



## The Renaissance Spirit of the Scientist-Entrepreneur

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### Abstract

At the dawn of the Renaissance, there was a strong sense of living in the end of days. Obscured by the shadow of the Middle Ages, the desire for a renewed identity, shaped by both humanitarian and scientific learning, was in its infancy. Artists and scientists began the work of dismantling of everything that for centuries had been taken for granted. The Italian Renaissance contributed significantly to breaking down the boundaries – those of ideas, as well as, those of geography or demarcated by political power. The new entrepreneurship coming into force in Medicis Florence, in Venice under the Doges and in Milan dominated by Ludovico il Moro, taking place as a result of advances in the textile industry and in the wake of the Italian Renaissance, extended beyond the geographic and political borders and found profitable links with Flanders and, therefore, with the Renaissance in the Low Countries (corresponding roughly to the present-day Netherlands, Belgium and Luxembourg). It was in Flanders that the innovator and influential cartographer, Gerardus Mercator (1512–1594) depicted the ‘outside’ world - that world beyond normal individual experience which had until then been precluded from view – thus paving the way for long-distance exchanges. The Renaissance has been a long thread stretched across centuries: from the earlier European Renaissance of the Middle Ages to Japan of the Togugawa Period (1603–1868); the Timurid Renaissance and then the Bengali Renaissance of the Indian subcontinent, from which arose personalities such as the scientist Satyendranath Bose (1894–1974); the American Renaissance at the turn of the nineteenth and twentieth century; and from the “New Culture Movement” which began in 1917 up to the present day, with the Chinese Renaissance taking after centuries of oblivion of the Middle Kingdom.

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### Casting an Eye on India Renaissance

Since the fifteenth century, coinciding with the European Renaissance, the Timurid Renaissance – a Turkish-Mongolian descendant of the dynasty of the warlord Tamerlane and related to the dynasty of Genghis Khan, founder of the Mongol Empire – creates an artistic and entrepreneurial milieu with a strong stream of cultural and commercial exchanges between



Persia and the Mughal Empire (1526-1857) of the Indian subcontinent. Under the Grand Mughals, Ahmedabad, capital of the Sultanate of Gujarat, became a leading manufacturing centre, which exported its products to foreign countries (Nehru, 1946).

At the turn of the eighteenth and nineteenth centuries, Bengal was the 'renaissance counter-figure' of Medicis Florence. In the course of nearly a century and a half, the Bengali Renaissance was an innovative milieu of social and religious reformers, giants of letters and scientists. Illustrious personalities such as the multi-linguist physicist, biologist, botanist, archaeologist and writer of science fiction Sir Jagadish Chandra Bose (1858–1937) and the physicist Satyendranath Bose (1894–1974), with their pioneering research that ranged from quantum mechanics (Nath Bose) to radio and experimental science (Chandra Bose) tilled the land on which start-ups were then seeded and grew that now enrich the landscape of the digital economy.

The Bengal Renaissance finds and maintains the unity even in the most bewildering diversity of poets such as Rabindranath Tagore (1861-1941) and universal experts and scientists like Sir Jagadish Chandra Bose and Satyendra Nath Bose. Ideas of the two sides combine together and give rise to new ones, which live a life of their own. It is essentially with this well rooted attitude that the 'Renaissance personality' of India stands out as a globetrotter who builds bridges between cultures: proof of this is the circulation of talent in research and science-driven entrepreneurship between Silicon Valley in California and Bangalore, two 'hot' and 'twin' shores of all-round innovation.

### **Science and Technology: Who Drives Whom?**

The formidable naval power of Venice, an innovative urban plan of the city of Ferrara, the inventive genius of Leonardo in Milan, the city of Urbino that excels in the military art and defence technology: four examples of Renaissance cities where science and technology have crossed throughout that time.

Since then, the question remains open on the *primum mobile*. Is science the engine of economic and social progress, or is it technology that drives science? What if science and technology form a system that co-evolves and is self-organised at the extent that the relationships between the two players allow a common life?

Technology expands the field of exploration by science and it does this by realizing tangible and intangible artefacts – as highlighted by George Bugliarello (1984) – which extend our biological and mental capabilities.

Between the fifteenth and seventeenth centuries, the sea undertakings to discover new lands led to significant advances in the scientific fields of astronomy and cartography. In that "Age of Discovery", as it was christened the time of the great geographical explorations, developments in technology and techniques of navigation, which occurred through trial and error on the part of sailors, triggered the speculative process by scientists.

In the early Renaissance, the Johannes Gutenberg's invention of the printing press represented a quantum shift. The German printer and other technology craftsmen with a deep understanding of mechanics – "the ingenuity of the makers of the machines", in the words of Adam Smith (1776) – managed to anticipate the advancements of science. In the eighteenth century, it was Adam Smith (1723-1790) who brought out the original and primary role of common workers and artisans in developing technologies followed by revolutionary scientific discoveries. In Book I,

Chapter I of *The Wealth of Nations* (1776), Smith wrote, "A great part of the machines made use in manufactures...were originally the inventions of common workmen".

Already in the light of the events of that time, the assumption that science precedes technology is a belief not always borne out by the facts. The debate is ongoing as shown by the article of Matt Ridley on the columns of the Wall Street Journal (2015):

*When you examine the history of innovation, you find, again and again, that scientific breakthroughs are the effect, not the cause, of technological change. It is no accident that astronomy blossomed in the wake of the age of exploration. The steam engine owed almost nothing to the science of thermodynamics, but the science of thermodynamics owed almost everything to the steam engine. The discovery of the structure of DNA depended heavily on X-ray crystallography of biological molecules, a technique developed in the wool industry to try to improve textiles.*

The generally accepted view is that science explains and predicts natural, social and economic phenomena, whereas technology is the practical application of science and relies on techniques, tools and machines to solve problems that science has explained and predicted. Supporters of the priority of science claim that the cases where the technology leads to scientific discoveries are accidental. In general, science can only come before technology since the understanding of scientific principles is the basis for their practical application. For others, on the contrary, deep scientific insights are fruits that fall from the tree of technological change. Still others see in science and technology a couple dancing together, hand in hand. In cyclic mode, sometimes is the science to set the rhythm; in other circumstances, the opposite is true. What is certain is that the linear sequence 'science>technology>innovation' has long been questioned.

We seem to be faced with an endless series of parallel instances. Whether the science or the technology be involved in triggering the process which then leads to entrepreneurial innovations, it all depends on the spontaneous process of interaction between human beings, as long as their way of acting unbidden is not restricted by laws and customs.

Amongst economists and scientists themselves there is an increasing support for the idea that technology is able to organize itself, by creating the environment that then science will explore. As an autonomous organism – which the maverick science writer Kevin Kelly has dubbed "technium" – a technology to raise the wave of innovation that will then be riding by the inventors and entrepreneurs it has itself found.

To the printing process, Gutenberg applies techniques and instruments used in other sectors - from the punch for goldsmith to screw-type wine presses. This contamination is the beginning of a long process of design and development of a variety of communication tools, object of study of a specific discipline that deals with the entire set of human artefacts and technologies, which act as media in the sense of message to communicate and interact among human beings assigned by the Canadian sociologist Marshall McLuhan (1991 to 1980).

Other impressive examples are the Wright brothers, Orville (August 19, 1871 – January 30, 1948) and Wilbur (April 16, 1867 – May 30, 1912), aviation pioneers, and Guglielmo Marconi (1823-1904), the pioneer of radio transmissions over long distances. More recently, computer technology has opened the door of a science that is named after computer – "computer science". In turn – argues the computer scientist Danny Hillis – "The computer, with its mechanistic playing out of predetermined rules, is the direct descendant of the clock": namely, "the gears of the clock which spun out science, and all is many cultural descendants" (Kelly, 2010).

A shift of perspective shows the inextricable connection between science and technology. It seems to be no dichotomy between the two. Scientific advancements far from astronomical science contributed to the technological developments of the telescope, which in turn has led to breakthroughs in astronomy and astrophysics. Yet – a matter of no little significance – it should also be noted that the deep knowledge of the astronomers has not always produced the expected results. For example, in the eighteenth century the long-term problem of how to calculate the longitude was solved by a technological craftsman, the carpenter and clockmaker John Harrison whom we owe the marine chronometer, and not by the court astronomers led by Nevil Maskelyne (Sobel, 1995).

The technology that has led to the construction of the particle accelerator – the “Large Hadron Collider” – at CERN in Geneva has led to significant progress in physics, letting physicists discover between 2011 and 2013 the particle imagined by the Nobel Laureate Peter Higgs (the “Higgs boson”). On the other hand, the same technology that led the way to a scientific discovery depends in turn on previous advancements in the field of physics. This viewpoint provides grist to the mill of those who argue that science and technology go hand in hand.

Science related to military defence has far-reaching consequences in the field of technology – Internet is one of the cases most emphasised. Hence the arguments in support of the absolute need to increase public funding for research. A request that is confronted with the problem of crowding-out: namely, whether and how much the pool of private resources for research shrinks once governments intervene to increase the capacity of the public reservoir.

In the light of the above, the linear path from science to technology is not so obvious as it is commonly thought. Nor does it seem obvious that public funds injected in research have an impact on economic growth. An OECD study (2003) on the sources of economic growth in the member countries states that “The results...point to a marked positive effects of business-sector R&D, while the analysis could find no clear-cut relationship between public R&D activities and growth, at least in the short-term”. Certainly, it must take into account the long-term spillovers from public research. In this respect, we should not disregard the role of technology as an accelerator of scientific advancements as well as of their economic benefits, while serving as a trait-d’union between science, innovation and new entrepreneurship.

### **The Scientist-Entrepreneur: “I think, I act and therefore I construct”**

Science and the various forms of art are united by the ability to surprise people, to arouse fantasies and passions within them. In science as in art, the imaginative minds draw models that should take a second nature to have a practical impact. This ‘second nature’ is the attitude to entrepreneurship. The intentional and systematic growth of entrepreneurship with new entrants from science and art is the hallmark of an entrepreneurial renaissance. From the limited practical impact of Leonardo’s machines to the long-term or failure of commercialization of research at Bell Laboratories and the Xerox Research Lab, big ideas and great models will be producing sustainable and widespread success in society only if properly enhanced by the ‘ability of making’ innovation, manufacturing, marketing, and commercialization.

In the first Renaissance, with the fusion of art and science the mankind’s thinking flew high showing positive impacts on entrepreneurship. We have the perception of artists of great renown like Michelangelo, Botticelli e Dürer as entrepreneurs. They gave evidence of negotiation ability with their patrons and customers, as well as creativity by inventing new business models and business strategies, and organizational skills of even hundreds of people assisting them in bringing to completion their artworks. Michelangelo – as William Wallace notes (1994) –

organized and handled day-to-day operations at the building site of San Lorenzo, a key Florentine monument of the Renaissance, as well as the artist's personal and professional relations with nearly three hundred persons who assisted him in carrying out the designs.

With artists, scholars and scientists shared the passion for invention-driven innovation and entrepreneurship, which enabled the creation of machines to better investigate and dominate the physical world. The challenge of the second Renaissance before us is that the encounter between art and science can provide an even greater impetus to entrepreneurship.

The irreversible change of the way in which society unties the knots that over time were intertwined between knowledge, culture, education, art, science, and every other aspect of knowledge characterizes a Renaissance age. The renaissance person loosens the knots without separating the threads of knowledge from those of doing. The Cartesian dictum "Cogito ergo sum" (I Think Therefore I Am) couples up with that proposed by Edward de Bono, the father of lateral thinking (1967) - "Ago ergo erigo" (I act therefore I construct).

The renaissance person enhances the thought with the action of doing. She accomplishes this task by building a bridge between her own mental algorithms and their translation in productive processes, be physical as well as in the domain of virtual reality. Representative figures of knowledge into action are the scientists who from their discoveries draw entrepreneurial inspirations that give life to science-driven start-ups of which they are the founders.

The Renaissance spirit and thought defy commonly held opinions about scientists. It is said that their ideal locations are the major research centres of the most prestigious universities where they would enjoy full autonomy and could rely on valuable human resources and rich research funds. Not so in industry where, although the available resources were considerable, scientists would benefit much less freedom for the secrecy imposed on the results of their investigations, and where the quality of their research would certainly be greatly inferior, having mainly to address themes relating to applied research not so challenging when compared with pure research. Neither juicy earnings bestowed by industry would encourage scientists so much so to induce them to refrain from performing work as interesting as that offered by the academic research centres.

They are the Renaissance thinkers as Steven Shapin, historian and sociologist of science at Harvard University, who put upside down the edifice of science as it is usually described. Shapin says in an interview following the publication of his book *The Scientific Life: A Moral History of a Late Modern Vocation* (2008- <http://www.press.uchicago.edu/Misc/Chicago/750248in.html>), "If we look at the pure research done in industry and that done in academia, many of the most popular contrasts describe the situation rather poorly. If autonomy is the issue, many industrial scientists from early in the twentieth century enjoyed as much of that as their academic colleagues. And the same applies to notions of secrecy and openness. A clear contrast of quality between university and industrial science similarly seems not to hold, while a presumption that applied research and development requires less brain-power than pure research is just dogmatic".

In our own age, as happened to some extent with the printing press in the Gutenberg era, ideas and contents by leveraging on digital technologies acquire that commercial value which in the industrial age had been only assigned to material goods. Thus, in the renaissance profile of the scientist, one can glimpse increasingly pronounced the traits of the entrepreneur. A profile, however, is not equally visible in the various parts of the world. In the suggestive entrepreneurial history of India and Italy, for example, the figure of the scientist entrepreneur albeit highly regarded was marginal, taking the centre stage blue collars and technicians active

in manufacturing and company founders, who have made fruitful the soil of industry in both countries. Yet, the world-renowned scientists displaying an entrepreneurial spirit can help translating into commercial ventures the most complex problems of the research community. To make growing the number of scientists who, setting up companies, are able to reconcile interest in research with entrepreneurship, it is necessary that a country be endowed with industrial research laboratories where scientists can combine thought with action. Having being relocated abroad the research laboratories of large companies and not managing to attract new ones, a country meets insurmountable difficulties in giving rise to new industries that are fed by scientific discoveries and in which scientists play the role of (co-) founders. This is what happened in Italy once IBM and Microsoft transferred elsewhere their labs already present in the country.

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### Author's Profile

**Piero Formica** started his career as an economist at the OECD Economic Prospects Division in Paris, before moving to academics. Professor Formica is the Founder of the International Entrepreneurship Academy and was a Professor of Economics with a special focus on innovation and entrepreneurship at the Jönköping International Business School in Sweden. He is currently a Senior Research Fellow of the Innovational Value Institute at the Maynooth University in Ireland where he leads an international research team on experimentation and simulation of high-expectation start-ups, and is the course leader of Experimental Entrepreneurship at the University Centre for Entrepreneurship, Design and Innovation.

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