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Abstract: Risks and opportunities are elements that exist in every process. Risk can have a negative impact on the process while opportunity is a potential that has a beneficial impact. Biodiesel production from UCO (Used Coconut Oil) is produced through a long cycle. Partial identification of risks and opportunities has been carried out. However, this identification is not fully integrated into a system. Our study comprehensively presents the results of the identification of risks and opportunities at each stage of biodiesel. The SIPOC cycle is used to identify risks and opportunities that arise at each stage. Risks and opportunities in the biodiesel business process from UCO are identified through a risk-based thinking approach in ISO 9001:2015. External Issues and Interest parties relevant to the business process are considered so that biodiesel from UCO becomes a sustainable business process.

1 INTRODUCTION

The use of bioenergy as an energy source to replace fossil fuels is a concern for the Indonesian government. Biodiesel as a substitute for diesel has long been developed and becomes an alternative that continues to strengthen its bargaining position. Including biodiesel from UCO which still has problems in its production cycle. Indonesia's biodiesel production in 2020 was recorded at 8.6 million kl. This is inseparable from the mandatory policies of B20 in 2016 and B30 in 2020. Indonesia is targeting 30% of biodiesel blends in subsidized diesel fuel by 2022. It takes approximately 9.59 million kl of biodiesel per year to meet the domestic demand. Therefore, if the used cooking oil potency is managed properly, it can meet 32% of the national biodiesel demand (Ministry of Energy and Mineral Resources, March 17, 2021) (Prasetiawan, 2022). From the cooking process, 40-60% of cooking oil (6,46-9,72 million KL) becomes used cooking oil (UCO).

However, UCO actually generates economic, social, and environmental benefits provided that their disposal management are well coordinated (Perdana, 2021). The main feedstock for biodiesel production in Indonesia is crude palm oil (CPO), which is also increasingly used for domestic food production and industrial applications. In fact, Indonesia can meet its domestic demand for CPO until 2025 using the equivalent of 63% of the oil palm planted area in 2014, while keeping the same average yield (Khatiwada, Palmén, & Silveira, 2021). Projections of future demand in 2025 for Indonesian crude palm oil are 6.9 Mtonne from for domestic food production and industrial application, then at least (40% x 6.9) can be used as feedstock for biodiesel. Unfortunately, the UCO collected in Indonesia has only reached 3

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million KL or only 19% of the total national cooking oil consumption. Of the 3 million KL that was collected only 570 KL was converted for biodiesel (ESDM, 2020). The challenge of UCO is abuse by recycling UCO for resale. Utilizing UCO requires an approach that takes stakeholders into account. Supply chain management is a relevant approach to implement because the flow of materials, information flow and money flow can be managed in an integrated manner along the supply chain (Ampuh & Doni, 2015). Utilization of UCO and its processing into biodiesel requires an integrated management of material flow, information flow and money flow. All of these flows will involve parties such as cooking oil consumers, UCO collectors, biodiesel processors, governments and biodiesel consumers.

Besides Indonesia, several other Asian countries also have potential UCO amounts, but only a few can be collected. India (13%-19%), Malaysia (30%-45%), Japan (21%-37%). However, several countries were able to collect higher UCO, namely China (60%-80%) and Korea (76%-92%) (Kristiana, Baldino, Searle, & Stephanie, 2022). Another problem faced in biodiesel production from UCO is the price of UCO which exceeds the price of virgin oil for biodiesel due to incentive policies and non-transparent rules and regulations (Grinsven, Toorn, Veen, & Kampman, 2020). The identification and risk management of the biofuel process has been carried out by several researchers. Biofuels can be produced in various forms, solid liquid and gases. The main hazards and the importance of managing risks have been identified (Nair, 2011) and (Ntzisymeon, Kamenopoulos, & Tsoutsos, 2019). Combustion, emission and engine performance characteristics of biodiesel and process waste have been identified (Enweremadu & Rutto, Combustion, emission and engine performance characteristics of used cooking oil biodiesel-A review, 2010) and (Hayder & Puniyarasen, 2016). he identification is still separate and has not been comprehensively integrated into business processes.

For this regard, to the design of biodiesel production and distribution in the next few decades, a risk and opportunity need to be assessed and managed. In this article, researchers will present the results of an analysis of risks and opportunities in the biodiesel production process with a process approach from upstream to downstream. Sources of secondary data obtained from the observations of previous researchers. Opportunities are used to make improvements and maximize the process in generating output. The Risk-Based Thinking (RBT) approach involves the systematic definition and management of processes, and interactions between processes aimed at taking advantage of existing opportunities and preventing unwanted risks.

2 METHODOLOGIES

This article uses a descriptive study method and emphasizes a qualitative analysis approach as a research methodology through reference to relevant theories and information-based policies regarding UCO and biodiesel. The data was collected by using the literature study with triangulation technique. Secondary data used were obtained or collected from scientific literature, mass media, government

2.1 Theoritical Background

In ISO 9001:2015, Risk-based thinking enables an organization to determine the factors that could cause its processes and its quality management system to deviate from the planned results, to put in place preventive controls to minimize negative effects and to make maximum use of opportunities as they arise. Risk is the impact of uncertainty and any such uncertainty can have a positive or negative impact. Opportunities can arise as a result of a favorable situation to achieve the desired result. Actions to address opportunities may also include consideration of the associated risks. There are two concepts about risk and opportunity. First, if an activity or process can achieve the desired result, then the activity has no risk. Second, we can determine or identify risk if the activity or process has a "potential" of adverse impacts. We can determine the opportunity if the activity or process has a potential beneficial impact.

In DIS 45001, Risk is defined as the combination of the likelihood of an event occurring related to severe injury; or work-related illness or exposure of a person to a Hazard. So hazard is the nature of the process that can harm the individual, and risk is the probability that it will occur along with how severe the consequences will be. RBT makes preventive action a part of strategic and operational planning to eliminate risks and maximize opportunities in the business.

In Indonesia, sustainable biodiesel as renewable energy can be reviewed into three aspects, including environmental aspects, social aspects and economic aspects (Yasinta, Karuniasa, & Mahawan, 2021) (Dimawarnita, Kartika, A, & Hambali, 2021). Government policy related to UCO is a significant issue in its collection, processing and use (Prasetiawan, 2022) (Zhou, Searle, & Kristiana,

2021) (Perdana, 2021) (Nurkhoiry, Azahari, Amelia, & Roosganda, 2021) (Syahdan, Arkeman, & Wijaya, 2017) (Liu, Liu, Agyeiwaa, Li, 2018). In other asian countries China, the economic and environmental assessments result that the integration of stakeholders and markets increase efficiency and sustainability. Unfair profit allocations will decrease the amount of recycled materials (UCO) (Zheng, et al., 2020). In EU, UCO is included in the category of "edible oils and fat" where the policies for its collection and processing have been regulated in the "Household UCO" and "Biodiesel" policy framework (Staff, 2015). In Turkey, Problem of Biodiesel Standards, Lack of Awareness, Special Consumption Tax, Biodiesel Distribution and Logistics (Erdoğan & Keskin, 2015).

Supply chain has become the most topic of research on UCOME (UCO Methyl Ester) or biodiesel, the UCO recycle mode in China, US and Japan is studied in this research. (Zhang, Ozturk, Wang, & Zhao, 2014) (Zhang, Ozturk, Zhou, Qiu, & Wu, 2015). Optimization and Sustainable supply chain at UCOME is a topic of study by researchers (Jiang & Zhang, 2016) (Gkouskos, Tournaki, Giamalaki, & Tsoutsos, 2018) (Geng, Zhang, Sun, & Geng, 2019) (Reza, Chaharsooghi, K, Kashan, & Babazadeh, 2020). Raw material price subsidies and finished products sales subsidies increase the profits of recycler (Zhang, Li, Zhou, Hou, & Qiu, 2013). On biofuel supply chain biodiesel price and social objective have a significant impact, but the environmental objective has low impact on the bio-refinery in an emission allowances trading scheme. (Zhang & Jiang, 2016). Hazard and emission risks are also considered in the manufacture and application of biodiesel from UCO. The manufacture of biodiesel can be hazardous if suitable precautions are not taken, as it involves the storage, handling and use of several hazardous substances (Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019) (Nair, 2011). Identification and evaluation of wastes from biodiesel process are studied The qualification was based on Total Suspended Solid (TSS) test, Chemical Oxygen Demand (COD) test, pH test and Oil and Grease (O&G) test (Hayder & Puniyarasen, 2016). Combustion, emission and engine performance from the use of UCOME are also other issues to consider (Enweremadu & Rutto, Combustion, emission and engine performance characteristics of used cooking oil biodiesel-A review, 2010) (Sethin & Somnuk, 2022). The risks that arise in UCOME's business processes have been assessed, including the AHP approach (Jachryandestama, Nursetyowati, Fairus, & Pamungkas, 2021) (Kurnia & Hadiguna, 2016). This is then we use as the basis for conducting an assessment in this research. The above issues affect the sustainability of biodiesel as specially from UCO and pose a risk to the business process.

2.2 Risk-Based Thinking and Develop Structure Methodology

The method developed in this research is to adopt the principle of risk-based thinking in ISO 9001:2015 with the SIPOC (supplier-input-process-output-customer) approach to carry out risk and opportunity analysis in the UCOME or biodiesel business process, Figure 1 Risks and opportunities are embedded in the PDCA (plan-do-check-act) cycle. To establish the objectives of the system and its processes, management must determine the risks and opportunities at the "Planning (6)" stage (ISO 9001:2015, clause 6). These (risks and opportunities) are then taken to the next cycle. The concept of risk-based thinking is implemented in the biodiesel business process from UCO. Through the SIPOC approach, risk events in the UCOME business process are identified at each stage. Furthermore, risk assessment and mitigation are carried out. The method developed in this research is to adopt the principle of risk-based thinking in ISO 9001:2015 with the SIPOC (supplier-input-process-output-customer) approach to carry out risk and opportunity analysis in the UCOME or biodiesel business process, Figure 1 Risks and opportunities are embedded in the PDCA (plan-do-check-act) cycle. To establish the objectives of the system and its processes, management must determine the risks and opportunities at the "Planning (6)" stage (ISO 9001:2015, clause 6). These (risks and opportunities) are then taken to the next cycle. The concept of risk-based thinking is implemented in the biodiesel business process from UCO. Furthermore, risk assessment and mitigation are carried out. The following is the framework developed in our research:

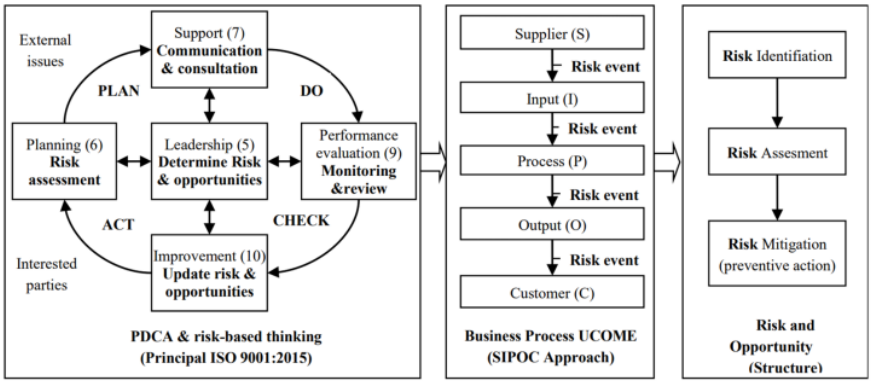

Figure 1: The overview of adopted methodology.

3 RESULT AND DISCUSSION

In this section, we describe the relevant issues and risk-opportunities derived from various sources such as journals or proceedings, reports, and our previous research. UCOME Risk-opportunity identified and its process, presented in the form of tables and flow diagrams.

3.1 External and Internal Issues

The organization (in this study is the producer of UCOME) shall determine external and internal issues that are relevant and that affect to the process (ISO, 2015). External issues can include legal, technological, competitive, market, cultural, social and economic environments. Internal issues are related to organizational issues, so they are not discussed in this study.

Table 1: Internal and external Issues

Issues	Scope	Positive issue (+)	Negative issue (-)
Internal	N/A		
External	Environment	Reduction on impact of global warming and to support all efforts in reducing carbon-dioxide emissions on earth (Nurkhoiry, Azahari, Amelia, & Roosganda, 2021)	Suffering from illegal logging, seasonal forest fire and some illegal mining operations (Nurkhoiry, Azahari, Amelia, & Roosganda, 2021).
		the environmental objective has a positive impact on the bio-refinery in an emission allowances trading scheme (Zhang & Jiang, 2016)	Accompanied by side reactionary pollutant (Tsoutsos, Tournaki, Paraíba, & Kaminaris, 2016)
			Health and safety issue, risk or hazard management (Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019) (Nair, 2011)
Issues	Scope	Positive issue (+)	Negative issue (-)
	Economic	Oil palm industry has become economic growth, biodiesel has been catching up in the development (Nurkhoiry, Azahari, Amelia, & Roosganda, 2021).	
		New jobs creation (Tsoutsos, Tournaki, Paraíba, & Kaminaris, 2016)	
		Circular Economy concept implementation (Perdana, 2021)	
	Social	To fulfil the international standard and regulation and the achievement of the SDGs (Nurkhoiry, Azahari, Amelia, & Roosganda, 2021).	

Issues	Scope	Positive issue (+)	Negative issue (-)
		the social objective has a significant impact on simulating biorefinery to collect more kitchen waste. (Zhang & Jiang, 2016)	
	Policy, Regulation	Renewable energy policy, mandatory biodiesel policy program (Nurkhoiry, Azahari, Amelia, & Roosganda, 2021).	determination of biodiesel price by the government (Ampuh & Doni, 2015)
		Fostering a low carbon economy is a key pillar of EU policies (Gkouskos, Tournaki, Giamalaki, & Tsoutsos, 2018)	unfair profit allocations will decrease the amount of recycled materials (Zheng, et al., 2020)
		Subsidy mode by (Zhang, Li, Zhou, Hou, & Qiu, 2013)	
		Quality (biodiesel standard), Engine performance, Emission characteristic (Enweremadu & Rutto, Combustion, emission and engine performance characteristics of used cooking oil biodiesel-A review, 2010) (Sethin & Somnuk, 2022)	

Note: (+) (-) positive or negative impact for suistainability UCOME production.

3.2 Interested Parties in UCOME

Utilization of used cooking oil requires an approach that takes into account the needs and expectations of stakeholders (Ampuh & Doni, 2015). The following are the results of the identification of interested parties with their functions and their needs and expectations in Indonesia. Figure 2 gives a schematic representation of any interested parties and shows the interaction of its elements.

Each organization (interested parties) provides products or services consistently that meet customer requirements (needs and expectation) and applicable statutory and regulatory. In figure 2, Its seen that the government has significantly roles which regulation or policy that they were released. It can affect the process in each function.

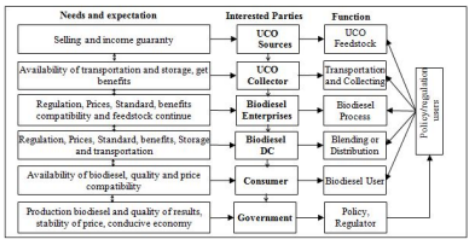

Figure 2: Representation interest parties' interrelationship.

3.3 Risk Identification in UCOME Production

Tables must appear inside the designated margins or In this section, the researcher provides a complex view of the risks that arise in the use of UCO for biodiesel from upstream to downstream. Through risk-based thinking and the SIPOC diagram approach, risks can be identified in a sequential and comprehensive manner. Table 2, shows the risk identification of UCOME's business processes. The risk number (R1, R2 etc.) indicates the identification of the risks inherent in the business process.

Several studies have been conducted on the specific risks in the UCOME production. Based on previous studies, risks are classified into several categories. The categories are, Supply risks, Product recovery risks, Government risks, Demand risks, Financial risks, Operational risks, Hazard risks and Quality risks. Each element in the SIPOC chain has a different category and amount of risk. Interested parties and risk descriptions are described for each element of Supplier (S), Input (I), Process (P), Output (O) and Customer (C). Table 2 below is a summary of the results of risk identification for each SIPOC security element. Sources of data are provided to facilitate tracing and as a review study for further research. The results of the identification of these risks also need to be analysed to the stage of Risk Assessment and Mitigation.

Table 2: Summary risk identification in SIPOC-UCOME

Interested parties	Risk category	Risk number	Description	Sources
SUPPLIER (S)				
Household, Restaurant, Hotel, Food Industries, UCO Collector, Government, Business Owner	Supply risk	R1	UCO supply points, distribution centres (DCs) and biodiesel plants	(Jiang & Zhang, 2016) (Geng, Zhang, Sun, & Geng, 2019)
	Supply risk	R2	Logistics costs (collecting, spoilage, transportation of UCO)	(Ampuh & Doni, 2015) (Kurnia & Hadiguna, 2016)
	Supply risk	R3	Uncertainty feedstock supply	(Geng, Fu, & Sun, Stochastic Programming of Sustainable Waste Cooking Oil for Biodiesel Supply Chain under Uncertainty, 2021) (Kurnia & Hadiguna, 2016)
	Supply risk	R4	Low participation levels from citizens	(Tsoutsos, Tournaki, Paraíba, & Kaminaris, 2016)
	Financial risks	R5	Uncertainty price feedstock UCO	(Caldeira, et al., 2019) (Kurnia & Hadiguna, 2016)
	Supply risk	R6	Inconsistent or low partnership	(Kurnia & Hadiguna, 2016)
	Supply risk	R7	Illegal collector and exporter	(Jachryandestama, Nursetyowati, Fairus, & Pamungkas, 2021) (Prasetiawan, 2022)
	Government risk	R8	Policy (regulations or legalities)	(Ampuh & Doni, 2015)
	Government risk	R9	Changing regulations and policies	(Geng, Fu, & Sun, Stochastic Programming of Sustainable Waste Cooking Oil for Biodiesel Supply Chain under Uncertainty, 2021)
	Hazard risk	R10	Hazard Car accident during oil transfer	(Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019)
INPUT (I)				
	Quality risk	R11	Quality variation of UCO feedstock	(Kurnia & Hadiguna, 2016)

Table 2: Summary risk identification in SIPOC-UCOME

Interested parties	Risk category	Risk number	Description	Sources
Employee, Business Owner, Government	Quality risk	R12	High standards demand for UCO as raw material	(Liu, Liu, Agyeiwaa, & Li, 2018)
	Hazard risk	R13	Hazard Fire in the collection area	(Nair, 2011) (Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019)
	Hazard risk	R14	Hazard Explosion from methanol spillage	(Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019)
	Hazard risk	R15	Storage of Flammable and Toxic Materials	(Nair, 2011)
PROCESS (P)				
Employee, Business Owner, Government	Operational risk	R16	Improper selection or usage of: technology/methodology, raw material, location and facility	(Nair, 2011) (Kurnia & Hadiguna, 2016)
	Operational risk	R17	Inadequate facility for the selected process Land area; Nearby facility and effects from and on them, Proximity to utilities like water, steam, power etc	(Nair, 2011)
	Operational risk	R18	Unsafe design and layout	(Nair, 2011)
	Operational risk	R19	Faulty construction and commissioning	(Nair, 2011)
	Operational risk	R20	No/inadequate provision for (Ventilation, Lighting, Rest and cleaning, Weather protection)	(Nair, 2011)
	Operational risk	R22	Inadequate provision for pressure relief, safe discharge of dangerous release and overpressure protection.	(Nair, 2011)
	Operational risk	R23	No provision for remote monitoring and control of the process	(Nair, 2011)
	Operational risk	R24	Provision for production using temporary/make shift arrangements.	(Nair, 2011)
	Hazard risk	R25	Inadequate assessment of hazards in establishing connection to existing facility for sharing power, utilities, structure etc.	(Nair, 2011)
	Operational risk	R26	Complex procedure, Low recovery rate of UCO	(Liu, Liu, Agyeiwaa, & Li, 2018)
	Operational risk	R27	Capacity of production, economic of scale	(Kurnia & Hadiguna, 2016)
	Hazard risk	R28	Hazard from Methanol spillage during reactor feed	(Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019)
	Hazard risk	R29	Hazard Skin contact with H2SO4, NaOH	(Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019)
	Hazard risk	R30	Hazard from Lightning	(Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019)

Table 2: Summary risk identification in SIPOC-UCOME

Interested parties	Risk category	Risk number	Description	Sources
	Hazard risk	R31	Runaway/uncontrolled reaction	(Nair, 2011)
	Hazard risk	R32	Explosion hazards and overpressure releases	(Nair, 2011)
	Hazard risk	R33	Toxic hazards, Steam flashes	(Nair, 2011)
	Hazard risk	R34	Hazards from Batch Processing, Material Handling, Other Related	(Nair, 2011)
OUTPUT (O)				
Government, Business Owner, Civilian,	Hazard risk	R35	Pollutants and side reaction	(Tsoutsos, Tournaki, Paraíba, & Kaminaris, 2016)
	Hazard risk	R36	Wastes from biodiesel production (glycerine, soap etc)	(Hayder & Puniyarasen, 2016)
	Government risk	R37	Policy (regulations or legalities)	(Ampuh & Doni, 2015)
	Government risk	R38	Fostering a low carbon economy is a key pillar of EU policies	(Gkouskos, Tournaki, Giamalaki, & Tsoutsos, 2018)
	Government risk	R39	Insignificant subsidies or not effective Subsidies mechanism	(Zhang, Ozturk, Wang, & Zhao, 2014) (Zhang, Ozturk, Zhou, Qiu, & Wu, 2015)
	Government risk	R40	Unfair profit allocations will decrease the amount of recycled materials	(Zheng, et al., 2020)
OUTPUT (O)				
Government, Business Owner, Civilian,	Government risk	R41	Changing regulations and policies	(Geng, Fu, & Sun, Stochastic Programming of Sustainable Waste Cooking Oil for Biodiesel Supply Chain under Uncertainty, 2021)
	Financial risks	R42	Fluctuate price Biodiesel	(Kurnia & Hadiguna, 2016)
	Financial risks	R43	Price policy of biodiesel	(Ampuh & Doni, 2015)
	Financial risks	R44	Biodiesel production costs have been high in the country	(Rezaei, Chaharsooghi, K, Kashan, & Babazadeh, 2020)
	Financial risks	R45	Lack of efficient economic incentive	(Liu, Liu, Agyeiwaa, & Li, 2018)
	Government risk	R46	Not a special regulation for UCO management	(Perdana, 2021)

Table 2: Summary risk identification in SIPOC-UCOME

Interested parties	Risk category	Risk number	Description	Sources
	Product recovery risk	R47	Failure in screening defective products	(Jachryandestama, Nursetyowati, Fairus, & Pamungkas, 2021)
	Product recovery risk	R48	The design of inventory and safety stock capacity of collectors and reprocessing centres	(Jachryandestama, Nursetyowati, Fairus, & Pamungkas, 2021)
CUSTOMER (C)				
Consumer, Business Distribution Centres	Product recovery risk	R49	Transportation mode, network design, delivery time uncertainties	(Ampuh & Doni, 2015) (Jachryandestama, Nursetyowati, Fairus, & Pamungkas, 2021) (Kurnia & Hadiguna, 2016)
	Product recovery risk	R50	The impact of implementing a take-back obligation.	(Jachryandestama, Nursetyowati, Fairus, & Pamungkas, 2021)
	Quality risks	R51	Quality (fulfil biodiesel standard), Engine performance, Emission characteristic	(Enweremadu & Rutto, Combustion, emission and engine performance characteristics of used cooking oil biodiesel-A review, 2010) (Sethin & Somnuk, 2022) (Kurnia & Hadiguna, 2016)
	Quality risks	R52	Customer complaint or rejected	(Kurnia & Hadiguna, 2016)
	Demand risks	R53	A small market for biodiesel	(Liu, Liu, Agyeiwaa, & Li, 2018)
	Demand risks	R54	Uncertainty biodiesel demand	(Geng, Fu, & Sun, Stochastic Programming of Sustainable Waste Cooking Oil for Biodiesel Supply Chain under Uncertainty, 2021) (Kurnia & Hadiguna, 2016)

The risks table above is generated from several studies in countries. They have different risk categories and priority levels. It depends on the method of approach used. As regards the hazards, The study of M. Hatzisymeon et al. (Hatzisymeon, Kamenopoulos, & Tsoutsos, 2019) stated that the highest priority was the risk of explosion from methanol spills, skin contact with acid, car accidents, fire and lightning. As regards the risks in the GSC approach, The study of Raden et al. (Jachryandestama, Nursetyowati, Fairus, & Pamungkas, 2021), stated that supply risk is the highest risk, and is followed by product recovery, demand, financial, and operational risks. The study of Ruri et al. (Kurniawan & Hadiguna, 2016), mentions the priority of risks in the design of the UCOME supply chain. Where feedstock is the main risk, followed by demand risk, quality, production, transportation and partnership. Finally, by knowing the risks in the SIPOC chain, users are more aware and need to take precautions to eliminate or reduce the negative impact of these risks. It can also be used to formulate policies for interested parties. UCOME business owners can properly manage technology, standards and management. They cannot operate their business alone. Collaboration and partnership are necessary to operate a sustainability business.

4 CONCLUSIONS

This research shows that the UCOME production has complex risks at every stage. The risk identification generated in this study results from a review of several sources relevant to the UCO process into biodiesel. As well as the results of experiments and research conducted by the author. New risks may have been identified, and interdependencies between risks should be considered. UCOME business actors need to respond to internal and external issues and the needs and expectations of stakeholders.

The government has a significant role in creating the sustainability of UCOME production. In the end, the ISO 9001:2015 risk-based thinking approach is able to identify the risks that exist in every UCOME business process. Next, risk assessment and mitigation actions will need to be carried out to determine priority values and preventive actions.

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