

Risk Management of Start-up Company (Case Study: SM Company)

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— *Review of* —
**Integrative
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ABSTRACT

Artificial Intelligence (AI) is the driving force of the industrial revolution 4.0. PT. Telkom Indonesia has a strategic role in industrial infrastructure 4.0 through Amoeba Management. SM Company (not a real name) is one of the startup manages by Amoeba Management that has been successful and has already launched its product in the VR & AR platform. In March 2020, the Covid-19 pandemic had hit Indonesia and had a negative impact on the national economy. Many companies, especially startups are getting a difficult situation. SM Company is affected and has to face the uncertain conditions by the pandemic. Therefore, to maintain stabilization company due to uncertainty during the pandemic, the effectiveness of implementing risk management can help SM Company through difficult times. By following ISO 31000, The first step in the risk management process is Risk identification. It comes by discussion with the CEO, SWOT Analysis, and Internal/External analysis. After that, creating risk measurement using Analytical Hierarchy Process (AHP) to defined risk owned by SM Company. Next, risk evaluation which maps the risk and evaluates the amount of risk to be mitigated. The last step is creating an implementation plan for SM Company. Based on the results, SM Company has 6 risk categories, including Business Risk, Financial Risk, Operational Risk, Reputational Risk, and Legal/Regulatory Risk. There is no risk categorized in the critical risk level and in the low-risk level. There are 9 risks categorized as high risks and 24 risks categorized as medium risks. The implementation plan and the schedule were formulated for high-risk levels. The action plan consists of a strategy in how to address risk, what action to be taken, and who is responsible for action to reduce the likelihood and impact of these risks.

Keywords: Risk Management, Startup, Covid-19, Analytical Hierarchy Process (AHP).

1. INTRODUCTION

Due to the importance of the transition for the position of a country in a global market, government-led initiatives were introduced all around the world to support the transition. Industry 4.0 is a strategic initiative recently introduced by the German government. The development of industry 4.0 in Indonesia is also strongly encouraged by the Ministry of industry. Currently, several national industrial sectors are ready to enter the industrial 4.0 eras. The intelligence of some of these industries has increased for automation of communication between machine-to-machine, human-to-human, artificial intelligence, and advanced technology (Rojko, 2017).

Artificial Intelligence (AI) is the driving force of the industrial revolution 4.0 that promises a lot of convenience for society and industrial sectors. This term supports the

existence of the Internet of Things (IoT) and big data where AI can be implemented (Yogaswara,2019). This AI supports all industrial sectors to lead industrial digitalization. Related to the campaign “digitalization of the on-hand industry,” we can see all the development and productivity of industry, such as digitizing data using Virtual Reality (VR) & Augmented Reality (AR) (Kominfo, 2019).

Virtual Reality (VR) is a computer-generated experience in which a user interacts with an artificial 3D world through the use of electronic devices such as special VR goggles with a screen or VR gloves with sensors. The user may have a realistic-feeling experience in this simulated artificial world. Augmented Reality (AR) differs from VR, AR enhances graphical overlays to the actual environment rather than creating a completely interactive experience (Ong, 2004). Recent reports by Grand View Research, Inc. states that the global VR market size was valued at USD 15.81 billion in 2020 and is expected to grow at a CAGR of 18% from 2021 to 2028. In addition, the increasing usage of VR & AR technology in training, oil & gas, and manufacturing sectors are driving the market growth.

In order to support industries in Indonesia to navigate the digital and industrial 4.0 eras, PT. Telkom Indonesia has a strategic role in industrial infrastructure 4.0 through Amoeba Management. SM Company (not a real name) is one of the startup manages by Amoeba Management that has been successful and has already launched its product in the VR & AR platform. SM Company faces a variety of challenges as it runs its business. In March 2020, the Covid-19 pandemic had hit Indonesia and had a negative impact on the national economy. Based on the startupranking.com, In March 2018 Indonesia had 2,079 startups. In addition, in April 2020, the figure had decreased to 1,719. It means, within one year there are more startups went into bankruptcy than those that have just started. Based on the results of research conducted by Katadata, only 48.9% of startups were able to survive until 2021 in Indonesia, 20.9% of startups survive around 6-12 months, 20.1% of startups struggling within 3-6 months, while 10% have gone bankrupt. This research involves 139 startups in the period March to June 2020. Due to Covid-19, SM Company also experienced uncertain conditions. Several plans of SM Company such as expanding to the tourism industry failed, the uncertainty of income that causes SM company’s income decreased by 50%, several work contracts were terminated which had an impact on SM Company’s business prospects, and the main change is the need for adaptations to the operating model that usually meet and explain directly to the client. But due to the pandemic, everything was done remotely which could lead to less strong engagement both internally and externally.

Many companies, especially startups are getting a difficult situation. SM Company is also affected and has to face any risks that may occur from the uncertain conditions by the pandemic that can impact the stability of the company. Therefore, to maintain stabilization and anticipate any risks and failures due to uncertainty during the pandemic, the effectiveness of implementing risk management by identifying, measuring and mitigating the possible risk can help SM Company through difficult times. Risk management is the process which enable Company to a practice proper risk assessment, and to resolve potential problems before they occur and already occur, contributes to success (Ariff et al.2014). The implementation of risk management of SM Company was considered to overcome the problems mentioned following ISO 31000, which contains risk management principles and guidelines.

2. LITERATURE REVIEW

2.1 Risk Management

Risk management is a process carried out by corporate entities such as the board of director, management, and other staff, in an applied in strategy environment and around the organization, events that which impact the company, and managing risks to achieve a company objectives. Risk management is important for efficiently dealing with possible future events that cause uncertainty and responding in a way that decreases the probability of negative outcomes while increasing the likelihood of positive outcomes. (COSO, 2004)

The risk management process starting from monitoring the problem, identifying and collecting the company's risks, measuring risks, and then deciding whether managing, accepting, mitigating, or refusing risk and then formulating a system for monitoring the risk (Olsson, 2002).

According to ISO 31000:2018, risk management has three elements: principle, framework, and process. The risk management theory is the foundation of risk management practice or philosophy. The framework is the structural and systematic implementation of risk management strategy in the organization.

2.2 Risk Type

The following are risk types:

1. Business Risk

Business risk refers to the possibility of not meeting business objectives/goals due to ineffective plans and strategies, insufficient resources, or changes in the economic or competitive environment (Olsson,2002).

2. Financial Risk

Financial risk refers to internal behavior or failures of the organizations, especially individuals, processes and systems. Financial risk arises from an organization's exposure to market price fluctuations as well as interactions with sellers, consumers, and counterparties in transactions. (Horcher,2005).

3. Operational Risk

Operational risk refers to loss due to acts on or by individuals, processes, systems or technology or similar, which have an operational impact. (Olsson,2002).

4. Reputational Risk

Reputational risk refers to the risks of an organization's reputation affected. (Olsson,2002)

5. Legal/Regulatory Risk

Legal/Regulatory risk refers to the risk of non-compliance with legal/ regulatory (Olsson,2002)

2.3 Risk Measurement

Risk measurement involves measuring the probability of risk that may occur and its potential impact (Horcher, 2005). There are several risk measurement methods, such as Value at Risk (VaR), Monte Carlo Simulation, and Analytical Hierarchy Process. VaR is a statistical measure that defines a particular level of loss in terms of its chances of occurrence, Monte Carlo simulation consists of repeatedly simulating the random processes that govern market prices and rates (Crouhy, 2014). Then, the decision-making method used in this research is the Analysis Hierarchy Process (AHP) because the AHP method has a hierarchical structure so that it can determine the criteria until to the lowest of sub-criteria. In addition, AHP has the ability to analyze multi-criteria weights based on the comparison of preferences of each element in the hierarchy (Saaty, 2008).

The Analytical Hierarchy Process (AHP) is a general theory of measurement. AHP is used to derive ratio scales from both discrete and continuous paired comparisons. These comparisons can be taken from actual measurements or from a fundamental scale that reflects the relative strengths of preferences and feelings. AHP has a concern about deviations from consistency, its measurement, and dependence within and between the groups of elements of its structure. It has the widest range of uses for multi-criteria decision-making, planning, resource allocation, and conflict resolution (Saaty, 1987).

The method of AHP is a methods in decision-making processes, developed by Thomas L. Saaty, a mathematician from the University of Pittsburg, the United States in the 1970s. AHP aims to quantify the relative priority of the given set according to the appropriate value scale. The decision is based on the perception of the individual who is supposed to make the final decision and to assess priorities, emphasizing the importance of consistency and correlation of the alternatives which has been compared in the whole decision-making process (Saaty, 2008).

According to Saaty (2008), we must decompose a decision into the following steps in order to produce goals in an ordered manner:

1. Defines the problem and determines the type of knowledge required.
2. List the selection or risk criteria, starting from general to specific.
3. Create a decision hierarchy from the top, based on decision goals, and then create goals from a broad perspective and from the middle to the lowest level.
4. Build the pairwise comparisons matrices. Each element at a higher level is used to compare the element below it.
5. Use the priority obtained from the comparison to compare the priorities of the next lower level. This should be done with all elements. Then, to get an overall priority, add its weighted value. Continue to weight and add until the lowest levels final priority is determined.

According to Saaty, pairwise comparison is a direct one-on-one comparison of two different elements. Saaty developed a 1 to 9 scale, which is the basis of what is known as a pairwise comparison. The scales from 1 to 9 are used to determine how much better one factor is than another. The human brain is well suited to discriminate intensities, initially into three basic levels: Low, Medium, and High. This scale is used to compare each element at the same level. Saaty proposed the calculation of a consistency index to ultimately obtain a consistency ratio (CR) <1.0 or 10%.

3. RESEARCH METHODOLOGY

Research Methodology in this research consists of data collection, risk management process and implementations plan. The aim of this research was to identify potential risks and risk mitigation strategies for the SM Company. The following are the steps of the research methodology shown in Figure 1.

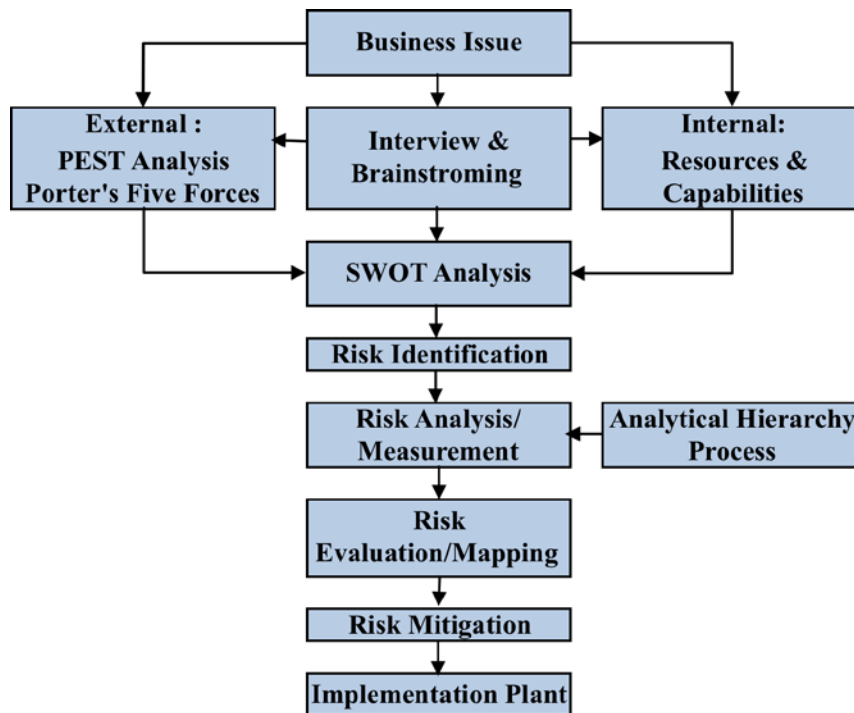


Figure 1. Research Methodology

The research methodology process begins with an interview with SM Company's CEO, who is responsible for and understands the entire business, in order to gather and describe the company's business issues. PESTLE analysis and Porter's Five Forces are used for external company analysis, while Resources and Capabilities analysis is used for internal company analysis. Identifying the risks that may occur in SM Company is the first step in the risk management process. Interview and discussion with the CEO, external analysis, internal analysis, and SWOT analysis are also used to identify risks. After defining risk identification, create risk measurement using Analytical Hierarchy Process (AHP) to determine the value of the identified risk owned by SM Company. The next step is risk evaluation, which maps the risk and evaluates the amount of risk to be mitigated. The final step is creating an implementation plan.

The methodology used for this research is qualitative and quantitative data. Analyzing the internal and external environment of the SM Company to understand the business situation generates the qualitative data. The quantitative data is obtained by calculating the risk assessment of the SM Company.

4. RISK ANALYSIS/ MEASUREMENT

Risk analysis/measurement is the second stage of the risk management process. The aim of risk analysis and assessment is to understand the essence and characteristics of risk. Risk analysis evaluates risks to provide decisions about whether risk needs to be treated and risk treatment strategy and methods. The results provide insight for decisions to mitigate the risk. The software used in this research is an Expert Choice implements the Analysis Hierarchy Process (AHP).

4.1 Risk Analysis/ Measurement Using AHP

The Analysis Hierarchy Process (AHP) is a method for decision-makers to generate alternative decisions and choose the best option based on various parameters or priorities

for making particular decisions. According to Saaty (2008), the decision needs to follow these steps:

1. Step 1: Structuring the Problem Element into a Hierarchy

In this first step, after identify the risk there are several risk factors in SM Company and transform into a hierarchy. Each risk is given by code shown in Figure 2.

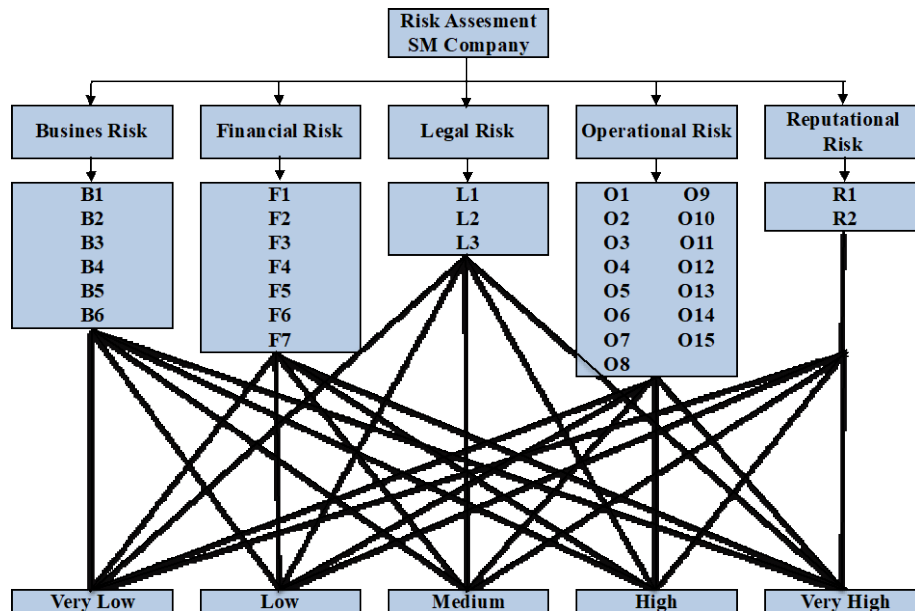


Figure 2. Hierarchy of Risk Assessment

2. Step 2: Develop Relative Weight on Each Level

The second step, the value of each criteria, sub-criteria, and risk level is calculated. The pairwise comparison scale is a numerical calculation of the relative value of two elements and the basic pairwise comparison scale is shown in Table 1. The calculation of a consistency index to ultimately obtain a consistency ratio (CR) <0.1 or 10%.

Table 1 Pairwise Comparisons Scale

Value	Definition	Explanation
1	Equal Importance	Two elements contribute equally to the objective.
3	Moderate Importance	Experience and judgment slightly favor one element over another.
5	Strong Importance	Experience and judgment strongly favor one element over another.
7	Very Importance	One element is favored very strongly over another, its dominance is demonstrated in practice.
9	Extreme Importance	The evidence favoring one element over another is of the highest possible order of affirmation.
Intermediate values can be represented using the values 2,4,6 and 8		

3. Step 3: Synthesize and Determine Level of Risk Likelihood and Impact

The third step is determining level of risk likelihood and impact and the judgment shown in Table 2.

Table 2 Judgment Matrixes and Weight of Criteria

Level of Likelihood	Value	Level of Impact
Very Low Probability	1	Very Low Impact
Low Probability	2	Low Impact
Medium Probability	3	Medium Impact
High Probability	4	High Impact
Very High Probability	5	Very High Impact

5. DATA ANALYSIS AND FINDINGS

5.1 Result of Risk Analysis / Measurement Using AHP

The comparisons matrix is to determine the relative weights of the various elements of risk, such as AHP Lvl 1 (risk category), AHP Lvl 2 (risk factor), and AHP Lvl 3 (likelihood and impact). The results of the comparisons matrix are processed by Expert Choice and normalized in Microsoft Excel as shown below.

1. Result of 1st Level of Analytical Hierarchy Process

In risk measurement, the 1st level of the AHP defines risk category analysis. Each risk type has the weight result. The higher weight result, the more important the risk type. Based on the results of the 1st Level of AHP analysis, financial risk has the most important risk category with a weight of 0.280. The second is Operational risk with a weight of 0.224. The third is Business Risk with a weight of 0.211. The fourth is Legal Risk with a weight of 0.210. The fifth is Reputational Risk with a weight of 0.074. Result of 1st Level of AHP shown in Table 3.

Table 3 The Result of 1st Level of Analytical Hierarchy Process

Risk Type	Weight	Ranking
Financial Risk	0.280	1
Operational risk	0.224	2
Business Risk	0.211	3
Legal Risk	0.210	4
Reputational Risk	0.074	5

- Based on the result, financial risk is the most important risk in SM Company because SM Company gets the targets that need to be achieved from PT. Telkom as an investor. Financial risk also affects in business prospects, operational activity, company reputation and stabilization of SM Company.
- Operational risk is the second priority of SM Company because SM Company is a technology company, which produces and delivers products and services to customers directly, so that if there are problems during production or

delivery, it will affect operational activity, operational costs and reputation of the company.

2. Result of 2nd Level of Analytical Hierarchy Process

Based on the result of 2nd Level of AHP analysis, each risk factor has the weight result to determine ranking of each risk factors. In Business Risk, the highest factor is Sales Target with a weight of 0.0509. In Financial Risk, the highest factor is Price Volatility with a weight of 0.070. In Operational Risk, the highest factor is Inadequate Backup Data with a weight of 0.024. In Reputational Risk, the highest factor is Quality of product and services with a weight of 0.056. In Legal/Regulatory Risk, the highest factor is Uncertainty of the Business Regulation with a weight of 0.139. The detail result is shown in Table 4.

Table 4 The Result of 2nd Level of Analytical Hierarchy Process

Risk Category		Risk Factor	Risk Code	Weight	Ranking
Business Risk	0.211	Competitor	B1	0.010	6
		Sales Target	B2	0.0509	1
		Price Competition	B3	0.025	5
		Customer Demand Volatility	B4	0.045	3
		Limitation Market	B5	0.029	4
		Terminate Contract Risk	B6	0.0506	2
Financial Risk	0.280	Limitation of Funding	F1	0.026	6
		Late Payment	F2	0.042	3
		Financial Capability	F3	0.016	7
		Excessive Production Cost	F4	0.036	4
		Uncertainty of Income	F5	0.057	2
		Excessive Operation Expense	F6	0.033	5
		Price Volatility	F7	0.070	1
Operational Risk	0.224	System Down	O1	0.004	15
		Asymmetric Information	O2	0.005	14
		Work Accident	O3	0.006	13
		Technological Innovation	O4	0.022	2
		Conflict Management	O5	0.009	12
		Risk of Late Response	O6	0.015	8
		Not Comply with SOP	O7	0.018	6
		Production Time Delay	O8	0.013	11
		Delivery Time Delay	O9	0.019	5
		Inadequate Data Backups	O10	0.024	1
		Integration Risk	O11	0.017	7
		Employees Turnover	O12	0.014	10
		Environmental Competence	O13	0.021	3
		Waste Product	O14	0.015	9

		Product Development	O15	0.020	4
Reputational Risk	0.074	Quality of product and services	R1	0.056	1
		Customer Complaints	R2	0.019	2
Legal Risk	0.210	Uncertainty of The Business Regulation	L1	0.139	1
		Regulated Industry	L2	0.044	2
		License Compliance	L3	0.028	3

According to the results, the following is an explanation of each high-risk category is:

- Business Risk**
The highest risk factor in the business risk category is Sales Target, with a weight of 0.0509 and has high-level likelihood and medium impact. SM Company needs to validate customer segments and business expansion during the market validation stage and Amoeba Management set the expected revenue target. According to the CEO, SM Company has reached the sales target of 80% of the set target. Moreover, SM Company's income decreased by 50% of the target set due to pandemics.
- Financial Risk**
The highest risk factor in the financial risk category is Price Volatility with a weight of 0.070 and has a high level of likelihood and a medium level of impact. Relations with the supplier are crucial for SM Company, because the material is not easily obtained from various suppliers. Therefore, price volatility from suppliers has a high probability because SM Company has to adjust the price from the suppliers. If SM Company undermines the relation, it will have an impact on the supply of materials needed for VR & AR production, which will disrupt SM Company's business operations.
- Operational Risk**
The highest risk factor in the operational risk is Inadequate Backup Data with a weight of 0.024 and has a medium level of likelihood and high level of impact. The risk can occur because of negligence and the absence of regulation to regularly backup data. Inadequate backup data has a very high impact on all operational activities.
- Reputational Risk**
The highest risk factor in the reputational risk is the Quality of product and services with a weight of 0.056 and has a medium level of likelihood and impact. According to the CEO, they always try to adjust to the customer needs and wants. Even though SM Company still develops the standard quality control of the products, SM Company always prioritizes customer satisfaction. Therefore, reputation is an important thing in this business environment because this can cause the customer bad satisfaction, not using SM Company's services and causing customer loss.
- Legal/Regulatory Risk**
The highest factor is Uncertainty of the Business Regulation with a weight of 0.139 and has a high level of likelihood and a medium level of impact. SM Company is one of Telkom's internal startup, which is funded by Telkom. So that SM Company must adjust the regulations given by Telkom. Uncertainty of the business regulation between SM Company and Telkom is the main

important thing because Telkom still has not accommodated a certainty of legality for SM Company, and it can be affected to the business operational of SM Company.

3. Result of 3rd Level of Analytical Hierarchy Process

The 3rd Level of Analytical Hierarchy Process result is calculating the likelihood and impact of each risk factor. The calculation using five level of risk (*Very High, High, Medium, Low, Very Low*) as shown below.

Table 5 Result of 3rd Level of AHP for Likelihood
(Source: Analysis)

Risk Category		Risk Factor			Risk Level Likelihood				
					VH	H	M	L	VL
Business Risk	0.211	Competitor	B1	0.010	0.0012	0.0052	0.0012	0.0012	0.0012
		Sales Target	B2	0.0509	0.0060	0.0261	0.0063	0.0063	0.0063
		Price Competition	B3	0.025	0.0030	0.0130	0.0031	0.0031	0.0031
		Customer Demand Volatility	B4	0.045	0.0063	0.0063	0.0201	0.0063	0.0060
		Limitation Market	B5	0.029	0.0041	0.0041	0.0131	0.0041	0.0039
		Terminate Contract Risk	B6	0.0506	0.0071	0.0071	0.0226	0.0071	0.0067
Financial Risk	0.280	Limitation of Funding	F1	0.026	0.0037	0.0037	0.0118	0.0037	0.0035
		Late Payment	F2	0.042	0.0058	0.0058	0.0186	0.0058	0.0055
		Financial Capability	F3	0.016	0.0022	0.0022	0.0070	0.0022	0.0021
		Excessive Production Cost	F4	0.036	0.0051	0.0051	0.0161	0.0051	0.0048
		Uncertainty of Income	F5	0.057	0.0070	0.0282	0.0083	0.0070	0.0063
		Excessive Operation Expense	F6	0.033	0.0047	0.0047	0.0149	0.0047	0.0044
		Price Volatility	F7	0.070	0.0087	0.0347	0.0102	0.0087	0.0077
Operational Risk	0.224	System Down	O1	0.004	0.0006	0.0006	0.0020	0.0006	0.0006
		Asymmetric Information	O2	0.005	0.0008	0.0008	0.0022	0.0008	0.0009
		Work Accident	O3	0.006	0.0009	0.0009	0.0028	0.0009	0.0008
		Technological Innovation	O4	0.022	0.0028	0.0108	0.0030	0.0028	0.0028
		Conflict Management	O5	0.009	0.0012	0.0012	0.0038	0.0012	0.0011
		Risk of Late Response	O6	0.015	0.0022	0.0022	0.0069	0.0022	0.0021
		Not Comply with SOP	O7	0.018	0.0026	0.0026	0.0082	0.0026	0.0024
		Production Time Delay	O8	0.013	0.0019	0.0019	0.0060	0.0019	0.0018
		Delivery Time Delay	O9	0.019	0.0027	0.0027	0.0087	0.0027	0.0026
		Inadequate Data Backups	O10	0.024	0.0033	0.0033	0.0105	0.0033	0.0031
		Integration Risk	O11	0.017	0.0024	0.0024	0.0076	0.0024	0.0023
		Employees Turnover	O12	0.014	0.0022	0.0022	0.0022	0.0049	0.0021
		Environmental	O13	0.021	0.0029	0.0029	0.0092	0.0029	0.0027

		Competence							
		Waste Product	O14	0.015	0.0021	0.0021	0.0068	0.0021	0.0020
		Product Development	O15	0.020	0.0028	0.0028	0.0089	0.0028	0.0027
Reputational Risk	0.074	Quality of product and services	R1	0.056	0.0078	0.0078	0.0248	0.0078	0.0074
		Customer Complaints	R2	0.019	0.0026	0.0026	0.0083	0.0026	0.0025
Legal Risk	0.210	Uncertainty of The Business Regulation	L1	0.139	0.0172	0.0688	0.0203	0.0172	0.0153
		Regulated Industry	L2	0.044	0.0061	0.0061	0.0195	0.0061	0.0058
		License Compliance	L3	0.028	0.0039	0.0039	0.0123	0.0039	0.0037
				Level of Likelihood	0.1338	0.2747	0.3275	0.1368	0.1262

After performing pairwise comparisons level 2, then continued with the calculation of pairwise comparisons for the level of likelihood. Based on Table 5, after getting the weights of the 5 levels of risk values (Very Low, Low, Medium, High, Very High), then the 1 value that has the highest value is taken to represents the priority of the risk factor. For example:

- In Competitor (B1), it shows that the weight of the highest level of risk is 0.0052, so that the competitor states that the level of likelihood is High.
- In Limitation of Funding (F1), it shows that the weight of the highest level of risk is 0.0118, so that the limitation of funding states that the level of likelihood is Medium.

Table 6 Result of 3rd Level of AHP for Impact
(Source: Analysis)

Risk Category		Risk Factor			Risk Level Impact				
					VH	H	M	L	VL
Business Risk	0.211	Competitor	B1	0.010	0.0017	0.0017	0.0017	0.0036	0.0015
		Sales Target	B2	0.051	0.0071	0.0071	0.0227	0.0068	0.0071
		Price Competition	B3	0.025	0.0037	0.0037	0.0103	0.0040	0.0037
		Customer Demand Volatility	B4	0.045	0.0076	0.0076	0.0076	0.0133	0.0089
		Limitation Market	B5	0.029	0.0043	0.0043	0.0119	0.0047	0.0043
		Terminate Contract Risk	B6	0.051	0.0073	0.0073	0.0205	0.0081	0.0073
Financial Risk	0.280	Limitation of Funding	F1	0.026	0.0038	0.0038	0.0107	0.0042	0.0038
		Late Payment	F2	0.042	0.0060	0.0060	0.0169	0.0066	0.0060
		Financial Capability	F3	0.016	0.0023	0.0023	0.0064	0.0025	0.0023
		Excessive Production Cost	F4	0.036	0.0052	0.0052	0.0146	0.0057	0.0052
		Uncertainty of Income	F5	0.057	0.0082	0.0082	0.0230	0.0090	0.0082

		Excessive Operation Expense	F6	0.033	0.004 8	0.004 8	0.013 5	0.005 3	0.004 8
		Price Volatility	F7	0.070	0.010 2	0.010 2	0.028 4	0.011 1	0.010 2
Operational Risk	0.22 4	System Down	O1	0.004	0.000 6	0.000 6	0.001 8	0.000 7	0.000 6
		Asymmetric Information	O2	0.005	0.000 8	0.000 8	0.002 2	0.000 9	0.000 8
		Work Accident	O3	0.006	0.000 9	0.000 9	0.002 5	0.001 0	0.000 9
		Technological Innovation	O4	0.022	0.003 2	0.003 2	0.009 1	0.003 6	0.003 2
		Conflict Management	O5	0.009	0.001 2	0.001 2	0.003 4	0.001 4	0.001 2
		Risk of Late Response	O6	0.015	0.002 2	0.002 2	0.006 3	0.002 5	0.002 2
		Not Comply with SOP	O7	0.018	0.002 7	0.002 7	0.007 4	0.002 9	0.002 7
		Production Time Delay	O8	0.013	0.001 7	0.006 7	0.002 0	0.001 5	0.001 7
		Delivery Time Delay	O9	0.019	0.002 8	0.002 8	0.007 9	0.003 1	0.002 8
		Inadequate Data Backups	O10	0.024	0.002 9	0.011 7	0.003 4	0.002 6	0.002 9
		Integration Risk	O11	0.017	0.002 1	0.008 4	0.002 5	0.001 9	0.002 1
		Employees Turnover	O12	0.014	0.002 0	0.002 0	0.005 5	0.002 2	0.002 0
		Environmental Competence	O13	0.021	0.003 0	0.003 0	0.008 3	0.003 3	0.003 0
		Waste Product	O14	0.015	0.002 2	0.002 2	0.006 2	0.002 4	0.002 2
		Product Development	O15	0.020	0.002 9	0.002 9	0.008 1	0.003 2	0.002 9
Reputational Risk	0.07 4	Quality of product and services	R1	0.056	0.008 0	0.008 0	0.022 5	0.008 8	0.008 0
		Customer Complaints	R2	0.019	0.002 7	0.002 7	0.007 5	0.002 9	0.002 7
Legal Risk	0.21 0	Uncertainty of The Business Regulation	L1	0.139	0.020 1	0.020 1	0.056 2	0.022 1	0.020 1
		Regulated Industry	L2	0.044	0.006 3	0.006 3	0.017 7	0.006 9	0.006 3
		License Compliance	L3	0.028	0.004 0	0.004 0	0.011 1	0.004 4	0.004 0
				Level of Impact	0.146 9	0.167 0	0.371 5	0.164 5	0.148 2

After performing pairwise comparisons level 2, then continued with the calculation of pairwise comparisons for the level of likelihood. Based on Table 6, after getting the weights of the 5 levels of risk values (Very Low, Low, Medium, High, Very High), then the 1 value that has the highest value is taken to represents the priority of the risk factor. For example:

- In System Down (O1), it shows that the weight of the highest level of risk is 0.0018, so that the competitor states that the level of likelihood is Medium.
- In License Compliance (L3), it shows that the weight of the highest level of risk is 0.0111, so that the limitation of funding states that the level of likelihood is Medium.

After measuring the levels of risk likelihood and impact, it can be concluded in the following Table 7.

Table 7 Final Result of AHP
(Source: Analysis)

Risk Category		Risk Factor			Likelihood Level		Impact Level	
Business Risk	0.211	Competitor	B1	0.010	0.0052	High	0.0036	Low
		Sales Target	B2	0.051	0.0261	High	0.0227	Medium
		Price Competition	B3	0.025	0.0130	High	0.0103	Medium
		Customer Demand Volatility	B4	0.045	0.0201	Medium	0.0133	Low
		Limitation Market	B5	0.029	0.0131	Medium	0.0119	Medium
		Terminate Contract Risk	B6	0.051	0.0226	Medium	0.0205	Medium
Financial Risk	0.280	Limitation of Funding	F1	0.026	0.0118	Medium	0.0107	Medium
		Late Payment	F2	0.042	0.0186	Medium	0.0169	Medium
		Financial Capability	F3	0.016	0.0070	Medium	0.0064	Medium
		Excessive Production Cost	F4	0.036	0.0161	Medium	0.0146	Medium
		Uncertainty of Income	F5	0.057	0.0282	High	0.0230	Medium
		Excessive Operation Expense	F6	0.033	0.0149	Medium	0.0135	Medium
		Price Volatility	F7	0.070	0.0347	High	0.0284	Medium
Operational Risk	0.224	System Down	O1	0.004	0.0020	Medium	0.0018	Medium
		Asymmetric Information	O2	0.005	0.0022	Medium	0.0022	Medium
		Work Accident	O3	0.006	0.0028	Medium	0.0025	Medium
		Technological Innovation	O4	0.022	0.0108	High	0.0091	Medium
		Conflict Management	O5	0.009	0.0038	Medium	0.0034	Medium
		Risk of Late Response	O6	0.01	0.006	Medium	0.0063	Medium

			5	9	m			
		Not Comply with SOP	O7	0.018	0.0082	Medium	0.0074	Medium
		Production Time Delay	O8	0.013	0.0060	Medium	0.0067	High
		Delivery Time Delay	O9	0.019	0.0087	Medium	0.0079	Medium
		Inadequate Data Backups	O10	0.024	0.0105	Medium	0.0117	High
		Integration Risk	O11	0.017	0.0076	Medium	0.0084	High
		Employees Turnover	O12	0.014	0.0049	Low	0.0055	Medium
		Environmental Competence	O13	0.021	0.0092	Medium	0.0083	Medium
		Waste Product	O14	0.015	0.0068	Medium	0.0062	Medium
		Product Development	O15	0.020	0.0089	Medium	0.0081	Medium
Reputational Risk	0.074	Quality of product and services	R1	0.056	0.0248	Medium	0.0225	Medium
		Customer Complaints	R2	0.019	0.0083	Medium	0.0075	Medium
Legal Risk	0.21	Uncertainty of The Business Regulation	L1	0.139	0.0688	High	0.0562	Medium
		Regulated Industry	L2	0.044	0.0195	Medium	0.0177	Medium
		License Compliance	L3	0.028	0.0123	Medium	0.0111	Medium

- Based on the Table 7, it can be seen that in Business risk, the Sales Target has a high level of likelihood because SM Company still developing their market. So, the probability of Sales Target not achieve more likely occur. Moreover in the pandemic situation. Then, the level of Sales Target impact is Medium because the financial condition of SM Company still support by PT. Telkom. So, the financial loss impact is not significant as well.
- In Operational Risk, the Production Time Delay has a medium level of likelihood because production time delay in SM company has a probability to occur but still manageable because SM Company already adjust the timeline of each project while produce VR/AR product and services. Unfortunately, the level of impact is high because the impact of production time delay itself will create over budget costing and affect to reputation of the SM Company.

5.2 Risk Evaluation

Risk evaluation is a process that helps to support and complete risk assessments. It could aid decision-making based on the findings of a risk analysis that meets certain requirements. This method is carried out by comparing the risk level that was determined in the previous steps and comparing process is performed using the mapped risk level (ISO31000:2008). Likelihood and impact rating scale shown in table 8.

Table 8 Likelihood and Impact Rating Scale*Source: Interview*

Likelihood Rating Scale			Impact Rating Scale		
Rating	Description	Annual Occurrence	Rating	Description	Explanation
Very Low	Rare	At least Once or Never	Very Low	Incidental	Does not really have any noticeable impact, not causing financial loss.
Low	Unlikely	1-2 times per year	Low	Minor	Minor development fixing maybe required, causing financial loss 1 – 5 million IDR.
Medium	Possible	3-4 times per year	Medium	Moderate	May result moderate complaint by customer, almost certainly need to be addressed in development and causing financial loss 5-10 Million IDR.
High	Likely	At least once or more per quarter	High	Major	May cause hard complain from customer, require significant development change in one or more condition, and causing financial loss 10-20 Million IDR.
Very High	Frequent	Several times per month	Very High	Extreme	Services completely inaccessible by customer for one or more day, causing loss of one or more customer, and causing financial loss > 100 million IDR.

Regarding to Table 8, likelihood and impact rating scale will divide by two conditions.

- In the Likelihood Rating Scale, the description means for the probability of the risk that may occur in future conditions and the annual occurrence is for the risks that already occur.
- In the Impact Rating Scale, the description means for the condition that represent situation while the risk occur, it cause some complaints from customer, require a development change and also causing financial loss.

Following Table 9, is summary for the likelihood and impact from each risk factor.

Table 9 Risk Classification Based on Risk Level
(Source: Analysis)

Risk Category	Risk Factor		Likelihood	Impact
Business Risk	Competitor	B1	High	Low
	Sales Target	B2	High	Medium
	Price Competition	B3	High	Medium
	Customer Demand Volatility	B4	Medium	Low
	Limitation Market	B5	Medium	Medium
	Terminate Contract Risk	B6	Medium	Medium
Financial Risk	Limitation of Funding	F1	Medium	Medium
	Late Payment	F2	Medium	Medium
	Financial Capability	F3	Medium	Medium
	Excessive Production Cost	F4	Medium	Medium
	Uncertainty of Income	F5	High	Medium
	Excessive Operation Expense	F6	Medium	Medium
	Price Volatility	F7	High	Medium
Operational Risk	System Down	O1	Medium	Medium
	Asymmetric Information	O2	Medium	Medium
	Work Accident	O3	Medium	Medium
	Technological Innovation	O4	High	Medium
	Conflict Management	O5	Medium	Medium
	Risk of Late Response	O6	Medium	Medium
	Not Comply with SOP	O7	Medium	Medium
	Production Time Delay	O8	Medium	High
	Delivery Time Delay	O9	Medium	Medium
	Inadequate Data Backups	O10	Medium	High
	Integration Risk	O11	Medium	High
	Employees Turnover	O12	Low	Medium
	Environmental Competence	O13	Medium	Medium
	Waste Product	O14	Medium	Medium
	Product Development	O15	Medium	Medium
Reputational Risk	Quality of product and services	R1	Medium	Medium
	Customer Complaints	R2	Medium	Medium
Legal Risk	Uncertainty of The Business Regulation	L1	High	Medium
	Regulated Industry	L2	Medium	Medium
	License Compliance	L3	Medium	Medium

The risk matrix is the next step of measurement and used with four levels of risk. In addition, matrix color codes explain about different levels of risk. The following is the definition of risk level Table 10.

Table 10. Definition of Risk Level

Risk Level	Description
Low	Risk with low likelihood and impact no significant action is needed
Medium	Risk with medium likelihood and impact that tolerable to business
High	Risk with high likelihood and impact that can danger the business
Critical	Risk with very high likelihood and impact can danger and threaten the business

Risk matrix is a simple tool to rank and prioritize risk of events and to make decisions whether certain risks can be tolerated. A risk matrix is visualizes in diagram, the risk are divided depending on their likelihood and their impact or the extent of damage. So, the worst case can be determined.

Impact	Very High	Yellow	Orange	Orange	Red	Red
	High	Yellow	Yellow	Orange	Orange	Red
	Medium	Green	Yellow	Yellow	Orange	Orange
	Low	Green	Green	Yellow	Yellow	Orange
	Very Low	Green	Green	Green	Green	Yellow
		Very Low	Low	Medium	High	Very High
		Likelihood				

Figure 3 Risk Mapping Template

The following are the results of risk evaluation that already plotted in the risk matrix according to the score obtained from each risk. Figure 4. shows the result of risk mapping.

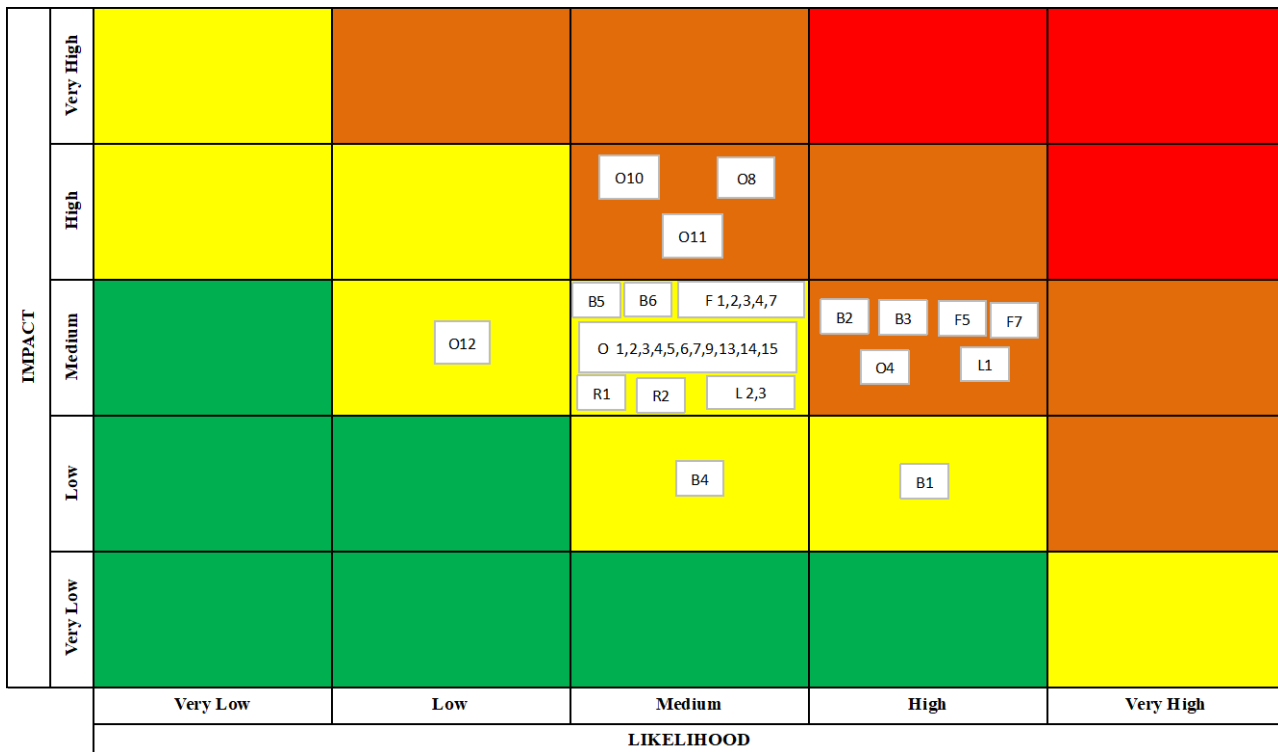


Figure 4 Risk Mapping Result

Based on the result, it can be concluded that in this research:

- 9 risk factors categorized in high risk level: B2 Sales Target, B3 Price Competition, F5 Uncertainty of Income, F7 Price Volatility, O4 Technological Innovation, O8 Production Time Delay, O10 Inadequate Data Backups, O11 Integration Risk, L1 Uncertainty of The Business Regulation.
- 24 risk factors categorized in medium level: B1 Competitor, B4 Customer Demand Volatility, B5 Limitation Market, B6 Terminate Contract Risk, F1 Limitation of Funding, F2 Late Payment, F3 Financial Capability, F4 Excessive Operation Cost, F6 Excessive Operation Expense, O1 System Down, O2 Asymmetric Information, O3 Work Accident, O5 Conflict Management, O6 Risk of Late Response, O7 Not Comply with SOP, O9 Delivery Time Delay, O12 Employees Turnover, O13 Environmental Competence, O14 Waste Product, O15 Product Development, R1 Quality of Products and Services, R2 Customer Complaints, L2 Regulated Industry, L3 License Compliance.

5.3 Risk Mitigation

Risk mitigation is the process and actions to enhance opportunities and reduce threats regarding the risk impact. Implementing risk mitigation is the method of performing risk mitigation actions by developing, planning and implementing risk mitigation.

According to the COSO framework, there are four method of risk mitigation such as:

- Accept: Not taking any action and accept the risks and condition.
- Share: Transfer a portion of the risk or external collaboration.
- Reduce: Taking actions to reduce probability and impact.
- Avoid: Avoid any activities that potentially create the risk.

Table 10 Classification of Risk Mitigation

Risk Level	Mitigation
Low	Accept
Medium	Reduce, Share
High	Reduce, Share
Critical	Avoid, Reduce, Share

The following is a risk mitigation plan from each risk factor:

Table 11 Risk Mitigation Plan

Risk Factor		Level of Risk	Risk Mitigation	Action Plan
Sales Target	B2	High	Reduce	Market expansion and penetration to other industry.
Price Competition	B3	High	Reduce	Conduct a through market pricing analysis.
Uncertainty of Income	F5	High	Reduce	Entry to the right market with has a prospect.
Price Volatility	F7	High	Reduce	Make a price contract or agreement with third parties
Technological Innovation	O4	High	Reduce	Create and implement a creative strategy of technological innovation
Production Time Delay	O8	High	Share	Find a third parties who can supply but still has the same production cost
Inadequate Data Backups	O10	High	Reduce	Maintenance the network, backup data regularly
Integration Risk	O11	High	Reduce	Maintain the data base, hardware and developing software regularly
Uncertainty of The Business Regulation	L1	High	Reduce	Make an MoU with holding company to get a legal regulation
Limitation Market	B5	Medium	Reduce	Entry to the right market with has a prospect
Terminate Contract Risk	B6	Medium	Reduce	Create an agreement contract with customer and implement contract penalties
Limitation of Funding	F1	Medium	Reduce	Maximizing available funds
Late Payment	F2	Medium	Reduce	Customer education, applies late penalties
Financial Capability	F3	Medium	Reduce	Audit financial exercise
Excessive Production Cost	F4	Medium	Reduce	Make a cost estimation for production budgetary
Excessive Operation Expense	F6	Medium	Reduce	Make a cost estimation for operation activity, audit operational cost exercise
System Down	O1	Medium	Reduce	Monitor and maintain server regularly
Asymmetric Information	O2	Medium	Reduce	Customer education, update tutorial on website
Work Accident	O3	Medium	Reduce	Implemented work safety based on existing provisions
Conflict Management	O5	Medium	Reduce	Develop a communication strategy, Hold a monthly evaluation

Risk of Late Response	O6	Medium	Reduce	Perform maintenance regularly
Not Comply with SOP	O7	Medium	Reduce	Briefing and training employee
Delivery Time Delay	O9	Medium	Reduce	Improve the effectiveness of time delivery
Environmental Competence	O13	Medium	Reduce	Monitor working environment
Waste Product	O14	Medium	Reduce	Make an adjustment for the product to provide newest solution, market survey and customize the product as customer needs
Product Development	O15	Medium	Reduce	Conducting research to find out the needs and wants of the product
Quality of products and services	R1	Medium	Reduce	Implement quality management system
Customer Complaints	R2	Medium	Reduce	Maintain customer satisfaction and improve customer services
Regulated Industry	L2	Medium	Reduce	Build relation with intense cooperation and communications with government
License Compliance	L3	Medium	Share	Make a contract with third parties
Competitor	B1	Medium	Reduce	Differentiation product
Customer Demand Volatility	B4	Medium	Reduce	Market survey and make a good demand forecast
Employees Turnover	O12	Medium	Reduce	Monthly evaluation to improve quality of work

6. CONCLUSION

According to the results, SM Company has many potential risks and requires proper-implemented risk management. SM Company still must improve its services and maintain its quality to increase the performance and sustainability of the company.

Based on the result, SM Company has 6 risk categories including Business Risk, Financial Risk, Operational Risk, Reputational Risk, and Legal/Regulatory Risk. Risks are obtained from the interview and discussion with the CEO of SM Company, SWOT analysis, and other literature research. From the result of risk identification, SM Company has 33 risk factors.

Risk analysis/measurement using Analytical Hierarchy Process (AHP) with Expert Choice Software. Based on the result of risk analysis, there is no risk categorized in the critical risk level and in the low-risk level. There are 9 risks categorized as high risks and 24 risks categorized as medium risks. The highest factor in Business risk is Sales Target. In Financial Risk, the highest factor is Price Volatility. In Operational Risk, the highest factor is Inadequate Backup Data. In Reputational Risk, the highest factor is the Quality of products and services. In Legal/Regulatory Risk, the highest factor is Uncertainty of the Business Regulation.

Based on the interview and discussion, there are 9 risks categorized in high risks level and need to made further mitigation, and implementation plan is Sales Target, Price Competition, Uncertainty of Income, Price Volatility, Technological Innovation, Production Time Delay, Inadequate Data Backups, Integration Risk and Uncertainty of The Business Regulation.

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