



HUMAN TOUCH OF INDUSTRY 4.0: A BRIEF LITERATURE REVIEW

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Abstract

The body of research on Industry 4.0, or what's known in China as China 2025, is mostly focused on its technical aspects, prospects and constraints. The purpose of this literature review is to shed light on the human factor in the midst of this industrial revolution and study its implications on the design of processes since in the future the interaction of humans with machines will be closer than ever. This literature review includes published research and conference papers from the last six years. According to our findings, some studies did acknowledge the implications of Industry 4.0 on the human factor but they still focused on the technical aspects of those implications. In terms of advantages, the literature indicates that the presence of robots may positively affect the human worker's performance speed-wise. Other papers highlighted ethical and psychological concerns related to human robot interaction with some focusing more on the occupational, safety and health aspect. The literature also expressed concerns that this industrial evolution might threaten the existence of labor unions since employees risk losing power in a highly automated workplace. Changes brought about by industry 4.0 are inevitable. Future research should study how these industrial changes affect the human worker and what can be done to make such changes favorable to humans. Employee motivation in light of industry 4.0 needs to be particularly studied so that human needs are not neglected in the midst of this industrial revolution.

Keywords: Industry 4.0, China 2025, learning factory, organizational structure, Smart HR, Internet of Things, human-robot interaction



INTRODUCTION

Technological advancements and innovation have been the main drivers of the competitive advantage for the world's most successful manufacturing companies. In order to thrive in this fast-paced economy, smart production systems have been employed and a huge proportion of the production process has been automated.

The twenty first century has seen a shift from merely automated production to the employment of cyber-physical systems and the internet of things in the manufacturing process. This evolution is often referred to as Industry 4.0 with the number four referring to the fourth industrial revolution.

The changes brought on by Industry 4.0 are not limited to manufacturing. In fact, human labor and management practices will also be affected. Some researchers might believe that this evolution in industry will lead to the reduction and disappearance of a few jobs as well as the creation of new types of jobs. The literature on Industry 4.0 is mostly focused on the improvement of technical aspects. Researches who study Industry 4.0 from the human resource management (HRM) perspective are limited by the lack of literature focused on how to digitalize HRM functions and make them smart. It is true that Industry 4.0 and the use of robots is expected to lead to major layoffs but there will still be workers who need human resource practices to ensure a smooth organization of resources. Unfortunately, studies addressing the impact of robots on social settings and the way people respond to them are very few in number. However, motivating employees in an ever-evolving context is crucial in order to get the best out of them. So how should motivation be expressed in a workplace characterized by the heavy use of robotics and decreased reliance on employees?

VIRTUAL REALITY AND THE WORKFORCE OF THE FUTURE

The three articles discussed in this paragraph acknowledge, in principal at least, that there is a human factor in this ongoing industrial transformation, yet they still focus more on the technical aspects of the trend and ignore -to some extent- its direct implication on the workforce. For instance, Visser (2019) specifies three dimensions related to the future of work which are the work itself and its demand of automation-compatible capabilities, the workforce and the necessity to adapt to the demands of automation, and the workplace and its increased incorporation of technology.

In discussing the workforce of the future, Visser (2019) mentions Generation Xers and their desire for a more fluid workforce. According to this article, Generation Xers don't feel comfortable with the traditional work rhythm, aka nine to five working day, and expect more focus on their ability to deliver than on the amount of time spent at the

office. In fact, Visser who, heavily and not very critically, depends on a Deloitte presentation, ignores the fact that in the industrialized world, workers are aging and might be less open to new technologies and hence appreciate a rather “dull” nine to five setting. At the same time, Visser brings in other “bullet words” like holacracy while failing to link that to any industrial context. According to Visser, Generation Xers will happily accept more fluidity at work. Visser also recommends that the workforce be more fluid and adaptive. The examples given by Visser which were related to the banking and software development sectors are too limited to explain how to apply a fluid workforce and organizational ideas like “holacracy” to the real industrial world.

Caputo et al. (2018) and Paelke (2014) focus on a human-centered workplace and its design, but still follow a very technical approach where the key in success is summarized in a good interface between man and machine (Paelke, 2014). The findings of Caputo et al. differ from previously discussed articles in that he compares actual workplaces with the workplace designs (where humans are interacting with robots and other machines) as “calculated” and recommended with very elaborate software. He compares how collaborative workplaces were designed and how in reality later humans work/interact with robots. Hence the article of Caputo et al. acknowledges that the workplace simulation in an Industry 4.0 setting is useful while at the same time highlights the need to verify the authenticity of how humans really move and they behave. The question how the workforce feels when they are again neglected just being simulated and seeing simply as part of an interface remains unanswered in this article. The main focus of those articles is ergonomics. According to Paelke’s reference list (i.e. his not very balanced choice of literature), it is obvious that the ultimate goal should be a standardized process in which humans are seen as potential trouble and sources of inefficiency.

ON ROBOTS AND THEIR HUMAN “COLLEAGUES”

Although the World Economic Forum believes that half of all routine jobs will be done by robots by 2025, it seems not to bother the workforce too much. As another research pointed out, in essence people see robots less of a threat to their job (Workers more threatened by humans than robots, 2019). Demir, Doven and Sezen (2019) paint a picture (they call Industry 5.0), where the integration of robots and hence co-working with humans will become more and more important. In their paper, Industry 4.0 is still seen as mass production phenomenon, where big data and AI are in a very intelligent way, which still follow a Taylor concept of organization. Demir et al. understand that it will take evolutions of all kinds (legal, ethical etc.) for this integration (humans into a robot dominated process) to succeed. Interestingly, in their paper Demir et al. specifically mention human resource issues related to the increased reliance on

robots at work such as organizational behavior, structure and work environment. They share with Murashov, Hearl and Howard (2016) ethical and also psychological concerns.

The article of Murashov et al. (2016) focuses on the occupational safety and health (OSH) aspect of the use of robots in the workplace. An interesting example given in the article is the current use of service robots in the medical field. They stress that people must be able to predict the movements of the robot they interact with and suggest robots should, to some extent, mimic human workers in order to reduce people's emotional stress.

Shehadeh, Schroeder, Richert and Jeschke (2017) explain how a workplace should be organized in order to improve interaction between robots and humans. They made use of existing organizational structure models, defined them and analyzed their advantages and shortcomings for hybrid human robot teams. However, they did not come to a solution to the real problem (integration of resources). Instead, they presented some ideas on how to test and adapt the current models. Like Visser (2019), the article of Shehadeh et al. expressed appreciation for leaner, less bureaucratic structures, but still falls short in explaining how to manage and organize such structures.

Vasalya, Ganesh and Kheddar (2018) observed the influence of robots on the performance of humans. In an experiment it was shown that robots may influence, to a certain degree, the speed of a human conducting his part of the job, while the accuracy remains unchanged. This research might be a positive beginning to elaborate more on the influence of co-working with robots while also auditing the emotional wellbeing of humans.

ON ERGONOMICS OF CO-WORKING / OCCUPATIONAL HEALTH CONCERNS RELATED TO INDUSTRY 4.0

To start, Badri, Trudel and Souissi (2018) state that the current literature fails to adequately show how Industry 4.0 will have impact on occupational health legislation. The authors state that only 36 percent of the reviewed articles (peer reviewed) contained the keywords (a combination of health & safety), while more than 64 percent of checked conference papers deal with health & safety issues in regards to industry 4.0. The question of why this is the case is neither raised nor answered. Badri et al. (2018) fear that the new OSH regulations pertaining to Industry 4.0 will be reactive and not proactive and that workers may have to face adverse consequences before those regulations are put in place. The article then generally lists the advantages seen by the introduction of smart factories (reduction of cost, shorter time from factory to market etc) but unfortunately is lacking of some references (like "Proto lab, 2016") to give substance to the claim. At the same time, it seems also that data security is the biggest threat to the health of workers, while other potential risks are being played down.

The claim that more conference papers than scientific articles are published on OSH (Occupational Safety and health) and ergonomics is backed by another paper (Kadir, Broberg, & Conceição, 2019). Kadir et al. also mention the lack of empirical data in the research on industry 4.0 and the human factor and complain of its focus on future scenarios instead of providing reliable and tested recommendations. This paper more clearly states the risks that come with a co-work setting (robot and human). This article also focuses on the positive effects (cognitive, sensorial among others) of Industry 4.0 (wearables for example) yet is short in showing limits of acceptance of wearing such aids and limits of amount of information that humans can process or the impact on motivational aspects of devices telling humans what to do.

CONCERNS / IMPACT OF INDUSTRY 4.0 ON LABOR LIFE

In a rather weak conference paper (“digital transformation affects every part of society in different ways”) Kurt (2019) argues that trade unions will have less influence and power in an Industry 4.0 environment, because simple workers will be replaced by educated workers who will be less interested in a union taking his cause.

Besides neglecting the fact that nowadays for example pilots are highly unionized and not seen as simple laborers, Kurt fails to link bargaining power of skilled workers with the disappearance of traditional labor unions. Kurt’s claim of labor unions being impacted by Industry 4.0 might hold true if the unions’ loss of power is explained by a vast automation-induced decrease in the number of workers who therefore won’t need a union to voice out their concerns as it becomes more feasible individually.

The threat to the existence of labor unions is seen real in Industry 4.0, that might be one motivator behind another paper that was co-authored by the leading German union (IG Metall). In their paper, Reuter et al. (2017) introduce the reader to a future model factory, where in cooperation with the union (IG Metall), workers of the future will be trained in the idea of “Industrial Citizenship”, where the “the workers don’t leave their social rights at the plant’s gate” (Reuter et al., 2017). The union clearly worries about correct working conditions while failing to define them, at the same time Industry 4.0 is seen as a threat to data privacy.

From an HR practitioner’s perspective, the current literature sees the need to transform how HR trains and more importantly retains the talents needed to run Industry 4.0. In a nutshell, the big data collected in the process is seen as a source of learning and interacting (Rana & Sharma, 2019). As previous mentioned “democratized” tools are seen essential to communicate, which would be in line with preciously discussed concepts such as holacracy. Elderly workers do not play a role in that ideas which ignore the demographic reality in most advanced industrial nations. Employer branding, heritage and job-related know-how important to

hire new talents on the other hand, “hard hats are far removed from the virtual reality..” (Emerald Publishing Limited, 2019). Therefore, there might be a contradiction between what people being attracted to in an employer versus what people actually need to know, especially when it comes to engineering jobs in an Industry 4.0 situation.

As mentioned earlier, conference papers on Industry 4.0 are more common than research papers. One example of an interesting conference paper is the one written by Spottl (2017). The author is talking about the “ironies of automation” phenomena, where people monitoring more and more complex processes can’t possibly grasp the processes in its whole width. This crack in understanding “the big picture” might lead to a feeling of anxiety. The same paper also presents a survey, where the results are all significant and all more or less questions are answered “I agree” or “I fully agree”. Spottl gives a set of “basics” that he believes the future worker in a 4.0 environment will need. Spottl also lists some challenges stemming from the transition to Industry 4.0 which include thorough knowledge about work processes, dealing with data and trouble shooting. Yet he fails to explain how he wants humans to grasp and master processes, i.e. overcome the “ironies of automation” paradox.

CONCLUSION

Research on the formality of Industry 4.0 is abundant. However, they are mostly targeting the technical aspect of this industrial evolution. As far as the human factor is concerned, the studies we reviewed looked into the implications of these industrial changes on workplace design, occupational safety and health and labor unions. While introducing robots and machines to previously less-automated workplaces certainly calls for changes to workplace design and ergonomics, the psychological and motivational needs of employees should not be ignored. Research on the impact of this industrial evolution on human labor and motivation is significantly lacking. Since the transition from current manufacturing methods to new more developed methods is likely to create an atmosphere of uncertainty, it’s important that employee motivation be adequately addressed to ensure that this transition is successful at all levels. Future research should address the human aspect of industry 4.0 and provide sound and scientifically valid solutions to safeguard the employee well-being in the wake of this industrial revolution.

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