

# **Occupational Health and Safety Risk Identification and Analysis of Warehouse in Distribution Sector post pandemi Covid-19**

**Amalia Ardiana**

Master of Industrial Engineering Student, Faculty of Engineering, Universitas Mercu Buana  
Jakarta, Indonesia  
[amaliaardiana92@gmail.com](mailto:amaliaardiana92@gmail.com)

**Sawarni Hasibuan**

Master of Industrial Engineering Program, Faculty of Engineering, Universitas Mercu Buana  
Jakarta, Indonesia  
Corresponding email: [sawarni02@mercubuana.ac.id](mailto:sawarni02@mercubuana.ac.id)

## **Abstract**

The Covid-19 pandemic that has occurred since the early 2020s has changed lifestyles and business processes a lot, one of which is the increase in online shopping. Consequently, the need for space to store goods increases. Distributor is a business unit that does not have a production process so that the warehouse becomes the main factor that supports the success of a business. Each business unit has potential hazards that can be risky, varying from low to high. This research aimed to identify and analyze occupational safety and health risks in the warehouse territory, particularly in the distribution sector. Hazard identification and risk assessment were carried out using the HIRA-AI method using the AS/NZS 43600:1999 standard. Risk is categorized into 3 categories i.e. low, medium, and high. The results showed that 15 activity categories in the warehouse territory consisted of 38 hazards and 42 risks. To be specific, there are 25 low-risk activities, 14 medium-risk activities, and one high-risk activity. Furthermore, from 40 occupational safety and health risks, there were 19 residual risks generated. To conclude, risk identification and analysis help organizations in achieving their optimum goals.

## **Keywords**

Risk Identification, Warehouse, Distributor, HIRA-AI

## **1. Introduction**

In Indonesia, the economy's upswing is experiencing quite a volatile situation. Previously in 2019, the economic growth was 5%, while during the Covid-19 Pandemic, it contracted to -2.1% margin in 2020. However, in 2021 the economic upturn rose again by 4.4% (BPS, 2021). In addition, from the whole 17 existing economic sectors in Indonesia, BPS noted that three business sectors experienced vast major expansion; these 3 sectors were transportation and warehousing, provider and supplier of accommodations, food, and beverages, as well as health services.

Laila (2020) estimates that the necessity of E-Commerces warehouses is predicted to escalate by about 3,400 hectares in the next five years. This statement is supported by the intensified numbers of online buyers and the pandemic situation that limits people's activities. Thus, e-commerce entrepreneurs keep pushing on to boost the volume of warehouses. It is reckoned that popular e-commerces such as Lazada have 12 logistics warehouses, and Blibli has 20 warehouses. Meanwhile, Shopee only has two warehouses.

A warehouse is a matter related to the utilization of storage space, therefore, reaching the optimal, effective, and efficient outcomes benefiting the organizations. On the other hand, the related issue of warehousing often escapes the attention of business stakeholders since it is not a priority/ major matter in the business processes. Accordingly, there are several problems that frequently arise in the field of warehousing, including inefficient warehouse layout, records of the inventory, location of goods, picking processes, and quality control.

Kulinska and Giera (2019) mentioned that diving deep into the identification and analysis of risk factors, especially in the warehouse reception section, correlates with the value of goods. Thus, it is critical to identify risk as a form of prevention that will arise from certain factors.

The risk identification that will be studied in this research covers all warehouse activities. In particular, occupational safety and health risks are closely related to the level of security for workers and their activities.

## **1.1 Objectives**

This research purposed to identify and analyze the warehouse department's occupational safety and health risks. All employees can apply the importance of understanding safety and health compliance. Hence the business processes can run smoothly whilst achieving business unit goals and maximum customer satisfaction.

## **2. Literature Review**

### **2.1. Warehouse**

The warehouse was not only used as a storage place but also became an added value to the supply chain. Some warehouses have assembly, packaging, and repair operations facilities. The warehouse function is instrumental in the supply chain because it can determine the site location, type, and warehousing arrangement (De Koster et al., 2017). The requisite for warehouses cannot be separated from costs or burden on operations, such as the labour needed, land, and information systems. On the contrary, the demand for warehouses cannot be denied, and they play a major role in the economy. Judging the warehouse's function can also match customer needs and consolidate products to reduce transportation costs (Bartholdi and Hackman, 2011). Last but not least, the role of the warehouse becomes an important element in the supply chain process (Terviez et al., 2018)

### **2.2 Distributors**

Suryanto (2016) states that a company that acts as a producer will not be able to distribute goods directly to final consumers (users); this is due to several factors, namely Geographical-Gap (differences in the geographical distance), Time-Gap (differences in time distance), Quantity-Gap (differences in the number of production) and Communication and Information Gap (difference in information and communication). Therefore, producers need a partner to help move a product or service produced to consumers as users who are called distributors.

Henanta (2014) distributor is a company business unit that implements distribution strategies that are directly related to consumers. In addition, distributing the company's goods from the factory to the customer or end users. The distributor's function is to be the temporary place for storing goods (in the form of a warehouse), keeping the goods secured from being damaged or defective while stored in the warehouse. In addition, distributors also carry out marketing functions, namely promoting, and delivering new information or programs to customers directly. A distributor is a place for storing assets or ready-to-sell goods, so it is assumed that the distributor either owns or rents a warehouse; therefore, the distributor has a relationship with the seller, warehouse, and customer (Erol & Ferrell Jr., 2004).

### **2.3 Risk Identification**

A risk is an unforeseen event that could undermine or enhance the work objectives. Therefore, a team is needed to identify and isolate all possible risks around the workspace or environment. In addition, the risk is a condition in which the possible events of a decision are known. On the other hand, risk actions can be predicted based on the probability and impact of their occurrence. Thus, identifying risks immensely helps the work of an organization to run effectively (George, 2020). Risk identification is the basis for all risk management processes, which must be carried out regularly and continuously. Whereas there are several common areas or processes for risk identification, namely, strategic planning, business functions, projects, processes, and activities (Williams, 2017). Risk identification aims to produce a comprehensive list of risks, such as their source areas, impacts, events, causes, consequences, and potential. Thus, it can increase, prevent, decrease, accelerate or delay the achievement of goals (Committee, 2009).

### **2.4 Methods of identifying occupational safety and health risks**

Identifying occupational safety and health risks involves identifying potential hazards at work. This is one of the requirements for the elements of an occupational safety management system or known as the Occupational Health and Safety Assessment Series (OHSAS). Based on the quote from Ramli (2010), there are several types of risk identification methods related to occupational safety and health, including Checklist, What-If, Hazard and Operability Research (HAZOPS), Failure Modes & Effect Analysis (FMEA), Fault Tree Analysis (FTA), Job Safety Analysis (JSA), Hazard Identification and Risk Assessment – Aspect Impact (HIRA AI) which is a combination of quantitative and qualitative analysis.

This research used the HIRA-AI method to identify and analyze occupational safety and health risks in the warehouse area of one of the distributor companies in Bekasi City, West Java.

## 2.5 HIRA-AI

Hazard identification and analysis of risk aspects and impacts are essential to the work safety process. This document is helpful for employers who do not have the time, expertise, or knowledge to undertake the process. In the form of a simple chart for identifying hazards and then adding them to the Hazard List, assessing the level of risk they pose, and suggesting ways to control the hazard (Ramesh et. al. 2017).

HIRA (Hazard Identification and Risk Assessment) is a method to identify potential occupational hazards by defining the characteristics of hazards that are likely to occur and monitoring the evaluation of risks that are likely to happen through risk assessment using a risk assessment matrix (Wardhana, 2015).

## 3. Methods

This type of research is semi-quantitative. The research design is a descriptive research design using risk identification methods from each activity and data collection techniques by field observations, literature studies, and interviews with warehouse staff and HSE staff as many as three people.

The preparation of HIRA-AI begins with identifying activities in the PT FMM warehouse area by interviewing warehouse staff, then researchers and HSE expert staff identify hazards from each activity and conduct discussions on risk assessment for each hazard. The risk assessment results from multiplying the likelihood and consequences and then producing a risk category that is included in the risk matrix. Furthermore, the risk matrix will show how hazardous it is and how to control the hazard that should be carried out.

The process of identifying occupational safety and health risks is carried out using the Hazard Identification and Risk Assessment-Aspect Impact (HIRA-AI) method, referring to Tron and Than (2021), following the research stages:

### a. Hazard Assessment

At this step, identification of hazards and potential hazards, as well as risks, is carried out, and assigning a hazard rating based on likelihood and severity through observation and interviews with warehouse staff and HSE staff.

The hazard assessment was carried out using the AS/NZS 4360:1999 standard consisting of Likelihood (L) and Consequence (C) and a risk matrix. Likelihood shows how likely an accident is to occur, while Consequence shows how severe the impact of an accident is. The reference for assessing the Consequence criteria can be seen in Table 1, while the Likelihood criteria are in Table 2.

Table 1. Consequence criteria

Level	Criteria	Description
1	Insignificant	No injuries, low financial loss
2	Minor	First aid treatment, on-site release immediately contained, medium financial loss
3	Moderate	Medical treatment required, the on-site release contained with outside assistance, high financial loss
4	Major	Extensive injuries, loss of production capability, off-site release with no detrimental effects, major financial loss
5	Catastrophe	Extensive injuries, loss of production capability, off-site release with no detrimental effects, major financial loss

Source : (Madill, 2003)

Table 2. Likelihood criteria

Level	Criteria	Description
1	Rare	It is expected to occur in most circumstances
2	Unlikely	It will probably occur in most circumstances
3	Possible	It might occur at some time
4	Likely	It could occur at some time
5	Almost Certain	It May occur only in exceptional circumstances

Source : (Madill, 2003)

The risk assessment matrix can be seen in Table 3. where risks are grouped into three categories, namely low, medium and high, with an explanation of each category in Table 4 below.

Tabel 3. Risk assessment matrix

Consequence ( C )	Likelihood (L)				
	5	4	3	2	1
5	25	20	15	10	5
4	20	16	12	8	4
3	15	12	9	6	3
2	10	8	6	4	2
1	5	4	3	2	1

Source: (Madill, 2003)

Tabel 4. Description of risk assessment

Grade	C x L	Category	Action
A	(15-20)	High	Priority action, senior management attention required
B	(8-12)	Medium	Management responsibility must be specified
C	(1-6)	Low	Manage by routine procedures

Source: (Madill, 2003)

#### b. Hazard Control

At this stage, carry out hazard and risk control from the previous assessment

#### c. Provision of information

At this stage, notification of information, education, training, and monitoring of hazards and risks to all employees is carried out

#### d. Doing Review

At this stage, a review of the hazard assessment and control process is carried out so that the small risk can be further assessed or analyzed.

## 4. Data Collection

After observations, literature studies, and interviews with related workers. The analysis results of the identification of activities and risks posed in the warehouse area are shown in Table 5 below.

Table 5. Hazard Identification and Risk Assessment – Aspect Impact Warehouse Area at PT FMM

No	Activity	Hazard	Risk	Risk Assessment			
				L	C	RR	Cat
1	Administration office  <i>Area: Indoor</i>	Paper usage	Resource-saving	0	0	0	L
		PC/Laptop screen light	Eye irritation	2	1	2	L
		Use of ATK with sharp sides (scissors, cutter)	incision wound	2	1	2	L
		Use of electricity (for PC, Laptop, AC, Lamp, etc.)	Waste of resources	2	2	4	L
			Resource-saving	0	0	0	L
		Electrocution (Electrical installation)	Loss of consciousness	2	3	6	L
		Electric short circuit	Fire	2	4	8	M
		Printer ink (Cartridge and Toner)	Environmental pollution	2	2	4	L
		Exposure to dust	Eye irritation and respiratory problems	2	1	2	L
2	Official Travel  <i>Area: Outdoor</i>	Completeness of official letter & vehicle	Violation of traffic rules administration	1	2	2	L
		No caution	- Minor to significant injuries - Vehicle damage	3	5	15	H
		Vehicle maintenance	Vehicle damage	2	2	4	L
			Vehicle good condition	0	0	0	L
		Emission	Air pollution	2	3	6	L

No	Activity	Hazard	Risk	Risk Assessment			
				L	C	RR	Cat
3	Use of Forklift: - Loading & Unloading - Allocation - Asset transfer	Lifting unit	The unit is broken	1	2	2	L
		Hit by unit	Minor to major injuries	2	4	8	M
		Crashing	- Minor to major injuries - Asset damage	2	5	10	M
		Blind Spot when lifting goods	Operator view is limited; damaged goods	3	3	9	M
	<i>Area: Outstorage, Hall A, Hall B dan Hall C</i>	Blind spot at the pedestrian crossing	Injured people, damaged goods	3	3	9	M
		Engine vibration	Minor injuries	3	2	6	L
		Emission	Air pollution	3	3	9	M
4	Use of table saw	Sharp work tool	Wound	2	3	6	L
		Sound when cutting	Hearing loss and comfort	2	3	6	L
	Wood cutting process	Exposure to wood dust	Eye irritation and respiratory distress	2	2	4	L
		Wooden side (if there are sharp fibres)	Wound	1	2	2	L
	<i>Area: Outstorage, Hall B and Workshop Area</i>	Wind spikes (93 dB)	Hearing loss	3	3	9	M
		Unit height >1.8 m	Fall	2	2	4	L
		Reuse of packing waste	Resource-saving	0	0	0	L
5	Chemical storage (Ethanol "microscope lens cleaner" and Xylene "reagent")	Flammable	Fire	2	4	8	M
		Glass bottle container (handling)	Broke, Spill	2	3	6	L
		Room temperature is not maintained	Chemical reaction	2	4	8	M
	<i>Area: Snap on Area</i>	direct contact	Skin irritation, Eyes, Breathing	2	3	6	L
6	Oil Storage <i>Area: Hall B</i>	Drops, splatters, oil spills	Polluting the environment (soil)	2	4	8	M
7	Preparation of goods that ready to send/picking list						
7.1	Pick up goods on shelves with a height of > 1.8 meters	Stumbled, Fell	- Minor injury - Asset damage	2	2	4	L
		Dropped by goods < 10 Kg	- Minor injury - Asset damage	2	2	4	L
		Room temperature is not maintained	Chemical reaction	2	4	8	M
7.2	Goods packing	Stumbled, Fell	- Minor injury - Asset damage	2	2	4	L
7.3	Handling heavy goods >25 Kg – 100 Kg	Lifting goods using a trolley	Asset damage	3	3	9	M
8	Handling heavy goods > 100 Kg – 1 ton <i>Area: Hall A</i>	The hand pallet failed to operate	Asset damage	3	3	9	M
9	Emergency Condition <i>Area: Indoor (Office)</i>	Fire, Earthquake, Medical Emergency	Death, disability, burns, damage to equipment and property	5	2	10	M

**Note:** Cat = Category; L = Likelihood; C = Consequence; RR = Risk Rating

## 5. Results and Discussion

### 5.1 Hazard Control

Hazard control is divided into two categories, namely the current control and control suggestions derived from residual risk, producing a very low hazard category. Residual risk is the level of risk that remains after the risk control method has been selected and implemented (ISO/IEC, 2014). The following is a hazard control result from the current risk matrix and the results from residual risk in Table 6.

Table 6. Hazard Control in every activity of PT FMM's Warehouse Area

No	Activity	Current Control	Residual Risk				Suggestion Control
			L	C	RR	Cat	
1	Administration office	- Does not use stacked plugs - Make sure there are no chipped cables	2	2	4	L	Make sure conditions are safe before work
	Area: Indoor	- Running a pest control program Electrical installation is certified once a year	2	2	4	L	General Affairs Division routinely inspects electrical installations
2	Official Travel	- Obey traffic rules - Drive carefully	1	2	2	L	-
	Area: Outdoor	- Perform routine vehicle maintenance - Conduct emission tests for monitoring	2	2	4	L	-
3	Use of Forklift:	Make sure the forklift used is according to the lifting capacity	2	2	4	L	-
	- Loading & Unloading	The lifting area must be clear	1	2	2	L	Additional personnel/guide assistance (as needed)
	- Allocation						
	- Asset transfer						
	Area: Outstorage, Hall A, Hall B, and Hall C	- The forklift operator is a competent and authorized person - The forklift operates at a safe speed	1	2	2	L	Additional personnel/guide assistance (as needed)
		- Adding personnel/guide assistance - Make sure the rotary lamp works	2	2	4	L	-
		- Adding personnel/guide assistance - Added forklift lane markings	2	2	4	L	-
		- Perform routine forklift maintenance - Conduct emission tests for monitoring	2	2	4	L	-
4	Wood packing process	Using earplugs with an NRR of 25 dB	2	2	4	L	-
	Area: Hall B, workshop area, and Outstorage						-
5	Chemical storage (Ethanol "microscope lens cleaner" and Xylene "reagent")	- Storage location using air conditioning/AC setting the temperature not more than 20° C - Keep away from heat sources	2	2	4	L	-
		- Keeps the room temperature cool	1	2	2	L	-

No	Activity	Current Control	Residual Risk				Suggestion Control
			L	C	RR	Cat	
6	Area: Snap on Area	- Installing MSDS					
		- Implement access control					
		Use PPE, rubber gloves, and masks	2	2	4	L	-
6	Oil storage	- MSDS: no specific hazard	2	3	6	L	
		- Make sure there is no leaking packaging					
		- Provided Oil Spill Kit in Hall B area					
7	Preparation of goods that ready to send/picking list						
7.1	Pick up goods on shelves with a height of > 1.8 meters send	- Keeps the room temperature cool - Implement access control	1	2	2	L	-
7.2	Handling heavy goods >25 Kg – 100 Kg	Do not pile up items that block the worker's view	2	2	4	L	-
7.3	Handling heavy goods > 100 Kg – 1 ton	Do not pile up items that block the worker's view	2	2	4	L	-
8	Emergency Condition	Available emergency alarms, public speakers, APAR, emergency response team, evacuation routes;	2	1	2	L	-
	Area: Indoor (Office)	Induction rules for guests and new employees; Simulation plan once a year; Collaboration with the nearest hospital.					

## 5.2 Proposed Improvement

Based on the results of the conducted risk assessment, it shows that of the overall activities in the warehouse area of PT FMM, there are 15 activity categories consisting of 38 hazards and 42 risks, with details of 25 low-risk activities, 14 medium-risk activities, and 1 high-risk activity. If based on the percentage, it can be seen in Figure 5.1 with details of 62% of activities with low risk (low risk), 35% of activities with medium risk (medium risk), and 3% of activities with high hazard, this can be seen in Figure 1.

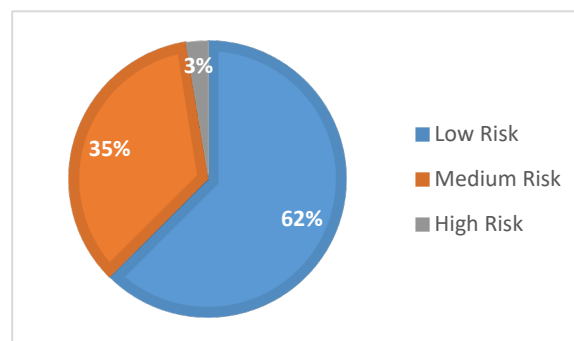


Figure 1. Occupational Health and Safety Risk Assessment at Warehouse Area PT FMM

The high hazard in PT FMM's warehouse area activities is on business trips with the hazard of not being aware; this is because the potential hazards on the trip can cause mild to severe injuries and can even cause death. Thus, the frequent type of risk in the warehouse area is low-risk, so handling and controlling hazards can be carried out on an ongoing basis with the activities carried out by related workers in their daily lives .

Based on the risk assessment, two controls aim to reduce risk to the lowest level. It can be seen in Figure 2, wherein the first risk assessment, the number of activities with low-risk was 25 activities, 14 medium-risk activities and 1 high-risk activity, which then carried out more profound control to produce 19 low-risk activities and no more risk activities, neither medium nor high. It aims to achieve an acceptable level of risk and can be controlled directly in order to avoid further harm or risk.

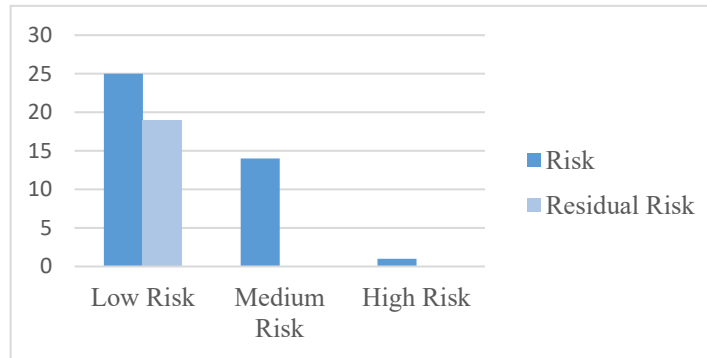


Figure 2. Risk control comparison

### 5.4 Organization Implication

This research provides important lessons about the risk for the company's management and external parties to the company. The reason is that it can reduce disruption to business processes, resulting in losses for the company itself. Occupational safety and health are important in maintaining the stability of activities or activities in the work environment. Enforcement of standard work procedures, work instructions, and hazard control forms are tools that can be used in an organization or company to control hazards and risks. The results of this research indicate that hazard control using the HIRA-AI method can reduce the frequency of disturbances in the company and ensure a safe and healthy working environment and conditions. This is evidenced by the amount of risk that can be reduced and can be well controlled in the company.

## 6. Conclusion

Life after the COVID-19 pandemic has forced all economic sectors to change dynamically. The business processes still need to run flawlessly in order to meet the demands. The call for warehouses increases along with rapid changes in buying and selling environment, such as from online/conventional methods were mostly changed to online. Therefore, it is vital to analyze the risks in the warehouse so that business processes can run well. The carried out risk identification includes occupational safety and health risks with a risk matrix assessment that produces 40 risks. Although the residual risk generated has been reduced from 40 to 19 risks, the risk remains the organization's responsibility. Occupational safety and health in this organization or company also include company policies as stated in the company's QHSE policy.

This research is closely related to the balance of workers' work and a work environment that will create safe and comfortable conditions. It is hoped that with this risk identification and analysis, the achievement of company goals will be optimal.

## References

- Bartholdi, J., & Hackman, S. (2011). *Warehouse & Distribution Science*. Georgia: Georgia Institute of Technology.
- Besterfield, D. H., Michna, C. B., Besterfield, G. H., Sacre, M. B., Urdhwareshe, H., & Urdhwareshe, R. (2012). *Total Quality Management*. Noida: Pearson.
- BPS. (2021). *Berita Resmi Statistik*. Jakarta: Badan Pusat Statistik.
- Committee, J. T. (2009). *AS/NZS ISO 31000:2009*. New Zealand: Standards New Zealand.
- De Koster, R. B., Johnson, A., & Roy, D. (2017). Warehouse design and management. *International Journal of Production Research*, Vol. 55, No.21, pp. 6327-6330.
- Erol, I., & Ferrell Jr, W. G. (2004). A methodology To Support Decision Making Across The Supply Chain of An Industrial Distributor. *International Journal of Production Economics*, pp 119-129.
- George, C. (2020). The Essence of Risk Identification in Project Risk Management : An Overview. *International Journal of Science and Reserach*, Vol 9, Issue 2, pp. 973-978.



- Hernanta, R. (2014). *Analisis Strategi Distribusi (Studi Pada Distributor PT Unilever Indonesia Tbk Area Kota Batu*. Malang: Universitas Brawijaya.
- ISO/IEC . (2014). *ISO/IEC GUIDE 51:2014*. Switzerland.
- Kulinska, E., & Giera, J. (2019). Identification and Analysis of Risk Factors in The Process of Receiving Goods Into The Warehouse. *Foundation of Management*, Vol. 11, pp. 103-118.
- Laila, R. (2020, december 31). <https://www.trenasia.com/kebutuhan-gudang-e-commerce-diprediksi-melonjak-hingga-3-400-hektare-dalam-5-tahun>. Retrieved from <https://www.trenasia.com/>.
- Loredana, E. M. (2017). The Analysis Of Causes And Effect Of A Phenomenon By Means Of The "Fishbone" Diagram. *Annals Of The Constantin Brancusi University Of Targu Jiu*, Issue 5, pp. 97-103.
- Madill, K. (Risk Management). *AS/NZS 4360:1999*. New Zealand: Standards Australia License.
- Ramesh, P. R., Magibalan, S., & Senthilkumar, P. (2017). Hazard Identification And Risk Assessment In Automotive Industry. *International Journal of ChemTch Research*, Vol 10, No.4, pp. 352-358.
- Ramli, S. (2010). *Pedoman Praktis Manajemen Risiko Dalam Persepektif K3 OHS Risk Management, Seri Manajemen K3 002*. Jakarta: Dian Rakyat.
- Suryanto, M. (2016). *Sistem Operasional Manajemen Distribusi*. Jakarta: Grasindo.
- Terziev, V., Latyshev, O., & Georgiev, M. (2018). The Warehousing As An Element of Army Logistic System In Conditions Of Artics (From Experience of Bulgarian-Russian Cooperation). *International E-Journal of Advances in Social Sciences*, Vol IV, Issue 12, pp. 778-785.
- Tron, H., & Than, N. H. (2021). Hazard Identification And Risk Assessment In Wastewater Treatment Plant of Di An City. *Thu Dau Mot Univeristy Journal of Science*, Vol. 3, Issue 1, pp. 115-128.
- Wardhana, R. T. (2015). *Analisis Risiko Keselamatan dan Kesehatan Kerja (K3) Dengan Metode Hazard Analysis*. Jember: Universitas Jember.
- Williams, C. (2017). *5 Effective Methods To Identify Risk In Your Organization*. Florida: Enterprise Risk Management

## Biographies

**Amalia Ardiana** is a master's student in Industrial Engineering from UNiversitas Mercu Buana, Jakarta, Indonesia. She graduated with her bachelor's degree at Riau University in 2009. She had worked as an assistant in Pusat Teknologi Agroindustri – BPPT, Banten. She already has six years of experience working in the logistics of the distributor sector in general trading at PT Fajar Mas Murni. She also has five years of experience as internal audit in logistics. She passed basic logistics training and internal audit training.

**Sawarni Hasibuan** is an associate professor in the Industrial Engineering Department at Universitas Mercu Buana, Jakarta, Indonesia. She completed his Masters in Industrial Engineering at the Bandung Institute of Technology and obtained a Doctorate in Agro-industrial Technology, Bogor Agricultural University. She has carried out several research and publications in industrial management, green & sustainable manufacturing, supply chain management, risk management, risk supply chain management, and renewable energy.