Ouverture de 'The 4th Industrial Revolution. Business Model Innovation & Global Competition'*

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Abstract

The 4th Industrial Revolution is expected to lead to a paradigm shift in business, with strong effects on manufacturing and service processes, and consequent competitive advantages for firms, industries, and regional/national systems. Such effects will manifest in the disruption of traditional incumbents and the re-organization of production processes where information and communication technologies, artificial intelligence, and operational technologies enable smart, self-organizing distribution systems in factories

Keyword: Global Competition; Industry 4.0; New Global Players; Japan; South Corea; China; Industrial Revolution; Business Models.

1. Overture

The 4th Industrial Revolution is expected to lead to a paradigm shift in business, with strong effects on manufacturing and service processes, and consequent competitive advantages for firms, industries, and regional/national systems. Such effects will manifest in the disruption of traditional incumbents and the re-organization of production processes where information and communication technologies, artificial intelligence, and operational technologies enable smart, self-organizing distribution systems in factories. As a consequence, firms and regional/national manufacturing systems will face increasing pressure to change. This pressure coalesces around adopting novel creation, production, and distribution methodologies, and adapting the related internal practices and processes.

□ *The 4th Industrial Revolution, developed by the largest corporations to establish more competitive scenarios, is the most recent on a global level. The 4th Industrial Revolution fundamentally disrupts the technologies characterizing the first three industrial revolutions: the first based on the mechanization of industrial plants and centred on the textile sector; the second linked to the assembly line and integrated mass*

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production systems; the third associated with the diffusion of information technologies in the digital age.

Such discontinuity is linked to the effects of a multiplicity of technologies (e.g., additive manufacturing, smart factories, cyber-physical systems, Internet of Things, etc. often dubbed Industry.4.0 technologies) and globalization. The joint effect of the two phenomena leads to issues including servitization; reshaping organizations, industries, markets and society; the role of innovative ecosystems; the emergence of new business models and business model innovation; challenges and opportunities for international competition (e.g., outsourcing, reshoring, increased global competition, sustainable manufacturing, etc.); updating the skills of the workforce, potential changes in the job market, unemployment, inequality; the role of open, collaborative, user-driven innovation as a driver of the adoption of Industry 4.0 technologies and solutions.

Several workshops in 2018 and 2019 (at the University of Trento, LUISS Rome, University of Salerno, University of Ancona and University of Torino, in partnership with the international journal Symphonya. Emerging Issues in Management) contribute to the debate on the impact of the 4th Industrial Revolution by bringing together the academic and industry perspectives. As such, the workshops intend to facilitate the discussion of manufacturing and service firms at the micro-level, and the regional competitive advantage of industries and nations at the macro-level. In so doing, the workshops provide scholars, practitioners, and policy makers the opportunity to investigate the implications of the 4th Industrial Revolution.

2. Industry 4.0. US, EU, and the New Global Players (Japan, South Korea, China)

Globalisation has been driven by the capital and technology of multinationals. Globalisation is essentially the geographic extension of competitive markets, a process dependent on the removal of barriers, and overcoming distance through technology (Sigurdson, 1990). This trend has accelerated since the 1980s, as technological advances (the Internet and telecommunication infrastructures) have facilitated travel, communication, and doing business (Brondoni, 2014). As a result, the traditional rules of oligopolies have completely changed, with links between firms becoming strategic on a very large scale (Chen & Chen, 2001; Delapierre & Mytelka, 1998), and industrial rivalry tending to occur among global networks comprising a multiplicity of firms with different knowledge bases, particularly focused on managing innovation and creative imitation (Brondoni, 2013).

Globalisation has radically modified the traditional fundamental principles of industrial output constituted by: the static localisation of manufacturing facilities; the presence of workers at manufacturing sites; stocks of raw, semi-finished materials, and finished goods stored close to manufacturing facilities and consumer markets; ‘long’ organisational structures with the rigid, planned, and often fragmented division of roles (Brondoni, 2008).

The transformation from MNCs to global networks has led towards vertical specialization and highly diversified patterns of collaboration across inter-firm and intra-firm transactions coordinated by global corporations (Luethje, 2001). Global

networks have significantly reduced the importance of 'context specific skills'. The Internet worldwide platform pushes knowledge into a standardized format with minimal costs, readily transferrable across national borders and firms, with business collaboration between modules connected by standardized interfaces (Hayashi, 2002).

The global competitive innovation and imitation landscapes have significantly changed the relative position of many countries. In particular, the United States has changed its worldwide competitive position, previously governing the diffusion of innovations and the 'block' of imitations, but now having lost its historical leadership, seeking a new role in controlling the innovation and imitation processes.

> □ *US corporations maintain the primacy of innovation in global markets, and US-based firms have been the undisputed leaders of next-generation technologies (from IT, to space, to semiconductors).*

US global firms are very prudent in innovating globally, preferring to produce and sell across the globe through parent companies. From a general point of view, US-based global production networks are primarily focused on incremental innovation ('creative imitation') and especially the defending property rights of basic 'essential patents' (Brondoni, 2013).

Conversely, Japanese global production networks primarily focus on innovation and breakthrough technologies with competitive policies to not only innovate globally, but also produce or sell across the globe through their own companies.

Similarly, South Korean global corporations are focusing their policies on creative imitation. South Korean chaebols rapidly industrialized by copying the Japanese international model of economic growth, and in the last 10-15 years, shifted from international markets to global competition, investing heavily in R&D in the pursuit of corporate mass-market production strategies.

Finally, China's industry has evolved from a distant-follower (primarily focused on imitation) to an immediate follower (with a specific development model), with significant investments in R&D dedicated to creative product imitation and product/process innovation.

In essence, globalisation has rapidly expanded the market potential of corporations headquartered in countries with a high propensity to innovation (e.g., Japanese companies). Globalisation has also promoted the growth of new countries, especially in the Far East (e.g., South Korea, India, Taiwan), with favourable market conditions (first of all in terms of low labour costs) to develop advanced skills for innovation and creative imitation (Brondoni, 2013).

Conversely, the main European countries (such as the UK, Germany, and Russia) lost their leadership in innovation, although they played a leading role in the development of last century's closed markets. Italy also lost its primacy in craftsmanship, despite its important industrial history based on creative skills famous the world over (Brondoni, 2012).

For companies operating in global markets, the 4th Industrial Revolution means increasing productivity and production flexibility, with higher product quality, more efficient processes, and completely new business models.

□ *For the manufacturing industry, the 4th Industrial Revolution is not an end but a means. The development guidelines - big data, open data, Internet of Things, machine-to-machine, cloud computing, analytics - are tools that allow companies to compete more effectively in their reference markets, provided they develop appropriate positioning strategies in global markets (Crapelli, 2018).*

The 4th Industrial Revolution technologies determine the transition from the traditional factory model to a new intelligent structure (smart factory) characterized by digital production, interconnected processes, and production systems able to make the best use of available resources.

Producing more and wasting less, adopting global corporate policies that supplant the business model based on excess supply (over-supply model, in which rivals-competitors face volatile production and progressively falling prices), to affirm a global business model based on the progressive disappearance of marginal global companies (oversize economy characterized by lower production and sales costs, and by large company size) (Brondoni & Bosetti, 2018).

The changes the 4th Industrial Revolution imposes on business models lead to:

- higher production flexibility through creating small lots at large-scale costs;
- greater competitiveness of the offer by virtue of the greater functionality deriving from the Internet of Things (IoT);
- much more efficient productivity by reducing errors and reducing set-up times (zero defects production).

3. The 4th Industrial Revolution. Four Open Issues

The changes that globalization and Industry 4.0 technologies generate do not mark a univocal development path. Highlighted below are four highly critical areas that also lead to different directions of change.

Change in business models. One the one hand, the extension of communication networks and access to data, and on the other, the possibility of increasing the personalization of products through the man-machine and machine-machine interfaces, as well as the introduction of new technologies such as additive manufacturing, open the way for new ways of responding to the market. Network data enable identifying “long tails” to outline even very small market niches to be able to respond economically using flexible technologies. At the same time, however, new problems arise: the strong externalities in data management and logistic economies reinforce the role of new intermediaries, information and logistics platforms, able to channel the exchange of information, products, and services (Eisenmann, 2008).

□ *The economy in which production scales tend to vanish, that of shepherds who, through the Internet, reach distant markets to sell typical products, entails new intermediaries, with the economies enjoyed by large corporations operating in networks and with a logistics organization that, to take advantage of integration, must reach considerable dimensions.*

One wonders if and how the potential of the technologies of the 4th Industrial Revolution can be a driving force of the enhancement of the individuality of consumers and producers, or if there is a risk of crushing both in the aggressive competition that takes place in intermediation platforms.

Change in organizational models. Will organizational models tend to be centralized or decentralized as a result of information and communication technologies? Where will the fundamental knowledge for business management be located and how will it be accessed? The debate that began at the beginning of the 2000s on the coexistence of organizational flattening and decision-making (Rajan & Wulf, 2004; Guadalupe & Wulf, 2010; Wulf, 2012; Guadalupe et al., 2014) found new cues in the vast international analysis program of managerial and organizational practices (Bloom et al., 2015). These authors distinguish and empirically verify the decentralization power of information technologies vs the push towards centralization driven by communication technologies. Once again, there is an ambiguous effect of the technologies of 4th Industrial Revolution, and distinguishing between different technologies helps better understand the phenomena, and highlight possible conflicting outcomes.

Change in work models. This is certainly not a new topic. The debate that took place between the end of the 1990s and the early 2000s was linked to the depletion of intermediate tasks (the hollowing middle), in favour of work with a high level of knowledge on the one hand, and high demand for manual skills on the other (Acemoglu & Autor, 2010), but not necessarily qualified. Wage polarization went hand in hand with the hollowing middle: manual workers, unlike knowledge workers, were affected by competition and an abundant job offer. The last few years have seen also increasing depletion of knowledge, labour, and the concern is that, with the dissemination of artificial intelligence, this will rapidly spread to more and more extensive areas of work with high cognitive content (Baudry et al., 2013). Some fear the disappearance of work. If the issue of the destruction of work is controversial, all agree on problems like: the mismatch between job demand and offer, retraining and reallocation of excluded workers, updating the training models of new entrants, redesigning the tasks. The speed of these phenomena is currently a major concern: adapting to the new skills required by the pervasive nature of new technologies can hardly be achieved through the long cycles of human capital formation required by education systems. But what relationship must be established between the formation of knowledge that takes place in the initial phases of individual life and that which can be produced in the course of work experience?

Change in the models of diffusion of technologies and managerial solutions. Also in this regard, the topics of discussion are not new, but take on new shades due to the speed of the phenomena. The fundamental question is whether in this technological wave, spontaneous diffusive forces will prevail or if conversely there is a risk of a new separation between countries and regions with strong technological development and countries or companies for which the loss of production capacity becomes unbridgeable (Baldwin, 2016). For emerging countries, opportunities are opening up to restructure value chains, linking individual production phases and shortening catching up times; but at the same time, these choices manifest are exposed to global competition. A similar issue applies within countries: in developed countries, but which are not at the

technological frontier, there is the risk of consolidating dualistic models of development in which a group of companies can compete in terms of technology, quality, and differentiation of production, opposed by a large faction of companies seeking a response in the reduction of labour costs and containing investments (Tundis et al., 2015).

The four themes briefly presented indicate possible development alternatives. Beyond the easy enthusiasm for industrial policy measures recently implemented by some countries to facilitate the transition of the industrial system towards the 4th Industrial Revolution, the problems that the governance of the economy at the system level and individual companies face are much more far-reaching. Transition and technological change must be accompanied and incentivised, but a long-term vision must also consider the effects that such changes will produce. The governance of an ongoing change process whose direction is unclear constitutes in itself a new challenge for management and for the management models of systems and companies: it is a matter of adopting a direct approach not so much to the realization of a project, but guiding a complex system characterized by emerging and scarcely predictable phenomena or, to recall a fitting expression, to harness complexity (Axelrod & Cohen, 1999).

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