Analisis Kelelahan Kerja Menggunakan Fatigue Assessment Scale pada PT. Indonesia Power Priok POMU

by Ika Dwiyana Lestari

The Blue Print of Intelligent Decision Support System for Supply Chain Kenaf Agroindustry

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Abstract. The purpose of this study is to develop the blue print of Intelligent Decision Support System (IDSS) in the supply chain network of Kenaf Natural Fibre Agroindustry (KNFA) which has not been much studied. This paper will be an important contribution to KNFA studies in Indonesia. This blueprint refers to the two echelons of the KNFA supply chain network, namely the upstream supply chain network (KNFA) and the middle-stream supply chain network (textile industry). The simulation of the inventory collaboration model in the upstream supply chain have been carried out on the Net Beans IDE 12.0 application. Consecutive research will carry out a simulation of the inventory collaboration model in the middle-stream supply chain network, and develop a digital platform with an Android studio application for smartphones based on android, and Net beans application for desktops.
Keywords: intelligent decision support system, inventory collaboration, performance, supply chain, value added

INTRODUCTION

In an era of volatility, uncertainty, complexity and ambiguity (VUCA), the entire supply chain network, especially the upstream supply chain, is required to be able to respond immediately in making decisions on changes in demand for kenaf dried fibre. This uncertainty can occur in the number of orders, order time, and delivery location. The conditions that occur in this uncontrolled external environment indicate the importance of the supply chain network to take advantage of the use of IDSS to support its decision making.

DSS is a decision support facility that can be utilized by decision makers to produce decisions that can improve efficiency and effectiveness the performance [1] in the supply chain network [2]. Based on the literature review, DSS are also considered effective in providing recommendations for decision makers in the construction field [3], building maintenance [4], distribution [5], cellular manufacturing [6], transportation [7], scheduling [8], fishery [9], retailer [10], and business organization [11].

The IDSS that will be developed in this study is presented in the form of a blue print which is the grand design of the IDSS supply chain for kenaf natural fibre (KNF). This blue print describes the identification and analysis of the needs of stakeholders along the supply chain network, the IDSS development design in the blueprint, the IDSS configuration, and the IDSS blueprint implementation plan in the KNFA.

This study will be the basis for supporting decisions on issues of improving the performance of the upstream and middle-stream of KNF supply chain. The problem of improving performance is solved out by developing a collaborative inventory model and increasing the value added of KNF [12].

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There have been many studies related to kenaf cultivation [13], the benefits of kenaf in carbon dioxide absorption [14], and the potential of kenaf [15]. Nevertheless, there is no research that has conducted a study on the intelligent supply chain design model for the development of the KNFA, and specifically research that has developed the IDSS supply chain for KNF [16]. Hence, this study seeks to find research gaps in the development of IDSS in the supply chain of KNF. This study is expected to contribute in developing value added and competitiveness of KNF in Indonesia.

This study aims to construct the IDSS blueprint for the supply chain of KNF. This blueprint will be used as a guideline in implementing the IDSS implementation plan in the upstream and middle-stream supply chain networks in order to improve its performance. This blueprint will include a database management system, a model-based management system, and a knowledge-based management system that will be developed as IDSS configuration. The purpose of making this blueprint is to answer the question of how to make an IDSS blueprint for the KNF supply chain that can be easily implemented for users. The outcome of this study is expected to improve the welfare of farmers and workers on kenaf land, increase value added, improve efficiency, and improve supply chain performance, contribute to increasing the export value of kenaf fibre, and contribute to increasing the competitiveness of Indonesian kenaf fibers.

METHOD

The framework of this study begins with the identification of stakeholder needs based on all actors who play a role in the supply chain network and related to the economic-socio-human resources-technology aspects. The next stage is to make an IDSS blueprint for the supply chain of KNF. The flowchart of the framework is presented in Figure 1.

This study will result an IDSS blueprint that will be utilized for the upstream and middle-stream supply chain networks only. The downstream supply chain network has not been included as a user in this blueprint, although in the future, the digital platform being developed will include the downstream industry as users. This study does not present the results of the decision making of kenaf dried fibre demand prediction based on artificial neural networks and fuzzy neural networks but will describe the inventory collaboration model that applies to the upstream supply chain network in the model base management system section. Some of the conditions presented are the scope of this study.

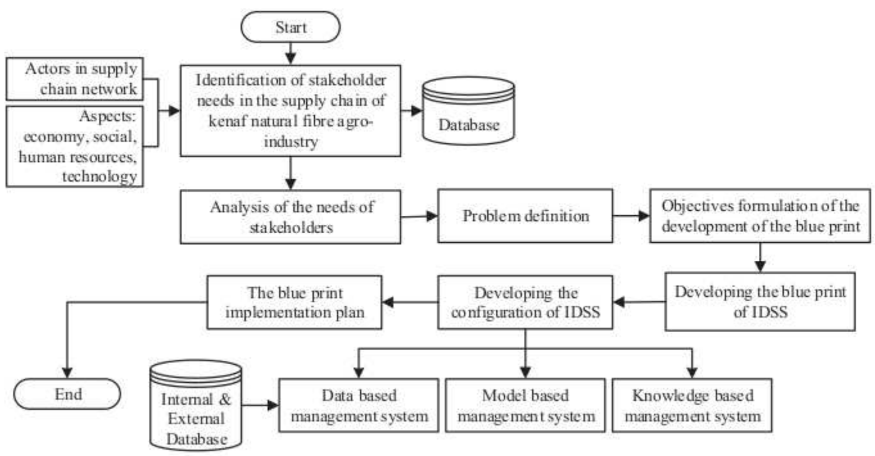

FIGURE 1. Research framework.

RESULT AND DISCUSSION

Identification and Analysis of Stakeholder Needs

The stakeholders in this study are presented in Figure 2, expanded from [12]. Stakeholders who will become users in developing this blueprint are the owners in upstream industry, general managers in the intermediate industry, and online buyers at the marketplace. Developing this blueprint, the level of demand for kenaf dried fiber from uncertain online buyers is predicted by the artificial intelligence network, while the level of demand from intermediate industries is predicted by a fuzzy approach. This is the importance of the upstream industry in becoming users of the IDSS platform.

The middle-stream industry uses this platform to share information on its inventory levels, so that the upstream industry will be alert if the middle-stream industry inventory levels have reached the reorder point. This information flow can be received well and timely feedback in order fulfillment by the upstream industry to intermediate industries, if there is a system that supports the decision-making process in determining the number of product shipments on demand. On the basis of this needs analysis, the middle-stream industry is assigned to be the user in this IDSS blueprint.

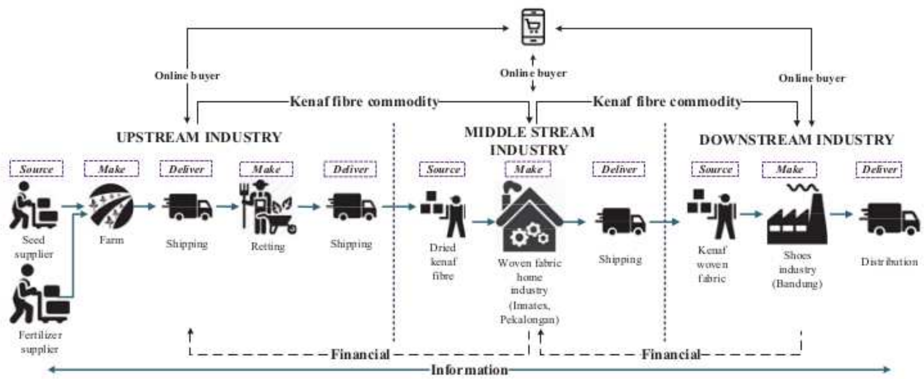

FIGURE 2. Supply chain network model of kenaf fibre.

Developing The Blueprint of IDSS

This IDSS blueprint was developed based on a conceptual model related to the collaboration that exists in the kenaf natural fibre supply chain network. Collaboration is tied vertically and horizontally. The main objective in making the IDSS blueprint is to increase the effectiveness of decision making in improving the performance of KNFA. This improvement is achieved by increasing the value added of kenaf, optimizing inventory costs and minimizing the shortage cost inventory by collaboration. In the IDSS blueprint, which is presented in Figure 3, there are database requirements related to inventory performance and collaboration. Data will be obtained from two echelons in the supply chain network, namely in the upstream industry (KNFA) and in the middle-stream industry (textile industry). This data will be entered as a data warehouse to be extracted through the extract, transformation and load (ETL) process.

Data that has been collected, filtered, processed and combined with relevant data is then stored in a database to be ready to manage based on model based management system. For inventory collaboration, a multi objective optimization inventory collaboration (MOOIC) model will be used. To improve the performance of KNFA, supply chain performance measurement model by SCOR and fuzzy analytical hierarchy process will be used.

Specifically, for the decision making of inventory collaboration model, besides involving horizontal collaboration between the two echelons, the study will also involve vertical collaboration. The vertical collaboration occurs between the upstream supply chain network, namely KNFA as the producer of kenaf dried fibre and online shoppers that meet and sharing information in the marketplace via the internet network. All activities of the centralized data processing unit and dialogue management system will be facilitated through a management interface called the NFiSCA (Natural Fiber Supply Chain Analytics) digital platform [16].

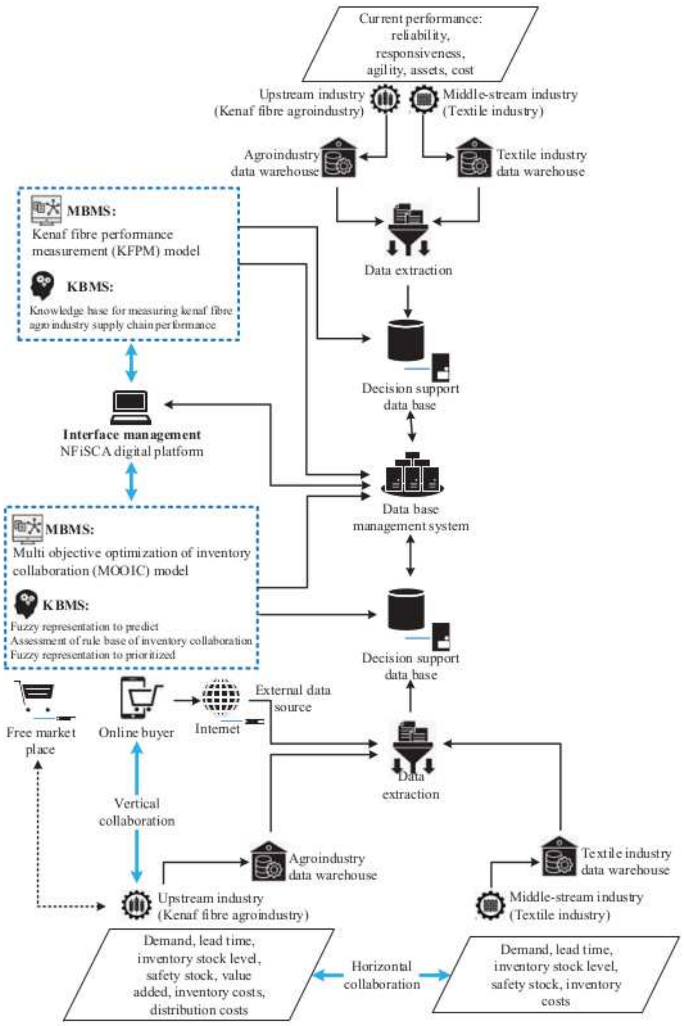

FIGURE 3. The blueprint of IDSS.

The Configuration of IDSS

IDSS configuration in this study consists of Data Based Management System (DBMS), MBMS, and Knowledge Based Management System (KBMS). All the three management systems are put together to do data management centrally on a management interface that has been mentioned. At the same time, this interface will also facilitate a dialogue management system. IDSS configuration is presented in Figure 4.

Data Base Management System

The data base comes from internal and external data. Internal data is the primary data from both echelons in the upstream and the middle-stream supply chain network. External data is data obtained from online shoppers in a market place via the internet. Internal data obtained include data of input-output cost data in the supply chain network, value added, demand, lead time, inventory stock level, safety stock, inventory costs, distribution costs, and data related to performance measurement of kenaf natural fibre supply chains. The requirement of input-output costs data are land rental costs, labor costs, fuel costs, transportation costs, and engine operating costs. The labor cost data complements the labor cultivation, kenaf harvesting, and kenaf retting. Cost of consumables to buy kenaf seeds, manure and pesticides. The transportation cost is the cost of sending the kenaf harvest to the soaking location for the retting process.

Data related to performance include: data on the time fulfillness of sending and receiving kenaf dried fibre, data on the accuracy of the number of shipments and receiving of kenaf dried fibre, and industry agility data if product demand is suddenly increase. This data will refer to the metrics and attributes which contained in the Supply Chain Operation Reference (SCOR) model.

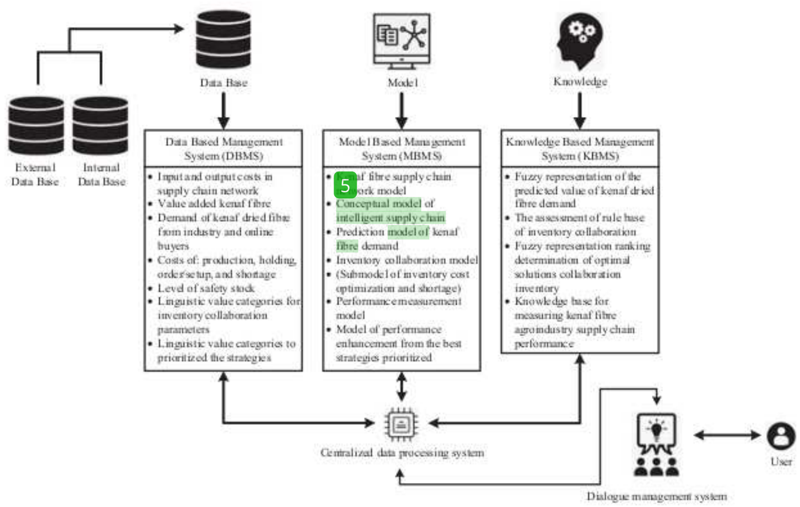

FIGURE 4. The Configuration of IDSS.

Model Base Management System

The first model that has been developed in the KNFA IDSS supply chain is the supply chain network model. This model will identify the flows of information, material, and financial, and source-make-deliver actors ranging from kenaf seeds in the upstream industry to textile derivative products in the downstream industry. An intelligent conceptual model of supply chain will be developed for the variables related to the development of the KNFA supply chain. This conceptual model will also initiate the development of this IDSS blue print.

Demand as an inventory collaboration input must be quantitatively identified. Input of demand of kenaf dried fibre will be obtained from horizontal and vertical collaboration results. Input of demand from horizontal collaboration will use the fuzzy time series (fuzzy logical relationships) model. Input of demand from vertical collaboration, which come from the online buyers will use an artificial neural network model with the back propagation method.

Input data to be able to predict demand from online buyers on the internet will be obtained through web crawling methods. Web crawls will be performed on the top 10 links from 100 URL pages. The results of the data obtained from web crawling will be processed as input training data, target data, and test data with an artificial neural network approach.

The inventory collaboration model that will be developed to support decision making for both echelons in the upstream and middle-stream supply chain networks is a multi-objective optimization model. The definition of inventory collaboration model of KNFA supply chain is a representation of real world behavior in the form of cooperation through information sharing along the kenaf natural fibre supply chain network, horizontally between the upstream industry (KNFA) and the middle-stream industry (textile industry), and vertical between the upstream industry and online buyers in the market place. This collaboration is oriented towards decision making to minimize inventory costs and minimize the amount of inventory shortages. The methodology of intelligent system and metaheuristic are used to obtain optimal solutions according to the preferences of actors who have shared information, taking into inventory levels and lead time.

The Multi Objective Optimization Inventory Collaboration (MOOIC) model is a model that will be developed from a perpetual Economic Order Quantity (EOQ) model with multi objective optimization. The MOOIC model will be completed using Particle Swarm Optimization (PSO). Some results of feasible solutions from PSO will be displayed on the Pareto front optimal, to establish some optimal solutions that are feasible on the Pareto front. Then, the selection of the best optimal solution will be based on decision maker preferences using the Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS).

As already stated, the SCOR model will be used to measure the performance of KNFA at this time. Based on the results of these measurements, a strategy will be established to improve the performance of KNFA.

In MBMS, coding is developed to support decision making to the prediction of demand for online buyers and middle-stream industry, inventory costs and inventory levels, as well as measuring the performance of the supply chains of the upstream and middle-stream industry. One code that has been successfully developed in MBMS is MOOIC in the upstream supply chain network. This algorithm was developed using the PSO metaheuristic algorithm, and coded with the Net Beans IDE 12.0 application based on the Java programming language and the MOEA library for the algorithm evolutionary library. The MOOIC is presented in formulations (1) and (2).

$$Minimasi\ C(Q,k) = \left\{\frac{CD}{Q} + \left(hP\left(\frac{Q}{2} + k\sigma_L\right)\right) + CSI\right\} \tag{1}$$

$$Minimasi\ JSI(Q,k) = \frac{D}{Q}\int_{r}^{\infty}(x-r)f_{D_L}(x)dx \tag{2}$$

Subject to:

$$0 \leq Q \leq D$$

$$0 \leq k \leq D/\sigma_L$$

The model simulation generates consist of 100 solutions for both objectives and 10 variables. The minimum value of 8.59E+09 and a maximum value of 6.19E+10 for the minimum inventory costs objectives, while minimum value of 1.08+E02 and a maximum value of 1.08+E05 for the minimizing inventory shortage costs objectives.

Model Base Management System

This knowledge will be the input that will improve data management in its processing with the related MBMS mentioned. KBMS will be stored in the database management system to be ready to be processed with the available MBMS and DBMS. As well as MBMS, KBMS will also be an input and feedback for interface management. As presented in Figure 3, a fuzzy representation of expert opinion will be conducted to predict the demand for kenaf dried fibre from the textile industry. An expert rule base assessment will be needed to determine the value of collaboration parameters in inventory collaboration.

KBMS that will be used to support decision making consists of four knowledge based. The first knowledge based is related to the demand prediction of kenaf dried fibre from the textile industry. The second knowledge based is the knowledge from experts to assess the parameters of successful inventory collaboration between two echelons in the KNFA supply chain network.

The third knowledge based is the knowledge based from expert judgments that will be represented through linguistic language developed in Fuzzy TOPSIS. The fourth knowledge based is the knowledge based that will be utilized to provide the best strategy in order to improve KNFA supply chain performance. Figure 5 presents IDSS data flow from the developer interface management or the NFiSCA digital platform. This platform will be connected to a database server and a web server, and will support decision making related to demand predictions, inventory collaboration, performance measurement, and the best strategies for improving the performance of KNFA.

These informations will be made available to users to make decisions. Users are KNFA in the upstream industry network and the textile industry in the middle-stream industry network. Meanwhile, users will share information about the availability of kenaf land, kenaf production levels, and the occurrence of information sharing based on horizontal and vertical collaboration. Critical success factors in this data flow diagram are the increase of profits in both echelon, the decrease of the inventory cost, and improvement of the KNFA supply network performance.

Implementation Plan

The design of the implementation plan in DSS is the stage of developing the interface management. Therefore, this system must be designed with a scheme and display that is easily understood by users. The current condition of the pandemic, forcing all parties to want to learn to use all forms of applications that can improve business, performance and competitiveness globally.

Users in the upstream supply chain network are users whose mobility is quite high, because they have to carry out the inspections to the kenaf land, the kenaf soaking area, the kenaf dried fibre warehouse, and its workspace. Therefore, this system will benefit well if it can be implemented on an Android-based smartphone. The minimum specifications for an Android-based smartphone are Android 5 for the operating system, and contain 4GB of RAM, and a minimum of 200MB of storage.

The NFiSCA digital platform as an interface management must be designed with flow and userfriendly for its users. Ease of use will increase the effectiveness of decision makers in the upstream and middle-stream supply chain networks. The applications that needed to develop IDSS for KNFA are presented in Table 1.

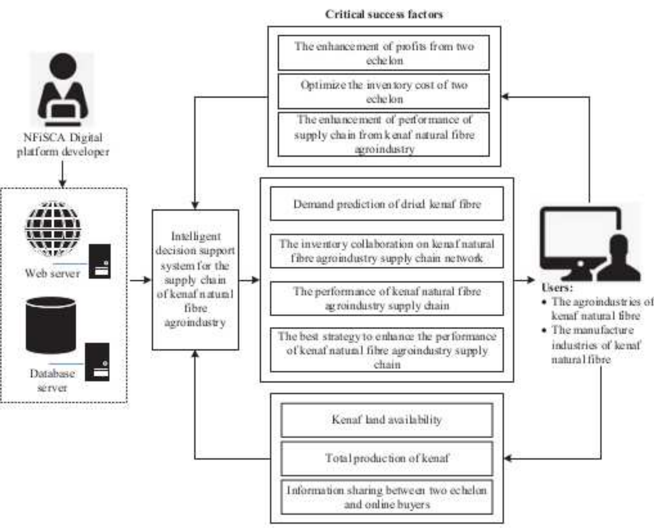

FIGURE 5. IDSS Data Flow Diagram.

TABLE 1. Application and function of IDSS development.

Application	Function
Net Beans IDE 12.0	Applications for the system development process, from coding to model simulations based on the Java programming language
MOEA	Library evolutionary algorithm to develop MOOIC and demand forecasting
jFuzzyLogic	Library to process the Fuzzy Inference System
MySQL DBC	Data base management system that uses the SQL language as a connector between applications and database servers

CONCLUSION

The development of the IDSS blueprint has been developed to specifically enable to increase the effectiveness of decision making and KNF supply chain business performance. Performance improvement is evidenced through the enhancement of value added and inventory collaboration. The MOOIC is modeled by PSO which has been successfully developed and coded by Net Beans IDE 12.0.

In consecutive research, the simulation will determine decision using fuzzy system approach, such as fuzzy TOPSIS or LINMAP. The development of this IDSS blueprint research is to build the NFiSCA digital platform on an android smartphone with the Android studio application, and on the desktop with the Net Beans IDE 12.0 application.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8