Jora, Octavian-Dragomir et al.

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ARTIFICIAL INTELLIGENCE AND ARTISTIC IMAGINATION: REVISITING THE CULTURAL ECONOMY OF INDUSTRIAL REVOLUTIONS

Octavian-Dragomir Jora[1], Mihaela Iacob[21], Vlad I. Roșca[3], Mihai-Răzvan Nedelcu[4], Alexandru Florin Preda[5] and Matei-Ștefan Nedef[6]

1)2)3)4)5)6) Bucharest University of Economic Studies, Romania

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Abstract
The "economic" naturally meets the "cultural" because both spheres deal, differently albeit convergingly, with "values" and "valuations". Materially crafted and spiritually charged, tactile/tangible and ineffable/intangible, privately owned and collectively enjoyed, nourished currently and cherished diachronically, the supply of demandable cultural goods and services defines and refines us as humans. The economics of culture, notwithstanding its deeply rooted epistemological fragilities – "pricing the pricelessness" of masterpieces or fitting artistry into "production functions" –, is in greater distress when asked to predict how tech sense will affect human sensibility. Job specifications and business structures become under assail when technologies unfold, as it is the case with the Fourth Industrial Revolution (IR 4.0) and its long prophesized and still surprising Artificial Intelligence (AI). The present article aims at shedding some critical and creative light onto three lines of inquiry at the byroads of industriousness and artfulness with economics, as well as ethics. Firstly, the outstanding social-political-economic traits pertaining to the historical waves of Industrial Revolutions are re-inventoried, observing both peculiarities and patterns. Secondly, there are emphasized, although hardly exhausted, the prevailing economic reciprocations between the technological shifts and the cultural movements (in visual arts). And thirdly, given envisageable megatrends, catalysts/inhibitors and game-changers, AI's impact upon the art economy is investigated and illustrated via some emblematic cases. This study aims to open up a frontier research – the future of cultural ecosystems –, addressable/assessable as exercises of immersive foresight, and not as detached forecasting.

[1] Corresponding author, **Mihaela Iacob** – e-mail: mihaela.iacob@fin.ase.ro.

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Introduction: economists, translators between engineers and artists in a 4.0 age?

The bonds between *cultural studies* and *economic science* – timeless, as they endure "materially" married, yet peripheral, as they seem "spiritually" divorced – need to be revisited and reviewed with the advent of the *Fourth Industrial Revolution* (*IR 4.0*). It is in the midst of the debates on the future of "humanity" (understood as *species* and *spirit*) – given the new technologies that affect and alter micro-/meso-/macro-/mondo- business organizations, production processes, consumption habits – that this research endeavour unfolds. Both cultural facts and economic tools are subject to an intricate intellectual "stress test", therefore scrutinizing the "4.0" cultural *concepts/definitions* and *attitudes*/*behaviours*, observable in *markets'* as well as in *policies' deliverables* will help us to fairly (fore)see what we might risk losing or stand to win, culturally, as communities, nations, human kind.

Industrial Revolutions (IR) remain at the crossroads of several binomials: *intellectual design* and *spontaneous emergence*, *institutions* and *technology*, *necessity* and *fortuity*, and so forth. The shifts from mechanised production (IR 1.0) to mass production (IR 2.0) then to automated production (IR 3.0) and to the ascending scale/scope of digital transformation (IR 4.0) – with Artificial Intelligence (AI) as flagship technology – triggered mode(l)s of development, devised profound societal upheavals and fuelled worries about freedom and fairness. *Culture(s)* too host(s) such *civilizational* twists and turns – as spots of reflection on social disruptions, as sites of refuge from own uprooting, as spaces of sharable hidden energies – and IR 4.0 excites and upsets them via novel ideological biases, vanguard niche markets, public versus private spaces trade-offs, or geo-cultural/-political/-economic resets.

Awareness of limitations and difficulties

Any economist truly aware of the very nature of economics finds himself in an awkward position when called for predictions. Issuing a 100% *scientific* verdict regarding the social *future* is just an illusion: the free-willed human *persons* and the inert physical *particles* differ in (im)predictability (and engineering!) *by nature*, not *in degree*. Contemporary *economics* shall keep this in mind and avoid the "fatal conceit", as Hayek (1988) put it, of "social constructivism".

When dealing with fluid/volatile times where the *estimated evolutions* themselves *evolve*, *interdisciplinary foresight* is the precautionary route. *Economists* need not extra calculus-powers, but additional inputs from allies such as philosophy and sociology, psychology and anthropology, cognition and communication sciences – all the more within *cultural economics* researches. The interplay between *cultural* and *economic* rationales and realms remain complex, dynamic, bilateral, nonlinear.

From the tentative ancestors such as J. Bodin, B. Mandeville, D. Hume, A. Smith, A.R.J. Turgot, F. Galiani, J. Bentham, D. Ricardo, J.S. Mill, W.S. Jevons, A. Marshall, L. Robbins or J.M. Keynes to the founding fathers W. Baumol and W. Bowen's (1966) *Performing Arts: The Economic Dilemma*, cultural economics steadily evolved (Ginsburgh, 2000). However,

there persist some poignant frailties of the current approaches and missing bits in the available knowledge, thence inviting to further "frontier" reflection.

For instance:

- Cultural economics does/should not imply hybridizing core economic concepts ("cultural" value/capital/sustainability), but restoring their accuracy, so as to obtain a clear sight of cultural economy – see Jora (2016), criticizing Throsby (2001);
- The cultural economics literature lacks a systematic portrayal of IR-driven transformations, yet one to be kept away from the temptations both of absolutizing history and of relativizing theory – see Mises's (2013) epistemological caveats;
- In the contemporary accounts on the place of the cultural life in the age of IR 4.0, it became highly fashionable to bet on a waning share for the "human touch" – see Harari's (2016) undeveloped thesis on "useless humans" applicable to art fields.

Assessment of opportunity and originality

Somehow uncustomary for scientific literature, yet deliberately devised/designed as such, this review essay lays at the beginning (and not at the concluding point) of a research route. Investigating how the most spiritualized territory of human existence – culture/art – interferes with the technical-scientific – materially-prone – trait is worth of economists' curiosity and concern at least for three reasons:

- "Of vision" (i.e., quasi-theoretically). An economics-informed parallel between entrepreneurs and artists might still prove to be of interest, observing their un/common features (however, critical in their hypostases as IR-drivers and/or IR-absorbers): making/breaking fashions and currents?; speculative/passive towards the change of tastes?; un/parsimoniously engaging their own wealth?;
- "Of revision" (i.e., historically). A synoptic and systemic study of the main economic-cultural mutations from one "generation" of IR to another is still missing. For starters, a sketch of transformational patterns can be observed in labour force (from fully-fledged artists to auxiliary personnel) and business structures (cultural entities or industries) in evocative timespans and emblematic spaces;
- "Of prevision" (i.e., foresight). Some goods/services, of which cultural ones are the most illustrative, are praised precisely because another human provides them, making them truly unique. No matter how productive AI, Machine Learning, Quantum Computing or Robotization get, IR 4.0 faces a limit: consumers' preference for the human touch, epitomisingly etched in cultural/creative goods.

Acknowledging methodology and structure

Without entering the debates pertaining to the philosophy of science, the present authors are fully aware of the (*grosso modo*) *methodological* disparity between the social vs. natural sciences (Apăvăloaei, 2018). Hence, a well-balanced approach is advanced, calibrated to the subject/theme and stage/objective of the research, finding adequate (*stricto sensu*) *methodological* means for the adopted ends. The "*mix of methods*" implies (related to the abovementioned – broadly stated – objectives):

- "Armchair-reasoning" – (praxeo)logical/deductive analysis of the coherence of core cultural economics concepts (a plug-in already exercised within previous studies in cultural economics by the present authors);

- "Library-work" – a critical and creative survey of qualitative and quantitative historical data on processes at the confluence of cultural movements and IRs, thus bridging pop narratives with scientific indicators;
- "Field-investigation" (interviews, questionnaires) – to be prepared for the next stages of the research and targeting stakeholders (involved in academia, artists' professional organizations, businesses and policy-making).

The present article is organized in three major parts, framed by the introductory (already displayed) and concluding remarks (indicating possible/potential research reverberations):

- Firstly, Industrial Revolutions' main social-political-economic traits are overviewed;
- Secondly, core economic reciprocations between technology and artistry are pointed;
- Thirdly, some AI's takes on artistic production-distribution-consumption are studied.

1. A (hi)story of Industrial Revolutions: teleology and technology, back and forth

"What made the modern world was, proximally, innovation in machines and organizations, such as the spinning jenny and the insurance company, and innovation in politics and society, such as the American constitution and the British middle class." (McCloskey, 2008). See also: McCloskey (2016).

Each Industrial Revolution (IR) has been a manifestation of two of humanity's most powerful drives: the first one is *to gain mastery over nature and over one's own destiny*; the second one is *consistently simplifying the external world*. Miniaturisation as seen in various technological appliances is an example of the latter, decreasing the complexity of man's tools and environment (an example being the evolution of cell phones from the large size of the very first phones to the heavily compacted forms of smartphones today). This in turn frees up more effort to be used for other kinds of creative work, thus creating a feedback loop that enables mankind's third most powerful drive: *to expand its creative capacity*. Here, a comparison to thermodynamics can be drawn: any activity that requires energy is liable to generate heat that is not put to use and is lost to the environment, and technologies have been developed to recover that heat (Jouhara et al., 2018). Similarly, the more effort a human activity requires, the more time and missed opportunities it generates; the opportunity cost can be roughly seen as the economic equivalent to heat waste in thermodynamics. As such, much of mankind's history was its drive to reduce the effort required by certain types of activities (e.g., repetitive, redundant, or physically-intensive tasks, or any action that is not the ultimate purpose of an endeavour), thus freeing up more time, attention and effort to be directed to more useful purposes, to yield the same results with fewer resources.

Another comparison can be made with entropy: whereas Nicholas Georgescu-Roegen (1971) used the concept to highlight the irreversible degradation of natural environment when used in economic activities, we can use it to metaphorically summarise the history of human activity. Simplistically, entropy is the total amount of energy that can no longer be used, and occurs whenever a transformation of energy occurs in any given system, such that the system can no longer return to its original state unless it gets energy from source outside of itself. In an ordered system (i.e., with few processes and therefore less heat used), entropy is low and stays constant, while in a less ordered system, entropy increases (i.e., more energy is lost owing to more processes taking place). Energy from the Sun is dissipated into outer space; the heat Earth receives from it flows from hotter areas to colder areas, and the heat from the

centre of the earth flows towards the surface, from hot to cold. In other words, more and more energy is lost and cannot be recovered through a backwards transfer (e.g., from cold to hot). Therefore, can the history of human activity not be viewed as an attempt to minimise "economic entropy", i.e., to limit the amount of effort and time spent on labour-intensive tasks in order to be able to put to better use to more productive or creative activities? In such a case, then, can we not further infer that Industrial Revolutions, even if not purposely, enhance the cultural economy by freeing up resources to be devoted to creative journeys?

Liberating idea(l)s, then capital accrual

Humanity's historically recent socio-economic evolution was heavily influenced by the Industrial Revolutions – past and present – and this trend will likely continue as the Fourth Industrial Revolution (IR 4.0) steadily unfolds (Damoc, 2021). Even if the technological aspects are different from one IR to another, the constant is given by the abruptness, as the term "revolution" describes radical changes. Much like how the said "twin transitions" – "green" and "digital" – mark Industry 4.0, the First Industrial Revolution (IR 1.0) also had a dualist nature, that of a technologically advancing world capable of rethinking and recalibrating to accommodate a shift from farming to industry and commerce, and that of massive reactive social changes, reforms and disruptions that followed (Allen, 2017). On the other hand, the very idea of Industrial Revolution is put to the test, as it represents a concept which was critically influenced by Romanticism (Coleman and Hoppit, 2009). Most historians recognize that the 19th century Industrial Revolution was an evolution of the previous centuries' economic progress that followed the emergence of the Age of Discovery (Allen, 2011), of Europe's geographical explorations (and forthcoming colonial exploitation?) and the Scientific Revolution (even if the advances in sciences did not preceded, as expected by many, the technological ones, but more often than not, things happened the other way round) (Mokyr, 1990).

Moreover, the birthplace of the Industrial Revolution, the British Isles, is highly circumstantial. 19th century Britain focused on international trade and colonial expansion and had a high-wage economy, a large population and cheaper energy costs (due to the abundance of coal) compared to the rest of Europe, making energy focused production technology profitable, in a society highly influenced by the Enlightenment and Newtonian science (Mohajan, 2019). In a deeper sense, it was the prior subtle (r)evolution in the "rhetoric of the economy" (McCloskey, 2016), that prepared the "industrial enlightenment" (Mokyr, 1990), in a "business dominated civilization" (Schumpeter, 2008), minding of Adam Smith's "moral sentiments" and "invisible hand" mixing and matching. Later on, this thesis was translated into how honouring bourgeois/capitalist "virtues/dignity/equality" – meaning a new sense of practical holiness of "buying low and selling high", as opposed to the puritan one, of "prayers and charitable works" – paved the way for the modern, unprecedented and sustained economic growth/development (even if not necessarily "sustainable", in the current parlance and problematization) and was allowed to move along its avenue, even if not without hindrance, as illustrated by the contemporary mythology of anti-capitalism (Zitelmann, 2023; Cerna, 2023).

Mechanical gadgets and social widgets

Even so, the *First Industrial Revolution*, which spanned from the second half of the 18th century to the first half of the 19th century (Kamitake, 2008), is still an influential entry in the codex of humanity's socio-economic history, rivalling Renaissance (De Vries, 1994). The

technology-oriented aspects of the IR 1.0 are best represented by the railway, the invention of the steam engine and the proliferation of mechanical production (Schwab, 2019), which later translated into economic development in a constantly globalising world, where commerce was becoming indispensable, giving way to the rapid spread of trade policies, tariffs, subsidies and even the "free trade" – reaching its peak in the 19th century, and only mimicked in the 20th, a century of "trade liberalization" – and the modern banking systems (Allen, 2017).

One of the most important developments is the change in demographics, as medical advancements led to population growth, as child mortality rates decreased and fertility rates increased (Mohajan, 2019), not to mention that the IR 1.0's economic effects eroded the social structure of societies, as the middle class augmented and mass education was promoted, leading to an educated workforce to benefit from higher productivity and higher wages (Allen, 2017). The fabric of society would further be disrupted during this technologically innovative age by the development of nationalism – the antechamber of nation-state building, of identity-based self-determination –, vividly expressed in arts, especially in literature and music, politically-patronised and recognizable today as "the" classical masterpieces (Hobsbawm, 2014).

Innovation in the technological sector went further, as the late 19th and early 20th centuries marked the beginning of the *Second Industrial Revolution* (IR 2.0), enabling mass production through the development of electricity and assembly lines (Schwab, 2019). Entrepreneurs applied science to the production processes, leading to an increase in engineered products and technological advancements like standardized manufacturing, with innovations such as steamships, telephones, fertilizers and mass production factories, meeting the global rising demand for goods (Philbeck and Davis, 2018) – culminating with the generalized diffusion of the Taylorist-Fordist style of industrial management, while, at the same time, exacerbating the accusations attracted by IR 1.0, such as the alienation, passivation, de-skilling and ill-health of the workers.

The *Third Industrial Revolution* (IR 3.0), which ignited in the 1960s, is commonly advertised as the electronics/computer revolution, as this era was set in motion by advancements in semiconductors, mainframe computing, personal computing and the emergence of the internet in the 1990s (Schwab, 2019). Furthermore, the post-World War II IR 3.0 reshaped global economics and perspectives, with new breakthroughs such as the outer space and nuclear power races, further driving an increase in connectivity and rapid advancements in computational power (Philbeck and Davis, 2018), whilst the ensuing economic and political globalization cohabited with superpowers' (i.e., USA- vs. USSR-led blocs) and supersystems' (i.e., capitalism-democracy vs. socialism-dictatorship) Cold War, an equally technological and cultural clash.

Therefore, the IR 1.0 transformed the socioeconomic and intellectual landscapes of the 19th century world and rather than completely replacing one world with another, it laid the framework through which such transformation was to be realised (Hoppit, 1990) as more industrially-revolutionary episodes followed, each with its own key societal disruptive capabilities. However, one compelling aspect of the Industrial Revolutions is the uneven speed with which they spread worldwide. As Schwab (2019) points out, 17% of the world has yet to fully experience the IR 2.0 as it lacks electricity, while over half has yet to experience the IR 3.0, as it lacks internet access; on the other hand, the 19th-century spindle

took nearly 120 years to evade the borders of Europe, while the internet had expanded globally in less than a decade.

This time it is different; same as always

This is where the *Fourth Industrial Revolution* (IR 4.0) comes into play, a disruptive force that is set to bring unprecedented levels of automation and hyper-connectivity, marking the trail which originated with the steam engine and made its way towards electricity and further to electronics (Tan and Shang-su, 2017). Artificial Intelligence (AI), Machine Learning, Internet of Things, Autonomous Vehicles, Biotechnology, Neurotechnologies, Blockchain, Quantum Computing, 3D Printing, Advanced Robotics are set to erode the boundaries between the physical, digital and biological realms (Philbeck and Davis, 2018), thus, not the individual technologies, but the merging of these technological dimensions are the main driver of Industry 4.0 (Skilton and Hovsepian, 2017), all while the socio-economic ramifications of further automation and connectivity are still questioned.

One common feature of each Industrial Revolution was a visible change in society: the Agrarian Revolution laid the groundwork for society, and as humanity progressed from a hunter-gatherer society to a sedentary lifestyle that gave way to basic urban settlements with centralised administration, as well as stratification of human society into classes. The IR 1.0 saw the transformation of manufacturing processes, enabling future mass production, rapid urbanisation and the rise of a middle class made of entrepreneurs. This tendency was further deepened in the IR 2.0 that allowed for greater connectivity and increasing the rate of globalisation. The Digital Revolution, the more popular name for the IR 3.0, transformed the role of information in society and tailored a novel class of white-collar workers skilled in data entry and manipulation of digital machines, so inviting the IR 4.0.

It should be noted that while Schwab (2019) sees the IR 4.0's importance as comparable to that of the previous three, Moll (2021) views it instead as a natural tech evolution of the IR 3.0, undermining its influence and disruptive capabilities. Nevertheless, these viewpoints manage to show the opaque state of affairs regarding the socio-economic disruptions caused by present and future technological changes, adding to the uncertainty regarding coming innovations and transitions. All IRs have resulted in profound societal and cultural upheavals, both positive such as better standards of living, increased urbanisation and literacy rates, which allowed a greater share of the population access to knowledge, as well as negative such as rising unemployment, inequality owing to the creation of new social classes or, taken to the extreme, "dehumanisation" (Thachduryany, 2017).

2. A (hi)story of "businesses and pleasures": amid industriousness and artfulness

"…Renaissance arts blossomed only when paper became cheap enough for most artists to afford. The French Impressionists used new colours, based on new scientific research on chemicals, that came from the industrial revolution. Rock and roll required the electric guitar and the advanced recording studio…" (Cowen, n.y.). See also: Cowen (2000).

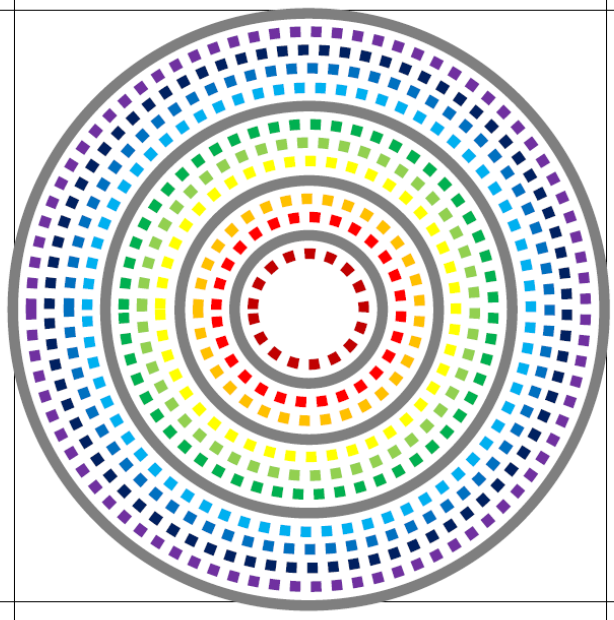
IR 4.0 + Art = ***Digital Art (computer-assisted-human-made + computer-generated-human-programmed + AI autonomously generated)***	◆ *-1700s Gothic, Renaissance, Classic (Baroque, Rococo) Art* ◆ **1760s- The First Industrial Revolution (steam power)** ◆ *1820-70 Pre-Impressionism / 1870-90 Impressionism / 1880-1906 Post-Impressionism* ◆ *1880-1930 Primitivism / 1905-10 Fauvism*	***IR 1.0 + Art =*** ***Impressionism (artists mobility, tools portability, thematic twist) + Photography + Printmaking (lithography, etching)***
◆ **2016(-labeled): The Fourth Industrial Revolution (AI power)**		◆ **1870s-: The Second Industrial Revolution (electrical power)** ◆ *1907-14 Cubism / 1910-14 Orphism, Blue Rider / 1917-31 Neo-Plasticism / 1916-23 Dadaism / 1924-45 Surrealism* ◆ *1909-19 Futurism / 1915-25 Suprematism, Constructivism* ◆ *1919-33 Bauhaus (reaction to Arts&Crafts)*
IR 3.0 + Art = ***Pop Art (mass production, "retail therapy") + Performance Art (mixed media entertainment industry) + Minimalism (industrial [by-]products) + Gaming***	◆ **1970s-: The Third Industrial Revolution (digital power)** ◆ *1943-70s Abstract Expressionism* ◆ *1956-70s Pop Art* ◆ *1950s- Conceptualism, Fluxus, Arte Povera, Performance Art / 1960-75 Minimalism / 1970-89 Postmodernism* ◆ *1990s- Digital Art*	***IR 2.0 + Art =*** ***Constructivism (new industrialized building materials) + Futurism (glorification of industrialized war) + Bauhaus (against industrialized mass production) + Cinematography***

Figure no. 1. Industrial Revolutions' technical and thematic imprint upon Artistic Movements
Source: own representation.

The emergence of visual art dates back approximately 40,000 years, preceding the advent of written language. During this epoch, our ancestors crafted some of the earliest known images, motivated by fundamental needs such as sustenance, protection, and social bonds. Although commonly associated with elaborate paintings and sculptures exhibited in museums, art encompasses a broader spectrum, extending to any creation that evokes emotional responses.

Exploring the trajectory of art through history reveals its intrinsic connection to societal progress, evolving alongside the expansion of human civilizations (Johnson, 2003). While primal human societies prioritized survival, early forms of artistic expression, such as cave paintings and rock engravings, served as mediums for communication among tribes. Notably, the Venus of Willendorf, a sculptural depiction of a nude woman with exaggerated fertility attributes, stands as a remarkable exception of this era, hinting at symbolic and abstract cognition.

As human societies transitioned towards greater literacy, exemplified by ancient civilizations like Egypt, Greece, Persia, China, and Rome, art evolved towards more naturalistic representations, reflecting advancements in cultural and intellectual realms. Throughout history, art movements have acted as mirrors, reflecting and instigating societal transformations. From the Renaissance's exaltation of humanistic ideals to the Romantic era's fervent pursuit of individuality, artists have consistently intertwined their creations with the prevailing ideologies and socio-political undercurrents of their era. These movements not only revolutionized artistic expression but also exerted profound influence on the societal landscape, disrupting norms, stimulating contemplation, and kindling the flames of change (Barnett, 1965). Art, therefore, stands as both a product of its time and a catalyst for evolution, shaping collective consciousness and inspiring the metamorphosis of societies across the ages, in an incessant drive.

Changing tastes in changing times

This transition from agrarian to industrial modes of organization laid the foundational bedrock for the entwining of art, commerce, and societal constructs that would hallmark subsequent epochs. The Industrial Revolution sparked profound societal introspection, known as the "social question", prompting a quest for innovative methods to govern burgeoning populations. This period was characterized by stark disparities between the impoverished masses and the affluent elite, often erupting into violent confrontations and fostering the rise of ideologies such as socialism, communism, and anarchism. Preceding this transformative era, the agrarian sector dominated the workforce, comprising independent farmers, landowners, tenants, and agricultural labourers. This period marked a watershed moment, heralding sustained growth in the living standards of ordinary individuals, hence fuelling the cultural conundrum: *are free markets or, on the contrary, state-backed hierarchies better equipped to produce truer, better, more beautiful "art"?*

Art (too) hosts, since always, an inherent struggle (of ideas): between *freedom* and *serfdom*. And although the choice seems simple, artistic voices and touches continue to demand corrective-coercive incursions into the "reckless" freedom of the markets, which would fail to find the "authentic" (Coase, 1974). Re-listening to the prominent speeches in 19th-century Britain (a cradle of classical liberal intellectual revelations and Industrial Revolution), such as M. Arnold, W. Morris, J. Ruskin, a profound distrust of capitalist culture seems the rule (Goodwin, 2006). This position was re-powered from then on by the total(itarian) Marxist-Leninist attack on bourgeois freedom. Nowadays, "conservatives" (preaching the preservation of the axial values of divinity, nation and family) and "progressives" (adherents of New Age theologies, political correctness and gender ideologies) accuse each other of excesses, a grip that is carried out equally in parliaments and markets, on picture rails and performance stages, and that on a quite "industrial scale".

Turning back (in fact, forward) to the transition towards a production and subsequentially consumer-driven society during the early modern period, this ushered in a significant shift in

socio-economic structures and cultural norms. Scholars have underscored the pivotal role of *consumerism* in shaping patterns of production, distribution, and consumption across various industries, including the arts and crafts sector (Cowen, 2002), culminating with the advent of the bestselling Andy Warhol's Pop Art. The proliferation of consumer goods not only transformed material lifestyles but also engendered new cultural practices and aesthetic sensibilities. As consumer preferences increasingly favoured products that epitomized status and refinement, artisans and craftsmen responded by imbuing their creations with artistic flair and decorative embellishments (Hopkins, 2012). This commodification of artistry underscored the entwined relationship between consumer culture and pure art, wherein creatorship became cherished as a marker for cultural capital.

Technique, topicality and tutelage

During the progression of the generations of Industrial Revolutions (Jora and Iacob, 2022), a tripartite reconfiguration materialized at the confluence of art, commerce, and societal domains, heralding transformative shifts in the cultural-artistic milieu and engendering scrutinies of the entrenched norms and practices.

- *Technological gains*

Technological innovations enabled artists to create outside the confines of the studio and explore new forms of expression. While IR 1.0, seething with Savery-Newcomen-Watts' steam engines drew millions to urban centres, it also helped artists "hit the road", in the sense of mobility and portability: Stephensons' locomotives, combined with Rand's tin paint tubes, aided artists to escape their workshops in order to paint *en plein air*. This not only transformed artistic techniques but also encouraged a closer observation of nature and everyday life (Lubar and Kingery, 1993). Photography emerged as a disruptive force, providing artists with a new means of capturing reality with unprecedented accuracy, while inciting the inroads of the Impressionism's subtleties, which otherwise risked to stay hidden in the plain-sight of the too explicit photos. Similarly, advancements in printmaking, such as lithography and etching, democratized the dissemination of art and facilitated mass production. Likewise, from the steel furnaces of Huntsman and Neilson, Bessemer and Kelly, indirectly emanate masterpieces of architectural art. Artists could now reach broader audiences, challenging the elitist nature of the art world. However, despite the transformative potential of these advancements, artists who embraced them were often marginalized and not considered true artists. The shift towards unconventional artistic practices sparked resistance from traditionalists who viewed these innovations as a departure from established norms (Berman, 2010). This resistance underscored deep-seated tensions between innovation and tradition within the art world, raising fundamental questions about the nature of artistic authenticity and the criteria for defining artistic merit (Bourdieu, 1993).

- *Subject-matter shifts*

The onset of industrialization announced a significant transformation in the thematic focus of art, characterized by a conspicuous shift towards depicting factory workers, cityscapes, and snapshots encapsulating the essence of modern life. This departure from conventional themes challenged established paradigms of aesthetic allure, as artists began to imbue the quotidian with profound significance, thereby elevating the mundane to the echelons of esteemed artistic expression (Clark, 2007). Such thematic diversification served as a poignant reflection of the evolving socio-economic landscape wrought by industrial progress, wherein

the realities of urbanization and mechanization permeated the collective consciousness. An exemplary illustration of these transformative shifts can be discerned in Claude Monet's oeuvres, notably within the *Gare Saint-Lazare* series. This Impressionist series depicting the bustling atmosphere of a train station during the 19th century era of modernization and industrialization was obviously heavily contextual. Created in the early months of 1877, the *Gare Saint-Lazare* series comprised twelve paintings, seven of which were showcased at the Third Impressionist Exhibition later that year. Today, these iconic works are housed in various esteemed institutions worldwide (Musée d'Orsay, Fogg Art Museum, Art Institute of Chicago, National Gallery, Musée Marmottan Monet, Pola Museum of Art, Lower Saxony State Museum), as well as in several private collections. Over the Atlantic, in the US, the failures of the financial-industrial capitalism during the Great Depression, irrespective of its disputed roots (Rothbard, 2000 vs. Bernanke, 2004), as well as of the New Deal reset, feature in the Smithsonian Institution's galleries, among other art fiefdoms.

- *Changing patronage*

The practice of art collection involves amassing a collection of artworks, whether by private individuals or public institutions. This tradition boasts a rich historical lineage, with many of today's esteemed art museums originating from magnificent private collections curated by royalty, the aristocracy, or affluent capitalists (such as Andrew Mellon, in Washington, D.C.) throughout history. A form of art collecting existed in the earliest civilizations – Egypt, Babylon, China, and India – as arrays of precious objects and artworks stored in temples, tombs, and sanctuaries, as well as in the palaces and treasuries of kings. European interest in art lapsed during the Middle Ages, and the monasteries became the main repositories of cultural objects. But the Italian humanists' rediscovery of the classical Greco-Roman cultural heritage during the Renaissance renewed interest in antique art and the collecting of it (Encyclopaedia, Art Collection, 2023). With the rise of a new class of industrial bourgeoisie, patronage patterns in the art world underwent a profound transformation. Wealthy industrialists ascended as the primary patrons of the arts, wielding considerable influence over artistic production and consumption dynamics (Crane, 1997). The prevailing rationale behind the proliferation of art production was mainly attributed to the dynamics of commerce and unfettered trade. This prevailing viewpoint posited that the burgeoning demand stemmed primarily from the evolving tastes of the middle-class demographic, motivated primarily by a consumerist bias. Notably, works by artists of perceived lesser calibre, whose recognition might have eluded aristocratic circles, now assumed conspicuous positions within public auction houses and commercial exhibition spaces.

3. A (hi)story of future art markets: beauty is in the (blind?!) AI of the beholders

"*…Théâtre D'opéra Spatial, an artwork made using Midjourney, controversially won an art competition in the US for its creator Jason Allen…*" (Whiting, 2024).

Generative AI indeed represents a ground-breaking advancement in *cultural/creative industries*, offering unprecedented possibilities for artists and creators to explore new avenues of expression and push the boundaries of traditional artistic processes (Amankwah-Amoah et al., 2024; Feuerriegel et al., 2024; Shumakova et al., 2024). Such systems can (almost) autonomously (at the command of human mind, yet with rather limited human intervention – at least, significantly minimal compared to the traditional way of art creation) generate unique, state-of-the-art and diverse content in music, photography, literature or

design, having the potential to revolutionize the way art is conceptualized and produced, challenging preconceived notions of authorship and human creativity in the digital age (Marquis et al., 2024; Yılmaztekin, 2022). By using Machine Learning algorithms and Neural Networks, generative AI systems can analyse vast amounts of data to produce original and innovative artistic outputs (Hutson et al., 2023).

As algorithms increasingly contribute to the creative process, the conventional understanding of authorship and originality is subject of questioning. This fusion of human ingenuity (as known) and computational capabilities (yet to be explored) leads to contemplations about the extent to which digital capabilities can replicate human emotions and intentions. This is because art is often regarded as a distinctly human endeavour, capturing and conveying emotions, expressing own and collective experiences, and acting as a commentary on those experiences (Bellaiche et al., 2023). Introducing AI systems into the social paradigm of art raises the question of how artists' work may be altered / automatized by AI (if ever deemed as *art*). While this shift could redefine the societal perceptions of art and adjust the recognition of who qualifies as an artist within the art social network (Lima et al., 2021), it could be used in economic reconsidering how, when, where, the *(quasi-)art 4.0* is worth *investing*, *producing* and *consuming*.

Table no 1. Facts and figures on the involvement of AI in the production, distribution and consumption of art

	Indicator	Value	Source
1.	AI market value (2022)	$136.55 billion	Grand View Research (2023)
2.	Projected market worth (2030)	$2 trillion	Grand View Research (2023)
3.	Largest regional market share: North America	36.8%	Grand View Research (2023)
4.	Highest-valued AI art sold so far (Portrait of Edmon Belamy)	$432,000	Christie's (2022)
5.	Total number of AI images created	15 billion	Valyaeva (2023)
6.	Daily AI images created	34 million	Valyaeva (2023)
7.	Highest-valued AI company (OpenAI)	OpenAI – $20 billion	Valyaeva (2023)
8.	First significant AI art generator (1970s)	AARON system	Kate Vass Gallery (n.a.)
9.	Dall-E (images created)	916 million	Valyaeva (2023)
10.	Stable Diffusion (images created)	12.59 billion	Valyaeva (2023)
11.	Midjourney (images created)	964 million	Valyaeva (2023)
12.	Adobe Firefly (images created)	2 billion (in 6 months)	Valyaeva (2023)
13.	AI annual growth rate in media and entertainment (2020-2025)	36.20%	Chauhan (2023)
14.	Market revenue of AI/ML in the arts sector (by 2026)	Cca. $750 million	Chauhan (2023)
15.	Increase of digital activities in museums (including AI) (2022)	At least 15%	European Parliament (2023)

	Indicator	Value	Source
16.	Generative AI added value to the global economy	$4.4T (trillion)	Okuha (2023)
17.	Highest-valued AI art NFT (Asymmetrical Liberation) sold	$324.9k	Okuha (2023)
18.	Major exhibitions featuring AI art worldwide (as of 2021)	Over 30	Eser (2023)
19.	Growth of the AI presence in the art world (2018-2020)	28%	Eser (2023)
20.	Successful digital initiatives in art driven by AI (2019)	81%	Eser (2023)
21.	Belief in AI transformation of the art world (by 2030)	63% of art organizations	Eser (2023)
22.	Consumers expectation of interaction AI brands (incl. art)	88% (9 in 10)	Eser (2023)
23.	Expected generative AI art market size (by 2032)	$5,840 million	Okuha (2023)
24.	Generative AI art market size (2022)	$212 million	Okuha (2023)

Source: own compilation from indicated sources.

AI in the production of art

There are various ways in which technology 4.0 is changing the cultural/creative landscape, including the emergence of innovative methods leveraging open-source software and digital marketplaces for assets such as computer graphics and 3D models. In fact, the very foundations of Industry 4.0 technologies can often be traced back to the highly innovative spaces of creative professionals, particularly those involved in the 3D augmented reality (AR) video games. The advanced creative tools emerging from Industry 4.0 are set to eliminate technical barriers for designers, allowing them to focus more on their artistic vision and subjective interpretation. Fields like architecture have long benefited from technologies like computer-assisted design and 3D rendering software; nowadays, fashion and other art disciplines are also embracing these technological advances (UNCTAD, 2022).

The role of algorithms in the creative process has increased, building on their incipient use in creative software. These advancements are already integrating into the core of arts and the related cultural/creative sector and are expected to exert a significant influence in the future. "Generative design" refers to a process in which algorithms are utilized to produce a variety of solutions for a specific design challenge (graphic design, product/industrial design, fashion design, architectural design). While this approach predates the digital era, now, generative design is commonly associated with the application of computers and generative AI, while being also characterized as "evolutionary", underscoring the idea that the algorithms employed frequently draw inspiration from natural processes (European Parliament, 2019). Already, generative AI is at home in many fields of the cultural/creative sector:

- *Painting*. Turkish-American artist Refik Anadol uses AI and Machine Learning in order to create immersive experiences (Bulut, 2023). The dynamic visuals which result from such big data analyses are unique because they are culturally rooted to a certain "*genius loci*". Most of his works are site-specific. In his 2016 project "*Wind of Boston: Data Paintings*", Anadol imputed weather data about the winds blowing around Boston, collected from the local airport for one year;

- *Architecture*. As United Nations predicts a population of 11.2 billion by 2100, housing, working places, urban public estates are in dire need to be swiftly and smoothly redesigned, and AI tools help economizing times and spaces alike. The reminiscences of Frank Lloyd Wright, Gaudi, Le Corbusier are felt in Dall-E, Midjourney, Stable Diffusion or China-based Wanyu He's XKool playful, almost-Sci-Fi, imagery, still easily convertible to inhabitable buildings (Wainwright, 2023);
- *Music.* American artist Taryn Southern has utilized AI technologies to compose music and even create entire albums (Salvaggio, 2023). Other notable examples are MuseNet, SoundRaw or AIVA, AI-powered music composition tools that have been used to create unique and original pieces (Verma, 2021). By analyzing vast amounts of music data, these tools can generate melodies and harmonies that are indistinguishable from those of human composers (Boryczka et al., 2023).

AI in the distribution of art

As with other major technological breakthroughs, AI also beholds the potential of revolutionizing the distribution of art. Whether this is about fully digital business models in arts distribution, such as streaming music or movies via Spotify or Netflix, or about digital twins, such as using VR/AR tools for providing curator information to the visitors of museums or galleries, overall, AI has got the potential to enlarge consumer's access to arts via more flexible and widespread digital channel distribution, minding/closing many gaps.

Swiss artist Urs Fischer challenges traditional art market norms by using blockchain technology, as he transcends physical limitations to craft digital sculptures that are then ingeniously sold as non-fungible tokens (NFTs) on blockchain platforms (Bourron, 2023). In the same line, with traditional art markets disrupted, artists and galleries embraced online sales platforms, while websites and social media saw increased activity, therefore allowing artists to reach collectors and audiences directly, and build communities (Jeannotte, 2021). Additionally, Industry 4.0 can reduce market entry barriers for businesses, as the more affordable and smaller-scale digital tools can aid developing nations in transitioning from low-volume, handcrafted goods while retaining the cultural uniqueness (UNCTAD, 2022).

AI in the consumption of art

The COVID-19 pandemic severely restricted access to cultural and artistic experiences worldwide, closing the doors of museums, theatres, galleries and disrupting the usual ways artists and audiences interact with art. However, such physical restraints accelerated the shift towards digital platforms, virtual exhibitions and online galleries, allowing art to be accessible and breaking down geographical barriers to cultural access. Virtual tours by immersive reality headsets have enabled people's (inter)cultural exploration from their homes (Oihab Allal-Chérif, 2022).

Museums and virtual galleries enhanced by AR are transforming the art experience and appreciation, offering more immersive ways for visitors to engage with exhibits. Through AR-enabled technology devices, visitors can access supplementary information on the exhibits (Rich Tocher, 2021). Moreover, Industry 4.0 technologies have made art more accessible, enabling creators without traditional art backgrounds to participate in artistic endeavours and allowing wider audiences to experience art (past of contemporary) through digital platforms (Bellaiche et al., 2023).

In the physical spaces of cultural consumption, museums and art galleries have embraced AI technology to enhance visitor experiences (Suroto et al., 2020; Yi et al., 2022). The use of AI-powered chatbots and virtual assistants has enabled institutions to provide personalized tours answer visitor inquiries and, at the same time, gather valuable data on visitor preferences (Costin and Eslava, 2022; Ivanov, 2023). Therefore, this data-driven perspective allows cultural institutions to tailor their exhibitions and marketing campaigns in order to engage deeper with their audiences.

Conclusions: the "purgatory" towards Renaissance 4.0 or Dark Ages 4.0 in Art?

As it has always been the case with the Industrial Revolutions, no matter their moment in history, technological advancements also meant regional *developments* as well as *disparities*. The digital drivers and divides nowadays exists because of regional possibilities in terms of how far digital technologies are accessible to different societies in the world. Future research might explore how digital access can enhance or dampen the worldwide cultural economy. As the popular idiom has it – "AI was invented in the US and regulated in the EU" –, a geopolitical analysis might be interesting in order to find out how the millenary cultural cradle of Europe might lose pace in the digital economy of arts/culture due to stricter regulations of IR 4.0 (see the IA-Act) compared to the US. An open eye is to be kept on China, India or Russia (the latter involved in a cultural-civilizational warfare, where ideology – a cultural product – may be, and already is, weaponized with the "4.0 armoury"). The AI-faked political imagery becomes a kind of "deep societal pornography".

Future research, more applied than theoretical (yet without excluding the latter), already featuring on the "radar" of the present authors, may target issues of *freedom* and *fairness* in producing/distributing/consuming AI-charged art. Thus, the following are worth of inquiry: the profiles of various art segments (literature, performative art, new art) where AI-toolkits mark their presence economically (e.g., efficiency in terms of time, usage of resources, environmental footprint etc.); the importance of AI marketing tools and digitalized selling platforms, such as auction houses and galleries, AI's impact on international art trade, the involvement to the "4.0 generation" financial dimension (e.g., the role of cryptocurrencies, as against traditional money and payment instruments); the manner and measure in which AI-related platforms contribute to the diversity, equality, inclusivity of art experience, from the perspective of the art consumer, and how much customers are perceived to be recognizing/responding to/remunerating digital art, as compared to the more old-school art.

Also, future research might explore the anthropomorphisation of the cultural economy through AI-generated (ro)bots and how they manifest upon the artistic expression. Such a topic would be worthy of investigation in the context of the arguments brought in this paper that cultural production and consumption are, so long (and at least partially) safeguarded by "*the human need for human touch*" – without prophesizing, but not excluding either, the emergence of a non-violent, neo-luddite rejection of AI's pretence in having a say in "real-deal" art. There is possible/plausible/probable (but preferable?) that AI-bots and AI-algorithms, fed with large amounts of data, learn to replicate human decision and behaviour, and, thus, replicate to even more of a finer detail the "human nature" in arts, not only in "*techne*"? Still, Cultural Economy 4.0, with its praised algorithmic creativity, user experience in culture, or human-AI artistic duets, cannot escape the "*emptio-venditio*" economic test for validating art: *beauty is also in the eye (besides AI!) of the money-holder*.

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