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FROM GUTENBERG TO ChatGPT:
THE CHALLENGE OF THE DIGITAL UNIVERSITY

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Mr. Rousseau holds a Bachelor of Arts and a Bachelor of Economics from the University of Sherbrooke. He continued his education at the University of Western Ontario, where he received a Ph.D. and the T.M. Brown Award for the best thesis in economics in 1974. Upon his return to Quebec, he embarked on an academic career, first at the Université du Québec à Montréal and then, beginning in 1975, at Université Laval where he was Director of the Economics Department. During these years, Mr. Rousseau also advised the Canadian and Quebec Governments on several issues. He was director of research and co-author of the Report on Savings in Quebec, published in 1980, and a consultant to the House of Commons Standing Committee on Finance, Trade and Economic Affairs, which conducted an inquiry into bank profits in 1982. He also co-authored an economic impact analysis published in 1985 as part of the White Paper on Personal Taxation.

In 1986, he joined the National Bank where he held several strategic positions, including Senior Vice-President, Treasury and Financial Markets. From September 1990 to April 1991, Mr. Rousseau was Secretary of the Bélanger-Campeau Commission on the political and constitutional future of Quebec. From 1992 to 1994, he assumed the management of Boreal Insurance and then became President and Chief Executive Officer of the Laurentian Bank of Canada. He was President and Chief Executive Officer of the Caisse de dépôt et placement du Québec from September 2002 to May 2008. From 2009 to 2017, he was Vice-Chairman of Power Corporation of Canada and Power Financial Corporation. He has served on the boards of directors of several Power Group companies, including Great-West Lifeco Inc. and its subsidiaries, IGM Financial Inc., Investors Group Inc., Mackenzie Inc. and Putnam Investments, LLC. In addition, he was a member of the Board of Directors of the Global Financial Markets Association from October 2010 to July 2014. He serves on the boards of Santander Bank, N.A., Santander Holdings U.S., Inc. and is Executive Chairman of the Board of Noovelia Corporation.

Mr. Rousseau's contribution as an economist and concerned citizen has been recognized and celebrated on many occasions. In 2004, Concordia University awarded him an honorary doctorate in law. In 2006, he was elected to the Academy of Great Montrealers in the economic sector. He was awarded the medal of Commander of the Order of Montreal on December 17, 2016. In 2006, at the Entretiens Jacques-Cartier, a forum for discussion of major societal issues, he received an honorary doctorate from the Université Lumière Lyon 2. In 2007, the University of Sherbrooke awarded him an honorary doctorate, while the Université Laval awarded him this distinction in Administrative Sciences. Mr. Rousseau was named a member of the Order of Canada on December 27, 2018. Mr. Rousseau has been personally involved with several social and cultural institutions as well as institutions in the education and health care sectors by leading several fundraising campaigns. He has also volunteered for over twenty years with the Montreal Heart Institute Foundation, including nine years as Chairman of the Board until July 2018.

Mr. Rousseau was a member of the selection committee of the Apogee Canada Research Excellence Fund in 2015 and 2016. Since 2012, he has been president and founder of the Fondation Tremplin Santé, which works with youth camps in Quebec and Canada, and since 2010, he has been founding co-chair, with Mr. Charles Sirois, of the QG100 Network, which brings together more than 80 global companies in Quebec. Mr. Rousseau was a visiting professor at PSE – École d'économie de Paris from September 2018 to May 2022. He is a Senior Fellow of the C.D. Howe Institute and a Visiting Fellow at CIRANO; he is an associate professor at HEC, Montreal; he is also an organic maple farmer in Dunham, Quebec.

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Acknowledgements

The purpose of this paper is to better understand the magnitude of the challenge that the digital world poses to the academic community and to propose some ideas that can help academics in their efforts to adapt to the digital world. The impact of the digital revolution in the world of university education can be summarized as follows: in a digital world, knowledge is accessible and, overall, at very low cost, whereas the level and types of skills required to evolve in a digital world are more complex. The university has lost its quasi-monopoly in the transmission of this knowledge and has not yet established its essential role in the acquisition of new skills. The university is also threatened in its traditional capacity to attract, retain and promote the architects of tomorrow's world who are increasingly active in ecosystems driven and even often controlled by the big industrial winners of the digital revolution. A reflection and a discussion are necessary. The digital world being a world of data, information and knowledge, this world can only be the natural world of the community of professors, teachers, researchers, and students. The digitization of education is a unique opportunity to make it more accessible to as many people as possible.

Le but de ce texte est de mieux cerner l'ampleur du défi que pose le monde numérique au milieu universitaire et de proposer quelques idées pouvant alimenter la réflexion des universitaires dans cette démarche d'adaptation au monde numérique. L'impact de la révolution numérique sur le monde de l'éducation universitaire peut se résumer à ceci : dans un monde numérique, les connaissances sont accessibles à tous et, somme toute à très faibles coûts alors que le niveau et les types de compétences requises pour évoluer dans un monde numérique sont plus complexes. L'université a perdu son quasi-monopole dans la transmission des connaissances et elle n'a pas encore établi pleinement son rôle, pourtant indispensable, dans l'acquisition des nouvelles compétences. L'université est également menacée dans sa capacité historique d'attirer, de retenir et de promouvoir les artisans du monde de demain qui sont de plus en plus actifs dans les écosystèmes animés et même souvent contrôlés par les grands gagnants industriels de la révolution numérique. Une réflexion et une discussion s'imposent. Le monde numérique étant un monde de données, d'information et de savoir, ce monde ne peut être que le monde naturel de la communauté des professeurs, des maîtres, des chercheurs et des étudiants. La numérisation de l'éducation est une chance unique pour le rendre plus accessible au plus grand nombre.

To quote this document:

Over the past two millennia, there have been several ways to preserve, transmit and even create knowledge; oral tradition, hand-writing, printed writing and digital writing. The oral tradition and the manuscript dominated for more than 1,400 years, until the introduction of the printed book in 1451, resulting from the mechanical invention of Gutenberg. It would then take a little over 550 years before the invention of the electronic medium would displace the printed book, taking on an unprecedented scale thanks to the contemporary digital revolution, the result of the meshing of computer technology, robotics, artificial intelligence and data science.

The first Western universities, in the Middle Ages, expanded the oral tradition of knowledge sharing while multiplying the use of the manuscript, thus creating real communities of teachers and students; the arrival of printing allowed the multiplication of universities where both oral and written knowledge would continue to play a determining role in the creation and the transmission of knowledge even if the "medium" had evolved from the manuscript to print and then to digital.

Over the years, the university model has been refined and developed along a fairly linear pathway, expanding its role from education to research and innovation, and increasing the number of disciplines offered and the number of clients served. In each university city, the university became a flourishing institution, essential to its international influence, to the point where its contribution is often measured by the size of its student base, the footprint of its campuses, and the importance of its specialized libraries; it is, however, the reputation of its researchers that establishes the reputation of each university during this long pathway during which academic freedom has been able to assert itself.

 "University freedoms borrowed much from ecclesiastical freedoms. Students and teachers, whether they were churchmen, were assimilated to clerics subject only to ecclesiastical justice, which was considered more equitable. But they were also largely excluded from local ecclesiastical justice, being subject only to their own institution, the professors and the rector, the elected head of the university – or to the pope or his delegates. Academic freedom thus marked the emergence of a right of its own, which gave teachers and students a special place in society. This right was the same, throughout the Western World, for all those who belonged to the supranational institutions that were, in essence, the first universities.

"At the end of the Middle Ages, the assertion of national states forced academic freedom to fit into this new political framework, as a mere derogatory practice to common law and always subject to revision.

As a venerable vestige of ancient independence and a privilege granted by the prince, they had an ambiguous status from then on[1]."

The digital revolution will weaken this status. In fact, the digital revolution has disrupted the long linear pathway of the university by removing its quasi-monopoly in the preservation and sharing of knowledge because it makes access to information, knowledge, and data easier and, all in all, less expensive. Digital technology is as revolutionary as print was and its influence on the university will be just as considerable because this revolution radically impacts all sectors of the economy by accelerating the robotization and digitization of the processes of creation, manufacturing and distribution of goods and services. These innovations use technologies such as radio-frequency identification (RFID) as well as Internet of Things (IoT) technologies to automatically link them to communications networks. These innovations are intertwined with virtual reality, intelligent algorithms and artificial intelligence technologies and literally flood institutions and organizations with data that must be analyzed, managed and protected.

> The university's traditional ability to attract, retain and promote the architects of tomorrow's world is being challenged. Its ability to train critical minds and to contribute to the transmission of universal values is also shaken by this tsunami of change.

The digital world is born, and with it has come a whole new set of radically new skills that students, teachers and researchers at our universities must quickly master in order to evolve in this New World and contribute to making it more humane and equitable. Indeed, all sectors of commercial, economic, cultural, or social activity without exception already require digital and technological knowledge and skills from all participants in the labour market. This is increasingly referred to as "numeracy". In this new industrial logic of the digital world, the winners are already well identified. They are the famous GAFAMs (Google, Apple, Facebook, Amazon and Microsoft) closely followed by the NATUs (Netflix, Airbnb, Tesla and Uber) and the Chinese digital giants, the BATXs (Baidu, Alibaba, Tenant and Xiaomi). These giants are fuelled by the research, innovations, and mobile applications (APIs) created by their ecosystem partners bringing together many of the brains at the heart of this digital revolution on various corporate campuses. A notable example of this phenomenon is the birth of Chat GPT. Chat GPT for "Generative Pretrained Transformer", is an artificial intelligence tool that has been trained to continue the text or written dialogues, much like humans do, using phenomenal amounts of textual data. This free online application even has the ability to understand and reproduce human language quite accurately. It allows its user to ask questions and make queries of all kinds and get

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[1] Jacques Verger, The UNESCO Courier, November 2001.

good answers to technical or other problems on an infinite number of subjects. These answers are generally sound, but can also be incomplete or even include mistakes.

The university's traditional ability to attract, retain and promote the architects of tomorrow's world is being challenged. Its ability to train critical minds and to contribute to the transmission of universal values is also shaken by this tsunami of change. It must be recognized, however, that the medical, engineering, and natural science faculties in the United States, which have developed close, abundant, and continuous contact with hospitals, large companies and public administration since the end of the 19th century, have been better able than many others to recruit and retain talented people. They have contributed enormously to the advancement of scientific knowledge and education in applied sciences. The unprecedented concentration of Nobel Prize winners in science in the United States is very convincing in this regard[2] .

The contemporary digital revolution is also occurring at the very moment when major upheavals are hitting the planet: the climate emergency, aging populations, "deglobalization", population displacements, wars, pandemics, the crisis of inequalities, ethics and democracies. These upheavals challenge academics and this is why their community must adopt a new rationale and thus renew their mission to better respond to these challenges of civilization. This community must not only adopt a vision and operating methods adapted to the new realities linked to digital technologies, but it must also consider these major upheavals. All of this forces it to integrate into ecosystems where knowledge is shared and new skills must be rapidly acquired.

The purpose of this paper is to better understand the scope of the challenge that the digital world poses to the academic community and to propose some ideas that could help academics in their efforts to adapt to the digital world. My deepest conviction is that the digital revolution will have greater impacts on our societies and civilization than those caused by the discovery of printing in the 15th century and its industrialization, which played a determining role in the first and second industrial revolutions. This is why the first part of this paper is dedicated to a historical reminder of Gutenberg's printing revolution, while the second part will illustrate how the characteristics of the digital revolution support such a deep conviction. A third part will provide more details on the challenge of adaptation that the digital world poses to universities while the fourth part will evoke the contours of the paradigm shift that this adaptation will impose. The fifth part will present a dream scenario that will allow us to better understand the magnitude of the change management that awaits academics. The conclusion will review some key concepts and principles to guide the approach to action. The university can no longer "be up and alone", it must be "at the centre and with" multiple partnership ecosystems, in a hybrid physical/virtual model. This is how it will be able to maintain its historical leadership as a watchdog of knowledge in a complex

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[2] Nathan Rosenberg, Paths of Innovation: Technological Change in 20th-Century America, Cambridge UP, 1998

world, continue to establish the authenticity of facts and impose the necessary rigour of science and objectivity.

THE PRINTING REVOLUTION: GUTENBERG 1.0

While the history of humanity is one of countless scientific discoveries and technological innovations that have changed how we live, how we move, how we trade, and how we discover and exploit the earth, the historical breakthroughs that have changed the way knowledge is stored, shared, and disseminated have been few.

Indeed, oral tradition and handwritten transcription were the components of the dominant paradigm until the invention of the printing press by Gutenberg at the crossroads of the Middle Ages and the Renaissance in 1451. A few centuries earlier, there had been printing inventions using wooden blocks in China, but these technologies had not spread like Gutenberg's, which used metal and was quickly industrialized. Thanks to this industrialization, Gutenberg's invention became and remained "the" way to store and disseminate knowledge for more than 500 years[3], that is, until the first digital books appeared in the early 1970s.

Despite and perhaps because of this very long period during which printing is "the" means of preserving and disseminating human knowledge, historians identify Gutenberg's discovery of printing as the main cause of the many upheavals that changed the entire planet[4] .

We will present some of them.

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[3] History.com, Editors, updated: October 10, 2019 – Original: May 7, 2018 - https://www.history.com/topics/inventions/printing-press

[4] Gutenberg was not the only one to invent the printing press using metal moving printers according to Cartwright, Mark: World History Encyclopedia – modified November 2, 2020. https://www.worldhistory.org/trans/fr/2-1632/la-revolution-de-limprimerie-dans-leurope-de-la-re/

1. **THE FIRST NEWS NETWORK WITH PRINTED SHEETS.**

For Roos[5], the first of these great upheavals was the appearance of a network of information and news. Even after printing and selling the 180 copies of the Bible, Gutenberg did not succeed in making his invention profitable[6] so that his creditors and many others became his competitors and spread his invention throughout Europe and this in the middle of the Italian Renaissance. If the region of Tuscany was the epicentre of this Renaissance, in the cities of Florence and Siena, we must recognize that Venice also participated in this great movement thanks to its busy commercial port. This city was home to new entrepreneurs who printed leaflets, news of the "world". These leaflets were sold to the sailors and captains of the ships that docked at the various ports in the Mediterranean and elsewhere. They were sold to scholars who read them in the evening in pubs and inns. The "auditors" paid in one way or another for this information and news service. As Professor Ada Palmer of the University of Chicago puts it: "It became normal to go to the news every day". A network of information and news was born. Between 1460 and 1500, many cities in Europe hosted printers. A century later, in 1605, the first official newspaper "Relation" was printed and distributed in Strasbourg[7] .

2. **THE ITALIAN RENAISSANCE AND THE ACCESS TO KNOWLEDGE ACCELERATE THANKS TO THE REDUCTION OF THE COSTS OF REPRODUCTION OF WRITINGS.**

For historians, even though the Italian Renaissance began long before Gutenberg's invention, the reduction in the cost of books through printing greatly accelerated the sharing of knowledge, enabled discoveries and propelled the Renaissance movement. Ada Palmer recalls that the cost of a handwritten book in the 1400s was equivalent to the cost of a house, while only 100 years later, a printed book could be purchased for the equivalent of a month's salary for a school teacher in Venice.

3. **THE BIRTH OF THE BEST-SELLERS. LUTHER'S MESSAGE GOES VIRAL!**

Martin Luther, the main initiator of the Protestant Reformation, is said to have called the invention of the printing press "God's greatest gift", for not only did it enable him to post his 95 theses on the church door in Wittenberg, but it is estimated that between 1522 and 1545 there were more than 4,000 editions and reprints of his writings, representing more than a third of the works of German literature of that period. During the Reformation, Luther made extensive use of the printing press for his tracts and writings. Calvin, another architect of the Reformation, did the same as the Catholic Church to defend and propagate its dogmas. Historians point to the impact of this religious conflict on the industrial development of printing

[5] History.com – 7 Ways the Printing Press Changed the World – Updated: September 3, 2019 – Original: August 28, 2019 – https://www.history.com/news/printing-press-renaissance

[6] https://www.google.ca/search?q=gutenberg+l%27adventure+of+l%27print+film&ie=UTF-8&oe=UTF-8&hl=in-ca&client=safari

[7] History.com Editors – Updated: October 10, 2019 – Original: May 7, 2018 – https://www.history.com/topics/inventions/printing-press

in Germany and elsewhere in Europe, as well as the effect of the number of copies sold on the average cost of printed books and on printing technologies. The industrial book was born[8] .

4. THE PRINTED BOOK GIVES RISE TO COPYRIGHT.

The printing industry imposed rules on the book: typography, page layout, table of contents and pagination. These rules facilitated the reading of texts. With time, all books have a title page that shows the date of publication and the name of the author: "In the era of the manuscript, to reproduce a text, there was no question of permission or compensation: by improving the circulation of the written word, the copyist took a praiseworthy action. On the other hand, once the recourse to the copyist proves to be superfluous, the author has rights on his text, which cannot be reproduced without his authorization (the 'copyright'). Because of its role in the emergence of the figure of the author, the printing press modifies the very relationship to the book object, thus leading to the introduction of such crucial notions as copyright and plagiarism."[9] Later, these notions will also be found in the rules governing intellectual property associated with inventions and innovations.

5. THE BOOK ESTABLISHES THE FOUNDATIONS OF THE SCIENTIFIC REVOLUTION: ERROR-FREE REPRODUCTION.

In 1620, the British philosopher Francis Bacon, the father of the scientific method, identified three inventions that changed the world: gunpowder, the nautical compass and the printing press. In the age of handwritten texts and oral tradition, not only was the scientific community separated by geography and language, but these handwritten texts were generally full of errors. However, publishing and reproducing the original texts, figures and characters without errors allows scientists to trust what they read and thus go further. This reliability of the data and discoveries of each other has become a determining factor for researchers.

6. THE BOOK PROMOTES FREEDOM OF THOUGHT AND POPULAR REVOLUTIONS.

As books and therefore ideas and knowledge became accessible, places of exchange and discussion multiplied and the intellectual world gradually distanced itself from the court, the church and official

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[8] Futura Sciences: Isabelle Bernier – July 11, 2019 – https://www.futura-sciences.com/sciences/questions-reponses/epoque-moderne-histoire-imprimerie-elle-origine-conflits-religieux-xvie-siecle-11816/

[9] Taillefer, Hélène. 2006. "Deux révolutions de l'écrit : de l'imprimé au virtuel", Postures, Dossier "Espaces inédits : les nouveaux avatars du livre", No. 8. Retrieved online – http://revuepostures.com/sites/postures.aegir.nt2.uqam.ca/files/taillefer-08.pdf

> For more than 600 years, the book has dominated despite the appearance of many means of communication and dissemination such as the telephone, radio, television, because the written word remains unalterable. But the digital revolution will upset this paradigm.

academies; discussions were held in salons, cafés and literary societies. On the one hand, with the reproduction of very numerous copies, it became impossible to destroy the new ideas "heretical" in the eyes of the royal or religious power and the censorship of these "prohibited" publications made them bookshop successes. On the other hand, the great thinkers of the Enlightenment all quickly became authors who contributed greatly to the democratization of knowledge and, by the same token, to the emergence of public opinion[10] and to the emergence of the French Revolution[11] .

7. IT BECAME POSSIBLE TO MAKE A LIVING FROM WRITING AND TO EXERT A GREAT INFLUENCE.

It is impossible to imagine humanity's journey since the Middle Ages without the printed book and its impact on the spread of ideas, ideals and ideologies. "By 1515, all the great classical writers were available in print, most in multiple editions and many as collections of complete works. Moreover, classical texts printed in multiple identical copies, in the hands of scholars throughout Europe, could now be easily compared to the original manuscripts. Handwritten books had often perpetuated errors, omissions, and additions made by individual copyists over the centuries, but now, gradually, definitive editions of classical works could be produced that were as close as possible to the original work. In short, printed works became both the cause and the fruit of collective international scholarship, and this phenomenon was fruitful in many other fields, from astronomy to zoology[12] .

The printed book became popular and quickly contributed to greater literacy and the spread of ideas about science, religion, the arts and life in general. The 19th century[13] in particular was marked by several authors. Among them, Baudelaire with *Les Fleurs du mal* in 1857, Victor Hugo with *Les Misérables* in 1862, Dostoyevsky with *Crime and Punishment* in 1867, Darwin with *On the Origin of Species* in 1859, and the Communist Party with its Manifesto in 1848. For the 20th century, the list would be too long, and it should be noted that since the printed book first came into existence, authors' rights and the profession of

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[10] *Le livre du manuscrit à l'ère électronique*, Gilmont, Jean-François, published May 1, 2001, Edition Céfal: https://www.amazon.ca/-/fr/Gilmont-Jean-François/dp/2871300569

[11] *Les origines culturelles de la Révolution française*, Chartier, Roger, published in 2011, Édition Gallimard: https://www.seuil.com/ouvrage/les-origines-culturelles-de-la-revolution-francaise-roger-chartier/9782020398176

[12] Cartwright, Mark. The Printing Revolution in Renaissance Europe. Translated by Babeth Etiève-Cartwright. World History Encyclopedia. modified November 2, 2020. https://www.worldhistory.org/trans/fr/2-1632/la-revolution-de-limprimerie-dans-leurope-de-la-re/.

[13] Sens Critique – Web Article – Top books of the 19th century
https://www.senscritique.com/top/resultats/Les_meilleurs_livres_du_XIX_siecle/1096902

publisher have been introduced, and with it, many scientists, writers and philosophers have been able to earn a living by publishing their ideas, experiences and aspirations.

8. THE PRINTING INDUSTRY MADE THE COPYIST'S TRADE DISAPPEAR AND GAVE BIRTH TO SEVERAL OTHER TRADES.

Limiting ourselves to the new professions directly created by the discovery of printing, we must recognize those of printers, typographers, writers, publishers and to a very large extent librarians, booksellers, distributors, critics who have experienced great gains in popularity and have become professionalized with the development of the book industry.

9. PRINT IS AN INSTRUMENT AT THE HEART OF THE INDUSTRIAL REVOLUTIONS.

The first Industrial Revolution intensified at the end of the 18th century and allowed the mechanization of production thanks to the invention of water and steam engines, as well as machine tools. This was followed by the second revolution which, at the end of the 19th century, developed thanks to the electrification of factories and the setting up of assembly lines. It was then that mass production was widely imposed, inspired by the model of Henry Ford's factories. It is impossible to imagine such industrial upheavals in a world of "manuscripts and oral tradition". Of course, whenever a new engine, a new machine tool, or new ways of distributing electrical power or organizing production were introduced into factories, these "modern" instruments were accompanied by installation and maintenance guides for the users. This written and printed accompaniment is still present even today for consumer and manufacturing objects. What's more, printing itself has made fabulous technological gains that have contributed to and benefited each of the industrial revolutions.

10. THE PRINTED BOOK IS THE FOUNDATION OF THE UNIVERSITY: A PLACE TO STORE, SHARE AND CREATE KNOWLEDGE.

The "printed book" has thus, since its appearance nearly 600 years ago, defined how knowledge should be stored, shared and created. The book has dominated despite the emergence of numerous means of communication and dissemination such as the telephone, radio and television, because the written word remains unalterable. During this long period, the university has become and remained the place to acquire, disseminate and even create in large part human knowledge. But the digital revolution will upset this paradigm.

THE DIGITAL REVOLUTION: GUTENBERG 5.0

The 1970s saw the emergence of the third industrial revolution, the computer revolution. It will be characterized by a wave of automation, computerization and robotization that will be accompanied by a greater penetration of electronics and information technologies in all sectors of the economy. It is at this time, for example, that "Project Gutenberg" was born, which aimed to digitize books.[14]

> The digital revolution, not even 50 years old, has already clearly illustrated how quickly new technologies must be adopted and how quickly institutions must adapt.

The fourth Industrial Revolution, the digital revolution, is said to have originated in Germany around 2011-2013[15] and it quickly spread to the rest of the world. With this revolution came Industry 4.0 with the push of artificial intelligence and higher-speed communications networks such as 5G. In just a few years, it unleashed a tsunami of changes that are affecting not only the manufacturing industry, but also the distribution of goods and services across all industries and all types of private and public organizations.[16]

The main characteristic of new technologies is that they overlap to establish permanent networks of communication and interaction between people, objects and machines through the digitization of all processes of creation, research, manufacturing, distribution. At each step of the digitized processes, new data is created and must be managed.

In this pre-digital world, the information costs incurred by producers to communicate with suppliers and customers, on the one hand, and the distribution, exchange and transaction costs between the different players, on the other hand, were so high that to dominate an industry it was essential to either master the supplier market by being vertically integrated, or to rule the distributor market by having built a strong horizontal presence in a region or market.

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[14] Source Wikipedia: Project Gutenberg – https://fr.wikipedia.org/wiki/Livre_num%C3%A9rique

[15] Fourth Industrial Revolution: Current Practices, Challenges and Opportunities by Antonella Petrillo, Fabio De Felice, Raffaele Cioffi and Federico Zomparelli. Published February 28, 2018: https://www.intechopen.com/books/digital-transformation-in-smart-manufacturing/fourth-industrial-revolution-current-practices-challenges-and-opportunities

[16] Towards Data Science – Simon Greenman, May 6, 2018: Who Is Going to Make Money in AI? Part I

For example, if the regional weekly newspaper had built up a dominant position as the main medium for disseminating local and regional news to everyone in the region, it was able to capture the advertising revenues of regional suppliers. It had the lowest communication costs and this advantage allowed it to dominate the news market. Of course, it could face competition, but even then, the industrial dynamics of the pre-digital world were preserved.

In a digital world, the industrial logic is radically modified, because with the generalization of the Internet, the marginal cost of disseminating additional information to a large number of customers is almost zero, just as the marginal cost of executing a transaction is almost zero. Of course, building a business based on intensive use of the Internet represents significant fixed costs and takes time, but once the software and network infrastructure have been put in place, the marginal cost of information, transaction and distribution via the Internet tends toward zero. Moreover, there are now platforms and applications that allow to launch a new business on the Internet at costs radically lower than those that prevailed in a pre-digital world (and even at the beginning of the digital world): as an example, the Canadian company Shopify offers just this type of service to small and medium-sized businesses by proposing monthly packages from the simplest to the most sophisticated (shopify.com). [17]

It is this change in overlaying technologies and in the cost structure that is causing a new business and operating paradigm, and setting up a new industrial dynamic that is giving rise to and growing new "business models". This tsunami of change is also bringing about, for the first time in 600 years, entirely new ways of preserving, sharing, disseminating, and even creating knowledge. While the invention of the printing press sparked many developments over a period of more than 600 years, the digital revolution, which is not even 50 years old, has already clearly illustrated how quickly new technologies must be adopted and how quickly institutions must adapt.

To be convinced of this, it is enough to make a brief comparison between the great historical changes caused by the invention of the printing press and the many upheavals already created or announced by the digital revolution. Here are some examples:

1. The first news network was born through printed pamphlets/A massive social media network was born through digital.

2. The reduction in the cost of reproducing written material accelerates access to knowledge/Access to knowledge is accelerating thanks to the digitization of information and data. Almost everything is available and free on the Internet.

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[17] A more complete analytical description of the digital revolution can be found in the first section of the project report published at CIRANO on the digitization of the agri-food sector – https://cirano.qc.ca/files/publications/2020RP-34.pdf.

3. Luther's message goes viral/Every day many messages go viral (the Arab Spring, the Yellow Vests, Trumpism, etc.).

4. The printed book gives rise to copyright/The digital world blithely flouts these rights and there is still a search for governance and data protection rules and greater cyber security. ChatGPT would already get very acceptable results on university exams. This adds pressure on knowledge and skill assessment modes.

5. The book establishes the foundations of the scientific revolution/The digital world opens the way to multiple scientific revolutions such as in the physical and biomedical sciences as well as in epistemology thanks to big data and the great computing capacities provided by the digital revolution.

6. The book promotes freedom of thought and the emergence of popular revolutions/The digital world crystallizes the power of individualism, the "I", while facilitating popular gatherings of all kinds.

7. It becomes possible to live from one's writings and to exert great influence/Never has it been so easy to produce, to create, to broadcast, to blog, to become an influencer; all can be journalists, writers, theorists (some of conspiracies, others of fake news), artists. The offer is so abundant that only those who own or invest in digital platforms seem to make an income; many cannot make a living from their writings; others see their work disappear; it's a jungle of "winner takes all" and great inequalities of wealth and income are increasing.

8. The printing industry has made the copyist's trade disappear, to give birth to several others/Digital technology has already made several jobs in the printing industry and other sectors disappear, while all sectors of the economy are looking for skills in artificial intelligence, data analysis, etc.

9. The printing press was an instrument at the heart of the industrial revolutions/The digital revolution represents a fourth Industrial Revolution and is at the heart of the ecological revolution, thanks to the traceability and transparency that digital technology allows, at the heart of the necessary health revolution thanks to its contribution to prevention and at the heart of the educational revolution thanks to the reduction of the costs of access to knowledge, data and information.

10. The book is the foundation of the university: a place to store, share and create knowledge/Digital technology removes the university's quasi-monopoly on the storage, sharing and creation of knowledge, as it becomes accessible to all, at little cost. Moreover, digital technology brings back the oral and gives a preponderant place to the visual. With ChatGPT, everything changes again, the written word comes back in force.

DIGITAL, COVID AND THE UNIVERSITY

Several experts from academia and the private sector have been quick to propose approaches to help university leaders meet the challenges of the digital world. After all, the university can also be seen as an organization and modern concepts and methods of change management and strategic planning can very well be adapted to apply to universities. This is true, but not completely as we will see, there is more. However, the BUSINESS MODEL CANVAS "BMC" approach is relevant in this context. Following are a few essential elements. (See Figure 1.)

During the recent pandemic, academia has become a digital learning laboratory for faculty, students and administrators as well as for researchers and their staff.

It is useful to recall that the dominant model of our universities is that of a large teaching and research institution (Key Activities) with many buildings housing cohorts of specialists in multiple fields (Key Resources). They are supported by research and administrative professionals (Costs) and together they contribute to the construction of knowledge and its national and international dissemination (Key activities). They are also responsible for the training of competent graduates who will make the reputation of their alma mater (Client Relations) and who will occupy jobs in all spheres of society (Value Propositions). It is because they deliver a degree, a certificate of knowledge and skill acquisition (Value propositions) that universities receive revenue in the form of tuition fees paid by students (Revenue).

These revenues are supplemented by government grants, gifts from their alumni and major donors, and modest royalty revenues from their participation in discoveries that have been commercialized. These large institutions are also distinguished from one another by the type of partnerships they have established with other universities and other private or public institutions (Key Partners), by the composition of their domestic, regional or international student body (Clients), by their fields of excellence, by the ways in which they make their training accessible (e.g., continuing education, evening courses, distance education), as well as by their administrative efficiency (Channels).

We have just described the nine blocks of what Osterwalder and Pigneur[18] called the "business model" and which they popularized by proposing the Business Model Canvas, the famous "BMC", which groups these nine blocks together to understand how a private or public organization combines them to create value. Figure 1 illustrates these blocks and the BMC concept.

Figure 1 – Business Model Canvas (BMC)[18]
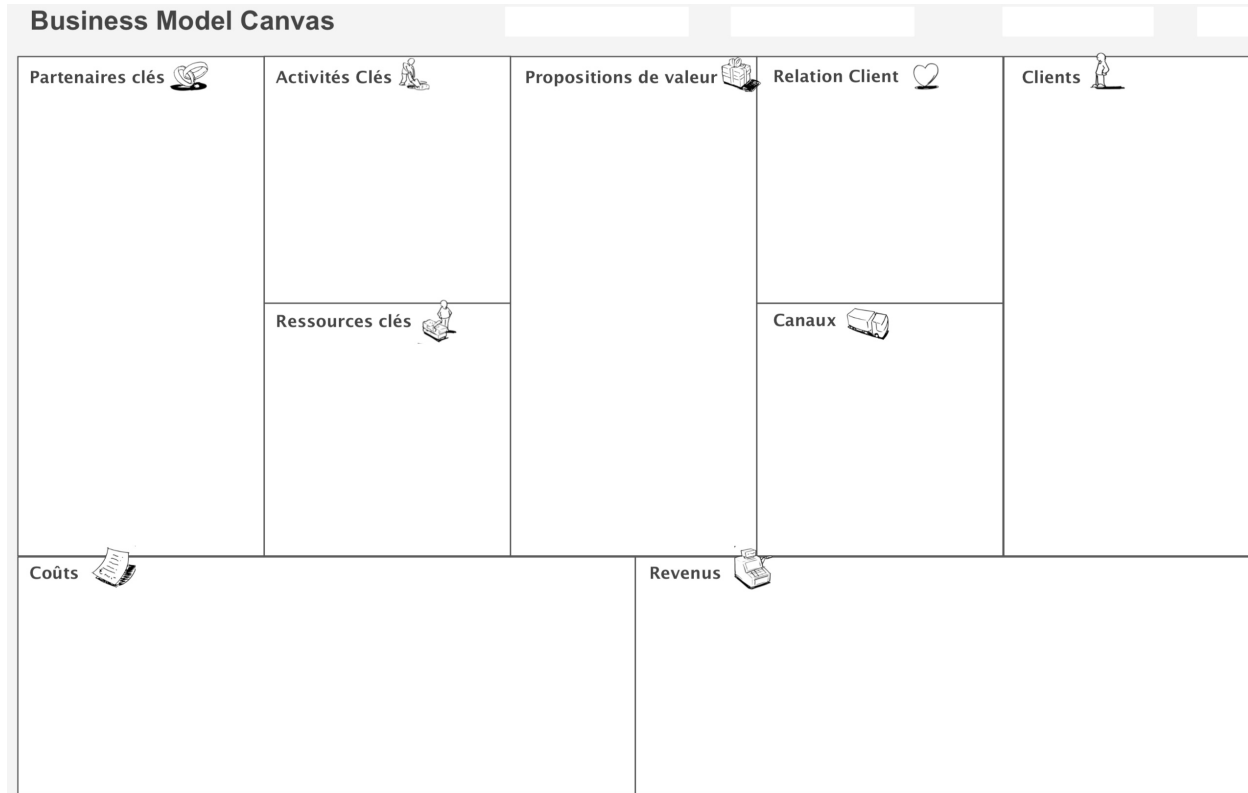
Osterwalder and his co-authors[19] later refined their concept to better understand how organizations create value for themselves, but also, and more importantly, for their customers, by introducing VPD, or Value Proposition Design.

This concept of BMC/VPD has quickly become a widely used tool for understanding in a concrete way the strategic options available to an organization facing complex choices. A very good example of this usage is

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[18] Business Model Generation: A Handbook for Visionaries, Games Changers and Challengers, Alexander Osterwalder & Yves Pigneur, February 2013, published John Wiley & Sons: https://play.google.com/store/books/details/Business_Model_Generation_A_Handbook_for_Visionari?id=L3TnC7ZAWAsC&hl=en_CA&gl=CA

[19] Value Proposition Design: How to Create Products and Services Customers, Alexander Osterwalder, Yves Pigneur, Gregory Bernard, Alan Smith, October 20, 2014, Edition Wiley – https://www.amazon.ca/-/fr/Alexander-Osterwalder/dp/1118968050

the Ernst & Young[20] (E&Y) study on *"University of the Future"*. Let's give credit to E&Y who, back in 2012, understood that academia had become *"A thousand-year-old industry on the cusp of profound change"*.

Their study was set in the Australian context, but it was universal in scope.

Digital will be dominant and it will force the university to become a hub of partner ecosystems that foster the acquisition and sharing of skills needed to develop, govern and manage the digital world.

E&Y analysts identified, as early as 2012, five major trends that would impact the university sector and this was well before COVID-19. These trends are:

a.   The democratization of knowledge and its access;

b.   A market that is now less captive and more uncertain sources of revenue;

c.   The emergence of digital technologies;

d.   Greater global mobility

e.   Pressure from the industry, which has become both a competitor and a partner.

In his master's thesis at the University of Twente in the Netherlands, Luttikhuis[21] was one of the first to apply this OMG concept to the University of the Future. He was followed by Ibrahim and Dahlan[22], who in the same year took up E&Y's analysis and presented it in the practical scheme of the CMB.

E&Y analysts have identified three broad lines of possible evolution of business models (or operating models) that would enable universities to cope with a future that has become so complex. They are: the streamlined status quo model; the dominant niche player model; and the innovator model.

-Those that adopt the "streamlined status quo" will continue to operate as a very large university organization in both teaching and research, but these institutions will transform the way they serve students and manage their administrative processes, redefining their interrelationships with their partners,

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[20] Ernst-Young (2012). University of the Future - A thousand year old industry on the cusp of profound change–
http://www.bu.edu/EdTechcouncil/files/2012/10/Ernst-Young-Higher-University-of-the-Future-2012.pdf

[21] A new business eco-system for the "University of the Future" – First steps towards identifying the "business model of the future" for Higher Educational Institutions – Rethinking University teaching: a paradigm shift? – Malou Oude Luttikhuis, University of Twente, Netherlands, 2016 – https://essay.utwente.nl/71125/1/OudeLuttikhuis_MA_MB.pdf

[22] Designing Business Models Options for "University of the Future", Jamaludin Ibrahim & Abdul Rhaman Ahmad Dahlan, October 2016 – https://www.researchgate.net/profile/Jamaludin_Ibrahim/publication/312109550_Designing_business_models_options_for_University_of_t he_Future/links/5999bc80aca272e41d3ec390/Designing-business-models-options-for-University-of-the-Future.pdf?_sg%5B0%5D=wsna7mYTvpb2BpCpSNnopQxnGKQusFWaQeG84SuUoQGqQ9T2hvQpHLqyDAIj0c-06gETOF2-dhC6Bp-Dp1kcRQ.BBxjEMkHJll1ofd3wUh6PQodIGlzQMTRc7g1fpyX-FyinCMoz9ZbxmCrzZ3HoGb0BIjINPLsnfxZRGYrETkEHA&_sg%5B1%5D=Ye99hl1GYOOPD_1xbZwM9dN4FfpurAOucsVjgtb80jLh1_BkeRkD4miV1 TNxb7jpbN0lHbxpnydR648FpcLSfx4eJrPTlhblcpVsdPPyH5Ff.BBxjEMkHJll1ofd3wUh6PQodIGlzQMTRc7g1fpyX-FyinCMoz9ZbxmCrzZ3HoGb0BIjINPLsnfxZRGYrETkEHA&_iepl=

students and community. According to many experts, this streamlined status quo option will be difficult, as it will require significant self-generated revenues and a "business" positioning that ensures the ability to fund the status quo while investing to adapt to new technologies.

-The "dominant niche players" will be both existing universities and new players who will redefine the service offer and ways of doing things; they will create disruptions and bring about radical transformations, but by specializing in certain clienteles such as international students, professionals in certain industries or executive education. In fact, these niche players would be a threat especially in certain sectors such as administration, engineering and professions governed by professional orders.

-Finally, "disruptors" from the private or public sector would really shake up universities in almost all faculties and disciplines and with almost all clienteles by combining content offerings and approaches from the media, the world of venture capital, and large companies. MOOCs, Coursera, OER, EDX, Udacity, etc. have already appeared in this category in different forms.

Very quickly during the last decade, the digital revolution has intruded into the academic world as well as into other sectors of the economy and society. The transversal nature of this revolution has been understood. Leaders of our universities, as well as major international organizations such as the Organisation for Economic Co-operation and Development (OECD), the World Economic Forum (WEF) and several other national and international associations of the knowledge and research community, have been interested in the relationship between the university business model and digital transformation,[23] the impact of digital technologies on university education[24] and even the management of tensions specific to the university community during the transformation imposed by the digital revolution. [25]

But this "soft" transformation of academia to digital models was radically accelerated by COVID-19, which in a matter of weeks completely shifted academia to remote work and digital networks. The academic world has become a digital learning laboratory for faculty, students, administrators, researchers and staff. This learning was not limited to better understanding devices and software, it educated everyone on the extraordinary potential of digital communication and its limitations.

[23] ResearchGate – University Business Models and Digital transformation, Predrag Matkovic, Pere Tumbas & Veselin Pavlicevic, November 2018 – https://www.researchgate.net/publication/329156210_University_Business_Models_and_Digital_Transformation?enrichId=rgreq-a655dd17528ba2363fd7ed956062cb7e-XXX&enrichSource=Y292ZXJQYWdlOzMyOTE1NjIxMDtBUzo2OTYyNDA2ODk5MjYxNDRAMTU0MzAwODEyNDUyMw%3D%3D&el=1_x_2&_esc=publicationCoverPdf

[24] ResearchGate – Higher Education in the Digital Age: The Impact of Digital Connective Technologies, Abdullah Saykili, January 2019 – https://www.researchgate.net/publication/330770798_Higher_Education_in_The_Digital_Age_The_Impact_of_Digital_Connective_Technologies?enrichId=rgreq-48735767ae62f0d782aa683d9db775fb-XXX&enrichSource=Y292ZXJQYWdlOzMzMDc3MDc5ODtBUzo4NTEzMDU0NTUxNjU0NDBAMTU3OTk3ODQ0NTUyMA%3D%3D&el=1_x_2&_esc=publicationCoverPdf

[25] IDEAS – Digital Transformation for Business Model Innovation in Higher Education: Overcoming the Tensions, Albert Rof, Andrea Bikfalvi, Marquès Pilar, Montilivi Campus, 2020 – https://ideas.repec.org/a/gam/jsusta/v12y2020i12p4980-d373226.html

Questions quickly arose about the economic value and cost of a 3- or 4-year bachelor's degree,[26] on optimizing the virtual customer experience,[27] and adjusting the business model in the face of the pandemic.[28]

Despite all the hullabaloo, the operating model adopted by the vast majority of universities was that of a "streamlined status quo". The pandemic was dealt with using the tools of the digital world, and as soon as possible, the vast majority of universities have done everything possible to return to what was done before the pandemic. This is not unlike most private companies and public organizations. Very few have adopted the "dominant niche player model" or the "disruptive innovator model" in the way the university operates or in its mission.

While Covid pushed universities toward digital by adopting "a streamlined status quo", this shift was not anticipated and illustrated the magnitude of the challenges and resistance to change that universities will face in their digital transition. In June 2020, for example, Watermeyer et al.[29] published the results of their survey of 1148 professors working in UK universities and their findings were clear: for these professors *"Online migration is engendering significant dysfunctionality and disturbance to their pedagogical roles and their personal lives. They also signpost online migration as a major challenge for student recruitment, market sustainability, an academic labour-market and local economies"*. The authors mentioned that these same professors were concerned that this migration to digital could threaten their jobs, as some academic institutions have already moved more than 25% of their teaching online. Not coincidentally, as early as July 2020, the World Economic Forum[30] stated that COVID-19 had three messages for the academic community:

"Developing a virtual culture for universities will require both imaginative and creative implementation, as well as open leadership and an innovative mentality.

- Learning technology should not be envisioned as a mere utility but as an academic opportunity. Instructional design, multimedia production and data analytics are vital.

- Scholars from all disciplines will have to be motivated and well equipped as their courses and programs are reconfigured and adapted to a new and uncertain future."

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[26] Forbes – How COVID-19 Could Shift The College Business Model: "It's Hard to go Back", Alison McCauley, April 10, 2020 – https://www.forbes.com/sites/alisonmccauley/2020/04/09/how-covid-19-could-shift-the-college-business-model/

[27] Forbes Editor's Pick- Is COVID-19 Forcing Your digital Transformation? 12 Steps to Move Faster, Blake Morgan, April 5, 2020 - https://www.forbes.com/sites/blakemorgan/2020/04/05/is-covid-19-forcing-your-digital-transformation-12-steps-to-move-faster/

[28] Elsevier – Industrial Marketing Management, volume 88, July 2020, pages 214-224 – Analyzing the impact of the coronavirus crisis on business models, Thomas Ritter, Carsten Lyund Pederson -https://www.sciencedirect.com/science/article/abs/pii/S0019850120303084

[29] Springer Link – COVID-19 and digital disruption in UK universities: afflictions and affordances of emergency online migration, Richard Watermeyer, Tom Crick, Cathryn Knight & Janet Goodall, Higher Education 2020: https://doi.org/10.1007/s10734-020-00561-y

[30] World Economic Forum – COVID-19 has accelerated the digital transformation of higher education, Samuel Martin Barbero, July 21st 2020 – https://www.weforum.org/agenda/2020/07/covid-19-digital-transformation-higher-education/

Very quickly several studies of the impact of COVID-19 on the digital shift in academia became available; these include the work of the Washington EAB[31], the publications of the Higher Education Policy Institute[32], those of Sà and Serpa[33] on the pandemic as an opportunity to stimulate a sustainable university teacher, and the highly original "case study" by Nelsen et al.[34] on the digital transformation of the Faculty of Social Sciences at Aalborg University in Denmark.

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[31] EAB. Five greatest mistakes in higher education COVID-19 strategy, Melanie Ho – https://eab.com/research/strategy/whitepaper/mistakes-higher-education-covid-19-strategy/

[32] Higher Education Policy Institute – The Future of Higher Education after COVID – BY Nick Hillman, October 16, 2020 – https://www.hepi.ac.uk/2020/10/16/the-future-of-higher-education-after-covid/

[33] MDPI, The COVID-19 Pandemic as an Opportunity to Foster the Sustainable Development of Teaching in Higher Education, October 15, 2020, Maria José Sà & Sandro Serpa – https://res.mdpi.com/d_attachment/sustainability/sustainability-12-08525/article_deploy/sustainability-12-08525.pdf

[34] Accelerated Digital Transformation: The Case of the Online University Caused by COVID-19, Jeppe Agger Nielsen, Sabine Madsen & Christian Ravn Haslam, November 2020 – https://www.researchgate.net/publication/343761894_Accelerated_Digital_Transformation_The_Case_of_The_Online_University_Caused_By_Covid19

A CHANGE OF ACADEMIC PARADIGM

The truth is that long before the pandemic, the academic world was already being hit by the digital revolution. "EdTech", the term used to summarize all digital technologies and new business models in the world of education, was already growing rapidly. These digital technologies have the capacity to create efficiencies, propose new modes of standardization, and facilitate access to knowledge and change learning methods.

"The integration of multimedia gamification mobile casual and informal learning apps and peer-to-peer platforms are all making content increasingly immersive; designed to not only attract students but also keep them engaged – all the way to the end. This is changing the way pupils are consuming education in the same way Cloud technology has changed the way, we consume music and television."[35]

But these multiple benefits of digitizing the university require significant investments by the institution, staff, and students. Classrooms and labs must be optimized; islands of meeting space for teamwork must be established; communication networks and charging outlets must be installed; during and after the digital transition period, a competent and available technical support function must be established; equipment, licenses, and numerous digital subscriptions must be purchased; and all participants must be trained in these new technologies and manage the change to the New World. These capital and operating expenses will need to be funded. At the same time, the university will have to compete with the EdTech industry, which will increasingly offer cheaper and more flexible distance learning, just as it will have to compete with the digital industry to recruit its digital experts for teaching, research, innovation and administration.

> This challenge of identifying, defining and acquiring 21st century competencies has been a central concern of educational specialists, academic leaders and multiple private and public groups and initiatives in several countries and internationally for many years.

The global EdTech market was already valued at more than US$76 billion in 2019 and was expected to grow at more than 18% per year for the next ten years. [36][37] It was and still is promised a bright future, as

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[35] Hottopics.HT, What is EdTech and why is it such a big opportunity?, Benjamin Vedrenne-Cloquet – https://www.hottopics.ht/14731/what-is-EdTech-and-why-is-it-important/

[36] Grand View Research – Education Technology Market Size, Share & Trends Analysis Report by Sector (Preschool, K-12, Higher Education, by End-User (Business, Consumer), by Type, by Region, and Segment ForecastS, 2020-2027, July 2020 – https://www.grandviewresearch.com/industry-analysis/education-technology-market

[37] McKinsey Global Institute, Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages, November 28, 2017, by James Manyika, Susan Lund, Michael Chui, Jacques Bughin, Jonathan Woetzel, Parul Batra, Ryan Ko and Saurabh Sanghvi – https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages

education is one of the most permeable sectors to the digital revolution, as well as the sector that will have the most influence on the distribution of the benefits of this revolution.

Digital will be dominant and it will force the university to become a hub of partner ecosystems that foster the acquisition and sharing of skills needed to develop, govern and manage the digital world.

This challenge of identifying, defining and acquiring 21st century competencies has been a central concern of educational specialists, academic leaders and multiple private and public groups and initiatives in several countries and internationally for many years. Examples include the work of the American Association of College for Teacher Education and its participation in P21[38], the work of the American Association of School Librarians[39], Trilling and Fadel's book[40] in 2012, Lonka's contribution in 2015[41], as well as the work of the Partnership for 21st Century Learning in Washington[42] and the work of the European Parliament also made available in 2015[43] .

In an article published before COVID-19, A. Saykili[44] summarized very well several of these works and publications aimed at understanding how the digital revolution will change society, the economy and the world of education and identified the new skills that will be required of the learner, the teacher and the impact on the learning environment.

For the learner, it will be necessary to know how to learn, how to innovate, and to have minimal information technology skills. All of this will require the development of critical thinking, problem solving and communication skills. It becomes impossible to acquire these skills without some degree of numeracy. These numerous studies also indicate that these new skills will obviously be in addition to the need for excellent knowledge in the sciences, arts, humanities and philosophy! That's a whole program and a lifetime program rather than a short study and entry program!

For the teacher, his or her role and responsibilities are modified according to the now well-known expression of "sage on stage" to "guide on the side", that is, the passage from the role of one who provides information and knowledge to the role of one who facilitates the learning of knowledge and skills. The changes imposed on both the learner and the teacher will result in many transitions in the teaching environment.

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38 AACTE, Integrating Digital Technologies in Remote K-12 Learning: Lessons for Higher Education Preparation Programs, Liz Kilb, Ph.D, Christine Terry, Research and Strategy Advisor – https://aacte.org/events/integrating-digital-technologies-in-remote-k-12-learning-lessons-for-higher-education-preparation-programs/

39 Maine Policy Review, Volume 22, Digital Literacy and Public Policy through the Library Lens, Marijke Visser, 2013 – https://can01.safelinks.protection.outlook.com/

40 21st Century Skills: Learning for Life in Our times, Bernie Trilling & Charles Fadel – https://www.amazon.ca/-/fr/Bernie-Trilling/dp/1118157060

41 European Parliament – Directorate-General for Internal Policies – Policy Department Structural and Cohesion Policies B, Workshop Documentation, 2015- https://www.europarl.europa.eu/RegData/etudes/STUD/2015/563389/IPOL_STU(2015)563389_EN.pdf

42 LearnTechLib, What 21st Century Learning? A review and a synthesis, Punya Mishra & Kristen Kereluik, Michigan State University, March 7, 2011 – https://www.learntechlib.org/primary/p/36828

43 International Council for Open and Distance Education, EU Digital Education Action Plan 2021-2027 announced- European commission – https://www.icde.org/icde-news/eu-digital-education-action-plan

44 ResearchGate – Higher Education in the Digital Age: The Impact of Digital Connective Technologies, Abdullah Saykili, January 2019 – https://www.researchgate.net/publication/330770798_Higher_Education_in_The_Digital_Age_The_Impact_of_Digital_Connective_Technologies

Finally, Saykili identifies five transitions that will hit the learning environment:

1. From standardized to individualized learning;

2. From standardized assessment to specialized assessment;

3. From a model of having a head full of knowledge to having a head that knows where to find that knowledge;

4. From a model focused on as much content as possible to one focused on developing skills to access the most current knowledge, ensure its currency and veracity while knowing how to learn it;

5. From a learning-by-acquisition model to a learning-by-experience model thanks to new EdTech technologies such as intelligent algorithms, virtual reality, etc.

It is very relevant here to highlight the publication of the CIRANO report: "Comparative analysis of AI ecosystems in order to identify innovative practices in training and knowledge transfer".[45]

Teaching, training and educating are thus redefined, but in all cases, the adoption of digital technologies frees up resources and, above all, the time of the "MASTERS" to train the critical mind that is so essential in this New World. The communities of "MASTERS" who will have understood this relationship between a successful digital transition and the liberation of resources to better instruct, train and educate the architects of tomorrow's world will be the true leaders of change...can we dream of it.

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[45] De Marcellis-Warin, N. (2022). Analyse comparative d'écosystèmes en IA dans le but de repérer les pratiques innovantes en matière de formation et de transfert de connaissances (2022RP-20, CIRANO). https://doi.org/10.54932/SXOH3928

A DREAM SCENARIO

It is easy to feel comforted by the fact that, all in all, universities have reacted fairly and even very well to the health crisis by accelerating the digital switchover that was already largely underway!

However, in almost all cases universities have continued to conduct their usual research and teaching activities using digital means of communication and meetings, but they have not made a true digital transformation of their business model or mission. They have adjusted and adapted to the constraints of public health by accelerating the digitization process. But let's dare to imagine what might happen if they did make this true digital transformation... let's dream a little...

Let's imagine that a Quebec university radically changes its raison d'être, its mission, its vision and its operating model by transforming itself in the following way:

> *Let's imagine that a university in Quebec radically changes its raison d'être, its mission, its vision and its operating model by transforming itself...*

1) This university is substantially reducing the number of its undergraduate programs, and the content of these programs is offered online by the best educators from different universities and industries selected through an international competition; each selected program uses the best EdTech tools. These courses use all the pedagogical tools of an "open source" approach that is already very popular in the technology world.

2) This university is expanding the use of podcasts, webinars, Ted Talk lectures, audiobooks, docuseries and multiple learning applications at the heart of digital pedagogy. Its faculty advisors will have built, along with its professors, some laboratories at the cutting edge of digital learning technologies so that its ecosystem will place the university at the heart of new artificial intelligence applications such as Chat GPT. All the methods of control of knowledge and skills are confronted with new challenges; the new digital university will have to quickly find the means to make Chat GPT and its replicas, allies in the current and continuous academic training.

3) This digitized university aims to be a competitor to Google[46] and all the other large companies that want to invade the field of education by offering non-university certifications at substantially lower costs, but increasingly recognized and accepted by private and public employers.

4) These courses are complemented by coaching sessions that help students acquire not only knowledge but also technological skills and master analytical and digital communication tools and means; students and faculty coaches participate in exchange sessions that help develop critical thinking skills, conduct case studies associated with the subjects covered, and, when relevant,

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[46] Google, Inc, Justin Bariso, August 2020, https://www.inc.com/justin-bariso/google-plan-disrupt-college-degree-university-higher-education-certificate-project-management-data-analyst.html

interact with institutions and businesses in certain ecosystems co-hosted by the university and private, public and community partners.

5) Some of the faculty at this university have qualified as undergraduate teachers in the international competition, others have become coaches to students, a number of full-time researchers, others leaders of business incubators, while some have been given roles in the community and society ecosystems that house this 4.0 university. All have had the opportunity to pursue careers interacting with the rest of the world in their fields of specialization. These fields are very broad, as they span the humanities, arts, humanities, social sciences, as well as the physical, natural, and applied sciences, not to mention professional areas including law, medicine, business and engineering, architecture, etc.

6) These undergraduate programs are offered online throughout the regions of Quebec and elsewhere in the world; they are becoming important sources of net revenue for this university which, thanks to these new resources, can finance its specialization in four or five fields with research centres at the cutting edge of these disciplines and devote itself to the training of graduate students. These research centres are world-renowned and provide a wide range of income from their discoveries and inventions. These researchers and their wards have a global impact in their fields of specialization and their university has become a beacon in these fields and an example to follow.

7) This university has succeeded, through its hybrid model, in offering a true experience of socialization, meeting and interaction between students and professors. It is an effective and open hybrid agora. The hybrid model allows for a balance between face-to-face activities with colleagues and professors and digital sessions.

8) This university continues to offer a passport for the rest of one's professional life by awarding diplomas attesting to a successful and credible academic career, the acquisition of recognized knowledge and skills.

9) This university's diverse student body, faculty, and hybrid model allows all students to build networks of colleagues and friends who will support them throughout their lives.

10) This model has been so successful that within two or three years, other universities have adopted it, so that the Quebec university system is totally transformed and occupies a dominant place in university education throughout the world while better serving the regions and Quebec businesses and institutions.

11) Quebec has become a must and its market share continues to grow. Other universities that have only digitized their activities without really transforming themselves are experiencing a decline in their clientele and the loss of their local and international branding. It's a crisis!

This example illustrates three things:

- In the pre-digital world, universities' strategic choices were both more limited and simpler than in the digital world. The traditional paradigm pushed universities to replicate the same universal design, with few exceptions. With limited resources, they compete for them. The performance criteria for accessing them are branding, size of endowment, number of students, and therefore

become the primary determinants of university revenues. In this paradigm, branches have so many constraints that their strategic choices are limited in number and scope.

- In a digital world, the universe of choices is almost infinite: universities that have made decisive strategic choices and have had them accepted by their immediate and wider community will succeed in their digital transformation, gaining in efficiency and productivity thus freeing up resources to focus on their new purpose and mission. Resistance to change becomes the main challenge. Some universities will not want to make these choices of greater specialization, fearing that they will no longer be at the service of their region, when in fact the opposite is true; the hybrid model, the use of digital technology, the formation and development of regional ecosystems, and the connection to the major issues facing our societies will mobilize the regions as never before.

- This requires both choices and a true digital transformation. Academic institutions and governments will be forced by the digital revolution to redefine universities and university systems. The winners will be those who are able to manage the change rather than undergo it. The reader will have understood that this example of a university adopting a disruptive model could come from anywhere on the planet, and that in fact, several institutions have already begun testing components of these new models.

As the digital revolution of 4.0 accelerates in all areas, all humanity is discovering how to use these systems and intelligent machines to improve human capabilities. We no longer talk about how these machines replace human work but rather how they can interact with humans and improve the result of their work while taking into account environmental dimensions, creativity, customization of work and product. The 5.0, which is characterized by this greater interaction between human work and machines, is once again shaking up universities, but this time with dimensions that open wide the doors to regain a place of choice.

Indeed, while being extremely weakened by the digital world, the University is also the institution that can have the most impact on the reduction of income and knowledge gaps that the digital revolution will bring about. The digital world being a world of data, information and knowledge, this world can only be the natural world of the community of professors, teachers, researchers and students. The digitization of education is a unique opportunity to make it more accessible to as many people as possible. The still prohibitive costs for many young people here and abroad, geographic constraints, and still discriminatory attitudes of institutions toward minorities are examples of many problems that change management and technology can help solve. A case in point is the critical importance of facilitating the entry of women into this world of technology and digital and therefore education. Many people, and I am one of them, see the digitization of education as a true revolution that will facilitate equal opportunities in a world that is both uncertain and full of promises.

> The digital world being a world of data, information and knowledge, this world can only be the natural world of the community of professors, teachers, researchers and students. The digitization of education is a unique opportunity to make it accessible to as many people as possible.

We must therefore adopt a much broader perspective in order to appreciate the magnitude of the challenge and the height of the ambitions that we must have for the University of the Digital World. It is for these reasons that the schema that must be used to discuss the future of the university must not be limited to the BUSINESS MODEL CANVAS, but it must be a much more comprehensive schema that includes:

a) The purpose and mission of the university;
b) The university's vision and operating model;
c) The university's ecosystems and their outreach.

Table A presents such a schema for the three historical paradigms corresponding to the oral and manuscript world, the printed book world and the digital and data world.

Table A

Three Worlds and Three Universities

The paradigms historical / The attributes of the university	Until 1456 The world of the oral and the manuscript	1456 – 2010 The world of the printed book	2010 - The world of digital and data
Purpose and mission	• Under the protection of the Church and the kings • Guardian of the divine truth • Reproduction of manuscripts	• Guardian of academic freedom • Arts, science, humanities and professional education in medicine, law, engineering and other fields • Basic and applied research • Imprint of the acquired knowledge	• At the centre of ecological, health, demographic, digital and ethical issues • Raison d'être: a beacon on the complexity of the modern world • Monitoring and knowledge sharing mission
Vision, operating mode and business model	• Training the ecclesiastical and civil elites • Models, medieval, arts, medicine, civil, canonical and theological law	• Large buildings housing specialists engaged in the creation and dissemination of knowledge • Teaching and research, especially the campus/reference library • Revenue from tuition, grants and donations	• In the "centre and with" and not "high and alone" • Facts and Science • Shared Imprimatur • Hybrid physical and virtual model/EdTech as a service • Exchange platforms
Impacts and ecosystems	• Almost closed ecosystems • Numerous conflicts between religious orders	• Private and public partners • Important branding • Outreach through research and graduate impact • Important economic and social impacts	• Involved in many successful sectoral and regional ecosystems • Animation of a network for sharing skills • Multiple impacts

Henri-Paul Rousseau 2023

Most universities clearly state their mission, vision and values, and generally include references to society[47] and partnerships. But it is rather rare to read a definition of the "raison d'être" anchored in the major issues of our society, to find indications on the vision and the operating model adapted to the digital world. The ecosystems that will be crucial to the realization of its vision and mission are rarely mentioned or described.

The diagram proposed here includes these dimensions and highlights certain orientations. The university must renew its raison d'être and its mission by positioning itself at the centre of the issues facing our civilizations and societies and by recognizing its primary role as a beacon in the complexity of the modern world. It is no longer just a general research and teaching mission, but one that explicitly incorporates these major issues. These broad issues are now recognized by a wide range of scientific, political and economic leaders in many countries. Academic leaders must participate in this renewal of the raison d'être of private and public organizations.

The vision of the university can no longer be that of a physical place, "upstairs and alone", but rather that of a community of people "at the centre" of ecosystems ensuring, with partners, the authenticity of facts, scientific rigour and objectivity, and providing a framework for vigorous and respectful debate. Its model will most likely be a hybrid between virtual and face-to-face exchanges, and many of the EdTech and other technologies are also used extensively in these ecosystems, as well as in its relationships with other education, research and innovation ecosystems. It is these relationships that will be the new "faculties" and "departments".

A university will be called a leader in a particular field because its network of ecosystems in that field will be highly trafficked, highly used and highly coveted. These ecosystems will bring together a diversity of talented people in the different technologies of EdTech, AgriTech, FinTech, GovTech depending on the priorities chosen. No one will be able to embrace everything and do everything.

The formation of these ecosystems involves multiple collaborative arrangements between the university and businesses and/or governments. These collaborations already exist, but they will grow rapidly because many leaders in the private and public sectors now realize the urgency of acting collectively to address global issues and because the academic and industrial worlds are very complementary in their capabilities and research areas. In fact, the number of publications signed by authors belonging to both worlds has doubled in the last five years and professors and practitioners alike realize that scientific articles resulting from collaboration between researchers from the academic world and those from the industrial world are by far more cited than "purely academic" works[48]. The very recent discoveries related to drugs and vaccines against COVID-19 have clearly demonstrated the effectiveness of this collaboration between governments, companies and universities. However, the sharing of risks and rewards of this type of collaboration will need to be reviewed.

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[47] Blog Admin, What do universities want to be? A content analysis of mission and vision statements worldwide, Julian Cortes, December 2017 – https://blogs.lse.ac.uk/impactofsocialsciences/2017/12/20/what-do-universities-want-to-be-a-content-analysis-of-mission-and-vision-statements-worldwide/

[48] Elsevier, University-industry collaboration, A closer look for research leaders, December 17, 2020 https://can01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.elsevier.com%2Fresearch-intelligence%2Funiversity-industry-collaboration

One can imagine similar and equally effective collaborations on the issues of energy and ecological transition, on the challenges of aging and inequalities, on the challenges of cyber security, as well as on the problems of governance and global risks.

The management methods will be agile and flexible like those used during the COVID-19. However, the transition to such a vision and these new models cannot be done without a call to all, launching a collective vigil of the digital revolution, its impacts and its relationship to the ecological emergency, the aging population, the crisis of inequalities and ethics and the health crisis.

This exercise of collective vigilance will become a prerequisite for digital transformation, as stakeholders will have understood and assimilated the scope of the changes and will have less resistance to the new. It is therefore a collective process to generate and test ideas and gain strong buy-in for the renewal of the University's purpose, mission and vision of the digital world.

This text aims to contribute to the reflection on the university of tomorrow and, despite the many ideas put forward, it remains incomplete for three reasons:

First, it does not constitute a census of all the digital transformation experiments undertaken by several universities in recent years and accelerated by the recent health crisis. Liebowitz has recently edited a dozen research papers that report on numerous experiments in digital transformation of the university sector that illustrate and document both the technological facets and the social and human aspects of these experiments that aim to discover the "new normal"[49]. This collection by Liebowitz has only just been published in early 2023.

Second, it is impossible to account for the changes and multiple questions that ChatGPT and its competing replicas will cause. ChatGPT was launched in November 2022 and is part of a widespread evolution in artificial intelligence – largely due to the discoveries of Quebec researchers – that has already contributed to the creation of a multitude of new commercial, social and cultural activities. Recent AI breakthroughs are based on machine learning and are used to develop chatbots of all kinds, to translate various languages, to create content, to offer enhanced advisory services to investors, consumers, and employees, to manage social media, to develop new e-learning tools, to set up virtual assistants, etc. Even if the results are sometimes approximate, many applications have already started to invade the market. These applications are: Copy.ai, to help with writing, Many Chat, a marketing tool, HotPot, a creative and design tool, Brand Mark, also a designer assistant, Lumen5, a tool for creating videos and visual contents, Curiosity, INK, PhotoRoom, etc. It is expected that the upcoming release of ChatGPT4 will bring about new services and productivity gains that have been sought after for so long. Although the technology behind AI is advancing ever so incrementally, many in the tech community see ChatGPT as a turning point in the digital revolution as it is a loud wake-up call for the potential of AI for businesses, governments and the public. Its rapid adoption, as well as the development of competing platforms and their interaction with complementary technological assemblies such as the metaverse in its many forms[50], will be a factor in accelerating and

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[49] Jay Liebowitz, Digital Transformation for the University of the Future, World Scientific,2023.

[50] Metaverse in Education: Vision, Opportunities, and Challenges. https://arxiv.org/abs/2211.14951

transforming learning and training methods, both in the job market and in the world of education. A revolution within a revolution!

Finally, what is relevant for each university is also relevant for the university system; what public support and funding policies should we enact to accelerate and facilitate the digital transition of universities? Will we be able to maintain the universal design for university instruction for long? What specializations for what university? All these questions and many others will have to be discussed and this text, incomplete, does not address all the questions on THE QUEBEC UNIVERSITY OF THE FUTURE[51] that were recently raised by the Chief Scientist of Quebec and the many participants in this process. At most, this document is meant to be a complement to this collective effort of reflection.

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[51] L'UNIVERSITÉ QUÉBÉCOISE DU FUTUR : Tendances, enjeux, pistes d'action et recommandations, Document regroupant le Rapport des journées de délibération et le Document de réflexion et de consultation. Submitted by Dr. Rémi Quirion, Chief Scientist of Quebec to Ms. Danielle McCann, Minister of Higher Education, 2021.

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