TEKNIKA: JURNAL SAINS DAN TEKNOLOGI

Homepage journal: http://jurnal.untirta.ac.id/index.php/ju-tek/

Analysis and determination of tofu production risk mitigation strategy using FMEA and AHP methods (Case study: UD XYZ)

Anisa Dwi Aryani [a,1], ***Wahyuda Wahyuda*** [a], ***Suwardi Gunawan*** [a]

[a]*Industrial Engineering Study Program, Faculty of Engineering, Mulawarman University, Jl. Quaro, Mr. Head, district. Samarinda Ulu, Samarinda City 75125, East Kalimantan, Indonesia*

[1]Corresponding author: anisadwi.a18@gmail.com

ARTICLEINFO

Article history:
Submitted 07 January 2022
Reviewed 31 May 2022
Revised 28 June 2022
Accepted 29 June 2022
Available online on 29 June 2022

Keywords:
AHP, BCOR, fishbone diagram, FMEA, tofu.

Kata kunci:
AHP, BCOR, diagram *fishbone*, FMEA, tahu.

ABSTRACT

In the tofu production process, UD XYZ is inseparable from the risks that may occur so that it can interfere with tofu production activities. Therefore, to handle the existing risks, it is necessary to carry out risk management by mitigating risks. Data collection techniques used are secondary data and primary data. The data processing technique and data analysis used the Failure Mode Effect Analysis (FMEA) method and the Analytical Hierarchy Process (AHP) method. The results of data processing using the FMEA method are known to be risk factors for raw materials with the highest RPN value, namely the risk of poor soybean quality with an RPN value of 720, the risk factor for the highest RPN production process is the risk of the dose of supporting raw materials not in accordance with the RPN value of 320, and the highest RPN finished product risk factor is the risk of damaged tofu when packaged with an RPN value of 36. The results of data processing using the AHP method with the help of Benefit, Cost, Opportunities, and Risk (BCOR) criteria are known that the criteria with values the highest is the benefit criteria with a value of 0.600. In the risk of raw materials, namely the quality of soybeans is not good, it is known that the chosen alternative strategy is to use the best raw material supplier with a value of 0.738. In the risk of the production process, namely the dose of supporting raw materials is not appropriate, it is known that the chosen alternative strategy is to make a Standard Operating Procedure (SOP) with a value of 0.671. The existence of SOPs will help to achieve goals because of the design that guides employees in carrying out their duties and to minimize errors when carrying out their respective tasks.

ABSTRAK

Dalam proses produksi tahu, UD XYZ tidak terlepas dari risiko-risiko yang mungkin terjadi sehingga dapat mengganggu aktivitas produksi tahu. Oleh karena itu, untuk menangani risiko yang ada maka perlu dilakukan manajemen risiko dengan memitigasi risiko. Teknik pengumpulan data yang digunakan adalah data sekunder dan data primer. Teknik pengolahan data dan analisis data menggunakan metode *Failure Mode Effect Analysis* (FMEA) dan metode *Analytical Hierarchy Process* (AHP). Hasil pengolahan data menggunakan metode FMEA diketahui pada faktor risiko bahan baku risiko dengan nilai RPN tertinggi yaitu pada risiko kualitas kedelai tidak baik dengan nilai RPN sebesar 720, pada faktor risiko proses produksi RPN tertinggi yaitu pada risiko takaran bahan baku pendukung tidak sesuai dengan nilai RPN sebesar 320, dan pada faktor risiko produk jadi RPN tertinggi yaitu pada risiko tahu rusak saat dikemas dengan nilai RPN sebesar 36. Hasil pengolahan data menggunakan metode AHP dengan bantuan kriteria *Benefit, Cost, Opportunities*, dan *Risk* (BCOR) diketahui bahwa kriteria dengan nilai-nilai tertinggi yaitu pada kriteria *benefit* dengan nilai 0.600. Pada risiko bahan baku yaitu kualitas kedelai tidak baik, diketahui bahwa alternatif strategi terpilih adalah menggunakan *supplier* bahan baku terbaik dengan nilai 0.738. Pada risiko proses produksi yaitu takaran bahan baku pendukung tidak sesuai, diketahui bahwa alternatif strategi terpilih adalah membuat Standar Operasional Prosedur (SOP) dengan nilai 0.671. Dengan adanya SOP dan pemilihan *supplier* bahan baku terbaik akan membantu memitigasi risiko prioritas sehingga risiko tersebut dapat dikendalikan dan frekuensinya berkurang.

Available online at http://dx.doi.org/10.36055/tjst.v18i1.13809

1. Introduction

Soya bean is the source of main vegetable protein and oil vegetable, processed peanut soy is also known to have price affordable by the public. Needs soya bean domestic increases every year because the amount of consumption in the community continues to increase following the increase amount resident. According to the Information Data Center Agriculture Secretary General Ministry of Agriculture in 2019, the production of soybeans in Indonesia in 2018 amounted to 982.60 thousand tons, while consumption direct about 1.99 million tons, so the production of domestic soybeans yet capable Fulfill existing needs [1].

Production is activities that can change the input and becomes output [2]. Production knowledge, in general, started from the election ingredient raw, production process knowledge and product so know until ready marketed to the consumer. UD XYZ is one of the factories engaged in processing food made from base soybeans. In one day, UD XYZ produces know 6 to 7 sacks of soybeans, with heavy soybeans per sack being 50 kg.

Production knows what UD XYZ does not miss from possible risks occur so that could disturb production know. Risk is a certain situation that is being faced by a person or company in which there is a possibility of loss [3]. Risks that occur in production know among others, namely, quality Soybean used no good that is seen from peanut Soybean used for make know in the state no ok, happened error moment measure ingredient standard, as well happening product damage so know like know destroyed. Based on existing the risk could give impact loss to factory know like no fulfillment needs request consumer. Risks must be controlled, this aims to minimize the impact that occurs as a result of the risks posed [4]. Because of that, to handle existing risk the so need did manage risk. Analysis and Mitigation Risks that occur in the factory know conducted with the use methods Failure Mode Effect Analysis (FMEA) and methods Analytical Hierarchy Process (AHP).

Method Failure Mode Effect Analysis (FMEA) will identify several risks during production. Identification conducted with giving value on each potency failure Risk based on level occurrence, level severity, and level detection, with highest RPN value and enter in factor risk tall will made risk priority deep determination of treatment strategy risk [5]. To determine treatment strategies risk for reducing or resolving risk priority based on the highest RPN conducted with the method Analytical Hierarchy Process (AHP). The Analytical Hierarchy Process (AHP) is one of the technique quantitative used for taking decisions using several variables with process analysis graded [6].

The study was previously used as a reference including the application of FMEA and AHP Methods in Management Strategy Formulation Yogurt Production Process Risks. Research results using the FMEA method show the risk highest of each variable which is the quality of fresh milk (milk contains bacteria pathogens), production processes (quality starter bacteria decreased/died), and the product so (competitor product kind). Based on the calculation of AHP obtained a strategy for minimizing the risk that is training intensive for the breeder, increasing care machinery and equipment, and partnership with perpetrator other businesses [7]. Study about analysis and determination of mitigation strategies risk in the production process product sweet potato processing. Research results with the use FMEA method found 53 risks with 15 risks to the product bakpia, 16 risks to the product thymus, and 22 risks to the product wingko. Using the AHP method obtained 19 mitigation strategies with 6 mitigation strategies on the product bakpia, 6 mitigation strategies on product thymus, and 7 mitigation strategies on the product wingko [8]. Study about analysis risk and production process mitigation strategies rice with results study using Fuzzy FMEA obtained in the form of 25 risks with risk priority input (competitor buyer rice), process (damage to the driving motor main), and output (supplier competitors). Based on a calculation using AHP known mitigation strategies selected priority that weaves partnership 0.731, maintenance machine by routine 0.637, and maintains quality product 0.637 [9].

2. Research Methodology

There are two data sources used in this study namely primary data and secondary data. Primary data is research data obtained directly from the source original or not through an intermediary. Primary data collection techniques use three-technique which is techniques observation of the field, interviewing respondents, and filling out the questionnaire by respondents. Observation is an activity carried out directly in the field to find out the incident or atmosphere that occurs significantly at the research location, while the interview is a question and answer activity between the researcher and the respondent, this is useful for obtaining information related to research [10]. The second data used is secondary data, namely the data obtained no directly obtained from other sources such as the internet, books, and working document as supporting data or complement the primary data [10].

Observation direct to UD XYZ in particular moment ongoing production process know conducted with method observe the production process know, the stages of the production process know at UD XYZ, see potency risk what only in the production process know. The interview was conducted together with the respondent namely Mr. X the owner of UD XYZ, to clarify the risks involved in the tofu factory and to find out the causes and effects of the risks in tofu production. The charging questionnaire by respondents conducted as many two stages, which is first filling in the FMEA questionnaire conducted to obtain a list of risks in production activities in the tofu factory, to obtain severity, occurrence, and detection values. On each of the risk lists and last is fill in AHP questionnaire conducted to determine mitigation strategy right risk from the risk that is obtained from comparison data in pairs between alternative mitigation strategy risks for determining weighting priority respondents. Data secondary used is a profiling data company, activity data production, and study literature research. After Step data collection, then conducted data processing using the method Failure Mode and Effect Analysis (FMEA), Cause and Effect Analysis (CEA) method Analytical Hierarchy Process (AHP) with BCOR criteria.

2.1. Failure Mode Effect Analysis (FMEA)

Failure Mode and Effect Analysis (FMEA) is used for check all activity where failure could happen. Every failure, made estimation the effect to system, design, process, or total service, seriousness its occurrence, occurrence (frequency), and detection her. Failure Mode and Effect Analysis (FMEA) will identify action necessary corrective for prevent happening failure, with thereby ensure power durability, quality and reliability highest in product or service. Following this is steps carried out in method Failure Mode and Effect Analysis (FMEA) [11].

a. Identify known and potential failure modes,
b. Identify cause and effect from each failure mode,
c. Prioritizing identified failure modes by the risk number priority (RPN): failure (Severity -S), frequency of failure (Occurance -O), and the ability to detect failure (Detection -D),
d. Provide act carry on the problem and action corrective.

Function from use Failure Mode and Effect Analysis (FMEA) is a tool to help decide in analyze priority risk by quantitative. The Risk Priority Number (RPN) will help give consideration action corrective on any failure mode with use formula as following [12].

$$RPN = S \times O \times D . \quad (1)$$

Rating score severity (severity) is a numerical rating of seriousness impact of failure on customers. Ratings score occurrence is the expected frequency or the cumulative number of failures (based on experience) that occurred. The rating score failure detection (detection) is a rank numeric of probability that a given control will find a specific cause or failure for prevent thing bad happens. That rating score can see in Table 1, Table 2, and Table 3 [11].

Table 1. Severity effect [11].

Effect	Severity effect	Ranking
Hazard with no warning (HWOW)	May endanger the operator or equipment. Greatly affects the safe operation of the process and/or involves non-compliance with government regulations. Failure happens without warning.	10
Hazard with warning (HWW)	May endanger the operator or equipment. Greatly affects the safe operation of the process and/or involve non-compliance with government regulations. Failure will happened with warning.	9
Very High (VH)	Disturbance big in line production. Almost 100% product possible for thrown away. Process not could reliable. Customers really don't satisfy.	8
High (H)	Disturbance big in line production. Some (>30%) products possible for thrown away. Process possible stop. Customer no satisfied.	7
Moderate (M)	Interruption is currently in production. Moderate (> 20%) of product may have to be discarded. Process walking, but some inconvenience there is.	6
Low (L)	Low disturbance on the production line. Moderate (< 15%) of products may have to be reworked. Process walking, but some small interference exists.	5
Very Low (VL)	Very low disturbance on the production line. Moderate (< 10%) of very low product may have to be reworked. Process running, but there is a small glitch .	4
Minor (MR)	A or disruption to the production line. A small portion (<5%) of the product may have to be reworked. Process s is running, but there is a minor glitch.	3
Very Minor (VMR)	Very little disturbance on the production line. A small portion of the product may have to be reworked.	2
None (N)	No effects noticed by customers. Failure will not affect the customer	1

Table 2. Value occurance [11].

Ranking	Incident	Probability of failure	Criteria
10	Almost Certain	1 of 2	Failure almost certain happened, the history of the process is similar show many failure
9	Very high	1 of 3	Very high probability occur failure
8	Tall	1 of 8	Possibility tall occur failure
7	Relatively tall	1 of 20	Possibility often occur failure
6	Trending _ tall	1 of 80	Possibility medium occur failure
5	Currently	1 of 400	Sometimes amount failure occur
4	Relatively low	1 in 2,000	A little occur failure
3	Low	1 of 15,000	Very little failure
2	Very low	1 of 150,000	Seldom occur failure
1	Not there is	1 of 1.500.000	Similar process history no show existence failure

Table 3. Detection value [11].

Detection	Rating	Criteria
Almost undetectable	10	No controls to detect potential failure
Very small	9	There are very few controls to detect potential failures
Small	8	There are few controls to detect potential failure
Very low	7	There is control but very low ability to detect potential failure
Low	6	There is control but low ability to detect potential failures
Currently	5	There are controls that have moderate/sufficient capability to detect potential failures
A bit high	4	There is a control that has a moderate ability that tends to be high to detect potential failures

Detection	Rating	Criteria
Tall	3	There are controls that have a high ability to detect potential failures
Very high	2	There are controls that have a very high ability to detect potential failures
Almost Sure	1	Controls can almost certainly detect potential failures

Risk Priority Number (RPN) is obtained based on score severity, occurrence and detection. RPN risk level created scale for make it easy company or organization determine action in face existing risks [13].

Table 4. RPN risk level [13].

Risk Level	RPN
Very high	X □≤ 200
Tall	120 – 199
Currently	80 - 119
Low	20 - 79
Very low	0 - 19

In face risk owner risk need to do action for avoid existing risks, terms this conducted with determine level risk until limit certain to know how respond existing risks, namely with accept or give tolerance to risks faced [14].

Table 5. Response risk [14].

Risk level	Risk appetite	Risk tolerance	Action and escalation
Very high	The risk is unacceptable and needs control treatment, especially responsive action	The risk is not accepted and tolerated, the risk treatment needs to be reviewed for improvement or additional treatment or new replacement	Need the attention of the board of directors, control can be delegated to the relevant director and supported by a detailed plan
Tall	The risk is unacceptable and requires control treatment, both preventive and responsive		Requires the attention of the relevant director, the control is escalated to the relevant senior manager and is supported by a detailed plan
Currently	The risk is unacceptable and needs control treatment, especially preventive measures		Control is escalated to senior manager as risk owner and supported by detailed plan
Low	Risk is unacceptable but control treatment is only carried out if the benefits outweigh the costs	Risk is unacceptable but tolerable, risk treatment is ALARP (As Long As Reasonably Practical)	Sufficient control by field managers in accordance with applicable policies
Very low	The risk is acceptable so it doesn't need treatment, it's enough with existing controls, but needs to be controlled monitor by risk owner	The risk can be accepted and tolerated so that it does not need adequate treatment with existing controls, but needs to be monitored by risk owner	Maintain existing controls and monitor increased risk events for risk treatment

2.2. Cause and Effect Analysis (CEA)

Cause and Effect Analysis (CEA) or also known as Fishbone Diagram, namely draft analysis because the result that Kaoru Ishikawa discovered for identify problems and causes with method make form a fish skeleton. The consequence of the problem is depicted as fish head and causes the problem described in section fishbone [15]. Cause and effect could use for the various thing of them as follows [16].

a. Help in identifying the cause and one more problem detail from the root,
b. Help in raises the view to search solution from a problem,
c. Help in doing identification or further fact-finding,
d. Help identify the actions taken to get the desired result, and
e. Help explain problem completely and in detail.

2.3. Benefits, Opportunities, Costs, and Risks (BCOR)

The strategic analysis can be done using the criteria of Benefit, Cost, Opportunities, and Risk (BCOR), the calculation is carried out using the pairwise method comparison. Desired criteria as benefits (Benefits), unwanted criteria as costs (Cost), events that may occur and can be detrimental or beneficial as criteria for opportunities (Opportunities), and risk as criteria (Risk). Definition criteria are strategically based on Benefit, Cost, Opportunities, and Risk (BCOR) [17].

a. Benefits, namely considerations that can give benefit or superiority to an organization or company,
b. Cost, that is considerations that can cause loss for an organization or company,
c. Opportunity, that is considerations that can give possibility profit in the future come for an organization or company, and
d. Risk is a consideration that can give the possibility of future loss come for an organization or company.

2.4. Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) is method for solve something complex situation and not structured into the number of components in hierarchical arrangement, with give score subjective about importance every variable by relative, and set which variable has highest priority to use influence result on situation it [18]. Hierarchy have definition as something representation from a complex problem in something multilevel structure where the first level that is goal, which then followed by the level of factors, criteria, sub-criteria, and so on to the last level from alternative. In method The Analytical Hierarchy Process (AHP) has evaluation to all criteria and alternatives with comparison in pairs [19]. Is known possible stages conducted in use method Analytical Hierarchy Process (AHP) which can spelled out as following [20].

a. Define problem and then set desired solution,
b. Make structure starting hierarchy with destination general and continued with criteria and alternatives choice,
c. Make matrix comparison in pairs that describe contribution relatively or influence every element to destination or criteria that are a level above it. Comparison conducted based on choice or judgment from maker decision with evaluate level interest something element compared element other,
d. Normalize the data with share score from every element inside paired matrix with total value of every column,
e. Count score eigenvector and test the consistency, if no consistent so data collection (preference) is necessary repeated. The eigenvector value in question is score eigenvector maximum obtained,
f. Repeat steps 3, 4, and 5 for whole level hierarchy,
g. Count Eigen vector from every matrix comparison in pairs. The eigenvector value is weighting every element,
h. Test consistency hierarchy. If not fulfill with CR≤0.1 then evaluation must repeat back.

1) Count Consistency Index (CI)

$$CI = (\max - n) / (n - 1) \tag{2}$$

2) Random Index (RI)

Table 6. Random index [18].

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

3) Calculate Consistency Ratio (CR)

$$CR = CI / RI \tag{3}$$

The research instrument used the AHP method in the form of a questionnaire questionnaire. The questionnaire contains questions about the comparison of two elements or pairwise comparisons, the scale used is a scale of 1 to 9 The level of intensity of interest can be seen in Table 7 [18].

Table 7. Level of intensity interest.

Intensity interest	Definition	Explanation
1	Equally important	Two criteria contribute same to destination
3	A little more important	Experience and assessment a little support one criteria on other criteria
5	More important	Experience and assessment are very supportive criteria on other criteria
7	very important	One very strong criterion over others domination showed in practice
9	Absolute important	Supporting evidence one criteria above the others is order affirmation highest possible
2,4,6,8	For consideration between values on	Values Among two score close consideration

Values comparison between elements that have been obtained, then processed for determine rating weight elements (criteria) of whole existing elements. Well element qualitative nor element quantitative could compared in accordance with evaluation from informants/respondents (judgment) who have determined for produce weight priority [18].

3. Results and Discussion

3.1. Identification Risk

Identification is based on data collection through literature studies, observations and interviews conducted with tofu factory owners, it is known that the risks that occur in tofu production activities are contained in three risk factors, namely risk factors for raw materials, risk factors for the production process, and risk factors for finished products. The risks that exist in the risk ingredient raw materials, production processes and products so could see in Table 8.

Table 8. Risk list data

No.	Risk factors	Risk
1	Raw material	Soybean quality is not good
		Wood cannot be used as fuel
		Raw material prices go up
		Raw materials arrived late

No.	Risk factors	Risk
2	Production process	The dosage of supporting raw materials is not appropriate
		Error printing tofu
		Tofu printer is broken
		Broken heat supply hose
		Soybean grinding machine is broken
		Mistakes when soaking soybeans
		Tofu juice does not boil steadily
		Power outage
3	Finished product	Tofu is damaged when stored
		Tofu is damaged when packaged
		Tofu producer competitors
		Delivery delays know to customers

3.2. Rating Risk Use FMEA Method

After conducted identification risk, step next in FMEA method is to do evaluation risk. Evaluation to the risks that occur conducted with use questionnaire and filled out by the owner factory know as respondents. Existing risk given score based on score severity impact failure (severity), value possibility happening failure (occurrence), and the value of level detection failure (detection). Got results evaluation risk based on identification that has been done on production know, at UD XYZ which can be seen in Table 9.

Table 9. Risk assessment results.

Factor risk	Risk	Severity	Occurance	Detection
Raw material	Soybean quality is not good	8	9	10
	Wood is not could used as ingredient burn	7	8	2
	Raw material prices go up	5	7	3
	Raw materials arrived late	3	3	1
Production process	Dosage of supporting raw materials is not appropriate	8	4	10
	Error print know	3	2	2
	Tofu printer is broken	7	2	1
	Broken heat supply hose	5	2	1
	Soybean grinding machine is broken	8	3	2
	Mistakes when soaking soybeans	7	3	2
	Tofu juice does not boil steadily	8	3	1
	Power outage	7	1	10
Finished product	Tofu is damaged when stored	5	2	1
	Tofu is damaged when packaged	6	3	2
	Tofu producer competitors	2	5	1
	Delivery delays know to customers	4	2	1

In order to get knowing risk priority must conducted mitigation need to do measurement risk and then ranking risk based on highest RPN value. Measurement risk conducted use FMEA method and then rank risk so that could find risk highest entry into the category need conducted mitigation. Calculation RPN value on factor risk ingredient raw with risk quality soya bean no good with category severity (S) is 8, occurrence (O) is worth 9, detection (D) is worth 10 using the RPN formula is 8x9x10 with 720 results. Complete results RPN calculation on each risk could see in Table 10.

Table 10. Ranking RPN risk

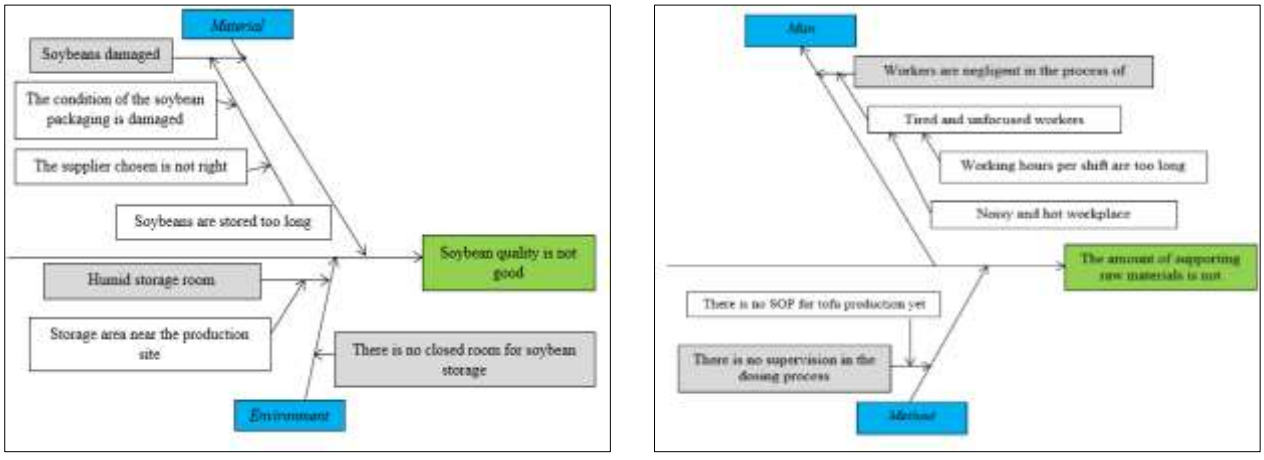
Factor risk	Risk	RPN	Category	Rank
Raw material	Soybean quality is not good	720	very high	1
	Wood is not could use as ingredient burn	112	Currently	2
	Raw material prices go up	105	Currently	3
	Arrival of raw materials	9	Low	4

Factor risk	Risk	RPN	Category	Rank
Production process	Dosage of supporting raw materials is not appropriate	320	very high	1
	Power outage	70	Low	2
	Soybean grinding machine is broken	48	Low	3
	Mistakes when soaking soybeans	42	Low	4
	Tofu juice does not boil steadily	24	Low	5
	Tofu printer is broken	14	Very low	6
	Error print know	12	Very low	7
	Broken heat supply hose	10	Very low	8
Finished product	Tofu is damaged when packaged	36	Low	1
	Tofu is damaged when stored	10	Very low	2
	Tofu producer competitors	10	Very low	3
	Delivery delays know to customers	8	Very low	4

Based on Table 10 shows that the risk factor for raw materials is the risk with the highest RPN value, namely the risk of poor soybean quality with an RPN value of 720. The risk factor for the production process is the risk with the highest RPN value, namely the risk that the dose of supporting raw materials does not match the RPN value of 320. The risk factor for finished products is the risk with the highest RPN value, namely the risk of tofu being damaged when packaged with an RPN value of 36. Refers to determining the level of risk The RPN value in Table 4 is known that RPN value with value 720 includes into the risk level very high RPN≥200 and based on Table 5 regarding response level risk, if risk is at a very high level so risk no could acceptable and necessary treatment control especially action responsive, because that need conducted mitigation risk to risk quality soya bean no good. On factor production process risk with highest RPN value that is at risk dose ingredient raw supporter no in accordance with RPN value of 320. Refers to the determination of the risk level The RPN value in Table 4 is known that RPN value with value 320 including into a very high-risk level RPN≥200 and based on Table 5 regarding response level risk, if risk is at a very high level so risk no could acceptable and necessary treatment control especially action responsive, because that need conducted mitigation risk to risk dose ingredient raw supporter no appropriate. On factor risk product so risk with highest RPN value that is at risk know damaged moment packed with RPN value of 36. Refers to the determination of the risk level The RPN value in Table 4 is known that RPN value with value 36 includes into the risk level low namely RPN 20-79 and based on Table 5 regarding response level risk, if risk be at level low so mitigation risk to risk knows damaged moment packed enough by the owner factory know in accordance applicable policy.

3.3. Risk Fishbone Diagram

In order to identify the sources of priority risk causes, a fishbone diagram is used as a tool to identify the causes of risks that occur in tofu production activities, which can be seen in Figure 1 as follows:



(a) **(b)**

Figure 1. - (a) Quality *fishbone diagram* soya bean no good; (b) *Fishbone diagram* dose ingredient raw supporter no in accordance.

In identification because consequence using fishbone diagram tools is done with all factor 4M+1E will be but at the time to do data collection only obtained a number of factors only one of them factor materials, environment, methods, and man. Identification result because consequence with help fishbone diagram tools obtained that at risk quality soya bean no good have source reason from side materials and environment. On root material reason the problem, be at less specifically choose suppliers and conditions packaging soya bean moment purchase damaged Thing this make soya bean too long stored in the warehouse storage, thing the result in seed soya been broken. In the root environment reason problem originated from the place storage close the place production so that result in room storage moist, and not there is room closed for the place storage soybeans.

From result identification because consequence with help fishbone diagram tools obtained that at risk dose ingredient raw supporter no in accordance have source reason from side man and methods. On the root man reason, the problem is in place less work conducive that is noisy and hot, and the working hours per shift are too long so that worker feel tired and not focus moment work Thing this result in worker negligent during the manufacturing process

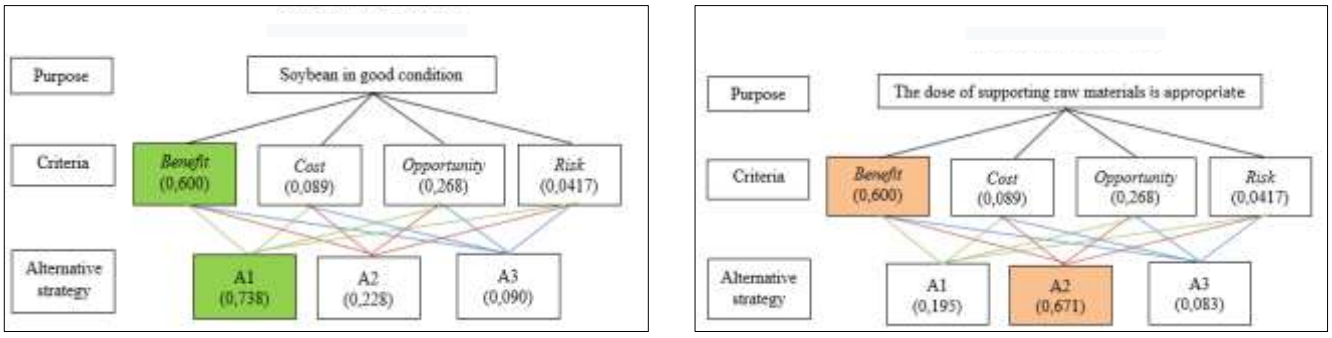
know. In the root method reason the problem is not yet production SOP know so that result in no existence supervision stricter and more structured in the dosing process.

3.4. Data Processing with Analytical Hierarchy Process (AHP)

Stage data processing using AHP method is performed with stages started from determination purpose, manufacture criteria, determination alternative mitigation strategy risk, preparation structure hierarchy, formation matrix comparison pair, normalization weight and consistency test, and determination of mitigation strategy priorities risk. In study this based on priority the risk that has been known, found destination main in handle from the risk that exists in the risk ingredient raw that is soya bean in condition good and risk in the production process that is dose ingredient raw supporter no appropriate.

Criteria are made based on Benefit, Cost, Opportunity, and Risk (BCOR) criteria to assist in considering alternative decisions on appropriate risk mitigation strategies, in accordance with the objectives that have been set. Alternative strategy for factor risk ingredient raw that is using the best raw material supplier (A1), creating a special raw material storage warehouse (A2), and arranging the location of the raw material storage room (A3). Alternative strategy for factor production process risk that is create a comfortable work environment (A1), create Standard Operating Procedures (A2), and regulate employee working hours (A3). Determination of alternative strategies is carried out to deal with priority risks for each of the previously known risk factors. The purpose of determining this strategy is to deal with risks that occur by reducing the frequency of occurrence of risks, reducing the impact, and increasing the ability to detect risks that exist in tofu production activities. After determining alternative risk mitigation strategies, the next step is to develop a hierarchical structure based on objectives, criteria, and alternative risk mitigation strategies. Structure hierarchy based on objectives, criteria and alternative mitigation strategies risk could see in Figure 2.

If structure hierarchy has made so next is conducted formation matrix comparison in pairs. Matrix comparison in pairs made based on results from AHP questionnaire conducted together respondent that is owner factory know. Result of questionnaire that has been filled in by the respondent will processed return the data with test normalization weight and consistency test. Destination conducted testing this for test consistency comparison among criteria and between alternative strategies as well for show priority each element. If in the consistency test of incoming data into the category consistent then the data can be accounted for answer the truth and continue step by step next that is priority strategy determination for mitigate risk. In determining the priority of risk mitigation strategies, it is carried out based on the greatest weight of each criterion and alternative strategies. The results of the calculation of the weight of the criteria and alternative strategies can be seen in Figure 2.



(a) **(b)**

Figure 2 . - (a) Structure hierarchy factor risk ingredient raw; (b) Structure hierarchy factor production process risk.

Based on structure hierarchy in Figure 2, it is known that for handle risk factor risk ingredient standard, got priority criteria selected that is on the criteria benefits with value 0.600 and priority alternative strategy chosen that is use supplier's ingredient raw best (A1). Mitigation strategy risk use material suppliers raw best need conducted for reduce impact the risk that occurs consequence from quality ingredient standard used not good which one can influence smoothness activity production and influence quality the resulting output. Soybean used as ingredient raw making know should fulfill quality seed soybean SNI 01-3922-1995 with minimum quality II [21].

For handle risk factor production process risk, obtained priority criteria selected that is on the criteria benefits with value 0.600 and priority alternative strategy chosen that is make Standard Operational Procedure (SOP) (A2). Compilation Standard Operational Procedure (SOP) at UD XYZ is carried out based on the problem that happened in production know that is during the measuring process ingredient raw supporters. With existence SOPs in something company, will help the company for achieving goals with design which serve as guidelines for employees in carrying out their duties and to minimize errors when performing their respective duties.

4. Conclusions

Based on the results of the research that has been done, the following conclusions are obtained:

1. There are 16 risks production that occurs at UD XYZ, risk the divided to in 3 factors risk 4 risks on factors ingredient standard, 8 risks on production process factors, and 4 risks on factors product so.
2. Mitigation risk need done on factor risk ingredient raw that is risk quality soya bean no good because have risk highest with an RPN of 720, mitigation risk need done on factor production process risk that is risk the dosage of supporting raw materials is not appropriate because have risk highest with an RPN of 320, and mitigation risk factor product so that is risk know damaged with RPN 36, enough customized based on policies applied by the owner company.
3. Got the criterion with the highest score is on the benefit criteria with value 0.600. The priority of alternative risk mitigation strategies on the risk of raw materials, namely the quality of soybeans is not good, the alternative strategy chosen is to use the best raw material supplier with the value of 0.738 and the priority of alternative risk mitigation strategies on the risk of the production process namely the dose of supporting raw materials is not appropriate, alternative the chosen strategy is make Standard Operational Procedure (SOP) with value 0.671.
4. Mitigation strategy risk quality soya bean no good is with use material suppliers raw best with method choose supplier based on soybeans that meet quality seed soybean SNI 01-3922-1995 with minimum quality II. Mitigation strategy risk dose ingredient raw supporter no in accordance that is make

Standard Operational Procedure (SOP) (A2). Compilation Standard Operational Procedure (SOP) at UD XYZ is carried out based on the problem that happened in production know that is during the measuring process ingredient raw supporters.

Acknowledgement

Writer says thanks to the owner of UD XYZ who has given opportunity for to do study by straight away. The author also thanks to the family especially to my mom Mrs Dewi Suryani and my dad Mr Suarno, who continue to support and pray for the author and to friends who helped until the research complete.

REFERENCES

[1] Wahyuningsih. (2019). Buletin Konsumsi Pangan, *Pusat Data dan Sistem Informasi Pertanian Sekretaris Jenderal Kementerian Pertanian*, vol. 09, no. 01, pp. 32–42.

[2] Herawati, H., & Mulyani, D. (2016). Pengaruh kualitas bahan baku dan proses produksi terhadap kualitas produk pada UD.Tahu Rosydi Puspan Maron Probolinggo. *UNEJ E-Proceeding*, pp. 463–482.

[3] S. Mulyawan. (2015). Manajemen Risiko. *CV Pustaka Setia.*

[4] Kuncoro, D. K. R.., Pratiwi, P. A. N., & Sukmono, Y. (2018). Pengendalian risiko proses produksi crude palm oil dengan metode Failure Mode And Effect Analysis (FMEA) dan Fault Tree Analysis (FTA). *Jurnal Ilmiah Teknik Industri*, vol 1, no. 1, pp. 01–06.

[5] Utami, R. T., & Hariastuti, N. l. P. (2016). Analisis kecacatan produk menggunakan metode FMEA dan FTA Pada PT.XXX. ISBN 978-602-98569-1-0.

[6] Irawan, J. P., Santoso, I., & Mustaniroh S.A. (2017). Model analysis and mitigation strategy of risk in tempe chips production. *Industria: Jurnal Teknologi dan Manajemen Agroindustri*, vol 6, no. 2, pp. 88–96.

[7] Prasetiyo, M. D., Santoso, I., Mustaniroh, S. A., & Produksi, R. (2017). Strategi pengelolaan risiko proses produksi yoghurt. *Jurnal Teknologi Pertanian*, vol. 18, no.1, pp. 1–10.

[8] Sufiarso, K.Y., & Munawir, H. (2018). Analisis dan penentuan strategi mitigasi risiko pada proses produksi produk olahan ubi jalar (Ipomoea Batatas L) (Studi kasus:UMKM kelompok wanita tani "Murakabi" Kabupaten Karanganyar). *Doctoral dissertation, Universitas Muhammadiyah Surakarta.* vol. 10, no. 1, pp. 279–288.

[9] Yahman, M. B., Widada, D., & Profita, A. (2020). Analisis risiko dan penentuan strategi mitigasi pada proses produksi beras. *Jurnal Matrik*, vol. 20, no. 2, pp. 67.

[10] Perdiana, R.H., Ridwan, W., Yusup, I., & Koeswandi, T. A. (2021). Analisis strategi bauran pemasaran dalam meningkatkan volume penjualan mie ayam Mang Nana. *Prosiding The 12th Industrial Research Workshop and National Seminar*, pp. 1456 - 1459.

[11] Stamatis, D. H. (2015). *The ASQ Pocket Guide to Failure Mode and Effect Analysis (FMEA).* ISBN: 978-0-87389-888-1.

[12] Mufrodi, A. R., & Effendi, U. (2017). Strategi mitigasi risiko proses pengemasan menggunakan metode Failure Modes and Effects Analysis (FMEA) dan Analytical Hierarchy Process (AHP). *Jurnal Teknologi dan Manajemen Agroindustri*, vol. 10, pp. 1–21.

[13] Wijaya, R. A. P., & Hakim. A. R. (2020). Perancangan perangkat audit internal untuk sistem keamanan informasi pada organisasi XYZ developing internal audit tool for information security system. *Jurnal Teknologi Informasi dan Ilmu Komputer (JTIIK)*, vol. 7, no.3, pp. 435–442.

[14] Susilo, L. J, & Kaho, V. R.(2018). Manajemen risiko berbasis ISO 31000:2018 untuk risk leaders dan risk practitioners. *Jakarta: PT Grasindo.*

[15] Badariah, N., Sugiarto, D., & Anugerah, C. (2016). Penerapan metode Failure Mode and Effect Analysis (FMEA) dan expert system (sistem pakar). *Jurusan Teknik Industri Fakultas Teknologi Industri Universitas Trisakti*, pp. 1–10.

[16] Murnawan, H., & Mustofa. (2014). Perencanaan produktivitas kerja dari hasil evaluasi produktivitas dengan metode fishbone di perusahaan percetakan kemasan PT. X. *Jurnal Teknik Industri HEURISTIC*, vol.11, no.1, pp. 27–46.

[17] Sari, A. F., & Suprayitno, G. (2020). Perancangan model pengambilan keputusan pemilihan pemasok di perusahaan manufaktur produk farmasi dengan pendekatan ANP BOCR. *Jurnal PASTI*, vol. 14, no. 2, pp. 127.

[18] Marsono. (2020). Penggunaan metode Analytical Hierarchy Process (AHP) dalam penelitian. *Bogor: IN MEDIA*.

[19] Munthafa, A., & Mubarok, H. (2017). Penerapan metode Analytical Hierarchy Process dalam sistem pendukung keputusan penentuan mahasiswa berprestasi. *Jurnal Siliwangi*, vol. 3, no. 2, pp. 192–201.

[20] Novianti, M. F. (2017). Analisis sistem produksi roti tawar dengan metode Failure Mode and Effect Analysis (FMEA) dan Analytical Hierarchy Process (AHP). *Repository.ub.ac.id*, pp. 149–200.

[21] Meyza, M. I., Nawansih, O., & Nurainy, F. (2013). Penyusunan draft standard operating procedure proses pengolahan tahu-Studi kasus di sentra produksi tahu Gunung Sulah Bandar Lampung. *Jurnal Teknologi Industri dan Hasil Pertanian*, vol. 18, no.1, pp. 62–77.