Articles

Industrial Safety and Occupational Health Strategies: The Case of a Water Treatment Plant in Ecuador

Estrategias de Seguridad Industrial y Salud Ocupacional: Caso Planta de Potabilización de Agua en Ecuador

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ABSTRACT

This research aims to establish strategies in Industrial Safety and Occupational Health (SISO) using the case study of a water treatment plant in Ecuador; preventive activities in this area are poorly developed, being relegated to the background for not being considered important for production processes, this reality is worrying because despite the efforts made to implement a series of public policies; the figures of accidents and incidents indicate that it is still required to improve the SISO systems, to ensure the life, health and integrity of workers. The methodology used is descriptive and correlational, applying the inductive, deductive and analytical method, in addition to the integration of elements and sub-elements of an Occupational Safety and Health Management System proposed by the Andean Instruction Regulations, Resolution 957: 2008, and the ISO 45001:2018 standard; the population of interest was considered to be the 59 people working at the Water Treatment Plant in Santa Elena-Ecuador, of which 24 were selected to collect data through a survey. As a result, the proposed strategies are on par with the ISO 45001:2018 standard, which includes all the necessary requirements that an organization must have to ensure the safe provision of its services,

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minimizing risks or accidents, and providing a safe working environment for people.

Keywords: industrial safety, occupational health, management system, strategies, risks, accidents, prevention.

RESUMEN

Esta investigación tiene como objetivo establecer estrategias en Seguridad Industrial y Salud Ocupacional (SISO) utilizando el caso de estudio de una planta potabilizadora de agua en Ecuador; las actividades preventivas en esta área son poco desarrolladas, siendo relegadas a un segundo plano por no ser consideradas de importancia para los procesos productivos, esta realidad es preocupante ya que pese a los esfuerzos que se realizan, por implementar una serie de políticas públicas; las cifras de accidentes e incidentes indican, que aún se requiere mejorar los sistemas SISO, tal que permitan asegurar la vida, salud e integridad de los trabajadores. La metodología empleada es de tipo descriptiva y correlacional, aplicando el método inductivo, deductivo y analítico, además de la integración de elementos y subelementos de un Sistema de Gestión de la Seguridad y Salud en el Trabajo que propone el Reglamento del Instructivo Andino, Resolución 957: 2008, y la norma ISO 45001:2018; se consideró como población de interés a las 59 personas que laboran en la Planta Potabilizadora de Agua en Santa Elena-Ecuador, de los que se seleccionó a 24 para levantar los datos a través de una encuesta. Como resultado, las estrategias que se proponen están a la par de la norma ISO 45001:2018 misma que recoge todos los requisitos necesarios con los que una organización debe contar para garantizar que se realice una prestación segura de sus servicios, minimizando los riesgos o accidentes, y proporcionando un entorno de trabajo seguro para las personas.

Palabras clave: seguridad industrial, salud ocupacional, sistema de gestión, estrategias, riesgos, accidentes, prevención.

INTRODUCTION

Occupational Safety and Health is defined by the International Labor Organization (ILO) as a discipline that focuses on the prevention of injuries and diseases related to the different work activities developed by human beings, as well as the protection and promotion of workers' health, which aims to improve working conditions and the integral well-being of workers (Quessed, 2018). Vásquez (2007) states that Occupational Safety and Health under a broad and integrating sense that encompasses traditional practices in relation to Industrial Safety, Industrial Hygiene, Ergonomics, Psychosociology and Occupational Medicine, has not had the expected acceptance in most organizations, due to the poor results demonstrated by such activity, which in turn has determined that in many organizations the preventive activity is relegated to the background by not considering it as part of productivity. The Actuarial Directorate of Research and Statistics of the Ecuadorian Institute of Social Security in its closing report presented by Hidalgo (2019), details the amounts of each of the benefits granted by the Labor Risks Insurance at the close of 2018, among them we have: Subsidies for Temporary Disability, where $4,012,151.45 was paid annually; likewise, the Compensation for Partial Permanent Disability which resulted in $4,896,197.95; on the other hand, the payment referring to Pensioners for Partial Permanent Disability was $16,542.662.38; in the same way, the Total Permanent Disability Pensioners received a payment of $9,080,519.47; likewise, the Absolute Permanent Disability Pensioners received a payment of $908,379.06; in the same line, the Orphan Pensioners received $7,541,721.83 and finally, the Widow Pensioners received a payment of $17,520,399.38.

According to the General Insurance of Labor Risks of Ecuador (SGRT) from 2013 to 2022 regarding work accidents in Ecuador, 98,210 cases have been reported in the usual center or place of work, 35,884 going to and returning from work, 13,157 due to commuting, 11,708 in another center or place of work and 3,148 on secondment. In the province of St. Helena from 2013 to 2022 with respect to occupational accidents, 888 cases have been reported in the usual center or place of work, 265 going to and returning from work, 141 by commuting during the workday, 188 in another center or place of work and 37 on secondment (SGRT, 2022). Occupational accidents are part of a reality of worldwide concern and despite the efforts made to implement a series of public policies, the statistics presented and the amounts paid by IESS regarding the benefits provided by the Occupational Risk Insurance indicate that it is still necessary to improve the systems to ensure the life, health and integrity of workers. According to the International Labor Organization, every day people die due to accidents or illnesses related to their work activities, approximately 2.78 million deaths per year as described

by Dumont (2020). According to Toro (2020) Ecuador has a regulatory framework for Occupational Safety and Health made up of the Constitution, international and regional instruments (International Covenant on Economic, Social and Cultural Rights, Andean Instrument on Occupational Safety and Health, Resolution 584 of the Andean Community of Nations and the Regulations to the Andean Occupational Safety and Health Instrument, Resolution 957), agreements entered into with the International Labor Organization, the Labor Code, Executive Decree (2393) and Legislative Decree (assembly), ministerial agreements, the Mining Law, and various regulations, the latter of which are currently under review.

Taking into account Cordero (2003) where he refers to Executive Decree 2393 of the Regulation of Safety and Hygiene and Improvement of the Working Environment, based on Art. 14.- Of the Committees of Safety and Hygiene at Work, paragraph 1. (Reformed by Art. 5 of D.E. 4217, R.O. 997, 10-VIII-88) In every work center where more than fifteen workers work, a Committee of Safety and Hygiene at Work must be organized. 997, 10-VIII-88) In every work center where more than fifteen workers are employed, a Work Safety and Hygiene Committee shall be organized, composed on a parity basis by three representatives of the workers and three representatives of the employers, who shall appoint a president and secretary from among its members, who shall serve for one year and may be reelected indefinitely. If the president represents the employer, the secretary will represent the workers and vice versa. Each representative will have a substitute elected in the same way as the incumbent and who will be the principal representative in case of absence or impediment of the incumbent. On the other hand, Executive Decree 2393 of the Regulation of Safety and Hygiene and Improvement of the Work Environment, in Art. 15.- Of the Work Safety and Hygiene Unit, details in point 1 that the companies or Work Centers qualified as high risk by the Interinstitutional Committee, which have a number of less than one hundred workers, but more than fifty, must have a technician in safety and hygiene at work. According to the degree of danger of the company, the Committee may require the creation of a Health and Safety Department. Likewise, permanent companies with more than one hundred permanent workers must have a Safety and Hygiene Unit, directed by a technician in the matter who will report to the highest authority of the company or entity. The Ministry of Labor through the Unified Labor System (SUT) in the health and hygiene module allows employers within public and private companies to register the indicators related to occupational health management, in order to prevent the occurrence of occupational diseases. Likewise, the portal has socialized the checklists of the legal technical requirements in occupational health and safety, which companies with 1 to 10 workers and companies with more than 10 workers must comply with on a mandatory basis. (Ministry of Labor, 2020). With the publication of the Regulation of the Andean Instructions for Safety and Health at Work (RIASST) Resolution 957 RIASST (2008)

states that it is binding for the countries of the Andean Subregion i.e. for: Colombia, Ecuador, Peru and Bolivia; consider Art. 1 where it recommends the application of a Management System containing Elements and Subelements, with the purpose of prioritizing the safety and health of employees.

Currently the water purification plant in Ecuador, has some guidelines of an OSHMS based on the standards of OHSAS 18001:2007, however, the International Organization for Standardization (ISO) has replaced it with ISO 45001:2018, considering that it is the first standard that provides a comprehensive framework in the Occupational Health and Safety Management Systems. (Hurtado & Ramos, 2018)The company must propose strategies based on the comprehensive standard, considering that, unlike OHSAS 18001:2007, ISO 45001:2018 has the worker as its central axis and seeks uniformity of criteria. The company under study has lacked defined policies in the field of industrial safety, as it needs regulations that allow planning, organization, management, control and monitoring in the field of occupational risk prevention; the company has faced a significant number of problems that have been reflected in incidents, accidents and the work performance of its workers. The Health and Safety strategies proposed are based on an integrated management system that links the aspects of Art. 1 of the Andean Instrument Regulation R.957 with the ISO 45001:2018 standard, which includes all the necessary requirements that an organization must have to ensure that it provides its services safely, minimizing risks or accidents, and providing a safe working environment for its workers. In this work, three specific objectives are proposed to be developed; the first one evaluates the compliance of the Industrial Safety and Occupational Health processes in accordance with the guidelines of the Single Work System (SUT); the second one analyzes the different methodologies that are implemented within an Occupational Safety and Health Management System (OSH) and finally, strategies are defined based on current regulations in the field of Industrial Safety and Occupational Health that allow improving the management system of the water purification plant in Ecuador.

To Arias (2015) Industrial safety studies accidents and occupational hazards with a preventive and investigative approach, while occupational health studies occupational diseases based on early diagnosis and relevant treatment. Likewise, occupational health encompasses industrial hygiene, occupational medicine and occupational mental health, while industrial safety encompasses ergonomics and environmental analysis. The World Health Organization (WHO) states that health is a state of perfect physical, mental and social well-being and not merely the absence of disease (World Health Organization [WHO], 1948). In Decision 584 Substitution of Decision 547, of the Andean Instrument on Safety and Health at Work, working conditions are addressed as a generator of occupational health situations, or risks for workers, as pointed out by Parra (2019)where the importance of continuous evaluation and the application of occupational safety

standards prevails. Employers are responsible for providing their workers with adequate environments, preventing risks and adopting preventive measures to avoid work overloads, exposure to hazardous biological, physical and chemical agents.

According to Collado (2008) the term Risk, always determines the existence of a future and hypothetical damage, whose production is not completely determined by the causal events or conditions that we are able to identify and characterize. Thus, when the way of performing a job implies the possibility of suffering damage to health, we will speak of occupational risk. Normally, occupational hazards are the consequence of inadequate working conditions; these hazards can be: biological, chemical, physical, mechanical, psychosocial and ergonomic. As pointed out by Delgado (2016) occupational risks can have several causes, such as: risks derived from the safety conditions of the workplace structure or the production process, machinery and equipment; risks originated by physical agents; risks originated by chemical contaminants; risks originated by biological agents; risks derived from the organization and adaptation to the workplace; psychological risks and risks derived from the human factor.

Estela & Tamayo (2021) argue from the conceptual, legal or technical point of view, the accident is a phenomenon that has a negative impact on the health and physical integrity of the worker, but additionally generates a number of negative effects on materials, inputs, equipment, machinery, environment and finances; manifesting itself in direct and indirect costs, which impact employers, employees, actors of the General System of Labor Risks (SGRL). They cause deaths, disabilities, economic losses, loss of quality of life, time, pain to workers and families, generating great costs for the General Social Security Health System (SGSSS) and in particular to the SGRL. Additionally, they affect organizational efficiency and development and translate into economic damage to society. In short, occupational accidents leave their mark on the company, the worker, the family and society. According to González et al. (2016) occupational accidents are those that can be generated by immediate or basic causes: the immediate ones are those that produce the accident directly and are formed by unsafe acts (inadequate behaviors of workers that can cause an occupational incident) and unsafe conditions (facilities, equipment, machinery and tools that are in poor condition and put workers at risk of suffering an accident). But to achieve an effective solution to occupational accidents, it is essential to recognize and control the basic causes, which give rise to the immediate causes composed of personal factors (incorrect work habits, incorrect use of equipment, tools and facilities; physical or mental defects, hearing deficiencies, etc.) and work factors (poor supervision and leadership; inadequate policies, procedures, guidelines or practices; inadequate planning and/or scheduling of work.

The Ibero-American Organization of Social Security indicates that Occupational Risk Prevention studies, through methods of an interdisciplinary nature, the set of measures necessary to avoid or reduce the risks derived from work, which cause at the level of

workers, accidents and occupational diseases (Organización Iberoamericana de Seguridad Social [OISS], 2018).. Risk prevention is a discipline aimed at improving the safety and health of workers at work, developing the necessary measures to prevent risks arising from working conditions, using risk assessment as a tool. Romeral (2012) deduces that in compliance with this general duty of protection, the employer must adopt as many measures as necessary to make effective the rights of workers with respect to risk assessment, information, consultation and participation, training of workers, actions in cases of emergency and serious and imminent risks, health surveillance and constitution of prevention services; all this taking into account that the cost of such health and safety measures should not fall on the workers themselves.

In the context of the Ecuadorian Institute of Social Security (IESS), it defines occupational diseases as chronic conditions, directly caused by the exercise of the profession or occupation performed by the worker and as a result of exposure to risk factors, which may or may not produce incapacity for work. Professional or occupational diseases will be considered those published in the list of the International Labor Organization (ILO), as well as those determined by the Resolution of the Committee for the Valuation of Disabilities and Employer's Liability (CVIRP), for which the cause-effect relationship between the work performed and the resulting chronic disease in the insured party must be proven, based on the technical report of the SGRT (Ecuadorian Social Security Institute). (Instituto Ecuatoriano de Seguridad Social [IESS], 2016).. The Chilean Institute of Labor Safety (2014) sustains that an occupational disease is one that is caused, in a direct manner, by the exercise of the work performed by a person and that produces incapacity or death. To be considered as an occupational disease, there must be a causal relationship between the work and the pathology that causes disability or death.

In the opinion of Arellano et al. (2020) the Occupational Health and Safety Management System was developed with the objective of identifying, evaluating, controlling and establishing strategies to reduce the risks and hazards to which the employee is exposed within an organization. This system is indisputably linked to quality management, and to achieve its objectives, it is first necessary to control the potential risks and hazards in the company's processes that may result in minor or major damage. This will reduce the impact of accidents and absenteeism and improve the productive performance and quality of life of your employees. The international standard ISO 45001 states that the purpose of an Occupational Health and Safety Management System provides a framework for managing opportunities and risks. The objective and expected results are to prevent work-related illnesses and injuries of employees and to provide safe and healthy workplaces; as a result, it is crucial for the organization to eliminate hazards and reduce risks by implementing preventive measures and effective protection. (International Organization for Standardization [ISO], 2018)..

As posed by Porter (2017) strategy is about creating a link between a company's activities; the success of a strategy depends on doing many things well, not just a few, and integrating them together. If there is no such thing, there is no distinctive strategy and not much sustainability, which makes decisions about what not to do as important as decisions about what to do. Threats to strategies are generally considered to come from outside the company due to changes in technology or competitor behavior. Zimmermann (2020) states that in Spain the Occupational Health and Safety Strategy establishes two general objectives. The first general objective focuses on promoting better implementation of occupational safety and health legislation and its consolidation in the Autonomous Communities, especially in small and medium-sized companies. For its part, the second objective enunciates the favoring of the continuous improvement of working conditions with respect to all workers equally, with special attention to the prevention of occupational diseases and work-related illnesses. Reyes et al. (2017) sustain the importance of a thorough literature review accomplishment in order to compile updated maintenance strategies and activities, principles and clear practices under the relationship approach between Lean Manufacturing strategies as continuous improvement and safety management systems, where it is considered that these should work in harmony. Both approaches should have the common goal of reducing accidents and minimizing hazards. Arias (2017) states that Ecuador's current legal regulations establish the mandatory implementation of the Occupational Safety and Health management system in all public and private institutions in the country, regardless of whether it is a manufacturing or service company. In this regard, the Ecuadorian Social Security Institute (IESS) has adopted the "Ecuador Model" methodology for the system, establishing four management pillars: administrative, technical, human talent and basic operating procedures.

According to Espinosa & Salinas (2013) the correct definition and implementation of strategies in a successful way is vital for any organization, but transforming strategies into action is a complex and difficult task. For its eligibility it is necessary to establish general criteria that allow choosing the most suitable strategies. In this sense, there are five necessary criteria that will serve as references for the final definition of strategies as shown in Table 1.

Table 1. *Eligibility Criteria for Strategy Selection*

Criteria	Description
Diagnosis of the situation	A diagnosis of the current situation of the organization in terms of Occupational Health and Safety will be made by means of an information base.
Address	The strategies are focused on occupational risk prevention.

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Projection	Refers to the time of applicability of strategies, these can be short, medium and long term.
Alignment	It is important that these strategies are linked to the objectives, vision and mission of the institution.
Definition	To define strategies, it is important to consider always starting with an analysis of the eligibility criteria 1 to 4, before taking into account the context in terms of objectives for a final decision.

Source: own elaboration

The process to define the strategies is done through a matrix integrated by the elements or aspect of the Andean Regulation R.957 with the ISO 45001:2018 standard, these will be defined based on the evaluation obtained from the processes executed in the Occupational Safety and Health with the case study.

MATERIALS AND METHODS

This research is developed in the water treatment plant in the province of Santa Elena in Ecuador, in order to establish strategies in the Industrial Safety and Occupational Health. It is considered necessary to take into account the methodologies that are implemented within an OSH Management System to strengthen risk prevention and improve compliance with the different processes associated with Industrial Safety and Occupational Health. For the development of the research, the descriptive study is used considering that the theoretical disaggregation of the variables and bibliographic reviews of key concepts are used. Analytical research is used on the legal regulations in force in Ecuador, whose procedure allows analyzing and comparing the variables of study, in addition to identifying strategies in the field of Industrial Safety and Occupational Health; therefore, an analysis of the results obtained in the information gathering is carried out, in order to define strategies to improve the management system of the water treatment plant in Santa Elena. On the other hand, correlational research is used, which has the purpose of examining the link between the different methodologies implemented in an Industrial Safety and Occupational Health Management System. (Teodoro, 2018). The scientific method used is qualitative research that allows identifying non-numerical data in the Industrial Safety and Occupational Health strategies, based on the aspects that integrate a Management System, through a literature review. Likewise, quantitative research focused on the collection and analysis of data regarding the compliance of processes is used, in addition to performing an analysis in descriptive statistics of the variation of accidents considering the last 8 years, from January 2015 to December 2022, through databases obtained from the Ecuador water treatment plant. The inductive reasoning used allows knowing general principles about the object of study, designing strategic actions according to the OSH environment through direct observation and interviews with those involved. In addition, applying the analytical method allows analyzing data obtained in the research, starting from an exhaustive

analysis of the study variables through the measurement of indicators obtained from the processes developed by Occupational Safety and Health in the water treatment plant in Ecuador. (Palmett, 2020). The population used are the workers of a water treatment plant in Ecuador, which is made up of 59 people. The type of sampling used is by convenience (Otzen & Manterola, 2017)The type of sampling used is by convenience (Otzen & Manterola, 2017), surveying 24 people to collect data and learn in depth about the object of study. In addition, semi-structured interviews are used, resorting as prior preparation to the construction of an interview script, which is directed to three experts, the first in Integrated Management Systems, the second to an expert in Industrial Safety and the third is an expert in Occupational Health.

According to Osorio & Añez (2016) primary information sources are based on original data, collected and analyzed by the author; whereas, secondary information sources refer to information resulting from the review, analysis and synthesis of documents such as books, articles, business statistics, research reports, etc. Based on the above, in the development of this research the primary sources are obtained through surveys, interviews and observation applied to workers, experts in Occupational Safety and Health and the conditions in which the activities are developed in the water plant. On the other hand, with the secondary sources, the theoretical and reference argumentation related to the topic of study and the designed proposal is achieved, for this purpose, the physical documentary review and electronic sources are used, which will allow access to statistical reports, reports, books, scientific articles, theses and documents related to the research topic.

Within this framework, data collection techniques and instruments are implemented as a tool to obtain useful information and thus identify critical indicators related to the case study, as shown in Table 2.

Table 2. *Data collection techniques and instruments*

Surveys and questionnaire	Expert interviews and script	Observation
The surveys are conducted in person, they are directed to the workers of the water treatment plant in Ecuador, in order to evaluate the Occupational Safety and Health of the company; therefore, a questionnaire of 12 questions of policies and procedures, 15 questions of working conditions (classified in safety, hygienic, ergonomic, psychosocial conditions) and 3 questions regarding health, this	This technique is used to know the current situation of the company under study in relation to Occupational Safety and Health. This is developed through a semi-structured interview script that includes 7 questions directed to an Integrated Management Systems expert, an Industrial Safety expert and an	By means of this research technique, a natural observation is achieved in relation to the object of study in order to describe and analyze situations about the reality of workers in relation to Occupational Health and Safety in the water purification company in Ecuador (García et al.,

under Likert scale, in order to validate the proposal is made. (Bernal, 2016).	Occupational Health expert. (Troncoso & Amaya, 2017).. 2010). (García et al., 2010).

Source: Own elaboration

Surveys and questionnaires base their information on the validity of the verbal information of different perceptions, feelings, attitudes or behaviors transmitted by the respondent; information that turns out to be difficult to translate into a measurement, which is why it is considered important to use evaluation scales for better quantification. According to García et al. (2009) questionnaires are designed to measure parameters, which must meet the following characteristics: be simple, feasible, reliable, accurate, appropriate to the problem and capable of measuring changes. To assess the validity of the content, judgments from different sources (literature review, expert opinion, pilot study) should be considered. This procedure should ensure empirically that the content of the instrument is adequate. There are also other ways of assessing content validity, such as factor analysis, which explores the responses to the questions in the questionnaire and attempts to group them according to underlying factors that identify possible dimensions. In the validation of the survey and questionnaire of this research, important aspects were considered such as the development of a pilot survey answered by two workers of the water purification company in Ecuador, being this information reviewed and analyzed under the criteria of two specialists in Industrial Safety and Occupational Health, where the approval was ratified regarding the clarity of the questions according to each dimension identified, this in order to present a definitive and solid questionnaire.

Based on the criteria of Padilla et al. (2019) the expert judgment evaluation strategy allows gathering evidence of content validity since the judges' evaluations help to review the relevance and representativeness of the items, as well as their relationship with the purposes of the instrument and with the domain of interest. In other words, this technique provides a basis for decision-making to improve the design of research instruments. For Díaz et al. (2013) the semi-structured interview presents greater flexibility than a structured one, due to the fact that they start from planned questions, which can be adjusted to the interviewees. Its advantage is the possibility of adapting to the subjects with enormous possibilities to motivate the interlocutor, clarify terms, identify ambiguities and reduce formalisms. The script and expert interview implemented in this research is validated according to the objectives set out, in addition to being reviewed by an expert in Integrated Management Systems with high knowledge in Occupational Safety and Health, where he supports the consolidation of the script as they are open questions addressed to people with capacity and ease of response. It is important to consider that the interview, being semi-structured, offers the researcher a considerable margin of maneuver to probe the respondents, in addition to maintaining

the guidelines of the script between researchers and interviewees, resulting to be more consistent.

Cronbach's Alpha coefficient is a method that allows obtaining the reliability and trustworthiness of a set of data so that the theoretical construct is as relevant as possible. The result of applying this indicator admits values between zero and one; for values close to one, the greater the internal consistency of the group of variables and dimensions; and for a lower consistency, for values close to zero. The minimum acceptable value for Cronbach's alpha coefficient is 0.70; below this value the internal consistency of the scale used is low. On the other hand, the maximum expected value is 0.90 (Celina & Campo, 2005). According to the results obtained, Cronbach's Alpha value was 0.903, a result that indicates that the reliability of each of the questions in the instrument is "Excellent", so that statistically the results and interpretations derived from it will be consistent, providing significant information from the disaggregation of the dimensions of the variables under study.

RESULTS

The evaluation of compliance and opportunities for improvement of the Industrial Safety and Occupational Health processes in accordance with the SUT guidelines at the Ecuador water treatment plant are shown in Table 3.

Table 3. *Evaluation of Industrial Safety and Occupational Health compliance of the Ecuador water treatment plant.*

Percentage of compliance		
Dimensions	Complies	Not Compliant
Human talent management	15,00%	5,00%
Documentary management	9,00%	6,00%
Occupational risk prevention management	8,75%	11,25%
Natural hazards and anthropogenic risk management	9,38%	5,63%
Occupational health management	7,14%	12,86%
Permanent Service	1,43%	8,57%
total	50,70%	49,30%

Source: Own elaboration with data from the Ecuador water treatment plant.

The analysis of compliance shows that the company is not complying with 49.30% of the dimensions evaluated by the Ministry of Labor under its SUT platform; therefore, there are opportunities for improvement in order to strengthen the processes to be

implemented in Occupational Safety and Health. Human talent management: Industrial Safety and Occupational Health has a third level technician and an occupational physician, in addition to maintaining the processes in conjunction with the Occupational Health area.

Documentary management: Industrial Safety and Occupational Health shall keep under control the documents that are registered in the SUT.

Occupational risk prevention management: Methods for risk factor evaluation and control must be defined, considering that there is no evidence of risk factor measurements or procedures, in addition to reviewing the personal protective equipment delivery matrix and defining the follow-up method, the perception of personnel for use, storage, final disposal, and keeping monthly records of delivery. A plan should be presented for training, considering that there is no evidence of follow-up to confirm the percentage of compliance. Regarding signage, a survey of all required signage should be carried out and a report and its requirements should be prepared. In high-risk work, procedures must be developed and made known to all workers, and training records must be kept at least once a year.

Management of natural hazards and anthropic risks: An annual plan of drills and emergency exits that are free of obstacles must be defined and emergency equipment such as good quality smoke detectors and lighting devices must be installed. Occupational health management: There are two experienced physicians, and records must be kept of their occupational health training. It is also suggested that the nursing staff work full time, covering all the company's shifts. The social worker who provides services will work in coordination with the medical team to carry out the company's comprehensive health program. In this health area there is no evidence of planning of promotional programs registered in the SUT.

Permanent Service: The institution must provide first aid kits with necessary emergency implements, in addition to maintaining the areas in adequate conditions for their use.

Table 4. *Record of occupational accidents in the 2015-2022 period.*

Year	Number of occupational accidents	Cargo
2015	1	Supervisor
2016	1	Auxiliary
2017	4	Auxiliary and operators
2018	4	Technicians
2019	1	Auxiliary
2021	12	Assistant, operator, and technical assistant

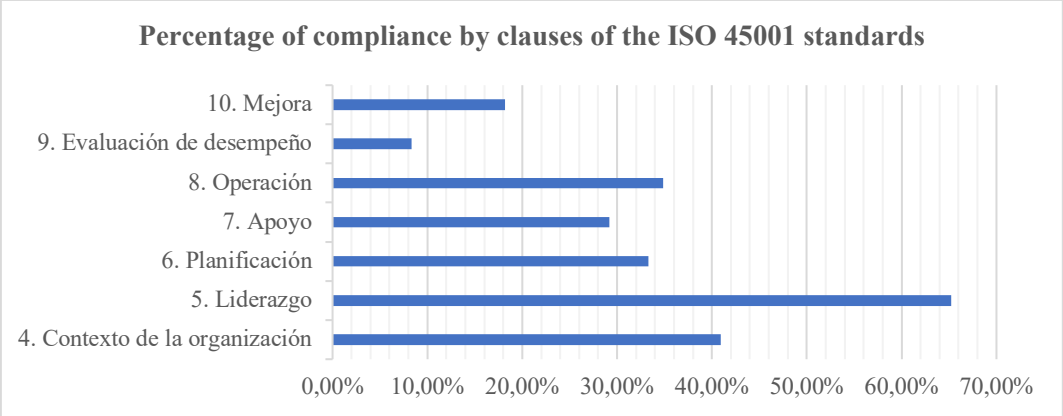
2022	2	Operator and Assistant

Source: Own elaboration with data from the Ecuador water treatment plant.

As shown in Table 4, in the year 2021 the occupational accident rate at the Ecuador water treatment plant increased considerably; it should be taken into account that in this year the covid-19 viral disease was already present worldwide; however, there are more risk factors that influence accidents (physical, mechanical, chemical, biological, psychosocial, ergonomic, environmental). On the other hand, it is analyzed that from 2015 to 2022 the operators and auxiliaries are the ones who stand out most in accidents. The risk matrix that rests in the Industrial Safety area and that is included in the SUT platform shows that operators are exposed to mechanical, physical and chemical risks, while auxiliaries are exposed to mechanical risks, both with a high probability of occurrence.

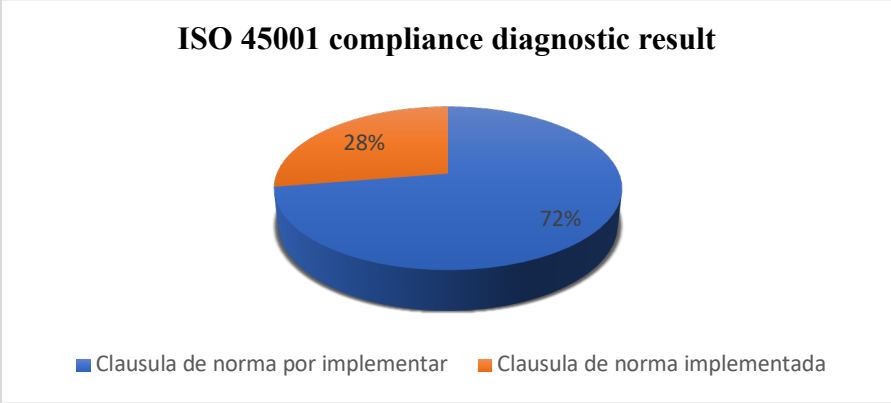
The Ecuador water treatment plant has been working under the guidelines of OHSAS 18001; however, part of this standard has not been complied with, as shown in Table 3, where the company's evaluation of the parameters to be met by the SUT was carried out. It is important to note that the water treatment plant carried out a consulting process regarding an initial diagnosis for the migration of ISO 45001 standards, with the following results.

Figure 1. Percentage of compliance with ISO 45001 standards.



Source: Own elaboration with data from the Ecuador water treatment plant.

Figure 2. Diagnostic results of ISO 45001 standards



Source: Own elaboration with data from the Ecuador water treatment plant.

According to the results of compliance, 28% of ISO 45001 has been implemented in the institution, while 72% of the standard remains to be developed. It should be noted that the migration process from OHSAS 18001 to ISO 45001 has been left deserted in the Ecuador water purification company due to recurring administrative changes in the institution and the level of commitment of the members of the Occupational Health and Safety area.

Based on the results obtained in the surveys of 24 employees at the water treatment plant in Ecuador, total percentage and partial results were determined for the 3 dimensions with their indicators on a Likert scale (1 SD: totally disagree, 2 SD: disagree, 3 N: neutral, 4 DA: agree and 5 TDA: totally agree).

Table 5. *Percentages achieved in Dimension 1*

Dimension 1	Indicators	%TED	% ED	% N	% DA	TDA
Workplace policies and procedures	Importance of OSH	8,3%	4,2%	12,5%	37,5%	37,5%
	Training	4,2%	8,3%	20,8%	58,3%	8,3%
	Emergency Plan	16,7%	4,2%	20,8%	37,50%	20,8%
	OSH Committee	8,3%	4,2%	8,3%	45,8%	33,3%
	OSH Procedures	-	-	33,3%	54,2%	12,5%
	Personal Protective Equipment	-	16,7%	20,8%	33,3%	29,2%
	Work Permit and Technical Accompaniment	20,8%	12,5%	16,7%	37,5%	12,5%
	Obligations regarding the use of PPE	16,7%	-	29,1%	25%	29,2%

	Inductions for Admittance	4,2%	12,5%	20,8%	25%	37,5%
	Medical Entrance Examinations	20,8%	-	12,5%	41,7%	25%
	Internal Regulations	20,8%	8,3%	41,7%	16,7%	12,5%
	Competency Certificates	12,5%	16,7%	4,2%	37,5%	29,2%
Average Total		11,1%	7,3%	20,1%	37,5%	24%

Source: Own elaboration with data from the Ecuador water treatment plant.

In reference to dimension 1, policies and procedures in the workplace maintain a moderately positive trend between "Agree" and "Strongly Agree" totaling 61.5%, although this value does not guarantee total satisfaction, the socialization of the emergency plan, internal OSH regulations, work permits with technical accompaniment of OSH personnel and strict supervision regarding the use of PPE should continue to be strengthened.

Table 6. *Percentages achieved in Dimension 2*

Dimension 2	Indicators	%TED	% ED	%N	DA	%TDA
Working conditions	Safety Conditions	24,0%	15,6%	11,5%	28,1%	20,8%
	Hygienic Conditions	13,3%	17,5%	17,5%	21,7%	30%
	Ergonomic Conditions	10,4%	22,9%	25%	16,7%	25%
	Psychosocial Conditions	20,8%	25%	25%	14,6%	14,6%
Average Total		17,1%	20,3%	19,7%	20,3%	22,6%

Source: Own elaboration with data from the Ecuador water treatment plant.

In relation to dimension 2 of Working Conditions, 22.6% of workers indicated that they "Strongly Disagree" that the conditions under which they perform their activities are not correct, on the other hand, all the total percentage averages maintain a low trend, where it is urgent to implement corrective measures to improve the Safety Conditions (working on unstable floors or confined spaces, Hygienic (exposure to chemical products, noise, solar radiation, dust, gases, viruses, bacteria and fungi), Ergonomic (the worker's posture time when performing an activity) and Psychosocial (excessive workload, mental effort, unfair salary, ignoring the worker's opinions or ideas).

Table 7. *Percentages achieved in Dimension 3*

Dimension 3	Indicators	%TED	% ED	%N	% DA	%TDA
Health	Occupational Accidents	37,5%	12,5%	12,5%	12,5%	25%
	IESS Validation	16,7%	16,7%	20,8%	8,3%	37,5%
	Occupational Diseases	29,2%	20,8%	25%	-	25%
Average Total		27,8%	16,7%	19,4%	6,9%	29,2%

Source: Own elaboration with data from the Ecuador water treatment plant.

Dimension 3 reflected in Table 7 corresponds to Health, which maintains total average percentage values of 6.9% and 29.2% for a total of 36.1% in "Agree" and "Strongly agree" with the frequency of accidents and occupational diseases presented in the workers of the Ecuador water treatment plant during the performance of their duties, In addition to not registering work-related accident reports with the IESS, strengthening these indicators will allow the company to reduce the accident rate shown in Table 4.
The proposed strategies are based on the guidelines of a management system in accordance with the Andean Regulation on Occupational Safety and Health and the ISO 45001:2018 standard, prior to which the key points of action are detailed.

Table 8. *Occupational Safety and Health Strategy Matrix*

Management	Strategies	Realization time
Administrative Management	Respect and comply with Health and Safety legislation.	Short Term
	Establish strategic planning appropriate to the changing administrative context in the public organization.	Long Term
	Establish assertive Occupational Health and Safety policies and communication channels.	Medium Term
Technical Management/Planning	Reduce lost time accidents and illnesses.	Medium Term
Human Talent Management	Training and information for workers.	Medium Term
Management of Basic Operational Processes	Identify hazards and assess risks in the workplace and implement effective preventive controls.	Short Term
Internal Audit Management	ISO 45001 Internal Audit Process.	Long Term
Improvement Management	Focus on continuous improvement.	Long Term

Source: Own elaboration
Key Performance Points

Strategy 1: Respect and comply with the Occupational Health and Safety legislation.
The Industrial Safety and Occupational Health Units must maintain a structure that complies with current regulations. In this case, there is no permanent specialty doctor or nurse at the Ecuador water treatment plant; however, the space does exist, and the company's existing doctors are located in the main office.
The number of positions and functions should be based on the number of workers, as indicated in Executive Decree 2393. This decree also states that these units must report directly to management due to the inherent inherent responsibility that this entails, without the need to be under another area that does not have competence.
Strategy 2: Establish strategic planning appropriate to the changing administrative context in the public organization.
Administrative changes have generated a drastic social impact, affecting organizations, especially in public institutions as in the present case. It is necessary to apply methodologies that imply changes in terms of time and quantity in order to avoid discomfort in the personnel that is stable or with appointment, with this it is intended that the productivity does not decrease drastically but partially until the new positions or political positions are adapted.
Strategy 3: Establish assertive Occupational Health and Safety policies and communication channels.
Industrial Safety and Occupational Health work together, so it is necessary to create an application or computer system to keep the guidelines and documentation under strict control in order to facilitate the requirements requested by the Ministry of Labor.
The Ecuador water treatment plant has areas that are highly exposed to insecurities, risks or dangers, which is why the company has security and surveillance cameras managed by a department that is not its responsibility. The management of generating a complete monitoring room should be handled by the Industrial Safety area in order to provide rigorous control in the institution.
Strategy 4: Reduce lost-time injuries and illnesses
To strengthen strategy 4, it is necessary to establish protocols for reporting suspected occupational diseases and work-related injuries. It is also important to prioritize the investigation of occupational accidents through procedures or methods to determine their causes, in order to take control measures as a means of prevention.
In order to prevent accidents and occupational diseases, priority must be given to the evaluation and control of risk factors, and control measures must be followed, in addition to implementing work permits prior to an inspection by Occupational Health and Safety technicians.

The Occupational Health area must reinforce the protection of workers in situations of greater risk or vulnerability, in order to present the respective reports to management and to be taken into account in decision making if required.

To improve accident prevention, intensive and prolonged actions are required to raise awareness of occupational hazards, including traffic accidents, focusing on their main causes and preventive measures.

Strategy 5: Employee training and information

Strategy 5 will focus on implementing an annual training plan certified by competencies for workers, including senior management (managers, directors, chiefs or coordinators, and supervisors), as well as the socialization of emergency plans (drills and training), internal regulations, and the strengthening of emergency preparedness and response.

The Joint Organizations must have an annual plan as management of the committee and hold monthly sessions where several aspects are analyzed, among them the monthly accident or incident rate, in case of existing, correction criteria must be issued.

Strategy 6: Identify hazards and assess risks in the workplace and implement effective preventive controls.

The safety conditions under which the worker is exposed must be evaluated by the Industrial Safety and Occupational Health technicians, where the hazards will be identified and if unsafe conditions exist, a technical report must be issued prior to the work permit as support for corrective measures.

Hygienic conditions will continue with the monitoring of preventive measures against covid-19, and should also focus on a previous evaluation or measurement with the purpose of making operational changes such as: new equipment, improvement of facilities, implementation of protective equipment, among others.

For Ergonomic conditions, an activity evaluation methodology should be implemented and, based on the results, an action plan should be developed to reduce musculoskeletal disorders in the workplace. In addition to physical factors, psychosocial and organizational factors should be taken into account in order to develop preventive, rehabilitation and return-to-work strategies.

In the Psychosocial conditions, an evaluation method must be defined that is developed by collecting information on each worker in order to anticipate preventive interventions in case of situations that deviate from the Occupational Health and Safety standards. Special attention will be paid to measurements or indicators related to work stress (excessive workload, mental effort, among others).

Strategy 7: ISO 45001 Internal Audit Process

An internal audit should be implemented at least once a year in order to ensure that the management system used in the company is improved, evaluating and optimizing the Occupational Health and Safety programs, being essential to identify weaknesses in the human resources departments. The reports will reveal the needs of the company to

generate further corrective actions that can be implemented in the short or long term. Priorities should be set based on results. Problems that represent a greater risk to the integrity of workers should be prioritized to be addressed by the employer triggering changes in OSH that can prevent injury, illness and in extreme cases, death.

The internal audit must analyze the performance evaluations in the company, and look for a methodology that allows knowing their validation, since many times these evaluations are rejected by the workers, considering that the evaluator is usually the immediate bosses and is biased by the state of mind in which he/she is or by the degree of friendship with the evaluated person.

Strategy 8: Focus on continuous improvement.

In this strategy, the company's managers, through their leadership, should be concerned about the safety and health of workers, holding regular meetings to know the status of the areas, considering that this is the core of the group's progress in strengthening risk prevention. In addition to proposing a system of continuous improvement, monitoring mechanisms should be implemented to verify compliance with the objectives proposed by the institution. According to Díaz et al. (2017) the Industrial Safety and Occupational Health influences the work performance of workers, also emphasizes that state institutions do not have a clear knowledge of the importance that OSH means. This criterion will depend on many factors, it is true that public institutions should strengthen risk prevention, however, dissatisfaction appears due to sudden changes in public positions, considering that we all have different criteria to develop the work entrusted. Not all companies give it the importance, however, there are others that do, and this is based on the guidelines and regulations since each institution needs a technician in Industrial Safety, Doctors with experience in Occupational Health and if necessary, psychologists and social worker, depending on the number of workers. For Delgado et al. (2020) international instruments are not enough in the regulations of Occupational Safety and Health, so he warns the public authority and professional entities to detect gaps in the regulations and therefore give continuous improvement to the legal regulations; through research we agree with the author because there is much legal basis that tends to confusion, which is why in this case we apply strategies with a focus on a management system that allows to have a greater order in terms of the objectives that every company seeks to reach a goal of zero occupational accidents.

CONCLUSIONS

The evaluation of compliance and opportunity for improvement of the Industrial Safety and Occupational Health processes in accordance with the guidelines of the SUT in the Ecuador water treatment plant showed that 49.3% does not meet the requirements in relation to the dimensions evaluated by the ministry, therefore, there are opportunities for improvement in order to strengthen the processes to be implemented in the OSH.

When performing the analysis of occupational accidents in the Ecuador water treatment plant, it is analyzed that from 2015 to 2022 the operators and assistants are the ones who stand out the most in accidents due to the different functions and field work they perform; however, the causes are unknown because it is confidential information of the company under study.

The management system currently implemented at the Ecuador water treatment plant is linked to the OHSAS 18001 standard; however, the results obtained by the consulting firm in relation to the migration from OHSAS 18001 to ISO 45001 indicate that 28% of ISO 45001 has been implemented at the institution, while 72% of the standard remains to be developed.

Experts in the field of Industrial Safety and Occupational Health mentioned that the strategies linked to the regulations help to strengthen the prevention of occupational risks, as long as the procedures are complied with. The work must be carried out as a team between the employee and the employer. In these aspects, 8 strategies are presented that go according to the guidelines of a management system of the Regulations of the Andean Instructions for Occupational Safety and Health and the ISO 45001:2018 standard, prior to this, the key points of action are detailed.

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