

Industrial Manufacturing Workstations Suitability for People with Disabilities: The Perception of Workers

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Abstract. The inclusion processes of people with disabilities in industrial production lines are being carried out. Thereby, getting to know the current workstations is important for planning, designing and developing new assistive technology products. Thus, this paper presents an analysis study of industrial manufacturing workstations based on the perception of workers without disabilities. For this, it relies on a survey with a questionnaire given to 222 workers from different processing industries. Analyzes are presented and interpreted in sets. It establishes that the inclusion processes are happening, but still in a superficial way. There is an inclusion gap directly related to the needs for modification and, in reality, favoring the inclusion of workers with milder disabilities.

Keywords: Industrial manufacturing · Inclusion process · Workstations · Assistive products · Workers perceptions

1 Introduction

When talking about industrial manufacturing processes one must understand the complexity that surrounds this condition. A manufacturing line is developed to meet the manufacturing of products with quality and efficiency. Thereby, its steps are organized so that the sequence follows production patterns that must be guaranteed by the workers who work there. The entry of professionals into the work of these processes requires the ability to develop a set of skills in an appropriate way. When a person with disabilities is included in these processes, it is not always possible to organize the work in order to reconcile existing activities with personal abilities. Thus, adaptation and inclusion processes are necessary, which makes way for the development of new assistive products.

Assuming that the inclusion process is a reality, it is relevant to bring up the perception of suitability of the current industrial workstations and to verify how the companies' experience can contribute to this complex process. However, the verification of suitability from the point of view of the disabled worker could lead to a restricted one, since each person with disability could explain their difficulties. In order to understand in a general way the current adequacy for disabled people, it is understood that the perception of workers without disabilities would be more adequate. Moreover, product development processes usually start from the overview of the current situation to the understanding of the context and planning of a new product to be developed [1–5]. This stage is important

for opening up possibilities for new assistive technology products aimed at improving the quality of work of people with disabilities in industrial manufacturing.

Thus, the objective of this paper is to present the analysis of a survey aimed at the pursuit of the perception of the suitability in the current industrial workstations, from the point of view of workers without disabilities, taking as reference two cities in the South of Brazil. This type of analysis contributes to the understanding of the current conditions of inclusion and the methods used in practice by the manufacturing sector of processing industries.

2 Theoretical Framework

2.1 Industrial Manufacturing Workstations

New ways of organizing work emerged from increased deployment of flexible production systems around the world. This work philosophy generated a series of transformations in the production strategies of the industries, which came against the current common model of mass production, centered on hierarchy, standardization, routinization and exclusion of workers from the decision process. Thus, flexible production has brought new premises, regarding a more flexible way of organizing workers, a participatory management, a greater decision-making power of the employees in relation to production process, continuous training, demanding proactive, multipurpose employees who solve problems and learn from their mistakes, in addition to equipment and factories more flexible, in order to meet the greater variability of manufactured products [6–8].

In order to increase the possibilities of taking advantage of the technical and interpersonal skills of employees, employers have been using mechanisms to obtain functional flexibility. Among these mechanisms, some have been focused on the production process itself, such as the technological innovations just-in-time, based on the zero inventory premise, aiming at minimizing materials and inventories and, on cellular production lines where workers have a series of functions in a set of operations or machines, which characterizes his or her workstation. These mechanisms represent advantages for organizations, as employees are involved in a participatory model in order to plan, respond to production needs and collaborate on product quality [6]. Such demands also require more flexible professionals with the ability to take on roles on workstations, as well as participate in quality control circles and continuous improvement processes, previously restricted to specialists.

The type of production line adopted by the industry also affects the characteristics of the new production premises. In accordance with [9], production lines are usually subsets of production systems. Since there are several types of production systems, their characteristics generate production lines specific to each product or process. In this analysis, one must consider several characteristics, such as manual or automatic lines, product flow, dedicated or flexible workstations, high or low production rate and others. Production lines are complex systems. Understanding the production characteristics requires a qualified analysis in order to facilitate the development of a specific design.

Thus, [10] suggest the classification of production lines into four different types: by process, by product, fixed position and cellular. They also cite that each type of

production line generates a specific layout, allowing them to be analyzed separately. In this way, the production lines can be:

- By process, also called job shop or by function. It is the one where the machines and stations with similar functions are grouped and the products transit through several groups, without direct relation with a specific productive flow. Operators of this type of line can become specialists in a particular machinery set.
- By product or by flow. It is one in which the workstations or the equipment are arranged according to progressive stages through which the product transits, in the direction of the specific productive flow of the product. In this type of production line, the operators must have the flexibility to make different sets of operations in several workstations.
- Fixed position is the type of production line that the equipment and the workstations move to the product that is being processed, which usually remains fixed until its complete transformation. Operators require flexibility and wide mobility to perform multi-shift processes.
- Cellular is the line where different machines and workstations are sequenced according to the path of the product, but in formats that allow one worker to operate several at the same time. In order for this structure to be assembled, the products must have similar procedures, known as families. In this way, the manufacturing cells can be considered as a hybrid model, capable of absorbing characteristics of each types of existing production lines.

It must then be considered that the definition of a work position is not restricted to a single place where the worker carries out his or her activities. The wide variety of operations is usually associated with displacement, mobility, and the ability to switch between jobs, making decisions, and interfering with the productive process in an organized fashion. Thus, in order to meet such functions, assistive devices must be developed, enabling workers with different characteristics to meet the requirements of the job in a harmonious manner and to obtain similar productive results on different production lines.

2.2 Workers with Disabilities in Manufacturing

According [11], one in seven people has some kind of disability. This represents approximately 14% of the world's population. However, this situation varies for each country due to social, cultural, ethnic and other differences. In Brazil, [12] indicates that 23.9% of Brazilians have some type of disability. When it comes to work, 57.3% of men with disabilities and 37.8% of women with disabilities are employed. This number is still low, which shows a difficulty in dealing with this public, since people with disabilities are not grouped homogeneously. Disability is only one more factor of human diversity.

In agreement with [13], depending on classification, disabilities can be grouped into some types such as sensory deficiencies, associated with visual and auditory deficiencies; physical disabilities, related to mobility and orthopedic deficiencies; intellectual disability related to learning, comprehension and concentration deficiencies; and

psychosocial disabilities including mental illness, maladaptive behaviors and mood disorders, as well as multiple disabilities that fall into several categories.

What makes the inclusion process complex is the broad range of specific needs of each individual. [13] also explains that the way to make a disabled person productive for a workstation depends on the inclusion approach and the addressing of specific needs. The complexity of disability analysis is significant and the development of universal inclusion models are still a major challenge. In this way, a high variability requires the attendance of a great range of specificities. A deaf person may require colleagues and supervisors to communicate through sign language. However, a person with mobility difficulties has the need of a layout adjusted to optimal accessibility. People with intellectual disabilities may need to work in stages and with an easy-to-understand sequence. Thus, issues related to the productivity of people with disabilities should consider the diversity of needs and the impact on individuals.

In this context of relations of complexity, it is necessary to understand how the current process of inclusion is being treated, being it the basis for future development of specific assistive products for the inclusion of workers with disabilities in the industrial production field.

3 Methodology

This research is classified as exploratory [14] for it provides greater familiarity with a problem, in this case, the adequacy of workstations, as well as the discovery of the perceptions of a target public. The research method is a survey with data collection by means of a Likert-type scale questionnaire with 6 levels, where the respondent indicates the level of agreement for a set of statements. The analysis of the data was made on the average of the answers, defined as Average Ranking (AR), which indicates the average level of agreement for each statement. The neutrality threshold is close to 3.50 AR and average rankings above the neutrality limit are considered positive (agreement) and below, negative (disagreement).

The target audience was composed of professionals from the manufacturing/production area employed in several large industries in the cities of Joinville and Curitiba, southern region of Brazil. There was no selection of companies or types of workstations, with the basic prerequisite being that the worker did not have any type of disability.

The questionnaires were answered by 222 workers from the processing industry, whose profile identified in the initial questions showed that 78% of the respondents had finished high school and 41% had technical vocational training. The average age was 26 and they had a more stable working condition, being the average time of employment 5 years and 3 months. In addition, 31% said that they had already worked or monitored the activities of people with disabilities, even if for a short period. Only 11% said that they performed their activities predominantly in a seated position and the remaining performed tasks with workstation flexibility or moving around the factory.

4 Results and Discussion

Based on the survey developed for the research, the results are presented from four sets of answers: Company Adequacy, People Management Methods and Actions, Work of People with Disabilities and Workplace Suitability.

4.1 Company Adequacy

This part of the research aimed to identify how the workers' perceptions are in relation to the companies' efforts to adapt the general conditions of access and work in manufacturing. Thus, it focused on six statements to verify their agreements.

Analyzing the data from the compilation of answers, one can observe a positive average ranking (AR 4.10), which meets the greater agreement with the statements of the set. All the statements of this set had an average ranking higher than 3.5.

The greater agreement of the set was based on the statement that the company needs to modify its working conditions to receive a person with disability (AR 4.55). This shows that workers are aware of the need for inclusion in enterprises in general, where the means must be adapted to the characteristics of the people. It is then perceived a demand for new assisted technologies. In addition, it is also understood that the need to adapt workstations can already be seen as an obligation of the company to adapt its conditions to disabled professionals.

Although change of working conditions for disabled is understood as a necessity, when it comes to the industry that the professional is working on, the average ranking values fall. The statement about adaptations of facilities in the respondent's company (AR 4.19) was below the need for adaptations for any company. It can be understood that the workers' industries still do not reach the expectation of adaptation necessary for the inclusion of people with disabilities. The companies' specific conditions also had positive average rankings, such as the perception of existence of accessible information on health and safety at work (AR 4.25) and the provision of Fire Brigade training for the evacuation of people with disabilities (AR 4.00).

However, the lowest values of the statements set are in accordance and associated with the perception of modification of signaling and equipment. In relation to workplace signaling (AR 3.91), it can be understood that the average ranking value was perceived from the workplaces of the respondents, that is, from their workstation. This situation is also understood in relation to the statement of acquisitions or modifications of work equipment (AR 3.67), such as assistive technologies. Thus, it can be understood that, from the point of view of the worker, the perception of adequacy for people with disabilities decreases as they tap into the workplace. A company's need for adequacy (AR 4.55) had a higher index than the adequacy achieved in the respondent's industry (AR 4.19) and higher than in the workstation (AR 3.67).

In general, the result of grouping these statements indicates that the worker perceives modifications and adaptations for people with disabilities performed by his or her company. This is positive, for it demonstrates that activities associated to work adequacy and inclusion of people with disabilities have emerged in the midst of the routine of the manufacturing workers and are thus perceived. However, this view of adequacy is

reduced when approaching his or her workstation, where the professionals spend most of their effort. When talking about work equipment regarding assistive devices and means, this index is very close to a range of disagreement (AR below 3.5).

4.2 People Management Methods and Actions

People management decisions are very important to the success of the inclusion process of people with disabilities. It is expected, within the industry, leaders prepared to direct the adaptation activities, qualification and development of people. Thus, it is understood that areas with Human Resources/People Management have to have inclusion strategies aligned with direct manufacturing management, such as Leaders, Supervisors or Production Coordinators. In this way, actions related to these two sets of professionals may have their perceptions evaluation by production workers. It should also be taken into account that several professionals occupying leading positions in the manufacturing area have their origin as production operators. It is important to know how the vision of some leadership actions towards the current production workers is.

From this perspective, the aim was to understand the perception of methods and actions from a set of nine statements.

At first, according to analyzed data, it is verified that the average ranking of the statements set regarding methods and actions of people management (AR 3.52), is at the limit of neutrality. It is also noticed that some statements had their index very close to this limit, which indicates that the respondents had doubts in relation to some questions of the set. Even though the use of the six-level Likert item forces respondents to somehow agree, or disagree, average ranking too close to the neutrality limit cannot be measured and interpreted.

Perhaps the most striking index has been the highest average ranking. The statement that non-disabled employees need to be trained to work with people with disabilities (AR 4.48) exalts a perception of qualification not very common in the manufacturing area. In general, inclusion methods focus on the needs and characteristics of the individual with disabilities, organizing means, processes, tasks, etc., so this professional can work properly. However, inclusion is not always a success, since it can still be an isolated work, displaced from the context of people already working in production. Thus, inclusion itself is agreed and embraced by colleagues, but these understand that they need to learn to work with this new professional, still unfamiliar to them.

Regarding the ability of immediate superiors to work with people with disabilities, two statements indicated agreement. The first one, on the preparation of managers to supervise the work of people with disabilities (AR 3.87) and the second on the awareness-raising of managers regarding inclusion (AR 3.82) had similar average rankings. Even with values close to the neutrality limit, such values can be considered positive. Regarding the training and qualification of all employees, including professionals with disabilities (AR 3.97), agreement indicates that there is no discrimination or segregation for training and general information.

The strategies of guiding workplaces towards people with disabilities were evaluated through three statement. The lowest average ranking, with a high degree of disagreement, indicates that people with disabilities must work in sectors separated from people

without disabilities (AR 1.77). This view of inclusion by manufacturing workers, which had already appeared in the set regarding company adequacy, meets the understanding of the inclusion process as real and necessary. It demonstrates that manufacturing workers view the entry of people with disabilities into industrial workstations without the need to segregate them in separate, isolated locations. Neither direct them to repetitive tasks (AR 2.70), shown by disagreement with the statement on this subject. Thereby, the high acceptance for the sharing of workstations between disabled and non-disabled people by workers without disabilities can also be understood. On the other hand, the compliance with the statement that only a few sectors are suitable for people with disabilities to work (AR 3.98) may indicate that not all workstations are ready to absorb professionals with disabilities with the appropriate adaptations and assistive technologies. In a broader view of both statements and respondents' perspective, it can be interpreted that there should be no distinction between workplaces, but not all sectors are in a position to include a worker with disability.

Two statements had an average ranking close to the limit of neutrality. One on changes and adaptations of working hours for people with disabilities (AR 3.34) and another on the sensitization of working groups for inclusion (AR 3.71). It is understood that there is no clear agreement or disagreement on the statements, which loses the value of interpretation.

4.3 Work of People with Disabilities

The perceptions about the work of disabled people from the point of view of workers without disabilities were verified through eight statements. These express possible differences between the performance of the two groups of workers. With a total average ranking (AR 3.16) of disagreement for the statement set, the respondents indicated their agreement with few statements regarding the differences in work performance for any worker. Thus, there is little perception of difference between the labor of a person with or without a disability, considering the factors of the statement set.

The highest average ranking of agreement obtained by the statement set regards the possibility of people with disabilities to take up managerial positions of groups of people without disabilities (AR 4.39). This value indicates an acceptance, albeit theoretically, of the presence of the disabled worker at many points in the hierarchy of the production area, including group leadership. As well as in the answers to the set of methods and actions of people management, there is indication of comprehension of the process of inclusion as something natural for the manufacturing worker, without distinction of characteristics and career development.

Supporting the indication obtained, some statements indicate disagreement precisely by forcing a position on possible differences in performance. The statements about the quality of inferior work (AR 2.04) and low productivity (AR 2.33) of people with disabilities have obtained high disagreement, suggesting that these workers are not below the average of the rest of the workers. In fact, not even above average, for the statements regarding the greater commitment (AR 3.16) also indicated disagreement. In relation to a greater accident propensity (AR 2.80), there was also significant disagreement. Thus, one notices the perception of equality of work and results, like any manufacturing worker.

Three statements have not been evaluated nor interpreted, for they are very close to the limit of neutrality. The statements regarding sitting position (AR 3.41), being more stable in employment (AR 3.51) and presenting greater difficulties to work in flexible workstation (AR 3.66) were considered neutral, without an agreement or disagreement perception.

4.4 Workstation Suitability

One of the key points for the inclusion process of disabled people in industrial manufacturing is precisely the preparation and adequacy of workstations, as well as the development of appropriate assistive technologies. The worker must have broad execution conditions of his or her activities, which can be verified by the current workstations. Thus, through eleven statements, the perception of the workers was sought considering the categories of disability and the verification of the existing adequacies, where the total average ranking obtained for the statements set (AR 2.23) was of high disagreement.

The set of answers on workstation suitability had the lowest average ranking values. However, the statement that people with disabilities can adequately perform any type of work provide modified workstation structures (AR 3.80) had a slight agreement. This question brings to light that inclusion is directly associated with the adequacy of the means, devices, machines and processes of workstations, according to the respondents. By associating the perceptions from the company adequacy statement set, which indicate there should be no distinction between workstations, however not all sectors are in a position to include a disabled worker, it is understood that, with the appropriate adaptations, and assistive technologies, it is possible for a person with disabilities to work at any station.

Specifically on the respondent's workstation, the statements regarding the adequacy of his or her station for people with disabilities (AR 2.23), if anyone with disability can perform their activities (AR 2.18) and if the worker was already asked to provide suggestions for the adequacy of their station for people with disabilities (AR 1.80) had a high level of disagreement. These answers agree with the perceptions from the previous sets, which already indicated that, from the point of view of manufacturing workers, their stations are not suitable for inclusion.

As a final and complementary step, was sought to understand which categories could be included to work in the current respondents' stations. In this way, they were divided into seven statements for analysis of the average ranking. The statements with high disagreement was related to the adequacy of the station for blind people (AR 1.18), with monocular vision (AR 2.40), wheelchair users (AR 1.80), with compromised arm movements (AR 1.55), with mild mental disability (AR 2.20) and with severe mental disability (AR 1.31). It should be considered that respondents' perceptions regarding the categories and types of disability and the characteristics that impact the work performance may be scattered or even null, but the results indicate a rejection of the idea that current workstations are fit to receive most of people with disabilities.

On the other hand, the statement that deaf people can work adequately in current workstation (AR 4.11) had a high agreement index, probably because they needed fewer assistive developments and modifications.

5 Conclusion

From the set of responses of the survey, one can have an overview of the conclusions drawn for the research. Initially, it appears that, in general, industries have made changes and adjustments for the inclusion of workers with disabilities. However, from the viewpoint of workers without disabilities, such necessary adaptations are not reaching the workstation through assistive devices and technologies. Just as respondents indicate that their workstations are not adequate for inclusion, they do not indicate that workers with disabilities should work in isolation or apart from the rest. Thus, there is still difficulty in allocating these workers in the current conditions. On the other hand, there is a broad acceptance of inclusion of professionals with disabilities, with the only restriction being the training to understand a better the way to do it.

While respondents point out that inclusion should happen naturally, they also point that few people with disabilities are already able to work at their current workstation. This gap raised by the research shows that the process of inclusion is taking place in a more superficial way, without real opportunity for all people. It must be considered that, when it is necessary to include people with different abilities, it is necessary to make the adaptations that would enable the work of both disabled and non-disabled people. Such modifications include assistive products and structural adjustments, without which inclusion is limited to workers with minor limitations.

Considering the purpose of this paper, to present and analyze a survey for the search of the perception of workers without disabilities on the current industrial manufacturing workstations, a research with data collection by means of a questionnaire was developed. The process of analysis of the research was presented, emphasizing the highlights that represent the perceptions regarding the current workstations. Thus, it was possible to interpret the answers in a qualitative way and to understand how current production workers view the moment of inclusion in industrial workstations, its difficulties and conditions to carry out this process.

Finally, it is recommended for further studies to be carried out directly with current production managers, in order to compare with the resulting perception of this work. From a similar study, one can verify the reasons for this lack of inclusion and how assistive products and modifications for people with disabilities are developed in practice. This understanding may increase the database and find appropriate ways to guide this complex inclusion process, generating references for the development of assistive technologies for industrial manufacturing.

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