



01/2022

12/01/2022

Pedro Sánchez Herráez

Industrial revolution 4.0!: A new century of revolts in the Mediterranean?*Industrial Revolution 4.0!: A new century of revolts in the Mediterranean?***Abstract:**

Industrial Revolution 4.0 is already a reality: the combination of technology and digitisation gives economic processes capabilities and possibilities that are unparalleled in history, and will, apparently contribute to creating a new model of society, a new socio-economic paradigm. Although the parameters of this fourth industrial revolution differ from those of previous revolutions, the first, the quintessential industrial revolution, also shook the foundations of society to such an extent that it changed the socio-economic paradigm in such a way that it led, among many other consequences, to a century of revolutions in Europe and the migration of millions of people out of the continent in search of a better place to live. A brief account of developments in this regard, an assessment of some of the existing realities in the Mediterranean basin and the potential impact of this fourth industrial revolution on these realities make up this analysis.

Keywords: Industrial Revolution, Industry 4.0, Socio-economic Model, Mediterranean, Europe.

How to cite this document:

SÁNCHEZ HERRÁEZ, Pedro. *Industrial Revolution 4.0!: A new century of revolts in the Mediterranean?* IEEE Analysis Paper 01/2022.

https://www.ieee.es/Galerias/fichero/docs_analisis/2022/DIEEEA01_2022_PEDSAN_Revolucion_ENG.pdf and/or [bie link3](#) (accessed on day/month/year)

NOTE: The ideas contained in the Analysis Papers are the responsibility of their authors. They do not necessarily reflect the thinking of the IEEE or the Ministry of Defence.

The industrial revolutions!...

Although it is possible to find certain differences and nuances – even in the number of industrial revolutions that have taken place –, in general terms¹ four, including the current one, are generally defined by the terms "mechanisation", "electrification", "computerisation" and "digitalisation".

The first industrial revolution, centred on the invention of the steam engine at the end of the 18th century and the application of this invention to different techniques and procedures, marked a before and after in the history of humanity, by introducing machines in processes that until then had been carried out by human beings, with coal being the primary source of energy. In many respects, it is the quintessential industrial revolution, given the impact it had on the existing socio-economic model, with direct and indirect impact on a global scale.

The second industrial revolution took place in the late nineteenth and early twentieth centuries, including the middle of the twentieth century, during which the exponential development of the internal combustion engine and the spread of electrification developed a socio-economic model largely based on oil as the primary source of energy, while technology progressed and spread across the globe, making it smaller and more interconnected. The world wars, among other milestones, are a reference point for this reality.

During the second half of the 20th century, both the development of nuclear energy and the increasing use of natural gas as a means of energy production, together with the progressive introduction of robots and "computers" in production systems, as well as the development of information technology in the latter part of the millennium, were once again modifying not only production processes, but also socio-economic structures themselves, in this so-called third industrial revolution, in which the virtual world and the power of cybernetic machines were beginning to be perceived.

And already in the third millennium, the search for green energy as a way to generate a more sustainable model and to avoid or slow down the pace of climate change, together with digitalisation, are inducing a new – the fourth – industrial revolution.

¹ Various Authors, "Capturing the Fourth Industrial Revolution", *Foresight Africa 2020*, Brookings, page 61.

This fourth industrial revolution, also sometimes referred to as "Industry 4.0", has the combination of physical elements and advanced digital technologies at its core – the Internet of Things, artificial intelligence, robots, drones, autonomous vehicles, 3D printing, cloud computing and nanotechnology, among others – which will allow, among many other things, organisations, consumers and society to make decisions based on more data². But this fourth revolution will not be a mere continuation of the previous one³, but because of its scope, depth, degree of impact and influence on humanity as a whole, it will be a new and absolutely distinctive revolution.

If the first industrial revolution removed the foundations of the socio-economic model of the time, this fourth revolution could generate a new model that is very different from what has been known so far. But do these phenomena, these revolutions, only affect manufacturing processes?

...Are they just industrial?

The very concept of "revolution", as opposed to "evolution", already implies a rapid and drastic change, a "profound and usually violent change in the political and socio-economic structures of a national community"⁴; and the fact that it is called "industrial" perhaps only serves to highlight one of the primary causes of its unleashing.

Therefore, the paradigm shift, the rapid mutation of the relationship between technological change, prosperity and employment – always a complex and difficult relationship – implied by an "industrial revolution", means that there may be a tendency to slow down the advance and development of technology in many sectors in order to maintain existing systems.

This is nothing new; suffice it to recall the so-called "War of the 17 machines"⁵, as the episode of 2 March 1821 was called, during which a crowd of some 1,200 people

² The Fourth Industrial Revolution. At the intersection of readiness and responsibility", Deloitte, 2020, page 3. Available at <https://www2.deloitte.com/ch/en/pages/risk/articles/industry-4-0-intersection-of-readiness-and-responsibility.html> NOTE: all internet links in this document valid as at 4 January 2022.

³ "The impacts of the Fourth Industrial Revolution on jobs and the future of the third sector", Nicav.org Available at https://www.nicva.org/sites/default/files/d7content/attachments-articles/the_impact_of_the_4th_industrial_revolution_on_jobs_and_the_sector.pdf

⁴ "Revolución", *Diccionario de la Lengua Española*, Tricentennial Edition, 2021, meaning 2. Available at <https://dle.rae.es/revoluci%C3%B3n>

⁵ BERNABEU MUNUERA, Leandro. "La guerra de las 17 máquinas", El Saltodiario.com, 29 June 2018. Available at <https://www.elsaltodiario.com/movimiento-obrero/guerra-17-maquinas-alcoi-primera-protesta-ludita>

destroyed the carding and spinning machines installed in the town of Alcoy. These machines, which had arrived the previous month, constituted the beginning of mechanised production in the area, which had remained under the guild system almost unchanged since the Middle Ages, thus breaking the existing socio-economic paradigm, generating a revolt that spread for a long time throughout the region and required the intervention of troops to quell it.

In fact, there was a movement born in England, the Luddites⁶ – named after their supposed leader, Ned Ludd – which during the first part of the 19th century was dedicated to destroying the new machines that arrived in factories, arguing that they took jobs away from people; the movement was harshly repressed, including the use of troops and death sentences – in fact, the British government sent more military troops to fight the Luddites on its own soil than to the Iberian Peninsula to fight Napoleon – to prevent it from spreading and destroying the industrial revolution through which England intended to gain ground as an Empire and as a global power.

Indeed, the introduction of the powered loom led to the rapid destruction of 90% of the manual employment of people who were replaced by machines; however, it is also necessary to remember that, in three decades, direct and indirect employment in the same business sector increased by 4,400%⁷, as well as increasing the quality of life of the workers. Or, that in the case of the agricultural sector, from being an activity that employed 90% of the labour force in the 19th century, it now employs less than 2% of the population, and with higher productivity and serving a much higher demand. Consequently, and apparently, the first revolutions brought disorder and disruption for a time, until a new equilibrium was found through the implementation of a new model.

In fact, John Maynard Keynes – one of the most influential economists of the 20th century – in 1930 spoke ⁸ of "technological unemployment", of the loss of jobs generated by the implementation of new technologies... although he went on to later state that the system was rebalancing and generating more and better quality employment than previously.

⁶ GRODIRA, Fermín. "La verdadera historia de los luditas: no era tecnofobia, era lucha de clases", Xataka.com, 7 March 2017. Available at <https://www.xataka.com/historia-tecnologica/la-verdadera-historia-de-los-luditas-no-era-tecnofobia-era-lucha-de-clases>

⁷ GARCÍA EGEA, Teodoro. "¿Destruye empleo la revolución tecnológica?", *Cinco Días*, 4 April 2017. Available at https://cincodias.elpais.com/cincodias/2017/04/03/midinero/1491241272_191810.html

⁸ KEYNES, John Maynard. "Economic possibilities for our grandchildren", 1930. Available at <http://www.econ.yale.edu/smith/econ116a/keynes1.pdf>

But this "technological unemployment", spread over a long "transition phase", had powerful consequences on the surrounding social and economic structures, and therefore on social stability and order; in fact, in the same way as with artisanal production, the improvement in technical progress that implied an increase in the mechanisation of the countryside left millions of people with little or no training, without work, so that "unemployment was often the ultimate consequence of agricultural improvement", at least during that transition phase. And while this labour force was largely oriented towards the nascent industry – towards low-skilled and low-paid work – it also accelerated the haphazard growth of urbanisation and cities.

And without social support systems, having no work – or very precarious and poorly paid work – was synonymous with hunger and misery... and social revolts and revolutions, the first industrial revolution, the one that marked a before and after in human history, brought with it a stormy and tumultuous period.

Nineteenth century... a complex and revolutionary century!

The social consequences generated by the change of model were so intense and costly that it is not for nothing that the 19th century is known as the "century of revolutions", due to the number and intensity of the revolutions that took place; also given this complex and new reality, this period saw the birth of both the so-called "utopian socialism" – Saint-Simon, Fourier, Owen, etc. – and the "scientific socialism" of Marx and Engels, offering new models and paradigms in the face of the rupture of the existing one up to that time.

Thus, the situation could be described as follows: "Technologies were the pinnacle of wealth and success for some; poverty for others. The social divisions they created could become apparent in a small community, or lead to a large regional split. The new technologies were either resisted or welcomed; they suffered over the years as the old methods had suffered before. They created some new jobs, but also brought unprecedented unemployment for many others. The new methods, the new machines, not only meant a temporary worsening; they could also eradicate a trade and thus deny many people the possibility of working for the rest of their lives".⁹

⁹BERG, Maxine. "La era de las manufacturas 1700-1820", Editorial Crítica, Barcelona, 1987, page 257.

Therefore, the industrial revolution, together with the great changes generated both by itself and by other external or related causes – from the great advances in medicine to the powerful developments in transport – generated another series of consequences associated more or less directly with it.

Thus, European emigration was a particularly intense and significant phenomenon during the 19th century – although it is important not to underestimate the movement generated from Spain and Portugal to their American provinces during the 16th to 18th centuries – a migratory movement motivated, in addition to this improvement in transport and communications – which made the movement of growing masses of people to any part of the planet possible –, by demographic growth, economic crises, the lack of job opportunities and political repression, among other factors that created difficulties to live on the European continent.

Faced with this harsh reality, even if partially due to "technological unemployment" during a "transition phase", for people suffering the consequences of this change of model, the prospect of a new "El Dorado", or of a simple expectation of a better life¹⁰, even if they found themselves in other lands far from their own – in this case, and to a large extent, in the former colonies and on the American continent – seemed the best or only way out. And although it affected all social classes in differing ways, the basic profile of emigrants was essentially that of a peasant or worker, a poorly educated person with few resources who could only count on the using their hands to earn a wage.

Millions of people crossed the ocean. And, in turn, this constant and massive flow of people, in most cases without a high degree of labour specialisation, contributed to the development of manufacturing industries (which require little specialisation) and to the growth of cities¹¹ in the destination areas, thus explaining much of their sudden prosperity. Labour was required, it was "all to be done" and it was in the millions, as the activities in these countries under construction were essentially labour-intensive. And while figures vary, it can be estimated that between 40 and 50 million people left Europe during this period – a high percentage of the continent's population. Despite this, and

¹⁰ HATTON, Timothy J. and WILLIAMSON, Jeffrey G. "What drove the mass migrations from Europe in the late nineteenth century?", *Population and development Review*, Volume 20, Number 3, September 1994, pages 533–559. Available at <https://www.jstor.org/stable/2137600?origin=crossref>

¹¹ SUKKO, Kim. "Immigration, Industrial Revolution and urban growth in the United States, 1820-1920: factor endowments, technology and geography", NBER Working Paper Series, Number 12900, February 2007. Available at https://www.nber.org/system/files/working_papers/w12900/w12900.pdf

due to advances in medicine and certain living conditions, Europe's population growth was such that it doubled during the 19th century.

The "industrial revolution" and the breakdown of the existing model, together with population growth on the continent and expectations of better pay and living conditions across the sea led to the massive displacement of Europeans in the 19th century¹². But those were different times and a different kind of revolution... or were they?

Fourth industrial revolution...

In this new revolution, where, as happens periodically in history, everything "is new and everything will be different", it is indicated that the benefits of technological developments are exponential for society, at the same time as the reduction in costs is also exponential; thus, the materialisation of the so-called "Moore's Law"¹³ means that a telephone call or sending an email costs infinitely less than in the past, helping to generate an economy whose marginal costs tend to zero.

It is also argued¹⁴ that the development of Artificial Intelligence, one of the pillars of this fourth industrial revolution, could increase and enhance Europe's strategic autonomy by making it less dependent on other entities, as Artificial Intelligence can generate economic and geopolitical advantages and reduce dependence on technology from abroad, as Europe, the European Union, may be well positioned for this new revolution¹⁵, due to the high number and qualifications of many of the people needed to carry it out.

¹² A simple outline can be found in, "Migraciones europeas en el siglo XIX. Las causas", Universidad Nacional Autónoma de México. Available at http://uapas2.bunam.unam.mx/sociales/migraciones_europeas_causas/

¹³ In 1965, John Moore, an engineer working at Fairchild Semiconductor, predicted that the complexity of integrated circuits would double every year and at a decreasing cost, although in 1975 he updated his prediction, stating that this doubling would occur every two years, a law that is being fulfilled. COMPUTER HISTORY MUSEUM. "1965: "Moore's Law" predicts the future of integrated circuits". Available at <https://www.computerhistory.org/siliconengine/moores-law-predicts-the-future-of-integrated-circuits/>

¹⁴ HOFFMAN, Mia and NURSKI, Laura. "Tres frenos a la inteligencia artificial en Europa", Política Exterior, 15 December 2021. Available at <https://www.politicaexterior.com/tres-frenos-a-la-inteligencia-artificial-en-europa/>

¹⁵ ECHIKSONE, William. "Step aside Silicon Valley, there is a new tech hub in the town", Weforum.org, 19 April 2017. Available at <https://www.weforum.org/agenda/2017/04/step-aside-silicon-valley-there-is-a-new-tech-hub-in-town>

As a corollary of this Industry 4.0, it has been suggested¹⁶ that we are moving towards a new economic paradigm, towards a "zero marginal cost society" in which the Internet of Things, together with the decline of the capitalist system as we know it, the end of the verticality so marked in business structures and the collaborative commons – the shift from "exchange value", from the purchase and sale of a good or service to "sharing value"¹⁷, – as a simple example, home or car sharing platforms – will generate a mixed capitalist-commonsharing economy, a new economic model from which everyone will benefit.

But these same technological developments and this change of model also have their consequences, "technological unemployment" if only during a "transition phase" of unknown duration. Technology, therefore, could be that factor of production that is often underestimated or forgotten, but which allows, or is responsible for, the fact that a country's GDP growth may have little or no impact on the labour market.

One of the most obvious and visible cases is banking, which is evolving towards online banking from the traditional "branch"banking model ,which, while making it possible to manage similar volumes of resources and transactions with a much smaller number of employees, also entails a reduction in the number of people and physical spaces occupied by this economic activity on an almost massive scale. This new reality therefore means that sectors of the economy that have traditionally been labour-intensive are becoming capital-intensive¹⁸, and with much smaller workforces.

Certainly, this has been a reality during all revolutions, though perhaps not at the level expected for this one; as an example¹⁹, in the 1990s the three largest companies based in Detroit – once home to the mighty US car industry – were worth \$36 billion and employed around 1.2 million people, whereas today the three largest companies based in Silicon Valley – home to tech companies – are worth \$1.09 trillion but employ "only" 137,000 people, almost 10 times fewer direct jobs than their counterparts three decades ago.

¹⁶ RIFKIN, Jeremy. "La sociedad de coste marginal cero", Ediciones Paidós, Barcelona, 2014.

¹⁷ "El internet de las cosas y la sociedad colaborativa", *EL PAÍS*, 7 September 2014. Available at https://elpais.com/cultura/2014/09/05/actualidad/1409938985_426506.html

¹⁸ FERNÁNDEZ, Julio. "El trabajo tal y como lo conocemos podría desaparecer: La tercera revolución industrial", El Blog Salmón, 24 January 2018. Available at <https://www.elblogsalmon.com/economia/el-trabajo-tal-y-como-lo-conocemos-podria-desaparecer-la-tercera-revolucion-industrial>

¹⁹ GARCÍA EGEA, Teodoro. "¿Destruye empleo la revolución tecnológica?", *Cinco Días*, 4 April 2017. Available at https://cincodias.elpais.com/cincodias/2017/04/03/midiero/1491241272_191810.html

In addition, the rise of driverless cars, big data or smart data systems capable of analysing huge amounts of data, automated assembly lines, smart tags in supermarkets that do away with human cashiers, drone delivery, the replacement of clerical staff by robots and artificial intelligence systems – just look at how the Japanese company Fokoku Mutual Life Insurance has replaced the work of 34 clerks with the "IBM Watson Explorer" system, which, despite its cost, is expected to pay for itself within two years²⁰, or the increasing management of telephone switchboards by automated systems²¹ or callbots²², or the growth of investment systems managed by algorithms rather than brokers²³ – and given that the possibilities are almost endless, machines seem to be the winners.

...and another change of model?

If the so-called "blue collar" workers – due to the colour of their overalls – were the main victims during the processes of industrial automation, in the face of this new revolution, the so-called "white collar" workers – mainly linked to administrative and management tasks (although the differences between both categorisations go beyond this, as they even extend to the degree of training, salary received, social class, etc.) – may now be the main victims of the potential digitalisation of their functions, despite the fact that it is expected or assumed that a new type of worker linked to digital skills, the so-called "new collar" workers will be created.

It is pointed out that 85% of the jobs that will be available in 2030 have not yet been invented, as these new jobs will be linked in many cases to cognitive and emotional activity, and that human beings will be freed from the most burdensome tasks, as many of the jobs that exist today will not survive, or will survive in smaller numbers, due to the

²⁰ PASTOR, Javier. "En Japón la inteligencia artificial comienza a hacer el trabajo de los oficinistas", Xataka, 2 January 2017. Available ne <https://www.xataka.com/robotica-e-ia/en-japon-la-inteligencia-artificial-comienza-a-hacer-el-trabajo-de-los-oficinistas>

²¹ By way of example: "*Robots inteligentes gestionando centralitas telefónicas*", AVISOVOZ.com, Available at <https://www.avisovoz.com/centralitas-inteligentes-con-robots.html>

²² "¿Que es un callbot y para qué sirve?", AGENCIA12, 18 July 2019. Available at <https://agenciab12.com/noticia/que-es-callbot-para-que-sirve>

²³ "Un fondo de inversión gestionado por robots renta más que los de los humanos", *El Economista*, 16 October 2015. Available at <https://www.eleconomista.es/mercados-cotizaciones/noticias/7076828/10/15/Un-fondo-de-inversion-gestionado-por-un-robot-renta-mas-que-los-de-los-humanos.html>

advance of technology²⁴, especially for those related to the "3D rule" (Dirty, Dull, Dangerous) or those that are very repetitive.

It is also argued that the new industry generated by artificial intelligence can generate as many jobs as those destroyed, or even more, in sectors and with profiles such as engineering, software, hardware or linguistics²⁵, that many indirect jobs are created in other sectors, especially in the service sector in the local economy, with a greater multiplier effect for skilled jobs – as is the case of technological jobs –, going so far as to point to the creation of five low-tech jobs²⁶ for every high-tech job created, and that, as a sign of this reality, companies currently find it difficult to recruit due to the shortage of technological profiles²⁷ in the labour market.

But things could be different – and not necessarily better – with the fourth industrial revolution, given the immense capabilities of machines and artificial intelligence; already during the economic crisis that began in 2008, the creation of new jobs has often responded to more precarious and lower paid jobs²⁸; and in the next two decades, technology could replace 47% of current jobs in the United States²⁹, which, as a consequence, would bring with it an increase in socio-economic inequality by increasing the gap between social classes, between those who continue with a job or the possibility of obtaining one in the new digital environment or those who could be left out, those who could be left behind in this new revolution.

Economic inequality could widen, especially between those who have been able to keep their jobs or adapt to change very quickly and the rest, creating powerful social, political and economic tensions, with a direct impact on security and stability.

²⁴ BARCA, Kamila. "27 trabajos con muy pocas salidas que podrían desaparecer en los próximos años", 4 January 2020. Available at <https://www.businessinsider.es/10-trabajos-van-desaparecer-proximas-decadas-555013>

²⁵ "2017: ¿Preparados para un mundo de robots inteligentes?", CINCO DÍAS, 2 January 2017. Available at https://cincodias.elpais.com/cincodias/2016/12/30/tecnologia/1483133801_694493.html

²⁶ GOOS, Maarten, KONINGS, Jozef, and VANDEWEYER, Marieke. "Employment Growth in Europe: The Roles of Innovation, Local Job Multipliers and Institutions", Utrecht School of Economics Discussion Paper Series, Volume 15, Number 10, 2015, page 2. Available at <https://ideas.repec.org/p/use/tkiwps/1510.html>

²⁷ "La escasez de perfiles tecnológicos especializados es una de las principales dificultades de las empresas", *La Razón*, 3 January 2022. Available at <https://www.larazon.es/economia/20220103/4vi3wj7jivgrlg4snuf2kpy4ku.html>

²⁸ ALCOBER FANJUL, Xavier. "Desempleo tecnológico", *Cinco Días*, 4 March 2014. Available at https://cincodias.elpais.com/cincodias/2014/03/04/economia/1393966152_776083.html

²⁹ FREY BENEDIKT, Carl and OSBORNE, Michael A. "The future of employment: how susceptible are jobs to computerization?", *Oxford Martin*, 17 September 2013, page 38. Available at https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

And there is now a so-called "neo-Luddite"³⁰ movement, reminiscent of that which developed during the 19th century, related to all these issues.

The debate is not new; back in 2014, the Pew Research Center published research among nearly 2,000 researchers and experts on the question of technological advancement and work, and the result was fairly evenly split between those who were deeply concerned about the future of work in the new era (48%) and those who were optimistic (52%) about the amplification that the revolution will have for jobs³¹.

But there do seem to be a number of issues on which there is, apparently, a certain degree of agreement; one of them is that the education system is key to not only dealing with this new scenario, but also to minimising the transition period, which may be longer and more traumatic than at other times in history.

On the other hand, it is necessary to consider that development based strictly and exclusively on economic criteria generates a serious dysfunction, as it does not consider the human impact and social consequences of such developments, moving, as pointed out³², from technological dystopia to socio-economic dystopia.

And also, and increasingly so, it is being pointed out that, for the sake of implementing revolution 4.0, both companies and societies should design a strategy, an action plan from the highest level of planning to the lowest level of execution, and that, far from short-termism³³, it should have a medium to long-term vision (otherwise it would not really be a strategy) in order to allow these new tools and capabilities to be integrated harmoniously, and for the changes in organisations and structures, social and economic changes to be carried out in as orderly a manner as possible.

It is even suggested that, given the powerful impact that these new technologies can have on humanity as a whole, it is imperative that they be adequately bounded by legal, ethical and moral standards – as complex as it is to address these issues from a multicultural perspective and on a global scale – given the interrelationship that exists

³⁰ In this sense, JONES, Steven E., "Against technology: from the luddites to neo-luddism", *Taylor & Francis*, 2006.

³¹ SMITH, Aaron and JANNA Anderson. "AI, Robotics and the future of jobs", Pew Research Center, 8 August 2014. Available at <https://www.pewresearch.org/internet/2014/08/06/future-of-jobs/>

³² WEBB, Amy. "Los nueve gigantes. Como las grandes tecnológicas amenazan al futuro de la Humanidad", Ediciones Península, 2021.

³³ "The Fourth Industrial Revolution. At the intersection of readiness and responsibility", DELOITTE, 2020, page 5. Available at <https://www2.deloitte.com/ch/en/pages/risk/articles/industry-4-0-intersection-of-readiness-and-responsibility.html>

and must exist between technology and values. And, in this situation, it is values that should guide technological decisions³⁴.

But if these questions are being asked in the old, advanced Europe about this 4.0 revolution...

... what about the other side of the Mediterranean?

While the southern shore presents wide disparities as a whole, just as it does between the eastern and western Mediterranean – it is enough, without needing to show data, to think of the socio-economic differences between Israel and Libya, for example – it is necessary to bear in mind that the southern shore is not only the limit of the sea of water, the Mare Nostrum, but also the limit of the great desert, the Sahara; and that for centuries, the interconnections between the shores of the desert, the movements from Africa as a whole to the north – and from the north to the south – have been much greater than generally thought. The consideration of the Sahel, the southern edge of the desert, as the "southern frontier of Europe" and as a powerful interconnection node³⁵, as well as the reality of a global world, increasingly emphasise the role of the southern Mediterranean coast as an area of interconnection between Africa as a whole and Europe.

In this new era, in the face of this new revolution, many opportunities are opening up for the great riches of the south shore and the continent, from the benefits of digitalising the mining process³⁶ – African lands are full of natural resources – to the application of Artificial Intelligence to agricultural processes³⁷ – from the selection of the best crop varieties according to soil and climate to automated plant care – but challenges are also present.

³⁴ EHLRT, Ulf. "Why our values should drive our technological choices", NATO Review, 16 December 2021. Available at <https://www.nato.int/docu/review/articles/2021/12/16/why-our-values-should-drive-our-technology-choices/index.html>

³⁵ SÁNCHEZ HERRÁEZ, Pedro, DUPUY, Emmanuel and HORNERO, José. "El Sahel como centro de gravedad estratégico de África: retos para la seguridad", Instituto de Política Internacional, Universidad Francisco Vitoria, Análisis 16/2021. Available at <https://ipi-ufv.com/foro-sahel-europa-retos-seguridad/>

³⁶ SIGNÉ, Landry. "Digitaling Africa's mines", Project Syndicate, 23 November 2021. Available at <https://www.project-syndicate.org/commentary/africa-mining-industry-fourth-industrial-revolution-by-landry-signé-2021-11?barrier=accesspaylog>

³⁷ In this regard, "Potential of the fourth industrial revolution in Africa", *Technopolis, Research ICT Africa and Tambourine Innovation Ventures*, October 2019, page 31. Available at <https://www.technopolis-group.com/wp-content/uploads/2020/02/Potential-of-the-fourth-industrial-revolution-in-Africa.pdf>

On the continent, the three previous industrialisation waves did not take place directly³⁸, although some of their elements were gradually implemented; and the need arises for a scenario in which the fourth industrial revolution is not a reality³⁹... a genuinely possibilist scenario?

Offshoring and globalisation have so far allowed labour-intensive parts of the production and value chains to be installed in those parts of the world where labour is abundant and/or less costly, usually in developing countries and areas, which led to Asia Pacific, and especially China, becoming the "factory of the world".

In this sense, Africa's high demographic growth was beginning to suggest the possibility of the continent's industrial development based on its abundant labour force... but if it is no longer necessary to relocate, as processes become capital-intensive rather than labour-intensive, it is no longer necessary to relocate such production, which, added to the vulnerability generated by this relocation as revealed during the pandemic and the difficulties that the global supply chain is currently experiencing, all this contributes to consolidating the idea of "leaving production closer to home"⁴⁰, and prevents the installation of industries and investment in certain areas.

From another, more enabling perspective, the new industrial revolution offers an opportunity for an abundant and young workforce, creating new options on the fringes of the informal economy – one of the great realities of the African continent, as the percentage of informal jobs ranges from 86% on average on the continent to 67% in the north of the continent⁴¹ – in the service sector, which could grow faster than the increase in the workforce itself, and with better wages than in the informal sector, although there are serious difficulties and it is necessary not only to design and implement a holistic and realistic strategy in this regard, but also to create the necessary infrastructure, both physical and digital, for this possibility to become a reality.

³⁸ Various Authors, "Capturing the Fourth Industrial Revolution", *Foresight Africa 2020*, Brookings, page 61.

³⁹ "Potential of the fourth industrial revolution in Africa", *Technopolis, Research ICT Africa and Tambourine Innovation Ventures*, October 2019, page 17. Available at <https://www.technopolis-group.com/wp-content/uploads/2020/02/Potential-of-the-fourth-industrial-revolution-in-Africa.pdf>

⁴⁰ SÁNCHEZ HERRÁEZ, Pedro. "¡Flujo de recursos a escala global!... ¿y si hay un bloqueo?", Analysis Paper 36/2021, Spanish Institute for Strategic Studies, 6 October 2021. Available at https://www.ieee.es/Galerias/fichero/docs_analisis/2021/DIEEEA36_2021_PEDSAN_Flujo.pdf

⁴¹ FOX, Louise and SIGNÉ, Landry. "The Fourth Industrial Revolution (4IR) and the future of work: could this bring good jobs to Africa?", INCLUDE Knowledge Platform, 2021, page 8. Available at <https://includeplatform.net/wp-content/uploads/2021/06/Book-ESP-Fox-FINAL.pdf>

But, with the data at hand, it is necessary to highlight the fact that North Africa's youth population is among the most unemployed in the world, and the fact that even among those who have received a more complete education there has not been a higher rate of employability and a greater improvement in opportunities⁴². It is difficult to redirect the established socio-economic system, often due to a wide range of circumstances, ranging from the distribution of labour by sectors – still with a strong weight of the primary sector – to, in many cases, dependence on foreign income, whether from hydrocarbons or emigrants sending money home, as well as the weakness of the private sector⁴³.

And if the basic situation was already complex, after the economic crisis that began in 2008 and the Arab Springs of 2011 – the result of this social disenchantment with the existing model – the environment has only worsened, and not only on the southern shores of the Mediterranean⁴⁴, with the Covid pandemic acting as a catalyst and accelerator of the malaise and disenchantment, which has made everything worse... and has even made us question, even more so if possible, the existing models⁴⁵ in all areas of life.

Therefore, and in the same way as happened during the implementation of the first industrial revolution, when the absence or scarcity of social support systems meant that not having a job was synonymous with hunger and misery... the environment was ideal for revolts and social revolutions, so if the first industrial revolution, which marked a before and after in the history of humanity, brought with it a stormy and tumultuous period, this new revolution, which will imply a change without parallel in history, but will it mean the same thing?

⁴² "Topics", *Middle East Youth Initiative*. Available at <https://www.meyi.org/topics.html>

⁴³ In this regard, "Arab Human Development report research paper", *United Nations Development Programme (UNDP)*, 2019. Available at file:///C:/Users/WINDOWS%207/Downloads/52279%2520UNDP%2520Citizenship%2520and%2520SDGs%2520report_web.pdf

⁴⁴ SÁNCHEZ HERRÁEZ, Pedro "¿Arderá el Mediterráneo...sur?", Analysis Paper 04/2020, Spanish Institute for Strategic Studies, 19 February 2020. Available at https://www.ieeee.es/Galerias/fichero/docs_analisis/2020/DIEEEA04_2020PEDSAN_Mediterraneo.pdf

⁴⁵ SÁNCHEZ HERRÁEZ, Pedro. "Era COVID: ¿Un nuevo paradigma de seguridad?", Analysis Paper 36/2020, Spanish Institute for Strategic Studies, 18 November 2020. Available at https://www.ieeee.es/Galerias/fichero/docs_analisis/2020/DIEEEA36_2020PEDSAN_eraCovid.pdf

Twenty-first century... complex century! and revolutionary?

While it seems inevitable that the fourth industrial revolution is (already) a reality, and while issues such as "technological unemployment" and "transition period" are also realities, the fact that they are already known does not mean that they will not have a potentially devastating impact on a system already in a complex equilibrium and unbalancing at full speed, especially if the parameters of change of this new revolution are introduced.

Considering the change in the primary source of energy, it is enough to look at what is happening with regard to "green and renewable energies"; the energies of this new era. It should be remembered that, with the exception of nuclear energy, all other green energies – solar, wind, hydro and geothermal – are very expensive to transport, but above all are distributed very unevenly across continents⁴⁶, which in turn will lead to new imbalances such as those that have existed until now with gas or oil.

In fact, gas in Europe is now six times more expensive than at this time last year, while Finland has decided to start up Europe's largest nuclear reactor, which will cover 15% of national demand, raising the proportion of nuclear generation to 40%, although it already has 25% of the country's total covered by wind power⁴⁷, in the midst of the debate on whether nuclear energy can be considered "green energy" or not, as one of the ways to achieve Europe's extreme non-dependence on fuels from beyond its borders.

Energy and its generation are intimately linked to another strand of the current paradigm, the attempt to reduce carbon emissions in an attempt to mitigate or reverse climate change, which means that, apparently, everything that can be electrified will have to be electrified. This, in turn, will require more hydroelectric, wind... and nuclear power plants, and the extraction of massive amounts of copper, aluminium, cobalt, lithium and rare minerals, among other minerals, from the subsoil⁴⁸, with the footprint that this in turn generates and the torrent of global disputes over control of these new "strategic minerals".

⁴⁶ G. MANRIQUE, Luis Esteban. "La geopolítica de la transición energética", Política Exterior, 14 December 2021. Available at <https://www.politicaexterior.com/la-geopolitica-de-la-transicion-energetica/>

⁴⁷ "Finlandia pone en marcha el mayor reactor nuclear europeo en plena crisis energética", NIUS, 20 December 2021. Available at https://www.niusdiario.es/internacional/europa/finlandia-activa-reactor-nuclear-crisis-energetica-europea_18_3253697875.html

⁴⁸ <https://www.politicaexterior.com/la-geopolitica-de-la-transicion-energetica/>

The fact is that, in the midst of the energy transition, we are in the midst of an energy crisis, with its consequences of price rises, shortages and threats of blackouts and social unrest, a crisis reminiscent, albeit with different origins, of that of the 1970s⁴⁹.

Climate change, another clear and visible reality, also brings and entails consequences for human life and, therefore, for the economy – from the disappearance of coastal areas – agricultural, tourism, ports, etc. – under water due to rising sea levels to the growing difficulties for crops and the resulting food (in)security – which makes it an element of added concern and therefore forms part of the new socio-economic model – one only has to look at the growing disputes in the Sahel or in the Arctic to see how climate change influences socio-economic reality and, therefore, security⁵⁰. And, as the sixth UN report on the subject⁵¹ points out, the Mediterranean basin is one of the regions most affected by climate change, with potentially extremely serious and destabilising repercussions.

While technological unemployment is on the rise, especially on the northern shore, given the speed of change, many of the new jobs arising in the heat of the fourth industrial revolution are not being filled either; in fact, it was pointed out⁵² that by 2020 half a million jobs in Europe will remain unfilled due to a lack of technological profiles, despite the European Union working on these issues and monitoring the evolution and direction that countries are following in this digital transformation. Transition is never easy... although it can become very, very complex.

It is necessary to consider that the adoption and implementation of new technologies requires, and must require, a necessary process that implies that the substitution of the employment of people by machines does not take place in a fully automatic manner, as there are a series of safeguards and requirements from the legal, economic and,

⁴⁹ JOHNSON, Keith. "How the energy crisis made 2021 feel like the '70s", Foreign Policy, 22 December. Available at https://foreignpolicy.com/2021/12/22/world-energy-crisis-high-power-prices-blackouts-1970s-economic-political-turmoil/?tpcc=recirc_latest062921&utm_source=PostUp&utm_medium=email&utm_campaign=Editors%20Picks%20OC&utm_term=38205&tpcc=Editors%20Picks%20OC

⁵⁰ In this regard, HIDALGO GARCÍA, Mar. "Cambio climático y seguridad. Riesgos físicos y geopolíticos", Analysis Paper 49/2021, Spanish Institute for Strategic Studies, 1 December 2021. Available at https://www.ieee.es/Galerias/fichero/docs_analisis/2021/DIEEEA49_2021_MARHID_Cambio.pdf

⁵¹ "Climate change 2021: The Physical science basis", Intergovernmental Panel on Climate Change (IPCC), 2021. Available at https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf

⁵² "Medio millón de empleos se quedarán sin cubrir en la UE por falta de perfiles tecnológicos", Libremercado.com, 1 July 2019. Available at <https://www.libremercado.com/2019-07-01/medio-millon-de-empleos-se-quedaran-sin-cubrir-en-la-ue-en-2020-por-falta-de-perfiles-tecnologicos-1276640695/>

obviously, social points of view that mean that this process is not⁵³ direct... or even simple.

However, reality moves very fast, and in order to partially cover these new positions and opportunities that arise, so-called "bootcamps" have appeared,⁵⁴ – similar to basic military training camps, both in duration and intensity – where it is feasible to reorient the professional horizon by obtaining a certain degree of specialisation in a specific area and with an eminently practical and employability component. Although they are a suitable option for certain employment niches, they are not within everyone's reach, among other aspects⁵⁵, neither in terms of cost (high) nor in terms of doing it (availability). Thus, those who can utilise existing training advantages will have a substantial competitive advantage in the new economic model; and if there is dysfunction in this respect within one shore, it may be even greater between the two shores.

It is necessary to consider the almost exponential increase of the population in Africa, as the continent will double its current population by 2050⁵⁶, with no apparent real possibilities of employability for this growing and mostly young human mass; if in previous industrial stages the "human dividend" – the ratio of working age population to the total – provided a competitive advantage, in this fourth revolution, intensive in capital rather than labour...what will be the fate (physical and/or metaphysical) of millions of young people, with a level of education perhaps not quite in line with that demanded in this fourth revolution, and with little hope of having it in the future?

Moreover, this exponential population growth is also accompanied by a rapid and largely disorderly urbanisation process due to the limited capacity of authorities to provide basic services to the masses of newcomers to cities, with depressed areas and

⁵³ "Situación economía digital", *BBVA Research*, October 2016, page 8. Available at https://www.bbva.com/wp-content/uploads/2016/10/Situacion_ED_oct16_Cap2.pdf

⁵⁴ "Bootcamps, una formación exprés para impulsar tu carrera profesional", *Iberdrola*, 2021. Available at <https://www.iberdrola.com/talento/que-es-bootcamp>

⁵⁵ "Bootcamps. De camarero a programador: los entrenamientos "militares" para cambiar de profesión", *El Mundo*, 9 December 2021. Available at <https://www.elmundo.es/economia/2021/12/09/61aa5252fc6c830b088b45c4.html>

⁵⁶ Various authors. "Panorama de tendencias Geopolíticas Horizonte 2040", *Spanish Institute for Strategic Studies*, 2018, page 49. Available at https://www.ieeee.es/Galerias/fichero/OtrasPublicaciones/Nacional/2019/panorama_de_tendencias_geopoliticas_2040.pdf

slums flourishing, generating a powerful local and regional instability⁵⁷ with global interconnections, the so-called "geopolitics of slums".

It is therefore very difficult in these cases, due to the lack of adequate physical and economic infrastructures, to talk about "bootcamps", to increase the level of training or to redirect it towards digital skills. Very difficult.

If in the Mediterranean area, if in that environment where the Mare Nostrum links different continents, there is a powerful demographic growth on one of its shores (in contrast to a constant ageing and reduction of the population on the other), a growing gap in the standard of living between both shores, and social imbalances are growing everywhere, and expectations and hopes only seem to have a "flight forward" as a response, then what? A new century of upheaval in the Mediterranean?

In order to reflect

The establishment of a new economic model, and therefore a new social model, is advancing in leaps and bounds, at least in part of the world, and therefore has repercussions and connotations for the stability and security of a society, especially in a vast and diverse geopolitical space such as the Mediterranean.

Change is inevitable, and the waves marked by the various industrial revolutions have, in each epoch, inundated the lives of the world's citizens, generating powerful changes and effects. Despite the resistance to change, it has taken place, and has forced the adaptation and modification of patterns and schemes to achieve a new balance, sometimes in a serene and temperate way, sometimes in a hard, complex and violent manner, a "revolutionary" manner.

It is not a question of aligning oneself with this inevitable new wave of change as a "catastrophist", nor of positioning oneself as an "idealist" bordering on "delusional". Changes bring convulsions, they bring fractures and, on occasions, it is not easy to redirect a situation, and even less so if it takes place in such a disparate environment as the two shores of the Mare Nostrum.

⁵⁷ SÁNCHEZ HERRÁEZ, Pedro, "África en la 'era urbana': ¿hacia el desarrollo o al desorden?", Analysis Paper 14/2019, Spanish Institute for Strategic Studies, 24 April 2019. Available at https://www.ieeee.es/Galerias/fichero/docs_analisis/2019/DIEEEA14_2019PEDSAN-ciudadesAfrica.pdf

We have already suffered a "revolutionary century" when the production model changed so substantially that everything seemed new and everything broke down. Will it be the same in this new wave?

Hopefully not, we know what happened and we know the effects of "doing nothing", and we also know that facts do not cease to exist by ignoring them – as Aldous Huxley, the author of "Brave New World", a well-known dystopian novel, said. And since we live in the real world, not in a parallel world, perhaps it is time to remember that "when mighty winds blow, some build walls, but others build windmills".

Maybe that is the way, but do we want to? Will we do it?

*Pedro Sánchez Herráez**

COL.ET.INF.DEM

PhD in Peace and International Security

IEEE Analyst