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A Supply Chain Network for Material Supplying in Developing Countries

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Abstract: ***In many developing countries where the transportation infrastructures are limited, the supply chain systems are suffering from opportunity lost, return cost, and the flexibility of the logistics system. In particular, there is lacking efficient network models for material supplying and purchasing. In this study, a centralized supply chain model for material supply and acquisition in developing countries is proposed. The model utilizes the application of Web-based applications as a centralized information sharing and optimization across multiple suppliers and customers in the network. The model allows suppliers to provide sufficient information about their products and delivery details. On the other hand, customers are supported to find the products of their need in a fast, accurate, and economical way. The study model is expected to provide small and medium firms necessary tools to reduce time and cost in their business strategy.***
Keywords: Supply chain system, total cost, material purchasing, web-based applications.

I. INTRODUCTION

Major factories are allocated in developing countries where the labor costs are cheaper than others. The material providing for manufacturing thus are distributed across the regions. However, in developing countries, the development of transportation is limited. It prevents the flow of the products. One important issue is that the product information from suppliers to customers are not efficiency interchange. As a result, customers are usually facing the problem of searching for appropriate suppliers with the balance between product quality and delivery cost. In many cases, customers must purchase material with high cost just because of the long delivery distance. Whereas, it is possible to get materials with equivalent quality from the nearby suppliers. It reduces the cost and delivery time. Several studies have been proposed the integration model based on the information sharing in the supply chain system [1, 2]. It is noted that the information sharing system is applied for internal parties in the chain. It does not open for new customers or suppliers which are not supported to have information sharing access.

A similar information sharing system is supply chain system is the showroom and industrial exhibition [3]. The model aims at providing more information about the new product release, price, and services. One disadvantage of the showroom is that the location of the showroom usually need to allocate in a center area to aggregate the number of visitors. There is a fact that many small firms or private customers are staying far from the center and it requires time for travelling. In addition, the service in a showroom could significantly affect the initial purpose of the showroom which is delivering product information to the customers. Several studies about the effectiveness of the showroom in supply chain are reported in [4]. Traditionally, industrial forum or exhibition is an event that opening for the joined meeting between suppliers and customers. In the exhibition, the suppliers can find their customers and customers can find their suitable suppliers. It is however exhibition can be organized monthly or quarterly. To participate in an exhibition, suppliers must pay a certain fee to the organizers which again adds to the total cost of the chain.

In the recent years, with the development of technology, telecommunication is growing fast in developing countries. In addition, the industrial revolution 4.0 requires the adaption in both methodology and structure of the supply chain system. More services are conducted via remote apps and automation software. Information and data now can be pushed and store on cloud database instead of traditional methods, e.g. catalog, advertisement, newspaper, etc.

Inspire of new technologies, in this model a supply chain network is proposed. The model is built across multiple suppliers and customers via a network system. The system allows suppliers to deliver their products in a fast, accurate, and dynamical manners. Whereas, customers are beneficial in a way that the information about their need are available on cloud that they can access anywhere, at any time. In addition, customers be able to provide the feedback on the suppliers which helps to improve the quality of products and services. The study is organized as follow. Section 1 presents the introduction to the problem statement. Section 2 provides details about the proposed model. Section 3 analyzes important parameters and methodology to evaluate the model. Finally, Section 4 summary the expectation results and further works.

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II. PROPOSED MODEL

The model is composed by three components: Customers, Suppliers, and Outsourcing site. The data is stored and handle in the Outsourcing center. Customers provides their related information including: the identity, address, product specifications, and delivery details to the system. On the other hand, suppliers also register their identity, distribution location, product specifications, deliver planning and transportation cost to the system. Finally, Outsourcing unit will inquire all related data for sorting and matching between customers and suppliers based on the calculated ranking score. A short list of suppliers that have highest matching score will be provided to customers based on the predefined priorities such as deliver time, product specification matching, or transportation cost.

Matching score between the suppliers and customers is defined so the model can suggest appropriate suppliers to customers. Suppliers with higher matching scores are selected for shortlist recommendation to customers. The matching score s between suppliers and customers is calculated as follow.

$$s = 4r/p^2td,$$

where r is the supplier rating score history given by customers, p is the total price, t is the average delivery time, d is the distance between a supplier and customer. All parameters are normalized to the range [0, 1].

The matching score is homogeneous with the historical rating score from the customers in the system. Whereas, it is non-homogenous with total price, spanning of delivery time, and distance between the supplier and customer. That means the supplier located closer to customers and having shorter delivery time will have higher matching score.

Finally, the model architecture can be described as in Figure 1.

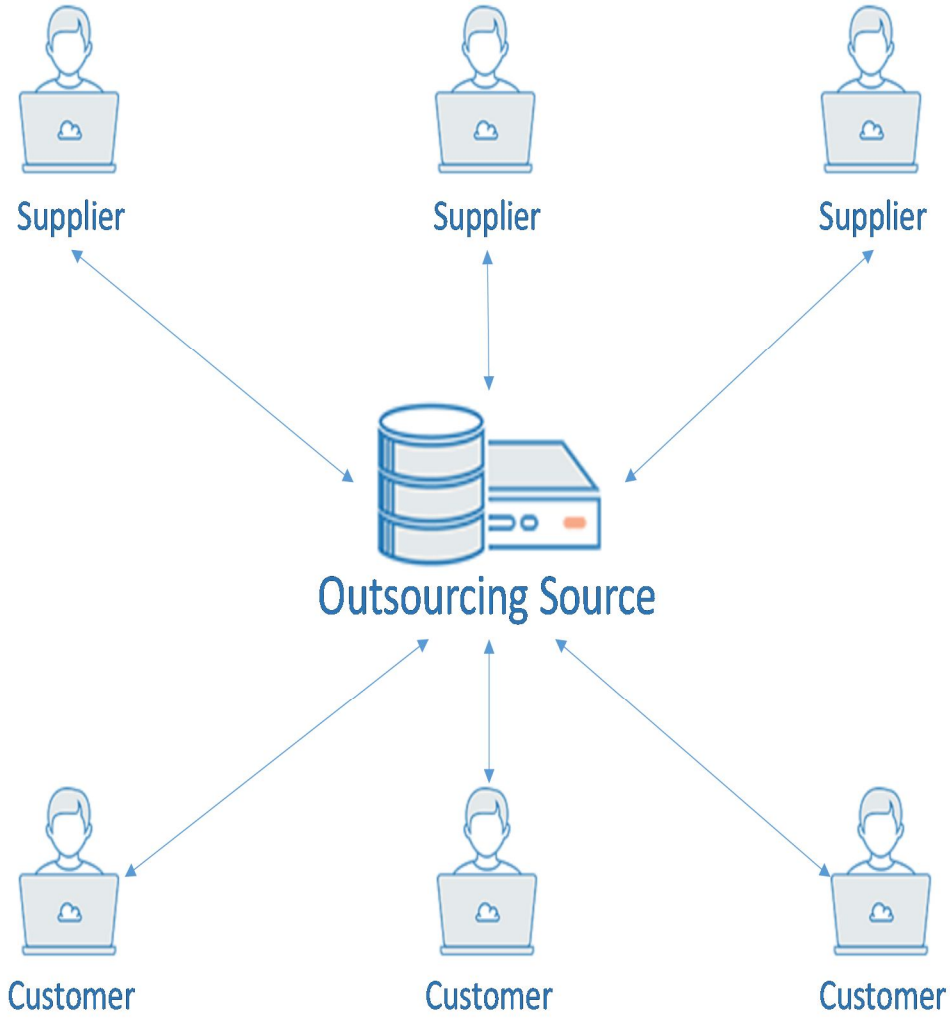

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Figure 1. The proposed supply chain networking model

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III. DATA ACQUISITION AND MODEL VALIDATION

To validate the model, a case study will be conducted for small and medium material suppliers in Vietnam. The data acquisition is constructed following the three stages. In the first stages, supplier's information is collected from 1000 small and medium firms across the country. The suppliers are selected based on their manufacturing areas which mainly focus on materials for textures and clothing industry. Detail information about the frequently customers, transportation, delivery distance, and customer satisfaction is collected through the historical record and surveys. In the next stage, a simulation model is built based on the available data and design model. The simulated system will be used to exam different scenarios of the supply network to determine the impact of relevant parameters on the total cost of the supply chain and other information of interests. Finally, the model is validated by comparing the simulated results with the actual data. If the results from simulation model and actual data are aligned, the model is implemented; otherwise, the model must be revised and re-validation. The procedure of model validation is represented in Figure 2.

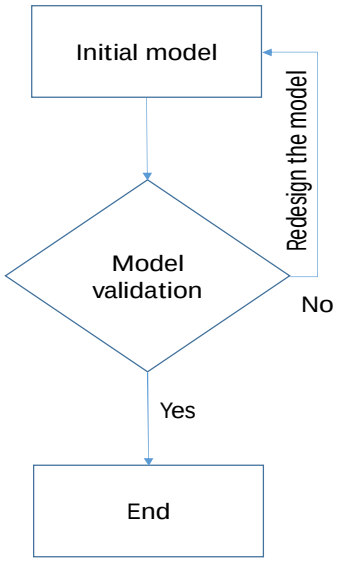
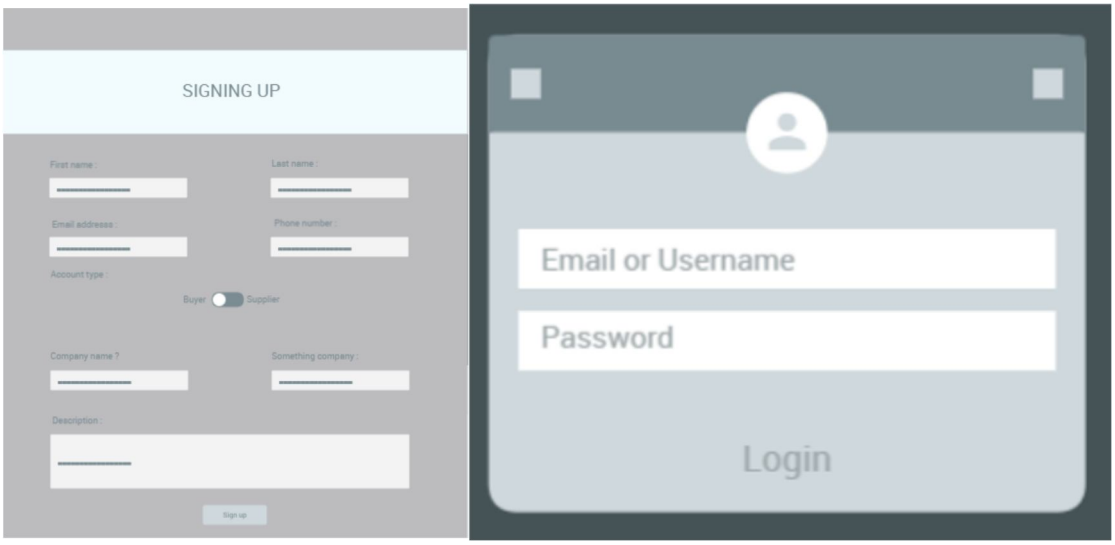


Figure 2. Proposed model validation flow

After model is validated, the model will be construct based on the web-based applications. Suppliers and customers can register their information and acquisition the information via an identity in the system. Several simple windows on the web application are shown in Figures 3-6. Figure 3a is a signup window for customers and suppliers. In this window, customers will provide their identity for delivery, rating, and placing inquires. On a similar window, suppliers will provide the details about the firm and specification of their products. Both parties can login to the system via a simple verification window as in Figure 3b.



(a) (b)

Figure 3. (a) Register window and (b) Login window

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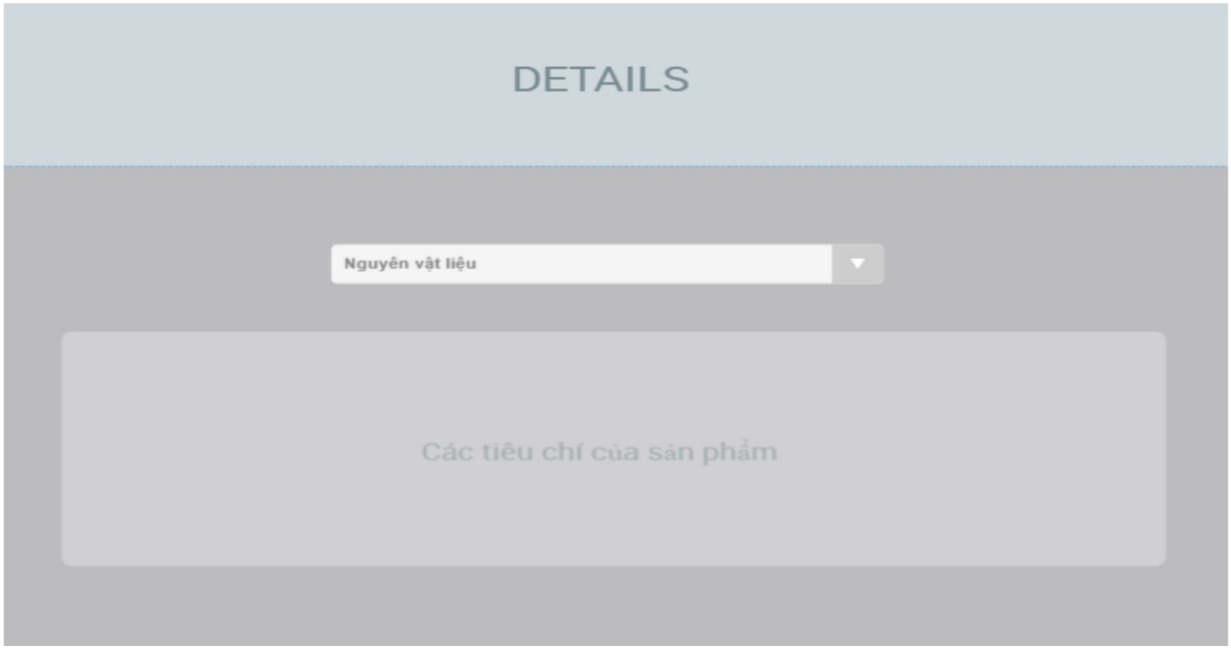

Figure 4. Product (Material) searching window

Figure 5. Supplier recommendation by the system

A window for filling the product specification that requires by customers is illustrated in Figure 4. In this window, customers can fill in all the information related to the inquired products such as product specifications, delivery time, total cost, etc. Finally, the system will retrieve information sent by customers and the database, process and release a shortlist of the best matching suppliers, see Figure 5.

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IV. FUTURE DEVELOPMENT AND EXPECTED RESULTS

In this paper, a supply chain network model is proposed aiming at providing a centralized information system for matching customer's needs and available suppliers in the markets. The model is expected to reduce the total cost of the supply chain. In the meantime, reducing the time and cost for customers by quickly providing them appropriate supply candidates. For suppliers, the model is beneficial in a way that the information about the products can be delivered to potential customers in a fast, accurate, and effective manners. Finally, the model is designed to reduce the percentage of order lost due to the lacking of information from both suppliers and customers sites.

In the next step, the model will be validated using actual data collected from customers and manufacturers as a case study in Vietnam. Besides, the system architecture must be built in order to launch the web-based applications which requires a careful system design using web applications tools such as SQL database, HTML, JavaScript, PHP, Graphic design, etc.

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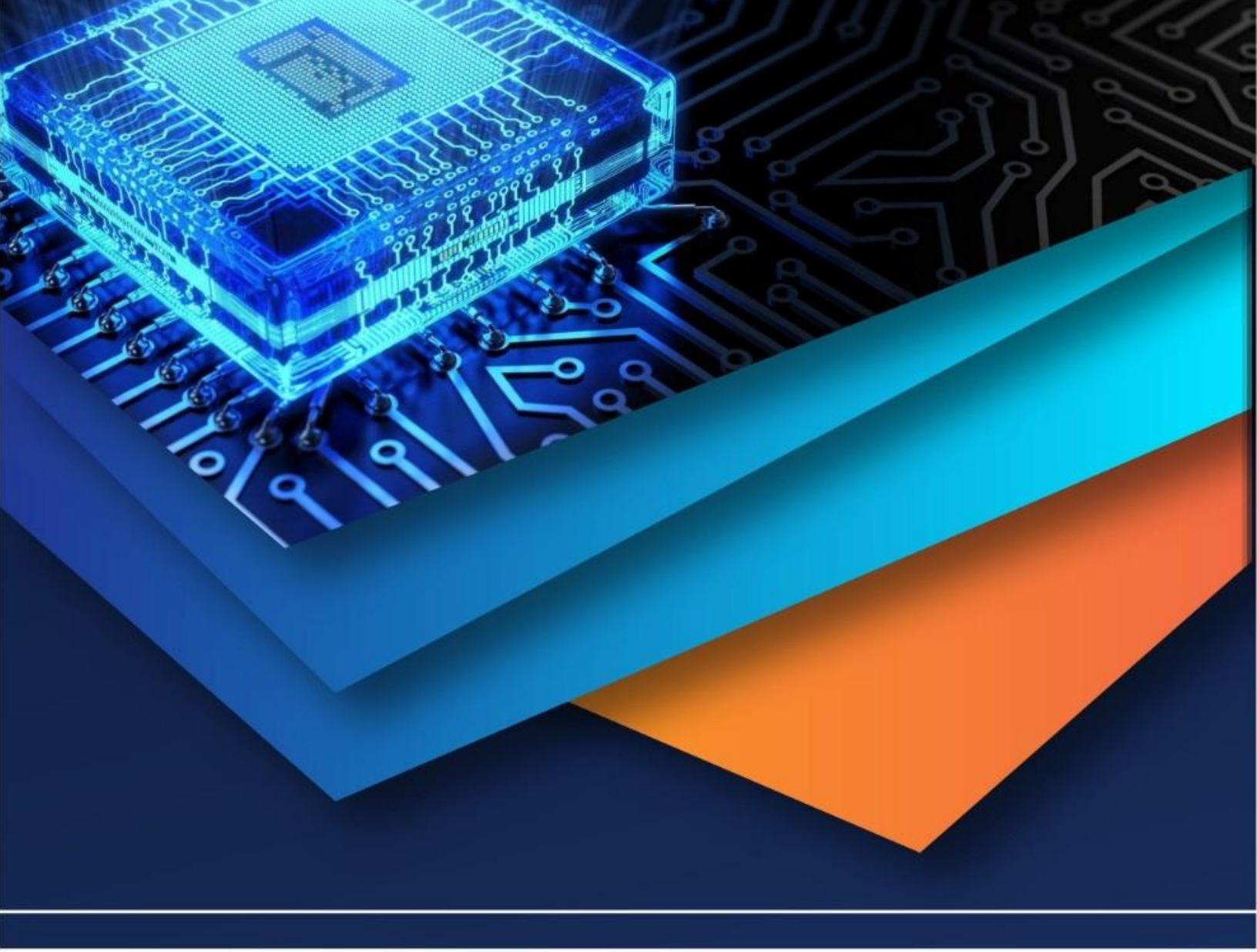

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