

Implementation OHSMS- ISO 45001:2018 to reduce Accidents in an MSE of the Construction Sector, Trujillo 2023

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ABSTRACT

The main objective of the research was to determine to what extent the implementation OHSMS-ISO 45001: 2018 reduces the accident rate in an MSE of the construction sector, Trujillo 2023. The research approach was with applied methodology and experimental design, proposed the solution of a practical problem through the implementation OHSMS, and the intervention with pre and post-test evaluations. The population and the sample consisted of 24 weekly records of occupational accidents (from 12 weeks pretest January to March and 12 weeks after test May to July 2023) in an MSE of the construction sector. From the sample, the 12 paired means (pretest and post test) were determined. Data collection used observation techniques and documentary analysis and as instruments: Checklist and Accident Record Sheets; and statistical analysis with SPSS software, determined that the intervention reduced the accident rate by 91.87%. Concluding that, the implementation OHSMS-ISO 45001: 2018 reduces the accident rate in an MSE of the construction sector, Trujillo 2023.

Keywords: *safety; health; work; accidentability; MSE.*

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Implementación SGSST- ISO 45001:2018 para la Reducción de Accidentes en una MyPE del Sector Construcción, Trujillo 2023

RESUMEN

El objetivo principal de la investigación fue determinar en qué medida la implementación de la Norma OHSMS-ISO 45001:2018 reduce la accidentabilidad en una MyPE del sector construcción, Trujillo 2023. El enfoque de la investigación fue con metodología aplicada y diseño experimental, se propuso la solución de un problema práctico a través de la implementación del SGSST, y la intervención con evaluaciones pre y post-test. La población y la muestra estuvieron compuestas por 24 registros semanales de accidentes laborales (de las 12 semanas preprueba de enero a marzo y de las 12 semanas posteriores a la prueba de mayo a julio de 2023) en una MyPE del sector de la construcción. A partir de la muestra se determinaron las 12 medias pareadas (pretest y postest). Para la recolección de datos se utilizaron técnicas de observación y análisis documental y como instrumentos: Lista de Verificación y Hojas de Registro de Accidentes; y el análisis estadístico con el software SPSS, determinó que la intervención redujo la accidentabilidad en un 91,87%. Concluyendo que la implementación OHSMS-ISO 45001:2018 reduce la tasa de accidentabilidad en una MyPE del sector construcción, Trujillo 2023.

Palabras clave: seguridad; salud; trabajar; accidentalidad; MSE

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INTRODUCTION

The topic addressed in this study is occupational health and safety in a small company (MSE) in the construction sector to reduce the increasing levels of accidents evidenced in it, for this purpose the Occupational Health and Safety Management System (OHSMS) was implemented under the regulatory protection ISO 45001: 2018, based on the methodology formulated by Silva (2023), in whose research he proposed the minimum guidelines, the specific clauses and the processes required for their implementation according to the size of the company and the purpose of its application.

The International Labour Organization (ILO)), in a recent estimate, noted that inadequate workplace safety and health procedures led to around 2.78 million deaths and 374 million non-fatal work injuries, with the latter meaning more than four days of absenteeism from work. However, statistics showed that the construction industry contribute significantly to workplace deaths and injuries outsider of multiple interventions implemented by construction companies (Abdelrahim, 2023; Bryan, 2021; Babalola et al., 2023; Oni et al., 2019; Rodrigues et al.,2020). In Latin America, like the world, micro and small enterprises (SMEs) are fundamental as they contribute decisively to generate jobs and play a preponderant role in the economy. On the other hand, in them, the application, development and execution of the Occupational Health and Safety Management System (OHSMS) is still very deficient, evidenced in the high number of workers exposed to high levels of risk are accidents, with serious and fatal consequences, which confirm the statistical data indicated by the governing body of global health (WHO) and that at the regional level 5'000 arise annually, 000 occupational accidents with 90 000 fatal events, meaning one occupational event every 2 seconds; that every 15 seconds a worker dies and more than 150 of them suffer an accident (Osorio, 2021; Álvarez et al., 2019; Santurtún & Shaman, 2023). At the national level, official statistics indicate that in the last 8 accident rates increased from 10 to 35 accidents per ten thousand people exposed to these events, meaning that they have tripled in the aforementioned period, also, in December 2022 2 453 notifications were reported, corresponding to non-fatal work accidents (97.15%) fatal accidents (1.02%) dangerous incidents (1.79%) and diseases occupational (0.04%). Identifying among the sectors affected by this problem, the

construction sector with 8.08% (fifth place). Likewise, among the main forms of non-fatal accidents most recurrent were among them, the fall of people (350 cases) excessive efforts (299) and blows and collisions with objects (263) (MTPE, 2022). Trujillo was identified as a city that reported occupational accidents, with the recurrent causes: distraction while working (66%), not having adequate signs of danger (45%) and concerns about extra-labor issues (44%), also, in the identification of responsible, according to the perception of the worker, they pointed out as the cause to the company for inadequate signaling (47%), lower number of OSH trainings (43%). The company in the construction sector, develops activities with the due perception of risk and danger in its work, considering the main item that requires compliance with specific regulations due to the uniqueness and characteristics of the construction sector. In the year 2022, according to the company's data, 82 work accidents were registered, in them, it was identified that 25% were contusions caused by excessive efforts, 15% of blows and collisions with objects and 10% of falling objects in the course of manual maintenance, leading to an increase in the frequency of occupational accidents, also in losses of man-hours and disabling days that led to higher rates of occupational accidents in the company and according to the analysis carried out by Ishikawa Diagram and the Pareto Chart, the lack of training in occupational safety and health was identified as the main causes of the occurrence of occupational accidents, improper use of personal protective equipment (PPE), lack of hazard identification matrix, risk assessment and determination of controls (HIRAC) as well as non-compliance with work procedures.

The theoretical foundations in which the study is framed are described below

Occupational Health and Safety Management System

From the aspect of theories. the Risk Management Framework (RMM) considers safety as a control problem, a work system is seen as a multi-hierarchical socio-technical system, and that these levels are linked in safety management by controlling dangerous processes through laws, regulations and standards (Ge et al., 2022). A traditional approach to safety management is an approach linked to control on the assumption that management must use its authority to set standards and ensure compliance. in order to improve safety in the workplace. An alternative approach is to focus on strong commitment and joint involvement of manager and worker to

occupational safety management through training, information exchange and participation in safety-related decisions. While the control-oriented approach would seem to be easier in microenterprises with few employees to monitor managerial commitment and worker participation would lead to greater effectiveness in the results obtained (Luciano, 2020). A management system is defined as the set of interacting elements in a continuous process, developing the optimal conditions in the performance of a task. It encompasses policies, objectives and means for their execution, monitoring, operational performance and process verification. A Management System is based on the PHVA methodology generates a continuous organizational improvement leading to optimal processes, likewise, it entails significant reductions in accidents, and increases in productivity, affecting the well-being of the worker and the economic result of the company (Álvarez and Riaños, 2018; Badri et al., 2018).

International Standard ISO 45001:2018

ISO 45001: 2018 is the normative basis established by the International Organization for Standardization (ISO) that identifies an OHSMS model being specific with its requirements and providing the instructions of the case. It is applicable to any organization in general and allows the OHSMS to be affected by evaluation and improvement, for the assurance of the prevention of work-related accidents and diseases (International Organization for Standardization, 2018). Šolc et al. (2022) reaffirm that the OHSMS is based on the PHVA Cycle (Plan-Do-Check-Act), as the iterative process used by the organization to develop continuous improvement. The phases of the PHVA Cycle are defined as: (a) Plan: determination and evaluation of risks as well as OSH opportunities (b) Do: implementation of processes based on planning, c) Verify: Monitor activities and processes linked to the OSH policy, and information on the result achieved and (d) Act: Actions and measures to establish continuous improvement as a philosophy of health and safety performance, as well as the achievement of the result (International Organization for Standardization, 2018). The ISO 45001: 2018 standard constitutes the standard of GSST Systems constituted by requirements and processes, the standard contains 28 requirements (Silva, 2023). According to the same author, it is important that the entity determines the scope of the SSMS, with the power to choose a total or partial implementation (Figure 1) whether for certification

purposes or not and also according to the financing to be used (own resources or external sources). It is applicable to any organization in general and allows the OHSMS to be affected by evaluation and improvement, to ensure the prevention of accidents and diseases related to work.

Figure 1
ISO 45001:2018 implementation requirements in small construction companies

	PHVA Cycle		Plan	Do		Verify	Act
	2 requirements	2 requirements	1 requirement	2 requirements	1 requirement	1 requirement	2 requirement
ISO 45001:2018 Requirements Non-certification Small Business Silva (2023)	4.1 Understanding the organization and its context	5.1 Leadership and worker participation	6.1.2. Hazard identification and assessment of risks and opportunities	7.3 Awareness 7.4 Communication	8.1.2 Eliminate hazards and reduce OSH risks	9.1.2 Compliance assessment	10.2 Incidents, nonconformities, corrective actions
	4.2 Understanding the needs of workers' expectations	5.4 Consultation and participation of workers					10.3 Continuous improvement

Note. Based on what Silva (2023) has exposed.

Accident rate

Accidentability has its theoretical basis in Heinrich's pyramid, whose work revealed that, for every serious injury resulting from a single accident, there were 29 minor injuries resulting from accidents and 300 accidents without injuries. The Heinrich Triangle is the basis of current industrial accident prevention programs. Its fundamental contribution is that the path that leads to the prevention of accidents that result in serious injuries lies in investigating all accidents, including accidents without injuries. It postulates that the distribution of the severity of occupational accidents is relatively constant. Decreases in minor accidents are followed by similar decreases in serious and fatal accidents, stating that in the occurrence of minor accidents it is useful to evaluate the safety performance of an organization (Marshall & Hirmas, 2018). Se han demostrado relaciones significativas entre la intención de comportamiento, las barreras humanas y de recursos, y el comportamiento real, lo que indica que una reducción de barreras para cumplimiento OHS podría mejorar el comportamiento positivo hacia su ejecución, concluyendo

que las iniciativas para reducir las barreras percibidas para el cumplimiento de la SSO deben explorarse con vistas a mejores desempeños de este más aún en las pequeñas empresas (Esterhuyzen, 2019).

The Theory of Multiple Causality is the foundation of accidents generally holding that there are causes and / or factors in the accident that motivates its presence and through the combination of them lead to the accident. From the aspect of related theories, occupational accidents, is explained by occupational accidents are unplanned, unpredictable or unintentional events that can cause some damage to equipment or cause injuries, or even the death of workers (Abdelrahim et al., 2023). The work accident represents an abnormal event, occurring abruptly and unexpectedly, its avoidability is normal, causes interruptions in work and causes damage and injuries to workers. In general, occupational accidents reduce and affect human capital and also generate financial losses. Therefore, OSH management tries to reduce injuries and risks at work, health problems and effects on the environment (Neto et al., 2023). The dimensions of accident rate are: Accident frequency: Component of accident rate that identifies the number of accidents per million man-hours of work. It can be estimated separately as fatal and non-fatal accidents. They must be the effective hours based on labor regulations. Accident severity: The component of accidents, comprising the number of man-days lost per million man-hours of work, which determines the degree of severity of accidents occurred. The preceding description and its impact on the company led to the decision to implement the Occupational Health and Safety Management System (OHSMS) under the regulatory protection of ISO 45001: 2018, which constitutes the standard for the implementation of the aforementioned system. Therefore, the research problem was formulated: To what extent does the implementation of OHSMS - ISO 45001: 2018 reduce the accident rate in an MSE of the construction sector, Trujillo 2023? The importance and necessity of the research was justified from the theoretical aspect because it was based on the ISO 45001: 2018 standard that represented the standard of the OHSMS implementation, as well as on the foundations of management theory and theory of accident models and also from the social justification was that the implementation contributed to workers being better welfare conditions and faced, efficiently solved and reduced occupational health and safety problems. In reference

to the economic justification, the research strengthened and strengthened the importance and usefulness of OSH management in favor of its workers, with vital contribution at the company level, and the minimization of accidents helped to reduce costs and increase profitability. According to the legal justification, since the Company developed activities at the national level, the investigation was based on the regulatory framework of Law No. 29783, Law on Safety and Health at Work, addressed under the ISO 45001: 2018 standard, which represented the standard of the OHSMS implementation, which led to the general objective was to determine to what extent the OHSMS- ISO 45001: 2018 implementation reduces the accident rate in an MSE of the construction sector, Trujillo 2023. The general hypothesis applied was: The OHSMS ISO 45001: 2018 implementation reduces the accident rate in an MSE of the construction sector Trujillo, and the specific hypotheses: The OHSMS ISO 45001: 2018 implementation reduces the accident frequency rate in an MSE of the construction sector Trujillo, and the OHSMS ISO 45001 implementation: 2018 reduces the severity frequency index in an MSE of the construction sector Trujillo, 2023.

METHODOLOGY

The methodology developed was quantitative approach, applied type, experimental design and explanatory scope. It comprised a population and sample of 24 weekly records of occupational accidents in the company (from 12 weeks pretest January to March and 12 weeks after test May to July 2023). As it was determined that the population and the sample that was investigated were the same, being a census sample, therefore no sampling was required. The unit of analysis was the weekly record of occupational accidents (frequency and severity) in the company. The documentary analysis technique was developed, using the data collection instruments: Checklist of compliance with ISO 45001 2018 requirements and the record sheets of occupational accidents that occurred both in frequency and severity. The research was based on key ethical values, transparency and reliability, the accuracy of the findings was guaranteed, as well as the reliability.

Implementation Procedures and Execution

Situational analysis of the Company. Is a company that directs its activity towards the construction, civil works, security and soil sector, specialized in certain areas of the market, In order to provide adequate protection to the worker, it implemented the Occupational Health and Safety Plan (PST), based on the fact that "Safety is everyone's responsibility". Considering that, has the responsibility for accident prevention, health protection, conservation and preservation of the environment in the works it executes, it has a TSP, having the Department of Safety as responsible for its preparation. Site workers are required to actively participate in the TSP, as evidenced by the policy references, procedures and practices.

Baseline diagnosis. According to Silva (2023), he points out that it is important for the entity to determine the scope of the SSMS, with the power to choose a total or partial implementation, whether for certification purposes or not and also according to the financing to be used (own resources or external sources). The analysis of the situation of the company was carried out through the baseline of the OHSMS, the revision of the minimum guidelines of ISO 45001: 2018 to a small company, evaluated with the Occupational Health and Safety Plan (OHSP), comprised 3 programs: Safety and Health at Work, Training and Inspections. Also, with respect to the Audit program; the company's Security Plan indicated that the internal audit is carried out by work executed to evaluate compliance with the constituent elements of the PSST. Table 1 shows the score of the baseline that has a general compliance of 37% compared to 88% registered after the ISO 45001: 2018 Implementation, whose details is exposed in Table 2, where it is appreciated that the phase of greater compliance.

Table 1
ISO 45001:2018 baseline assessment

Guidelines of evaluation	Baseline OHSMS	Implementation ISO 45001:2018
Plan dimension	50%	100%
Do dimension	42%	92%
Verify dimension	27%	82%
Act dimension	16%	67%
Compliance Index ISO 45001:2018	37%	88%

Implementation Action Plan. The methodological implementation of the improvement, which was appreciated in the baseline of the documentary analysis and that the company did not have complete, once the implementation and preparation of the documents was completed, it was reviewed, and the implementation was approved in a meeting with company managers.

Table 2

Baseline Diagnostics and Implementation OHSMS ISO 45001:2018

Baseline	Implementation
Understanding the organization and its context:	
The organization determined the general requirements based on ISO 45001:2018. It was evidenced that the operational staff has knowledge regarding OSH, however, there is no stable structure in relation to the OHSMS.	The analysis of the internal and external issues pertinent to the OHSMS was determined, the SWOT matrix was elaborated in which the strengths, opportunities, weaknesses and threats were detailed; with an action plan to develop the actions leading to control them.
Understanding stakeholder needs and expectations	
The company partially determined the stakeholders motivated by the interaction of its activities, the organization has not established, implemented, maintained and continuously improved an OSH management system, including the necessary processes and their interactions, in accordance with the requirements of the Standard.	As the company partially identified the interested parties motivated by the interaction of its activities, and considering that they are not yet documented. To this end, the Stakeholder Matrix was developed that identified the interested parties, in the internal document, in which the corresponding requirements and strategies were defined.
Leadership and commitment	
The company has a general organizational chart, also with specific objectives in occupational health and safety, on the other hand, the company has initiatives.	In this clause, senior management committed to the OSH policy and objectives for its continuous improvement, which enables the achievement of the proposed results.
Consultation and participation of workers	
The company has an Occupational Health and Safety Committee, meets once a month and on emergency occasions, minutes of last meetings were requested and it was evident that they did not hold all the monthly meetings.	Meetings of the OSH Committee were held to ensure consultation and participation of workers with representatives, and the mechanisms for worker training in OSH were reviewed.
Planning	
The company did not establish in the processes the points required in the clause of legal requirements and others applicable to the danger and risk, so they were not communicated in a timely manner.	The procedures and HIRAC matrix were standardized based on ISO 45001: 2018. A flowchart of the procedures was developed.
Awareness	

Records of diffusions of the OSH Policy and its objectives were evidenced. The worker recognizes the importance of his performance in the OHSMS, although the strengthening of awareness on their part is lacking.	The dissemination of the post-induction occupational health and safety policy was strengthened. The training flowchart was established and the trainings developed were identified, staff were sensitized to contribute to the effectiveness of the OHSMS.
Communication	
The company did not submit a Communications Matrix for its OSH management system, not determining internal and external OHSMS communications.	A methodology for the communications process was established, internal and external communication plans were developed
Eliminate hazards and reduce OSH risks	
The company showed deficiencies in activities, requiring planning and implementation according to established OSH requirements; No procedure was identified that describes activity and the tasks that link to its fulfillment.	The company showed deficiencies in its activities, so no procedure was identified that describes the activity and the tasks that are linked to its fulfillment. Methodology was established for the effective management of processes involved, to meet the requirement.
Compliance assessment	
The company has controls in the operational process, despite the fact that the result was not analyzed to establish the effectiveness of the OHSMS. It does not have a methodology for assessing compliance with regulatory requirements.	OSH indicators were established to measure performance, and the provision of documented information to substantiate and evidence the results.
Incidents, Nonconformities and Corrective Actions	
The organization did not present improvement management procedures linked to the OHSMS, likewise, it does not have procedures for nonconformities, corrective and preventive actions, as well as procedures for incidents, accidents and occupational diseases, suffering from statistics.	The responsibilities in the stages of OHSMS performance were specified, with the primary purpose of implementing corrective action to analyze the root causes and corresponding actions.
Continuous improvement	
The company does not yet have an OHSMS Continuous Improvement Program. It does not have evidence that the result of the process had been evaluated, making it possible to determine the needs or opportunities for continuous improvement.	Consequently, the methodology that allowed evaluating the results of each OHSMS process, in order to act on the opportunities and needs found. Its application is evaluated to ensure the functioning of the OHSMS.

RESULTS AND DISCUSSION

In relation to the general objective, the results showed that the significance level $p = 0.000$ determined to reject the null hypothesis and accept the alternative hypothesis, which advocated that the implementation OHSMS-ISO 45001: 2018 reduces the accident rate in an MSE of the construction sector, Trujillo 2023. Likewise, that the accident rate showed a decrease of 91.87% in response to the implementation, having registered 577.83 as a pretest measurement and 46.96 as the post-test measurement, evidenced an increase in compliance with requirements from 37% to 88%.

Table 3

Statistics of accident paired averages

		Stocking	N	Standard deviation	Standard error mean
Par 1	Pretest accident rate	577,8267	12	151,28797	43,67308
	Post-test accident rate	46,9575	12	25,07252	7,23781

Table 4

T-Student Test Matched Samples Accidentability.

		Paired differences					t	GI	Sig. bilateral
		Stocking	Standard deviation	Standard error mean	95% confidence interval of difference				
					Inferior	Superior			
Par 1	Pretest accident rate - Post test accident rate	530,87	144,53	41,72	439,04	622,70	12,72	11	,000

The results are consistent with those obtained by Durán and Pomayay (2022) whose findings showed that the OHSMS implementation improved the level of compliance by 57% and reduced the accident rate from 4.30 to 0.09; having the inferential analysis corroborated by means of paired means test T -Student with GIS level $p = 0.017$ that the OHSMS application under protection ISO 45001: 2018 standard reduces accidents in industrial companies. Both were consistent with Willis et al. (2021) whose inferential results established with the level of error less than 5% and with Pearson's correlativity parameter $r = - 0.604$ in demonstrating the significant incidence of the

implementation OHSMS managed to reduce accidentability and influenced for greater productivity in an industry from a developed intervention. Bochkovskyi & Sapozhnikova (2021) in Ukraine evidenced the benefits of the system implemented in the productive areas of the industrial company "Stalkanat-Silur" and concluded that the OHSMS minimize occupational risks, through the implementation of an automated management system. From the theoretical aspect, a management system is defined as the set of interacting elements in a continuous process, developing the optimal conditions in the performance of a task. A Management System based on the PHVA methodology generates a continuous organizational improvement leading to optimal processes, also leads to the company obtaining as results significant reductions in accidents, as well as increases in productivity, affecting the welfare of the worker and the economic result of the company (Álvarez y Riaños, 2018). Occupational accidents, is explained by occupational accidents are unplanned, unpredictable or unintentional events that can cause some damage to equipment or cause injuries, or even the death of workers (Abdelrahim et al., 2023). It was corroborated that the implementation OHSMS- ISO 45001: 2018 is decisive for the reduction of accident levels, identifying preventive measures adapted to the part of the work, area and factors when they significantly affect whether the measurement is taken or not, and the adoption of corrective actions. In relation to the first objective, the results obtained showed that the level of significance obtained $p = 0.000$ determined to reject the null hypothesis and accept the alternative hypothesis The implementation OHSMS- ISO 45001: 2018 reduces the accident frequency rate in an MSE of the construction sector; Similarly, it was evidenced as a result that the accident frequency rate registered a significant decrease of 72.91% in response to the Implementation, obtaining a frequency index of 665.31 as a pretest measurement and after the intervention, the accident frequency index registered 180.23 as the post-test measurement.

Table 5
Statistics of matched averages frequency of accidents

		Stocking	N	Standard deviation	Standard error mean
Par 1	Pretest frequency index	665,3150	12	67,25676	19,41535
	Post-test frequency index	180,2300	12	70,61514	20,38484

Table 6

T-Student Test Matched Differences Frequency of Accidents.

		Paired differences					t	GI	Sig. (bilateral)
		Stocking	Standard deviation	Standard error mean	95% confidence interval of difference				
					Inferior	Superior			
Par 1	Pretest Frequency Index - Post Test Frequency Index	485,09	83,56	24,12	431,99	538,17	20,11	11	,000

The results are consistent with those obtained by Palacios (2021) in whose research the results showed the variation of the accident rate from 2.75 to 1.38; also in the frequency of accidents, the indicator that registered 687.50 varied decreasing to 343.75 and finally in the severity of accidents, the indicator was 1 125.00 varied decreasing to 625.00. The inferential result allowed us to conclude that, in the construction company, the implementation applied through an-SST Plan significantly reduced ($0.008 < p$) the accident rate. Both being similar to the results obtained by Palacios (2021) whose findings showed that the rate of accidents on site decreased by 64%, and the stoppage time index decreased by 63%, The inferential analysis corroborated by means of a T-Student test with GIS level $p = 0.026$ that the OHSMS implementation developed under the ISO 45001 regulatory protection: 2018 significantly reduced the frequency of accidents, and the times of stoppage of works, so, consequently, they determined that the accident rate in the company significantly decreases. From the theoretical aspect, the Theory of Multiple Causality is the foundation of accidents generally maintaining that there are causes and / or factors in the accident that motivates its presence and through the combination of them lead to the accident. In two categories the leading factors are grouped being these those of Behavior, which includes factors of the worker: incorrect attitude, inappropriate physical and mental conditions and lack of knowledge. The second being the environmental factors, which occur in the wear and tear of equipment due to its use; the inadequate protection of hazardous work items and the application of unsafe procedures. Providing the theory described that the accident is not always the result of

a single action (Magda et al, 2023). Based on the above, it is confirmed that efficient safety management reduces the occurrence of accidents and the possibility of failures in construction projects and influences all other key performance indicators. such as quality of work and maximizing productive times by minimizing additional time and health care insurance costs. Regarding the second specific objective, the results obtained showed that the level of significance obtained $p = 0.000$ determined to reject the null hypothesis and accept the alternative hypothesis. The implementation OHSMS-ISO 45001: 2018 reduces the accident severity index in an MSE of the construction sector. Likewise, it was evidenced that the accident frequency rate decreased 72.60% due to the implementation, registering 862.47 pretest and 236.29 post test.

Table 7
Statistics of matched averages severity of accidents

		Stocking	N	Standard deviation	Standard error mean
Par 1	Pretest severity index	862,4717	12	175,41584	50,63819
	Post-test severity index	236,2933	12	103,98853	30,01890

Table 8
Test T-Student Matched Differences Severity of Accidents.

		Paired differences					t	Gl	Sig. (bilateral)
		Stocking	Standard deviation	Standard error mean	95% confidence interval of difference				
					Inferior	Superior			
Par 1	Pretest Severity Index - Post Test Severity Index	626,18	177,21	51,16	513,59	738,77	12,24	1	,000

The results are consistent with those obtained by Acosta and Pareja (2021) whose findings showed that the OHSMS implementation allowed the reduction of the accident rate by 89.79%; as a consequence that the frequency index decreased from 7 203.24 to 1 907.29, representing a decrease of 73.52% and that the severity index of the pretest accident, an index of 17 220.92 was obtained and in the post-test measurement of 2 859.71; representing a significant reduction of 84.83%. It was corroborated by means of a T-Student test with GIS level $p = 0.026$ that the

OHSMS application based on ISO 45001: 2018 reduces accident rates in construction companies. Both results are similar to the findings obtained by Shimizu et al (2021) whose statistical analyses showed as a consequence of the intervention, the reduction in the incidence of occupational accidents in the groups of causes analyzed, and work-related reductions / accidents were found in the economic activities of severity.

From the theoretical aspect, Heinrich's Triangle Theory was confirmed as the basis of industrial accident prevention programs, pointing the way that leads to the prevention of accidents that result in serious injuries lies in investigating all accidents, including accidents without injuries. It was shown that the decrease in the severity of occupational accidents is relatively constant, therefore, decreases in minor accidents are not always followed by similar decreases in serious accidents, confirming that the occurrence of minor accidents is useful for evaluating safety performance. It was demonstrated that the OHSMS interventions ISO 45001: 2018 and the corrective measures adopted, analysis and investigation of accidents and risk management, relating their causes and consequences affected the prevention factors in companies and significantly reduced accident severity levels.

CONCLUSIONS

In response to the implementation, the accident rate showed a decrease of 91.87%, registered 577.83 as a pretest measurement and 46.96 as the post-test measurement, in the implementation OHSMS ISO 45001: 2018, also that the difference of the means and the level of significance obtained $p = 0.000$ determined to reject the null hypothesis and accept the alternative hypothesis: The OHSMS implementation based on ISO 45001: 2018 reduces the accident rate in an MSE of the construction sector, Trujillo 2023. It was demonstrated that the implementation OHSMS-ISO 45001: 2018 is decisive to reduce accident levels by identifying preventive measures for accidents in work activity when they significantly affect, with the adoption of corrective actions, product of continuous improvement. From this, it is recommended that small companies develop the implementation OHSMS-ISO 45001: 2018 identifying accident prevention measures adapted to the part of work activity, area and behavioral factors when they significantly affect, with adoption of corrective actions, product of continuous improvement and as a tool to develop prevention

actions with an organized application; leading to reduction of accidents, and increase of productivity, contributing to the welfare of the worker and the economic result of the company. From the specific aspect, in the first place, it was concluded that, with the intervention, the accident frequency index showed a decrease of 72.91% in response to the implementation, registering 665.31 as pretest measurement and 180.23 as post-test measurement. Likewise, with the mean difference and the level of significance obtained $p = 0.000$, they determined the rejection of the null hypothesis and the acceptance of the alternative hypothesis: The implementation OHSMS- ISO 45001: 2018 reduces the accident frequency rate in an MSE in the construction sector; It showed that efficient safety management reduces the occurrence of accidents and the possibility of failures in construction works and influences Key performance indicators, such as quality of work, productive times, minimization of health insurance costs, rehabilitation and health expenses. Finally, secondly, it was concluded that the implementation ISO 45001: 2018 the accident severity index showed a decrease of 72.60% in response to the implementation, registering 862.47 as a pretest measurement and 236.29 as the post-test measurement, with the mean difference and with the GIS level. obtained $p = 0.000$ determined the rejection of the null hypothesis and the acceptance of the hypothesis: The implementation OHSMS ISO 45001: 2018 reduces the accident severity index in an MSE of the construction sector, Trujillo, 2023, corroborating that the intervention OHSMS ISO 45001: 2018 and the corrective measures adopted, analysis and investigation of accidents and risk management, which relate causes and consequences affect preventive factors and significantly reduce their levels of severity.

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