International Federation of Catholic Universities
Higher Education Foresight Unit

EMERGING TECHNOLOGIES IN HIGHER EDUCATION AND THE WORKPLACE: AN ASSESSMENT

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INTRODUCTION

In March 1964, a group of prominent American thinkers calling itself the "Ad Hoc Committee on the Triple Revolution" sent a report to then president Lyndon B. Johnson in which they warned that the transformations brought about by "cybernation," or, as they put it, "the combination of the computer and the automated self-regulating machine" would result in "a system of almost unlimited productive capacity, which requires progressively less human labor."

The report thus identified automation as the potential gateway to a dramatic revolution. The other two revolutions referred to in the name of the committee were, respectively, nuclear weapons and the civil rights movement. The accompanying letter expressed the authors' concern that Americans and their leaders were "unaware of the magnitude and acceleration of the changes going on around them," and that, if the recommendations in the report were not adopted, the nation would be "thrown into unprecedented economic and social disorder" (see A1, Cover letter to the Triple Revolution Report).

Among the policies recommended to the U.S. government for tackling the wave of automation in the labor market that the authors foresaw was the implementation, over time, of a guaranteed income for all Americans, employed or not.[1]

Earlier still, in 1949, Norbert Wiener, an MIT mathematician, wrote an essay (which for mundane reasons never made it to publication) for the New York Times on the subject of "what the ultimate machine age is likely to be." In it, he explained that "roughly speaking, if we can do anything in a clear and intelligible way, we can do it by machine." He also stated that the machines that were then "on the verge of being built" would "control entire industrial processes" and "even make possible the factory substantially without employees." "These new machines," he claimed, "have a great capacity for upsetting the present basis of industry, and of reducing the economic value of the routine factory employee to a point at which he is not worth hiring at any price."[2]

Several decades followed, in which it was easy to dismiss such warnings and view their authors as doomsayers who had turned out to be flatly wrong. Through the 1950s and 1960s, most of the West went on to experience unparalleled economic prosperity, with unemployment rates that governments in many countries across the world, including in Europe, can only dream of today. In addition, history had indeed witnessed other periods of transition from one production mode to another, which had also had their critics and Cassandras, and humankind had by and large adjusted. To

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[1] John D. Pomfret, "Guaranteed Income Asked for All, Employed or Not," *The New York Times*, March 22, 1964.
[2] John Markoff, "In 1949, He Imagined an Age of Robots," *The New York Times*, May 20, 2013.

limit the query to the not-too-distant past, it is worth remembering that the technological advances of the Industrial Revolution in the 19th century were still barely imaginable at its dawn, in 1815.[3]

However, though it would presumably not occur to many observers of history today to lament the advent of the Industrial Revolution, it is also worth pondering on the fact that the technological innovations that era brought about which directly affected manufacturing – the core of the Industrial Revolution, in particular the textile industry that, even prior to that time, had been a large employment pool in England and other European countries – substituted machines for human labor through countless manual tasks and jobs within just a few decades. The result in labor terms was a massive loss of jobs not only in Europe (with the Luddites in Britain starting to destroy machinery as early as in 1811 and eventually leading, among other factors, to the emergence of labor unions) but, more tragically, also in India and later China, which had been England's traditional centers of textile manufacturing and where millions were left unemployed, with many actually starving to death.[4]

Thus the transition into the industrial age was, by all accounts, not a smooth one, including in economic terms. Though many additional jobs were eventually created by the Industrial Revolution and the new era brought about not only unprecedented productivity but also, over decades, a remarkable improvement in living standards in the West, real wages stagnated for almost half a century in 19th-century England.[5] It also took roughly a century and a half from the start of the Industrial Revolution to see the modern welfare state and the vast improvements it brought in the social conditions of employed and unemployed people take hold. Nor did the entrenchment of the welfare state in the West after the Second World War mean the consolidation of relative prosperity for workers. As Norbert Wiener and the authors of the Triple Revolution report had foreseen, automation and robotization did begin to spread in industry from the 1970s (albeit not with the dire consequences on labor they had envisaged), once again boosting productivity to unprecedented levels, while over the same period, in the United States in particular, real wages stagnated again, reaching a peak in 1973 and never quite returning to the same level after the sharp drop caused by the oil crisis. Measured in 2013 dollars, average wages for production and nonsupervisory workers were in fact 13 percent lower in 2013 than in 1973 (see A2, Productivity growth vs. compensation growth in the U.S., 1947-2009).[6]

The backdrop to the wave of automation and robotization that affected industrial labor during that period was of course the emergence of globalization. Economists are still debating whether Western economies lost more jobs to the former or the latter during

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[3] Richard J. Evans, *The Pursuit of Power: Europe 1818-1914*, Preface (U.K.: Penguin Books, 2016).
[4] Sven Beckert, *Empire of Cotton: A Global History* (U.S.: Vintage Books, 2014).
[5] "Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation," McKinsey Global Institute, December 2017, p. 33.
[6] Martin Ford, *Rise of the Robots: Technology and the Threat of a Jobless Future* (U.S.: Basic Books, 2016).

those decades, though the emerging consensus today seems to be that automation was the main culprit.[7]

The question, therefore, may well be whether lessons can be learned from history to assess the potential impact of the latest wave of automation, which now involves not only robotization but the exponential expansion of artificial intelligence (AI), on the labor markets of the future.

Current assessments of what proportion of existing jobs may be lost in the coming years to robotization and AI (technologies that have begun to merge) vary widely, showing anywhere from a 14 to 54 percent automation impact on jobs.[8] It might, however, be a telling sign that sales of industrial robots worldwide went up 29 percent in 2017 compared to 2016, while according to an estimate by the International Federation of Robotics the operational stock of industrial robots worldwide will have more than doubled by 2020 compared to 2014 (see A3, Growth and forecasted growth in operational stock of industrial robots 2008-2020)[9]. As in the past, forecasts among the vast literature and media articles devoted to the subject are fairly neatly divided between, on the one hand, doomsayers who predict the end of human work as we know it with dire consequences of unprecedented economic inequality, and, on the other, fierce advocates of the AI revolution who foresee a world in which people, finally rid of the menial and repetitive aspects of work, will be free to unleash their creativity and devote more time to leisure. Regardless of the substance of forecasts, many reports ask, in reference to the past: is this time different?

There is one immensely significant dimension with respect to which it can already be said that yes, this time is different. Both the Industrial Revolution and the wave of automation that began to soar from the 1980s in an increasingly globalized world overwhelmingly affected manual jobs, whether in agriculture or in industry. The AI revolution, in contrast, has already begun to spread to occupational sectors that

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[7] See, for example 1) Daron Acemoglu, David Autor, David Dorn, Gordon H. Hanson and Brendan Price, "Import Competition and the Great U.S. Employment Sag of the 2000s," *Journal of Labor Economics*, Vol. 34, No. S1 (Part 2, January 2016), in which the authors estimate that 2.4 million American industrial jobs were lost solely to the rise of Chinese imports between 1999 and 2011; 2) Jean-François Jamet, "Où va l'industrie européenne ?," Questions d'Europe nº 82, Fondation Robert Schuman, December 3, 2007, where the author shows that 2.8 million jobs across the EU were lost to relocation and outsourcing to Asia between 1996 and 2006; on the other end of the argument, i.e. automation has caused more job losses than globalization, see 3) Michael J. Hicks and Srikant Devaraj, "The Myth and the Reality of Manufacturing in America," Center for Business and Economic Research, Ball State University, June 2015, in which the authors demonstrate that of the 5.6 million manufacturing jobs the U.S. lost between 2000 and 2010, 85 percent were eliminated through automation rather than international trade; and 4) Loukas Karabarbounis and Brent Neiman, "The Global Decline of the Labor Share," *The Quarterly Journal of Economics*, Oxford University Press, vol. 129(1).

[8] Darrel M. West, "Will robots and AI take your job? The Economic and Political Consequences of Automation," Techtank, The Brookings Institution, April 18, 2018.

[9] World Robotics Report 2018, International Federation of Robotics.

require middle- and high-skilled workers, in other words workers with a college education.[10]

It therefore seems safe to assume that institutions of higher learning across the world are now facing a challenge of unprecedented proportions in the phases of their modern-era development.

Over the last few decades, globalization has already significantly refashioned the sense that many universities across the world have had of their core mission. Increasingly, colleges and universities have become a marketplace where they behave as competitors who endeavor to draw in students that they view as consumers. The – evidently economic – rationale behind this rapid shift clearly defines college education primarily as a pathway to future job security and high earnings for enrolled students. Students themselves have in recent decades consistently viewed higher education as just that promise – though this perception has begun to sour.[11] Critics see this evolution as a deplorable shift from the tradition of a scholarly education whose quintessential function for centuries has been to pass on knowledge and encourage a spirit of inquiry among the young in attendance, even if the growing demand in government for educated officials that developed from the 13th century in Europe introduced early on the objective to train students toward a broad range of occupations.[12]

The development of digital technology that has penetrated higher education over the last decade – as it has every other dimension of human life and the labor market in particular in many countries across the world – seems to render the need for a reassessment of the mission of colleges and universities even more acute than the wave of internationalization of higher education already has. The digital revolution poses a double challenge to higher education: in the methods and practices of learning and of teaching, and in the very substance of what is taught in view of the disruption that emerging technologies are bringing to the labor market. Countless questions arise today in the minds of university administrators and faculty, and in societal debates at large: What should a college education contribute to students at a time when most observers of evolving labor trends and education experts agree to predict that the future of work will make the very idea of a life-long career obsolete and replace it with life-long learning? How will college education remain relevant? Will it? As more and more universities and governments begin to focus on and invest in the STEM (Science, Mathematics, Engineering and Mathematics) fields, what will become of the Humanities and the critical skills their teaching is supposed to impart? How will colleges and universities survive in an increasingly competitive, increasingly global environment?

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[10] See, for example Jeffrey J. Selingo, "Are Colleges Preparing Students for the Automated Future of Work?," *The Washington Post*, November 17, 2017, and Nancy Gleason, "Higher Education Must Prepare for the Rise of Machines," *Times Higher Education*, The World University Rankings, March 30, 2017.
[11] "Not What it Used to be," *The Economist*, December 1st, 2012.
[12] R.W. Southern, *The History of the University of Oxford* (UK: Oxford University Press, 1984).

These are some of the questions that this report seeks to investigate, through a focus on both the context and the loci in which this revolution is playing out. Part One explores the global framework that has made these questions relevant by examining the commoditization of higher education. Part Two provides an overview of the penetration of digital technology and AI on and off campuses to date and seeks to assess developing trends in the transformation of higher education. Part Three focuses on the labor market to gauge the impact of emerging technologies on labor markets to date, review developing trends and attempt to determine what skills will be in demand tomorrow.

In providing an overview of and some reflections on the disruptions to come in higher education, the author of this report does not claim to possess or offer specific expertise in the emerging technologies per se. Rather, the intention is to explore the subject through a social science lens, with a view to informing and encouraging fruitful debate among the managing teams of universities that are members of the International Federation of Catholic Universities, and, hopefully, also among those that are not.

PART ONE. THE GLOBAL CONTEXT: THE COMMODITIZATION OF HIGHER EDUCATION

In 1979, Edward Fiske, a former *New York Times* education editor, wrote an article for *The Atlantic* where he described what he viewed as "the most traumatic change now under way in American higher education: the shift from a seller's to a buyer's market." He recounted how, faced with the prospect of a demographic squeeze, American colleges and universities were increasingly resorting to marketing strategies and techniques designed by and for the corporate world, and to "importing" foreign students to boost enrollment. He stressed the need to "consider whether selling education is significantly different from selling cars or soap" and pointed out the perils involved in seeing colleges and universities adjust programs to meet the needs of the "market" and lower evaluation standards to ensure that the students they had enrolled at such great costs would indeed graduate. "Inherent in the marketing approach to institutional survival," he warned, "is the assumption that whatever will sell is right."[13]

Though advertising the merits of the education provided by their institution was in no manner a novel concept for colleges and universities at the time, it is now clear that the late 1970s and early 1980s were the beginning of a new era – one in which, irrespective of demographic trends, the need to turn an institution of higher learning into a brand name that would also attract a growing number of international students would become key to enrollment and endowment success, or, simply, to survival.

1. Internationalization and globalization

As shocking as such practices may have appeared to Fiske at the time, many universities across the world, yielding to the growing forces of the globalized market, have since then gone far beyond, in adopting not just policies of strategic planning and marketization borrowed from the corporate world but also entire business models. One broad impact of this evolution has been an increased focus on curricula that translate into employability for students and the embracing of internationalization strategies that include, inter alia, overseas partnerships, the development of branch campuses, and catering to increasingly diverse and increasingly international cohorts of students.

Understanding the transformations of the past few decades in higher education requires spelling out the distinction between internationalization and globalization. An internationalization process implies the development by a college or university, situated in a given national context, of relations with other institutions situated abroad within their own cultural, social and economic national systems. Such strategies remain fully in the control of universities that engage in them. In contrast, the process of globalization transcends national boundaries and entails dynamic

[13] Edward J. Fiske, "The Marketing of the Colleges," *The Atlantic*, October 1979.

forces and movements to which universities are submitted and on which they become dependent. More than internationalization, globalization puts on institutions of higher learning a type of pressure that poses multiple challenges to their governance bodies, which struggle to retain a modicum of distinctive identity, character and values. Many universities have responded to globalization by rescaling their activities and engaging in franchises, joint ventures and the quest for foreign direct investment. The role of national states remains significant in that states continue to determine the funding system for higher education and to contribute to its budget while granting recognition of diplomas and setting national-scale performance standards. However, this often adds pressure on academic institutions to seek international expansion

2. From administration to governance

These transformations have in turn upended the definition of university administration. In his classic 1986 book on the subject, Burton Clark identified the concepts of knowledge, beliefs and authority as key to the understanding of how universities are organized. He defined the structural dimension of universities, regardless of national system, as a "triangle" of coordination (that, he underscored, could generate tensions within the institution): one, market-like, between the educational offer and the demands of students and families; one between the university and the state authority; and one between the faculty corps and the professional administration.[14]

As business concepts began to penetrate academic institutions in the move toward the "entrepreneurial" university, the authority of the third pair, the "community of scholars" on one hand and the administration on the other, which together had constituted historically the core of the university, began to decline. The boundaries between universities and other institutions in the society at large began to blur while external – increasingly international – stakeholders, virtually absent in the early 1980s, began to acquire an increasingly decisive role, in particular as board members. Over time, the concept of "university administration" was replaced with that of "governance" – a mode of management that entails much more complex decision-making processes because it opens to a much broader community that often joins the local to the global and can include "industry, professional bodies and the media."[15] The five propositions formulated by Gerry Stoker in 1998 to define the concept of "governance" remain a sound analytical framework to envisage what the governance of globalized universities is today.[16]

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[14] Burton R. Clark, *The Higher Education System, Academic Organization in Cross-National Perspective* (U.S.: University of California Press, 1986).

[15] Graham Baldwin and Rick Wylie, "The Governance of a Globalised University, Towards Global Localisation," Rick Wylie (ed.), *Higher Education and Regional Growth: Local Contexts and Global Challenges*, Policy Network (U.K.: Rowman and Littlefield International, 2018), p. 90.

[16] These five propositions are: 1) a set of institutions and actors drawn from both within and without the institution; 2) relations of power dependence between these institutions; 3) several networks of actors; 4) management and techniques that aim to steer and guide rather than rely on authority; 5) blurred

3. Commoditization

With the end of the Cold War, history may not have "come to an end," as proposed in the early 1990s by Francis Fukuyama, but it imposed on the world a single economic model.[17] Propelled by the IT revolution, globalization has been both the process whereby this model was spreading across the planet and the end result of the imposition of this model across the planet. As trade, communications, finance and people were beginning to move more freely through national borders, the forces of the market and the dominance of the principles they conveyed – transactional relations, the pursuit of profit, consumption as the overarching goal proposed to the global society – went on to assert themselves universally. Prompting nations to increase their international competitiveness, globalization has compelled governments to prioritize the production of a highly-skilled labor force and the investment in research and development – pathways to gaining a competitive edge in a competitive world. This has reshaped education policies and, inter alia, induced institutions of higher learning to adapt to the needs of the global market.

The process, however, went much further, altering the delivery of higher education in three major ways. First, as most dimensions of individual and social life in the developed world were becoming commodified, so higher education began to be approached by universities and the society at large as the "selling" of a service to "customer" students, thereby causing a leading segment of the higher education sector to start "drifting into a market-oriented system" where education would be seen as a "commercial product to be bought and sold like any other commodity."[18] Second, the so-called "commercialization" of higher education came to be understood as referring to both the growing connections between universities and the private sector, and the push to have public education institutions adopt or mimic the management mode of the private sector.[19] Third and perhaps most dramatically, education increasingly came to be viewed in social and cultural terms as a service worth purchasing if and only if it virtually ensured the means for students to successfully compete in the global economy, that is, to obtain profitable and lasting future employment.[20] To mention only one example, the University of Texas in an almost comical embodiment of this perception, has made available to students a digital tool that allows them to see

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boundaries and responsibilities among institutions and actors. See Gerry Stoker, "Governance as Theory: Five Propositions," *International Social Science Journal* 50 (155).

[17] Francis Fukuyama, *The End of History and the Last Man* (U.S.: Macmillan, 1992).

[18] Frank Newman, Lara Couturier and Jamie Scurry, *The Future of Higher Education: Rhetoric, Reality, and the Risks of Market* (U.S.: Jossey-Bass Publishers, 2004).

[19] James L. Turk (ed.), *The Corporate Campus: Commercialization and the Dangers to Canada's Colleges and Universities*, Introduction: What Commercialization Means for Education (Canada: James Lorimer and Company Ltd., 2000).

[20] See Tatjana Takševa, "The Commercialization of Higher Education as a Threat to the Values of Ethical Citizenship in a Global World," *UCFV Review*, 2.1, 2008, pp. 8- 27.

how much they can expect to earn ten years after graduation depending on the major they will choose.[21]

This is of course in stark contrast with the time-old conception of knowledge as worth pursuing for its own sake and for the public good it potentially generates that the learning and teaching activity – and the university as a whole – have been grounded in since Greek Antiquity.

While there is no sound argument to be made on behalf of a higher education that would provide no economic benefit, the broad significance of this trend must be clearly understood.

One of the crucial transformations under way in this context is the alteration of the teacher-student relationship. Nothing in the tradition of the pedagogical endeavor had allowed any observer before to imagine that teachers were in the business of "selling" educational contents to students. As pointed out by James Turk, an instructor's role cannot be compared to that of a sales assistant selling a product and aiming to "please customers." It is, rather, "to challenge students, to provoke new ways of thinking, to make students uneasy with what they have taken for granted." This, Turk points out, "can be a difficult and unsettling process – the opposite of what is to happen to a retail customer who is to be placated and soothed into buying a product."[22]

Yet commoditization has prompted universities to introduce and expand systems of learning outcomes measurements that aim to quantify the benefits of education to students, thereby mimicking the methods used in the market to assess performance – of products in terms of customer satisfaction, of employees in terms of productivity, of corporations in terms of meeting sales objectives, etc. Jerry Muller argues that the "metrical canon" relies, wrongly, on the belief that it is both possible and desirable to substitute numerical indicators of comparative performance based on standardized data for judgment acquired through personal experience and talent. Indeed, he warns, in the field of education, this trend, extended in the United States to primary- and secondary-education level, while it consumes a vast amount of federal resources, has not had the expected result of boosting overall educational achievement.[23] In addition, Daniel Koretz shows that while the metric-based approach has had a minimal net effect on student learning, it has had a demoralizing effect on teachers, whose career progress has become dependent on the students' own measurement of their performance.[24] The ultimate embodiment of the university as a marketplace where performance can be measured and rated as that of any commercial enterprise is of course the now predominant diktat of world university rankings – a metric whose

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[21] Katherine Mangan, "A New Tool Breaks Down Earnings Potential for Different Majors. Here's What You Need to Know," *The Chronicle of Higher Education*, April 6, 2018.
[22] Turk, *The Corporate Campus*, p. 6.
[23] Jerry Z. Muller, *The Tyranny of Metrics* (U.S.: Princeton University Press, 2017).
[24] Daniel Koretz, *The Testing Charade: Pretending to Make Schools Better* (U.S.: University of Chicago Press, 2017).

methodology and even underlying principles have long been the object of controversy both in the society at large and within institutions of higher learning.[25]

It can safely be argued that the broad outcome of education, unless it is expected to be nothing other than a framed diploma that opens the gate to a lucrative job, does not lend itself to easy and instant quantification. Well beyond the provision of a pathway to work, college education has carried a time-old tradition of self-development ultimately aimed at enhancing the civic virtues of individuals and their sense of responsibility to the collective – be it the sum of their fellow human beings, the community, the nation, or – now – the world. One of the most significant challenges faced by higher education today is that of deciding what share of students' learning should address these unquantifiable and vastly unmarketable benefits.

Another, even more dramatic, transformation produced by the commoditization of higher education may well be, ultimately, the status of knowledge itself. Market-driven forces, bolstered by growing supranational convergence of higher education policies and forms of regulation combined with the penetration of university governance by private-sector stakeholders, are increasingly weighing on the question of what constitutes valuable knowledge in higher education. Universities are thus subjected to growing pressures to prioritize both academic fields and research through the lens of a utility calculus. Knowledge taught is hence veering away from the proverbial pursuit of "truth" toward what may suit or serve the interests of powerful market actors. In the developed world, this results in the increasing common public view that "liberal arts and value-based learning have gone out of vogue."[26] Many books and articles in professional and general publications have indeed been decrying the demise of the humanities (See A4, Number of teaching jobs in English and foreign languages fields advertised in the MLA Job Information List 1975-76 to 2016-2017). They underscore the fact that liberal arts and the humanities provide students with multiple benefits. Philosophy, history, literature and other liberal arts disciplines, they argue, are falling prey to the economic rationale that has overtaken higher education and puts a premium on business, health, engineering, technology, security and other disciplines in demand in the economy. But the study of liberal arts and the humanities, they emphasize, do give students transferable skills that employers seek out, such as, inter alia, critical analysis, the ability to question assumptions, and language and writing skills. Unlike STEM fields that may impart a more tangible market value to a degree, these disciplines cultivate in students what is genuinely and uniquely human – qualities that machines will probably (or hopefully) never be able to possess.[27] The

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[25] Alia Wong, "The Commodification of Higher Education, Colleges and Universities Have Become a Marketplace that Treats Student Applicants Like Consumers. Why?," *The Atlantic*, March 30, 2016.
[26] Beth Potier, "Teaching or Research? Students or Consumers? Role of Money, Technology in Education Eyed," *The Harvard Gazette*, October 18, 2001.
[27] See Nick Anderson, "Going for the Hard Sell as Interest in English Major Declines," *The Washington Post*, April 10, 2015; Steven Pinker, "The Intellectual War on Science," *The Chronicle of Higher* Education, February 13, 2018; Stanly Fish, "Stop Trying to Sell the Humanities,", *The Chronicle of Higher Education*, June 17, 2018; Paul Jay, *The Humanities "Crisis" and the Future of Literary Studies* (U.S.: Palgrave

very fact that a market utility argument has to be made in defense of the preservation of liberal arts and the humanities is in itself an apt indication of where they stand as disciplines, not just among students but also in decision-making processes among university governance.[28] On the other hand, a rising academic current argues that it is technology itself that will save the humanities. A fledgling subset known as the Digital Humanities has begun to rise, premised on the idea that computational tools and methods applied to the deciphering of classic texts – thus with capabilities the human brain has never possessed – will shed entirely new light on great works.[29]

Research carried out in academia, which has for so long been a symbol of excellence for institutions of higher learning especially in the United States, is also affected by the diktat of market rules. As public budgets aimed at supporting it dwindle away, its funding is increasingly provided by private corporate actors. The consequences for basic research, which does not offer the promise of a quick return on investments, have been dire, as funding goes to applied research that can lead to patents and commercialization.

4. Financial impact

Globalization has also entailed profound transformations in the financing of higher education. As pointed out above, the expansion of private-sector funding that has made universities accountable to external, non-state actors just as the capacity of national governments to support higher education was declining has contributed to spread the view that a college degree is a commodity that, like every other, should come with a price.[30] This has translated, inter alia, into the increase of tuition fees in many countries where college education is not overwhelmingly public and free. It has also opened the playing field to a growing number of for-profit providers that have been enabled to operate across national borders. Within colleges and universities, it has, for example, prompted the growing use of adjunct faculty, who work part-time for lower wages and fewer benefits and now comprise the vast majority of instructors in American academia – a cost-cutting trend that further devalues the teaching activity (see A5, Share of U.S. college and university faculty by tenure, 1969 and 2009, and A6, Trends in faculty employment status, 1975-2011).

Conclusion

Globalization has had some positive consequences on the development of higher education. It has promoted education policies that broaden access to students of merit

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Macmillan, 2014); George Anders, *You Can Do Anything: The Surprising Power of a "Useless" Liberal Arts Education* (U.S.: Little, Brown and Co., 2017).

[28] Randall E. Stross, *A Practical Education: Why Liberal Arts Majors Make Great Employees*, (U.S.: Stanford University Press, 2017).

[29] See, among multiple books, Steven E. Jones, *The Emergence of the Digital Humanities* (U.S.: Routledge, 2013).

[30] See Philip G. Altbach, "Why Higher Education is not a Commodity," *The Chronicle of Higher Education*, May 11, 2001.

from socio-economic categories that were broadly left out before, and has fostered an "increasingly international and mobile academic profession," as well as the creation of "global research networks."[31]

Yet the commoditization of higher education remains a process driven by academic institutions situated in the West – North America, Australia and leading European Union countries – and more likely to benefit that part of the world. In that sense and in a number of other respects, such as the quiet lowering of evaluation standards for graduation, the assumed mission of fostering equality that commercialized higher education claims to have taken on comes across as arguable at the very least.[32]

Greater fears yet are rising of a future world ridden with soaring inequality as we stand on the threshold of the AI revolution.

[31] Philip G. Altbach, "Higher Education and the WTO: Globalization Run Amok," *International Higher Education*, The Boston College Center for International Higher Education, No 23, Spring 2001.
[32] Muller, *The Tyranny of Metrics*.

PART TWO. EMERGING TECHNOLOGIES ON AND OFF CAMPUSES: TRENDS

This part first explores the changes that emerging technologies have already brought about in higher education and then proposes an assessment of changes to come.

To such a proposal it may be objected that, at a time when technological advances in the field of computers, automation and artificial intelligence are virtually occurring daily, a "now/in the future" approach constitutes a methodological hurdle rather than a path toward more clarity, simply because an "in the future" item may become a "now" item in a matter of weeks. There is merit in this observation, because the pace of technological innovation today makes it more difficult both to draw a sharp distinction between present and future, and to predict the future (provided that the latter has ever been less than difficult).

In the field of higher education, however, the trends observable today have been in the making for well over two decades, and there seems to be a broad consensus among experts as to at least what the very-near future will bring. Many universities across the world have been implementing some of the relevant fruits of technological innovations, and the perfect coincidence of transformations induced by the processes of internationalization and globalization explored in Part One with those generated by technology does lend credence to the endeavor to separate present and future for methodological – and indeed clarity – purposes. Absent technological advances in communication, in particular with respect to the production and circulation of data, there would have been, after all, no internationalization and globalization processes in higher education.

1. What has changed: The penetration of digital technology and AI on and off campuses

"The world is going to university," *The Economist* declared in a 2015 article describing how mass higher education was invented in the United States in the 19th century and, after spreading to Europe and East Asia in the 20th, is now expanding through the rest of the world, with the exception of sub-Saharan Africa. Between 1992 and 2012, the global rate of college-age population at university grew from 14 to 32 percent, and the number of countries with a ratio of enrolled students above 50 percent from 5 to 54 (see A7, Increase in college graduates in South Korea, U.S. and OECD countries 1995-2016). "University enrollment," the article says, "is growing faster even than demand for that ultimate consumer good, the car."[33]

The paradox in this fact is that while countries across the world continue to draw inspiration from the American system, the merits of getting a university education are being increasingly questioned in the United States. Several reasons account for this growing skepticism, in particular the ever-rising costs of higher education to national

[33] "The World is Going to University," *The Economist*, March 26, 2015.

budgets and families. Distrust clearly began to develop in the aftermath of the Great Recession of 2008. Graduates who then sought to enter the workforce were faced with the prospect of unemployment and underemployment at levels unprecedented in previous decades, and the perceptional impact of that crisis has proved to be long-lasting (see A8, Unemployment and underemployment rates for college graduates aged 21-24, 2007-2018). In the wake of the economic crisis, the belief that a college degree was a safe ticket to a well-paying job could no longer be taken for granted.

Though the global economy has vastly recovered over the last decade, this same belief is now being questioned again on a far wider scale and with a much broader impact for colleges and universities. The issue at stake today is no longer whether the economic outlook at the time of graduation will allow recipients of a tertiary education to rapidly obtain profitable employment, but to what extent, given the pace of technological changes in the labor market, this will even be possible. This concern arises after a decade in which, following the Great Recession of 2008, a new approach to higher education called the "student-success movement" grew to question the role of higher education, not only because of rising costs to families but also in view of low graduation rates and gaps in outcomes between students of different socio-economic and ethnic backgrounds.[34]

The learning experience in many universities across the world today is already dramatically different from what it was even a decade ago. It suffices to focus here on a handful of innovations that emerging technologies have made possible to grasp the significance of the changes in what "studying" means that have already taken place.

Online learning. Whether as part of the curriculum for enrolled students or as an offer geared to a wider public, online courses have been part of the learning practices in higher education since the early 2000s**.** The advantages they offer students enrolled at university are by now well known: flexibility, ability to follow courses without having to get to a classroom, the possibility to study when most convenient, etc. When they first emerged as an alternative to classroom learning, online courses, and indeed the full online colleges, both non-profit and for-profit, that then began to multiply, were indeed widely seen as a service that had the potential to revolutionize the meaning of higher education.

This was particularly true of massive open online courses (MOOCs), launched a decade later in 2011 with the awesome promise of democratizing university learning by allowing virtually anyone who wanted to take a college course to do so, in many cases at no cost. In just a few years, the MOOCs offer grew exponentially, from 3 initial courses opening on line in October 2011 to 7,465 in June 2017.[35] (See A9,

[34] "Student Success," in The Future of Learning, *The Chronicle of Higher Education*, 2018, p. 11.
[35] "Cumulative Growth in Number of MOOCs, 2011-17," *The Chronicle of Higher Education*, August 13, 2017.

Growth of MOOCs 2012-2018) By the end of 2017, Udacity, one of the leading providers, had reached a total of 81 million cumulative learners.[36]

MOOCs have undoubtedly achieved some of the goals their creators had intended, such as making high-quality educational resources available to categories of people across the world who would not be able to attend similar courses in person. Yet they have not thus far, as first announced, revolutionized access to higher education – let alone "kill" university degrees as many enthusiasts had predicted they would when the first courses were going on line.[37]. By 2013 or 2014, it was becoming apparent that completion rates for online courses were particularly low – ranging between 5 and 13 percent through various surveys.[38] Subsequent research showed that online courses were more likely to attract a demographic segment already well educated and employed, more male than female, and living in the developed world. In addition, a majority of distance learners were taking these courses out of intellectual curiosity or for work advancement rather than to acquire an essential education that they could have no other access to. A majority of beneficiaries were, in other words, part of the precise segment that the MOOCs offer did not primarily target, because they were a segment that was or had already been involved in higher education and were already doing well.[39] Accordingly, among enrolled students, online courses have also proved by and large to be handled more successfully by learners who were already better equipped to study than by those requiring pedagogical support.

It can therefore at the very least be said that, in terms of pedagogical progress, online courses have not brought about the promised revolution. They have also opened an entire dark side to higher education that the creators were apparently unable to foresee and that has to do with the integrity of students. Coursework on the internet has indeed multiplied the possibilities of cheating – now emblematic of the IT penetration in academia. Today, we live in an age of multinational cheating schemes that involve countless "essay mills" – services located in Asia or Africa that offer students to write their term papers or even take an entire online course (with a guaranteed top grade) for them, for a fee. With students in the developed world increasingly focused on getting the degree that gets the job and increasingly oblivious to the broad merits of higher education, essay mills have become a booming business that allows educated individuals in the developing world to make a decent living at writing papers that enable those students to cheat – an innovative way to perpetuate or even deepen North-South economic inequality. The classroom itself is no longer a relatively safe ground for evaluation: the rise of technology has bred social media sites

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[36] By the Numbers: MOOCs in 2017, Class Central, https://www.class-central.com/report/mooc-stats-2017/

[37] "Will MOOCs Kill University Degrees?," *The Economist*, October 2, 2013.

[38] See for example Maria Konikova, "Will MOOCs be Flukes?," *The New Yorker*, November 7, 2014, and D.F.O. Onah, J. Sinclair and R. Boyatt, "Dropout Rates of Massive Open Online Courses: Behavioural Patterns," edulearn, the University of Warwick, United Kingdom, 2014. https://warwick.ac.uk/fac/sci/dcs/people/research/csrmaj/daniel_onah_edulearn14.pdf

[39] See for example, Gayle Christensen, Andrew Steinmetz et al., "The MOOC Phenomenon: Who Takes Massive Open Online Courses and Why?," November 6, 2013, http://dx.doi.org/10.2139/ssrn.2350964

and apps that provide answers to quizzes and exams taken in class on fact-based questions, or allow students who previously took the exams to pass on answers.[40]

More broadly, the availability of online resources that rely on crowdsourcing has changed the relationship that students have to the material and subjects they study, and poses significant challenges to instructors, who can no longer view themselves as sole legitimate disseminators of content. Natasha Jankowski, director of the National Institute for Learning Outcomes Assessment based at the University of Illinois and Indiana University, sums up in these terms the transformed teacher-learner relationship: "It's about authentic demonstrations that are externally facing so students can be part of this data-rich environment and about how we're helping each other collectively to move us from a 'gotcha' assessment to creating a developmental learning experience. It's a different teaching-learning mentality."[41]

While technologies such as virtual reality, augmented reality, and 3-D printers are making their way onto campuses, in particular in scientific disciplines, those that for now seem to dramatically alter the configuration of the academic path for a growing number of students across the world are systems of educational technology and the new science they are producing: Learning Analytics.

Ed Tech and Learning Analytics. Over the last few years emerging technologies have spawned the exponential development of software and AI-aided, cloud-based technology – Ed Tech in short – that aim to adapt learning methods and customize curricula to fit each student's ability to move forward at his or her own pace. These systems use analytics to assess competency in the different areas of the curriculum, and then let students take the time to reinforce weaker areas, thereby creating a customized curriculum. Still in the early stages of development, Ed Tech is promoted by its startup creators as having the potential to end the practice of instructors teaching to the classroom average while lower-level learners are unable to catch up and those with the better abilities remain disengaged. The promise is that by automating ability assessment and the tracking of learning difficulties, better outcomes can be obtained by each student and by the class as a whole. In the process, the instructor shifts from the role of knowledge provider to that of facilitator and problem solver. Away from the classroom and from online courses, the technology also helps students refashion their curriculum as they move forward toward graduation. A growing number of universities in the developed world are thus partnering with tech companies and investing resources in developing the online

[40] On the ways of cheating that technology has made possible, see "How Students Cheat in a High-Tech World," the Focus collection of articles on the subject published in 2016 by *The Chronicle of Higher Education*.

[41] Emma Kerr, "What a Controversy Over an App Tells Us About How Students Learn Now," *the Chronicle of Higher Education*, May 15, 2018.

collection of student data that is needed to power Ed Tech – an activity known as Learning Analytics.[42]

Learning analytics consists in the collection of mainly two types of data: information about who incoming students are, such as demographics and performance in secondary education, and activity data as they move through the curriculum toward completion, such as how they are performing on course work and requirements, connections to the internet, comments posted on discussion boards, etc. Some systems track mobility on campus such as trips to cafeteria, the gym, the library or the tutoring center. Much as the tech giants collect user data on the internet to "enhance users' internet experience," i.e. concretely to direct to users advertising they are more likely to be responsive to, learning analytics gathers data that will make possible the personalization of the student's learning process. The technology used includes prediction (Predictive Analytics) that allows the college to identify trouble spots and intervene to boost performance. Through language-based and visual methods, algorithms detect underlying patterns and relationships in the data to help pinpoint learning difficulties and strengths. With the tailoring of the learning process to every student's singular learning personality as the ultimate goal, the educational focus in gathering data about students' performance – which has of course always existed at university, mainly through evaluation – shifts from outcomes to process. Ben Maddox, chief instructional technology officer at New York University, defines learning analytics as the use of "data from, about and with students to improve the learning environment and to research how we see, identify and understand more about learning."[43]

The broad idea is to remedy the "one-size-fits-all" approach that higher education has been traditionally grounded in, and to reduce or even close achievement gaps among students of increasingly diverse socio-economic and ethnic backgrounds so that more students can perform well at university, thereby increasing graduation rates. The overall societal goal, one might say, is one of social justice.

As with any data collected by the Big Four tech companies, data collected via learning does pose the question of data protection and ethics, which analytics faculty and professionals are aware of. As is the case everywhere else on the internet, the students' consent is obtained through the forms they sign upon admission. By and large, the consensus in the higher education community seems to be that, since the sole purpose of learning analytics is to help students "enhance their learning experience," the risk of data misuse is very low to nonexistent.

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[42] Investopedia Academy, which offers online financial courses, see http://www.investopedia.com/terms/e/edtech.asp and Education Technology, an edtech news online magazine. Also see http://www.edtechnology.co.uk/Article/what-the-edtech-learning-analytics.
[43] At Learning Analytics Summer Institute, June 11-13, 2018, Columbia University, NY.

Conclusion

Learning management systems (LMS) are the range of software applications that power all these technology-based activities, from online courses to blended learning that combine both online and traditional learning, and flipped classrooms where the delivery of instructional content is carried out online and classroom time devoted to questions and debate. LMS provide platforms that teachers at primary- and secondary-education level use across the world to manage their teaching and are also an option for employee training and retraining. They have thus also penetrated the market of higher education, and were valued at 5.2 billion dollars as an industry in 2017, with projections of this revenue more than tripling by 2021.[44] Google, Microsoft and Apple have joined this vibrant market by offering free educational online tools.

In the promotional material disseminated by LMS professionals and at conferences and fairs in which they participate, great emphasis is consistently put on the fact that the human dimension remains at the core of every one of these innovations and of all pedagogical tools aimed at assisting students. Yet criticism of present performance is also rising – more often, naturally, from non-stakeholders. One major objection raised against the spreading use of these technologies is that by focusing on individual students who create an entire relationship with the associated devices and platforms, Ed Tech does not foster the development of social skills – one area in which AI is particularly weak – as interacting with teachers and peers in a physical classroom does. This of course mirrors the growing societal concern over young people spending more time nowadays interacting with a screen than with any human in their surroundings.

On a broader scale, while online courses have so far failed to live up to their democratization promise and it is too early to seriously assess the overall impact of educational technology on performance enhancement and graduation rates in higher education, the virtues of customized learning vs. traditional education delivered in "one-size-fits-all" format appear to be taken for granted among all stakeholders as well as an overwhelming segment of non-stakeholders. Lost in the debate is the fact that these technologies clearly aim to make the learning experience less constraining, more game-like, in short more to the taste of the individual student. This does raise the question of whether there is indeed sizeable progress in habituating young people to reject constraint, to grow intellectually and mentally in an educational landscape where the rewards of pain – of long attention spans that have to be devoted to understanding complex, not always immediately stimulating, material, of the sense of being somewhat behind the best students in the class and having to invest efforts in catching up – are all but absent. Needless to add, arguments on behalf of such a "retrograde" view of education, and even questioning that seeks to shake up the

[44] Julia Boorstin, "A Lesson Plan from Tech Giants on How to Transform Education," CNBC, DISRUPTOR/50, https://www.cnbc.com/2017/03/28/microsoft-google-and-facebook-see-billions-in-future-of-education.html

assumptions behind the concept of customized learning, are barely audible in the current hype on the subject. They are, nevertheless, worth hearing.[45]

2. What's under way: an assessment

Devoting even a minimal amount of attention to the ongoing debate among AI specialists and observers at large makes one thing clear: the window of predictability on the advances AI and other emerging technologies may make in the future, near or far, is extremely narrow. Any firm scenario that may therefore be proposed as to what the future of technology in education may look like in any number of years would not just be a bold proposition, but also one very likely to be wrong. Only one prognosis can be made with more than relative safety: no promise of disruption to the disruptive seems to appear on the horizon. It is therefore reasonable to envisage continuity.

Discernable trends. It is thus clear that technologies that are developing today on and off campus will expand, both in nature and geographically, as governments across the world increasingly invest in them and struggle for their higher education systems not to be outpaced. The trends underlined in the previous section will keep evolving as emerging technologies – such as for example the use of robots as chatbots to enhance tutoring and advising – take hold and eventually lose the adjective.

By most accounts, the learning experience of tomorrow will be more active and interactive and take place in an environment that blurs the boundaries between the traditional classroom and the world outside of it. It will be less of a self-contained activity and more of an exchange with the "real world."

Already prominent among pedagogical strategies today is what is called "experiential learning," a "process through which students develop knowledge, skills, and values from direct experiences outside a traditional academic setting," which includes "internships, service learning, undergraduate research, study abroad, and other creative and professional work experiences."[46] This may be the way that students' social skills, unaddressed, as seen above, by educational technologies, will be fostered and developed. "In the future," says MIT's Sanjay Sarma, learning will have to "take place everywhere, not just in the classroom or at school." Learning processes will have to generalize the "practice of the flipped classroom, with shorter modules that take into account the fact that the average maximum attention span is ten minutes."

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[45] For an argument on behalf of "rigidity," see Kathleen Lowrey, "Old-School Learning Provides Firmness in a Disrupting World," *Edmonton Journal*, June 1st, 2017.

[46] What is experiential learning?, Experiential Learning Center, University of Denver, Colorado http://www.ucdenver.edu/life/services/ExperientialLearning/about/Pages/WhatisExperientialLearning.aspx

Education will aim to develop in everyone an "instinct for learning, a culture where people are constantly learning."[47]

The overall goal of learning strategies will be to develop competencies that allow students to adapt to any change through the waves of technological transformations they will experience in their future. To that end, teaching will no longer be focused on imparting knowledge but on helping students learn to learn, acquire a skill to learn that they will carry with them through their professional life, in which they will constantly have to learn and relearn. As Deloitte's Janet Foutty puts it, the motto of higher education will shift from "learn to work" to "work to learn."[48] In fact, Tom Galluzzo of IAM Robotics says, the education of the future will not necessarily consist in getting a degree but will emphasize getting hands-on experience with technologies.[49]

Preparing to face the future. There is a prevalent sense among education experts and other stakeholders that higher education, often accused of poorly preparing students for the challenges of professional life because, among other things, the university is vastly disconnected from the corporate world, will no longer have the option to maintain this status quo in future years. As digital and AI-technologies, coupled with automation and robotization, are transforming the workplace at a pace never experienced before by humankind, introducing and even immersing students in the world of work during their college years will become an imperative. This already takes the form of various types of partnering between universities and companies or factories – a trend that college governance will have to follow and expand in the future.

In fact, what all forecasts are unanimous about is the prediction that the leading type of education in the future will be life-long learning – one of the solutions proposed to deal with the technological tidal wave that is rapidly rising. As viewed in Part One of this work, globalization and internationalization have already pushed universities to reshape their programs and curricula to meet labor market needs. The technological revolution will push them further in that direction in the coming years, with calls already rising to make college education closer to vocational training and apprenticeships.[50] This evolution will probably continue to take its toll on the humanities and liberal arts, but the imperative to remain competitive in the international marketplace will leave college governance with little choice to not follow suit.

Joseph Aoun, the president of Northeastern University, recommends a holistic strategy for higher education to keep students relevant in the labor markets of the future. He believes that colleges and universities should promote curricula that include

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[47] Sanjay E, Sarma, professor of mechanical engineering and vice-president for Open Learning at the Massachusetts Institute of Technology, EmTech Next 2018, June 4-5, 2018, MIT Media Lab, Cambridge, MA.
[48] Janet Foutty, chairman and CEO of Deloitte Consulting, EmTech Next 2018.
[49] Tom Galluzzo, CEO of IAM Robotics, EmTech Next 2018.
[50] See for example Scott Carlson, "Why Colleges Need to Embrace the Apprenticeship," *The Chronicle of Higher Education,* June 4, 2017.

experiential learning and together provide technology, data and human literacy – i.e. literacy in skills that are unique to humans such as innovation, entrepreneurship, communication, global thinking, team work, etc. He is among those who advocate a leading role in life-long learning for universities.[51]

One recent innovation that combines the concepts of higher education and life-long training might point the way toward sustained future relevance for universities: the "open-loop university," created by Stanford University in 2014. Rather than a traditional degree obtained over four consecutive years, students can choose to accumulate six years of study whenever they want through their professional life. Michigan University went even further when it gave its MBA graduates the option to return for an executive-level program, free of charge, through their lifetime.[52]

These emerging and developing strategies for universities to maintain relevance in the world of tomorrow may come across as a tall order. Institutions of higher learning are often viewed as conservative bureaucratic machines that require time to adopt and adapt to changes. In the current context, there is the added problem that, in the future, technology and the way it is transforming the workplace may outpace any change that universities that strive to remain competitive will be able to put in place.

Conclusion

The expansion of education technology and increasing reliance of universities on it to reinforce their legitimacy, relevance and efficiency has already given rise to much criticism. Predictive analytics is only a fledgling trend among universities across the world. Even in the United States, only seven percent of universities have reported deploying these systems at institution level, though over half of all colleges are either piloting or expanding their use.[53] Yet fears already focus on the possibility that the classroom of the future may become too heavily dependent on these technologies, to the point that they will be allowed to prescribe not just *how* students learn but also *what* they learn.[54]

The adverse effect of digital and AI technology on social skills may also become an even greater issue as the use of devices and screens pervades the educational landscape the way it already has every dimension of young (and not-so-young) people's lives. In addition, in the obsessive drive to remain competitive and relevant, many universities seem to invest little in those skills that AI is said – for now – to lack, such as critical thinking, creativity and empathy – which, admittedly, are not easy to teach.

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[51] Joseph E. Aoun, *Robot-Proof: Higher Education in the Age of Artificial Intelligence* (U.S.: The MIT Press, 2017).
[52] Danielle Paquette, "In the Future, College Never Really Ends," *The Washington Post*, June 6, 2018.
[53] "Students Success," *The Chronicle of Higher Education*, p. 13.
[54] Nikol Rummel, Erin Walker and Vincent Aleven, "Different Futures of Adaptive Collaborative Learning Support," *International Journal of Artificial Intelligence in Education*, June 2016, Volume 26, Issue 2, pp. 784–795.

This is taking place at a time when the current student generation, already raised in complete exposure to the internet and mobile devices, exhibits, according to research, declining abilities in the kind of literacy that comes from reading - mindful knowledge acquisition, inductive analysis, critical thinking, imagination, and reflection.[55] Meanwhile, there is no convincing evidence to date that these technologies improve student learning, and the "focus on quantifying classroom experience," says Molly Worthen, an assistant professor of history at the University of North Carolina, "makes it easier to shift blame for student failure wholly unto universities, ignoring deeper socio-economic reasons that cause many students to struggle with college-level work."[56]

Finally, at global scale, another reasonable fear to express is that of seeing the penetration of digital and AI technologies in higher education deepen the divide and economic inequality between North and South. Though free Ed Tech platforms are making it easier for teachers in schools with few resources all over the world to improve the quality of education at primary and secondary level, universities in the developing world may rapidly find themselves at further distance yet from a position in which they can deliver education that is up to par with international standards and prepares students for competitive jobs that will benefit national economies.

[55] Patricia M. Greenfield, "Technology and Informal Education: What is Taught, What is Learned," *Science*, vol. 323, January 2, 2009.
[56] Molly Worthen, "The Misguided Drive to Measure 'Learning Outcomes,'" *The Chronicle of Higher Education*, February 23, 2018.

PART THREE: THE FUTURE OF WORK

What will automation do to jobs? This is the question that every stakeholder in and observer of the labor markets of today and tomorrow is raising these days. The answer, to say the least, remains elusive.

"There are about as many opinions as there are experts," claims an article in the MIT Technology Review. It then provides a list of forecasts, some of which go as far as 2035, that make it clear that there is no consensus among the numerous institutions now engaged in offering projections about jobs to be created and destroyed by automation. Looking at any given target year that these forecasts put forth also makes it clear that no distinct trend emerges even there (see A10, Predicted jobs automation will create and destroy).[57]

Putting some context around the issue requires an examination of what labor trends have been emerging and developing over the past decade as an earlier product of technology and global trade – in short, of what is now called the "gig economy."

1. The new casualization of work

As is often the case with neologisms, different definitions can be found for what the gig economy means. In simple terms, it is an economy where the form of labor that becomes pervasive is "a way of working that is based on people having temporary jobs or doing separate pieces of work, each paid separately, rather than working for an employer."[58] The term "gig" in the sense that is used here appeared in 1926 in reference to jobs assigned for a specific time, and often to "an entertainer's engagement."[59] The more elegant name for roughly the same concept is the "collaborative economy." At the core of all definitions lies the fact that jobs emblematic of the gig economy do not come with a permanent contract and are not permanent jobs. Nor do they come with the labor protections and benefits that have been typical of the welfare state. Their legal status is often blurry. They can be based on short-term contracts or done on a free-lance basis by independent contractors, and they now often involve online collaborative platforms intermediating work with individuals on line. The array of jobs in this category is very broad, ranging from delivery, ride hailing, restaurant and housecleaning jobs to translation, design and consulting (and outsourced essay writing). Gig economy workers in white-collar occupations are also referred to as "digital nomads."

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[57] Erin Winick, "Every Study We Could Find on What Automation Will Do to Jobs, in One Chart," *MIT Technology Review*, January 25, 2018.
[58] Cambridge English Dictionary on line.
[59] Merriam Webster's Collegiate Dictionary, 10th edition, 1993.

The gig economy has rapidly spread around the globe, bringing the opportunity of employment for young people in regions where youth unemployment is high such as parts of sub-Saharan Africa and Southeast Asia, or where steady employment for low-skilled youth is lacking such as parts of Europe. These jobs also help people with regular employment generate additional income. According to a 2016 Pew Research Center study, 24 percent of Americans reported earning money in the previous year from what is also called the "platform economy."[60] Leading gig work platforms praise their business models as innovations that will create a revolution in labor markets because they "can help lift people out of poverty." Enthusiasts believe that this "new world of work" can "have structural benefits on the global economy, such as raising labor force participation and improving productivity."[61] Proponents of the gig economy point out the benefits of flexibility, autonomy and potential higher incomes that it provides to its workers. Critics, on the other hand, emphasize the casualization of labor that the gig economy has brought about, offering in most cases no minimum wage, no sick or overtime pay, no paid vacation and no health insurance.

As traditional employers increasingly turn to the digital platforms for extra staffing according to need and see an advantage in the lower labor costs the outlet affords, labor experts are concerned that this growing trend will jeopardize steady work based on permanent contracts. "We're seeing only one trend here," says Diane Mulcahy, author of a book on the subject, "which is that the gig economy is big and getting bigger. Companies will do just about anything to avoid hiring full-time employees."[62] [63]

Millennials' participation in the gig economy is rising, and many value the alternative form of work it proposes more than traditional steady jobs.[64] Whether this, added to the economic factors already mentioned, indicates that the gig economy will indeed revolutionize the world of work remains an open question. A 2016 report compiled for the European Commission concedes that collaborative platforms have the potential to profoundly transform the labor market. But it also finds that, with a rate of 0.05 percent European Union workers involved in these jobs at present, there is no sign thus far that the gig economy is having a significant impact on the traditional labor market or on job creation and destruction in Europe.[65]

More broadly, the structure of work has been shifting away from the classical lifetime career or even long-term employment framework that had dominated labor markets for

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[60] Aaron Smith, "Gig Work, Online Selling and Home Sharing," Pew Research Center, Internet & Technology, November 17, 2016.
[61] Mark Graham, Vili Lehdonvirta, Alex Wood et al., "The Risks and Rewards of Online Gig Work at the Global Margins," Oxford Internet Institute, University of Oxford, 2017.
[62] Abha Bhattarai, "Now Hiring, for a One-day Job: the Gig Economy Hits Retail," *The Washington Post*, May 4, 2018.
[63] Diane Mulcahy, *The Gig Economy: The Complete Guide to Getting Better Work, Taking More Time Off, and Financing the Life You Want* (U.S.: AMACOM, 2016).
[64] Kelly Monahan, Jeff Schwartz and Tiffany Schleeter, "Decoding Millennials in the Gig Economy: Six Trends to Watch in Alternative Work," Deloitte Insights, May 1st, 2018.
[65] Willem Pieter De Groen, Ilaria Maselli, "The Impact of the Collaborative Economy on the Labour Market," CEPS Special Report No. 138, June 3, 2016.

generations. In the age of startup glamour, steady long-term jobs may no longer be a primary objective even for young people with a college education. Within corporations, the structure of work is changing as well. Management no longer means handing down the rules and projecting authority but being a team leader. Skilled staff is increasingly hired on a project basis, and then moves on. Work is increasingly done elsewhere, anywhere, anytime, even by those who still belong to a company that has physical offices somewhere.

Will this developing reconfiguration of labor coincide with the wave of AI, robotization and automation and thus result in a positive impact on labor, or will the two trends collide, with a compounding effect on job losses?

2. Robotization, automation, Artificial Intelligence: phase one

AI was first envisaged as a human fantasy in science fiction novels and movies that began to multiply in the first half of the 20th-century. It may, however, be argued that crafting automatons out of gold and bronze and assigning them various tasks such as guarding, serving or going to combat was a matter of routine for the gods of Ancient Greece.[66] The modern origin of AI is credited to Alan Turing, of Enigma codebreaking fame, who explored its mathematical possibility. The term itself was coined in the first academic conference on the subject at Dartmouth College in 1956. AI has thus been studied for decades, with advances in search and machine learning algorithms, and breakthroughs that for a long time elicited wonder only among scientists (see A11, Artificial Intelligence timeline 1930-2000).

Assessing the impact that automation and AI may have on future jobs could start with an analysis of what effect the penetration of robots has already had on industrial jobs – an activity sector that has been exposed to automation for several decades. Researchers Daron Acemoglu (MIT) and Pascual Restrepo (Boston University) did just that, in a 2017 study for the National Bureau of Economic Research titled "Robots and Jobs: Evidence from U.S. labor Markets." In it, they focus on the effect that the increase in robot usage had on the employment rates of different areas and industries in the United States between 1990 and 2007, while controlling for the influence of other factors such as job offshoring and increased imports from China. They find that each new robot added caused the loss of 3 to 5.6 jobs in a commuting zone observed, and a drop of 0.25 to 0.50 percent in local wages. They see negative effects "on essentially all occupations, with the exception of managers [...].Predictably, the major categories experiencing substantial declines are routine manual occupations, blue-collar workers, operators and assembly workers, and machinists and transport workers." While the metrics of the impact may appear small, it must be noted that the authors adopt a restrictive definition of robots (fully autonomous, multipurpose), and

[66] The hounds of Alcinous, immortal creatures guarding the palace of King Alcinous, and the twenty tripods of Olympus mounted on golden wheels and serving the gods gathered on Mount Olympus, all fashioned by Hephaistos, the god of craftsmanship and blacksmiths, are only two of many automatons described in Homer's Iliad and Odyssey.

that these are pre-AI era robots. In addition, they note that "interestingly, and perhaps surprisingly, we do not find positive and offsetting employment gains in any occupation or education groups." Thus the job loss due to robot penetration was not compensated by job creation of another type. However, they assess that even under the most aggressive scenario, the fraction of U.S. employment being affected by robots is relatively small, at least for the time being. "There is nothing here," they conclude, "to support the view that new technologies will make most jobs disappear and humans largely redundant."[67]

Addressing elsewhere the subject of emerging technologies and how they affect labor, Acemoglu, like many other economists, distinguishes between enabling technologies, which complement and increase the productivity of certain types of skills, and replacing technologies, which take over tasks previously performed by labor – each with very different labor implications. While enabling technologies are found to increase wages and labor demand because they increase workers' productivity, replacing technologies have the opposite effect. However, Acemoglu adds, many technologies combine enabling and replacing elements. Replacing technologies have already had a significant labor-reducing impact on jobs involving, inter alia, assembly tasks, switchboard operation, mail sorting, packing, stock trading, cash dispensing and operating machines. He points out that AI can be used not only for replacement but also for creating new tasks and functions, yet that at present the focus of investment is on the former rather than on the latter. However, if too many resources are directed at AI that replaces tasks and not enough at AI that creates new tasks, both labor and productivity, he warns, will suffer. On a final note, he warns that "we are getting ready for the technologies of the 21st century with an educational system that was designed in the mid-20th century and has been going backwards ever since."[68]

People across the world are now witnessing and experiencing daily the automation of tasks performed by humans only a few years ago – in automated check-out at retail stores, in e-commerce and through automated call-center systems, at hospitals and clinics. What has been the fate of workers thus replaced? Aggregate data at macroeconomic level on how many jobs have already been lost to digital and AI-powered automation is difficult to come by. But amid the warnings of major potential damage to labor in years to come, some voices have been rising to stress that we are already seeing significant labor disruption. Former U.S. Treasury Secretary and Harvard economics professor Larry Summers talks about "labor-substitutive

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[67] Daron Acemoglu and Pascual Restrepo, "Robots and Jobs: Evidence from U.S. Labor Markets," MIT Economics, https://economics.mit.edu/files/□de4r

[68] Massachusetts Institute of Technology, EmTech Next 2018, June 4-5, 2018, MIT Media Lab, Cambridge, MA. See also Daron Acemoglu and David Autor, "Skills, Tasks and Technologies: Implications for Employment and Earnings," Ch. 12 in *Handbook of Labor Economics*, Orley Ashenfelter and David Card (eds.) (U.S.: Elsevier B.V., 2011).

innovation", which, he argues, has so far only vastly benefited the top one percent. He believes that we are "only in the early innings of such a wave".[69]

From the innings to the wave, the recurring question with the elusive answer remains: what future impact?

3. Impact of robotization, automation and Artificial Intelligence on the future of work

Technological transformations have always resulted in short- to medium term job losses before economies could generate substantial job creation again. As seen in the introduction, the Industrial Revolution defined disruption, yet Western economies subsequently – mainly after the Second World War – went on to reach unparalleled productivity and prosperity, including for the working class. Could *this* disruption, in contrast, lead to a prolonged period of dire unemployment for millions or more and require decades for the global economy to adjust again?

As suggested above, experts and observers of the current transformations can be broadly sorted into an optimistic camp versus a pessimistic one. The former, in which members and leaders of the tech industry dominate, believes that this turning point in history will have compensation effects typical of the self-regulating power of the market comparable to those of similar technological revolutions in history. Among the pessimists, some conjure up the specter of human work as a whole made virtually obsolete. One main argument put forth by the pessimists is that this technological revolution is radically different from the previous ones. This trend has been embodied since 2013 by the seminal analysis of Frey and Osborne, in which the two Oxford University economists demonstrated that up to 47 percent of all American jobs could be lost to automation in the near future. They argued that what makes this wave of technological advances different is that machine learning (the ability of AI systems to learn independently from experience through data without being programmed for it) and mobile robotics allow machines to perform tasks that until now have been considered uniquely human – which goes far beyond the routine and repetitive tasks that AI has all but conquered. This new scope of automation includes cognitive actions such as self-driving and legal writing. This, the authors believe, will translate into automation that, unlike in previous waves of transformation, will not yield the compensation effects of sufficient job creation that had occurred over time in the past.[70]

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[69] See interview in Jim Tankersley, "Robots Are Hurting Middle-Class Workers, and Education Won't Solve the Problem, Larry Summers Says," *The Washington Post*, March 3, 2015.
[70] Carl Benedikt Frey and Michael A. Osborne, "The Future of Employment: How Susceptible Are Jobs to Computerisation?," Oxford University, September 17, 2013.
www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

In 2014, a year after the publication of this study, the subject of technology and unemployment dominated the World Economic Forum meeting at Davos. A Pew Research Center survey carried out at the summit showed that participants identified "structurally high unemployment/underemployment" as the second global risk of highest concern in a list of ten.[71]

One important driver of the fear generated by the AI revolution is that it is now believed that it will affect white-collar as well as blue-collar jobs, while the initial prevalent perception had been that, as in the past, the main impact would be on low-skilled jobs, so that at the very least the change, though daunting, would remain on known territory. Indeed, as early as 2012, Vinod Kholsa, a Silicon Valley investor, ventured to predict that in health care AI would make 80 percent of doctors redundant.[72] Another prevalent forecast is that AI and robots will affect the developing world even more than the developed one, because, as automation gains ground in the West, industrial jobs outsourced to developing countries will collapse (much as what happened with the rise of the Industrial Revolution.) A 2016 United Nations report estimates that two thirds of all workers in the developing world could be replaced by automation.[73]

Though there seems to be a prevalence of research supporting the pessimists' camp, other studies have found that job elimination from automation was vastly overestimated. A 2016 OECD working paper establishes that automation and digitalization are unlikely to destroy a large number of jobs. It rejects the occupation-based approach of Frey and Osborne and suggests instead a task-based approach. It argues that the estimated share of jobs at risk should not be equated with actual employment losses for three reasons. First, automation is a slow process and technological substitution does not usually happen as expected. Second, workers can adjust to technological changes by switching tasks, which prevents unemployment. Third, technological changes also generate new jobs by stimulating higher competitiveness and demand for new technologies.[74] In addition, this year, the Brookings Institution analyzed 28 industries in 18 OECD countries from 1970 to 2018 and found that automation not only did not reduce the overall number of jobs available but even increased it, though it also showed that automation has caused wage stagnation by reducing the share of human labor in the value added to work.[75]

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[71] Jacob Poushter, "World Economic Forum Survey Identifies Top 10 Global Risks for 2014," Pew Research Center, January 23, 2014.
[72] Vinod Khosla, "Do We Need Doctors or Algorithms?," Temin and Company, January 10, 2012, www.teminandcompany.com/must-reads/perception-psychology/160-do-we-need-doctors-or-algorithms
[73] "Robots and Industrialization in Developing Countries," UNCTAD, November 2016.
[74] Gregory M.T. Arntz and U. Zierahn, "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis," *OECD Social, Employment and Migration Working Papers,* No. 189, OECD Publishing, Paris.
[75] David Autorand and Anna Salomons, "Is Automation Labor-Displacing? Productivity Growth, Employment, and the Labor Share," BPEA Conference Draft, Spring, the Brookings Institution, 2018.

As the handful of research publications mentioned here from an overwhelming volume of analytical work produced on the subject over the past three decades makes clear, we are back to the original observation that forecasts of job losses to automation and AI in the coming years, and arguments made on behalf of one side or the other, far from dispelling the confusion, result in adding to it. This poses a major problem for a host of stakeholders in today's society such as, among others, policymakers, business owners and leaders, workers and, most significantly, for the higher education sector.

Be that as it may, the next logical question is that of what skills will be in demand in the labor markets of the future.

4. Tomorrow's skills

Research, media articles and societal debates on the subject of how to prepare future workers for the challenges of the automating economy are also plentiful. Paradoxically though, they all seem to be pointing in similar directions – a surprising fact in view of the heterogeneous character of impact forecasts.

Most studies and prognoses converge to establish that broadly new skills will be necessary for people to either simply survive, or thrive – depending on one's outlook – in the digital and AI age. As seen above, a growing number of institutions of higher learning across the world are already undertaking major changes in the curricula they propose to students and in the guiding they offer through academic programs. However, by most accounts, many more educational transformations will be needed for well-paying work to remain a viable option in the years or decades to come, and these transformations of course do not solely involve colleges and universities.

Besides the lack of visibility in future labor trends, first and foremost among the factors that are putting educational and training institutions in a difficult position is the pace of technological advances. A 2015 Burning Glass Technologies report showed that the demand for data-science skills had tripled over only five years. It also concluded that many of the skills needed to remain in demand in the future labor markets – such as, inter alia, organization, communication, negotiation, and writing, analytical and computer skills – were skills that could be learned throughout a professional path.[76]

Earlier this year, the McKinsey Global Institute published an extensive report on future skills (see A12, Automation and AI will change the skills needed in the workforce). The study quantifies time spent on 25 core workplace skills today and in the future in the United States and five European countries, focusing on five activity

[76] The Human Factor, The Hard Time Employers Have Finding Soft Skills," Burning Glass Technologies, 2015 www.burning-glass.com/wp-content/uploads/Human_Factor_Baseline_Skills_FINAL.pdf

sectors: banking and insurance, energy and mining, healthcare, manufacturing and retail. It proposes five key findings, three of which apply to the skill supply side. First, the demand for technological skills (least in demand today) will surge by 55 percent until 2030, followed by emotional skills (e.g. leadership, managing others). Second, the demand for basic cognitive skills (e.g. data input and processing) and manual skills (e.g. equipment operation) will drop by 14 and 15 percent respectively. Third, the demand for high-skilled workers will grow and job loss caused by automation will mainly affect low-skilled workers, thus exacerbating the growing inequality trend of the past two decades.

Many other studies and findings could be reviewed, with similar results. Unlike with research seeking to forecast the proportion of jobs that will be eliminated by AI and automation and within what timeframe, foresight surveys that focus on skills draw a clear picture of where to go for young people who are considering post-secondary training or education options. What remains to be seen is whether many institutions involved in post-secondary education, universities in particular, will be able to implement the changes that would allow them to impart those talents.

Tomorrow's skills seem to be embodied by two major characteristics. First, competences across the board, even with high levels of specialization, will have to include a mixed range of both professional and personal skills. Second, acquiring skills will no longer be confined to the formative years of life but will continue throughout professional life via life-long learning, i.e. life-long training and retraining.

This clear-cut end to a rather perplexing overview of future trends in labor warrants a direct transition to the broad conclusion of this report.

CONCLUSION

Taking stock of the dramatic societal and economic transformations that are under way prompts the question: are we ready?

Much of the literature devoted to the future of work argues that the answer is no. Governments and lawmakers are not by and large moving to put forth policy and legal frameworks aimed at reining in the impact of what may be a tidal wave on developed and developing societies alike. Proposals abound, such as government funding of lifelong training and retraining, the implementation of a universal basic income or even – at Bill Gates' suggestion – taxing robots. It is beyond the scope of this report to attempt to weigh in on such questions. But focusing on institutions of higher education alone inspires the same question: are they ready?

To remain relevant in the face of such daunting changes can be a harrowing endeavor, and it must be feared that not all academic institutions will be able to live up to the challenge. Pointing the way toward how colleges and universities should evolve to adapt are the two major characteristics that the current research consensus seems to ascribe to the skills that will be in demand tomorrow: the ability to engage in life-long learning, and the acquisition of hybrid and nimble skills. It would seem wise to imagine that only those universities that can rapidly embrace this new reality and reinvent themselves accordingly have a chance of thriving in what is certain to be an even more competitive landscape in the future. Many may dislike how these trends will affect the very core and nature of higher education. But just as an alternative economic model is yet to emerge across the planet, so it seems that there will be little leeway in seeking unconventional paths.

Depending on the socio-economic policies of countries, initiators and actors of life-long learning frameworks today are mainly found either in the business sector, where employers invest in training and retraining staff, or at state level where governments engage in policies that either update or redirect workers' skills – in many cases without devoting the necessary impetus and budgets to the task. This is unfortunately true of the United States and most of the European Union, with the exception of Scandinavian countries, which have been implementing efficient reskilling policies for their populations for decades. In years to come, universities, which have by and large stayed away from or even looked down on these programs, should become major players in life-long learning. The example of Stanford's "open-loop" university and of Michigan University may be an indication of a wise developing trend. An economy where knowledge acquired at an early stage in life will no longer last through an entire career path seems to offer an opening field of development and growth for institutions of higher learning intent on remaining competitive. The budgets and organizational efforts required to seize this opportunity may render the choice difficult for countless universities, but there is little doubt that the prospect carries high potential for the higher education sector.

Hybrid skills, the other marker for future skills in demand, can also be seen as an opportunity. Reorienting curricula to foster such flexibility will require a type of restructuration that makes increasing room for interdisciplinary teaching and learning. This too, for many institutions, will represent a major endeavor. But in a tech-dominated society, striving to cater to this need may well be what could spell redemption for the humanities and liberal arts. A growing number of universities are now offering hybrid degrees in science and humanities and calls are rising from education professionals, the business sector, international institutions and other stakeholders to put an end to the dichotomy between the two broad fields in tertiary education.

In the final analysis, the world to come, such as delineated in these countless reports, studies and surveys, may well prove unendurable if the thoughtfulness, sense of moral and ethical priorities and historical continuity, and – simply – the elevated literacy that the study of the humanities have bestowed on students for many centuries are not a foundational part of the spiritual compass among the educated youth.

APPENDICES

A1. Cover letter to the Triple Revolution Report

March 22, 1964

Dear Mr. President:

We enclose a memorandum, The Triple Revolution, for your consideration. This memorandum was prepared out of a feeling of foreboding about the nation's future. The men and women whose names are signed to it think that neither Americans nor their leaders are aware of the magnitude and acceleration of the changes going on around them. These changes, economic, military, and social, comprise The Triple Revolution. We believe that these changes will compel, in the very near future and whether we like it or not, public measures that move radically beyond any steps now proposed or contemplated.

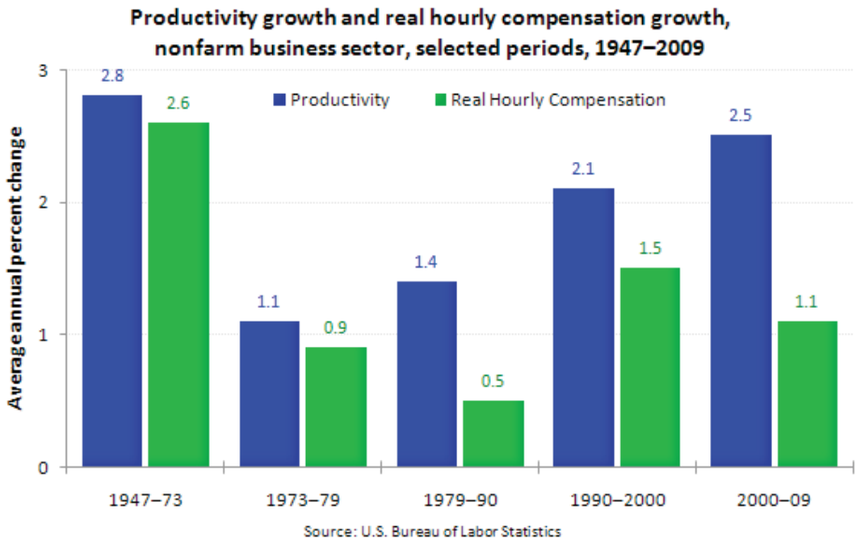
We commend the spirit prompting the War on Poverty recently announced, and the new commissions on economic dislocation and automation. With deference, this memorandum sets forth the historical and technological reasons why such tactics seem bound to fall short. Radically new circumstances demand radically new strategies.

If policies such as those suggested in The Triple Revolution are not adopted we believe that the nation will be thrown into unprecedented economic and social disorder. Our statement is aimed at showing why drastic changes in our economic organization are occurring, their relation to the growing movement for full rights for Negroes, and the minimal public and private measures that appear to us to be required.

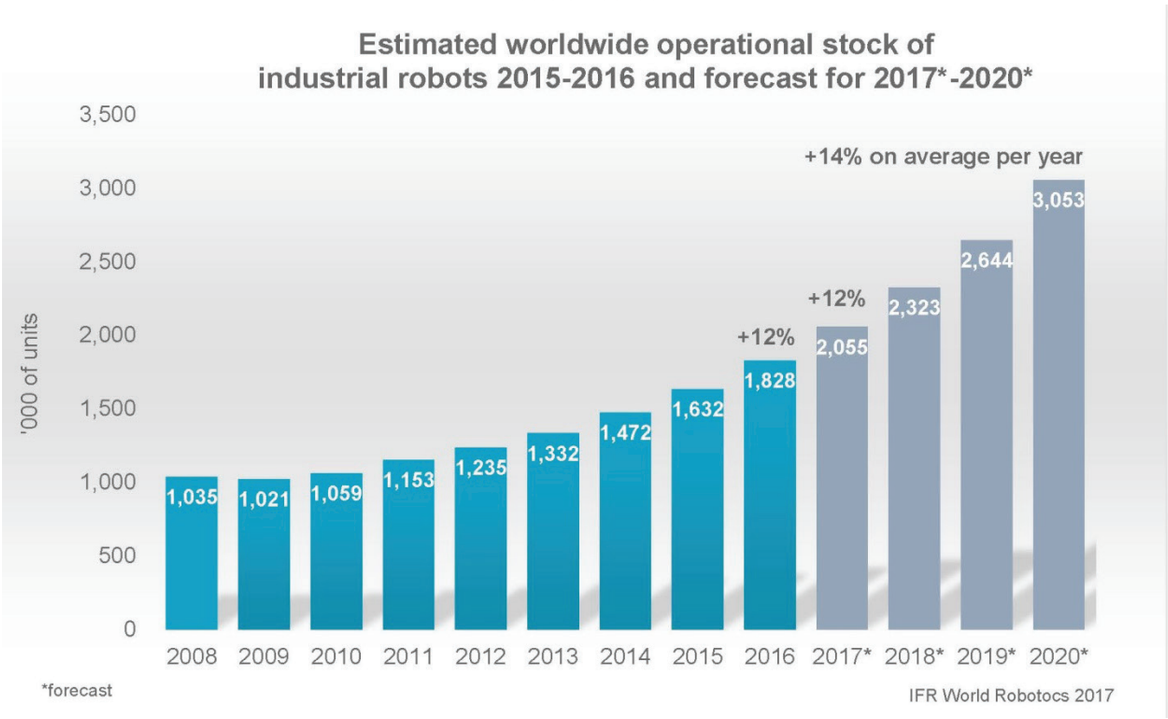
Sincerely,

Donald G. Agger
Dr. Donald B. Armstrong
James Boggs
W. H. Ferry
Todd Gitlin
Roger Hagan
Michael Harrington
Tom Hayden
Ralph L. Helstein
Dr. Frances W. Herring
Brig. Gen. Hugh B. Hester
Gerald W. Johnson
Irving F. Laucks
Gunnar Myrdal
Gerard Piel
Michael D. Reagan
Ben B. Seligman
Robert Theobald
William Worthy
Alice Mary Hilton
David T. Bazelon
Maxwell Geismar
Philip Green
H. Stuart Hughes
Linus Pauling
John William Ward

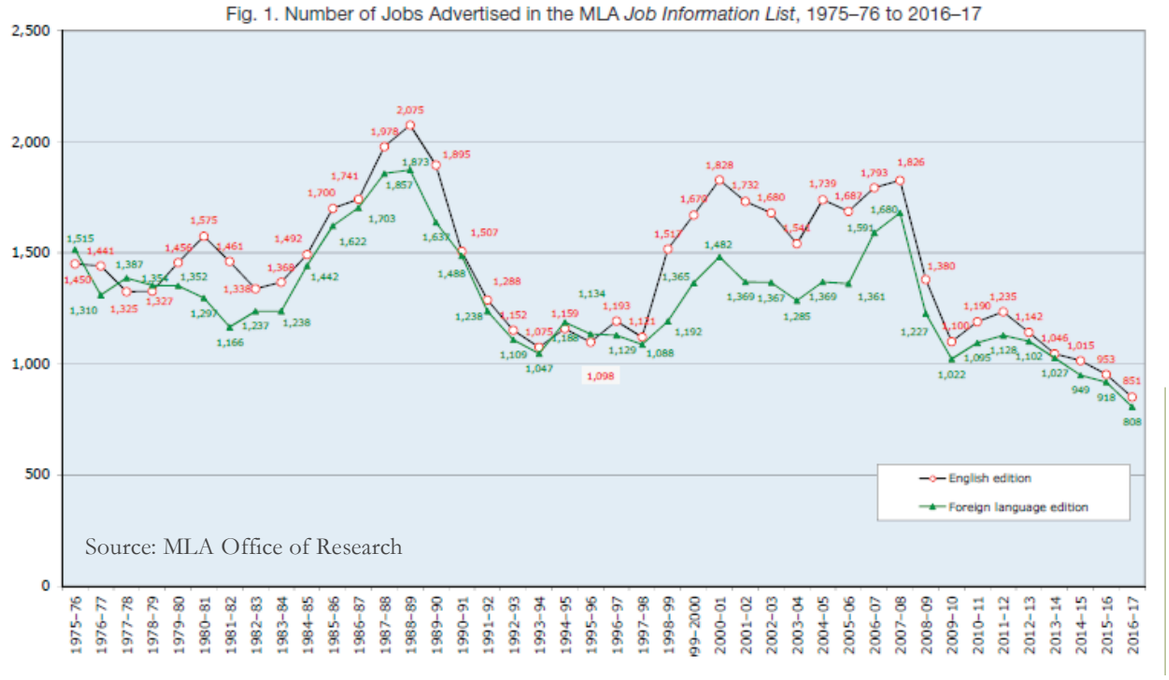
A2: Productivity growth vs. compensation growth in the U.S., 1947-2009



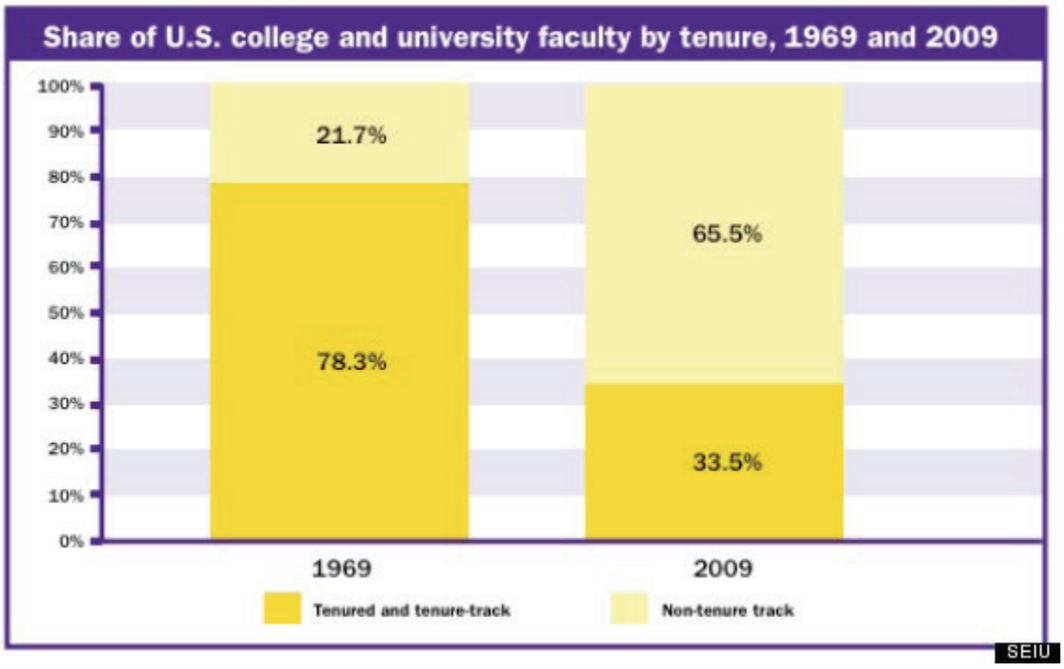
A3: Growth and forecasted growth in operational stock of industrial robots 2008-2020



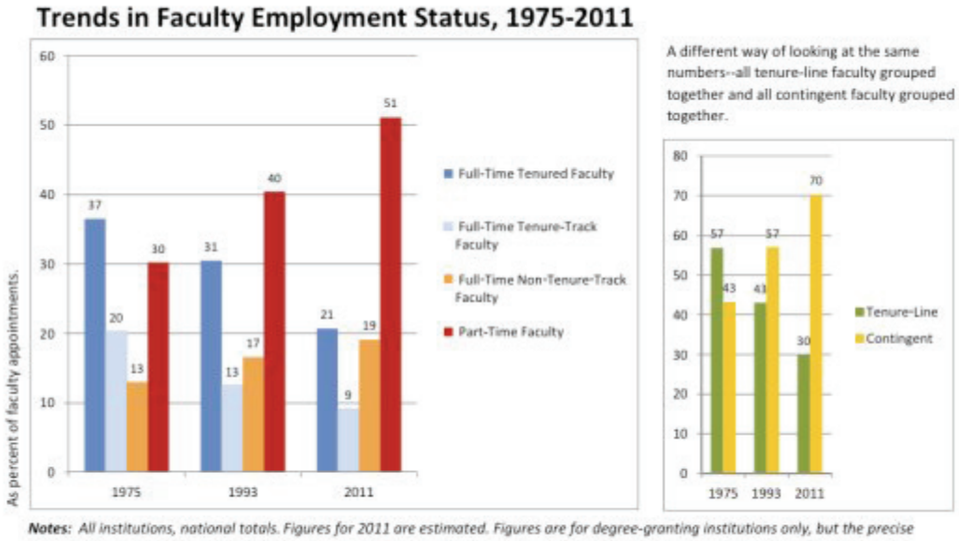
A4: Number of teaching jobs in English and foreign languages fields advertised in the MLA Job Information List 1975-76 to 2016-2017



A5: Share of U.S. college and university faculty by tenure, 1969 and 2009



A6: Trends in faculty employment status, 1975-2011



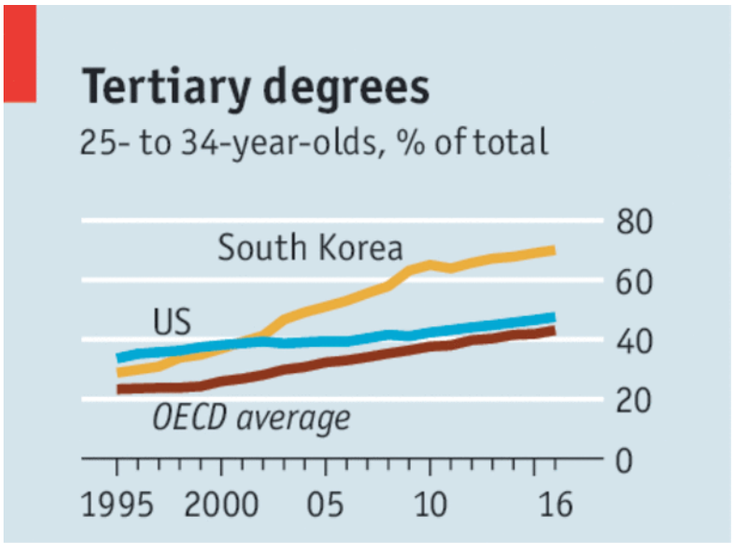
Notes: *All institutions, national totals. Figures for 2011 are estimated. Figures are for degree-granting institutions only, but the precise category of institutions included has changed over time. Percentages may not add to 100 due to rounding.*

Source: *US Department of Education, National Center for Education Statistics, IPEDS Fall Staff Survey; published tabulations only.*

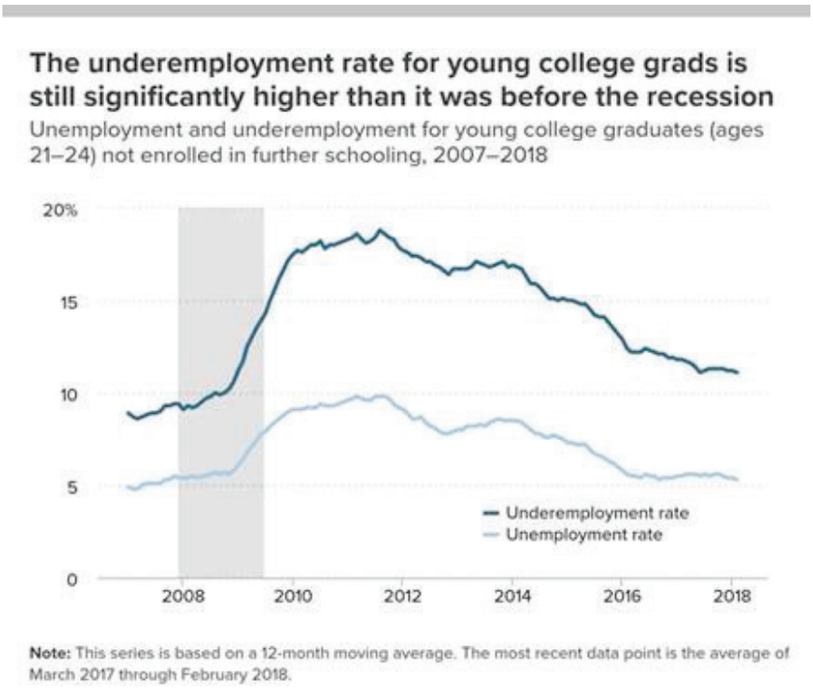
Compiled by: *AAUP Research Office, Washington, DC; John W. Curtis, Director of Research and Public Policy (3/20/13)*

AAUP

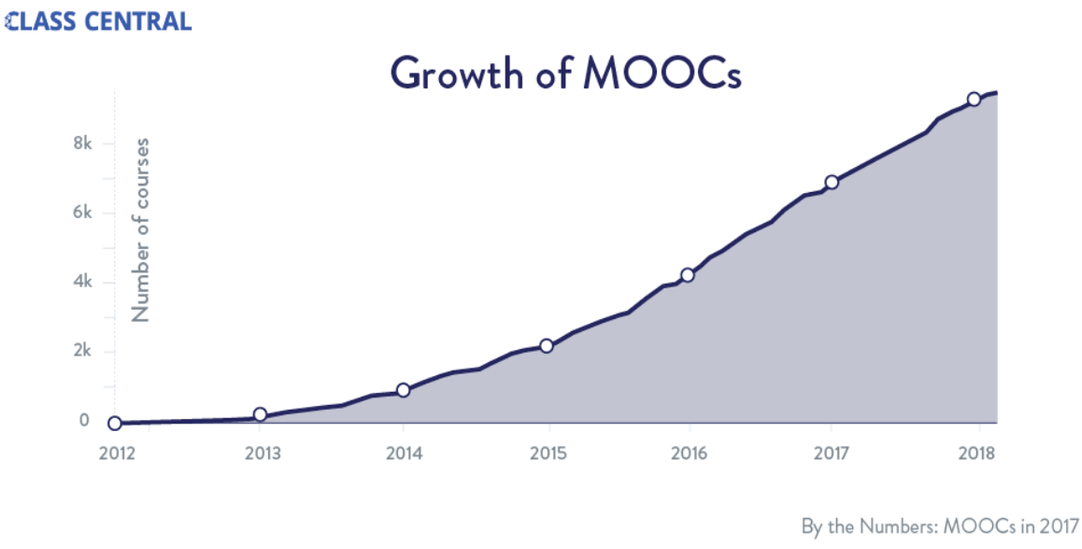
A7: Increase in college graduates in South Korea, U.S. and OECD countries 1995-2016



A8: Unemployment and underemployment rates for college graduates aged 21-24, 2007-2018



A9: Growth of MOOCs 2012-2018

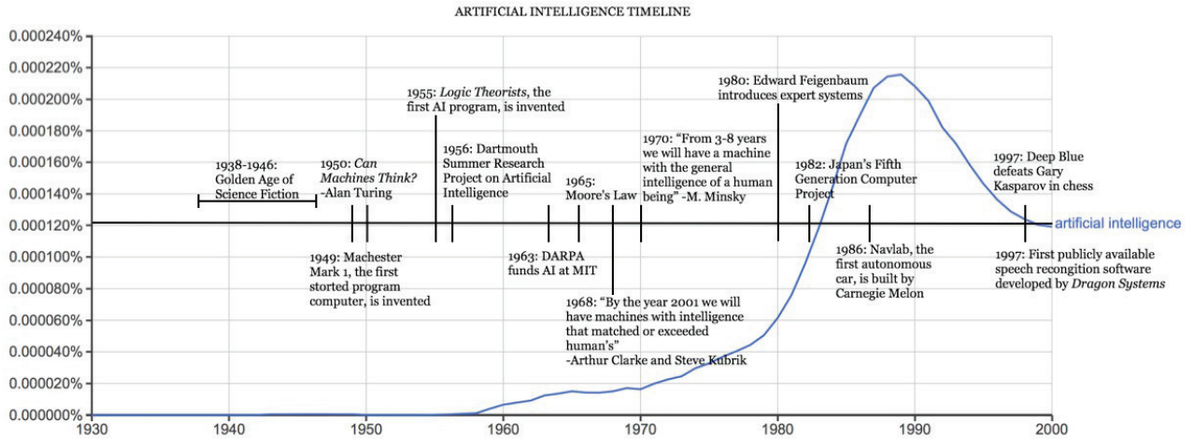


A10: Predicted jobs automation will create and destroy

Predicted Jobs Automation Will Create and Destroy

When	Where	Jobs Destroyed	Jobs Created	Predictor
2016	worldwide		900,000 to 1,500,000	Metra Martech
2018	US jobs	13,852,530*	3,078,340*	Forrester
2020	worldwide		1,000,000-2,000,000	Metra Martech
2020	worldwide	1,800,000	2,300,000	Gartner
2020	sampling of 15 countries	7,100,000	2,000,000	World Economic Forum (WEF)
2021	worldwide		1,900,000-3,500,000	The International Federation of Robotics
2021	US jobs	9,108,900*		Forrester
2022	worldwide	1,000,000,000		Thomas Frey
2025	US jobs	24,186,240*	13,604,760*	Forrester
2025	US jobs	3,400,000		ScienceAlert
2027	US jobs	24,700,000	14,900,000	Forrester
2030	worldwide	2,000,000,000		Thomas Frey
2030	worldwide	400,000,000-800,000,000	555,000,000-890,000,000	McKinsey
2030	US jobs	58,164,320*		PWC
2035	US jobs	80,000,000		Bank of England
2035	UK jobs	15,000,000		Bank of England
No Date	US jobs	13,594,320*		OECD
No Date	UK jobs	13,700,000		IPPR

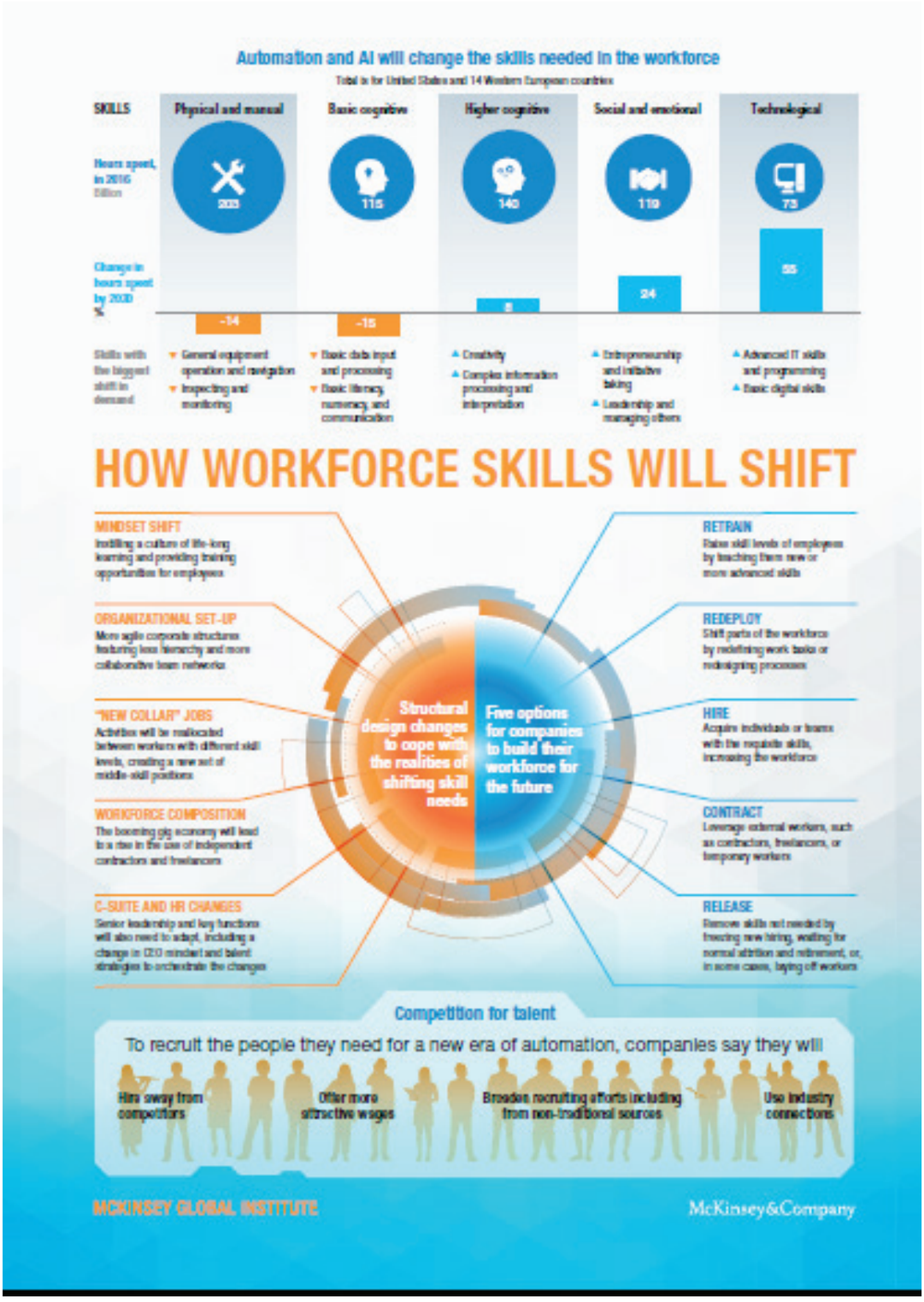
A11: Artificial Intelligence timeline 1930-2000

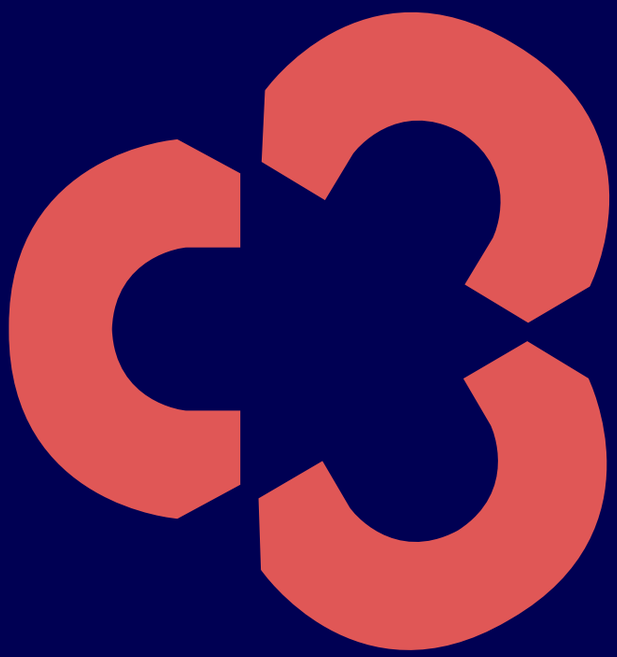


Source: The History of Artificial Intelligence, Science in the News, Graduate School of Arts & Sciences, Harvard University

Source: MIT Technology Review, Erin Winick, Jan. 25, 2018

A12: Automation and AI will change the skills needed in the workforce





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