Academia during the Fourth Industrial Revolution: Challenges and Opportunities

President of the Technion - Israel Institute of Technology

Professor Peretz Lavie

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Dear Rector (Prof.) Di Sciascio, honored guests, faculty, and students,

It is a great pleasure and honor to participate today in this festive event celebrating Politecnico Di Bari's inauguration ceremony of the academic year

What is the role of academia in the 21st century? We live in

a world that is not only new but also one that is reinventing

itself and changing at a dizzying pace, year after year. We

live in a time that has been named "The Fourth Industrial

Revolution".

To date, we have known 3 industrial revolutions.

The first occurred in England in the late 18th century when the textile industry was mechanized, the power of steam was harnessed and the factory was born.

The second began 100 years later, peaking at the beginning of the 20th century with the construction of production lines at the Ford car factory in the USA, and immediately afterwards numerous factories rapidly manufactured great quantities of inexpensive, identical items. The third revolution began in the 1970s when electronics and information technologies were applied to accelerate production processes.

At this time it would be premature to determine decisively whether the Fourth Industrial Revolution is merely an upgrading of the Third Revolution or whether it is in fact worthy of its own title.

What we can already safely say about the Fourth is that it is characterized by technological innovations which bring the world of physics closer to the biological and digital worlds, which seem to be gradually merging into one singular being.

Several technologies are at the heart of the Fourth Revolution: the exponential growth in computational power and the reduction in its cost; Big Data and Cloud Technology; Availability and Mobility of Internet Connectivity, which is literally in the palms of our hands; the Internet of Things – IOT – which, like invisible spider webs, create connectivity among limitless gadgets, items and systems; Artificial Intelligence and 3D Printing which will disrupt the industrial production floor to the core, and the ability to read genetic code and change it at will. This genetic editing will create a real revolution, with an impact reaching far beyond medicine.

In a survey conducted at the Davos Economic Forum among economists and managers of leading companies in January 2016, there was wall-to-wall agreement that in the year 2025:

- 10% of the population will wear clothes connected to the Internet and 50% of Internet traffic will lead to the home and its appliances, and at that time the first robot will function as a fully-fledged pharmacist at the pharmacy.

- The first car printed on a production line of 3D printers will emerge, as will 5% of consumer products.

- In 2025, 90% of the population will have permanent access to the Internet and 10% of the cars in the USA will be autonomous, requiring no human manipulation.

These innovative technologies will transform the way we live, the way we work and how we treat one another. This revolution will impact many industries and many individual existing professions and will dramatically change the economic models upon which many countries are managed today.

Autonomous systems based on Artificial Intelligence will replace people in many fields. Anyone who has recently visited airports and banks can plainly see how autonomous tools are replacing bank tellers and airline employees who used to cash our checks and prepare our boarding passes, usually with a smile.

Research conducted in recent years reveals frightening data: millions of people will lose their jobs during the next 20 years, turning over their positions to robots and autonomous systems.

Just imagine what 1.7 Million US truck drivers will do if Uber does succeed in teaching trucks to drive themselves on the roads of North America?

The fourth revolution differs from its predecessors in pace and scope. The rate of change is unprecedented. Who imagined only ten years ago that in the future each one of us would carry a phone in our pocket smart, enough to provide us with access to any Encyclopedia or scientific journal, to call a cab or communicate with a friend across the globe, all with identical ease?

Interestingly, the establishment of the *Politecnico di Bari* coincided in 1990 with the birth of the scientific discoveries that paved the way to the Fourth revolution. In 1990 the human Genum project formally began, and in December 1990 the World Wide Web software was first tested by Tim Berners-Lee in CERN.

I don't believe there are many in this hall who would dispute that the educational systems, especially those of higher education, must adapt themselves, in terms of both teaching and research, to the fourth revolution. To my assessment, today we are not appropriately addressing this challenge and I hope we have not fallen asleep on our guard of? the Ivory Tower. The first signs that the academic world is already changing are everywhere. Printed textbooks are disappearing as students increasingly rely on "Prof Google" and more and more universities establish massive open online courses, offering their best professors to a universal public through global online platforms, entirely free of charge. Some even provide entire web-based degree programs.

We must self-inspect and quickly – are we educating and training our students for the world in which we expect they'll be operating in 2025?

What must we do to ensure that university and college graduates will not become only competent surfers of the digital wave of bite-sized communications, saturated in a sea of information **but unable to navigate the wider ocean in search of deep understanding**.

We must make sure that our students will be fit to join the workforce of the second and third decades of the 21st century.

This is a broad topic, requiring considerable systematic, in-depth thought. Initially, I'd like to offer 6 preliminary action venues:

1. We must examine the curricula to ensure that the **skills** we are affording our students indeed are well aligned with what **shall be required** in 2025. There is no doubt that the professional demands and the map of skills is evolving rapidly. Some say that half of today's first graders will work in professions that do not exist at present. We must try to understand what those new professions will be and what skills and proficiencies will be required for them. In his poem The Rock, the Nobel Laureate poet T. S. Eliot asks: "Where is the wisdom we have lost in knowledge?"

We live in a world where we are flooded with information, more than we can possibly process. Messages constantly bombarding us and we can communicate with more people than ever before.

But wisdom is not gaining more information, nor simply organizing information into knowledge.. Wisdom is the proper use of knowledge. Universities should follow the Book of Proverb's advice (chapter 4) "get wisdom at any cost." We should be more than providers of knowledge and skills, we should help make our students wiser. This is essential to meet the challenges of the Fourth revolution.

2. We must change our **teaching methods** and align them better with the new world. The academic system is intrinsically conservative, not quick to adopt new teaching and learning methodologies. However, in my opinion, the technological innovations which have transformed our lives do not leave us with many alternatives but to find new ways to cope with the World of Wikipedia.

We are already seeing the first buds of this, in the form of MOOCS – Massive Online Open Courses, Flipped Classes and Problem Based Learning. The Technion presented several MOOC courses using Corsera's platform that attracted more than 100,000 viewers worldwide. Interestingly, one of the courses, in nanotechnology, was presented both in English and in Arabic. The course in Arabic attracted more than 20,000 viewers from all Arab countries, thus demonstrating that education can be a bridge even between enemies.

But these examples are still just preliminary, experimental, cautious explorations, most often by individual motivated teachers.

3. The rapid pace of change, rendering current material obsolete within a few short years, necessitates placing much more emphasis upon - and explicit commitment towards - **continuing education**. The academic system must recognize that learning does not end upon conferring a degree, it must take upon itself responsibility for updating the knowledge of its graduates. A physician who studied one single course in genetics during the 20th century, and a brief "genetics for medicine" at that, must be brought up to date on the wonders of genetics in the 21st century in order to care for patients appropriately.

4. The rapid changes occurring in our lives will require a constant, close-up and personal, conversation between **academia, industry and the governmental system**. This constant conversation is crucial. It will direct the academic system towards the expected changes and help it adapt to these changes by receiving feedback as to its degree of success or lack thereof. The responsiveness of the institutions of higher education to societal demands will emphasize and increase the social responsibility of universities and colleges.

5. **Academic research** must change too. The differentiation between basic and applied research, sometimes artificial, is continuously blurring.

In a world in which the pace of change is so rapid, the distance between the two types of research is reduced to a minimum. Future research will also be multidisciplinary, requiring close collaborations among different disciplines and skills. Universities' departmental fences should be removed to support the interdisciplinary efforts needed to create innovative research. Scientific breakthroughs depend on expertise from all the sciences and bureaucratic and cultural barriers to problem-focused research must be removed.

Universities must take this into consideration in all and any future planning of research centers and investments in research infrastructure.

6. The new world further poses challenges to the **social sciences, humanities and the arts.**

Though it is clear that technological changes are already impacting the way we - and especially our children and grandchildren - relate to one another and communicate, it is difficult to estimate to what extent these changes shall impact society in its entirety, the relationships within it and its values.

I don't think we fully understand the social and human meaning of the ability to change the genetic code at will, nor do I think anyone has addressed the question of how countries will cope with the replacement of millions of people by autonomous machines, or how Whatsapp, Twitter, and surfing among limitless sources of information across cyberspace are shaping the thought patterns of our children in ways that are different from those we have known till now.

These are questions we must address. It will be difficult to construct a creative, equal and happy society without developing innovative thought and expression pathways by researchers in social science, humanities and the arts.

In conclusion, the fourth industrial revolution poses the entire academic system with complex challenges. On one hand, the future holds great promise for heathier lives of enhanced quality, but on the other, there are significant dangers on the horizon. The academic system must recognize this state of affairs and quickly adopt the necessary changes to successfully meet the challenges heading our way.