Article

Fuzzy Logic Method for Measuring Sustainable Decent Work Levels as a Corporate Social Responsibility Approach

Alma Nataly Abundes-Recilla 1, Diego Seuret-Jiménez 2, Martha Roselia Contreras-Valenzuela 1,∗,† and José M. Nieto-Jalil 3,∗

1 Faculty of Chemical Sciences and Engineering (FCQeI), Autonomous University of Morelos State (UAEM), Avenida Universidad 1001, Colonia Chamilpa, Cuernavaca, Morelos CP 62209, Mexico; alma.abundesre@uaem.edu.mx
2 Research Centre in Engineering and Applied Sciences, Autonomous University of Morelos State (UAEM), Avenida Universidad 1001, Colonia Chamilpa, Cuernavaca, Morelos CP 62209, Mexico; dseuret@uaem.mx
3 Tecnologico de Monterrey, School of Engineering and Sciences, Reserva Territorial Atlilxáyotl, Puebla CP 72453, Mexico
∗ Correspondence: martzacv@uaem.mx (M.R.C.-V.); jnietoj@tec.mx (J.M.N.-J.); Tel.: +52-7773297039 (M.R.C.-V.); Tel.: +52-2229090496 (J.M.N.-J.)

Abstract: The purpose of this study was to propose an interactive computer system that utilises the MATLAB Fuzzy Logic Designer to measure the level of implementation of SDG 8, which focuses on sustainable decent work (SDW) and economic growth. This study used policies and laws as parameters to determine the presence or absence of SDW. The fuzzy method was implemented in car windshield manufacturing in the auto parts industry as a case study to define and quantify work conditions and to determine the level of sustainable decent work (SDWL). The study described environmental conditions, such as noise, lighting, and heat stress; ergonomic factors, such as exposure time, the mass of the object manipulated, and lifting frequency; and organisation at work, such as workplace violence, salary, and workday, as linguistic variables. The level of the presence or absence of SDW was defined as their membership functions. The resulting vectors determined the absence of SDW with a score of 1.5 in two linguistic variables: environmental conditions and ergonomic factors. Some features of SDW in the linguistic variable organisation at work had an SDW score of 5. The SDWL vector determined a final score of 1.24, indicating the absence of decent work in production areas. This study found that the workers suffer a lack of long and healthy lives and a bad standard of living without economic growth due to work-related musculoskeletal disorders and work illnesses, increasing their out-of-pocket spending and catastrophic health expenses. As a CSR approach, assessing SDWLs helped managers improve policies and work conditions.

Keywords: corporate social responsibility; fuzzy logic; decent work; ergonomic risk evaluation; work conditions

1. Introduction

Measuring the level of sustainable and decent work (SDW) in industrial processes can be challenging due to several factors. Firstly, the concept of SDW is multifactorial, making it difficult to measure. Secondly, the lack of information on the subject further complicates the measurement. Finally, each industrial process has different work safety parameters, which makes it difficult to establish universal standards for measuring SDW. Addressing these issues, a method for measuring sustainable decent work levels (SDWLs) that utilises fuzzy logic is proposed in this paper. The SDWL interactive computer system was built using MATLAB Fuzzy Logic Designer. It was tested to validate its performance in a case study to determine the level of SDW engaged in producing car windshields in the auto parts industry. Many firms do not currently have formal Corporate Social Responsibility (CSR) policies and programs implemented as a part of their value chain [1] because they
contain features that require firms to have and maintain a sustainable production process and that creates firstly external constraints (environmental government policies), which influence their competition in the market trend, and secondly, domestic pressures, such as excessive yields of manufacture and extra-economic support in measuring process and operation improvements [2], thus the firms neglect their responsiveness about the work conditions under which personnel perform their tasks.

In general, work is any activity, whether intellectual or material, that people do to achieve a desired outcome, regardless of the level of technical expertise required for a particular profession or trade [3]. Thus, a worker is an individual who provides personal work to an entity in a subordinate position, and this employment normally is the means by which society allocates and utilises limited resources for a better quality of life, reallocating funds to meet present and future needs [4,5]. However, the concept of SDW does not apply to this study in cases where resources are obtained through unemployment subsidies or social subsidies for people who are unable to work because the subordinate position does not exist. Besides protecting the planet, sustainable development promotes prosperity in education, health, social protection, and job opportunities [6]. Protecting workers’ rights and encouraging safe and secure working places and environments is part of economic growth [7]. The United Nations (UN) proposed SGD 8 as part of their 2030 Agenda for Sustainable Development [8], which focuses on “Decent Work and Economic Growth”. This goal aims to promote sustainable decent work (SDW) by allowing individuals to engage in productive activities that offer reasonable income, workplace security, and social protection for their families. SDW also encourages personal development and social integration. Employees of any workplace, including men and women, people with or without disabilities, and minors, interact with the physical conditions of their workplace environment. Therefore, measuring the absence or presence of SDW in workplaces must be essential for guaranteeing families’ economic growth. Unsafe and insecure working places and environments cause occupational illness, which reduces the economic growth of workers and their families because they cannot work due to the consequences of disease or accident, increasing out-of-pocket spending and catastrophic health expenses like outpatient care, hearing equipment, wheelchairs, therapy for musculoskeletal disorders, and unsubsidised medications, among others [9]. Unfortunately, many organisations and countries fail to consider the impact of work conditions on health and the expenses associated with it as part of SDW. Therefore, companies play a significant role in advancing sustainable development if they adopt voluntary actions to implement the three sustainability dimensions (economic, environmental, and social) in their organisations [10]. Voluntary sustainability standards are crucial to ensure that fundamental human rights, worker health and safety, and environmental impacts are considered. However, a clear governance framework must be in place to enhance the credibility of voluntary efforts and promote coordination and alignment across initiatives. Unfortunately, not all countries have established such a framework [11].

The evaluation of the presence or absence of SDW has been present in some way in the research literature; the most representative works for this article are described as follows: Barford et al. [12] focus on group surveys and statistics in low-income countries to identify empirical and conceptual drivers of youth perspectives on SDW scarcity; however, implications about the work were not considered. A qualitative approach to validate the decent work scale (DWS) in French society was proposed by Vignoli et al. [13], but only some components of SDW (life satisfaction, family–work conflict, and meaningful work) were considered; nonetheless, job safety and health were not included in their study. The links between three components of health (general health, symptoms, and healthy behaviours) concerning work-generated fatigue were examined by Duffy et al. [14], i.e., they determined the presence or absence of SDW through fatigue. One of the dimensions established by Yildirim et al. [15] that adds value to SDW is safe working conditions, which positively impact the motivation of workers; nevertheless, industrial conditions were not defined. Lout et al. [16] establish safety at work as one of the main elements in measuring the absence of SDW. Finally, Yan et al. [17] select a scale to measure the
perception of decent work by measuring the well-being of workers in the workplace. The International Labour Organization (ILO) has devised a global measurement of decent work using questionnaires, but it does not include information about work conditions or suggestions for improving them. As a result, the ILO recommended developing an investigation into unsafe industrial work conditions [18]. Few works directly address work conditions related to SDW and CSR. The three most relevant for this investigation include the one developed by Raufflet et al. [19], who acquired and described the concept of “regulatory scripts”, defined as the practices proportioned by a group of enterprises in mining and oil in response to international CSR standards; their study includes an analysis of work environmental systems and safety and health conditions from an index control point of view. The other work, by Kwon and Park [20], proposed a quantitative method of realising the responsible development of emerging technologies via text analysis of future-oriented web data and scientific publication data; this technique allows developers of emerging technologies to consider social concerns and human norms alongside more typical engineering ideals. Finally, Hadj [21] analysed the role played by CSR in improving the responsible innovation and the competitiveness of North African small and medium-sized enterprises by focusing on the commitments toward internal and external stakeholders and environmental management and formulating a sustainable development model based on responsible innovation in small and medium-sized enterprises. The works in this section considered the voices of stakeholders, and some considered CSR policies; they proposed decision-making based on user requirements considering SDW with a CSR focus. Analysing the information described above, it was possible to establish that previous investigations have not addressed fuzzy logic methods in combination with labour environmental factors to develop a new SDW evaluation method as a CSR approach. In their work, Ali S. et al. [22] highlight the need to ensure the robustness of results obtained through alternative scenarios. Therefore, this paper proposes new scenarios for SDG 8. Thus, this article sets a new frame of reference in studying sustainable decent work. Considering that, through a solid evaluation of data, fuzzy logic allows the incorporation of a technique that minimises the differences in point of view during decision-making. Using the fuzzy method to determine the level of SDW during the evaluation of work task conditions makes it possible to define the level of a presence or absence of SDW. Consequently, it was possible to determine whether the physical work environment complies with the sustainable decent work concept. This article reports a proposed method for evaluating the presence or absence of SDW inside workplaces by analysing three main groups of conditions: environmental conditions, ergonomic factors, and organisation at work, which directly impact the quality of the working lives and personal lives of occupationally exposed personnel (OEP). The application was developed in the MATLAB Fuzzy Logic Toolbox (FLT) [23] and applied to evaluate six areas in the production of car windshields in the auto parts industry. This paper’s contribution and research’s novelty lie in:

1. The design of a fuzzy logic method to define and quantify work conditions to determine the level of sustainable decent work as a CSR approach.
2. The definition of the presence or absence of sustainable decent work using policies and laws relating to sustainability and safety and health in work.
3. A proposed CSR approach tool that establishes a multivariable record for measuring and monitoring the level of sustainable decent work in the workplace.

This hypothesis will demonstrate that the fuzzy logic tool is helpful as a CSR approach in the results and discussion sections.

The rest of the paper is organised as follows: The materials and methods are described in detail in Section 2. The results of this study are presented in Section 3. The discussion and conclusion of the investigation are presented in Sections 4 and 5, respectively.

2. Materials and Methods

As was mentioned above, SDW and economic growth promote and allow individuals to engage in productive activities that offer three features: reasonable income, workplace
security, and social protection for their families. They also encourage personal development and social integration [8]. Their definitions are extensive and multifactorial, so in this research, the scope will be limited only to evaluations in industries that seek to comply with SDG 8 guidelines. In this context, three variables representative of these features were defined: environmental conditions, ergonomic factors, and organisation at work. To deeply measure workplace security, environmental conditions and ergonomic factors were chosen because they represent the characteristics of the process that directly affect the workers’ health and cause work-related illnesses and musculoskeletal disorders impacting their standard of living and well-being, sometimes forever. Organisation at work measures reasonable income and personal development through salary per day; social integration was measured through hours per workday and violence at work. In the case of formal work, all employees have social protection for their families; consequently, this feature was not considered for measurement in this study.

In the language of sustainability, some concepts are imprecise or vague (fuzziness); for example, how do we measure “responsibility” or the quality of being “decent”? Usually, a company can be defined as highly responsible with their employees or not, or a work can be decent or not; in both cases, the meaning depends on who expresses the sentence and the expertise in the topic. Therefore, the main concern of fuzzy logic is representing, manipulating, and drawing inferences from such imprecise statements [24]. For this study, the term decent was defined as fuzzy in the sentence, so it cannot be determined with absolute precision. However, it is used in SDW and CSR decision-making. Representing the sentence “it is a sustainable decent work” was difficult to assert whether it was true or false. Thus, SDW was defined as a function and its components as variables (Xs). The relationship between SDW and Xs becomes a matter of degree and depends on policies and laws relating to sustainability, safety, and health in work to create different subsets, which can be represented as follows:

\[
\text{Subset}_{\text{SDW}}(x) = \begin{cases} 
1 & \text{if } x \in \text{SDW presence} \\
0.5 & \text{if } x \in \text{SDW some presence} \\
0 & \text{if } x \notin \text{SDW absence} 
\end{cases} 
\]  

The individual mathematical fuzzy models for the presence or absence of SDW were determined by its components \(X_{\text{SDW}}\) in Equations (2)–(11) during the fuzzification process. The methodology proposed for the research is divided into two stages: Phase I defines the fuzzy rules based on three groups of fuzzy sets. Phase II involves programming the Fuzzy Logic Toolbox to determine the SDWL.

2.1. Problem Description

Recent research has focused on applying surveys and developing statistics to identify perspectives on SDW and classify the relationship between components of health and poor motivation. However, the relationship between environmental conditions, ergonomic factors, and organisation at work to determine SDW level is often neglected. This study has applied a fuzzy logic method as a socially responsible approach. This has resulted in a significant problem: defining the degree of membership in a set of work conditions to express the degree to which some condition exists (in our case, SDW), despite its vagueness/fuzziness, in decision-making. To address this issue, we have developed a fuzzy logic method that considers the relationship between safety and health risk levels and workstation conditions. We first specify in advance parameters for the fuzzy variables that define risks and hazards for workers in industrial workplaces. Then, we define membership rules as elements of association and segmentation. Finally, an SDWL is introduced by adding a socially responsible point of view. In subsequent sections, we describe this fuzzy process to better understand how it works.
2.2. Case Study

The case study was developed in a company in Mexico; therefore, the applicable salaries and regulations correspond to this country. In manufacturing car windshields, the production process imposes safety conditions and risks that can harm workers’ health; therefore, direct labour workers were considered major internal stakeholders for this study. To identify whether tasks were carried out in a socially responsible environment, a fuzzy logic method for measuring sustainable decent work levels was developed and implemented in six production departments (laminating, tempering, post glass, supply chain, and quality control). For developing the evaluation, only a sample of 10% of workers were interviewed due to the process involving a total of 3000 workers divided into three work shifts. Tasks in all departments require manual material handled with a mass of windshields from 11 kg to 26 kg and a quota of 2100 pieces per shift. The daily salary varies from USD 12 to USD 18, depending on the work department. Tasks involve overtime and high stress.

2.3. Phase I: Fuzzification

To apply fuzzy logic (FL) methods, it was necessary to declare the SDW variables and safety and health parameters that should be measured. Next, the parameters for measurement were converted into appropriate fuzzy sets to define their vagueness; this step is called fuzzification [25]. FL is a mathematical formalism used in this investigation to emulate the ability to correctly evaluate work conditions based on linguistic data. Therefore, FL admits information regarding variables (environmental conditions, ergonomic factors, and organisation at work) to build the fuzzy sets. The relationships between sets of variables were combined to determine decisions [26]. Fuzzy degrees are membership percentages in a fuzzy set. Vagueness/fuzziness expresses a degree of some condition that exists and represents the “level” of presence or absence of SDW.

2.3.1. Defining Fuzzy Models and Fuzzy Sets

Levels of Risk in the Fuzzy Model: As fuzzy choices, the membership functions with three levels of presence of SDW were determined in Equation (2) using the following parameters:

- Low level of risk—presence of SDW—environmental conditions, ergonomic factors, and organisation at work in workplaces which generate minimum fatigue or stress and lead to work-related illnesses in the long term—scored between 0 and 3;
- Medium level of risk—some presence of SDW—environmental conditions, ergonomic factors, and organisation at work in workplaces which generate fatigue and stress and lead to work-related illnesses in the medium term—scored between 2 and 7;
- High level of risk—absence of SDW—environmental conditions, ergonomic factors, and organisation at work in workplaces which generate extreme fatigue and stress and lead to work-related illnesses in the short term—scored between 6 and 10.

\[
\text{Level of Risk}_{SDW}(x) = \begin{cases} 
1 & \text{if } 6 \text{ points} \leq x \leq 10 \text{ points} \\
0.5 & \text{if } 2 \text{ points} \leq x \leq 7 \text{ points} \\
0 & \text{if } 0 \text{ points} \leq x \leq 3 \text{ points} 
\end{cases}
\] (2)

To define the parameters for the environmental conditions used as fuzzy sets, international safety and health parameters were considered as follows:

Noise Fuzzy Model: The European, Asian, and Latin American legislation establishes that for an 8 h workday, the levels of noise exposure without protection before damage is produced must be less than 80 dB [27–29]. The ILO states that the levels workers are exposed to in an 8 h workday should not exceed 90 dB and defines that the maximum permissible exposure, in terms of average daily noise levels, can vary, depending on the country, from 80 to 85 or 90 dBA, with accumulation factors of 3, 4, or 5 dBA [30]. In some countries, such as Japan, permissible noise levels are set between 50 and 85 dBA, depending on the type of work performed and considering the physical and mental workload [31]. In the case of pregnant female workers, the protection of the unborn baby’s hearing organ
must also be included; according to the Spanish Society of Gynaecology and Obstetrics (SEGO), tasks should not be carried out in excessive-noise conditions (more than 80 dB) after the 20th–22nd week of gestation [32]. Therefore, the fuzzy model was determined in Equation (3) with the following parameters:

- Low level of risk—presence of SDW—noise less than 80 dB;
- Medium level of risk—some presence of SDW—noise between 80 dB and 90 dB;
- High level of risk—absence of SDW—noise higher than 90 dB.

\[
\text{Noise}_{SDW}(x) = \begin{cases} 
1 & \text{if } x < 80 \text{ dB} \\
0.5 & \text{if } 80 \text{ dB} \leq x \leq 90 \text{ dB} \\
0 & \text{if } 90 \text{ dB} \leq x
\end{cases} \tag{3}
\]

Lighting Fuzzy Model: In some Latin American countries, it is established that a minimum of 200 lux is required to perform a task with a simple vision [33]. The ILO has established a comprehensive reference framework by defining lighting levels depending on the type of task being performed: for example, for tasks with limited visual requirements: from 200 lux to 300 lux; for tasks with normal visual requirements: from 500 lux to 1000 lux; and for special or high-precision work: from 1000 lux to 20,000 lux (for example, surgeries) [34]. In Japan, the illuminance of working conditions was defined per the type of work: for example, 300 lux or more for precision work, 150 lux for ordinary work, and 70 lux for rough work [35]. Therefore, the fuzzy parameters for the lighting of machinery, office spaces, and inspection were set as follows:

- Low visual requirement: low level of risk—presence of SDW—lighting from 70 lux to 300 lux;
- Normal: medium level of risk—some presence of SDW—lighting from 200 lux to 750 lux;
- Demanding: high level of risk—absence of SDW—lighting higher than 500 lux.

\[
\text{Lighting}_{SDW}(x) = \begin{cases} 
1 & \text{if } 70 \text{ lux} \leq x \leq 300 \text{ lux} \\
0.5 & \text{if } 200 \text{ lux} \leq x \leq 750 \text{ lux} \\
0 & \text{if } 500 \text{ lux} \leq x
\end{cases} \tag{4}
\]

Heat Stress Fuzzy Model: The ILO Encyclopaedia considers a cold work environment to be where the temperature is below 20 °C and a sensation of thermal neutrality to be between 20 and 26 °C [36] in light or sedentary work conditions, wherein the estimation of the thermal stress that a worker is subjected to is made through the WBGT index (wet bulb and black globe) [36,37]. Therefore, the fuzzy parameters for hot or cold environmental conditions measured via the WBGT index indoors at workplaces were:

- Cold: low level of risk—presence of SDW—heat stress from 10 °C and under to 23 °C;
- Thermal neutrality: medium level of risk—some presence of SDW—heat stress between 20 °C and 30 °C;
- Hot: high level of risk—absence of SDW—heat stress from 27 to 45 °C, considering that from values close to 40 °C, heat disorders begin to occur in humans.

\[
\text{Heat stress}_{SDW}(x) = \begin{cases} 
1 & \text{if } 10 \text{ °C} \leq x \leq 23 \text{ °C} \\
0.5 & \text{if } 20 \text{ °C} \leq x \leq 30 \text{ °C} \\
0 & \text{if } 27 \text{ °C} \leq x \leq 45 \text{ °C}
\end{cases} \tag{5}
\]

In the case of ergonomic parameters defined according to the standard ISO 11228-1:2021 [38], in a task related to manual material handling, the time of exposition is considered an unfavourable condition when the mass of the handled object is over 25 kg and the frequency of lifting is above 900 movements per shift. A cumulated mass of 6500 kg in a shift of 8 h should not be exceeded. Thus, the fuzzy sets were defined as follows [39]:

Time of Exposition Fuzzy Model:

- Low level of risk—presence of SDW—exposition time of 0 min to 80 min;
• Medium level of risk—some presence of SDW—exposition time between 60 min and 120 min;
• High level of risk—absence of SDW—exposition time of 100 min to 180 min or more.

\[
\text{Time of exposition}_{SDW}(x) = \begin{cases} 
1 & \text{if } 0 \text{ min} \leq x \leq 80 \text{ min} \\
0.5 & \text{if } 60 \text{ min} \leq x \leq 120 \text{ min} \\
0 & \text{if } 100 \text{ min} \leq x \leq 180 \text{ min or more}
\end{cases}
\] \hspace{1cm} (6)

Mass of the Handled Object Fuzzy Model

• Low level of risk—presence of SDW—mass of 0 kg to 10 kg;
• Medium level of risk—some presence of SDW—mass between 7 kg and 15 kg;
• High level of risk—absence of SDW—mass of 13 kg to 25 kg or more.

\[
\text{Mass of the object}_{SDW}(x) = \begin{cases} 
1 & \text{if } 0 \text{ kg} \leq x \leq 10 \text{ kg} \\
0.5 & \text{if } 7 \text{ kg} \leq x \leq 15 \text{ kg} \\
0 & \text{if } 13 \text{ kg} \leq x \leq 25 \text{ kg}
\end{cases}
\] \hspace{1cm} (7)

Frequency of Handling Fuzzy Model

• Low level of risk—presence of SDW—handling frequency of 0 movements to 700 movements;
• Medium level of risk—some presence of SDW—handling frequency between 600 movements and 1100 movements;
• High level of risk—absence of SDW—handling frequency of 900 to 1800 movements or more.

\[
\text{Frequency of handling}_{SDW}(x) = \begin{cases} 
1 & \text{if } 6 \text{ movements} \leq x \leq 10 \text{ movements} \\
0.5 & \text{if } 2 \text{ movements} \leq x \leq 7 \text{ movements} \\
0 & \text{if } 900 \text{ movements} \leq x \leq 1800 \text{ movements or more}
\end{cases}
\] \hspace{1cm} (8)

To define the organisation at work, the parameters contained in the Mexican standard NOM 035 STPS:2018 were used as a score from 0 to 13 points for evaluating psychosocial factors concerning workplace violence, salary, and the workday [40].

Workplace Violence Fuzzy Model

• Low level of risk—presence of SDW—workplace violence score of 0 points to 8 points;
• Medium level of risk—some presence of SDW—workplace violence score between 9 points and 12 points;
• High level of risk—absence of SDW—workplace violence score of more than 13 points.

\[
\text{Workplace violence}_{SDW}(x) = \begin{cases} 
1 & \text{if } 0 \text{ points} \leq x \leq 8 \text{ points} \\
0.5 & \text{if } 9 \text{ points} \leq x \leq 12 \text{ points} \\
0 & \text{if } 13 \text{ points} \leq x
\end{cases}
\] \hspace{1cm} (9)

Salary (in México) Fuzzy Model

• Low level of risk—presence of SDW—salary of more than USD 30 per day;
• Medium level of risk—some presence of SDW—salary between USD 12 and USD 30 per day;
• High level of risk—absence of SDW—salary of USD 6 to USD 12 per day.

\[
\text{Salary}_{SDW}(x) = \begin{cases} 
1 & \text{if } 30 \text{ USD} \leq x \\
0.5 & \text{if } 12 \text{ USD} \leq x \leq 30 \text{ USD} \\
0 & \text{if } 6 \text{ USD} \leq x \leq 12 \text{ USD}
\end{cases}
\] \hspace{1cm} (10)

Workday Fuzzy Model

• Low level of risk—presence of SDW—workday between 4 h and 8 h;
• Medium level of risk—some presence of SDW—workday between 7 h and 10 h;
• High level of risk—absence of SDW—workday between 9 h and 12 h or more.
2.3.2. Defining Linguistic Variables and Fuzzy Rules

Our objective is to predict the different levels of SDW from the following three variables: environmental conditions, ergonomic factors, and organisation at work. To build the linguistic model, it was necessary to define fuzzy IF–THEN rules, and input variables and consequent sentences were defined as linguistic variables as follows:

- **Variable → Environmental conditions.** Linguistic variables → Noise, Lighting, and Heat _Stress;_
- **Variable → Ergonomic factors.** Linguistic variables → Exposition _Time, Mass _Object, Lifting _Frequency;
- **Variable → Organisation at work.** Linguistic variables → Workplace _Violence, Salary, Workday;
- **Membership function → absence of SDW;**
- **Membership function → some features of SDW;**
- **Membership function → presence of SDW.**

Because FL is an intuitive model used for determining the level of the presence of sustainable decent work, two ranges of evaluation were needed. First, an assessment of risk in SDW with a score from 1 to 10 points was defined, considering 1 as the absence of SDW and 10 as the presence of SDW. The second was for the SDWL, with a score given from 1 to 10, where 1 defines the absence of SDW, and 10 establishes the presence of SDW. The fuzzification of variables to conform to the universe of discourse and linguistic variables, fuzzy choices, and consequent sentences to define the SDWL is presented in Figure 1 and was used to determine the fuzzy rules.

\[
Workday_{SDW}(x) = \begin{cases} 
1 & \text{if } 4 \text{ h} \leq x \leq 8 \text{ h} \\
0.5 & \text{if } 7 \text{ h} \leq x \leq 10 \text{ h} \\
0 & \text{if } 9 \text{ h} \leq x \leq 12 \text{ h or more}
\end{cases}
\]  

(11)

**Figure 1.** Universe of discourse between linguistic variables, fuzzy choices, and membership functions to define SDWLs.
Considering the rule that if \( N \) is the number of linguistic variables and \( S \) is the number of linguistic values, then the possible number of fuzzy rules will be \( S^N \) as indicated by Equation (12).

\[
\text{Number of FR} = S^N \tag{12}
\]

Therefore, 108 rules were determined, 27 for each variable, including the resulting evaluation, as is shown in Table 1. All combinations of the linguistic variables through the IF, AND, and THEN represent the inference stage to define the level of SDW for each work condition.

2.4. Phase II: Defuzzification

Programming the Fuzzy Rules in the Fuzzy Logic Designer

Mathematically, a fuzzy set is one in which the contra-domain is the interval (0, 1), and the domain is the universe [39]. Thus, if the degree of membership is closer to 1, the more included the element will be in each set, i.e., there is a level of presence of SDW. If the degree of membership is closer to 0, fewer elements will be included in each set [41], and there is the absence of SDW. Therefore, FL determines the inferential mechanism needed to reach the output value related to the SDW level, numerically determining its presence or absence. The fuzzy sets define the universe of discourse (universe of possible actions). They can be represented graphically as a function when the universe of discourse \( X \) (or underlying domain) is continuous (not discrete), as is shown in Figure 2. Once the fuzzy set was defined, the groups of 27 rules defined in Table 1 for each linguistic variable were entered into the Mamdani-type inference in the Fuzzy Logic Toolbox; an example is shown in Figure 3, and the rest of the rules are shown in the figures of Appendix A.

![Figure 2. Example of a graphic representation of a membership function built by the Fuzzy Logic Designer: (1) fuzzy sets for each risk level of decision, (2) domain for each fuzzy set, (3) linguistic variable, and (4) membership score. The red line identifies the selected fuzzy set, and the black boxes are positioned in the parameter limits of the function. The black lines in the membership function plot indicate unselected fuzzy sets.](image)

Finally, the defuzzification consists of converting the fuzzy sets into a crisp single value that is the precise representation of the fuzzy sets [25]. The defuzzified values represent the level of sustained decent work in any workplace, ranging from 1 to 10.
Table 1. Fuzzy rules. We have made a change to the letter style by using italics for variables.

<table>
<thead>
<tr>
<th>Rule No.</th>
<th>Environmental Conditions</th>
<th>Ergonomic Factors</th>
<th>Organisation at Work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IF</td>
<td>AND</td>
<td>IF</td>
</tr>
<tr>
<td>1</td>
<td>Low</td>
<td>Low</td>
<td>Absence</td>
</tr>
<tr>
<td>2</td>
<td>Medium</td>
<td>Low</td>
<td>Absence</td>
</tr>
<tr>
<td>3</td>
<td>High</td>
<td>Low</td>
<td>Absence</td>
</tr>
<tr>
<td>4</td>
<td>Low</td>
<td>Medium</td>
<td>Some</td>
</tr>
<tr>
<td>5</td>
<td>Medium</td>
<td>Low</td>
<td>Some</td>
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<td>6</td>
<td>High</td>
<td>Low</td>
<td>Absence</td>
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<tr>
<td>7</td>
<td>Low</td>
<td>Medium</td>
<td>Absence</td>
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<tr>
<td>8</td>
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<td>Medium</td>
</tr>
<tr>
<td>12</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>13</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>14</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>15</td>
<td>High</td>
<td>Medium</td>
<td>Some</td>
</tr>
<tr>
<td>16</td>
<td>Low</td>
<td>Medium</td>
<td>Absence</td>
</tr>
<tr>
<td>17</td>
<td>Medium</td>
<td>High</td>
<td>Absence</td>
</tr>
<tr>
<td>18</td>
<td>High</td>
<td>Medium</td>
<td>Absence</td>
</tr>
<tr>
<td>19</td>
<td>Low</td>
<td>High</td>
<td>Absence</td>
</tr>
<tr>
<td>20</td>
<td>Medium</td>
<td>Low</td>
<td>Absence</td>
</tr>
<tr>
<td>21</td>
<td>High</td>
<td>Low</td>
<td>Absence</td>
</tr>
<tr>
<td>22</td>
<td>Low</td>
<td>Medium</td>
<td>Presence</td>
</tr>
<tr>
<td>23</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>24</td>
<td>High</td>
<td>Medium</td>
<td>Some</td>
</tr>
<tr>
<td>25</td>
<td>Low</td>
<td>High</td>
<td>Absence</td>
</tr>
<tr>
<td>26</td>
<td>Medium</td>
<td>High</td>
<td>Absence</td>
</tr>
<tr>
<td>27</td>
<td>High</td>
<td>High</td>
<td>Absence</td>
</tr>
</tbody>
</table>
The frequency of environmental conditions organised by membership function.

Table 2. Frequency of environmental conditions organised by membership function.

<table>
<thead>
<tr>
<th>Linguistic Variables</th>
<th>Membership Functions</th>
<th>Ranks</th>
<th>Laminating</th>
<th>Tempering</th>
<th>Post Glass</th>
<th>Supply Chain</th>
<th>Quality Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>Low_Risk</td>
<td>&lt;80 db</td>
<td>2</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Medium_Risk</td>
<td>80–90 db</td>
<td>39</td>
<td>35</td>
<td>16</td>
<td>10</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>High_Risk</td>
<td>&gt;90 db</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Lighting</td>
<td>Low_Risk</td>
<td>70–300 lux</td>
<td>43</td>
<td>55</td>
<td>42</td>
<td>0</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Medium_Risk</td>
<td>200–750 lux</td>
<td>92</td>
<td>91</td>
<td>7</td>
<td>49</td>
<td>23</td>
<td>262</td>
</tr>
<tr>
<td></td>
<td>High_Risk</td>
<td>&gt;600 lux</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Heat Stress</td>
<td>Low_Risk</td>
<td>10–23 °C</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Medium_Risk</td>
<td>20–30 °C</td>
<td>7</td>
<td>10</td>
<td>0</td>
<td>40</td>
<td></td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>High_Risk</td>
<td>27–45 °C</td>
<td>15</td>
<td>8</td>
<td>50</td>
<td>3</td>
<td>25</td>
<td>101</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>594</td>
</tr>
</tbody>
</table>
To define the level of SDW for the set environmental condition, the three highest frequencies were evaluated with the following parameters: Noise 90 db, Lighting 500 lux, and Heat Stress 32 °C. This fuzzy evaluation is shown in Figure 4a. The columns in yellow are the membership vectors, which represent graphically the rules for each membership function, and the column in blue represents the evaluation result. For example, in the Heat Stress membership vector equal to 32 °C, the rules 7, 8, 9, 16, 17, 18, 25, 26, and 27 were activated in the high-risk zone; in the Lighting membership vector equal to 500 lux, the rules 10, 11, 12, 13, 14, 15, 16, 17, and 18 were activated in the low-risk zone; and in the Noise membership vector equal to 90 db, the rules 3, 6, 9, 12, 15, 18, 21, 24, and 27 were activated in the high-risk zone. Considering that the solution does not represent a direct relationship between columns and rows but evaluates memberships between rules is important. The resultant vector establishes that degree of membership. Therefore, the combination of all memberships activates rule 18 with a score of 1.5 in Absence_SDW, as shown in the membership function plots at the top of Figure 4a. To evaluate the ergonomic factors, the highest mass manipulated was considered to be 26 kg (windshield mass), with a frequency of 2100 liftings and an exposition time of 300 min per shift. The evaluation results are shown in Figure 4b and indicate the absence of SDW with a score of 1.5.

![Figure 4](image_url)

**Figure 4.** Individual evaluation by a set of linguistic variables: (a) ruler viewer for environmental conditions, with an SDW resultant score of 1.5; (b) ruler viewer for ergonomic factors, with an SDW resultant score of 1.5. Both cases indicate the absence of SDW. The yellow vectors indicate the rules that have been activated for each linguistic set, while the blue vector represents the SDW level (the resulting evaluation). The red line on the vectors corresponds to the value inputted for each linguistic variable.

A salary of USD 12 per day for direct labour workers was considered to evaluate the set organisation at work. The result from the evaluation of violence at work was positive with 10 points; twenty-one per cent of workers reported having suffered violence at work (see Table 3). Finally, the weekday was 12 h each third day, totalling 48 h per week.
The evaluation results are shown in Figure 5a and indicate some features of SDW with a resulting score of 5. Finally, the individual scores from each set were evaluated to define a final SDWL (see Figure 5b). The resulting score for the SDWL was 1.24, indicating that the production process of car windshields is carried out under conditions where there is an absence of sustained decent work.

![Figure 5](image_url)

**Figure 5.** Individual evaluation by a set of linguistic variables: (a) ruler viewer for the organisation at work with an SDW resultant score of 5, indicating some features of SDW; (b) ruler viewer for the final SDWL, with a resultant score of 1.24, indicating the absence of sustainable decent work. The yellow vectors indicate the rules that have been activated for each linguistic set, while the blue vector represents the SDW level (the resulting evaluation). The red line on the vectors corresponds to the value inputted for each linguistic variable.

Consequently, the company is required to modify its internal socially responsible policies. An example of an evaluation for the departments is presented in Appendix B. The results of 33 individual evaluations of workstations are shown in Table 4, wherein in 14 cases, there was an absence of SDW; in the other 14 cases, there were some features of SDW, and only 4 cases showed the presence of SDW.

The resulting score of 1.24 for SDWL negatively impacts each worker’s family economy, as was observed in the results of the out-of-pocket spending and catastrophic health expense interviews for 330 workers (see Table 3). For example, at some point in their life, 70% of the interviewed workers had paid between USD 1 and USD 50 for health expenses out of pocket due to work at least once per month; 31% had paid between USD 101 and USD 500 for health expenses out of pocket due to work at least once per month; and almost 3% had paid more than USD 500 for health expenses out of pocket due to work at least once per month. In the case of violence at work, only 18 workers stated that they had suffered violence at work; however, 45 workers refused to answer the questionnaire for fear of repression from their immediate boss: both cases were considered as violence, totalling 21%.
Table 3. Responses from 330 workers interviewed across 33 workstations and three shifts regarding their out-of-pocket spending, catastrophic health expenses, and violence at work.

<table>
<thead>
<tr>
<th>Question</th>
<th>Questions Answered with “Yes”</th>
<th>Questions Answered with “No”</th>
<th>Unanswered Question for Fear of Reprisals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you ever developed any work-related illnesses like back pain, loss of hearing, or a respiratory illness?</td>
<td>78</td>
<td>188</td>
<td>45</td>
</tr>
<tr>
<td>2. Have you experienced any work-related accident that temporarily prevents work?</td>
<td>86</td>
<td>180</td>
<td>45</td>
</tr>
<tr>
<td>3. Have you experienced any work-related pain or injuries that temporarily prevent work?</td>
<td>169</td>
<td>97</td>
<td>45</td>
</tr>
<tr>
<td>4. Have you been treated for occupational diseases by public health services (free of charge)?</td>
<td>185</td>
<td>81</td>
<td>45</td>
</tr>
<tr>
<td>5. Have you received treatment for work-related injuries or illnesses from a private healthcare provider in addition to the treatment you had already received?</td>
<td>150</td>
<td>116</td>
<td>45</td>
</tr>
<tr>
<td>6. Have you ever paid for out-of-pocket health expenses due to work at least once per month, between USD 1 and USD 50?</td>
<td>223</td>
<td>43</td>
<td>45</td>
</tr>
<tr>
<td>7. Have you ever paid for out-of-pocket health expenses due to work at least once per month, between USD 51 and USD 100?</td>
<td>43</td>
<td>233</td>
<td>45</td>
</tr>
<tr>
<td>8. Have you ever paid for out-of-pocket health expenses due to work at least once per month, between USD 101 and USD 500?</td>
<td>105</td>
<td>161</td>
<td>45</td>
</tr>
<tr>
<td>9. Have you ever paid for out-of-pocket health expenses due to work at least once per month for more than USD 500?</td>
<td>9</td>
<td>246</td>
<td>45</td>
</tr>
<tr>
<td>10. Have you ever suffered any type of abuse or threats from a superior that you consider to be violence at work?</td>
<td>18</td>
<td>267</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 4. Results of 33 evaluations of individual workstations.

<table>
<thead>
<tr>
<th>Workstation</th>
<th>Environmental Conditions</th>
<th>Ergonomics Factors</th>
<th>Organisation at Work</th>
<th>SDWL</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Laminating</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5.84</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>2 Laminating</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>5.81</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>3 Laminating</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>5.81</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>4 Laminating</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>1.78</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>5 Laminating</td>
<td>7</td>
<td>4</td>
<td>7.5</td>
<td>3.23</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>6 Laminating</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>5.8</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>7 Laminating</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5.84</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>8 Quality Control</td>
<td>8</td>
<td>3</td>
<td>8</td>
<td>1.78</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>9 Quality Control</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>5.8</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>10 Quality Control</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>8.84</td>
<td>Presence of SDW</td>
</tr>
<tr>
<td>11 Quality Control</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>8.9</td>
<td>Presence of SDW</td>
</tr>
<tr>
<td>12 Quality Control</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>5.8</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>13 Quality Control</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>5.81</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>14 Supply Chain</td>
<td>1.5</td>
<td>7.69</td>
<td>1.5</td>
<td>1.59</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>15 Supply Chain</td>
<td>4.53</td>
<td>3.79</td>
<td>4.03</td>
<td>5.83</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>16 Supply Chain</td>
<td>4</td>
<td>1.34</td>
<td>5</td>
<td>5.84</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>17 Supply Chain</td>
<td>4.04</td>
<td>2.38</td>
<td>5.67</td>
<td>5.79</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>18 Tempering</td>
<td>2.35</td>
<td>1.06</td>
<td>3.38</td>
<td>2.69</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>19 Tempering</td>
<td>1.5</td>
<td>3.85</td>
<td>7.32</td>
<td>1.81</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>20 Tempering</td>
<td>5</td>
<td>7.12</td>
<td>8.5</td>
<td>1.71</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>21 Tempering</td>
<td>8.69</td>
<td>8.22</td>
<td>1.5</td>
<td>1.53</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>22 Tempering</td>
<td>3.45</td>
<td>4.5</td>
<td>1.5</td>
<td>5.83</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>23 Tempering</td>
<td>2.35</td>
<td>1.24</td>
<td>5</td>
<td>2.69</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>24 Tempering</td>
<td>8.74</td>
<td>6.63</td>
<td>3.5</td>
<td>3.2</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>25 Post Glass</td>
<td>3.48</td>
<td>1.4</td>
<td>4</td>
<td>5.83</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>26 Post Glass</td>
<td>8.69</td>
<td>1.24</td>
<td>6.5</td>
<td>8.87</td>
<td>Presence of SDW</td>
</tr>
<tr>
<td>27 Post Glass</td>
<td>1.5</td>
<td>3.88</td>
<td>7</td>
<td>1.74</td>
<td>Absence of SDW</td>
</tr>
</tbody>
</table>
4. Discussion

This section discusses the results obtained from the fuzzy logic method for measuring sustainable decent work levels (SDWLs) applied to a case study in the production of car windshields as a validation. First, the theoretical implications are discussed to analyse the impact of the SDWLS and compare them with the current situation to define this study’s contributions to the existing literature and how it will be helpful for managers as a socially responsible approach, especially in the auto parts industry. Then, practical implications were defined to establish its contribution to real industrial situations.

The SDWL can classify information from each workstation and organise memberships between linguistic variables and risk levels to define the presence or absence of sustainable decent work. Comparing the linguistic variables of environmental conditions, ergonomics, and organisation at work with the variables defined in [10]—quality of life, equal opportunity, and workers’ rights—the proposed SDWL added an alternative way to analyse the social component of sustainability. Regarding the current situation in fuzzy logic models, Parra-Dominguez et al. [42] found that there are voices in the scientific community considering whether sustainable decent growth is suitable for measuring the progress of the 2030 Agenda and providing models for the pursuit of a long and healthy life, access to knowledge, and a good standard of living; in this context, the SDWL defines new critical criteria establishing 10 fuzzy models based on measurable international parameters, which impact important human aspects like violence at work and work-related illnesses. However, comparing results from vectors was not possible because the variables and their fuzzy models were not the same. In the case of the auto parts industry, the study proposed in [43] included ergonomic factors and organisation at work as variables to analyse Volvo’s production system. Compared with that study, the SDWL incorporates new parameters for work conditions and organisation at work with a sustainable emphasis rather than a production focus. Therefore, SDWLs can be used by the industry as a tool to meet voluntary sustainability standards like the proposals in [11].

The Equations (2) to (11) generate the resulting vectors which determine the absence of SDW with a score of 1.5 in two linguistic variables (see Figure 4a,b): environmental conditions and ergonomic factors; although these results vary marginally, in general, the models solves adequately. Having the same value in these results was unexpected, given that these linguistic variables include evaluation parameters that are very different. This allows us to assume that the sensitivity of the method requires improvement. On the other hand, the result of some features of SDW in the organisation at work sector having an SDW score of 5 was expected because the salary range is suitable for a company located in Mexico despite the work conditions. However, the resulting vector determines that the production of car windshields with a score of 1.24 has a poor SDWL. In the current case study, the effects of the poor SDW were supported by the results of the out-of-pocket spending and catastrophic health expenses interviews applied to 330 workers (see Table 4). The economic impact on workers occurs because public health is deficient in rehabilitation after accidents or musculoskeletal disorders. Therefore, workers must go to private means to achieve adequate rehabilitation and return to work. Considering both the workers’ salary and the sample size of interviewed workers, we can infer that these workers suffer a lack of a long and healthy life and a bad standard of living without economic growth due to a poor SDW (the cause of work-related musculoskeletal disorders and work illnesses), increasing their out-of-pocket spending and catastrophic health expenses.

### Table 4. Cont.

<table>
<thead>
<tr>
<th>Workstation</th>
<th>Environmental Conditions</th>
<th>Ergonomics Factors</th>
<th>Organisation at Work</th>
<th>SDWL</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 Post Glass</td>
<td>5</td>
<td>1.06</td>
<td>8.5</td>
<td>1.54</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>29 Post Glass</td>
<td>8</td>
<td>2.35</td>
<td>1.5</td>
<td>8.82</td>
<td>Presence of SDW</td>
</tr>
<tr>
<td>30 Post Glass</td>
<td>7</td>
<td>8.47</td>
<td>3</td>
<td>1.74</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>31 Post Glass</td>
<td>3.5</td>
<td>1.07</td>
<td>1.5</td>
<td>5.84</td>
<td>Some features of SDW</td>
</tr>
<tr>
<td>32 Post Glass</td>
<td>2.3</td>
<td>8.23</td>
<td>5</td>
<td>1.65</td>
<td>Absence of SDW</td>
</tr>
<tr>
<td>33 Post Glass</td>
<td>1.5</td>
<td>3.85</td>
<td>2.32</td>
<td>1.81</td>
<td>Absence of SDW</td>
</tr>
</tbody>
</table>
Therefore, these findings contribute to defining the most suitable task conditions and their parameters using policies and laws relating to sustainability to explain correctly the presence or absence of sustainable decent work. As a practical implication, the SDWL is helpful for managers in real-life situations, particularly in the case of producing car windshields in the auto parts industry (as shown in the case study). For example, from the economic implications, it was possible to identify safety and health parameters and safety costs by focusing on the linguistic rules highlighted in the resultant vectors. For example, in the noise vector, ergonomic factors vector, and workday vector, the rules over the safety conditions were activated; this allows for identifying improvements for the prevention program. This promotes establishing better CSR policies for places with identical risk conditions, saving time and implementation costs.

Finally, it is crucial to note that the outcomes of the SDWL evaluation are not definitive. Thus, further tests by supplementing more linguistic variables will be necessary to define new fuzzy rules and membership functions to determine the mathematical sensibility and method behaviour. In future research, the case study results will be classified according to gender to define if there are differences in SDW regarding work conditions, ergonomic factors, and organisation at work between males and females who work in the auto parts industry. Moreover, a new study will be implemented in cardboard manufacturing to define the SDWL’s usability as a CSR tool to meet voluntary sustainability standards.

5. Conclusions

In conclusion, a fuzzy logic method built in MATLAB Fuzzy Logic Designer was proposed in this work. This interactive computer system considers the relationship between safety and health risk levels and workstation conditions to identify the level of sustainable decent work in the production of car windshields in the auto parts industry. The method included environmental conditions, ergonomic factors, and organisation at work as linguistic variables related to three membership functions: the absence of SDW, some features of SDW, and the presence of SDW. The resulting vector determined there to be an absence of SDWL in the production of car windshields with a score of 1.24. Our evaluation indicates that workers in the production of car windshields suffer a lack of a long and healthy life and a bad standard of living without economic growth. Therefore, the SDWL can help managers implement voluntary sustainability standards and improve CSR policies, as was established in SDG 8. However, the outcomes of the SDWL are not conclusive. Moreover, further tests could be limited if more linguistic variables are added due to that fact that exponentially increasing the rules can be challenging to program, affecting the mathematical sensibility and method behaviour.

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Informed Consent Statement: Not applicable.

Data Availability Statement: Appendix A include the dataset generated and analysed during the present research.

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Conflicts of Interest: The authors declare no conflicts of interest.
Appendix A. Fuzzy Rules

Figure A1. Fuzzy rules for the linguistic variable of environmental conditions.

Figure A2. Fuzzy rules for the linguistic variable of ergonomic factors.

Figure A3. Fuzzy rules for the linguistic variable of organisation at work.
Appendix B. Examples of Evaluations by Department

Figure A4. Individual evaluation for the laminating department: environmental conditions with a score of 1.5, ergonomic factors with a score of 1.5. The organisation at work has a score of 4. The final SDWL, with a score of 1.3, indicates the absence of sustainable decent work. The yellow vectors indicate the rules that have been activated for each linguistic set, while the blue vector represents the SDW level (the resulting evaluation). The red line on the vectors corresponds to the value inputted for each linguistic variable.

Figure A5. Individual evaluation for the quality control department: environmental conditions with a score of 5, ergonomic factors with a score of 2. The organisation at work has a score of 6. The final SDWL, with a score of 4.81, indicates some presence of sustainable decent work. The yellow vectors indicate the rules that have been activated for each linguistic set, while the blue vector represents the SDW level (the resulting evaluation). The red line on the vectors corresponds to the value inputted for each linguistic variable.
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