Transition Industry 4.0 to 5.0-Renaissance of Human Driven Approach Adding Value to People & Management Performance

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Abstract
The current economic situation, under the recovery process after the 3-rd wave of the sanitary crisis of COVID-19, is still struggling with the technologic determinism of Industry 4.0. A good part of VUCA concept supporters (volatility, uncertainty, complexity, ambiguity) further emphasize the benefits of digital means development on large scale, but on the other hand, keep ignoring the repercussions of permanent changes which the global economy shall be confronted with. The fast pace of digital innovations is not always followed by an adapted pace of political or economic decisions, especially for the crisis moments. The actual crisis time highlighted by the pandemic COVID-19 provides a relevant example of testing the existing possibilities of vital functions of the worldwide ecosystem–post Industry 4.0. The offered facilities resulting from the new digital instruments of communication through IoT (Internet of Things), informative resources from Big Data, cloud computing & storage have succeeded in partially compensating and maintaining at a survival level the economic environment. Nevertheless, the blockages occurred in a vast field of the process industry, tourism, and hospitality trade, where the human factor is the central beneficiary and in the same the service provider. Under these circumstances, the need for re-balance solutions becomes more obvious, to put humanity on the right focus and meanwhile society common welfare. The comfort zone as an outcome of innovation effervescence left behind the focus on human initiatives towards the development of adapted leadership and new challenges management. The appearance of defined Industry 5.0 could be quantified as a natural stage and opportunity to develop the framework for social & human science (SSH) concepts for the next models of business and man creativity and future competencies. The main purpose of this paper is related to the analysis of the two industrial waves differences of Industry 4.0 and 5.0, with the following challenges and perspectives and the impact on the STEEP factors (social, technical, economic, ecologic, political). Both ways of thinking, the social science concept, and analysis of STEEP are found with similarities to identify the opportunities and threats for society future, in particular for industrial human factor and potential solutions could be identified through 3Dsimmetrical design approach.

Keywords
Industry 4.0; Industry 5.0; tehnologic determinism; human centric solution; STEEP factors; assimetry theory; 3Dsymmetrical design innovation.

Introduction

The industry is considered the main engine for the general economy and in particular for the European economy, having the most consistent contribution and jobs provider across the continent. Between 2009 and 2019, the industrial branch accounted for around 20% of the European GDP value, from which manufacturing represent 14.5% of the European economy. Recently, the political deciding factors recognized its economic importance impact in parallel with the need for new and adapted policies to the geopolitical climate. Europe is still an important player for industrial business and export as well, nevertheless is exposed on the long value chains, due to the vulnerabilities of unbalanced development of different places and variety of countries cultures.

The industry could keep the gained position through ongoing innovation and versatility. Industry 4.0, defined by the revolutionary technology of digitization, sensors interconnectivity, Big Data, and Artificial Intelligence (AI) is increasingly automating and optimizing a wide range of industrial processes. The 4.0 industrial revolution was defined in 2011 by Schwab and Kagerman as a technical-economic vision that lately indicates how more general technological advancements, even with origins in a non-industrial context, will be brought to provide and support the shift industry's economic position. On the other hand, a wave of change will have a ripple effect that goes far beyond the productions means, with transformation impact on society as well, especially for the active jobs. Changing roles may see certain activities threatened and others requiring new skills. The more profound transformation in the actual way of organizing the workforce will follow for traditional education, the life cycle of training, work retirement. The continuous automation may undermine the industry's role in society as an engine of development, employer, and entrepreneurship. The old image of Charlie Chaplin caught inside a machine mechanism, from "Modern Times", is no longer functional, due to modern working facilities and human motivation criteria, nevertheless, we are facing a new threat of man versus machine and the fear of traditional skilled operators becoming enslaved or replaced by machines.

Therefore, new international deals require a transition to a more circular economy and sustainable resources, including the non-conventionals, generated by digital non-pollution technologies. Recently, the program "Europe fit for the digital age" and the strategy "New European Industrial Strategy and skills agenda", will boost the research and pinpoint the addressed skills shortage for the digital era of society. Also, a focus of the EU is put on sustainable development (Eurostat, 2020)

The COVID-19 crisis has emphasized again, the major need for working methods updating and training process. This moment exacerbated the vulnerabilities of the industrial long value chains and to find the inflexibility either to lack innovation or not existing yet of implementing solutions. „The old "normal „shall be replaced by the new"

normal", to renew the role of industry in society" (European Commision, 2019, p. 6). The stage Industry 4.0, could be defined also as the digital technological revolution, still unfolded at the level of production relationships compatibility man-machine (Schlechtendahl et al., 2016). The new coming Industry 5.0 features the focus on the human factor as beneficiary and decider. The old lines between traditional „white collar" and "blue-collar" workers are blurred.

It is important to stress, Industry 5.0 is not just a chronological continuation of Industry 4.0, but as an evolving looking forward vision to co-existence of industry, emerging society, and environment. In essence, the new revolution stage is consequently an outcome of massive reduction from natural resources,anti-pollution involvement, and human society emancipation, by using the communication and IoT (internet of things) interconnection all over the world. Another direction of defining the next steps of Industry 5.0 is approaching the integration of production relationship as an interface man-machine 1:1, using the human brain creativity&decision strength to exploit the performance of industrial robots.

Paschek, Mocan, and Draghici (2019) analyze the Industry 5.0 impact on social and economic factors, summarizing the production revival success would be possible by shifting to "mass-automation „at the level of production means, managed through the creative competencies of human resources together with Artificial intelligence and Ciber-systems robots. „The reality on the ground is much different, however. Innovations, unprecedented by definition, do not necessarily follow a linear line from data to knowledge to application" (Didier, Duan, & Dupuy, 2015). Old ways of translational research and hasty solutions for implementation science are not a panacea and unlikely to succeed in Big Data environment" (Ozdemir & Kolker, 2016). Therefore the old traditional way of applying the science and research is obsolete, meanwhile the new way is still unclear. The paradigm of "interregnum" belonging to Antonio Gramsci (1971), at the beginning of the 20th-century show validity and is reconfirmed by Ozdemir's studies of "Birth of Industry 5.0", in 2017. The crises break out in the moment of ending the old era and birth of new sovereign order when the symptoms of morbidity occur. This is the moment of chaos, a discontinuity of governance between the old tradition and the design of the new one. This means, the new innovative order cannot provide 100% performance, right after the design stage, it needs sufficient time to experiment and to be in-depth practiced. Industry cross this stage of interregnum to be able to pass into level 4.0. The era of Industry 4.0 is not enough focused on human competencies, but more on technology development, thus the exit from interregnum will be possible when the ecosystem will be re-balanced by a constructive co-operation man-machine, with human-centric vision, aimed to come with Industry 5.0.

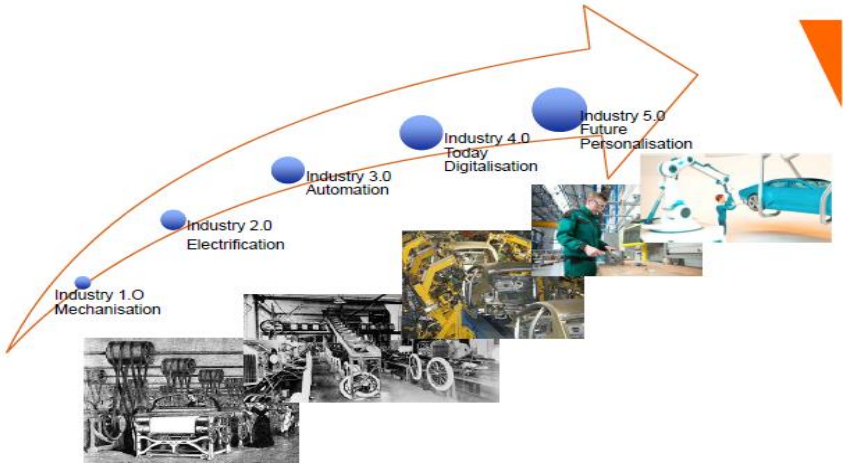

Figure 1. Industrial revolution stages 1.0-5.0
(Vanderborghtka, 2019)

Industry4.0. Definition, functions, principles, and challenges

Short historical data and definition of Industries stages from 1.0 to 4.0

Industrial revolution 1.0 is recognized as a start-up between the 18th and 19th centuries, when a certain range of domestic activities was centralized and transferred from "homemade products" to "professional outside activity", having the facility of mechanization. Steam energy became the source of progress and two manufacturing industries were born, such steel and textile industry (weaving looms). As a natural consequence, other trades were developed such as transportation, banks, and communication means. Besides, the living standards change, often bleak for the working and poor class, by moving the human society from rural to urban places.

The next step of Industry 2.0, at the beginning of the 20th-century, is defined by the new production system with innovative technologies generated by the electric power discovery. The impact on the social system is stronger, aggregating the two main social classes of the capitalist era, defined as working one and upper class detaining the entrepreneurial initiative and financial means. New industrial branches are developed, creating the future manufacturing trade covering chemistry, automotive, increasing the volume of production of textile, apparel, and construction active fields. Meanwhile, the polarization of social stakeholders has increased, igniting the turmoil of working-class and unions, debating ideological currents, and conflictual rallies aiming the political power.

Industry 3.0 was around the 1970s with the birth of computers, electronics, and IT through PLC (programmable logic controller). This time shall be remarked by a particular migration of occupational activities developed by traditional manufacturing industries towards less developed countries due to cheaper labor force. In other words, certain modern slavery appeared by an unfair exploiting the human resources,

meanwhile, the western European and North American countries developed towards the services of communication, logistics, and innovative business trade. Again the production relationships encountered another transformation, by fragmenting the working class into several categories, as a consequence of new activities content, defining the „blue-collar" (including the industrial flow operators and middle management)and "white collar"(linked to researching, scholastic, and top management level). The social conflict is escalating to a political one, confronting the capitalistic and communist ideology which was also reflected in the economic competition. The marketplace is divided between the capitalistic trade of the Common Market and communist countries C.A.E.R. at that time under the leadership of the former Soviet Union.

After these 3 stages of the industrial revolution, Industry 4.0 raised the technical progress to an unprecedented level, having the experience of previous stage 3.0 (Banabic, 2016). The new era is defined by the technology concepts, focused on CPS (cyber-physical system), IoT (internet of things), cloud computing, cognitive computing, and Big Data source of information (facilitate de accessed la internet). Initially, the aim was related to comfort zone improvement, for the consuming society, which later on turned into a progressive dominance of the IT industry keening the modernization of manufacturing equipment for higher performance and speed. After the year of Industry 4.0's birth, more and more criticism waves occurred into the society, highlighting the conflict between man and machine due to automatization threatening of industrial current jobs or shortage of solutions for most of the manufacturing domain, which asks for deep customization and applied "Additive manufacturing" for flexible production (Lee, Bagheri, & Kao, 2015). The definition of Industry 4.0 provided by Kagerman and Schwab is officially recorded in 2011, in Germany at an international trade fair, aiming the renaissance of industry on Europe after years of outsourcing the know-how to Asian countries, having a clear target, of counteracting the ascending economy of China on industrial production (Kagerman, 2014). More changes are to be considered, influencing the economy and managerial approaches (Raworth, 2017).

Functioning principles Industry 4.0

Considering the research data for Industry 4.0, according to the thesis of Fridol Mekkunnel (2019), the iteration of working principles contain the following items:
-*Interoperability:* based on IoT (Internet of things) and IoP (Internet of people), purportedly to create objects using the communication man-machine-working tools;
-*Virtualization:* to create a virtual model brought from the real world and simulate a real situation using a CPS (cyber-physical system). Afterward, CPS take over the task of monitoring the objects in a real environment to facilitate their execution and unload the difficult phases from human operators;
-*Decentralization*: insure the working autonomy among different units and increase the performance of CPS by making the bridge of communication and logistic, shorting the waiting lines, products lead time and improved quality. On the other hand, it should be recognized the issue been assigned on cases of having clashing on targets, decisions, or failures, due to unpredictable accidents, where the CPS operating could not decide onto the process;

-*Real-time capability*: the functions of execution, information stocking, data records, and process control are done in real-time, allowing fast decisions, eventual errors signal to come through the CPS. Further, the decisions made on commercial cost-benefit analysis, marketing, and new product development could be accelerated, become flexible, and adapted to market demands;
-*Service orientation:* the production is enabled to react, by making customer-oriented products. The solution is provided by an accurate connection between equipment, objects, and population through IoS-Internet of Service (as a sub-component of IoT-internet of things);
-*Modularity:* production is capable to adjust to a new market, especially to find flexible systems inside the organization by introducing the paradigm of Smart Factory with a short production cycle and quick response to the market delivery request. This demand is still debatable and not yet solved. The trial test was occurred by all the events determined by COVID-19 crisis. The capacity of logistics, online trading has flourished explosively during 2020-2021, nevertheless, other economic activities linked to domestic good manufacturing like apparel, footwear, and a good part of non-essential products were forced to drop or reduce, as a result of market demand and also due to limitation of implementing of digital solutions along the manufacturing process. Not to forget the fragility of operating long value chain which was emphasized, is still related to the inflexible of the routine decisional process with multi-control and confirmation factors.

Challenges ahead Industry 4.0

Upon researching a wide range of studies, such as belonging to Ozdemir, Kolker, Hekim, Mohelska, Rada, and Simoens, there are found common opinions which are expressing similar concerns and shall be treated as a constructive analysis for future improvement looking for the society's benefit. They are summarized as follows:
-*Ciber-systems security: is still at the risk* of breaches and data leaks. Cyber theft is also a big factor of challenges that must be considered. The critical issue is related to the potential danger of financial loss due to internal business data exposure, followed by reputation in such a situation.
-*Investment financial effort* assigned to digital solutions is still high. The changes are decided at the level of top management, CEO, or shareholders involved in the business. In such cases, the small organizations have reduced chances to cope with this difficulty, which may also lead to losing their market share in the future
-*Employment level for the active population* could be negatively affected by decreasing their actual input. It can challenge the category of workers with unchanging jobs competencies, especially for those with a low level of education, but mostly for the elder part of them.
-*Privacy data protection, including customers and producers* is under the threat, caused by interconnectivity during the communication, accomplishment, and delivery to the final customer. Online business, which has exploded during the COVID-19 crisis, will increase the public exposure along the whole chain of activities from consumers to producers. Also, the space between the customers and producers is uncovered by the critical level of manufacturing with complete automatization and reduced costs.
-*Education strategy* is needed to encourage the high level of engineering professional skills, besides the new ways of man-machine communication, to facilitate consistent,

long-running solutions for manufacturing. In front of the industrial challenging objective is the implementation of Smart Factory. This concept assumption started from the target of maximizing the profit upon automatization, agility, and flexibility, having the consequences related to unqualified operators reduction, personnel structure change, as new profiles are appearing on. This includes the triple smart dimensions into the relation, with the architectural form RAMI (reference architectural model Industry 4.0) of Smart Factory based on product cycle of life, processing items, and communication levels between all the entities. Prognosis "Future IQ, 2017" indicate the increasing role of future employees as freelancers, with high qualification and also the influence of activities that contain creativity, social contact, sensorial perceptions, expertise in various domains, and managerial decisions. The low-paid and low-skilled jobs are most vulnerable, besides the work in an office, turned into routine standard tasks for robots and AI. On the other hand, a more clear distinction must be done between the human manual work which needs a decision and also expertizes, and the human manual work which can be standardized. Here is the case of the manufacturing industry for fashionable or other creative products, currently very low appreciated for their human touch, suffering from a shortage of digitalization of technical solutions but also their vulnerability of long value chain (Behr, 2018; Colombi, 2014; Djelic & Ainamo, 1999). In their case, if applicable solutions will not appear, by a fair motivation of human labor and customized AI solutions, these fields of activities will disappear or will increase their cost by reducing the volume of products.

Industry 5.0. Definition, functions, principles, and perspectives

Definition-Industry 5.0

The debut of this stage was taken as a revolt expression against the dehumanization of the industry, counteracting the concept of Industry 4.0 focused mostly the side automatization and less concerned to human factor and community. One of the most interesting definitions belonging to Pieter Simoens, summarizes the main features shaping the framework "Yet it is precisely this threat that will be ended with the coming of Industry 5.0. In a world in which every individual wants to express oneself fully, there will be increasing demand for unique, customized, and personalized products. In such an era, the holy grail will no longer be robot-controlled mass production, but human creativity" (Simoens, 2019). The novelty of the new stage is provided by robotics exploiting, as it was designed by Universal Robots. The attention lies in application, going from simple to utilize the man-machine combination to no unmistakable alliances where the cooperation of man and machine occurs. This can be one consistent ground to trigger the satisfaction of final superior quality within a friendly environment for the final client and ecosystem. Industry 5.0 extends a good part of practical principles of stage 4.0, by motivating the human decedents and controllers with solutions for recognized asymmetries, softening the exacerbation idea of "automatize or dye".

Functioning principles Industry 5.0

Upon taking into consideration the concepts related to organizations cultures and society involvement for future generations training on new specialists and adapting

the up-skilling on seniors specialists towards the relationship with the robots, the functionality raise to a new level, starting from the researches of Fridol Mekkunnel (2019):
-*Interoperability:* based on system collaboration of equipment, tools, and computers;
-*Accurate information*: the ability of sensor-stocked computer system to obtain a virtual version of the real equipment, allowing virtual training through CPS (cyber-physical system)or human operating supervision of robots work;
-*Technical support*: Computers systems and AI can support with their update facility the human control and decisions;
-*Complementary and fragmented decision:* this task is transferred to artificial intelligence-enabled to complete specific decisions on their own;
-*Entertainment dividend:* the work shall be the vehicle of a satisfactory earning recognizing the importance and each individual performance. The society on the macro-level is forecasted with social emancipation and prosperity determined by dynamic innovations processes, but the welfare could be channeled differently according to economic development. Countries with a flexible and educated labor force, besides the legal framework, could be declared as winners, whereas unmodernized risk to lose due the competencies lack/limitation;
-*Social sustainability is obtained by fair appreciation, justice, environment, and economic health:* as the aging population increase, innovative technologies could enhance all society members' performance by interconnectivity, emotive health, reasoning, and physical functioning. In less than 3 years from this paradigm launching, the events of the COVID-19 pandemic crisis confirmed that on one side, the innovative technologies supported the economical survival and fast connection around the world, on the other side, the healing solutions were very much dependent on human and humanity, from treating the patients till the volunteering act of involvement for vaccines efficiency testing. More than that, despite all the digital facilities, the crisis exit is related to global immunity of population, based on strategical policies of mass-vaccination, which successful result will depend more on sharp management and agile organization system. Therefore, if Industry 4.0 introduces the concept of “Smart Factory “, Industry 5.0 defines the organization culture as ”agile management culture”. This vision is referring to adapting strength for human resources, technologies, and management functions. The new business “agile” model needs a reference cultural model for co-habitation along with the whole organization structure, gathering “smart” production means and relation man-man, man-machine, machine-machine. According to Ryann K.Ellis, agile culture means fast reaction and “flexibility extensively throughout the association” (Ellis, 2018).

Steep factors analysis for Industry 4.0 and 5.0

The main concern is related to the business model progress, as a vital nucleus for human society. The STEEP (social, technical, economic, ecologic, political) factors analysis represent an investigation managerial instrument to detect the main threats and opportunity from the business environment with further identification of appropriate strategies on the future development of various organizations' competencies and community human resources. Valuable information was extracted from recent researches belonging to the studies signed by Ozdemir Vural (2017), Doyle-Kent and Kopacek (2019), Paschek, Mocan, and Draghici (2019), Saeid

Nahavandi (2019) with late confirmation in January 2021, from the launched programs of European Commission/Directorate of Research and Innovation (European Commission, 2021). Actually, the whole society is crossing a transitory stage from 4.0 to 5.0 as explained by interregnum theory, after a reactive attitude against the technical determinism of Industry 4.0, advancing to the human-centric position of Industry 5.0.

Industry.4.0 –social factor impact

Industry 4.0 is recognized to be less aware of the human cost of all optimization of production processing, cumulating a trend of reluctance, due to visible fear of traditional jobs threatening the industrial manufacturing industry. The vision of human employees replacement by robots and AI entities was emphasized, because of adapted competence to the higher-performing industrial cobots. Key competencies are presented by Grzybowska and Łupicka (2017).

The elder generations X, Y, even Z were neglected, either for being unwilling to adapt or inappropriate approach to the valuable contribution of practitioners and experienced members of society.

Applied solutions for man-driven industries were not yet found (i.e. constructions, apparel, automotive)in danger to be forced for less costly strategies of outsourcing production to emergent countries exploiting the cheap labor force called in sweatshops. Similar data were found in the studies of Lewis (2017), highlighting the shortage of practical implementation of digital solutions 4.0. In a matter of cultural model, Industry 4.0 did not focus on managerial approaches or defining organizational cultures (Mohelska & Sokolova, 2018).

Industry.4.0-technical factor impact

This factor becomes de facto the center of industrial revolution 4.0, with the innovative technologies spread worldwide for communication as IoT (Internet of things), services with sensors interconnectivity, virtual space facility for training simulation, built-up entities with 3 D printing, controlling difficult tasks as surgical operations.

Industry.4.0 –economic factor impact

As a matter of business, integration of long value chain processing will be cost-effective dropping between10-30%, increased agility, superior quality 10-20%, and extending global markets. Cost reduction will be possible by horizontal integration of smart technology production lines to make smart products, with automated equipment, control sensors for faults prevention, difficult operations transfer to industrial robots. Vertical integration as well will be followed by collaboration and interconnection of all hierarchy levels of enterprises, leading to accurate faster planning, on-time information control, and real-time decisions. Markets expanding will be possible by "end to end engineering", with the full integrated process, including additive Manufacturing, customizing the operating according to final consumer request. „The digitalization IS the driving force for Industry 4.0 with several trends like connected

consumers, empowered employees, optimized production and transformed products". (Newman, 2017).

Industry.4.0-ecological factor impact

Industry.4.0 does not have a strong focus on environmental protection, nor has it focused on technologies to improve the environmental sustainability of the Earth, even though many different AI algorithms have been used to investigate from the perspective of sustainability. „While the existing studies linking AI algorithms with environmental management have paved the way, the lack of strong focus and action leads to the need for a better technological solution to save the environment and increase sustainability" (Nahavandi, 2019). Furthermore, according to Rada (2018), these influences are coming in relation to a waste prevention perspective, which defines 4 categories such as physical waste (generated by production and logistic), urban waste (from empty spaces and disintegrated infrastructure), process waste (exceeding stocks, inefficient trucks loading), social waste (people willing to work but having no opportunity, ineffective recruiting & employees retaining policies, assisted population unwilling to work).

Industry.4.0- political factor impact

The political impact is manifested by the official position of the German government, to Hannover fair, in 2011, announcing officially the beginning of a new industrial renaissance as a result of boosting the evolution of the IT industry and outcome in communication and industrial production.

Industry.5.0-social impact factor

"The worker of Industry 5.0 is not to be considered any longer as a cost, but rather as investment capital, balancing with financial revenue, thus human capital is more valorized and appreciated" (Breque et al., 2021). EIT Manufacturing has developed a typology of 8 future projections of working profiles, targeting newly developed competence, not their replacement with robots. They are containing the following: Super-strength operator (operator exoskeleton), Augmented operator (operator augmented reality), Virtual operator (operator virtual reality), Healthy operator(operator monitor tracker), Smarter operator(operator intelligent personal assistant), Collaborative operator (operator robot), Social operator(operator social network), Analytical operator(operator Big data analytics). Besides, the concern towards the higher qualified professional degree, special attention is given to physical and mental health, inside the working environment. The cyber entities detaining artificial intelligence or industrial robots will take over the high-risk tasks, the exhausting ones, and dull operations. On the other hand, most industrial sectors in Europe are struggling with the shortage of adequate skills and practical formation of recruited personnel, and formal education & vocational institutions do not offer answers to labor force demands. According to Deloitte, 70% of the millennial generation believe they have only some of the skills that will be required to succeed in the work of the future. Futhermore a new profile of the future specialist could be molded, trained to be pertinent with digital skills, and a parallel practicing on the job

or assigned customized coaching projects, to learn the particular content of the task along with social adapting to the lucrative environment. This way will involve the input of expertise detained among the generation X, Y, Z specialists, to be upskilled with digital competencies and become trainers/coaches for the young generation shift over. The World Manufacturing Forum has identified a set of 10 skills that will be needed in future manufacturing. From which only 4 are digital and 6 remaining are more transversal skills linked to creative, entrepreneurial, flexible, and open-minded thinking and open multi-cultural communication. A detailed presentation is shown in Figure 2.

Figure 2. 10 essential skills of specialist Industry 5.0
(World Manufacturing Forum, 2019)

Industry.5.0-technological factor impact

The human-centric approach in the industry puts core human needs and interests at the top of the production process, exploiting the technology as support in operating the process and adapting it to the needs of the worker. Under these circumstances, the entrepreneurs shall be diligent and identify the specific profile adapted to their activity complexity and to demand the needed technical options& customized cyber entities/equipment

Industry.5.0- economical factor impact

Sanitary crisis COVID-19 demonstrated how fragile the actual globalized economic strategy for production is. The ecosystem re-balance should be possible by the resilience of strategical chain values designed onto versatile production capacities and flexible business models, mostly for activities linked to human needs, health and security. In this regard, the energy efficiency of end-use sectors in the EU improved by 30%, at an annual average rate of 1,4%/year. Nevertheless, the situation of most energy-intensive industries continues to exist, strongly linked between economic growth and energy consumption. Such sectorial analysis imposes engaged efforts and sharply focused policy to innovate and apply solutions.

Industry.5.0-ecological factor impact

Respectful behavior for our planetary boundaries represents the new concept of circular economy and sustainability proposing objectives to be fulfilled in the matter of recycling natural resources, reducing waste, and environmental impact. Digital technologies are capable to contribute to the optimization of efficient resources consumption through AI and "additive manufacturing". The results from secondary raw materials being brought back into the economy around 12% could clearly be improved. Certain materials fit quite easily into the circular economy concept like those used for the IT industry while others (composite, fiber-reinforced plastics, metallurgical waste, etc.) present a much tougher challenge and require further research. Many European firms already recognize that industrial ecology is important in helping in globally competitive markets and longer-term positioning on the market.

Industry.5.0-political factor impact

A growing number of projects were conceived in the last five years, having the support of official institutions as the Directorate of innovation & research belonging European Commission, to amplify the outcome benefits of the digital revolution in terms of social, economic, and ecological impact. Some of them aim the changing business models by fostering a circular economy (Kyklos 4.0, Dralod, Paperchain), mass-personalization of products, processing flexibility (RICAIP, SYMBIOTIC), or human-robot inter-action in the manufacturing context (Facts4workers, EVRYON, HuManManufacturing, Rossini). The required aspect of workers skillset is treated by addressing through "Horizon 2020 strategy" with the projects of Erasmus(Beyond 4.0, SAM, Fit4FoF, Sais, Technequality) and those related to health, security and mental well-being are concerned such as (Plus, MindBot, H-Work, Empower).

The last events generated by COVID-19 crisis had a tremendous impact on all manufacturing industries, in particular to domestic goods of so-called non-essential purpose (automotive, apparel, footwear, hospitality industry) which need support to survive and also to revive in the next coming months, as a consistent part of the population is activating in this business. The changes from the political climate, such as the increased popularity of protectionist ideologies are gaining more attention and public attraction, demanding solutions in a matter of security and well-being at working place. Difficulties in finding new staff with adequate skills, as well keeping–

house the updated competencies have been an enduring problem for most industrial sectors. Therefore, a vital policy for education, professional re-conversion, and upskilling is more actual than ever, becoming very stressed by the business environment. Certain steps were done by an action plan for EU "Digital Education Action Plan (2021-2027) foster the development of a performing digital education, which shall be completed with other programs to facilitate integration for particular practical skills next to those identified by World Manufacturing Forum. The next period post-pandemic COVID-19 is recognized at an official level to be extremely important for recovery the industrial area and investing for the new "normal" of Industry 5.0. An investment fund was built in the very substantial European level response of 750 billion euro, "Recovery and Resilience Facility", to be accessed by the Member States to start-up and extend the reforms for the green circular economy, recovery of vulnerable activities, and upskilling professionals, by an efficient and fair contribution from all active human force, under circumstances of the digital era.

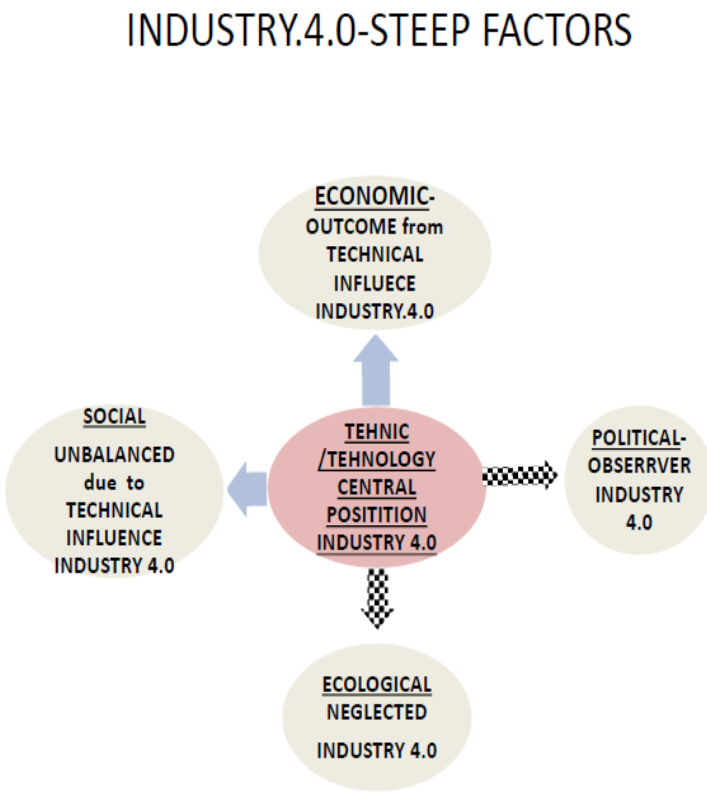

Figure3. Industry 4.0-STEEP factors impact

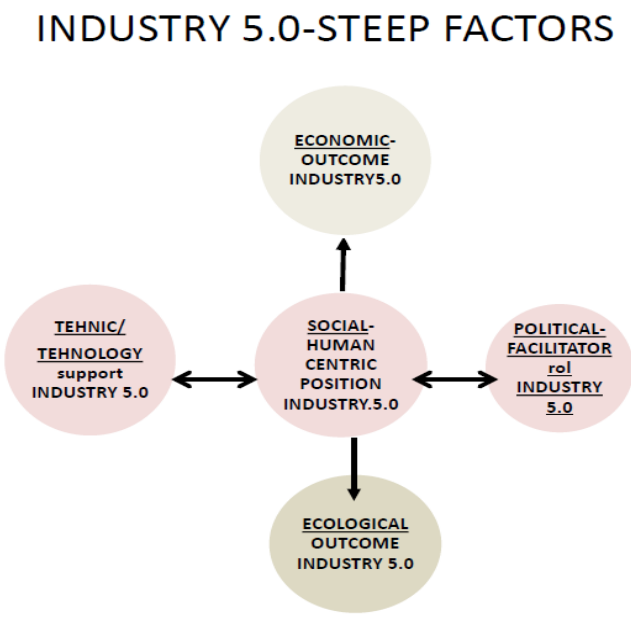

Figure 4. Industry 5.0-STEEP factors impact

Figures 3 and 4 show a synthetical image of dynamic transformation for STEEP factors' role along the stages of Industry 4.0 and 5.0. The central position of technology from stage 4.0 is transferred to social/human resources in stage 5.0, having the support of digital innovation(equivalent to technical factor) with reciprocal influence. The observer role of the political factor from stage 4.0 is upgraded to a facilitator for economic and ecological projects policy on stage 5.0, having also amplified and continued connection within the whole environment. In this way, the ecosystem features less focused before stage 5.0, as indicated by discontinuing connection shall be comprehended for its vital function of society's existence in the long term. Furthermore, the relations among STEEP factors turned to be stronger and interconnected as they are indicated by the arrows connectors. The previous analysis of STEEP factors found on the academic concept of" 4 design asymmetries in Industry 4.0", the elements of unbalanced ecosystem stage 4.0 with potential re-balancing solution through stage 5.0," proposed by Ozdemir and Hekim (2018). Certain solutions are proposed as well by the same concept, with a 3 D symmetry approach, based on the assumption of safe exit solution, innovation acceleration/deceleration brakes development, and symmetrical design for technical next generation of global governance (support offered by social and human science under the acronym of PETER: post Ethical Legal Social Integrity-Technology Evaluation Research).

The academic approach regarding turning Industry 4.0 into 5.0

"Innovation ecosystem needs to be governed and cannot be left alone to their own course" (Guston, 2015; Ozdemir, 2017, 2018). The way of controlling the phenomenon of innovation is important, thus a suitable selection of frameworks shall be decided,

with afterword's benefit from this research outcome and enable to answer to essential questions of "what, why, where, how and who". The presentation of the 4 design asymmetries is aiming to concord the common conclusion of scholastic theory and previous STEEP analysis of rebalancing ecosystem from Industry 4.0 through the instruments of Industry 5.0:

-Asymmetry 1: Extreme integration without safe exit strategy from the network
Complete integration of all connections between objects, human and man-object is vulnerable in the case is done only by IoE (internet of everything). The system risk collapsing in the event of network failure, by hacking or Internet viruses that can fully invade the integrated system. Examples could be provided from the power grids blackout with major consequences for hospitals activities, private data access till the paralyzed domestic activities such as plugging the home appliances. Beside the real-life examples, the extreme integration could lead to a mono culture in science and limitation of creative output in society.

-Asymmetry 2: Filter Bubbles versus Open systems:
This is a consequence of the 1-st asymmetry, referring to the entrenched habits, beliefs, values, prejudices of collecting data from virtual space, narrowing the researched channels of information. Again, examples could come from real-life based on filter bubbles created by our attributes at the logging to internet Google, Facebook. Thus, the Internet, AI, and all the alternatives channeled by IoT or IoE have a democratic potential for society access, but on the other hand could lead to open system constraints through unchecked filter bubbles, limiting exposure to ideas exchange and creativity efforts.

-Asymmetry 3: Acceleration versus Deceleration of Innovation
The innovations in science and technology depend on mobilization of expectation and return of investments for new opportunities coming from investors, entrepreneurs, government. These features put strong pressure on the innovations authors, who sometimes are subscribed to earlier faster project output. Their success could be ephemeral, lately replaced by others overpromises of technological artifacts, looking for a return on investment speed-up rate. The dilemma related to an accelerated innovation process by all means versus pace decelerate, to allow robust ideas getting a social attuned impact, could be solved by an accurate cost of opportunity. The relevant example of the moment is offered by the vaccines competition and debatable performances attributes between Pfizer (based on RNA modified revolutionary technology) and Astra Zeneca (based on a traditional method of genetically modified cold virus). Pfizer with years of researches behind but a shorter period of testing was confronted with an initial wave of reluctance but provided efficient results at the level of societal perception. Astra Zeneca despite the cumulated experienced technology and methods provided debatable results having a less positive impact on society. Afterward, all variants could be embraced, as long as the cost of opportunity is calculated and sustainably controlled for the well-being of communities.

-Asymetrix 4: Technology versus Society Outcome:
Drivers of Industry 4.0 theory and practice have been so far immediate solution-oriented professions belonging to the technical background, engineering and investors.

The normative dimension of Industry 4.0 governance is debatable, questioning the missing ethical & responsible social policy rules as a result of technical determinism with low involvement of social science and humanities. Therefore, two current ideologies are outlined, one turned to technical determinism (optimistic vision for society in permanent progress, robots replacing human tasks) and the other one, skeptic, catastrophic vision (society will be swept by the dominance of AI and cyber-entities).

Finally, these 4 asymmetries of Industry 4.0 could be resolved, the applied solutions are still under research process, yet the 3 D symmetrical approach has developed 3 theoretical directions, functioning into the ecosystem of Industry 5.0, upon the model shown in Figure 5:
-*built-in "safe exit „strategy, orthogonal directed*, to counteract the hyper-connected digital networks of *asymmetry no.1*;
-*accelerators &decelerators brakes*, capable of tuning the evolution speed of projects innovative output, to coagulate benefits in the long term, following the ethical, legal, and equity principles. This is looking to solve *asymmetry no.3.*
-*symmetrical design of next-generation global governance of technical policy "*facility a mix of collaboration within various projects of responsible technical specialists together with researchers from social science and humanities, increasing the value of innovative results by an appropriate cost of opportunity and analytical self-explanatory framework. This envisages asymmetries 3 and 4.

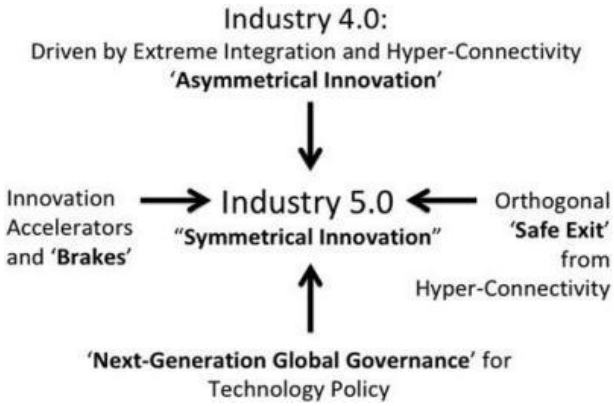

Figure 5. Industry 5.0-3D symmetrical proposals to re-balance Industry4.0 asymmetries
(Özdemir and Hekim, 2018)

Final researching result and used methodology

The previous concepts analysis were approaching the research strategy of "grounded theory" which combine the inductive and deductive methods, starting from the data offered by STEEP factors which predict and explain the reason for developing the transition from Industry 4.0 to 5.0, with a final result of diverging radial factors interaction presented onto figure 3-4. The deductive approach is justified by the result of the 4 asymmetries Industry4.0 launched by Özdemir which from one side explain the personal hypothesis of shifting vision from technical determinism 4.0 to human-

centric concept 5.0, due to the unbalanced influence of technical factors upon the ecosystem, business, and organizations through an era of Industry 4.0. On the other hand, the proposed 3D symmetrical solution to re-balance the system, belonging to a well-known researcher is taken as a foundation, reinforced by other viewers' researches which allow building another personal model. This last hypothesis could be considered for further tests on management and business organizations to confirm its prediction. Altogether the references and cited authors complete and recognize the personal construction based on the method of Collins and Hussey (2003) of grounded theory with inductive & deductive approach.

The proposed 3D symmetrical concept to solve the 4 asymmetries could be developed by using a managerial approach with a priority diagram of importance &urgent criteria to a macro level case, assuming a crisis of labor force competencies adapted to Industry 5.0. Therefore from the crisis condition considered onto quadrant defined by the maximum value of Importance & Urgent, the managerial priorities shall be organized and distributed in 3 directions of parallel actions, to be obtained in due time with all creative and specialized human forces. The quadrant of maximum Importance & Minimum urgent usually dedicated to top management and political dissidents are identified with "accelerators decelerators brakes of innovation. This group of stakeholders is dealing with strategies and major policies making decisions which are tunning the speed of innovation and analyzing the opportunity cost, following ethical, legal, social, integrity criteria (Fisher, 2005). The next quadrant of minimum Urgent-minimum Importance, assigned to the level of entrepreneurs/managers/education factors is identified to make" symmetrical design projects with the next generation of governance of technical innovation" because they are assigned to specific work, technics and action plans, subscribed to major objectives coming from the top-level policy. The last quadrant of maximum Urgent-minimum Importance is identified to find the "safe exit" equivalent to the contingency action plan, in our case the group of freelancers/project managers involving multi-skills specialists collaboration in absence of current employees.

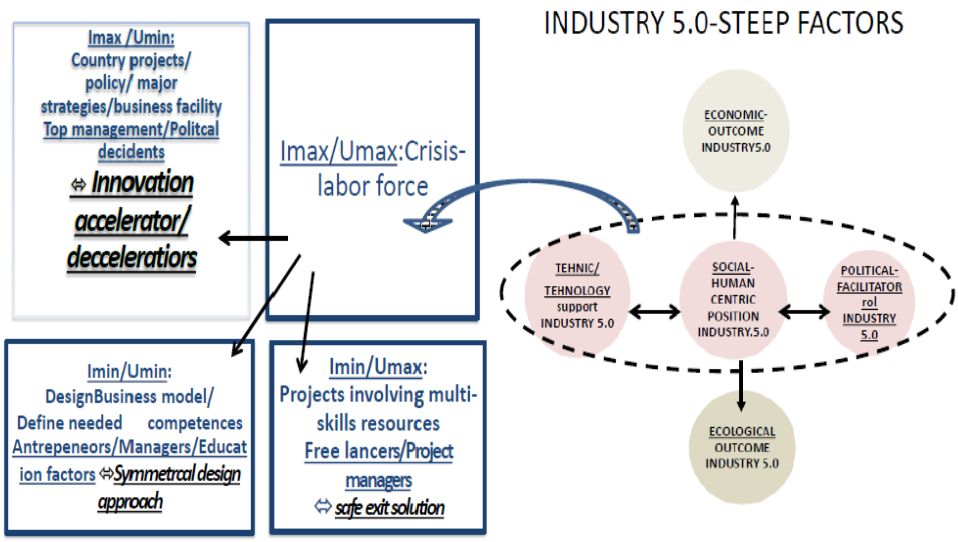

Figure 6. 3Dsymmetrical approach by priority management of STEEP Industry 5.0

Model limitation. Implication. Conclusion

Model limitation

The actual research and models construction recognize certain limits, as is still based on literature review and scholastic studies which are already demonstrated and recognized, but the personal experiment, case study, or a survey are necessary to add value. The actual study is at the first stage, further research work is following, related to the topic of human resources development and performance into Industry 4.0-5.0, therefore the work is still ongoing for more results.

Implication

Meanwhile, the implications of phenomenon Industry 4.0-5.0, for the internal environment such organizations& management, besides the external environment (communities and people) shall be emphasized. The main stakeholders of industrial plants such as entrepreneurs, top managers, and also middle managers are deeply responsible, to sustain the human resources for improved performance, respecting human needs. The new circumstances are calling for new strategies inside the organizations, on top management's behalf to identify the needed working competencies of their specialists, customizing the 10-set of skills (World Manufacturing Forum) according to the new type of working flows, activities, or equipment. The equitation shall take into account the components of reconversion and training for all the population segments, to enable a smart investment and benefit of getting the value of experience and practical knowledge of seniors, combining with the

agility and creativity of the new generation born on the digital era. The external environment represented by communities will get the benefit of growing as "Smart digital cities" by formal and vocational education which shall be sustained by institutions and government policies. The main objective to be followed is a mutual relation and common benefit, whereas the organizations are adding value by hiring smart specialists, resulting from the society and meanwhile the internal organizational training & professional reconversion support the various human resources, reducing the cost of the unemployment rate for the communities.

Conclusions

The actual complexity of social and economic relationship, crossed by the crisis Covid19, need a radical shift of business climate approach, strongly dominant by IT producers, by integration of all activities industrial sectors, including those less suitable to a complete digitalization or automatization.

The projects shall be tackled and comprehended as country major objectives, on long terms for education, molding the specialists' models and business development. The channels of customized investments to using the robotics for specific professional manufacturing sectors shall include the traditional industries still active and expertise of the labor force, upon the integration of communication by virtual tools and direct contact in a real environment.

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