Comparing Safety Risk Identification in the Manufacturing and Non-Manufacturing Industry: Systematic Literature Review

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Abstract

What is a safety risk and how is it implemented? The study of safety risks has evolved in the last few decades. However, the fragmented discussion makes it difficult to fully understand it. This research tries to answer the safety risks that are only known to people who actually work in the Occupational Safety and Health (K3) environment, but how about ordinary people? and how it is applied in the manufacturing and non-manufacturing industries by conducting a literature review of related scientific journals published from 2015 to 2021. Safety risk has become a methodology used by companies around the world to improve product quality and operating profit. It is no longer only used in the manufacturing industry, but also in non-manufacturing industries. The findings of this study can be a reference and recommendation for researchers and practitioners in studying the identification of further southern risks.

Keywords
Safety Risk, Literature Review, Manufacturing Industry, Non-manufacturing

1. Introduction

Occupational Health and Safety (K3) is a form of effort to create protection and security from various risks of accidents and hazards, both physical, mental and emotional to workers, companies, communities and the environment so that

they can be protected from work accidents, ultimately increasing efficiency and work productivity (Martalina et al., 2018), (Ivana et al., 2014), (Waruwu & Yuamita, 2016), (Sadewa et al., 2021), (Bando et al., 2020), (OZ Putri et al., 2017), (Siswanto, 2015), (Nurfauzan & Thaib, 2020), (Ukhisiella Gla et al., 2017). Work safety is the main requirement in the basic implementation of all work to be carried out safely in various fields (Susanto et al., 2020). This effort is carried out to avoid the risk of work accidents (S. Putri & Rahayu, 2018), (Widiastuty & Hidayat, 2019).

Safety risks include aspects of the work environment that can cause fires, fear of cutting electricity, bruises, sprains, fractures, loss of organs, vision, hearing (Parashakti & Putriawati, 2020), (Munandar et al., 2014). Risk identification is the process of finding, recognizing and describing risks where risk identification is an attempt to find and understand the risks that will occur in work for projects carried out by relevant agencies and individuals (Muhammad, 2020). The next step after successfully identifying the existing hazard sources, it is necessary to evaluate the level of risk to workers (Mindhayani, 2020). So this study aims to identify safety risks to workers (Rimantho, 2016), (Rahayuningsih, 2018) and compare manufacturing and non-manufacturing safety risks.

1.1 Objectives

Comparing the implementation of occupational safety and health in the manufacturing and non-manufacturing industries, which will identify what types of accidents occur the most and the least in each industry.

2. Literature Review

• Manufacturing

Table 1. Paper Manufacturing and accident identification

No	Title	Method	Accident Identification
1	Identifikasi dan Analisis Risiko keselamatan dan Kesehatan Kerja pada Area Produksi PT Pelita Cengkareng Paper	JHA (*Job Hazard Analysis*)	Paperboard material fall, chemicals, inhaled material dust, radiator water spurted, hit by a forklift.
2	Analisis Risiko Keselamatan dan Kesehatan Kerja manufaktur pada proses pembuatan Suku Cadang Mobil ARM Visor Shaft	*Job Safety Analysis* (JSA)	Pinched fingers, eyes hit by parts during the pressing process, parts bounced off eyes, inhaled fume from the machine, slipped.
3	Analisis Risiko K3 dengan Metode Hirarc pada Area Produksi PT Cahaya Murni Andalas Permai	Hirarc	Slipping due to slippery floors, falling, being hit by a moving vehicle/machine, electrocuted and exposed to extreme temperatures.
4	Analisis Kecelakaan Kerja dengan menggunakan metode *Hazard and Operability Study* (Hazop)	*Hazard And Operability Study* (Hazop)	Respiratory problems, eye irritation, torn palms, broken fingers, tripping, skin blisters.
5	Implementasi Manajemen Risiko Sistem Kesehatan, Keselamatan Kerja dan Lingkungan (K3) pada Pembangunan Flyover Pegangsaan 2 Kelapa Gading Jakarta Utara	*failure mode and effect analysis* (FMEA) & *fault tree analysis* (FTA)	Workers fall from a height on iron work, workers get electric shocks in electrical installation work, and materials fall from a height and hit workers during erection.
6	Artikel Penelitian Identifikasi Bahaya dan Risiko Keselamatan Kerja Pada Saat Overhaul di Area Kiln PT. X tahun 2017	Triangulation Method	Shocked, exposed to welding fumes, exposed to welding light, fire, exposed to dust and exposed to heat, crushed, pinched, cut, slashed, bumped.
7	Penggunaan *Job Hazard Analysis* dalam Identifikasi Risiko Keselamatan Kerja pada Pengrajin Logam	*Job Hazard Analysis* (JHA)	Eyes exposed to welding light, UV and infrared, inhalation of welding fume/ steam, electrocution, inhalation of polished dust
8	Analisis Risiko Keselamatan dan Kesehatan Kerja (K3) dengan menggunakan metode *Hazard and*	*Hazard and Operability Study* (Hazop)	Falling objects, pinched by objects, pinched fingers when tightening bolts, fatigue, slipping at the same height or

	Operability Manual di PT Cladtex Bi Metal Manufacturing.		level ground, wrong position when lifting, colliding with objects being lifted.
9	Identifikasi Bahaya Penilaian dan Pengendalian Risiko Keselamatan dan Kesehatan Kerja (K3) pada departemen Foundry PT. Sicamindo.	Hirarc	Exposure to hot liquids, exposure to heat, exposure to saw blades, exposure to pieces of aluminum scrap, scratched hands and crushed products.
10	Analisa Risiko Keselamatan Kerja pada Explorasi Minyak.	AS/NZS 4360:2004	Exposure to sharp objects, injuries lifting too heavy loads, effects of toxic gases (swelling, itching, shortness of breath and lung cancer), incomplete APD.
11	Analisis Risiko Kesehatan dan Keselamatan Kerja pada Pengrajin Mebel Kayu di industri informal "Bapak Y" Kabupaten Tasikmalaya.	*Job Hazard Analisis* (JHA)	Irritation and allergies to the respiratory tract/cough, skin allergies/itching.
12	Gambaran Tingkat Risiko Kesehatan dan Keselamatan kerja pada bagian produksi di PT. "X" Menggunakan metode *Hazard identification, Risk Assesment and Risk Control* (Hirarc) Tahun 2018.	Hirarc	Material dust, falls, chemical gases, noise, heat from processes/machines, hearing loss, muscle and back pain, cuts from cuts, cuts or bruises from pinching.
13	Identifikasi bahaya pada *Section Marking Cutting* dan *Shotblasting Process* di perusahaan manufaktur dengan metode Hirarc.	Hirarc	Lack of discipline, haste, fatigue, lack of awareness of K3 and Unsafe Conditions such as uneven floors, dusty work areas, noise, inappropriate/damaged APD, and machines that do not comply with applicable SOPs.
14	Analisa risiko Keselamatan dan Kesehatan Kerja pada divisi Boiler di PT. DAP.	Hirarc	Failure to fall, shortness of breath, dehydration, broken slings, stuck motors, clogged engines and pipe leaks.
15	Analisis potensi risiko Keselamatan dan Kesehatan Kerja dengan metode *Hazard Identification, Risk Assessment and Risk Control* (Hirarc) pada bengkel produksi CV. Javatech Agro Persada.	Hirarc	Machines (can be electrocuted), welding processes (impaired vision), smoke and dust (irritating and visually impaired).
16	Analisa potensi bahaya dan perbaikan sistem Keselamatan dan Kesehatan Kerja menggunakan metode Hirarc di PT. Boma Bisma Indra.	Hirarc	Get hit by sparks, hit by Gram, hit, pinched and hit by falling objects.
17	Analisis risiko Keselamatan dan Kesehatan Kerja menggunakan metode HAZOP's di area Gas Cleaning System di PT. RK.	*Operability Study* (Hazops)	Deviations that occur by recommending the prevention and treatment of deviation parts of functionability caused by operating failures can be by means of periodic maintenance, repairing damaged hydraulic hoses and if possible replacing gaskets and re-installing valves to get a good hose tension position.
18	Analisa risiko Keselamatan dan Kesehatan Kerja menggunakan standar AS/NZS 4360:2004, di perusahaan Pulp & Paper.	HIRA (*Hazard Identification and Risk Assesment*)	The raw material for pulp is crushed, exposed to NaOH liquid, legs caught in Stoper, exposed to Chlorina gas, stuck in the rewinder machine.

19	Analisis risiko Keselamatan Kerja pada kegiatan produksi Tower di PT. Kunango Jantan Padan.	Hirarc	The worker fell from the forklift, the worker's hand was squeezed during the process of transporting raw materials to the machine, hearing loss.
20	Manajemen risiko K3 pada Divisi Produksi menggunakan FMEA dan RCA di PT. XYZ.	*Failure Mode and Effect Analysis* (FMEA)	Accidents in the use of forklifts, work accidents when the machine is in error, the operator's organs are injured/broken, the operator is pinched by the machine during repair, and the maintenance evacuation route when the machine error is not safe.

• Non-Manufacturing

Table 2. Non-manufacturing paper and accident identification

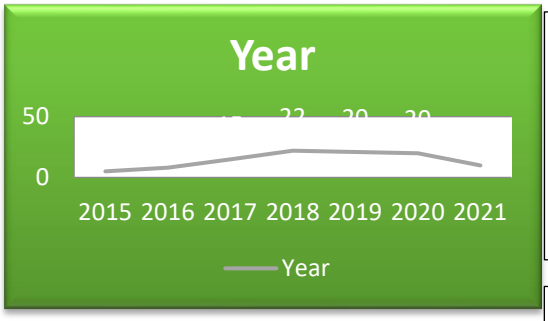
No	Title	Method	Accident Identification
1	Penerapan Kesehatan dan Keselamatan Kerja (K3) siswa di workshop tata kecantikan rambut SMK Negeri 7, Padang.	Quantitative descriptive	Air ventilation, personal hygiene (students) and use of practice tools.
2	Program Keselamatan dan Kesehatan Kerja di Laboratorium Pendidikan.	Qualitative descriptive	Exposure to chemical spills, falling or slipping, contact with heat, skin irritation, electric shock and complaints of dizziness.
3	Penerapan Keselamatan dan Kesehatan Kerja (K3) di lingkungan kerja Balai Inseminasi Buatan (BIB) Lembang	Qualitative descriptive	Using Personal Protective Equipment (APD) for the Lab and APD for the field (livestock raising).
4	Identifikasi risiko Kesehatan dan Keselamatan Kerja pada pekerja Pengumpul Sampah manual di Jakarta Selatan	Quantitative descriptive	Workers suffered stab wounds due to not wearing gloves, workers experienced respiratory problems due to work and musculoskeletal disorders.
5	Analisis risiko Keselamatan dan Kesehatan Kerja (K3) pada petugas kesehatan Instalasi Gawat Darurat Rumah Sakit Akademik UGM	Job Hazard Analisis (JHA)	Stab wounds and easily infected with infectious diseases, needles and sharp instruments puncture wounds and scrapes of ampoule fragments.
6	Analisis risiko Keselamatan dan Kesehatan Kerja di laboratorium RSUD Dr. H. Abdul Moeloek provinsi Lampung	Hazard uses Task Risk Analysis	Needle sticking in health workers can cause infectious diseases, the risk of being scratched by shards of glass when taking patient blood, irritation of the skin and eyes.
7	Analisis Risiko Keselamatan dan Kesehatan Kerja (K3) Pada Petugas Kebersihan di Rumah Sakit	JSA (Job Safety Analysis)	Exposure to dust and germs, exposure to bacteria/viruses and exposure to chemotherapy drugs, needle sticks, scratches by sharp objects, slips or falls due to slippery floors, allergies or irritation to the use of chemicals.
8	Identifikasi penerapan dan pemahaman Kesehatan dan Keselamatan Kerja (K3) dengan metode Hazard and Operability Study (Hazop) pada UMKM Eka Jaya	Hazard and Operability Study (Hazop)	Inhalation of the smell of spices can cause sneezing and coughing, the operator's fingers enter the Veltbelt accidentally touched, slip and get tired quickly, cold sweat and headache.
9	Analisis risiko Keselamatan dan Kesehatan Kerja (K3) pada petugas kebersihan Rumah Sakit Umum	JSA (Job Safety Analysis)	Exposure to germs, bacteria and viruses and exposure to chemotherapy drugs, being punctured by a needle or scratched by a sharp object, slipping

	Daerah Tugurejo, Semarang tahun 2017		or falling due to slippery floors, musculoskeletal disorders, falling from stairs, and electrocution, allergies or irritation to chemical use.
10	Analisis Risiko Keselamatan dan Kesehatan dengan menggunakan model Modified House pada Instalasi Gawat darurat (IGD) Rumah Haji, Surabaya.	Modified House of Risk (HOR)	There are no clear directions to the ER, confusing the patients, needle sticks, the layout of the ER room does not meet the standards, there is no isolation room for infected patients.
11	Penilaian Risiko Keselamatan dan Kesehatan Kerja (K3) pada Aktivitas pembuatan Gamelan	Hirarc	Exposure to heat, noise, exposure to welding rays, exposure to UV and infrared radiation, exposure to charcoal dust, inhalation of welding fume dust/fume and being hit by tin and copper raw materials.
12	Analisis risiko Keselamatan dan Kesehatan Kerja dengan metode Hazop dan pendekatan Ergonomi (studi kasus: UD. Barokah Bantul)	Hazop	Falling and slipping due to slippery floors, hot air temperatures, splashing of cooking oil when lifting crackers that have been fried manually, noisy work area, hot production room.
13	Analisis risiko Keselamatan dan Kesehatan Kerja (K3) pada pekerjaan perawat di Instalasi Gawat Darurat Rumah Sakit X, Sumatera Selatan	JSA (Job Satisfaction Analysis)	Needle sticks, scratches, burns, lumbago, sprains and contracting infectious diseases.
14	Manajemen risiko Keselamatan dan Kesehatan Kerja (K3) pada pekerjaan Galangan Kapal di Tanjungpinang	Quantitative descriptive	Working at heights, ineffective material maintenance, dusty work environment, confined space work, lack of lighting.
15	Analisis resiko Keselamatan Kerja pada departemen perawatan mesin potong PT. XYZ dengan metode *Hazard and Operability Study* (Hazop)	Hazard and Operability Study (Hazop)	The hand or finger joint is scratched and the blade is cut, exposed to wood chip dust, crushed by a circular table saw, pinched hand or finger lever.
16	Analisis manajemen resiko K3RS di Instalasi Gawat Darurat RSUP Dr. M. Djamil, Padang.	Qualitative descriptive	Risk of needle stick, risk of slipping, tripping, risk of cross-infection during the procedure, risk of exposure to hazardous and toxic materials (B3).
17	Analisis risiko Keselamatan dan Kesehatan Kerja (K3) kegiatan Bongkar Muat Pupuk.	Hirarc	Body slips and falls caused by slippery and rusty stairs, irritation, bruises due to tripping over scattered pallet boards and leaking parts, being hit by a truck, eye irritation, respiratory and hearing problems, fertilizer loading activities have a risk of back pain, bruises on hands, if the fertilizer falls from the net and gets caught in the tailgate when you want the net to be lowered into the tailgate.
18	Analisa risiko Keselamatan dan Kesehatan Kerja (K3) terhadap Kecelakaan Kerja serta Lingkungan dengan menggunakan metode *Hazard and Operability Study* (Hazop) pada proses Scrapping Kapal di Bangkalan Madura	Hazard and Operability Study (Hazop)	Operator slips while boarding the crane, (lift to truck), is crushed by the crane collapsing (towing the boat), sparks enter the eye/body (cut on board), not separating flammable equipment (cutting on board), Operator slipping while boarding the crane (lifting from ship).

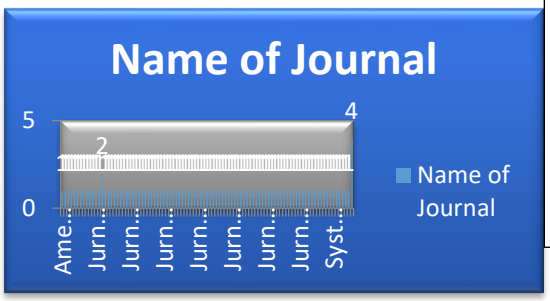
19	Analisis faktor budaya Keselamatan dan Kesehatan Kerja (K3) pada Penanganan Kargo di Bandara Soekarno Hatta, International Airport	Hirarc	The paper examines the management's commitment to safety, safety rules and procedures, the latest safety issues, practicality, safety concerns, employee involvement, reporting, awareness of personal safety, knowledge of safety, work facilities and equipment and time allocation.
20	Analisis resiko Keselamatan dan Kesehatan Kerja pada proyek Pasar Pelita Sukabumi menggunakan metode *Hazard and Operability Study* (Hazop)	Hazard and Operability Study (Hazop)	Sudden landslides hit, workers fell/slipped from a height, workers' hands were hit by hammers, formwork collapsed, workers' eyes were splashed by liquid concrete, crushed concrete molds that collapsed.

3. Methods

The research method used is the Systematic Literature Review (SLR). SLR is library activity by tracing or researching by reading books, journals, articles and other publications related to research topics to produce an article (Wicaksana & Anistyasari, 2020). The research method is carried out using the Systematic Literature Review method, namely by identifying, evaluating and interpreting existing studies (Diponegoro et al., 2021). The stages in the Systematic Literature Review are determining the research question, the search process, study selection, quality assessment, and the data extraction process (Angreni & Prastyaningsih, 2019). The literature search process is carried out using the following strategies:



Based on the analysis of the year of the study, the literature search conducted through inclusion and exclusion criteria, there were 100 journals that were relevant to the research. 2018 was the year with the most literature, namely 22 relevant literature.

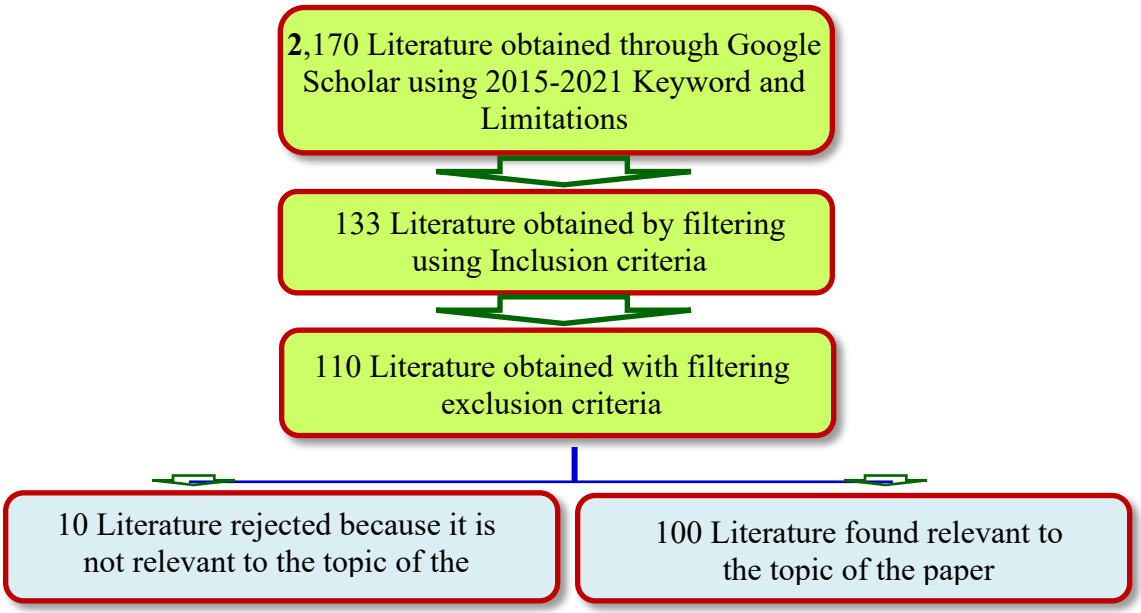


Based on the analysis of research publication journals, literature searches conducted through inclusion and exclusion criteria, there were 100 journals that were relevant to the research. The Indonesian Journal of Occupational Safety and Health is the most published journal with 4 literatures.

Based on the analysis of the research authors, the literature search conducted through inclusion and exclusion criteria contained 100 journals that were relevant to the research. Where each literature has a different author

•Year of publication: 2012-2021
•Publication Type: journal article
•Keywords: combination of "health and safety", "safety risk", "manufacturing industry" and "non-manufacturing industry"

The literature inclusion criteria used in this study are:	The literature exclusion criteria used are
• Written in Indonesian or English • Include occupational health/safety risk/ manufacturing industry/non-manufacturing industry • Published in 2015-2021	• Literature published before 2015 • Does not specifically discuss the safety risks of manufacturing/non-manufacturing industries



Picture 1. Selection of Inclusion and Exclusion in Literature Search Results
(Angreni & Prastyaningsih, 2019)

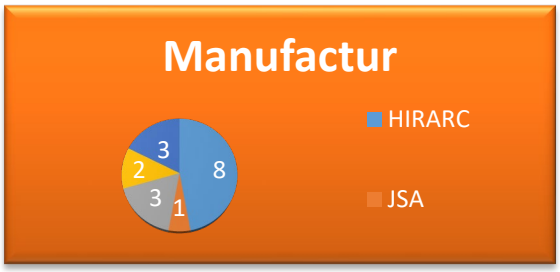
Research Question

To find out an overview of occupational safety risks, the following research questions were formulated:
RQ1: What is a Safety Risk?
RQ2: How to identify safety risks in manufacturing industry?
RQ3: How to identify Safety Risks in non-manufacturing industries?

4. Results and Discussion

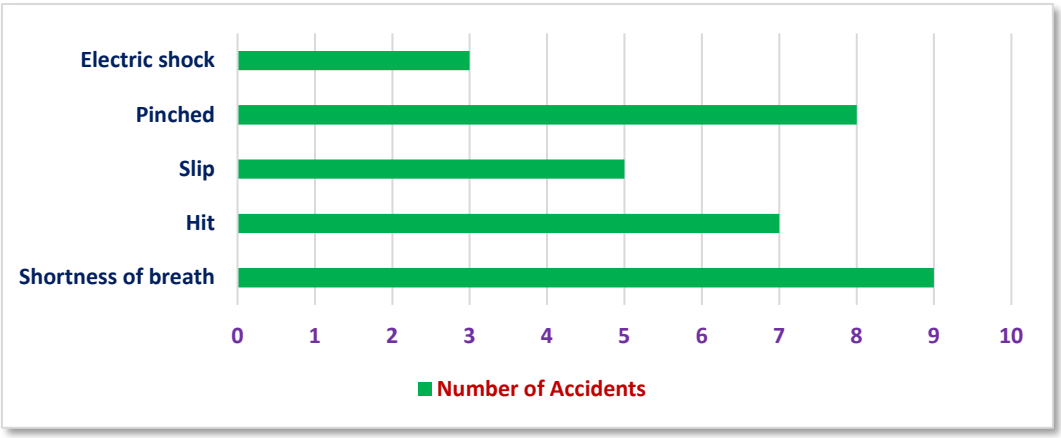
RQ1: What is a Safety Risk?
Risk is something that leads to uncertainty over the occurrence of an event that causes a loss, whether it is a small loss that is not so significant or a large loss that affects the survival of a company (Muhammad, 2020). Work safety is making safe working conditions equipped with safety devices, good lighting, keeping floors and stairs free from water, oil, mosquitoes and maintaining good water facilities (Paramita, 2012). Safety risks can occur due to aspects of the work environment that can cause fire, electric shock, cuts, bruises, sprains, fractures, and damage to limbs, vision and hearing (Hasibuan, 2017).

RQ2: How to identify safety risks in manufacturing industry?



There are 8 methods to identify safety risks in the manufacturing industry, namely: JHA, JSA, HIRARC, HAZOP, AS/NZS 4360:2004, Triangulation, HIRA and FMEA, where the most widely used methods are HIRARC, each 8 literatures.

Table 3. The five most common types of work in manufacturing.



RQ3:How to identify Safety Risks in non-manufacturing industries?

There are 8 methods to identify safety risks in non-manufacturing industries, namely: Qualitative Descriptive, Quantitative Descriptive, JSA, HIRARC, HAZOP, JSA, HAZARD Task Risk Analysis, where the most widely used method is HAZOP with 5 literatures.

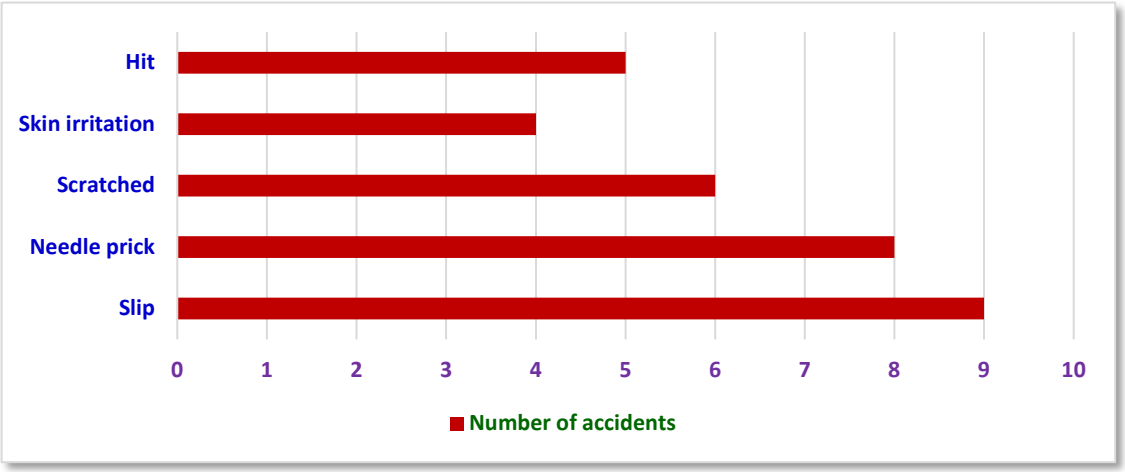


Table 4. Five types of accidents in non-manufacturing are the most common

5. Conclusion

Safety risks can occur due to aspects of the work environment that can cause fire, electric shock, cuts, bruises, sprains, fractures, and damage to limbs, vision and hearing (Hasibuan, 2017).
There are 8 methods to identify safety risks in the manufacturing industry, namely: JHA, JSA, HIRARC, HAZOP, AS/NZS 4360:2004, Triangulation, HIRA and FMEA, where the most widely used method is HIRARC as many as 8 literatures. There are 8 methods of identifying safety risks in non-manufacturing industries, namely: Qualitative Descriptive, Quantitative Descriptive, JHA, HIRARC, HAZOP, JSA, HAZARD Task Risk Analysis, where the most widely used method is HAZOP as many as 5 literatures.

Table 5. Equation of OHS risk identification in the Manufacturing industry and Non-Manufacturing.

No	Variable	Manufacturing	Non Manufacturing
1	Number of papers	20	20
2	Number of methods	8	8
3	Minimum number of accidents	4	4
4	The highest number of accidents	9	9

Table 6. Differences in the identification of OHS risks in the Manufacturing industry And Non-Manufacturing.

No	Variable	Manufacturing	Non Manufacturing
1	Most methods	Hirarc	Hazop
2	Most number of methods	8	5
3	The causes of identification of the least types of accidents	Electric shock (4)	Skin irritation (4)
4	Causes of identification of the most common types of accidents	Shortness of breath (9)	Slips (9)

5. Limitation and Future Research

Limitation Research: Due to the relatively short research time and the writer's ability to search for literature, the research results are not optimal. Future Research: Hope for researchers who want to research topics relevant to this

research to prepare enough time to conduct research and use international literature so that research results will be better.

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