in a digital environment and continually adjust to new ways of working and in new occupations. This highlights the need for life-long learning, personal development, and growth. If one adds to this the need for inclusive action to address the socio-economic inequalities while reorganising our cities to become healthier environments for a digitally supported population that works in a hybrid fashion while being resilient and environmentally focused in an increasingly changing world, a picture emerges of the society within which architects will have to function.

Predicted Changes in the Business Environment

How will the business environment in which many architects must function change during the next few years? Behrendt, Karlson, Kasah and Swan[54] reported that manufacturers regard digitisation, artificial intelligence and automation as the main drivers that will lead to an increase in productivity and profitability. Significantly, they also found that many manufacturers regard people and their organisation, as well as resilience and operational agility, as highly important.

De Boer, Giraud and Swan[55] hold that, the effects of the Ukrainian war ignored, the following will be major business disruptors in the next few years: the Fourth Industrial Revolution, sustainability, transformation, and people-centredness coupled with higher productivity and efficiency. Environmental impact will be critical for the sustainability and viability of a business. Technological development will be key to achieving these sometimes opposing goals. They cite the statement by Tricoire (Chief Executive Officer at Schneider Electric) that the aim is not only about energy consumption: "It is about reducing any consumption of resources by making everything much more efficient." This focus on efficiency is a recurring theme found in a range of literature.[56] It is an aspect that must hold important implications for architects, the buildings we design and the urban form in which they are situated.

Sustainability in the broadest sense, but particularly adopting to the challenge posed by environmental change, will be a major topic in business in the future: Robinson believes that those who manage to move first to reduce emissions will

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54. A. Behrendt, A. Karlson, T. Kasah, and D. Swan, *The CEO: Architect of the new operations agenda* (McKinsey & Company, December 2021), 6.

55. E. De Boer, Y. Giraud, and D. Swan, *CEO dialogue: Perspectives on productivity and sustainability* (McKinsey & Company, 3 November 2021), 1.

56. Sneader, and Singhal (2021), 6; P. Bernstein, *Ten thoughts on the future of practice* (The Architect's Newspaper, 20 April 2020), 1-4; Delorme, and Haig (2021), 2; De Boer *et al* (2021), 1; S. Fleming, *Top ten tech trends that will shape the coming decade, according to McKinsey* (World Economic Forum, 12 October 2021), 7.

be the first to have a more viable economy.[57] Nissenbaum (in Parker)[58] suggests that leaders will support the use of materials and systems that support environmental sustainability. McKinsey and Company[59] foresees that in an effort to grow, businesses will respond to sustainability goals and technological change. This includes investment in nature-based opportunities.[60]

Krishnan, Samandari, Woetzel, Smit, Pacthod, Pinner, Nauclér, Tai, Farr, Wu and Imperato[61] suggest that the net-zero transition we have to work towards would be universal, significant, and front-loaded. Furthermore, it will have uneven effects on sectors, geographies and communities, but it will create substantial growth opportunities despite causing significant disruption and a need for large-scale adjustment and rearrangement including reskilling. The new pursuit of these opportunities will not be painless. However, they were identified as the aspects that are of importance for this study.

Survival will force businesses to turn to automation, artificial intelligence robotics and globalisation[62] but Akella[63] believes that the focus should rather be regional. However, the Pew Research Centre quotes Chudakov [64] when warning that "we have reached a tipping point with our tools: They are now more sophisticated than our ability to fully appreciate their effects." The World Economic Forum believe that almost 50% of current work activities can be automated in the next decades, supported by faster digital connections and next generation computing. Fleming[65] continues by pointing out that new developments in material science could possibly transform various market sectors. Another important reason why businesses are turning towards technology is the ambition or need to grow; to build new business. McKinsey and Company[66] reports that business leaders foresee that five years from now half of their income will derive from parts of their businesses that presently do not exist.

The above indicate significant change and new knowledge requirements. In response, Baig[67] points to the need for all businesses and business leaders to embrace training and life-long learning for all members of staff and for chief information officers to "become the fastest learner". This statement underlines the importance of knowledge management as an aspect of human resource

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57. K. S. Robinson, *I imagined earth's future, and now COP26 honchos are curious* (Business Day, 28 October 2021).

58. Nissenbaum in Parker (2020), 4.

59. McKinsey and Company, *2021 Global report: The state of new business building* (McKinsey and Company, 2021), 2.

60. Hopman in McKinsey Blog, *Ahead of COP26: Seven sustainability trends to watch-and why they matter* (McKinsey Blog, 25 October 2021), 21.

61. M. Krishnan, H. Samandari, J. Woetzel, S. Smit, D. Pacthod, D. Pinner, et al., *Six characteristics define the net-zero transition* (McKinsey Sustainability, 25 January 2022).

62. Pew Research Center (2021), 5.

63. in Parker (2020), 3.

64. Pew Research Center (2021), 12.

65. Fleming (2021), 3.

66. McKinsey and Company (2021), 2.

67. A. Baig, *The CIO agenda for the next 12 months: Six make or break priorities* (McKingsley Digital, 1 November 2021), 6.

management. John Caulfield[68] supports this prediction and foresees that skilled labour will be scarce and will come at a cost.

Dondi *et al.*[69] predict that the proficiencies that have the potential to offer the best outcomes for individuals can be grouped according to their ability to generate employment, income and job satisfaction, as illustrated in Figure 2. These are proficiencies companies should develop in their workforce in the face of the shortages predicted by Caulfield.[70]

Note: Data from non-OECD countries presented higher variance and were excluded from this analysis.
¹Distinct element of talent.
²Probability of a survey participant being employed among citizens with income below the median.
³Probability of a survey participant being in the top quintile for income.
⁴Probability of a survey participant reporting being "fulfilled and satisfied" or "satisfied" with his/her job.

Figure 2. *Proficiencies Linked to Individual Advancement*[71]

This leads to the question of how companies will work in future. Davis[72] suggests that offices could adopt one or more of the following models:

- As it was (back to the 'old normal' with increased use of sanitisers).
- Clubhouse (a hybrid model where employees visit the central office when they need to but continue working from elsewhere).
- Activity-based working (employees work from the office but don't have a fixed workplace – instead they move around or work from home, depending on what they do and who they work with).
- Hub and spoke (instead of having one main office, firms have a number of smaller satellite offices scattered in areas close to employees' homes).

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68. A. Caulfield, *10 Predictions for the Construction Industry in 2022: Our prognostications focus on how AEC firms will streamline and modernize their projects and operations* (Building Design and Construction, 9 November 2021), 4.
69. Dondi *et al.* (2021), 11-12.
70. Caulfield (2021), 4.
71. Dondi *et al.* (2021), 12.
72. Davis, *Five models for the post-pandemic workplace* (Harvard Business Review, 3 June 2021), 3.

- Fully virtual (employees work from where it suits them with no main office).

Architectural practices, being businesses, will have to take note of these changes, firstly in order to consider how they can leverage these changes to provide better value to their clients, and secondly how they can proactively acquire the skills and specialisations that will be required. They will also have to adopt many of these aspects in order to keep up with the demands of a changing practice environment.

Predicted Changes in the Built Environment, the Building Industry and Architectural Practice

Predicted Changes in the Built Environment

The priorities listed earlier in this paper must spill over into the nature of our cities as we prepare for future pandemics while recovering from COVID-19. Bernstein[73] predicts that the effects of the current pandemic, including health concerns and supply stream instability, will force contractors to turn to automation on site and increasingly to pre-fabrication, a change that is in line with the drive for greater efficiency. He continues that this change will rely on tools and processes that require digital processes, and role players (including architects) that can answer this need. The 'Smart City'[74] that will arise will be the result of pressures for greater efficiency particularly in terms of the use of resources.

Bernstein suggests that we might see the emergence of design and construction version of the so-called 'gig' economy where the focus will change from full projects to discrete tasks and that new priorities, driven by epidemiological concerns, will emerge. Questions will be asked regarding ease of cleaning, health implications, and performance during lockdown restrictions. This implies that the urban form must change to provide for proximity and density while maximising the use of natural ventilation and space that will allow for social distancing through the provision of wider sidewalks. This implies greater emphasis on pedestrianisation and with that walkways, generous public open spaces and outdoor facilities that will aid the natural environment and the drive towards carbon neutrality.[75] Our homes will also need reorganising to allow for longer periods of home-stay and remote working. Likewise, the rise of the sharing economy and shared spaces combined with new developments such as driverless cars could result in infrastructure becoming the dominant feature of cities.[76] Land pressures could encourage higher densities and the so-called 'vertical city'. TMD Studio also foresees an increase in the rise of inclusive spaces and buildings offering a range of diverse functions (mixed use or multifunction buildings).

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73. Bernstein (2020), 2.
74. TMD Studio (2017), 4.
75. Bernstein (2020), 2.
76. TMD Studio (2017), 10.

Because of the need to have cities that are more environmentally and climate friendly our cities will have to work towards creating a more sustainable environment. In this the integrated goals of Yeang's partitioned matrix[77] (see Figure 3) can be used as a guideline for what must be achieved.

Not only will the need to address the issue of proximity influence the location of workplaces, but as described earlier, the functioning and thus layout of these spaces and changing purposes will influence our urban form in ways that will depend on the model chosen by most companies.
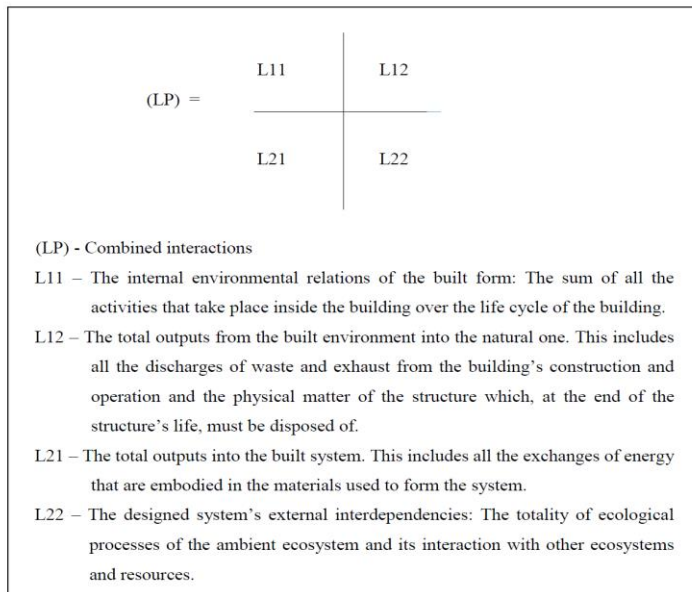
$$(LP) = \begin{array}{c|c} L11 & L12 \\ \hline L21 & L22 \end{array}$$

(LP) - Combined interactions

L11 – The internal environmental relations of the built form: The sum of all the activities that take place inside the building over the life cycle of the building.

L12 – The total outputs from the built environment into the natural one. This includes all the discharges of waste and exhaust from the building's construction and operation and the physical matter of the structure which, at the end of the structure's life, must be disposed of.

L21 – The total outputs into the built system. This includes all the exchanges of energy that are embodied in the materials used to form the system.

L22 – The designed system's external interdependencies: The totality of ecological processes of the ambient ecosystem and its interaction with other ecosystems and resources.

Figure 3. *Yeang's Partitioned Matrix[78]*

Predicted Changes in the Building Industry

Research by Building Design and Construction[79] has led to the following predictions regarding changes that the construction industry will undergo during 2022:

- Construction activity should increase.
- Supply chain disruptions might continue to cause delays.
- There could be a shortage of skilled labour.
- The nature and function of offices are changing, which should cause an increase in refurbishments and alterations.
- Environmental concerns and 'net-zero' building will become a definite priority.

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77. K. Yeang, *The green skyscraper: The basis for designing sustainable intensive buildings* (Munich: Prestel Verlag, 1999), 65.

78. Ibid.

79. Caulfield (2021), 1-11.

- Mass timber (and other new environmentally friendlier materials) will increasingly be developed and used; the development of carbon sequestrating concrete and ultra-high-performance concrete are examples of such developments.[80]
- Technology will play an increasingly important role in the building industry, and buildings will increasingly incorporate systems to monitor how buildings perform or are used.
- As mentioned above, greater use will be made of new and more environmentally sensitive materials such as carbon-reinforced concrete, three-dimensional printing[81] (refer to Figure 4), hydroceramics, self-cleaning materials[82] and hemp boards.[83]
- There will be an increased focus on the need for greater diversity, equity and inclusion to correct past imbalances.
- Greater digitisation and expanded digital facilities will facilitate and result in the seamless connection between digital twins and fabrication plants as well as the widespread use of sensors that will measure aspects across the industry. This includes jobsite efficiency and post-occupation building performance in the quest for greater efficiency, a quest that is ultimately driven by the need for environmentally friendly buildings.

Figure 4. *Three-Dimensional Printed Houses in Nacajuca, Mexico[84]*

As a result of climate change, particularly the possibility that the increase of more than 1.5 degrees Celsius above preindustrial levels by 2030 ensuing from a lack of conclusive commitments at the COP26 (see introduction), almost half of

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80. B. Brownell, "Post-COP26, how green can we make concrete?" *Architect; The Journal of the American Institute of Architects* (2021): 2-4.

81. D. Kamin, *In a tiny village on the outskirts of Nacajuca, Mexico, builders are creating new homes using a novel tool: an oversize 3-D printer* (The New York Times, 28 September 2021).

82. Equipe ArchDaily Brasil, *What are the smart materials in architecture?* (Equipe ArchDaily Brasil, 2022).

83. Brownell, "Hemp: The next disrupter in construction after wood," *Architect; The Journal of the American Institute of Architects* (2021).

84. Kamin (2021). Photo by Alejandro Cegarra/The New York Times

the world's population could be subjected to a climate hazard in the form of heat stress, drought, flood or another form of water stress in the next decade.[85] In view of the likelihood of this environmental stress, built environment designers will need be pro-active and will have to go even further than Yeang's recommendations (see above) in order to create environments that are resilient enough to withstand the possible implications of climate change.

Predicted Changes in the Architectural Profession

As with any major crisis, those architectural firms that adapt best to the situation will emerge as some of the best firms of the decade.[86] What are the changes and opportunities that architects can respond to?

Afshar[87] foresees that after the pandemic "every business will become a digital business". Along a similar line, Baig[88] suggests that principals in all types of businesses should place technology at the forefront of the business. Furthermore, that they will have to acquire high levels of digital technological skills in order to maximise the benefits of new digital platforms and that they adopt an expansive view of learning and skills development. This suggests accepting life-long learning as part of the firm's business strategies. It applies equally to architecture: Pandero in Archipreneur[89] believes that technological advancement will help architects resolve many of the challenges currently facing the profession.

De Boer *et al.*[90] believe that the global concern with climate and the environment has made a focus on and prowess in sustainability an essential requirement for any business. Fabris[91] reports that according to the United States of America Green Building Council's 2021 World Green Building Trends Report, building industry firms have chosen the construction of net-carbon-zero and/or net-carbon-positive buildings as their top priority. Also, on the topic of sustainability, Cohen[92] suggests that the climate crisis offers architects the opportunity to redefine the building sector by shifting their focus to the use of sustainable and low-carbon building materials. He believes that in this way architects can contribute to the quest for lower carbon emissions and help create a more resilient global supply chain, thereby creating a more sustainable future.[93]

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85. H. Bowcott, L. Fomenko, A. Hamilton, M. Krishnan, A. Mysore, A. Trittipo, et al. *Protecting people from a changing climate: The case for resilience* (McKinsey & Company, November 2021), 2.
86. Bernstein (2020), 2.
87. in Najam (2021), 4.
88. Baig (2021), 5-9.
89. Pandero (Archipreneur, *Real estate in the digital age: An industry in transition* (Archipreneur, 30 December 2019), 1).
90. De Boer *et al.* (2021), 2.
91. P. Fabris, "Creating net-zer/net-positive buildings is top priority in green building trends 2021 report: Findings also demonstrate compelling business case for building green," *Building Design and Construction* (2021): 2.
92. Cohen (2021), 1.
93. An estimated 40% of all carbon emissions can be attributed to the harvesting, manufacturing and transport of building materials (Cohen, 2021, 1).

Environmental-related concerns and the quest for greater efficiency are said to be the cause a resurgence of prefabricated modular buildings because of this building method's reduction in material wastage, greater consistency and fewer weather-induced delays.[94] Digitisation will allow designers to vary panel design and size easily to avoid the monotony that characterised buildings of this nature in the previous century.[95]

Increased collaboration on projects is one of the changes in the way architects practise[96]. Other changes predicted by TMD Studio is an increase in the use of virtual reality and immersive architecture (including building information modelling or BIM), relying on so-called 'big data' for design decisions in order to increase building efficiency, the rise of parametric architecture and buildings built by robots and 3D printers to construct buildings. Stanton[97] reinforces TMD's views by predicting that the focus will shift towards innovative solutions and how they benefit their users. He points out that clients increasingly demand more information and detail – which new software applications can provide. He predicts that many of the traditional aspects of architecture, for instance drawings, are going to fade away to be replaced by various digital outputs such as the building twin created by BIM software. However, Stanton argues that the heightened role of technology cannot take the place of the human component of architectural practice and can only replace some manual and more mechanical processes. Therefore, he encourages architects to embrace the use of technology in their practices. He holds that adaptability, flexibility and the earliest possible incorporation of digital and technological processes will ensure that the profession remain an important and fundamental component of the built environment professions.[98]

Since the onset of the COVID-19 pandemic architects have adopted a range of technologies in order to adapt to the changed circumstances. Ahmad[99] refers to LePage's statement that available technologies can provide architects with opportunities that did not exist previously. She lists a number of software applications that architects have incorporated into their normal processes in order to continue creating. These include Bluebeam, Google Workspace, Miro's (a digital whiteboard), Procore and PlanGrid. Like all businesses, remote work has proved to have both advantages and disadvantages. As mentioned earlier, new protocols will be needed to incorporate the advantages into whatever new style of work is adopted since a survey among American practices found that 93% preferred a hybrid work model.[100]

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94. D. Davis, "Modular architecture is back. Is it better?" *Architect; The Journal of the American Institute of Architects* (2020): 2; B. Stanton, *What is the future of architecture as a profession?* (Building Design and Construction, 30 July 2019), 4.

95. Davis (2020), 4.

96. TMD (2019), 2.

97. Stanton (2019), 3.

98. Ibid, 4.

99. F. Ahmad, "Has remote work changed the architectural profession for good?" *Architect; The Journal of the American Institute of Architects* (2021): 2.

100. M. Bernard, "CMG surveys AEG employers and employees on remote and hybrid work," *The Journal of the American Institute of Architects* 2021), 3.

Bingham and Porter[101] report on a study that found that embracing artificial intelligence technology in addition to heuristic techniques can help architects reach a better understanding of client requirements. The study also found that the role of the architect will remain critical but that it will be altered. They cite Reif's 2018 assertion that by 2020 creative thinking would have become the third most important skill needed in order to survive (and thrive) during the Fourth Industrial Revolution and also Osborne's statement that creativity could be the most difficult human ability to automate.

Stanton states that the focus is changing from purely architectural to the creation of an environment that is also user-focused and enhanced by electronic systems that will measure performance. According to him life-cycle costing will become increasingly important.[102]

Not everyone regards the increased reliance on technology as entirely positive. While Susskind and Susskind[103] see this change as inevitable, they foresee that it will not only drastically change the profession but will also lead to its decline, a situation that applies to all the traditional professions. According to Davis[104] the Susskinds believe that design is going to become less bespoke and more systematised. Davis does not agree with this view and points out that previous attempts to systematise design did not prevail: what did happen was that the design process was standardised and not the designs produced. The Susskinds also foresee that with the increasing use of the internet, professional expertise will become more widely distributed and available elsewhere (such as websites that sell generic house designs as a product), thus bypassing the need for an architect.[105] Smaller firms will be affected more detrimentally since large firms will be able to invest in technology that will allow them to cut costs and provide the type of digital support clients will insist on. They suggest that smaller firms should specialise for them to survive.[106] One of the biggest anticipated changes is the forced transition from an intuitive design process to one that is driven by (big) data. The challenge will be to collect data on how past designs are performing, and to organise, analyse and finally extract value from the results:[107] knowledge management will become a key aspect of practising architecture. Furthermore, according to the Susskinds, architects will no longer be able to use charisma and impressive visuals to sell their designs: employers will demand rational justification for decisions taken. Computers will no longer function as dumb tools applied by the architect: computers will take over certain design functions and will work collaboratively with architects. Also, the drive for greater efficiency will mean that

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101. K. Bingham, and G. Porter, *The preparedness of Master of Architecture graduates for the fourth industrial revolution (4IR)* (South African Council for the Architectural Profession Newsletter number 9, 22-31 July/September 2021), 22.

102. Stanton (2019), 4.

103. R. Susskind, and D. Susskind, *The future of the professions: How technology will transform the work of human experts* (Oxford: Oxford University Press, 2017), 95-100.

104. Davis (2019), 3.

105. Davis (2019), 5.

106. Davis (2019), 6.

107. Davis (2019), 7.

production schedules and stricter safety and sustainability regulations[108] will become more demanding and complicated. The higher performance criteria for buildings will lead to specialised design processes and increasing specialisations and an ever more product-based approach. There will be a need for a more entrepreneurial outlook where architects increasingly offer services outside the traditional scope of architectural practice, for instance designing business strategies, branding and even product design.[109] This could be possible but in order to diversify in this manner, architects will have to undertake further learning.

Richards[110] confirms that there will always be a need for architects. He bases his position on what he describes as the intrinsic value architects have for "society as creators of healthy, safe and beautiful buildings and spaces" as well as on the "relative value of architects to clients, particularly during an economic and public health crisis". Also, the Susskins are disregarding the human aspect associated with most professions. In doing so they are disregarding the abilities, creativity, value judgements and ethical conduct required from professionals.

Other abilities, particularly a range of soft skills, are suggested for architects during the Fourth Industrial Revolution. These include problem solving, communication, project management, systems thinking, improved social skills, and the ability to work with others. This list should be extended to include entrepreneurship, leadership, conflict management, emotional intelligence, mindfulness, and stress management.[111] Many of the aforementioned skills cannot be transferred to intelligent machines. These statements are in line with those mentioned earlier, based on the review by Dondi *et al.*[112]

In addition to the changes outlined above, young architectural practices are also experiencing a range of other challenges:[113] Cutieru relays the concerns raised by a variety of young practices from various part of the world. These practices indicated that their concerns are wide-ranging and numerous. They include:

- Climate change.
- Achieving greater equality in design.
- Fostering inclusion.
- Striking a balance between private and public concerns.
- Remaining relevant in an economy where our agency is diminishing in the face of real estate priorities, political indecisiveness and a variety of new 'specialists' entering the field.

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108. McKinsey and Company, *The next normal in construction; How disruption is reshaping the world's largest ecosystem* (McKinsey and Company, 2020), 3.
109. Davis (2019), 9.
110. W. Richards, *Why architects matter in a post-pandemic world* (American Institute of Architects, 2020), 1.
111. Bingham, and Porter (2021), 22-28.
112. Dondi *et al.* (2021), 12.
113. A. Cutieru, *The challenges faced by young practices* (Archdaily, 26 November 2021), 2-3)

While some of these concerns were identified before, many remained hidden in the various reviews above. However, they have to be addressed by the profession as a whole so as not to lose the talents of these young architects.

Bradford Perkins[114] criticises the scant time allocated in most architectural programmes to aspects such as marketing and business development, building and service agreements, managing and directing a design team working on complex projects, cost estimating, task scheduling, working internationally, developing a business plan and other aspects that take up the bulk of a senior architect's time. He is of the opinion that while the practice of architecture is becoming increasingly complex, architectural schools are not preparing their students to address these and future changes:[115]

> Today we are highly dependent on sophisticated technology platforms. More and more firms are competing beyond their local markets; many are working nationally and internationally. There is more competition, and it is far more sophisticated. The size and sophistication of the administrative and technology support personnel at most mid-size to large firms has grown to respond to an increasingly challenging business and technical environment. And the design assignments, project team structures, project delivery methods, and client expectations have become increasingly demanding and complex, requiring much more specialization, larger teams, and a vastly broader array of services.

The point is that if he and others who agree with him are correct, architects already enter the profession underprepared. Because of this, the changes predicted earlier will worsen this handicap. Thus, it is imperative that architectural education and training be reconfigured in order that architects acquire the skills highlighted above.

Analysis

The above was read and codes were assigned to themes as they emerged from the literature. 'Open coding'[116] where the researcher identifies themes from the literature was applied.

The next level of analysis comprised identifying patterns or interrelating themes and grouping related themes to identify meta-themes that might underlie the obvious and more superficial analyses.[117]

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114. B. Perkins, *What I wish I had learned in architectural school* (Building Design and Construction, 17 December 2021), 4.

115. Ibid.

116. D. K. Punia, "Multiple case study: my journey-from pure quantitative research to mixed research, and then from mixed research to pure qualitative research," in *Qualitative Research in Management* (Eds.) R. K. Gupta, and R. Awasthy (New Delhi: Sage, 2015), 178.

117. Ibid, 181.

Findings

The analysis revealed a total of eight meta-themes. They are discussed below.

After the Current Pandemic and War Have Passed, Things Will not Return to what they were before their Onset

As the adage would have it, change is a constant. The Ukrainian war will bring a change to the socio-economic and political relations that existed previously, and slow economic growth and reduced socio-economic spending, higher inflation and higher fuel prices can be expected. Similarly, the end of the pandemic will result in societal challenges exceeding those of the pandemic due to the escalation of injustices and inequalities during the pandemic. This will result in an increase in socio-political turbulence. In addition, new ways of doing, developed during the pandemic, will continue. On the positive side, change brings new opportunities that can introduce new business prospects.

Many Pre-Existing Socio-Economic and Political Problems Will Still Exist but they Must be Tackled with Urgency

The injustices and inequalities highlighted by the pandemic will have to be tackled as a matter of urgency because of the likelihood of more pandemics. A variety of wide-ranging actions will be needed to confront inequalities, improve efficiency and resilience, humanise capitalism, reconfigure supply chains, concentrate economic activity and reconfigure living areas while adapting to climate change. Politically, globalisation must be re-thought, while growing nationalism and power imbalances must be re-balanced: The global economy and society must become more inclusive, resilient, and sustainable. This is required to confront the prevailing socio-economic inequalities. However, the legacy of the Ukraine-Russian war will work against the achievement of these objectives. On the positive side, people who can adjust; those who are creative and innovative, skilled, flexible, energetic, and persistent will emerge strongest after the pandemic. The danger is that such a situation could possibly increase instead of decrease the inequalities that prevail unless actions instituted to address socio-economic upliftment are successful.

There Will be Many Changes and New Realities that Will Require Adjustment from Everybody

Other changes will emanate from existing and emerging trends. This will include changes such as the move to a cashless society, the normalisation of remote and hybrid work arrangements and the changeover from brick and mortar to online retail business.

From an economic perspective, the changes will bring new opportunities. Should the aim of inclusion be achieved, it will spread opportunities across society. This will allow more people to benefit because it will add more value than

automated systems and intelligent machines. At the same time, being skilled for work in a digital environment while continually upgrading to new ways of working will open doors to new jobs or occupations. Consequently, changes and opportunities will result from inclusion and the Fourth Industrial Revolution, adapting to climate change and the push for sustainability, transformation, a new people-centredness coupled with higher productivity, and efficiency in all aspects.

For businesses, to remain competitive it will be critically important to stay abreast with technological development. Businesses will need to turn to automation, artificial intelligence robotics, and globalisation. Environmental concerns will compel everyone to focus on reducing any unnecessary consumption of resources by making and doing everything in the most efficient manner possible. The architectural profession should note that construction activity, particularly refurbishments, driven by climate change, health concerns and the changes in the nature and function of buildings should increase and create opportunities.

The Fourth Industrial Revolution Will Dramatically Impact All Spheres of Life, Including Architectural Practice

The Fourth Industrial Revolution is primarily a technological revolution that will dramatically alter our socio-economic context and lead to transformation throughout all business ecosystems. Nevertheless, it will place the people who have adjusted to this new reality at the centre of innovation. It will require an empowered workforce and will boost productivity amidst an overarching concern for environmental sustainability.

An empowered workforce implies drastic change and continuous upskilling, with those who are not able to do so falling behind as there will be a reduction in the need for manual and physical skills. Furthermore, the need for basic cognitive skills will decrease and at the same time, the demand for technological, social, emotional, and higher cognitive skills will increase. The changes we face will make life worse for the majority who could fall behind unless the existing and rising inequality and authoritarianism, as well as the spread of misinformation, can be halted and reversed

Nonetheless, the Fourth Industrial Revolution and its reliance on digitalisation of processes has the potential to change our world for the better by bringing diversity and creativity to the process, if it is driven by a broad range of skilled innovators and if society can remain on top of the latest skill requirements.

The Other Main Driver of Change Will Come from the Imperative for Healthy, Sustainable, and Environmentally Friendly Living

Humankind's negative impact on the planet has become noticeable and commonplace. This has resulted in a willingness to bolster sustainable ways of living and doing and a focus on the use of materials that support nature and natural systems. In addition, the biopharma revolution is growing. The environmental drive is aimed at reducing consumption of resources by making everything far more efficient: sustainability in the broadest sense, but particularly the challenge

posed by environmental change will be a major topic in business in the future. The implication is that those who manage to move first will be the first to benefit from a more sustainable and resilient economy. Because of the pressing need to minimise climate change, leaders will be forced to support the use of materials and systems that support environmental sustainability and will be required to respond to sustainability goals and technological change, including investment in nature-based development.

The review has shown that the net-zero transition we strive for will be universal, significant, and front-loaded; it will have different implications for different sectors, geographies and communities. However, it will create substantial growth opportunities despite causing significant change and a need for large-scale adjustment and reorganisation, including reskilling and refurbishing.

Environmental concerns and the need to restrict climate change will in turn spur their own technological advances. In the building environment new materials such as carbon-reinforced concrete, the development of carbon-sequestrating concrete and ultra-high-performance concrete are examples of such developments. Other products that utilise waste materials are coming into use are different nature-based infrastructural alternatives such as mass timber and other new environmentally friendlier materials. The need for greater sustainability will lead to new, environmentally friendly materials increasingly being developed and used.

The Rapid and Dramatic Developments and Change Will Require that Everyone Adopt Life-Long Learning as Part of our Changed Lifestyle

The previous sections have indicated continuous and significant change and new knowledge requirements as we move into the future. This implies a need for continuous and life-long learning, personal development, and growth for all who wish to stay employable. For businesses and business leaders it indicates a need to embrace training and life-long learning for all members of staff, particularly since skilled labour will be scarce and will come at a cost.

Our Cities Will Likewise Have to Adapt to the Changed Circumstances

The changes foreseen will require the changing of our cities to become healthier environments housing a digitally supported population that functions in a hybrid fashion while being resilient and environmentally concerned in an increasingly changing world, as mentioned earlier.

It is predicted that contractors will turn to on-site automation and increasingly to pre-fabrication as a result of the drive for greater efficiency. This implies the implementation of tools and processes that require digital processes and a demand for architects who can answer this need. The need for greater efficiency will also result in the 'Smart City' where building performance is monitored continuously. It is also predicted that in future, when design proposals are under consideration, questions regarding the ease of cleaning, and health implications, including performance during lockdown restrictions, will have to be answered

Add to this that our urban form must change to provide for inclusivity, proximity and density, while maximising the use of natural ventilation, space that will allow for social distancing through the provision of wider sidewalks and walkways, as well as generous public open spaces. Public spaces and outdoor facilities that will aid the natural environment and the drive towards carbon neutrality will be required. There will also be an increase in the demand for inclusive spaces and buildings that offer a range of diverse functions (mixed-use or multifunction buildings). Our homes will also need reorganising to allow for longer periods of home-stay and remote working. Furthermore, built environment designers will need to create environments that are resilient enough to withstand the possible implications of climate change. All of this could increase the demand for architectural involvement.

Architecture and Architectural Practice Will Have to Adjust in Keeping with the Changes in Society

As with any major shift, it is those (firms) that adapt best to the changed situation that will use the new opportunities to emerge strongest – as some of the best firms of the decade. In view of the above-mentioned predictions of the current global shift, the principals in all types of businesses – architectural practices included – should make the incorporation of the latest technology a characteristic of their business. This applies particularly those practices doing commercial work. Architectural practices that wish to work in the mainstream and commercial spheres should therefore acquire first-rate digital and technological equipment and develop high levels of skills in order to maximise the benefits of new digital platforms and to avoid being left behind. The alternative would be for them and those small practices who do not have the required capital to identify and operate within a less technology-intensive field offering niche services of some kind. Nonetheless, this implies accepting life-long learning as part of the firm's business strategies for everyone to stay up to date on the latest materials, software, and equipment and how to use it. It will also be necessary to be able to use the knowledge generated in the process, as well as feedback received for use in future projects. Clearly, knowledge management will become increasingly important.

The need for technological advancement stems from the possibility of using technology to resolve some of the challenges currently facing the profession, for instance not being able to provide accurate estimates of the proposal's future performance (e.g., financial, thermal, energy consumption). Many authors contend that the global concern with climate and the environment has made a focus on and prowess in sustainability essential requirements for any business and that architects will be expected to provide accurate estimates of how their designs will perform from an environmental and investment point of view. This should be understood in the light of reports that building industry firms regard the construction of net-carbon-zero and/or net-carbon-positive buildings their top priority going forward. Hence, for architectural firms, technology and sustainable design can be seen as interrelated and of critical importance.

As found during the literature review, the climate crisis offers architects the opportunity to achieve this objective by shifting their focus to the use of sustainable and low-carbon building materials. Such a shift will also help create a more resilient global supply chain, thereby creating a more sustainable future.

Increased collaboration and the involvement of a wider range of specialists on projects is one change predicted for the way architects practise. Another prediction is an increase in the use of virtual reality presentations and immersive architecture (based on building information modelling or BIM) and relying on the previously mentioned 'big data' for design decisions in order to increase building performance and efficiency. Employing the latest software will be required to this end: many of the traditional aspects of architecture, for instance drawings, will fade away to be replaced by various digital outputs such as the building twin created through the use of BIM software. The danger to smaller practices is that they will struggle to afford such technology thereby being relegated away from projects where such accuracy is required, or that their lack of competitiveness could force their fees lower.

The societal challenges outlined earlier imply that the focus will shift towards innovative solutions and how they benefit their users. Also, as found during the review, creativity will become a most sought-after trait. This is because technology cannot replace the human component of architectural practice and can only replace some manual and more mechanical processes. The review highlighted that creative thinking would have become the third most important skill needed in order to survive (and thrive) during the Fourth Industrial Revolution and as Osborne pointed out,[118] creativity could be the most difficult human ability to automate. However, if creativity is understood as "the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others",[119] creativity will need to be augmented by adaptability, flexibility and the earliest possible incorporation of digital and technological processes. This could ensure that the profession remains relevant. As an example: embracing artificial intelligence technology and combining it with heuristic techniques can help architects reach a better understanding of their clients' requirements. Thus, the study found that the role of the architect will remain critical but that it will be altered: the focus will change from purely architectural aims to the creation of an environment that is user-focused and enhanced by electronic systems that will measure performance, among other things.

The increased reliance on technology could be considered as a positive aspect by some. In this regard a visit to the website of Foster and Partners could be very revealing. However, it must be said that the big firms will also have to recover the cost of the expensive software. What is true, though, is that they will be able to provide an enhanced service and smaller firms will no longer be able to compete. The Susskinds suggest that smaller firms should specialise in order to survive. Here an entrepreneurial outlook could be of great use.

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118. in Bingham and Porter (2021), 22.

119. R. Franken, *Human Motivation* (Pacific Grove, CA: Brooks/Cole Publishing Co, 1994), 396.

Other changes are foreseen. One is the forced transition from an intuitive design process to one that is driven by data (big data). Here the challenge will be to collect data on how past designs are performing, and to organise, analyse and finally extract value from the results: knowledge management will become a key aspect of practising architecture.

Computers will no longer function as dumb tools applied by the architect – computers will take over certain design functions and will work collaboratively with architects. All the while, the drive for greater efficiency will mean that production schedules and stricter regulations based on safety and sustainability will become more demanding and complicated and the performance criteria for buildings will lead to specialised design processes and increasing specialisations and an ever more product-based approach.

The review thus revealed a need for a more entrepreneurial outlook (already mentioned above) where architects increasingly offer services outside the traditional scope of architectural practice – for instance, in designing business strategies, branding and even product design (after further training). Some large firms have already added such services to their professional offering. In the light of the social inequalities highlighted earlier, architects should also venture into areas where community upliftment is needed.

The study confirmed that there will always be a need for architects. This view is based firstly on the intrinsic value architects bring to society as creatives, particularly the designers of healthy, safe, and aesthetically pleasing buildings and spaces, and secondly because of the value architects can have for their clients, particularly during and after an economic and health crisis when creativity will be called for on all fronts.

However, together with the need to incorporate knowledge management and an entrepreneurial outlook, architects will need to develop a range of soft skills that will be required during the Fourth Industrial Revolution. These include problem solving, communication, project management, systems thinking, improved social skills and the ability to work with others. This list should also be extended to include leadership, conflict management, emotional intelligence, mindfulness, and stress management. In addition, it emerged from the review that more time should be allocated in architectural programmes to the aspects of marketing and business development, building and service agreements, managing and directing a design team, working on complex projects, cost estimating, task scheduling, working internationally, and developing a business plan, as well as other aspects that take up the bulk of a senior architect's time. This could be so, but if the Fourth Industrial Revolution is going to call for greater creativity, already overfull programmes cannot add these worthwhile topics into the basic architectural courses. Architectural schools will have to introduce more post-professional programmes and short learning programmes.

Conclusions and Recommendations

This study set out to identify some of the possible directions into which the practice of architecture might develop in the next five to ten years and the opportunities that might come about because of the previously mentioned developments. It can be concluded that the practice of architecture will change on several fronts.

The developments and changes that will take place elsewhere in society and the economy will have a direct impact on the profession. Most notable will be the impact of the Fourth Industrial Revolution and climate change. Responses to the COVID-19 pandemic – particularly to bring about changes that will reduce the impact of any future pandemic – will also change the nature and the role of architects. Research has shown that steps to foster an inclusive, sustainable, and growth-based socio-economic realm will be required. It is in responding to these developments where architects – particularly smaller practices – might find future commissions. It has been mooted for many years that architects ought to spread their services to communities that do not yet benefit from the competencies architects have. Fostering an inclusive and sustainable milieu can benefit from architectural contributions. In doing so a more entrepreneurial stance will be of great value.

The most compelling reason for the profession's incorporation into the future socio-economic sphere is the inherent creativity associated with the profession. So, while this outstanding ability must be nurtured in all architectural programmes, there will be an increasing need for architects to adopt a continuous learning stance and to continuously learn new skills as listed in the previous section. While continuous development programmes (CPDs) can play a part, very often more in-depth study will be required.

In order to provide for this need, schools of architecture and professional bodies will need to introduce validated post-professional programmes where architects can learn the additional skills – particularly a range of soft and managerial skills that will be demanded from architects in the future.

While much of the previous section might seem to have negative implications for small and medium-sized practices, this need not be so. An entrepreneurial stance and an agile demeanour can see them develop specialisations and fill the 'gaps' left by bigger firms, particularly if the 'gig' economy predicted by Bernstein[120] materialises, if actions are required to prevent future pandemics, or when the need arises to adapt existing buildings to the changed lifestyles if climate change cannot be contained within reasonable levels.

In summary, the discussion at the end of the previous section has shown that the architectural profession will remain relevant and that current and future developments could mean that new opportunities for architects can ensue from technological developments; both in terms of systems and applications that develop as part of the Fourth Industrial Revolution and through new building materials and building technologies that will be introduced as a result of technological advancement and the quest for greater efficiency. While larger and

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120. Bernstein (2020), 2.

capital-rich practices might have an advantage in this context, niche opportunities could develop for application specialists. This could benefit smaller practices.

Adapting existing buildings and the public realm to the changes that global warming, the threat of future pandemics, lifestyle changes, technological developments, and the imperative for greater efficiency will require, is a second broad field in which opportunities for architectural practices might be identified. In this regard, smaller practices might be able to identify niche areas of operation.

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