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Industry 4.0 and Industry 5.0—Inception, Conception, Perception, and Rethinking Loyalty Employment

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Abstract

This paper delves into the transformative journey of Industry 4.0 and explores the emerging landscape of Industry 5.0. Beginning with the inception of Industry 4.0, characterized by the integration of digital technologies and automation in manufacturing, the paper traces the evolution of smart factories and interconnected systems. It examines the conception of Industry 4.0, highlighting key technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics that have reshaped industrial processes. Moving forward, the paper explores the perception of Industry 4.0, shedding light on its impact on production efficiency, supply chain management, and overall business operations. It discusses the challenges faced during the adoption of Industry 4.0 and emphasizes the paradigm shift towards data-driven decision-making. As the industrial landscape evolves, the paper anticipates the advent of Industry 5.0, focusing on human-machine collaboration and a more holistic approach to manufacturing. It examines the conception of Industry 5.0, emphasizing the integration of human-centric values, creativity, and adaptability in the production processes. In the context of this industrial revolution, the paper also addresses the rethinking of employment loyalty. It analyzes the changing dynamics of the workforce, emphasizing the need for upskilling and adaptability in the face of automation and technological advancements. The discussion extends to the role of employers in fostering a culture of continuous learning and employee engagement to ensure loyalty in the evolving industrial landscape. In conclusion, this paper provides a comprehensive overview of the inception, conception, and perception of Industry 4.0, while also anticipating the paradigm shift towards Industry 5.0. It underscores the importance of rethinking employment loyalty in the context of evolving technologies, emphasizing the symbiotic relationship between human creativity and technological innovation

Keywords: *Industry 4.0, Industry 5.0, Inception, Conception, Perception.*

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1. Introduction

With the gradual demise of the specific Industry 4.0 technocentric view on technology (Lasi et al., 2014), the onset of the Industry 5.0 (I5.0) paradigm emphasizes the need to integrate the human-centric, environmental, and social aspects in our thinking about technology, progress, and innovation. As a government-led initiative, Industry 4.0 stipulated approaches to economic policy-making driven by technology. In contrast, the follow-up initiative, i.e. Industry 5.0, promoted by various bodies of the European Union (EU) (Breque et al., 2021), seeks to add human, environmental, and social aspects back into the equation by restoring the centrality of people and the need to attain resilience and sustainability goals when trying to stimulate innovation and well-being of society at large (Enang et al., 2023; Jafari et al., 2022).

The focus on human-centric solutions is a means of counterbalancing the specific industry 4.0. overemphasis on technology and the technological component of innovation. Accordingly, a comprehensive understanding of the concepts and paradigms of Industry 5.0 and Innovation 5.0 requires that the human being is placed squarely in the equation. The application of Industry 5.0 technologies to business strategies, models, and processes can have some negative aspects, such as security risks and privacy issues (Lee et al., 2014).

Therefore, the first effort to overcome the criticalities of this process has been accomplished through the proposition of the Society 5.0 paradigm (CSTI, 2016; Fukuyama, 2018). The latter involves the balance of economic, technological and social outcomes and promotes the role of skills, knowledge, and the participation of multiple stakeholders in the development of innovation (Aslam et al., 2020).

Society 5.0 is a new paradigm that defines the proper exploitation of technology and innovation by leveraging on smart technologies to forecast the ideal form of a future smart society (Fukuda, 2020). According to this perspective, research must analyze the relationships between physical space and cyberspace to understand how advances in information and communication technology (ICT) can be leveraged to bring opportunities for growth and development in the social space to properly balance economic and technological developments with the resolution of social problems.

However, despite the increasing diffusion of research on Industry and Society 5.0, there is still the need to conceptualize the key dimensions of the 5.0 paradigm, intended as a broader concept that can encompass technological dimension (I5.0) and the cultural, social, and human factors identified by Society 5.0 (Konno, 2020). In addition, extant research does not explore the redefinition of innovation in line with 5.0 principles (De Felice et al., 2021) and does not analyze the impact of some factors, enabled by Industry 5.0 and that can act as mediating variables in the relationship between Society 5.0 and Innovation 5.0, such as

skills, knowledge and capabilities, stakeholder engagement and to apply a multileveled perspective to this issue (Carayannis et al., 2017; Cillo et al., 2019)

The analysis highlights the need to overcome the technocentric of Innovation 5.0 and to apply a new systems-based view grounded on knowledge creation, continuous improvement and the attainment of proactiveness as drivers for antifragility and the potential constant renewal of value generated over time (Carayannis et al., 2022; Corvello et al., 2023a). The results of the research allow for introducing a multidimensional conceptual framework for Innovation 5.0 based on the integration of technological, human, cultural and social dimensions that identify the levers for stimulating different shades of innovation (from supply chain to business model, from sustainable-oriented to social innovation). In this way, the study provides theoretical insights about the dimensions that can foster the development of Innovation 5.0 by overcoming the technocentric view.

Starting from the need to apply a new all-encompassing perspective, the paper detects the potential factors that can influence innovation mechanisms (for each of the four dimensions: technological, human, knowledge-based, and social) and seeks to shed light on the topics that need to attract more research in the future: human-centric solutions, resilience and antifragility, societal innovation.

Loyalty has become one of the vital concerns for organizations, especially in the context of the economic tensions related to the 'psychological contract' between employers and employees (Naus, van Iterson, & Roe, 2007; Sverke & Goslinga, 2003). Loyalty can be defined as "a strong tie that binds an employee to his/her company even when it may not be economically sound for him/her to stay there" (Logan, 1984). Employee Loyalty is "a deliberate commitment to further the best interests of one's employer, even when doing so may demand sacrificing some aspect of one's self-interest beyond what would be required by one's legal and other moral duties" (Elegido, 2013).

The definition of loyalty can correspond to the following expressions: "relation of trust, resistance to the adoption of opportunistic behaviour faced with an outside job offer" (Dutot, 2004); "significant length of service in the company, less inclination to search for outside job offers and a strong sense of belonging" (Peretti & Igalens, 2015); or "a feeling of belonging" combined with staying in the organization over the long term (Colle, 2006). An employee's loyalty to the occupation, his/her emotional investment, and the regularity of his/her commitment to the organization are key factors that determine the longevity and performance of organizations (Bakker & Schaufeli, 2008).

Kyle LaMalfa (2007) pointed out in his study that as an employer, you need to understand why your employees are emotionally connected to your business - and it's usually much more than salaries, training, or benefits. Research has shown that emotionally connected employees are the best employees as they are engaged and productive, and they feel authorised and appreciated. Frederick Reichheld (2006) in his study reported that loyalty, for those who plan to stay with an employer for at least two years, can be affected by several factors, like benefits and pay, working atmosphere, job contentment and customers.

Employee loyalty is critical for organizations as continuous turnover can be very expensive. In his study, he specified that one of the most effective ways to improve employee loyalty is to make employees feel like they are a significant part of the organization. His study found that only 55 percent of the employees surveyed feel like their

organization treats them well. He suggested that an employee feedback system can help raise employee loyalty by providing two-way communication between employees and management. If employees feel like the organization is listening to them, and recognizing them for their contributions, they will more likely be loyal to the company.

Ho Future, (1980) Rewards, financial or otherwise, should be valued and must be perceived as based on performance. Perhaps there is no hitch in acknowledging this principle. However, most organizations have far to go in implementing them. This study makes allusions to several management practices such as time-based compensation, inadequate performance appraisal, etc. that hinder reward-performance contingency and equity in the Indian context. Studies on loyalty based upon the analytical context proposed by Hirschman (1970), have interpreted it either as an attitude that inspires expression (voice) and discourages departure (exit) from the organization or as an alternative form of behaviour to both voice and exit (Guillon & Cezanne, 2014).

In a study that inquiries the financial consequences of employee turnover, Hinkin and Tracey (2000) proposed the five cost groups: separation costs, recruitment costs, selection costs, hiring costs, and loss of productivity costs. They developed a piece of computer software based on these five categories to simplify the labour turnover cost calculations. Their study revealed unpredictably high costs related to labour turnover and emphasized the duty of managers and human resources (HR) authorities to retain staff with practices beyond financial benefits (Ineson, Benke, & Laszlo, 2013). The studies conducted by Graham (1996) and Hizer (1998) showed that an organization's efforts in reviewing the relationship between employee satisfaction, customer satisfaction, efficiency, and financial performance revealed the following points: Grief-stricken employees have low efficiency and high absence records, Content employees are efficient, innovative, and loyal, A rise in job contentment would cheer up the employees, and lead to an increase in efficiency.

Employee satisfaction leads to customer loyalty (Graham, 1996) (Davidhizar & Shearer, 1998). Jawahar (2006) found that performance evaluation played a role in the relationship between employee satisfaction and employee loyalty in this study. Performance evaluation is an important element of loyalty because it is positively related to organizational commitment and negatively related to turnover intentions. Job satisfaction and organizational commitment fall into a broader definition of loyalty. A satisfactory appraisal system is also necessary to have a steady performance by employees. The appraisal fairness provides perceived fairness to the employees and elicits employee satisfaction and organizational, performance (Hassan, Nawaz, Abbas, & Sajid, 2013). Employee loyalty doesn't easily build up in a short period but it can be formed over a long time and influenced by a lot of variables. Such as work motivation, job satisfaction, and leadership. Work motivation has an important role for employees and can be one of the supporters of creating employee loyalty. High work motivation possessed by employees will make employees happy in carrying out their work, and healthy and create a desire to work optimally (Changgriawan, 2017).

Conversely, low work motivation can have a serious impact on employees so it can affect employee performance. Motivation is the desire to act. The existence of motivation can stimulate employees to move more energy and thoughts in realizing company goals. If the need for this is fulfilled then there will be satisfaction and fluency towards increasing

employee loyalty. Job loyalty will be realized if employees can complete work or duties that are their respective responsibilities (Wibowo, 2013).

Meanwhile, with high job satisfaction, employees will have high work morale so that employee performance will be maximized. Otherwise, with low job satisfaction, employee performance will be decreased and impact on employee performance which in the end can influence on the company's performance. For this reason, job satisfaction is very important in the company and supports company performance in the current era of globalization (Wijaya & Susanto, 2014). Work satisfaction is the level of pleasant feeling obtained from the assessment of one's job or work experience. For that, companies must recognize what factors make employees satisfied working in the company. With the accomplishment of employee job satisfaction, loyalty will also increase (Colquitt, J., LePine, J., & Wesson, 2012).

Another important role in increasing employee loyalty and employee performance is the need for the role and task of a leader. Given all the attitudes, decisions and actions of a leader, of course, they are very influential and even play an important role, so that they can become a benchmark for action and motivation for employees in all forms of positive work activities. With this, it can build enthusiasm job satisfaction and even employee loyalty (Citra & Fahmi, 2019). Leadership is a person's ability to influence others. In this case, his subordinates are such that the other person is willing to do the will of the leader even though he may not like it. Leadership as an effort to influence subordinates through a direct or indirect communication process to achieve certain goals, shows that it involves the use of influence, therefore all personal relationships can be a leadership effort (Hasibuan, 2014). Many studies have discussed and tested the relationship between work motivation, job satisfaction and leadership variables on employee performance. However, there is still rare research that tests employee loyalty as an intervening variable to assess whether there is a strong impact on the predictor variable within employee loyalty to improve employee performance. For this reason, this study has the novelty of using employee loyalty as an intervening variable and tests it together using a variance-based structural equation model (VB-SEM) approach in the chemical manufacturing industry.

High employee performance is vital for the success of any organization and many organizations pay significant efforts to achieve it but it does not always happen in the workplace. Various factors influence employee loyalty including assigning appropriate tasks, facilities and work environments that fully engage them in the work and opportunities for personal development (Zanabazar & Jigjiddorj, 2018). Loyalty also reflects the loyalty of employees to the company where they work and the tendency of employees not to move to another place, because loyalty can affect the comfort of employees working in a company (Siagian, 2014). Loyalty also describes the mental attitude of employees who remain at the company even though the company is experiencing progress or setbacks (Nitisemito, 2011).

Employee loyalty is influenced by three aspects, namely; rational factors such as salary, bonuses, career path, safe work environment, and facilities obtained. Emotional factors such as self-expectations, feelings to be challenged, work to be proud of, and respect by the company and work culture. Personality factors such as employee character and temperament are possessed by employees (Almasdi, 2012). This study uses employee loyalty indicators which refer to Putri, (2014) research results, including; (1) obeying regulations, (2)

being able to work well, (3) having the courage to take risks, (4). carrying out tasks without coercion, (5) not abusing authority.

Work motivation is a condition that encourages or becomes because someone does a job or activity, which takes place consciously (Bangun, 2012) also energy moves individuals to try to achieve goals expected in doing their job. Based on some of the above understanding, work motivation is a process move or encourage someone to do something to achieve the expected goals. Motivation is also referred to as drivers, desires, supporters or needs that can make a person excited and motivated to reduce and fulfil urges, to act and act according to certain ways to lead to the optimal direction (Jufrizen, 2017).

Motivation questioned how to encourage the morale of subordinates so that they want to work hard by giving all their abilities and skills to achieve the goals company (Hasibuan, 2014). Motivation is a psychological process that shows the interaction between attitudes, needs, perceptions, and decisions that occur in someone. Motivation as a psychological process arises from factors within people which are called intrinsic factors or external factors called extrinsic factors (Soeroso, 2004).

2. Research Methods

The method of writing this scientific article uses literature study/library research. Processing, and analyzing reference sources of books, articles, journals, and other internet sources, especially in the scope of entrepreneurship and human resource management. All references/reference lists in this article are cited through Google Scholar, Research Get, and other references. Literature Study (literature review) is a study conducted by researchers by collecting some books, and magazines related to research problems and objectives. This technique is carried out to reveal various theories that are relevant to the problems being faced/researched as reference material in discussing the research results. The research begins with a literature search related to the research subject. The literature search is the first step in collecting relevant information for research. The literature review is very important in making a scientific paper or essay, where the literature review provides ideas and objectives about the research topic to be carried out.

3. Results and Discussion

Organizations should consider the age of an employee in a higher sense while making hiring decisions. People who are single or are not settled with their family in a particular city would be more likely to change their current job when they get better job prospects elsewhere. This could be rarely seen in the employees who are married and are settled in a city as the cost of relocation would surpass the extra salary they would be earning in their new organization. Organisations also need to note that while female respondents were found to be more loyal to their organisations, male respondents were found to have more work experience in terms of years spent working. While the female respondents were more satisfied with their current salary and less likely to leave their current employer, the male respondents were found to be more dissatisfied with their current salary and open to other, more rewarding opportunities. From the employee's perspective loyalty is seen as a factor which may not necessarily bring them monetary benefits but would mask the drawbacks in them. An employee might not be target achieving but is loyal to his organization and works

hard to achieve his targets. So this loyalty shown by the employee towards his/her organization should allow the employee to cover up his drawbacks.

Organisations would do well to formally recognise an employee's loyalty, and most importantly, make them (the employees) aware of the fact their organisation acknowledges their loyalty and appreciates the same. Whether or not a company can afford to set up a reward or incentive scheme based on an employee's loyalty is something that solely depends upon the company's unique dynamics. This would foster a positive environment conducive towards increasing organisational performance. Loyalty as a factor is higher in people belonging to the 40 to 60 age band compared to those in the 20 to 30 age band.

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This is due to changing lifestyles and circumstances. The basic needs of people have changed over time. Money has been a major requirement for satisfying the basic needs of our current generation which would directly reflect on the number of years they work for a particular company. The current generation of people tends to change their jobs more often whenever they are offered better pay. This is not the case with the the people in 40 to 60 age band as they tend to remain satisfied with their current job and are less likely to leave when offered better pay.

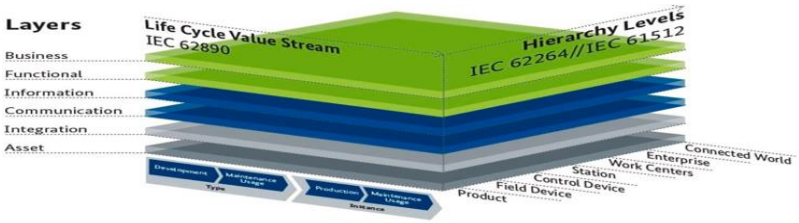
From the employee's perspective loyalty is seen as a factor which may not necessarily bring them monetary benefits but would mask the drawbacks in them. An employee might not be target achieving but is loyal to his organization and works hard to achieve his targets. So this loyalty shown by the employee towards his/her organization should allow the employee to cover up his drawbacks. Organizations would do well to formally recognize an employee's loyalty, and most importantly, make them (the employees) aware of the fact their organization acknowledges their loyalty and appreciates the same. Whether or not a company can afford to set up a reward or incentive scheme based on an employee's loyalty is something that solely depends upon the company's unique dynamics. This would foster a positive environment conducive to increasing organizational performance.

They expect the extra work they do to be rewarded by a raise in their salary or through some incentives. But in an American scenario, the employees are paid for their loyalty that is for the year of service for the organization and not for achieving their targets or achieving more than their target. But when it comes to companies with high attrition rates a loyalty-based system is a better option because it helps the employer to prepare well in advance for any resignations from their employees. This would help the organization prepare for the

requirements of any units. Slowly many companies in India have also started rewarding their employees based on the loyalty-based scheme.

3.1. Understanding Industry 4.0

Industry 4.0 refers to the intelligent networking of machines and processes for the industry based on CPS – a technology that achieves intelligent control using embedded networked systems [8,13]. There are different understandings of Industry 4.0, albeit all agree upon the Reference Architecture Model Industrie 4.0 (RAMI4.0). RAMI4.0 was developed by the German Electrical and Electronic Manufacturers.



(a) RAMI4.0 architecture model

(b) selected characteristics of RAMI4.0

Association (ZVEI) to support Industry 4.0 initiatives [14]. RAMI 4.0 model consists of a three-dimensional coordinate system (Fig. 1(a)) that depicts the architecture of Industry 4.0 systems. The "Hierarchy Levels" axis is derived from the information model of automation [15] and represents the different functionalities within factories or facilities; the "Layers" axis describes the decomposition of a machine into its properties and the "Life Cycle Value Stream" axis represents the life cycle of facilities and products. The latter includes business models and the benefit of using Industry 4.0 as well. Fig. 1(b) summarizes some of the characteristics of Industry 4.0 components based on RAMI4.0.

Vogel-Heuser and Hess discussed, (2016;13), the main design principles of Industry 4.0, which are summarized as the following: (1) Service-oriented reference architecture; (2) Intelligent, self-organizing CPPS.; (3) Interoperability between CPPS and humans; (4) Adaptability and flexibility to changing requirements; (5) Optimization for Overall Equipment Effectiveness; (6) Data integration across disciplines and the entire life cycle; (7) Reliable and secured communications between businesses, and (8) Data security.

Industry 4.0 is considered a technology-driven revolution to achieve higher efficiency and productivity and, as a high-tech strategy of the government, to enhance Germany's competitiveness in a global market. This may be further reinforced by the three dimensions of RAMI4.0. Product Life Cycle, Business Layers, and Factory Hierarchy. Boston Consulting Group identified nine key enabling technologies of Industry 4.0 i.e., Big data and analytics, Autonomous robots, Simulation, Horizontal and vertical system integration, Industrial Internet of Things, Cybersecurity, Cloud, Additive Manufacturing, and Augmented Reality. These technologies underpin the five Industry 4.0 central research themes (1) Horizontal integration through value networks, (2) End-to-end engineering across the entire value chain, (3) Vertical integration and networked manufacturing systems, (4) Cyber-Physical

Systems technology, and (5) New social infrastructures in the workplace.

Industry 4.0 may have been considered a technology-driven transformation. Some considerations and projected impacts from societal needs, such as sustainability, human-centricity, and resilience, are also visible. Industry 4.0 intends to address challenges such as resource and energy efficiency, urban production, societal needs, and demographic change. To reduce the consumption of energy and resources, changes in manufacturing processes and the design of machinery and plants are required.

Industry 4.0 may not be considered a human-centric initiative. That's as may be, the like of human-machine cooperation or operator assistant technologies, socio-technical approach, and work-life balance is not to be ignored. Industry 4.0 promotes new socio-technical infrastructures by transforming different aspects of a workplace such as health management and work organization, lifelong learning and career path models, team structures, and knowledge management. This is described as a socio-technical approach of the Industry 4.0 initiative leading to a paradigm shift in human-technology and human-environment interactions. It is anticipated that a worker's role is set to change significantly due to the increased use of technologies that are more open, virtual, and extensive. This is reflected by some of the design principles of Industry 4.0. Reflective of the second and third design principles (i.e., Information transparency and Technical assistance) is the increased use of technologies such as robot-assisted systems and augmented reality (AR) to provide workers with real-time information to improve decision-making and work procedures.

Smart assistance systems release workers from routine tasks so that they can focus on more creative and value-added activities. Flexible work organization is promoted to enable all workers to continue professional development more effectively and have a better work-life balance. The relevant technologies will also allow older workers to extend their working lives and remain productive longer. It has been recognized that in a smart factory, the role of employees will change significantly. Implementation of a socio-technical approach to work organization will offer workers the opportunity to enjoy greater responsibility and enhance their personal development. Industry 4.0's socio-technical approach strives for the so-called motto, "better, not cheaper". It argues that adopting an extreme version of the Taylorist approach to work organization based on frequent repetition of highly standardized and monotonous tasks is hardly the most promising way to implement Industry 4.0. The fact that smart factories will be configured as highly complex, dynamic, and flexible systems means they will need empowered employees to act as decision-makers and controllers.

3.2. Understanding Industry 5.0

Since 2017, scattered academic efforts have been pushing for the introduction of the Fifth Industrial Revolution. In 2021, the European Commission formally called for the Fifth Industrial Revolution (Industry 5.0), after discussions amongst participants from research and technology organizations as well as funding agencies across Europe in two virtual workshops organized by the Directorate "Prosperity" of Directorate-General for Research and Innovation, on 2 and 9 July 2020, by the formal release of the document titled "Industry 5.0: Towards a Sustainable, Human-centric, and Resilient European Industry" on 4 January 2021. This is similar to Industry 4.0 in 2011 by the German government, devising a top-down initiative in response to the changing societal and geopolitical landscape. Our analysis of

Industry 5.0 in this article is principally based on the sentiment of the European Commission.

Industry 5.0 recognizes the power of industry to achieve societal goals beyond jobs and growth, to become a resilient provider of prosperity by making production respect the boundaries of our planet and placing the well-being of the industry worker at the centre of the production process. Industry 5.0 complements the existing Industry 4.0 paradigm by having research and innovation drive the transition to a sustainable, human-centric and resilient European industry. It is apparent that Industry 5.0 results from the European Commission's consensus on the need to integrate social and environmental European priorities into technological innovation and shift the focus from individual technologies to a *systematic approach*.

With the acknowledgement that technological advances transform the way value is created, exchanged, and distributed, there is a pressing need for these technologies to be designed to support future societal values. The advent of these changes and questions closely linked to technological innovation requires the industry to rethink its position and role in society (Zhong RY, Xu X, Klotz E, Newman ST, 2017;3(5):616–30). In addition, the political priorities in Europe have significantly shaped their thinking. The Green Deal will require a transition to a more circular economy and increased reliance on sustainable resources, including energy. The crisis has highlighted the need to re-think existing working methods and approaches, including the vulnerability of global supply chains, to make their industries more future-proof, resilient, sustainable, and human-centric.

Industry 5.0 centres around three interconnected core values: human-centricity, sustainability and resilience (Fig. 2). The human-centric approach puts core human needs and interests at the heart of the production process, shifting from technology-driven progress to a thoroughly human-centric and society-centric approach. As a result, industry workers will develop new roles as a shift of value from considering workers as "cost" to "investment". Technology is to serve people and societies, meaning that technology used in manufacturing is adaptive to the needs and diversity of industry workers (Lu Y, Adrados JS, Chand SS, Wang L. 2021;7:734–7). A safe and inclusive work environment is to be created to prioritize physical health, mental health and well-being, and ultimately safeguard workers' fundamental rights, i.e., autonomy, human dignity and privacy. Industrial workers need to keep upskilling and re-skilling themselves for better career opportunities and work-life balance (Breque M, De Nul L, Petridis A, 2021) For the industry to respect planetary boundaries, it needs to be sustainable. It needs to develop circular processes that reuse purpose and recycle natural resources, reduce waste and environmental impact, and ultimately lead to a circular economy with better resource efficiency and effectiveness.

Fig. 2. Core values of Industry 5.0'

Resilience refers to the need to develop a higher degree of robust- ness in industrial production, arming it better against disruptions and ensuring it can provide and support critical infrastructure in times of crisis. The future industry needs to be resilient enough to swiftly navigate the (geo-political shifts and natural emergencies. Industry 5.0 identified the following six enabling technologies: (1) Individualized human-machine interaction technologies that inter-connect and combine the strengths of humans and machines, (2) Bio-inspired technologies and smart materials that allow materials with embedded sensors and enhanced features while being recyclable, (3) Digital Twins and simulation to model entire systems, (4) Data transmission, storage, and analysis technologies that can handle data and system interoperability, (5) Artificial Intelligence to detect, for example, causalities in complex, dynamic systems, leading to actionable intelligence, and (6) Technologies for energy efficiency, renewables, storage and autonomy.

As seen above, Industry 5.0 is not a technology-driven revolution but a value-driven initiative that drives technological transformation with a particular purpose (Fig. 3). Industry 5.0 presents some unique challenges that are not seen in the past, such as (1) Social heterogeneity in terms of values and acceptance, (2) Measurement of environmental and social value generation, (3) Integration from customers across entire value chains to SMEs, (4) Interdisciplinarity of research disciplines and system complexity, (5) Ecosystem-oriented innovation policy with agile, outcome-orientation, and (6) Productivity is required, while large investments are needed.

As a new initiative, the European Commission also outlined a series of implementation strategies from investment, marketing, and governance dimensions to promote Industry 5.0. Response from other governments and industries is still limited for the time being. Academia though has quickly embraced the discussions on Industry 5.0, as the Journal of Manufacturing Systems, International Journal of Production Research, and IEEE Transactions on Industrial Informatics all established relevant Special Issues to encourage the research on Industry 5.0 in 2021. IEEE Robotics and Automation Society (RAS) Technical Committee (TC) on Digital Manufacturing and Human-centered Automation has also highlighted its relevance to Industry 5.0.

Similar to Industry 4.0, Industry 5.0, aiming for success, will need substantial investment from government agencies. Regardless of the future of Industry 5.0, its core values – human-centricity, sustainability, and resilience, have become major driving forces for societal progress instead of a by-product of GDP-driven prosperity development. This is evident from recent government progress towards embedding them in national policies, such as the Paris Agreement, Sustainable Development Goals (SDGs) from the United Nations, the Well-being of Future Generations Act, Genuine Progress Indicator 2.0, The Economy of Well-being, National Performance Framework, and OECD Better Life Index.

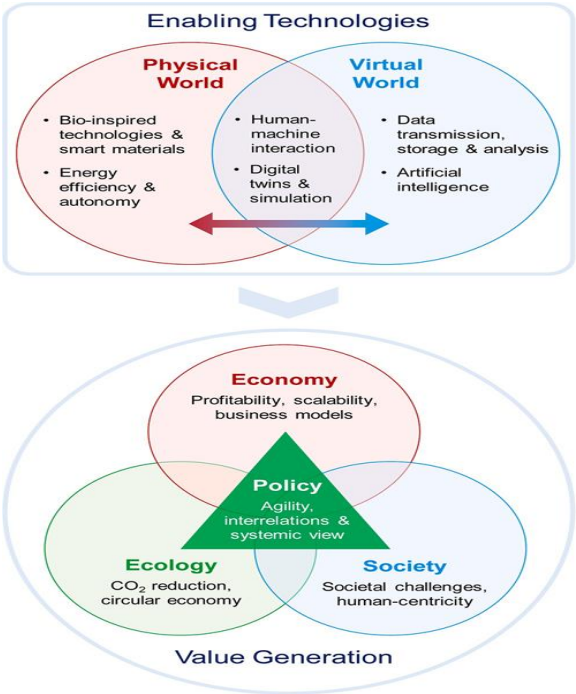


Fig. 3. Industry 5.0 goals and the technological enablers (reproduced based on)

The authors have intended to stand on neutral ground to provide the account for both Industry 4.0 and Industry 5.0 through Sections 1–3. This section may include some opinionated comments from the authors, but otherwise, the intention to remain impartial is still upheld. The remaining section is structured by following the five questions imposed at the beginning of this article. One should, however, not expect the provision of definitive answers to each of the questions. Instead, the questions are utilized for pertinent discussions to provide an answer or a partial answer as it may be to the question.

The perception by many has been that Industry 4.0 has a strong focus. on technologies or technological solutions. Such a focus is evident from some of the early policy and government manifestos. Research publications in the early years tend to be technology-focused, too. White- papers and business reports published by some top consulting firms, e.g., McKinsey and Boston Consulting Group, also have a clear technology slant. Industry 4.0, however, may not be considered oblivious to human-centricity, sustainability, and resilience. Resource efficiency and societal needs are found in some of the key publications. The Factory2Fit project, for example, aims at empowering and engaging workers in a more connected industrial environment. The workers are given more influence and hence greater responsibility in shaping the production process through virtual means.

However, Industry 4.0 addresses the issues of human-centricity, sustainability, and resilience from a consequential perspective and with a clear technological approach. Unlike Industry 4.0, Industry 5.0 makes a bold focus shift from individual technologies to a systematic approach. This approach empowers the industry to achieve societal goals beyond jobs and growth and places the well-being of the industry worker at the centre of the production process. This may help explain why Industry 5.0 is considered a different type of Industrial Revolution from the other Industrial Revolutions.

Can Industry 4.0 enabling technologies also help realize the goals of Industry 5.0, or do

we need to develop new Industry 5.0 technologies?

Boston Consulting Group identified nine key enabling technologies of Industry 4.0, whereas the EU identified six enabling technologies of Industry 5.0. The terminologies used for these technologies may differ, but there is a clear cross-over. It is believed that many enabling technologies of Industry 4.0 can help, and will undoubtedly be used to, achieve the societal goals of Industry 5.0. There are, however, some more targeted technologies of Industry 5.0 that require attention, such as bio-inspired technologies and technologies for energy efficiency, storage, and renewable energy.

Is Industry 5.0 a chronological continuation of Industry 4.0, similar to their predecessors (i.e., Industry 1.0 through to Industry 4.0)?

Industry 5.0 is not a chronological continuation of, or an alternative to, the existing Industry 4.0 paradigm. Industry 5.0 is the result of a forward-looking exercise, a way of framing how industry and emerging societal trends and needs will co-exist. As such, Industry 5.0 *complements* and *extends* the hallmark features of Industry 4.0. This may help set aside Industry 5.0 as a different type of Industrial Revolution from the others, acknowledging the other Industrial Revolutions are the chronological continuation of their predecessors.

It needs to be pointed out that some of the latest Industry 4.0 research has already extended the original thinking and intention of Industry 4.0. This is particularly evident in Germany, where fresh initiatives on resource efficiency, energy footprint, and Arbeit 4.0 (Labour or Work 4.0) have been pushed out in recent years.

3.3. Managerial Implications

Motivation cannot be seen it can only be inferred in human behaviour. Managers should not rely on their perceptions of the workplace situation; they should understand the behaviour of their subordinates and also, be acquitted with all the theories of motivation and applied them to the needs of their employees for effective job performance.

For employees who are motivated by physiological needs, their concerns do not centre on the job they are doing, they will accept any job that serves their needs. Managers should motivate employees in this category by offering them wage increases, better working conditions, more leisure time, longer breaks, and better fringe benefits.

Also, managers who feel that security needs are most important to their employees should not encourage risk-taking and innovation in solving problems but rather should focus on their employees by emphasizing rules and regulations, job security, and fringe benefits. The employee, in turn, will strictly follow such rules and regulations.

In the same vein, managers who believe their employees are striving to satisfy affiliation needs should act in a more supportive and permissive manner, emphasizing employees' acceptance by co-workers through extracurricular activities; such as picnics, organized sports programs and so on.

Employees with esteem needs want recognition and acceptance from others, managers who focus on esteem needs in their attempt to motivate their employees should emphasize public awards and recognition for services. This can be done through the use of achievement lists on the bulletin board, lapel pins, and the like to promote employees' pride in the workplace.

On the other hand, an employee focusing on self-actualization needs is striving towards self-fulfilment and increased problem-solving ability. Managers may motivate such employees by involving them in designing jobs and making them lead others in planning and implementing work procedures.

Furthermore, in the ERG theory, if a manager observes that an employee's growth is blocked, perhaps because the job does not permit satisfaction of his need or the organization lacks the resources to satisfy them, the manager should redirect the employee's behaviour towards satisfying relatedness or existence needs.

Vroom Expectancy theory focuses on three things: efforts and performance; performance and reward relationship; and rewards and personal goal relationship. Although, a more difficult goal causes a higher level of input, however, a vague goal will often be misleading and confusing. A person performs better when the goal is specified, Muslins (1985) notes that goals can be challenging, but should be clear and realistic. Managers should, therefore, design goals to enhance and maintain motivation in an employee. Managers should know their workers beyond their names and official titles or ranks; they should know that each employee should be handled specially.

Every manager within an organization should exercise good leadership to motivate their employee based on their performance without fairness or favour. Managers should avoid treating their employees based on blood relationship, godfatherism, or ethnic or religious affiliation rather, they should pursue fair play, equity and justice in the course of motivating their workers.

In addition, in-service training of workers to maximize their potential should be encouraged by the management, and good communication should be practised to avoid suspicion among workers. When all these are done, employees would be motivated for higher performance.

4. Conclusions

This review and analysis of paradigm shift for the people, organization, and technology highlights the challenges to introduce the concepts of new paradigms in each essential segment of manufacturing. In contrast with previously published reviews, the goal of this review was to develop a connection matrix between key enablers for Industry 4.0 and Industry 5.0 and essential segments of each manufacturing: people, organization, and technology. People will always be the main drivers of the activities in the production system. The humans who create and manage production systems need support in the preparation of infrastructure and resources for the introduction of new technologies. In further steps, they need support in transferring the knowledge from a virtual to a physical world, and vice versa. This requires future research in the domains of adaptation of technology to humans. Significant effort should be made in areas of data collection and interpretation through different useful reports so that people can make their decisions based on real-time data. In parallel, there is an effort to create robots that are autonomous and that can collaborate with people. However, these efforts should be made keeping in mind the influence on sustainability and resilience. On the one side, there are organizational, social, and ergonomic aspects where technology should be at people's disposal, but on the other side, there is energy reduction to satisfy environmental aspects. The crucial aspect is a balance between all essential segments in the context of new paradigms, but always keeping

humans in the centre. Generally, the Industry 5.0 paradigm brought the change of main research objectives from sustainability towards human-centricity. From the managerial perspective, it means focusing on workers' education and lifelong learning, instead of focusing on the purchase of new technology, or similar. In comparison with Japan and South Korea, the USA and EU are still not investing enough in the education of workers, which is becoming an essential issue. Furthermore, it is also important to consider the limitations of this research that are mainly linked to search criteria (keywords). Sometimes the keywords for the paper are not properly selected; thus, applying the keywords filter during the search excludes some high-quality papers, and perhaps includes some papers of lower quality. Future research could use wider search criteria, such as filtering abstracts instead of keywords, to create a more profound analysis of this topic. Finally, in future research, the proposed connection matrix can be extended and discussed within the context of specific subareas (i.e., specific subarea for technology can be augmented reality) and all effects of subareas can be seen from the aspect of basic driving concepts and key enablers for each paradigm.

The analyses of relationships conducted during research indicated the key conclusions in terms of the relationship between employee loyalty in the organization and the form of employment and they also showed statistically significant differences in this area. A majority of the respondents believed (this concerned, above all, people working under an indefinite duration employment contract) that the form of employment influences loyalty to the employer; a majority also rated the degree of their loyalty to the employer high. Employees working under an indefinite duration employment contract rated the impact of the current form of employment on loyalty to the employer higher than people who have a fixed-term employment contract. In addition, people who have an indefinite duration employment contract rated the degree of their loyalty to the employer higher than people who have a fixed-term employment contract.

People who work based on less stable forms of employment may be less loyal to organizations than those employed based on more stable forms. However, it should be remembered that all employees, regardless of the form of employment, ensure that the organization achieves the goals set. The basis of the above assumptions is the belief in the potential inherent in each employee. Therefore, the organization — wanting to shape the loyal attitudes of employees — can use several other factors that may determine loyal behaviour. Although research results cannot provide the basis for generalizing them for the entire population, they are a contribution to further, more in-depth research in this area, especially in the area of using and creating other forms of employee loyalty in the era of flexible organizations. The research conducted implies that managers should consider the issue of inspiring loyalty also of those employees who work in the organization based on flexible forms of employment, i.e., a contract of mandate. Building a database of loyal employees and associates of an organization can be one of the important elements of developing the competitiveness of an organization in a modern, flexible market.

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