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Article

Standardized tool for the identification and control of risks associated with tasks in the work environment

Herramienta estandarizada para la identificación y control de riesgos asociados con las tareas en el ambiente de trabajo

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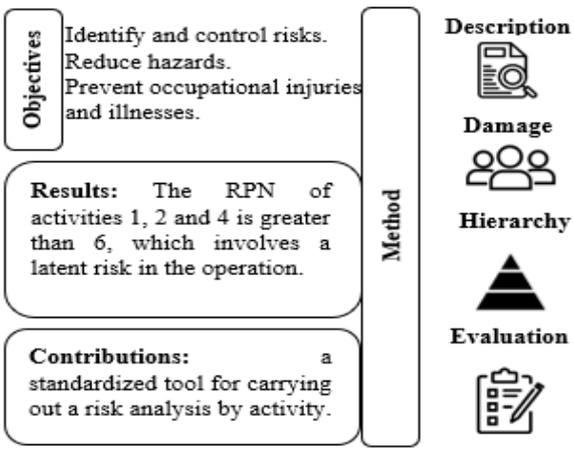
Abstract

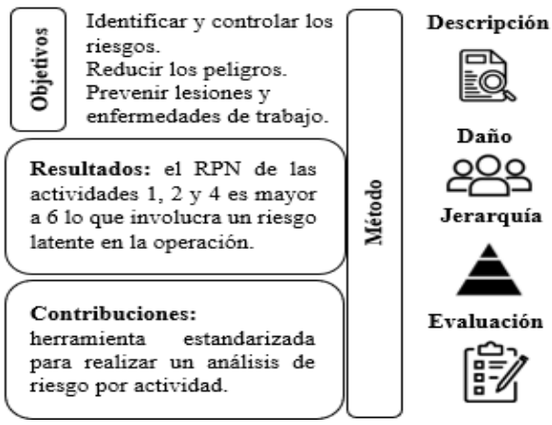
Performing a risk analysis by activity allows you to identify and control the risks associated with tasks in the work environment, reduce workplace hazards associated with the risks, as well as prevent or reduce injuries and illnesses in the worker. This article presents a standardized tool to perform a risk analysis by activity, each of the proposed stages is detailed, such as the description of the activity, identification of the risks present, description of the risks, identification of damage or potential effect, risk control hierarchy, identification of current controls, risk assessment and implementation of actions. Each of the stages takes you by the hand to systematically carry out a risk analysis by activity. Finally, the effectiveness of the tool implemented in carrying out a risk analysis is shown.



Risk analysis by activity, Hierarchy of Risk Control, Safety and hygiene

Resumen

Realizar un análisis de riesgos por actividad permite identificar y controlar los riesgos asociados con las tareas en el ambiente de trabajo, reducir los peligros del lugar de trabajo asociados con los riesgos, así como, prevenir o reducir las lesiones y enfermedades en el trabajador. En el presente artículo se presenta una herramienta estandarizada para realizar un análisis de riesgo por actividad, se detallan cada una de las etapas propuesta, tal como la descripción de la actividad, identificación de los riesgos presentes, descripción de los riesgos, identificación de daño o efecto potencial, jerarquía de control de riesgo, identificación de controles actuales, evaluación de riesgos e implementación de acciones. Cada una de las etapas lo llevan de la mano para realizar de manera sistemática un análisis de riesgo por actividad. Finalmente se muestra la efectividad de la herramienta implementada en la realización de un análisis de riesgo.



Análisis de riesgo por actividad, Jerarquía de control de riesgos, Seguridad e higiene

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Introduction

In the world of work, the identification of risks is crucial to safeguard all operational processes and risk analysis by activity is an instrument that allows us to distinguish, evaluate and mitigate or reduce all those risks associated with each of the activities within the business environment.

The concept of risk refers to the probability of an event, accident, or dangerous situation occurring that causes injuries, damages, or diseases that a person may be exposed to (Occupational Health and Safety Assessment Series, 2007). On the other hand, it is important to understand hazards, which refer to those inherent conditions capable of causing damage to people's health or damage to property (Open and Distance University of Mexico, 2024).

The safety of workers is very important, therefore, carrying out risk analysis for each of the activities performed allows the different hazards that may arise in each of the tasks to be clearly and accurately identified.

These analyses will help with the implementation and improvement of mitigation, prevention and correction measures of the risks, significantly reducing the probability that any type of identified risk will occur. In other words, accidents will be reduced and therefore the injuries that they entail.

However, there is very little information on how to implement risk-per-activity analysis.

This lack of information leads to poor or deficient implementation of these tools. This is why this article is of great importance, as it serves as a practical guide to improve the identification, mitigation or reduction of risks.

By understanding and effectively applying these bases, not only will operating risks be reduced, but your processes will also be improved by avoiding time wastage and safeguarding the safety of personnel. Many institutions lack these analyses, and this absence of risk identification can lead to poor assessments, omissions of critical risks and the poor application of control measures, ultimately resulting in an accident.

Developing an article that serves as a protocol to carry out a risk analysis by activity will not only facilitate the performance of these analyses but will also provide help to continue continuously improving risk control

The intention of this article is to provide the steps necessary to develop effective risk analysis by activity. First, the importance of risk analysis for the reduction or mitigation of these is raised. Subsequently, a standardized tool will be presented to carry out these analyses, which includes the identification of the activities, the evaluation of the severity, frequency, probability and impacts that the risks may cause, and the application of control measures.

Background

Companies must observe the risks to which workers are exposed when they perform activities that generate forced postures, repetitive movements, manual handling of loads, use of tools, manual equipment and/or handling of dangerous substances, which can affect their health or cause physical limitations or death.

Under this approach, risk analysis by activity is a useful tool to determine the risks present in the operation of machinery and equipment and to implement risk mitigation strategies.

According to recent studies of occupational risks registered in the Mexican Social Security Institute related to occupational risks determined by year of occurrence, according to the 2023 data, approximately 6,332 people were at risk for not wearing personal protective equipment, 143 people for lack of adequate clothing, 986 people for using inadequate tools or equipment, 20,473 people for using some inadequate help to lift, move, roll, etc., loads and 1,169 people for inappropriate stacking, this out of a total of 358,729 people who were exposed to a risk (Secretary of Labor and Social Welfare, 2024).

This section presents some works by different authors who contributed to this project. Guisela & Montalvo (Guisela & Montalvo, 2019) investigated which work activities with a higher risk of having cases of musculoskeletal disorders occurred in areas where mostly manual activities are carried out that require physical effort for a long time, causing injuries to the trunk and upper extremities.

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Hence the importance of investigating the risk factors associated with these pathologies and thus propose measures Corrective.

Cervantes and Hernández (Cervantes & Hernández, 2023) assessed the risks of biomechanical overload, in order to conduct anthropometric measurements for a prevention-oriented workplace redesign. The study showed that among the critical activities are the manual lifting of loads, performing static forced postures, repetitive movements of limbs. Their research was able to eliminate the danger of manual lifting of loads and reduce the risk of forced postures and repetitive movements of the upper limb.

Methodology

The risk analysis by activity is a very meticulous tool that aims to identify, evaluate and mitigate the risks that arise in each of the stages of the work processes (Cortés, 2012).

The following are the steps of the proposed tool for the identification and control of risks associated with tasks in the work environment, as shown in Figure 1.

Box 1

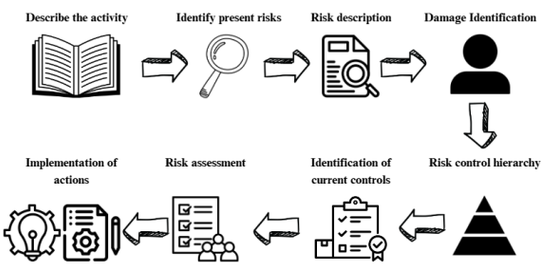

Figure 1
Steps to prepare a risk analysis by activity
Source: Own elaboration

To exemplify the standardized tool for the identification and control of risks associated with tasks in the work environment, a risk analysis is carried out by activity in the operation of a sit down electric lift truck, with a capacity of 3.5 tons, selecting only some of the activities that make up the risk analysis to exemplify the tool step by step.

The following are the stages of the standardized tool for the identification and control of risks associated with tasks in the work environment.

Describe the activity

First, each of the activities that make up a process must be defined and identified, from the simplest to the most complex, so that the risks and hazards will be evaluated.

Identify present risks

The identification of risks is crucial for conducting a risk analysis by activity, as it safeguards safety in the different work environments.

By determining the possible risks or dangers involved in each activity, accidents or problems can be prevented and therefore control measures can be taken before an incident occurs.

Risk Description

A specific and detailed description of the activity must be made, including how the danger or risk may cause or result in harm to the person when performing the task.

This description must be in accordance with the observations made by the analyst and with the help of the person who performs the activity, this collaboration between analyst and operator ensures that all the details of each process are recorded, so that the risk involved in carrying out said activity is specifically described.

Identifying the damage

The identification of damage refers to the physical effect of the risk or danger that results in an impact on the health and well-being of the person in charge of carrying out the activity. These effects can vary depending on the work environment and the person performing the task.

Risk control hierarchy

The control hierarchy aims to establish the best controls in the facility or workplace and consists of eliminating, minimizing or controlling the risks of exposure to hazards, to prevent the worker from taking individual actions that endanger him (Manuele, 2005). It is worth mentioning that controls can usually be combined at different levels to achieve an acceptable risk.

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The following types of controls are recommended in order of effectiveness, with the hierarchy clearly showing that each step is considered less effective than the previous one. Elimination is the most effective control and personal protective equipment (PPE) is the least effective, this does not mean that PPE is not useful or necessary to contribute to the safety of workers, however, if the risk is eliminated or replaced, this eliminates the need for the worker to wear any PPE, as seen in Figure 2.

Box 2

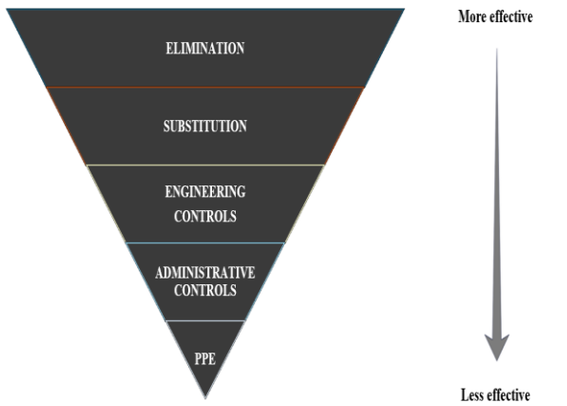

Figure 2

Hierarchy of Controls

Source: (National Institute for Occupational Safety and Health, 2024)

1. Elimination.

At this first level, alternatives are established to eliminate or suppress the risk that combats the root cause of the threats. This control is clearly the most efficient alternative to eliminate risk.

2. Substitution

Substitution together with elimination are the most efficient alternatives. At this level, the risk is not eliminated, but it is reduced to such an extent that way that the risk to which the worker is exposed is reduced.

3. Engineering controls

Ventilation systems; machine protection; sound boxes, circuit breakers, platforms and guards; Interlocks, lift tables, conveyors, and balancers, etc. are some of the engineering controls that are adopted to reduce the likelihood of risk.

4. Administrative controls

These controls are based on administrative instructions in which the worker is asked to follow some instruction or prohibit him from performing any activity, some most commonly used administrative controls are implementing warning signs, back-up alarms, beepers, labels or decals procedures, occupational safety procedures, job rotation, equipment inspections, the change of working hours, training, etc.

5. Personal protective equipment and elements

This last control is applied when it is not possible to apply any of the previous controls, there is a very wide variety of equipment and personal protection elements, for work at heights, head protection, hearing protection, respiratory protection, hand and arm protection, eye protection, among others (Secretary of Labor and Social Welfare M. , 2024).

Identification of current controls

In this section it is important to identify the controls that are implemented in the area, it is common to have some of them (Liberati, Farhad, & Dixo-Woods, 2018). In general, some of the controls that are frequently in place in the workplace are that workers already have training for personnel on topics focused on the identified risk, as well as training in the operation of machinery.

Additionally, certain designs are implemented to prevent the risks present, such as falls, hazardous materials, noise, confined spaces or manual handling. Among the controls applied to replace the risk are the reduction of energy, for example, by reducing the speed, force, amperage, pressure, temperature or noise of the machinery.

The implementation of some engineering controls on machinery or equipment such as ventilation systems, machine protection. They also find warning signs, some backup alarms, safety procedures, among others. As well as the use of some personal protective equipment. Considering that in many cases the control does not eliminate the risk, it is crucial to identify and assess these controls in order to carry out the analysis.

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Risk assessment

To assess the risk will be done according to the severity, frequency and probability of the risk with respect to a reference table. Severity, frequency and probability are generally classified on a scale of 1 to 5 or from 1 to 10, where each value is obtained by multiplying the value of the severity by the value of the frequency and the result multiplying it by the value that is assigned to the probability, the result of this operation is known as RPN (Risk Priority Number) see Table 1.

Box 3

Table 1

Steps to prepare a risk analysis by activity

		Severity					
		NM	First Aid	Waste of Time	Irreversible		
Frequency		1	3	6	10	**Probability**	
Monthly	1	**1**	**3**	**6**	**10**	1	Unlikely
Weekly	2	**4**	**12**	**24**	**40**	2	Possible
Diary	4	**16**	**48**	**96**	**160**	4	Likely
Hourly	6	**36**	**108**	**216**	**360**	6	True

Source: Own elaboration

The values obtained from the RPN are identified with a colour to facilitate their identification and determine the level of importance of the risk involved in the operation of the machinery.

Green identifies a minimum risk level, blue corresponds to a low risk level, yellow to a medium risk level and red to a high risk level. If the RPN value is greater than or equal to 6, risk control actions must be implemented.

Implementation of actions

This is one of the most important points of risk analysis by activity, it is the point at which additional actions or controls must be proposed to those that have been identified, in order to reduce the risk (Etherton, 2003).

Some of the actions that can be implemented are: reinforcing training on issues related to the identified risk, verifying that the systems are in optimal conditions, verifying the operation of emergency stops, placement of guards and interlocks as well as making safety observations during the activity so that real-time actions can be implemented to address the identified risk behaviours (Hjorth, 2018).

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Results

Below is the development of each of the stages of the tool, presenting the results of the risk analysis by activity, which was carried out for the operation of the lift truck.

Describe the activity

Table 2 contains the description of 4 activities selected from the total of activities that resulted from the risk analysis by activity, which was carried out in the operation of the lift truck, each activity is given a number (Num) this will allow us to identify them in each of the stages of the analysis.

Box 4

Table 2

Description of the activity

Num	Description of the activity
1	Check that the forks are in good condition.
2	Check that the grill is in good condition.
3	Before starting the operation, put on your seat belt.
4	Address the cargo for transfer.

Identify present risks

The identification of risks is determined according to all factors involved in carrying out the activity. Table 3 shows the risks involved in the activity.

Box 5

Table 3

Possible risks

Num	Possible risk
1	Mech.- burst/compression. Work/walking surface-5S, Order and Cleanliness (Material on Surface/Out of Place Do). Ergo .- Healthy postures or without excessive effort (Over Effort). Lift truck / PIT-Equipment Conditions.
2	Human error, human behaviour. Work/walking surface-5S, Order and Cleanliness (Material on Surface/Out of Place Do). Ergo .- Healthy postures or without excessive effort (Over Effort). Lift truck / PIT-Equipment Conditions.
3	Human error, human behaviour. Ergo .- Healthy postures or without excessive effort (Over Effort).
4	Mech .- Mass and speed (kinetic energy - uncontrolled movement). Mech .- Impact. Lift truck/PIT-Operating Environment. Lift truck / PIT-Mis-Operation.

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Risk Description

A specific description of the task must be made in which the present risk must be detailed and that may result in a mishap for the worker, as shown in Table 4.

Box 6

Table 4

Activity number and specific description

Num	Specific description of the activity
1	Mech .- burst / compression: trapping of hands when checking that the forks are in good condition. Work surface / walking-5S, Order and Cleanliness (material on the Surface / Out of Place Do): when carrying out the activity the employee may lose sight of the risk points around him and may trip. Ergo.- Healthy postures or without excessive effort (Over Effort): when carrying out the activity, the employee may end up in uncomfortable postures. Lift truck / PIT-Equipment conditions: failure to perform the activity correctly may cause the lift truck to malfunction, which may cause injury to the employee.
2	Human error, human behaviour: when verifying that the grill is in good condition, the employee may lose sight of the risk points around him and may be hit. Work surface / walking-5S, Order and Cleanliness (material on the Surface / Out of Place Do): when carrying out the activity the employee may lose sight of the risk points around him and may trip. Ergo.- Healthy postures or without excessive effort (Over Effort): when carrying out the activity, the employee may end up in uncomfortable postures. Lift truck / PIT-Equipment conditions: failure to perform the activity correctly may cause the lift truck to malfunction, which may cause injury to the employee.
3	Human error, human behavior: not putting on a seat belt exposes the employee to injury. Ergo.- Healthy postures or without excessive effort (Over Effort): when carrying out the activity, the employee may end up in uncomfortable postures.
4	Mech .- Mass and speed (kinetic energy - uncontrolled movement): by not respecting the speed when the employee operates the lift truck, he or she may lose control of the unit and cause injury or death. Mech .- Impact: when operating the lift truck the employee may lose control of it and cause injury or death. Lift truck / PIT-Operating environment: Failure to consider the spaces available to operate the unit could cause injury or death to the employee. Lift truck / PIT-Mis-Operation: Operating the lift truck without prior training could result in injury or death to the employee.

Identifying the damage

Table 5 shows the damages that were identified in the activities that are being analyzed in the operation of the lift truck.

Box 7

Table 5

Damage identification

Num	Damage
1	-Entrapment of extremities of hands. -Trips/Falls/Slips. -Unhealthy postures. -Bruises, fractures, Interior, Death, installation or damage to equipment.
2	-Physical injuries. -Trips/Falls/Slips. -Unhealthy postures. -Bruises, fractures, Interior, Death, installation or damage to equipment.
3	-Physical injuries. -Unhealthy postures.
4	-Contusions, hematomas, fractures, death, damage to facilities or equipment.

Risk control hierarchy

Table 6 shows the risk control measures that will be implemented in the activities analyzed in the operation of the lift truck.

Box 8

Table 6

Risk control hierarchy

Num	Risk hierarchy
1	Administrative controls
2	Administrative controls
3	Administrative controls
4	Administrative controls

Identification of current controls

Table 7 shows the current controls implemented in the operation of the lift truck.

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Box 9

Table 7

Identification of current controls

Num	Current controls
1	- Training for the operation of the lift truck.
- 2	- Training for the operation of the lift truck.
3	- Training for the operation of the lift truck.
4	- Training for the operation of the lift truck.

Risk assessment

The evaluation of the risk associated with the operation of the lift truck is shown in Table 8

Box 10

Table 8

Assessment of severity, frequency and probability

Num	Severity	Frequency	Probability	RPN
1	3	4	2	**24**
2	1	4	2	**8**
3	1	4	1	**4**
4	10	4	4	**160**

Implementation of actions

The actions that are proposed to be implemented are presented in Table 9.

Box 11

Table 9

Implementation of actions

Num	Actions
1	- Perform safety observations when the activity is carried out to reinforce risky behaviours. - Staff training for ergonomics, 5's, order and cleanliness. - Implement a checklist for the lift truck inspection.
2	- Perform safety observations when the activity is carried out to reinforce risky behaviours. - Staff training for ergonomics, 5's, order and cleanliness. - Implement a checklist for the lift truck inspection.
3	-
4	- Perform safety observations when the activity is carried out to reinforce risky behaviours. - Operator Certificate, Training. - Feedback on the use of personal protective equipment. - Implement a checklist for the lift truck inspection.

From the results obtained from the risk analysis by activity, we observed that in activities 1, 2 and 4 the RPN of each of them is greater than 6. Therefore, these activities have a latent present risk and for this reason we must implement actions to reduce the risk.

The controls that are recommended to be implemented in each of them are Administrative Controls, and the actions are those specified in Table 10.

Box 12

Table 10

Risk assessment result

Num	RPN	Recommended controls	Additional actions/controls identified
1	**Half**	Administrative controls	- Perform safety observations when the activity is carried out to reinforce risky behaviours. - Staff training for ergonomics, 5's, order and cleanliness. - Implement a checklist for the lift truck inspection.
2	**Low**	Administrative controls	- Perform safety observations when the activity is carried out to reinforce risky behaviours. - Implement a checklist for the lift truck inspection. - Staff training for ergonomics, 5's, order and cleanliness.
3	**Minimum**	Administrative controls	-
4	**High**	Administrative controls	- Perform safety observations when the activity is carried out to reinforce risky behaviours. - Operator Certificate, Training. - Feedback on the use of personal protective equipment - Implement a checklist for the lift truck inspection.

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Conclusions

The application of the standardized tool for the identification and control of risks associated with the operation of the lift truck, allowed us to observe the hazards that arise in the operation and to implement mitigation, prevention and correction measures of the risks.

The risks that were identified include exceeding the speed of the vehicle, not having the right order and cleanliness of the work area, not making a check list in which the conditions in which the unit is located, not placing the seat belt and not using the appropriate personal protective equipment; This can result in the operator being exposed to present hazards such as limb entrapment, tripping/falling and sliding, awkward postures when operating the lift truck, having some type of fractures or resulting in the death of the operator.

The future work of this research includes the application of this tool in different operations within a work area, to decrease the probability of any type of identified risk occurring.

Declarations

Conflict of interest

The authors declare no conflict of interest. They have no known competing financial interests or personal relationships that could have appeared to influence the content reported in this article.

Author contribution

The contribution of each researcher in each of the points developed in this research, was defined based on:

Cardona-Martínez, Clara: Contributed to the project idea, research method and technique. She supported the design of the proposal. She carried out the data analysis and systematisation of results, as well as writing the article.

Ramirez-Benhumea, David Alejandro: Contributed to the research method and technique. He supported the design of the proposal. He carried out the data analysis and systematisation of results, as well as writing the article.

Guevara-Hernandez, Eduardo: He carried the systematisation of results, as well as writing the article.

Beltran, Paulina: She carried the systematisation of results, as well as writing the article.

Availability of data and materials

The data obtained in this article were taken from the operation of a sit down electric lift truck, with a capacity of 3.5 tons, of which we had availability at all times.

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Abbreviations

PPE	Personal Protective Equipment
Num	Number of activity
RPN	Risk Priority Number

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