Imagining factories, factories that imagine, the imagined factory

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Abstract:
Production activities in industry are accompanied by stories, images and stage effects, since industry involves a projection, often in the long run, and thus puts imagination as much as science and technology to work. This imagination is so bountiful that it has even produced imagined industries, and has tirelessly spun revolutionary narratives about the past and future. Industry was born in the West out of a crystallization of a technical, scientific fantasy that became for real and has started imagining industries. This fantasy is now producing stories about the future of industry, ranging from "Industry 4.0" to the "industrial Internet", for the purpose of a hyperindustrial development.

Industry has always assorted its production activities with stories, images and scenarios, evidence of this being the highly symbolic World Fairs.[1] Since the start of industrialization, the big stories thus told have, depending on the times, been either positive and optimistic, or critical and pessimistic. Why? Because industry runs on the "imaginary" as much as on the science and technology that it puts to use. This "industrial imaginary" is so prolific that it has even produced industries of the imagination and has relentlessly spun revolutionary tales about its past and future. Industry runs on projections (often long-term); it is a "*power station with imaginaries*", to borrow a phrase from the sociologist Jean Baudrillard: its energy is the imaginary.

Industry has accomplished the big dream of the West for realizing a vision of a world controlled by science and technology for the sake of progress. Now that this vision is in the throes of a crisis associated with a process of deindustrialization, we need to return to the source of our beliefs about the industrialization process. Industry is not just a matter of economics and techniques; it is, first of all, a matter of philosophy, even mythology, since it realizes and conveys the Western industrialist creed. The philosopher Georges Canguilhem (2011:511) dwelled on the relation between industry and its underlying values or beliefs: "*Behind machinism (a technical phenomenon), it is necessary to discern capitalism (an economic phenomenon); and behind capitalism, it is necessary to discern a system of values, a rationalistic humanism. The ideal of human life is no longer an earthly paradise for which we are nostalgic but a garden that has to be cultivated. Machinistic humanism implies that mankind does not have a ready made place in nature but that its work must shape nature for the mind to dominate it.*"

[1] This article, including any quotations from French sources, has been translated from French by Noal Mellott (Omaha Beach, France). The translation into English has, with the editor's approval, completed a few bibliographical references. All websites have been consulted in November 2019.

The imaginary is not just a product of the imagination, nor a psychological faculty that each of us has. It is a collective language of narratives, a universe of dynamic forms and images with (a degree of) coherence. It is not contrary to what is real or rational but complementary to them. For this reason, it cannot be separated from the mental or material accomplishments that express it. The imaginary realizes itself in objects, works of art or techniques that, in turn, generate new "imaginaries". Software, once developed, becomes a video game or a virtual realm that produces new possible worlds, which industry will realize — just as a chemical combination becomes a seductive perfume or cosmetic that generates a dream-making industry.

Contemporary industries are making ever more devices for producing and developing imaginaries thanks to the digital technology of networks, "technobiology" and virtual reality, whence an ongoing proliferation of robots, clones, avatars, and other artificial beings. Through this permanent, intensive innovation process, the imaginary is, in turn, being technologized, even machine-tooled. The anthropologist Georges Balandier (1986:161) wrote about a "*techno-imaginary*", because "*this is probably the first time in human history that the imaginary is so strongly connected with techniques, dependent on them; and this calls for close attention.*"

The relations continue tightening between the imaginary, technoscience, creation and industry — not just because of the increasing output of the "technologies of the imaginary" (*e.g.*, movies, audiovisual products, video games, and virtual reality), which industrialization has invented during the past century, but even more (and at a deeper level) because industry itself proceeds from a powerful imaginary, a world-view constitutive of the West, which I have called "industriation" (Musso 2017) to distinguish it from the historical phenomenon of industrialization. Industry sprang from the crystallization of a philosophy and a technicoscientific imaginary (§1 of this article). By realizing itself, it generated new imaginaries and even industries of the imaginary (§2). Nowadays, it is multiplying narratives about its future, ranging from "industry 4.0" to the "industrial Internet" for accomplishing its hyperindustrial development (§3).

The industrial imaginary: Imagining factories

Etymology always comes in handy for genealogy. The word "industry" derives from *in-struere* in Latin: "who prepares, ponders, shapes within himself". For a long time, it referred to a skillfulness, talent and ingenuity related to know-how. A second meaning later appeared that referred to a trade, occupation, job, even an art. By extension, the word came to be used to describe all operations contributing to the production and circulation of wealth. By the 18th century, it was in ordinary usage for referring to the diligence or devotion to work as well as to the activity of producing and this activity's result. Modern industry is, in a way, a projection outwards of *in-dustria*, from making within one's self toward machine production (its secular objectification).

Through these many meanings, industry characterizes the Western world-view built on the Promethean and Faustian myths of the domination of nature and combined with a calculative, technical, scientific rationality. This world-view was realized in and through the action of producing, itself incarnated and organized in companies as of 1750 in Europe. Considering industry to be a world-view was not evident. After all, several civilizations have done without this world-view, which is a typically Western orientation and cognitive representation. Accordingly, the famous idea defended by Max Weber (2000) of a tight linkage between the Protestant ethic and capitalism has heuristic value, even though its historical exactitude has come under discussion. To its credit, Weber's approach argues that the capitalistic industrial revolution was the outcome of an ethos, even a religion.

To break with the contemplative vision of nature during Ancient Times, the industrial imaginary was built on four pillars:

- *1)* a horizontal view of nature, since mankind is the creator in the likeness or place of God;
- *2)* an anticipation of, and projection into, the future for the sake of progress;
- *3)* a quantitative, scientific rationality for calculating and controlling nature;
- *4)* an *antiphysis* for transforming nature through work, science and techniques (instead of contemplating it).

This horizontal view of nature, a requisite for realizing the spirit of industry, was adopted during the Renaissance. Light had to be natural, coming from this world instead of the beyond, as we see in the paintings of the Italian Renaissance. A calculative rationality gradually emerged. The quantification of time was a condition underlying the industrial imaginary. For instance, the invention of clocks and the measurement of time (already in monasteries) were keys to organizing production.

The birth of modern science fulfilled a major condition for this preindustrial rationality. For the origins of industrialism, John Nef, who studied what he called "industrial civilization", emphasized the importance of the new quantitative way of thinking and the scientific revolution, which started around 1630. The first industrial revolution took place in northern Europe in the 17th century. According to this American historian, what brought Europeans closer to industrialism in the middle of the 17th century than they had been a hundred years earlier was "*the commitment of the human mind to quantitative values and quantitative methods of reasoning, to tangible, verifiable evidence as the basis for scientific knowledge*" (1958:64). The founding moment of the spirit of industrialism was the start of the 17th century, a century of many revolutions: scientific (Galileo and Harvey), political (the English Civil War), philosophical (Descartes and Francis Bacon), religious (the Thirty Years War, 1618-1648), social (the revolts in 1629) and even climatic. During this revolutionary period, modern science conveyed an imaginary about experimentation and the transformation of nature, quite the opposite of the contemplation of the world and of the separation of intellectual from manual activities that prevailed in Ancient Times.

Several philosophers pondered the scientific and rationality of production. The two major figures were Francis Bacon and, of course, Descartes who, in his *Discourse on the Method of Rightly Conducting One's Reason and of Seeking Truth in the Sciences* advocated becoming "*masters and owners of nature*". From this vision of the modern world ensued a program of action for applying science and calculations to production for the purpose of dominating nature. This program gave rise, around 1750, to the opposition between a nurturing Mother Nature and a wealth-producing industry, between a Rousseauist view of the "denaturation" caused by industry and the view of "industrialization" that would prevail in England. The turning point in Europe occurred during the Scottish Enlightenment, led by the philosopher-economists David Hume and Adam Smith who opposed the physiocrats and formed in 1754 the Society of Edinburgh for the advancement of the arts, sciences, industry and agriculture in Scotland. This opened the way toward celebrating industry as a creator of wealth and tool of power for rulers.

The imaginary of industry prevailed once the factory system was invented and developed, well before the major inventions that are often said to be the causes of the "industrial revolution" (1780-1830). This imaginary was institutionalized through factories and realized through a gigantic process of mechanization. Once again, during a period of revolutions (in North America and France, the new revolution in science and techniques), the industrial spirit triumphed. It crystallized in "machinism", which, as Marx pointed out, signaled the birth of big industry. This industrialization has tirelessly expanded, accelerated urbanization and swept up commerce, peoples and lands.

The industrial imaginary thus became an "industrial order". A factory or company did not just produce goods and services, but also stories and images, symbols and myths. This tendency has been amplified during each of the three major "industrial revolutions" described by François Caron (2010). His history of modern industry relates each of these revolutions to a cluster of technological innovations and a source of energy: the first (1760-1830), to Watt's machine and railroads; the second (1860-1930), to electricity and petroleum; and the third (1950-2000), to nuclear energy and computers. Western societies have thus built three layers of "*technical macrosystems*" (GRAS 1983), namely networks of transportation, electricity and teleinformatics (HUGHES 1993). The Internet and information systems are the most recent.

Industry's two major theoreticians, if not ideologists, were Saint-Simon (1760-1825) and Auguste Comte (1798-1857), master and disciple. Henri Saint-Simon, a philosopher of industry who coined "industrialism", "industrialisitic", "industrialists" and "industrial society", defended two key ideas. First of all, industry bore all the virtues and promises that constitute a modern myth: freedom, peace, wealth, progress, work, know-how, intelligence, etc. Industry called for a new society: the "industrial society" which would be the end result of the imperfectly accomplished French Revolution. In *L'Industrie*, published in 1817-1818, Saint-Simon placed this epigraph: "*Everything by industry, everything for it*". According to him, "*industry really possesses all the forces of society*" or "*All ought to be and can be related to industry*" (vol. 2, pp. 1458 & 1461). The second idea was about the alliance between science and industry. Science and the "encyclopedia" were to be applied in industry, oriented toward production and placed at its service. Scientists and industrialists were the two major players in this change. Science was complementary to production. It and industry came together: "*Science must be related to industry. It must never lose sight of their common goal, production.*"

Two major disciples of Saint-Simon, both engineers from École Polytechnique, would provide variants from different angles of his vision: Auguste Comte from the angle of philosophy and Michel Chevalier (1806-1879) from the angle of economics and politics.

For Auguste Comte, who, young, had been Saint-Simon's secretary, industry was a "*great mental revolution*", even an "*antitheology*". In a "*catechism for positivists*", he wrote: "*Human existence started, in effect, by being essentially military in order to finally become fully industrial, while passing through an intermediate stage when conquest turns into defense. These are, of course, the respective characteristics of Ancient civilization, modern sociability and the transition of the Middle Ages*" (1891:329-330). In line with his famous "*law of three stages*", the march of history and civilization was leading to the positivistic stage and the upsurge of industry.

Meanwhile, Michel Chevalier, another of Saint-Simon's disciples and an engineer from the Corps des Mines, who would become economic advisor to Napoleon III, was lauding industry. His inaugural lesson at Collège de France, where he held the chair in political economy, sang its praises: "*It is, therefore, no exaggeration to declare that, through industry, mankind must really become the king of creation, the master of the universe. With industry, mankind, instead of being oppressed by matter, will keep it subject to his will.*" Mankind became a new god in a secular technoscientific world.

Nonetheless, Comte and Chevalier were very lucid about the ambivalence of the industrialization of the world, since it was impoverishing the working classes. Chevalier drew attention to this ambivalence in the following terms: "*Such as it now exists, it is not always a tender mother; it is sometimes, often, a cruel stepmother.*" By the way, industry was always the "woman-mother", "mother industry" or, the reverse, "bitter industry".

The industrial imaginary had need of not only big stories but also images and stage effects — an aesthetics. For this reason, texts were associated with ceremonies, exhibitions and works of art. A notable example comes from the *expositions universelles*, these World Fairs that glorified industry and the industrial revolution in Paris for more than a century and in London repeatedly from the Crystal Palace in 1851 to the Olympic Games in 2012. The Chicago World Fair (Columbian Exposition) in 1933 celebrated a century of progress with the slogan: "*Science discovers, genius invents, industry applies, and man adapts*" (CENTURY… 1933). Industry was portrayed as a young woman with a patriotic red-white-and-blue bonnet dancing on the globe.

Like other imaginaries, the industrial imaginary plays on an ambivalence and its reversibility. Talk about the land of bliss was talk about its opposite, a place of torment. Both sides of this story were staged, written up in the Romantic or ideological narratives of the 19th century, in particular by Friedrich Engels in *The Condition of the Working Class in England*, by Victor Hugo in his poem *Melancholia* and by Émile Zola in *Germinal*, which exposed child labor in the mines. As a consequence, a frightful imagery of factories struck the French imagination. Then, the two World Wars turned industry into a machinery of warfare and destruction. Industry thus came to be identified with war, according to Bergson, and with a loss of meaning, according to Hannah Arendt. The machine became machination with Fordism, as told on film by Charlie Chaplin in *Modern Times*. The negative side of the industrial imaginary obviously grew stronger during the 20th century, while industries of the imaginary, of dreams, luxury and leisure, were thriving.

Industries of the imaginary: Factories that imagine

By the end of the 19th century, the luxury goods industry and, soon afterwards, the movie and recording industries opened the way toward way we can call "industries of the imaginary" (FLICHY 1980). Industry thus created big machinery for producing imaginaries. The industrial spirit, though rationalistic, scientific and technical, gave birth to factories that imagine, that make dreams.

Associated with the three industrial revolutions identified by François Caron are three forms of industries of the imaginary, which are, in a way, "metaindustries". To name them, we can use three neologisms: *industrialism*, to borrow from Saint-Simon, then *Hollywoodism* with reference to the move industry, and finally, *siliconism* for the era of electronics and Silicon Valley. Industrialism signaled the rise of industrial capitalism, the development of science fiction and the industrialization of the book and newspaper industries. Associated with the Fordist and Taylorist rationalization of industrial production, Hollywoodism refers to the culture and entertainment industries (radio broadcasts, phonographs, movies, audiovisual products). And now, siliconism is associating contemporary information technology with the industries of software, electronics and virtual reality "*with a heavy investment of intelligence*" and creativity (BALANDIER 1986).

Early in the 19th century, Pierre and especially Aimé Guerlain (1834-1910) industrialized the manufacturing of perfumes. Through the imaginary and dreams, industry would win ever more markets and win over people. By the second half of that century, science fiction had become a literary genre, its circulation ramped up by the industrialization of newspapers and magazines, which were relatively cheap, had large press runs and ran serials.

The second industrial revolution (1880-1930) of electricity was part of a cluster of techniques and industries of the imaginary: telephones (initially "théâtrophones"), radio, moving pictures, and then television. These media captured consumers' attention while offering new leisure activities. They formed the entertainment industry. For Adorno and Horkheimer (philosophers of the Frankfort School), the Fordist system of production encompassed both the manufacturing and cultural industries. For them, the difference between Chrysler and General Motors was ultimately a mere illusion; and as much could be said about Warner Brothers and Metro Goldwyn Mayer. Hollywoodism came out of this industrialization of the imaginary, which peaked in the Californian city. By the mid-1920s, studios in Hollywood were producing 240,000 kilometers of film as they busily rationalized the organization of labor. Universal was even nicknamed the "sausage factory".

During the third industrial revolution (1950-2000), computers hooked up with telecommunications to produce, first and foremost, the Internet. This would radically alter the production system. Electronics has invaded production: automation and robotization in factories and the computerization of organizations and processes thanks to information systems. Many words have been used to describe this new system of production: "post-Fordism", "postindustrialism", "hyperindustrialism", "informational capitalism" (Manuel Castells), and "cognitive capitalism" (Yann Moulier-Boutang). Pierre Veltz (2008:48 & 2017) has preferred the "*hyperindustrial society […] characterized by the convergence between the industry of things and the industry of relations (services)*". With computerization, wage-earners are said to be "knowledge workers". The steerage of hyperindustry takes place via the endorsement and collaboration of consumers, through their "work". It is situated downstream in the production chain rather than upstream as at the time of Henry Ford, who said that a customer could choose the color of a car provided that it was black. Taking consumers and their feedback as the starting point for production implies catching their attention, recycling their desires and making them contribute. Symbols and signals must be used. The imaginary becomes a "raw material" for industry.

The new industrial forms of siliconism are often inspired by, and combined with, the Hollywoodian dream factories. Hollywood and Silicon Valley can be compared because they are two locations where industries of the imaginary have sprung up: the one based on film, the other on silicon chips. They are 500 kilometers apart but very similar in the way they industrially work on imaginaries. Like Apple or Spielberg's studios (DreamWorks), these metaindustries combine technical, scientific and artistic qualities and qualifications to work on and with imaginaries, fictions, narratives and dreams. Industry's strength depends of its capacity for creating and inhabiting "*new new worlds*" (BALANDIER 2001:95), *i.e.*, artificial worlds, and creating the emblems, beliefs, confidence, stories, signs, symbols, brands and images to be associated with products.

Each of the three industrial revolutions has borne metaindustries, which mark stages in the duplication of industry in a functional and in a fictional form — hard and soft, material and immaterial forms. These metaindustries tend to become the captain of all industries since they feed on intensive innovation and dreams. They now serve as the benchmark for the whole economy.

The factory to imagine: The imagined factory

One force of industry is its capacity for making projections into the future. Propelled by innovation, it has to have visions of the long term, produce prospects and make society dream. What about the current imaginaries of the future of industry and of factories of the future? What industrial imaginaries are in the pipeline for industry itself?

Several stories and images coexist, all revolving around three themes or myths from the industrial imaginary. Myths thrive on recurrence and ambivalence. The first theme revolves around the industry/nature dialectics (conflict/integration); the second, decentralization (or even "industrial personalization") in contrast with concentration; and the third, industry's ongoing reinvention through technical and scientific innovations or even a new revolution (the third or fourth, depending…).

The industry/nature dialectics comes in two major versions. The first is industry's end or death for the sake of a "fourth" sector (the service industry) or by a return to the past (back to nature and farming). Deindustrialization is presented as inevitable, an idea defended by, for example, Michel Houellebecq. In the novel *La Carte et le territoire*, he has imagined France in 2040 as a country, broken and resigned, of farming and tourism inhabited by neorural environmentalists. The second version of this dialectics is the return toward nature via the adoption of an "industrial ecology" or "green industry", and environmental resource management. This version likens an industrial system to an ecosystem that responds to the needs of the firms that are trying to reduce their carbon footprint in the biosphere for the purpose of "sustainable development".

As for the second theme, decentralization or even the individualization and personalization of industry in contrast with concentrations of factories, it has several variants. The first involves the "maker culture" of "fab labs" and 3D-printers. A booster of this variant is Chris Anderson, former editor of the magazine *Wired*, a beacon of Silicon Valley. What galvanizes this variant is the dream of startups: we all are to become individual entrepreneurs and innovators through the development of a decentralized, "sharing" industry, in the likeness of the Internet. Another motivation is wanting to do, to do it yourself, as Matthew Crawford, the philosopher and motorcycle mechanic, has recounted in his bestseller, *The Case for Working with Your Hands*. Tending in the same direction are the pronouncements that we are moving beyond the consumption/production dualism and toward an economy that, based on cooperation or sharing, is emerging out of the digital revolution. The pioneering examples of this are the free encyclopedia Wikipedia, fab(rication) labs and General Electric's prediction of a decentralized "Internet industry" (EVANS & ANNUNZIATA 2012). Another variant refers to the development of "local ecosystems", advocated in France in a report by Institut Montaigne (2018). The French government has even decided to set up twenty local ecosystems.

As for the third theme, the new industrial revolution — the third such revolution according to Jeremy Rifkin (2011) — reproduces and prolongs the industrial imaginary. It has unwavering faith in the future, technical progress and the imperative of innovation. This revolution is related to a new cluster of innovations combining NBIC (nanotechnology, biotechnology, information technology and cognitive science), new sources of energy and informatics. A very current phrase in Germany is "industry 4.0" for referring to this fourth industrial revolution of production, smart factories, and a connected, digitized industry. The strategy for "industry 4.0" was launched at the Hanover Trade Fair in 2011.[2] In 2014, Germany and China adopted an agreement (with specifications for standards) providing for cooperation on "industry 4.0" and training in German firms. In July 2018, Siemens and

[2] "*We are the first country to have this vision,*" declared Henning Kagermann, former CEO of SAP, Wolfgang Wahlster, president of the center of artificial intelligence, DFKI, and Wolf-Dieter Lukas from the German Ministry of Research.

Alibaba Cloud formed an alliance for developing an industrial Internet of things in China with *MindSphere*, an operating system open to the major Chinese cloud platform. The Chinese government drafted its strategy, "Made in China 2025", for creating a super production company by 2028 and transforming Chinese industry by 2049 (in time for the Popular Republic's centennial).

From the French viewpoint, the "future of industry" is not a big bazaar of "technological bricks", of families of "things" so broadly defined that they cover several forms of technology or services, such as: collaborative robots, smart machines, the Internet of things, big data, artificial intelligence, vertical and horizontal integration (of, for example, a supply chain), advanced methods of simulation, additive manufacturing (3D-printing), innovative materials and processes, enhanced reality, the storage and transmission of information (blockchains, the cloud, cybersecurity). Instead, it means putting these things in relation so as to create new industrial processes. Nor is the "future of industry" a simple digitization of existing industries, as Bernard Charlès, who heads Dassault Systems, has pointed out: "*The first trap is to think that the industry of the future will be just a digitization of current industry […] The second is to fail to combine these efforts with a reform of training programs. We must realize that innovation has become multidisciplinary.*" The future of industry is this radical transformation, even an "Industrial renaissance", which will create new occupations, products, uses, as well as different organizations and value chains. What is promised is an imagined, dreamed-of factory (smart, flexible, connected, elastic, economic, etc.) and maybe even a new model of industrial organization, beyond Fordism and Toyotism (lean manufacturing). Michaël Valentin (2018) has called this "Teslism" (a word formed from Tesla, Elon Musk's firm).[3]

Whether "industry 40", the industrial Internet, siliconism, Teslism or the "industrial renaissance", the factory being imagined has been announced. What is promised is a rupture of our culture, a new industry to be deployed (as during the previous revolutions) throughout society. The aim is to fuel the industrial imaginary that conveys the modern dream of the West, which Saint-Simon formulated at the start of the 19th century: "*All of society is based on industry*", "*Everything for it and by it*".

[3] This model is built on seven principles: *1)* story-making (or story-telling), in other words, a big project reaching beyond the firm; *2)* crossintegration or an organizational, societal integration that decompartmentalizes processes in connection with the ecosystem; *3)* sprawling traction or a crosssectoral vision of markets creating flows in a star network from a platform, and two-sided models in which producers are consumers and vice-versa; *4)* startup leadership (imbuiing work temas with a startup spirit); *5)* software hybridization (for capitalizing on the interconnection of all software throughout the chain); *6)* hypermanufacturing to enhance the industrial system, and *7)* human and machine learning (ongoing training) (VALENTIN 2018).

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