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ISSN : 1978-1431 print | 2527-4112 online Jurnal Teknik Industri 92 Vol. 21, No. 1, February 2020, pp. 92-103 https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 http://ejournal.umm.ac.id/index.php/industri ti.jurnal@umm.ac.id Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 Development of Risk Evaluation and Mitigation Systems for Logistics System Ahmad Rusdiansyaha, Della Deswiana Pratamaa, Muhammad Faisal Ibrahimb* a Department of Industrial Engineering, Institut Teknologi Sepuluh Nopember, Jl. ITS Raya, Keputih, Kec.

Sukolilo, Kota SBY, Jawa Timur 60117, Indonesia b Department of Logistics Engineering, Universitas Internasional Semen Indonesia, Jl. Veteran, Kb. Dalem, Sidomoro, Kebomas, Gresik Regency, East Java 61122, Indonesia * Corresponding author: faisalibrahim.ie@gmail.com 1. Introduction Globalization forces companies to focus on company activities to face competition [1] [2]. One of the most critical company activities is a logistic activity [3] [4]. Good logistics management can increase customer satisfaction because the product, quality, quantity, and location shipped are correct [5].

In logistical activities, various risks often arise, and it affects supply chain performance [6] and risks arising from the impact of an event and uncertainty [7] [8]. Risk can disrupt the flow of material, information, and cash flow, which in turn can affect sales and increase costs [9]. To compete, companies need to have proper logistical risk management [10] [11]. Therefore, mitigation activities are needed to manage risks. Several previous studies have proposed methods for managing supply chain risk. One popular method is the House of Risk (HOR) proposed by Pujawan and Laudine [12].

Several methods for supply chain risk management include the integration of the HOR and the Fuzzy Analytical Hierarchy Process [13], the HOR, and the Analytical network process [14], DEMATEL [15], and Quality Function Deployment (QFD) [16]. Several other methods are Fuzzy AHP [17], AHP [18], Fuzzy Bayesian-based Failure Mode Effect ARTICLE INFO ABSTRACT Article history Received December 30, 2019 Revised February 23, 2020 Accepted February 26, 2020 Available Online February 28, 2020 Logistic activities are significant activities that pose various risks for the company. These risks can affect the company ' s performance. To be able to compete in the globalization era, companies need proper risk management.

This study aimed to develop Risk Evaluation and Mitigation Systems. We offered four stages: risk identification, risk analysis, risk evaluation, and risk response. A case study was conducted to implement the proposed Risk Evaluation and Mitigation Systems. The results indicated that the proposed Risk Evaluation and Mitigation Systems were proven effective to be appropriately applied to evaluate company risks and provide mitigation recommendations. This is an open-access article under the CC – BY-SA license. Keywords Risk Management Mitigations Logistic Risk evaluation Jurnal Teknik Industri ISSN : 1978-1431 print | 2527-4112 online Vol. 21, No. 1, February 2020, pp. 92-103 93 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020).

Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 Analysis (FMEA) [19], and fuzzy-based HOR [20]. Wijai and Phongchai [21] used the HOR to analyze blood supply chain risk management. Ratnasari, et al. [22] analyze supply chain risk management in a newspaper company. Immawan and Putri [23] implement HOR to assess supply chain risk. Furthermore, Asbjørnslett [24] adopts a proactive approach to dealing with newly changing risks. Wee, et al. [25] discussed mitigation strategies in logical risk management from the perspective of process flow.

Based on previous research, one of the popular methods implemented in supply chain risk management is HOR. Unfortunately, the estimated loss and the possible risk have not been considered in assessing the risk. Therefore, this study aims to develop a Risk Evaluation and Mitigation System based on the HOR method. This study provides a new contribution to the Risk Evaluation and Mitigation System in company logistics activities. This complete paper structure is presented as follows: part 2 discusses Proposed Risk Evaluation and Mitigation Systems or Method and case studies; part 3 presents results and discussion, and lastly, part 4 concludes the study. 2. Methods 2.1

Proposed Risk Evaluation and Mitigation Systems This research constructed four stages in the proposed Risk Evaluation and Mitigation Systems, such as risk identification, risk

analysis, risk evaluation, and risk response (Fig. 1). The detailed description of each stage is explained as follows: Fig. 1. Four Stages Risk Evaluation and Mitigation Systems Risk Identification At the risk identification stage, this study proposes risk identification based on the company ' s business process.

Business processes were based on five business aspects: supplier, receiving, tracking, delivery, and customer. This business process is modified from the business aspects of the supplier, input, process, output, and customer. At this Risk Identification Risk Analysis Risk Evaluation Risk Response ISSN : 1978-1431 print | 2527-4112 online Jurnal Teknik Industri 94 Vol. 21, No. 1, February 2020, pp. 92-103 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 stage, each business process was recorded for risks, causes of risk, and impacts. The risk assessment is presented in the risk analysis section. Risk Analysis At this stage, risk analysis was based on the Likelihood and Consequence values.

Likelihood scores were obtained from the risk causes assessment based on five rating scales. The risk causes a likelihood scale is presented in Table 1. All risk causes at the risk identification stage were assessed for the Likelihood level of the risk causes. Consequently, this assessment was based on the value of the loss resulting from the impact of the risk. This study proposed a Consequence Assessment based on the losses resulting from the impact of the risk. All risk impacts were estimated by the amount of loss incurred. Furthermore, the big loss was in conversion to the Consequence scale.

This study suggested five Consequence Loss scales, which are presented in Table 2. The results of the Likelihood and Consequence assessment were used for the risk evaluation stage. Table 1. Likelihood (L) Scale for risk causes Scale Description Parameter 5 Almost Certain Mismatch always occurs every week 4 Likely No-Mismatch occurs within the last 1-2 month(s) 3 Possible No-Mismatch occurs within the last 3-5 months 2 Unlikely No-Mismatch occurs within the last 6-11 months 1 Rare No-Mismatch occurs within the last one year period Table 2. Consequence (C) Scale for risk effects Scale Description Parameter 5 Catastrophic Loss > Rp. 1,000,000,000 4 Major Loss Rp. 500,000,000 - Rp.

1,000,000,000 3 Moderate Loss Rp. 100,000,000 - Rp. 500,000,000 2 Minor Loss Rp. 10,000,000 - Rp. 100,000,000 1 Insignificant Loss < Rp. 10,000,000 Risk Evaluation Risk evaluation is a stage to evaluate the level of risk posed. At this stage, risk evaluation was based on calculating the Risk Priority Number (RPN). The RPN scores were generated from the Likelihood (L) and Consequence (C) assessments. The RPN formula is presented in Equation (1). Furthermore, this study projected five risk level categorization scales,

which are presented in Table 3. All risks were measured by RPN to determine the level of risk.

The RPN value was formed as an input in calculating the mitigation priority presented in the risk response stage. ?? = ?? ?? ?? (1) Risk Response This stage described the mitigation proposals and calculated mitigation priorities. Mitigation proposals were designed based on the causes of risk. The list of mitigation proposals was used as input for the calculation of mitigation priorities. The mitigation Jurnal Teknik Industri ISSN : 1978-1431 print | 2527-4112 online Vol. 21, No. 1, February 2020, pp. 92-103 95 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 priority calculation was modified from the House of Risk (HOR) model. The mitigation priority model can be seen in Table 4.

In the mitigation priority model, the value of the relationship between the causes of risk j and the mitigation action k is denoted as Ejk. The Ejk values used were 0, 1, 3, and 9. 0 indicated there was no relationship. 1 showed that there was an innate but weak relationship between the causes of risk and the proposed mitigation. 3 represented a moderate relationship between the causes of risk and the proposed mitigation. Nine indicated that there was a strong relationship between the causes of risk and the proposed mitigation. Table 3.

Risk level scale based on RPN Description Parameter Very high RPN value of 21-25 High RPN value of 16-20 Moderate RPN value of 11-15 Low RPN value of 6-10 Very low RPN value of 1-5 Furthermore, the RPN value of the risk cause j (RPNj) and Ejk was exemplified to calculate the Total Mitigation Effectiveness (TEM). The TEM formula is presented in Equation (2). Mitigation proposals were also assessed based on the level of difficulty (Dk). The mitigation Dk value showed the difficulty in mitigating due to unpredictable risks. This study exercised a Likert scale of 1 to 5. The higher the Dk value, the more difficult mitigation was to be carried out.

The value of Dk was utilized to calculate the effectiveness-difficulty mitigation ratio (EKM). The EKM formula for each mitigation is presented in Equation (3). Mitigation priorities were based on the order of the ECEC values from largest to smallest. ???? ? ?? ?? (2) ?????? ?? = ?????? ?? ?? ?? (3) Table 4. Mitigation Priority Calculation Model Cause Code Risk Cause (j) Mitigation Code (k) RPN (j) M1 M2 M3 M4 … … Mk 1 Cause 1 E11 E12 E13 E14 … … E1k RPN1 2 Cause 2 E21 E22 E23 E24 … … E2k RPN2 … … … … … … … … … … … j Cause j Ej1 Ej2 Ej3 Ej4 … … Ejk RPNj Total mitigation effectiveness ?????? 1 ?????? 2 ?????? 3 ?????? 4 … … ?????? ?? Mitigation difficulty D1 D2 D3 D4 … … Dk Mitigation

effectiveness- difficulty ratio ?????? 1 ?????? 2 ?????? 3 ?????? 4 … … ?????? ?? Mitigation priority ranking … … ISSN : 1978-1431 print | 2527-4112 online Jurnal Teknik Industri 96 Vol. 21, No. 1, February 2020, pp. 92-103 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System.

Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 2.2 A Case Study A case study was conducted in a chemical and pharmaceutical company in Indonesia to apply the proposed Risk Evaluation and Mitigation Systems. The logistics activities of the company were the focus of the problem in this study. Currently, the company ' s logistics activities were carried out internally. However, the company planned to transfer all logistics management to a third party (Third-party logistics (3PL)). 3 3PL candidates need to be considered in logistics management.

The company also tries to overcome logistics management through internal companies. Therefore, it is necessary to evaluate risks and determine mitigation priorities in managing logistics in this company. 3. Results and Discussion The four stages of risk evaluation and determining mitigation priorities are described in the following sub-sections. 3.1 Risk Identification Risk identification was performed in the logistics department, referred to as the supplier, receiving, tracking, delivery, and customer business processes.

The results of risk identification, causes of risk, and impacts can be seen in Table 5. Thirty-three (33) risks were collected for this problem. Furthermore, these 33 risks identified the causes of the risks and the impacts of the risks. There were 33 causes of risk and 29 impacts that result from the generated risks. 3.2 Risk Analysis At this stage, thirty-three (33) causes of risk were successfully assessed based on the Likelihood scale. The results of the likelihood assessment can be seen in Table 6. There were five causes of risk with a likelihood scale 1, eleven risk causes with a likelihood scale 2, and four risk causes with a likelihood scale 3.

For the 4 and 5 likelihood scales, the number of causes was eight and one, respectively. These results indicate that the likeliness and likely scale will be the dominant scale on the Likelihood assessment. Also, the Consequence assessment was delivered based on the estimated loss of company profit. The company loss was successfully estimated for 33 impact risks. The estimation results can be observed in Table 6. The results indicated that there were ten impacts with a consequence scale value of 1, two impacts with a consequence scale value of 2, eight impacts with a consequence scale value 3, and nine impacts with a consequence scale value 4.

Likelihood and Consequence assessment results were generated as a risk evaluation calculation presented in the risk evaluation sub-section. 3.3 Risk Evaluation Risk evaluation was underpinned from the level of risk classified based on the RPN. The results of the risk level can be seen in Table 6. It can be seen that five risks were in a low category, 14 risks were in the very low category, five risks were in the medium category, and the other five risks were in the high category. These results were utilized as the basis for proposing company mitigation. Jurnal Teknik Industri ISSN : 1978-1431 print | 2527-4112 online Vol. 21, No. 1, February 2020, pp. 92-103 97 Please cite this article as: Rusdiansyah, A., Pratama, D.,

& Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 Table 5. Risk identification Risk No Business Process Risk Name Risk Cause Impact 1 Supplier Purchase Order (PO) failed to be inputted PO was not listed in the delivery request letter The acceptance process is delayed, so that product rejection occurs 2 Supplier The product could not be disassembled PO was not in line with the goods Product availability distraction 3 Supplier RM failed to be inputted into the system CoA (Certificate of Analysis) document was not available The acceptance process is delayed, so that product rejection occurs 4 Receiving The receipt was less than the delivery request order/letter Quantity did not match with the delivery request order/letter RM availability distraction 5 Receiving Mismatching Inventory per batch Material mix in one palette batch Delayed acceptance process, so that the RM was rejected 6 Racking There was a difference in PO receipts number Failure to detect the number of inventory 7 Racking There was a difference in PO receipts Wrong item entry Failure to detect the number of inventory, RM could not be used immediately 8 Racking Mismatch PO Outstanding Wrong number of goods entry Failure to detect the number of inventory 9 Racking Inventory mismatch Wrong batch entry The disruption of certain RM availability 10 Receiving Overloading of stored Raw Material (RM) Transfer of RM placement from another Plant Additional warehouse rental costs 11 Supplier PO failed to be inputted into the system PO was not listed in the delivery request letter The acceptance process is delayed, so that product rejection occurs 12 Supplier The product could not be disassembled PO was not in line with the goods Product availability distraction 13 Supplier RM failed to be inputted into the system CoA (Certificate of Analysis) document was not available The acceptance process is delayed, so that product rejection occurs 14 Receiving The receipt was less than the delivery request order/letter Quantity did not match with the delivery request order/letter RM availability distraction 15 Receiving Mismatching Inventory per batch Material mix in one palette batch Delayed acceptance process, so that the RM was rejected 16 Racking There was a difference in PO receipts number Failure to detect the

number of inventory 17 Racking There was a difference in PO receipts Wrong item entry Failure to detect the number of inventory, RM could not be used immediately 18 Racking Mismatch PO Outstanding Wrong number of goods entry Failure to detect the number of inventory ISSN : 1978-1431 print | 2527-4112 online Jurnal Teknik Industri 98 Vol. 21, No. 1, February 2020, pp. 92-103 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System.

Jurnal Teknik Industri, 21(1), 92-103.
doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 Table 5. Risk identification (Continue) Risk No Business Process Risk Name Risk Cause Impact 19 Racking Inventory mismatch Wrong batch entry The disruption of certain RM availability 20 Receiving Overloading of stored Raw Material (RM) Transfer of RM placement from another Plant - 21 Delivery Could not send Finish Goods (FG) to an external warehouse Transporter could not provide a fleet for transportation FG stacking at the plant, the availability of FG in the shipping warehouse is less 22 Racking Lack of FG for order fulfillment Delay in sending FG to an external warehouse - 23 Racking There was a difference between the FG recorded and the external warehouse receipts Wrong recording of the number of items - 24 Racking Additional operator working hours There were so many orders at once Additional labor costs for overtime 25 Delivery Delivery could not be done immediately, it had to be verified first The type, quantity, and batch number of goods did not match the Picking Note document Additional working hours to re-check, late delivery of FG 26 Delivery Delivery could not be done immediately, it had to be verified first The type, quantity, and batch number of goods did not match the Picking Note document Additional working hours for rechecking, Delivery Order (DO) could not be issued immediately 27 Customer Could not be sent immediately on the date of request There were so many orders at once Delay or the cancellation of FG delivery 28 Customer Could not be sent immediately due to waiting for additional goods The volume of goods to be loaded was very small, not even one truck Delay or the cancellation of FG delivery 29 Delivery Could not send orders that had been made Transporter could not provide a fleet for transportation Delay of FG delivery 30 Delivery Goods sent did not match the request Items required were damaged in packaging Addition of new packaging costs, delay of FG delivery 31 Delivery Goods could not be sent Items dropped and packaging damaged during the transfer Addition of new packaging costs, delays to cancellation of FG shipments 32 Delivery Some Pallet batches remained unsent Delivery did not match DO - 33 Delivery Could not be sent immediately on the date of request There were so many orders at once Delay or the cancellation of FG delivery 3.3 Risk Response Based on risk evaluation, this study proposes 14 mitigation (Ms) proposals as follows: M1 is a reminder to suppliers to include clear and correct data. M2 is a check to the supplier so that the COA is also included.

M3 is a Daily Cycle Count of materials regularly and consistently. M4 is an additional lease for the external warehouse. M5 is to make sure every delivery route has a backup transporter. M6 contains a request to Customer Service so that it can issue orders gradually. M7 is for warehouse operators to Jurnal Teknik Industri ISSN : 1978-1431 print | 2527-4112 online Vol. 21, No. 1, February 2020, pp. 92-103 99 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 recalculate the number of items entered. M8 contains the instruction on checking the amount of cargo and clarification to the truck fleet drivers. M9 explains that every small order in number will be sent by Less Container Loaded (LCL).

The M10 contains the identification and repair of defective items as soon as they are found. M11 suggests that forklift operators do movements to carry goods at low speed. M12 is the use of 3PL- company 1. M13 contains the use of 3PL-company 2, and M14 describes the use of 3PL- company 3. Table 6. Assessment of Likelihood, Consequence, RPN, and Level of Risk Risk No. Risk Cause L Impact Estimated Loss C RPN Risk Level 1 PO was not listed in the delivery request letter 2 The acceptance process is delayed, so that product rejection occurs Rp 100,000,000 3 6 Low 2 PO was not in-line with goods 2 Product availability distraction Rp 500,000,000 4 8 Low 3 CoA (Certificate of Analysis) document was not available 4 The acceptance process is delayed, so that product rejection occurs Rp 100,000,000 3 12 Moderate 4 Quantity did not match with the delivery request order/letter 1 RM availability distraction Rp 100,000,000 3 3 Very Low 5 Material mix in one palette batch 2 Delayed acceptance process, so that the RM was rejected Rp 50,000,000 2 4 Very Low 6 Wrong entry of the 2 Failure to detect the number of inventory Rp - 1 2 Very Low 7 Wrong item entry 1 Failure to detect the number of inventory, RM could not be used immediately Rp - 1 1 Very Low 8 Wrong number of goods entry 3 Failure to detect the number of inventory Rp - 1 3 Very Low 9 Wrong batch entry 2 The disruption of certain RM availability Rp - 1 2 Very Low 10 Transfer of RM placement from another Plant 2 Additional warehouse rental costs Rp 182,000,000 3 6 Low 11 PO was not listed in the delivery request letter 2 The acceptance process is delayed, so that product rejection occurs Rp 100,000,000 3 6 Low 12 PO was not in line with the goods 2 Product availability distraction Rp 500,000,000 4 8 Low 13 CoA (Certificate of Analysis) document was not available 4 The acceptance process is delayed, so that product rejection occurs Rp 100,000,000 3 12 Moderate 14 Quantity did not match with the delivery request order/letter 1 RM availability distraction Rp 100,000,000 3 3 Very Low ISSN : 1978-1431 print | 2527-4112 online Jurnal Teknik Industri 100 Vol. 21, No.

1, February 2020, pp. 92-103 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 Table 6. Assessment of Likelihood, Consequence, RPN, and Level of Risk (Continue) Risk No. Risk Cause L Impact Estimated Loss C RPN Risk Level 15 Material mix in one palette batch 2 Delayed acceptance process, so that the RM was rejected Rp 50,000,000 2 4 Very Low 16 Wrong entry of the er 2 Failure to detect the number of inventory Rp - 1 2 Very Low 17 Wrong item entry 1 Failure to detect the number of inventory, RM could not be used immediately Rp - 1 1 Very Low 18 Wrong number of goods entry 3 Failure to detect the number of inventory Rp - 1 3 Very Low 19 Wrong batch entry 2 The disruption of certain RM availability Rp - 1 2 Very Low 21 Transporter could not provide a fleet for transportation 1 FG stacking at the plant, the availability of FG in the shipping warehouse is less Rp - 1 1 Very Low 24 There were so many orders at once 5 Additional labor costs for overtime Rp 300,000,000 3 15 Moderate 25 The type, quantity, and batch number of goods did not match the Picking Note document 4 Additional working hours to re-check, late delivery of FG Rp 5,000,000 1 4 Very Low 26 The type, quantity, and batch number of goods did not match the Picking Note document 3 Additional working hours for rechecking, Delivery Order (DO) could not be issued immediately Rp 500,000,000 4 12 Moderate 27 There were so many orders at once 4 Delay or the cancellation of FG delivery Rp 500,000,000 4 16 High 28 The volume of goods to be loaded was very small, not even one truck 4 Delay or the cancellation of FG delivery Rp 500,000,000 4 16 High 29 Transporter could not provide a fleet for transportation 4 Delay of FG delivery Rp 500,000,000 4 16 High 30 Items required were damaged in packaging 4 Addition of new packaging costs, delay of FG delivery Rp 500,000,000 4 16 High 31 Items dropped and packaging damaged during the transfer 3 Addition of new packaging costs, delays to cancellation of FG shipments Rp 500,000,000 4 12 Moderate 33 There were so many orders at once 4 Delay or the cancellation of FG delivery Rp 500,000,000 4 16 High Jurnal Teknik Industri ISSN : 1978-1431 print | 2527-4112 online Vol. 21, No.

1, February 2020, pp. 92-103 101 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 Furthermore, from the 14 mitigation proposals, calculations were then carried out to determine mitigation priorities. The results of the calculation of mitigation priorities are presented in Fig. 2. These results indicated that the use of 3PL-company 1 (M12) has the highest priority, followed by the use of 3PL-company 2 (M13) and the warehouse operator recalculates the number of items entered (M7). Fig. 2 Mitigation Priority Calculation 4.

Conclusion This study was projected to develop a Risk Evaluation and Mitigation System based on the HOR method. It succeeded in developing Risk Evaluation and Mitigation Systems. The case study results underlined that the proposed Risk Evaluation and Mitigation Systems could be appropriately applied to evaluate company risks and provide ISSN : 1978-1431 print | 2527-4112 online Jurnal Teknik Industri 102 Vol. 21, No. 1, February 2020, pp. 92-103 Please cite this article as: Rusdiansyah, A., Pratama, D., & Ibrahim, M. (2020). Development of Risk Evaluation and Mitigation Systems for Logistics System. Jurnal Teknik Industri, 21(1), 92-103. doi:https://doi.org/10.22219/JTIUMM.Vol21.No1.92-103 mitigation recommendations. In this study, we ignored the interdependence of risks and between mitigations. In real conditions, the dependence between risks and between mitigation is possible.

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