





# The perspective of trade union leaders from the Brazilian metallurgical sector on Industry 4.0

## *A perspectiva de dirigentes sindicais do setor metalúrgico brasileiro sobre a Indústria 4.0*

Jorge Muniz Junior<sup>1</sup> , Fernando Ramalho Martins<sup>1</sup> , João Paulo de Oliveira Santos<sup>1</sup> , Daniel Wintersberger<sup>2</sup> 

<sup>1</sup> Universidade Estadual Paulista – UNESP, Guaratinguetá, SP, Brasil. E-mail: jorge.muniz@unesp.br; fernando.martins@unesp.br; joao.oliveira-santos@unesp.br

<sup>2</sup> University of Birmingham, Birmingham, Midlands, United Kingdom. E-mail: d.wintersberger@bham.ac.uk

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**Abstract:** The aim of this paper is to investigate trade unionists leaders' perspective on Industry 4.0. Questionnaires and interviews were carried out. Two conclusions were pointed out: a fragmented understanding of the concept and the low participation of workers in the implementation process. Looking forward to a just transition, the improvement of either the conceptual grasp and the workers' participation are necessary.

**Keywords:** Industry 4.0; Trade unionism; Brazil; Industry 5.0.

**Resumo:** Este artigo apresenta a perspectiva dos dirigentes sindicais sobre o atual cenário da I4.0 no setor metalúrgico brasileiro. Foram aplicados questionários e realizada entrevista em uma amostra representativa. Evidencia-se i. compreensão fragmentada do conceito ii. baixo envolvimento dos trabalhadores no processo de implementação. Conclui-se que ampliar a participação e o entendimento conceitual dos dirigentes faz-se necessário para que uma transição justa ocorra.

**Palavras-chave:** Indústria 4.0; Sindicalismo; Brasil; Indústria 5.0.

## 1 Introduction

This paper comes from a series of talks and debates that happened at the Challenges of Industry 4.0 (I4.0) webinars. It was held by the ABC Metalworkers Union (SMABC), Sao Paulo State University (Unesp) and the Inter-Union Department of Statistics and Socio-Economic Studies (DIEESE) in 2021. The webinars discussed topics related to (1) Pillars of I4.0, (2) International experiences related to Brazil, Germany, China, (2) Brazilian government funding, (3) Internet of Things, (4) New professional soft and hard skills, (5) Trade unions in Europe. Among the panelists were: government experts, academics, consultants and union leaders, including the Secretary General of IndustriALL Global Union (2016-2021).

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The webinars produced an engaging debate, which is summarized in the research question: what is the perspective of union leaders on I4.0?

The paper focuses on leaders' perspectives on I4.0 implementation in the metallurgical sector. The union leaders are blue collar workers, who are elected by employees as representatives of workers.

Interviews and two focus group sessions were carried out with union leaders to discuss the findings and included the President of IndustriALL Brazil and a sample of union leaders.

Data communication between machines and manufacturing processes based on I4.0 technologies enables real time decision-making and learning processes (Zezulka et al., 2016). High-performance networks (Cyber Physical Systems - CPS), and data security arise as concerns ahead of the implementation process (Lu, 2017). Moreover, the dynamic integration supported by CPS enables the planning, analysis, simulation, implementation and maintenance of high-performance manufacturing processes (Lu, 2017).

Digital transformation influences manufacturing and distribution of goods and services, and impacts productivity, professional qualification, the environment, income distribution, social well-being (OECD, 2017; Schuh et al., 2017; Melo et al., 2022).

Emerging economies face difficulties related to labor and infrastructure in the digital transformation (Dalenogare et al., 2018; IndustriALL Global Union, 2017). I4.0 generates opportunities for different workers, if they have access to (re)education, (re)qualification and specialized training, and it is necessary to mitigate precarious work, unemployment, wage reduction, competition between human productivity versus machines (IndustriALL Global Union, 2017; Melo et al., 2022).

The challenges encountered by workers in the use of I4.0 technologies is misunderstood (Kipper et al., 2020; Holm, 2018; Hong & Muniz, 2022), and analysing how to increase workers' participation in the implementation of I4.0 is a research opportunity (Ahmed et al., 2020; Manesh et al., 2020; Ribeiro et al., 2022). The following questions arise:

- What factors should be considered in the development of I4.0 workers (Mosca, 2020; Digilina et al., 2020; Schneider, 2018)?
- How does I4.0 affect workers? What (re) qualifications do workers need to work with I4.0? (Motyl et al., 2017; Jerman et al., 2020)
- How have unions acted in the implementation of I4.0 (Eschmann & Khanna, 2020)?

The metallurgical sector is a fertile ground for research, providing representative institutional conditions that influence the implementation of I4.0 in Brazilian manufacturing.

The Brazilian automotive sector produced a volume of 2,25 million vehicles in 2021 (Organisation Internationale des Constructeurs d'Automobiles, 2023), and it was responsible for 18% of industrial GDP and 3% of total GDP in 2017, employing 1.3 million people directly and indirectly (Associação Nacional dos Fabricantes de Veículos Automotores, 2020). Brazil is facing unemployment and plant closures (i.e. Ford, Oxford Analytica, 2021), due to the current political-economic-sanitary crisis.

A common mistake of researchers linked with I4.0 is partly that it does not consider workers as engaged participants in the implementation of the new technology (Kipper et al., 2020; Valentina et al., 2021). Understanding how workers can contribute to the implementation of I4.0 is essential for Brazilian manufacturing sectors (i.e. automotive, aerospace, footwear) to act efficiently during a digital transformation. This study may indicate aspects to support a I4.0 just transition (IndustriALL Global Union, 2017),

review the role of unions, guide the professional (re)qualification of workers and new employees, involving companies, unions and universities.

This work contains dialogues with Organizational Engineering (Associação Brasileira de Engenharia de Produção, 2023) when discussing knowledge related to the management of organizations, encompassing the strategic and operational planning of production within a union perspective that is rarely addressed in production engineering. In a way, workers' perspective complements the understanding of Industry 4.0 implementation.

The paper has five sections, including this introduction. Section 2 discusses theoretical background, the context and the impacts of Industry 4.0 implementation. Section 3 presents the research method, followed by the findings (Section 4), and the conclusion (Section 5).

## 2 Context and possible impacts of Industry 4.0

Despite different interpretations of our economic history, “[...] the only general point of agreement is that something significant has changed the way capitalism works since about 1970 [...]” (Harvey, 1993, p. 163). Piore & Sabel (1993, p. 29) conceptualize it as a new “mode of production” called *flexible specialization*, stressing that it:

[This] is a strategy of permanent innovation: accommodation to ceaseless change, rather than an effort to control it. This strategy is based on flexible—multi-use—equipment; skilled workers; and the creation, through politics, of an industrial community that restricts the forms of competition to those favoring innovation.

Rifkin (2016, p. 84) argues that we are experiencing a moment of transition, in which a new communication/energy/transport matrix inaugurates an economic, organizational and social aesthetic. In its midst we find the Internet of Things (IoT), which “[...] will connect everyone and everything in a new economic paradigm that is much more complex than the First and Second Industrial Revolutions, but whose architecture is distributive, not centralized.”

The I4.0 aesthetic is part of industrial development programs in developed countries: in Germany and Brazil it is Industry 4.0 (Germany Trade and Invest, 2019; European Parliament, 2016), in the UK it is Manufacturing of the future (Engineering and Physical Sciences Research Council, 2018) and in the USA it is Advanced Manufacturing Technologies (Executive Office of the US President, 2018). The term I4.0 has its origin in 2013, from a report presented to the German Chancellor at the Hannover Messe. It was conceived as a way to encapsulate a new economic paradigm (Kagermann et al., 2016).

For IndustriALL Global Union (2017), the differential of this paradigm lies in its speed and potential to bring long term and significant changes “[...] on the economy, on disparities between the developing and the developed world, on the workforce, on the pricing of products and on our societies [...]” (IndustriALL Global Union, 2017, p. 4), concluding that: “Potentially, when the process of automation itself becomes automated thanks to technologies like artificial intelligence, there will be an acceleration of change unlike anything yet witnessed.” (IndustriALL Global Union, 2017, p. 4).

Davies (2015, p. 1) points out that “the widespread use of sensors, the expansion of the wireless communication network and the use of a growing number of robots and intelligent machines (...) would have the potential to transform the way goods are produced in Europe”. The use of new technologies, the decline in the industrial sector and market losses to Asian countries are the driving forces behind the European program to promote I4.0. The work by Kagermann et al. (2016) finds that there are conceptual differences in the use of the term:

In Germany in particular, the focus is on integrating information, communication and manufacturing technologies in smart, self-organising factories. In the US and increasingly also China, on the other hand, Industrie 4.0 is strongly associated with smart products, Internet platforms and the new business models that are based on them. (Kagermann et al., 2016, p. 6).

[...] In the US, Industrie 4.0 is generally included under terms such as the Internet of Things, smart production or the Industrial Internet. Consequently, Industrie 4.0 is understood to have a much wider meaning than in Germany. (Kagermann et al., 2016, p. 12).

I4.0 is in the spotlight in the academic, governmental and industrial discussion (Ribeiro et al., 2022), and has an economic and technological background. However, this discussion is “[...] ignoring or treating its social impacts very tenuously [...]” (IndustriALL Global Union, 2017, p. 4), as observed in studies in the private and public sector (Arbix et al., 2017; EU Commission, 2022), which is illustrated in the misunderstanding of the effects of I4.0 on developing economies (Dalenogare et al., 2018; IndustriALL Global Union, 2017). This is due to the fact that the discussion is led by a small number of countries and regions: “Europe has perhaps had the most influence, both in academia as well as in politics [...]”. (IndustriALL Global Union, 2017, p. 10). As a consequence of this discursive centralization, we need to pay close attention to the fact that “Industry 4.0 must not be allowed to become just another way for developed countries to punish less-developed ones.” Efficiency influences wage differences between workers from developed and developing countries.

Davies (2015, p. 3) makes it clear that there will be impacts on European jobs due to the efficiency gains brought about by I4.0, estimating that “[...] in Germany, Industry 4.0 will contribute to around 1% of GDP over the next ten years, creating up to 390,000 jobs.” The generation of jobs on the European continent can impact other territories. The case of Adidas becomes paradigmatic: due to the productive gains arising from the opening of a digitized factory, the option was made to relocate production units from East Asia to German territory (IndustriALL Global Union, 2017).

However, it is worth noting that research points to a less optimistic scenario when reflecting on the impact of automation on jobs, as summarized in Table 1 (IndustriALL Global Union, 2017).

**Table 1.** How technology can affect jobs: different estimates.

Organization	Estimates
University of Oxford	47% of workers in America at high risk of having jobs replaced by automation
PricewaterhouseCoopers	38% of jobs in US, 30% of jobs in UK, 21% in Japan and 35% in Germany at risk of automation
ILO (Chang and Huynh)	ASEAN-5: 56% of jobs at risk of automation in next 20 years
McKinsey	60% of all occupations have at least 30% technically automatable activities
OECD	OECD average: 9% of jobs at high risk. Low risk of complete automation but an important share (between 50 and 70%) of automatable tasks at risk
Roland Berger	Western Europe: 8.3 million jobs lost in industry against 10 million new jobs created in service by 2035
World Bank	Two-thirds of all jobs in developing countries are susceptible to automation

Source: IndustriALL Global Union (2017, p. 7).

The trade union movement is faced with challenges related to the threat of reallocation, the reduction of jobs and due to the deterioration of the labor market. It is in this context that we see the emergence of the concept of Union 4.0 (IndustriALL Global Union, 2017), capable of integrating and representing the most diverse categories of workers, so that a fair transition occurs. To this end, the following questions must be asked: How can workers from more favored regions or sectors contribute to improving the quality of life in less favored regions and sectors? Are there social policies aimed at mitigating the coming changes? Which worker requalification actions are being promoted?

The complexity of new tasks requires workers to be able to solve problems and deal with new technologies (Kaasinen et al., 2020; Schneider, 2018; Muniz et al., 2021). Increasing product variety requires assembly line workers to have knowledge and ability to regularly change their tasks in response to different assembly schedules and takt time (Holm, 2018; Muniz et al., 2021). The I4.0 context requires workers to acquire new skills and abilities to deal with the challenges of digital transformation and, therefore, it is necessary to develop new HR strategies (Kipper et al., 2020; Melo et al., 2022).

Within the scope of I4.0 there is a need for qualified workers which have soft skills such as, for example, the ability to work under pressure, creativity in problem solving, research skills and social skills such as, for example, communication and networking (Kaasinen et al., 2020; Kipper et al., 2020; IndustriALL Global Union, 2017; Melo et al., 2022).

I4.0 represents a great challenge for unions in developed countries and in peripheral countries such as Brazil where a) more than 14 million unemployed workers – apart from the discouraged ones who totaled almost 6 million in April 2021 (Mota, 2021); b) the precariousness of work mediated by platforms and informality haunt a large part of the workforce; c) the 2017 labor reform “[...] dedicated a good part of its decisions to making union activity unfeasible [...]” (Ramalho, 2021, online). Discussion with Brazilian union representatives and their institutions can build an important strategy, especially due to its local and institutional influence (Muniz et al., 2023).

Countries such as Germany, China and the USA have strong support for the implementation of I4.0 but Brazil indicates little focus, priority and allocation of resources for this target. Recently, the Brazilian Ministry of Economy (Brasil, 2022) presented a study related to technological solutions applicable to S&M industrial enterprises.

### 3 Methodology

A qualitative approach (Bernardes et al., 2019) was employed to explore the perspective of worker representatives regarding I4.0 as follows:

- A. literature review regarding workers dealing with I4.0 (Scopus database, 2010 to 2021), which includes finding relevant literature and analysis (Nakano & Muniz, 2018), using Keywords Industry 4.0 and their international synonyms (Manufactur\* of the Future, Smart Factor\*, Advanced Manufacturing Technology).
- B. research instrument building (questionnaire).
- C. data collection by applying questionnaires, interviews and focus group discussion with union leaders to assess the I4.0 implementation.

The final questionnaire was digitally sent to sixty (60) union representatives, resulting in ten (10) replies (14%). These respondents had at least four years of

experience as union representatives and were elected by the workers. Their profile is recorded in Table 2.

A Google Forms questionnaire was applied, which included the following questions:

- What do you understand about Industry 4.0 (or I4.0)?
- Is there a case(s) of Industry 4.0 technology implemented in your company?
- What difficulties did your company face during the implementation of this(these) technology(s)?
- How do these technologies affect, or will they affect jobs (in terms of productivity, quality...)?
- How did this influence or will it influence the worker's level of participation in decision-making and autonomy in production?
- How did the company deal with the implementation of these technologies?
- How did the union deal with the implementation of these technologies?
- How did workers and their representatives participate in decisions regarding this(these) implementation(s)?
- What (re)qualification actions is the company's HR considering for workers?
- What skills must be developed in workers to deal with Industry 4.0?
- What other points do you consider relevant for the implementation of Industry 4.0?
- Has COVID impacted your organization's deployment of I4.0 technologies or devices?

Confidentiality was preserved and interviewees were duly informed about and agreed to sharing the data they provided. Contact with the respondents was supported by ABC Metalworkers Union (SMABC).

**Table 2.** Union Leaders' profile (respondents).

size of the company where the respondents work (Sebrae, 2013) <sup>a</sup>	Localization	Time of working in the company [years]	Function	time as union leader [in years]
Medium	Southeast	14	Machine operator	8
Medium	South	8	Machine operator	4
Large	Southeast	31	Machine operator	7
Medium	Southeast	21	Senior assembler	16
Medium	North	10	Assembler assistant	8
Large	Southeast	15	Assembler	7
Medium	Southeast	20	Machine operator II	8
Medium	Southeast	11	Machine operator	6
Medium	Southeast	15	Tailor	12
Small	Southeast	21	-	5

A pilot testing was applied to (6) union leaders' non-probabilistic convenience sample (Rea & Parker, 2014), and the following validation questions were used:

- What other points do you consider relevant for the implementation of I 4.0?
- Did you have trouble answering any question? Which one(s)?
- Do you have any suggestions? Which one(s)?

<sup>a</sup> Small company: from 20 to 99 employees. Medium company: from 100 to 499 employees. Large company: more than 500 employees (Sebrae, 2013).

Content Analysis was applied to data analysis, which consists of a systematic and replicable method for capturing and transforming text fragments into categories, was deployed either for data collected with questionnaire's respondents and verification interview's respondents (Bardin, 2011). A Categorical Analysis technique was carried out, which uses a *a posteriori* coding process in order to reach meanings and to realize data categorizations.

An interview to discuss the findings was conducted with the President of IndustriALL Brazil and a leader of the Union of Metallurgists of the ABC, both with more than fourteen years of experience. Video conferences were employed in the data gathering process (Bertrand & Bourdeau, 2010; Sullivan, 2012) in order to minimize the limitations imposed by pandemic.

#### 4 Results and discussion

Workers representatives indicate little familiarity with the issue of Industry 4.0, as they refer to a fragmented view of the phenomenon, always associated exclusively with technology implementation cases (i.e robots, Information Systems). The lack of a big picture common to companies and trade unions suggests that it has not received the necessary attention by them. There is a need for better understanding related to I4.0 and its impacts, including a conceptual background, both in terms of technology integration and product development. Edwards & Ramirez (2016) present some analytical dimensions for unions to properly evaluate if a new technology should be embraced or not, which include: intended and/or unintended effects; direct and indirect effects; degree of reconstitution in use; immanence; degree of success and degree of discontinuity with the past. Adding to these dimensions, one could include impacts on the market, jobs created and eliminated, impacts on wages for new and old occupations, required abilities, necessity of new training protocols, etc.

When questioned about I4.0, interviewees associated it with: automation, artificial intelligence, robotization, modernization, industrial revolution and Internet of Things. The responded in the following ways:

*Modernization, automation of the company's equipment!*

*I understand it as the 4th industrial revolution.*

*New revolution in industrial operations. Internet of things.*

*An industrial revolution that started decades ago, and nowadays represents the advancement of significant technologies.*

*I understand that it is a process where everything is connected to each other (interconnected).*

*It is the fourth industrial revolution, which aims to automate industrial processes as much as possible.*

*This is the 4th industrial revolution that will make a big change in the world of work, bringing together several advanced technologies such as artificial intelligence, robotics, internet of things with a single objective of promoting the digitalization of industrial processes and increasing productivity.*

*It is a robotic intelligence where technology is taking over the world and taking manpower out of business.*

*It is the age of digital technology and general automation.*

*It is a new production concept with an emphasis on databases and automation in the production process and optimization of the relationship between customer/supplier and the company.*

The majority of respondents did not have an I4.0 holistic view. Only one respondent cited *artificial intelligence (AI) integrated into robots, where machines are controlled digitally via a network over the internet, from material input to product output, everything through data provided and recognized by the AI*. It was identified in the database (Google Forms) that this respondent has a concept derived from theory, given that he did not register a case of implementation in his company.

The president of IndustriALL Brazil and the trade union leader confirmed that the I4.0 is a black box for the workers. Furthermore, both highlighted that the interviewees relate I4.0 with traditional concepts of automation, robotics and information technology, all connected with Brazilian productive restructuring from the 90's.

*... that's why it gets confused [the concepts brought by the respondents], they [respondents] relate a lot of things with robotics... with microcomputers... with everything that is automation, and these are elements of the productive restructuring that took place in the late 90's and early 2000's.* President of IndustriALL Brasil.

Unionists reported recent cases of implementation, indicating that some parts of the companies do not have implementation cases of I 4.0 technologies, and the other parts shows specific applications (such as the use of cloud to save data, IT technologies, collaborative robots, automatization of a sector, including the use of IoT, automated arms in CNC lathe and cutting machines). There were also a few cases of reports of technologies dissociated from I 4.0, such as: COGNIX and ERP systems. The association of specific cases to the concepts of I4.0 also suggests a simplification in the grasp of the I4.0 implementation and its impacts. Therefore, there are no reports of significant cases of integrated systems linked to the new economic-industrial paradigm. Moreover, respondents highlight that the new I4.0 processes have been implemented without difficulties.

*In my view [the company] was super happy, because machines don't have feelings and don't file labor claims regarding rights.*

*Assertive decision making.*

*Adaptation and good results.*

*It was simple as it is a multinational and already has experience in Europe.*

*At first it was done on just one device...(as a test).*

*At the beginning, there were many difficulties in implementing this new concept, but they were overcome.*



Among the problems found, the respondents highlighted the following: *lack of knowledge on the subject, lack of technical training, systematic error in implementation, reduction of jobs and adaptation of employees, need for training.*

Regarding the impact on jobs, there are reports of increased productivity (efficiency) and quality in production lines but in some cases, the respondent mentions job reductions:

*A single machine wiped out an entire sector.*

*The [mechanical] arm does the work of two people, that is, two jobs are made redundant, because the machine does much more than the human being.*

According to the interviewees, the relation between I4.0 and unemployment is also related to the impact of Brazilian productive restructuring that generated increased productivity and layoffs.

*It was a time when productivity was greatly increased, but with a drastic reduction in jobs. So this is the thinking brought about by the productive restructuring, as I said, that took place in the late 90s and early 2000s... It automated production... It implemented some microcomputer processes... It made thousands of jobs redundant. President IndustriALL Brazil*

There was no report of worker participation in terms of I4.0 decision-making:

*There was no participation, no autonomy.*

*The possibility of workers to participate in decisions has decreased.*

*The operator only makes corrections if necessary.... Other than that, the automated arm does everything by itself.*

In the verification interview, the idea of a decrease in participation was reaffirmed:

*...independent of industry 4.0, [with] new technologies there is a loss of workers' participation in the decision-making process. Because with the implementation of automation, workers feel strange toward the [new] production process... so, from the moment the worker ceases to be part of the process... he ceases to lead part of the process. There is natural estrangement. [...] People respond based on what they are experiencing and not [necessarily based] on the implementation of Industry 4.0. President IndustriALL Brazil*

*I got that impression too. Union leader.*

Trade unionists pointed to the lack of workers' participation in implementation decisions. However, it was reported that workers have contributed with suggestions for improvement during use. This indicates an opportunity for worker participation in the deployment of I4.0 implementation.

*There was no participation of workers in implantation decisions.*

*We didn't participate, the technology came and was implemented. The suggestions came in the course of time, with the system.*

The perspective of trade...

*Workers participate in decisions through the union, once the union has already participated in decision making within the company.*

*In this case, we had no participation.*

*We do not participate.*

Concerning technology implementation, the union has paid attention to operational issues such as ergonomics and accident prevention, job cuts, worker reallocation and adaptation training.

*Here, mainly in terms of ergonomics, there were improvements in some production processes.*

*[Unions] follow transformations to guarantee job positions.*

*[Unions are] always alert to changes and sought to reallocate workers to other jobs within the company itself.*

It is worth noting a trade union leader report in which he suggested that qualification should be a worker responsibility and not a responsibility shared with the organization:

*We [union] only monitor and identify possible failures that could lead to accidents, inviting workers to start a specialization and new courses.*

The President of IndustriALL showed concern about the lack of knowledge of union leaders about I4.0, since this may bring limitations for their union activities, especially those related to the mitigation of problems that impact workers during I4.0 implementations:

*Who can imagine a leader saying that there is no participation of workers. It is his task [as a leader]. I [as a union leader] represent workers, and I am not able to see and share with them the worries [linked with I4.0], not even [to share] a general concept... President IndustriAll Brasil.*

He also pointed out that some directors have achieved a great knowledge by acting as workers' representatives during the technological implementation, especially in the automotive sector.

*... [the result of the questionnaire] shows that those who answered the survey [union leaders] did not grasp the issue... Only half a dozen people have grasped it, those who negotiated it [union leaders who participated in representative implantations], but not the others. So, people [respondents] paid attention only to the consequences... ergonomics, accident prevention... President of IndustriALL Brasil.*

The interviewees shed light on some significant cases in the automotive sector, in which there was a great debate between the company and the union, with the involvement of the workers:

*... it was a negotiated process, with the direct participation of the workers... there was an Assembly, there was discussion in the workplace, in the union. In the case of Mercedes, we spent more than a year negotiating ... I lost track of how many*

*meetings we held ... we held about 30, 40 meetings at the factory ... plenary sessions at the union, we held a lot of them!* President of IndustriALL Brazil.

Respondents revealed a modest involvement of Companies Human Resource Departments. Courses, lectures and training were mentioned as examples of HR actions. There was also a report suggesting a responsibility transfer from organizations to workers regarding qualification development: *they [HR] encourage us to study and get involved with the 4.0 revolution.*

*So far there is none [HR action]. By the way, we need to talk about it!*

*None at first! We had something during the company layoffs. They offered courses for us to understand all the difficult terms that managers spoke!*

*In the beginning there were some courses during the implementation of it.*

*Few.*

*They did not discuss.*

*[There were] changes of functions or sectors.*

*[There were] training and lectures.*

One interviewee remembered that the matter of qualifications were brought up in negotiations during the restructuring process:

*... during the production restructuring [in the 90's] requalification was negotiated ... it was a point of negotiation ... so it is an issue to call people's attention to, right? We went deep into this.* President of IndustriALL Brazil.

When asked about the skills and abilities that should be developed, respondents highlighted the need for training/courses on maintenance, programming, Internet of Things (IoT), information technology, design, IT and AI. It is worth noting that the literature also suggests a necessity of training in *soft-skills* (problem-solving method...).

*A priori, I believe that it is necessary to have an understanding about industry 4.0, and then train people in maintenance and programming.*

*[Training] in systems integration with the internet of things.*

*Computer skills, drawing, reading, among other needs, [according to] the reality of each one.*

*Training on these new technologies, mainly in the IT area.*

*Workers will have to qualify to improve themselves and [grasp] new technologies.*

*[Development in] internet and artificial intelligence skills.*

Workers' representatives regarded workers' engagement in I4.0 implementation as very important, as well as their qualifications to use the new technologies

(cybersecurity, additive manufacturing...). They also presented concerns about the impact of I4.0 for workers. It is worth noting that there is no report of union activities linked with these issues.

*[There should be a] concern about reskilling employees rather than replacing them with new qualified employees. [There should be a concern about] An integrated network with security and data delivery to the AI.*

*Training, training, training!*

*Cybersecurity , Additive Manufacturing.*

*It depends on the needs of each organization. I see it as a priority that the organization should invest in workers, not replace them for others who have had the opportunity to qualify for the new technology.*

*First of all, it would be necessary to talk to every worker about the implementation process and prepare them for changes to come, training them as necessary.*

*[It is important] to have a good internet network.*

*Looking for courses for workers, in order for them to be qualified and able to find a place in the labor market.*

*Digitalization.*

*Appropriate training for workers.*

*In my opinion, before the implementation of Industry 4.0, there should be studies focused on the impact that this will have on people's lives.*

Regarding these answers, the president of IndustriALL Brazil and the interviewed trade union leader regarded the impact of I4.0 on society as a very important issue to be studied. They added that it must go beyond the discussion of professional qualification.

*A keypoint pointed out by our people is professional qualification... Everybody mentions training, qualification. Our people are not concerned with Industry 4.0 theorization: what is the impact of it on people's lives, on our society. They [the company] do not realize...that training and qualification influences employability.*  
Brazilian IndustriALL President

*... it is true. It could pop up [something like], for example, "look, I think the union has to look for working hours reduction as soon as [the I4.0] advances"...* Union Leader.

*I guess that people still link I4.0 with the factory... they do not link it with society. So, I guess there is a narrow view regarding it... if one considers people's view, it goes back to the initial answers.... So, it is circumscribed to the factory... to robots, computers used in AI, to factory restructuring, to jobs that will be lost to robots... it is a straightforward view.* Brazilian IndustriALL President.

Trade unionists revealed a necessity of deepening discussions on: I4.0 and its impacts for workers, as follows:

*Trade unions speak to the working class about I4.0, [but] many people are not familiar with this subject. What was this revolution and where is it going to'... more studies are necessary on the impacts on job redundancy (and how the union may help those made redundant).*

*Courses, lectures on I4.0 [are necessary].*

*First, before thinking through the world of industry 4.0, I suggest that the government works on the subject, as we have been left behind in the global political discussion. If we don't move forward on the issue, we will be stuck in past revolutions, letting innovations pass us by and we will be swallowed up by foreign capital.*

*Disclosing more information to workers about industry 4.0.*

*[Spreading more] studies on the possible impact of layoffs in general.*

Covid does not seem to have had an impact on I4.0 implementation. Even so, there are some reports related to stoppage of the operation during lock down periods.

The trade unionists' concerns are aligned with the Sustainable Development Goals (SDGs, United Nation, 2023), specifically, the need for sustainable industrial transformations to support a just transition for workers (Eschmann & Khanna, 2020) such as Quality Education (SDG-4) to ensure inclusive and equitable education, and promote lifelong learning opportunities for all; Decent work and economic growth (SDG- 8) to promote sustainable economic growth, productive employment and decent work for all; and, Industry, Innovation and Infrastructure (SDG-9) promotes inclusive and sustainable industrialization, as well foster innovation. From this perspective, it is evident that one of the problems refers to the (re)qualification of workers, and the role of the educational system in adapting to industrial changes and, thus, dealing with systemic inequalities. Partnerships and Means of Implementation (SDG-17) between universities, organizations and unions may contribute to mitigating this problem (Muniz et al., 2022).

## 5 Conclusion

The perspective of Metalworkers Union representatives indicate concerns regarding Industry 4.0 implementation, in which workers have not been taking part in decisions whereas in the Brazilian context there is a lack of training, effective public policies, as well as not participating during the deals related to the implementation.

Metalworkers Union respondents have a fragmented view of the phenomenon of I4.0 implementation, illustrated by specific cases of technological implementation in manufacturing associated with experiences from the 1980s, such as lean manufacturing, TQM implementation and automatization based on robots (productive restructuring). Moreover, it can be argued that besides the necessity of a better education process, workers must observe that the current worldwide digital transformation process is completely different from historic industrial examples.

The participation of workers may benefit continuous improvement during the I4.0 implementation. On the other hand, their absence in decision-making processes may bring more challenges to the technological implementation process in the manufacturing sector. This worker participation required that workers: i. develop a

holistic grasp of the phenomenon; ii. take part in the implementation process; and iii. workers, companies and trade unions discuss this in depth and on a regular basis.

There are opportunities of further research related to empirical cases of I4.0 implementation based on trade union participation (i.e., automotive sector), comparing perspectives of worker representatives from different countries (Muniz et al., 2022; Muniz et al., 2023). Further research is necessary to answer the following questions:

- The restricted participation of workers would be a problem circumscribed to peripheral countries such as Brazil?
- Do unions have a comprehensive understanding, conceiving I4.0 as a new economic-industrial paradigm with the potential to impact the global employment structure?
- Would engagement between local and global unions be able to ensure a just transition?

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**Authors contribution**

Jorge Muniz Junior and Fernando Ramalho Martins were responsible for design, data collection, analysis and literature background. João Paulo de Oliveira Santos was responsible for data collection and analysis. Daniel Wintersberger was responsible for literature review.