# Adopting New Technology in Coffee Plantation: The Role of Knowledge Sharing in Supply Chain Management

Andrey Satwika Yogaswara[1], Andre Suryaningprang[2], Disman[2], Ratih Hurriyati[3]

[1]*Sekolah Pascasarjana, Universitas Pendidikan Indonesia.*
[2] *Sekolah Tinggi Ilmu Ekonomi Indonesia Membangun, Bandung, Indonesia*
[3,4]*Economics and Business Education Faculty, Universitas Pendidikan Indonesia.*
*Corresponding author: *yogaswara@upi.edu*

***Abstract*—The problem currently faced is that the ground coffee beans are dried and still found many defects, the defects are caused form sorting system, a good coffee system can increase sales of farmers businesses that initially only sold coffee beans without sorting with simple technology, but with the computerized method of sorting system and sales development will continue to increase with modern computer sorting standards than manual sorting and coffee beans become greenbean. in this study, the application of Computer Vision will be tested to facilitate a sorting process, a computer system with the help of a camera will introduce a type of coffee recognition system to Robusta and Arabica, this system is able to read the number of defects that exist in coffee, this system is able to be implemented and has more accuracy of 90%. coffee that has been sorted automatically will have a good quality and perfect shape of beans and will produce have unique aroma and will automatically increase the sale value. This system makes added value for coffee bean farmers, training on knowledge of the sorting system that uses computer applications and practices in running the system supports working farmers to work more efficiently and effectively and provide maximum results in accordance with market needs.**

***Keywords*—** *Computer vision, Coffee recognition, Greanbean.*

## 1. Introduction

For coffee farmers in indonesia generally are still family plantations and partly owned by government-owned (perhutani), land processing which is still traditional and characteristic of coffee farmers in the area of responsibility whose inheritance process has been handed generations. This sorting is using drying coffee beans, this process is very dependent on the weather conditions plantation in the area, drying is usually done in 1 month, some farmers use a greenhouse so that dried coffee is protected from dust and dirt, in the drying process sometimes will found that coffee beans are or exposed to pests, which are often referred to as defects, the type of defect it self can be divided into two, namely primary and secondary defects, in the grading and sorting process farmers still use manual tools that use sieves, the sorting system is categorized in several sizes of coffee beans, grading stages namely grade “A”, Grade “B” and Grade “C”, coffee is called grade if it has the same size and low contain water and does not have a defect, while grade B is seen from the size of a small coffee, this type of coffee beans are usually sold to the market local.

Manual sorting system will take a long time and cause varying sizes size, the solution of the problem above is to implement computerized for sorting system, this technology is widely applied in developed countries and easily implemented in agriculture. This technology can be implemented on a coffee bean sorting system, automatically computer has high precision capabilities, this system works by matching the pattern (Recognition) whose measurements are taken from the shape and size of the coffee beans and the sorted coffee beans are Robusta and Arabica types .

The method of measurement with a computer using the recognition technique or recognition of the types of greenbean and defects, the sorting system is done by using a sample of coffee beans taken at random, this computer-based sorting system will then recognize the type of arabica or robusta coffee, computer recognition will give a yellow marking to arabica and blue color on robusta, sorting system combined with computer vision techniques, this technology will trade and sort the harvested coffee beans. computer calculations will read how many defects that appear in the post-harvest and end of harvest.

The ability of coffee farmers in sorting coffee beans manually which has been done in a

downward way up to now is enough to contribute, but to further maximize the process of sorting coffee beans more accurately in its sorting process, then a system is needed to produce coffee beans that have a size similarly, the correct categorization with more efficient time in meeting market needs.

The current market needs for purchasing coffee beans are very high due to the rampant business of beverage products or coffee-based products. Increased sales of coffee beans are very high to be a factor causing coffee farmers to innovate in the sorting process efficiently and effectively so that it can meet market needs to the maximum.

Innovations in the use of the coffee bean sorting system must be made by each coffee farmer with the same skills and abilities so as to produce the best coffee beans for each coffee bean category even though the system is run by different coffee farmers but the results remain the same.

## 2. Literature Review

### 2.1 Grading System of Coffee

Determination of the color attributes can be used as a parameter or indicator of measurement of a food quality, the character shape of a coffee bean has unique characteristics and type, this is in accordance with those set by the SCAA (Specialty Coffee Association of America). In this study, it was discussed how to reconstruct the grading system on coffee with a camera, the camera is used to distinguish colors by comparing the value of L * a * b, the data from these colors are then analyzed using neural network algorithm technology. [1].

Another method is using implementing a neural network algorithm for classify types greenbean or using the Naive Bayes algorithm, in this method the classification technique is used with the use of RGB color parameters (Reg, Green, Blue), the data input system is taken using a digital camera [2]-[3].

Coffee farming itself is a product that has a very important selling value and has been traded globally, the assessment of the coffee itself can be seen from way and place of the coffee plan and the method of processing the coffee beans themselves. [4]

The aroma of coffee will appear on the coffee beans during the roasting process, the aroma arises after the coffee is roasting, the aroma itself is one of the parameters to determine a quality, the quality and aroma depends on where the coffee beans come from and the choice of technology used [5].

The technique of determining the color of coffee itself has a very strong relationship with color, “roastingan” or “sangrai” in indonesian languages will affect the aroma, the aroma is influenced by the oxidation process and the enzymatic effect combination, so that the quality of the coffee will always be maintained. some coffee samples can be taken randomly from sacks or grainpro, samples are usually taken with a size between 0.60 m (medium) and 0.30 m (height), each grainpro package contains 500 grams of sample, the sample has been separated for 12 months. The quality of coffee and aroma has been standardized by SCAA which conducts commercial grading, especially the grading system for coffee originating from Brazil. Quality checks are taken from greenbeans with different types and characteristics indication the color greanbean is as follows: blue-green, green, yellowish, mottled or bleached, while for the variable flavor sensors used are: fragnance, sweetness, acidity, flavor, body and after taste [6].

Coffee is generally harvested after the age of 8 to 9 months, the harvest process usually starts in October process is done by traditional picking or using tools [7].

Quality coffee beans will have a distinctive taste and aroma when roasted, the quality can be seen from the size of a large coffee bean and its perfect shape. It must be shown that to roast, the more same size of a bean have better to transfer and consequently roast proces. The number of damaged seeds also related to quality. the shape of a perfect coffee bean that is greater will increase finding a bad taste in cupping proses, this is due to the content and type of processed coffee beans mixed with other types or homogeneity in the cup, but the number of defects that look low is not necessarily, because that reason process picking early harvest becomes very important, for consideration coffee sample with 50% must have a size of 15 or equal to 6 mm enter into the medium size category and in one sack of coffee beans of a small minimum size of around 5.5 mm [8]. The sorting process is make the quality of the coffee better, the sorting itself can be done by separating the coffee beans with foreign objects from the branches foreign affected coffee beans [9].

Grading process of coffee beans based on the level of maturity, unripe cherries will be separated

to produce good quality coffee beans, the process finish when the coffee beans are in a washing tank, bad coffee will look floating and dry, through the washing process foreign objects such as gravel and sand can be directly separated [10].

Separation and contamination of coffee is done use of labeling, the process is taken on the coffee beans that have been peeled and perpendicular to an empty background, comparison of the data will be pull with data for searching high accuracy and reading rates, previous research methods using "in one labeling" the calculation and reading of the data will be repeated and carried out in each iteration of the shooting process, this process has been widely implemented in the coffee industry and the sorting system is automatically with robot hand when picking so the sorting process becomes more effective [11].

### 2.2 Training

#### *2.2.1 Definition of Training*

According to Mathis, Training is a process whereby people achieve certain abilities to help achieve organizational goals (12). Therefore, this process is related to various organizational goals, training and development can be understood narrowly or broadly. Limited training provides more specific knowledge about the skills that workers currently have. Sometimes there are boundaries drawn between training and development, with development that is broader in scope and focuses on individuals to achieve new abilities that are useful both for their current and future work.

Meanwhile, training is part of an investment in HR (human investment) to improve work skills and skills [13], and thus improve employee performance. Training is usually conducted with a curriculum that is tailored to the needs of the position, given in a relatively short time, to equip someone with work skills.

Training is defined as "an effort to improve the performance of employees in their current jobs or in other jobs that will be held immediately" [14]. Furthermore, in connection with this definition, a number of important points which are described below: Training is "a systematic process to change the work behavior of a group of workers in an effort to improve organizational performance". The training is related to the skills and abilities needed for the current work. Training is oriented toward the present and helps workers master specific skills and abilities (competencies) to succeed in their work.

Training is the process of teaching new or existing workers the basic skills they need to carry out their work " [13]. Training is one of the efforts in improving the quality of human resources in the world of work. Good workers, new or already employed need to take part in training because of the demands of work that can change due to changes in work environment, strategies, and so on.

#### *2.2.2 Purpose of Training*

The general objectives of the training are as follows: (1) to develop skills, so that work can be completed faster and more effectively, (2) to develop knowledge, so that work can be completed rationally, and (3) to develop attitudes, so as to create a willingness to cooperate between each worker and with the supervisor / leader.

#### *2.2.3 Training Process (stage)*

The stages in training and development include: (1) identifying training needs / need assessment; (2) setting training goals and objectives; (3) establishing success criteria with measurement tools; (4) establishing training methods; (5) try out and revise; and (6) implementing and evaluating [15].

### 2.3 Abilities

Abilities possessed by each individual will also determine the resulting behavior. What is meant by abilities or abilities is a talent inherent in someone to carry out an activity physically or mentally which is obtained from birth, learning, and from experience [16]. Meanwhile, ability is an individual's capacity to carry out tasks in certain jobs. [17]. Ability consists of two factors, namely: 1) Intellectual Capability, Intellectual abilities are abilities needed for perform various mental activities, think, reason and solve problem. 2) Physical Ability is the ability of tasks that demand stamina, skills, strengths and similar characteristics.

## 3 Methodology

Figure 1 is the process or stages used to test the grading system, the stages of the grading system are as follows:

***a) sample***

For system testing data randomly sampled coffee beans or greenbeans, the samples taken are Robusta and Arabica varieties. Size and type will be done automatically by the computer with the grading method, grading parameters can be seen from the shape and size as well as the number of defects or defective seeds in coffee beans.

***b) image segmentation***

In the part is the process where the picture taken visually will be segmentation process, this process is the separation between the main object and background, this method is expected to prevent noise calculation by comparing the main object takenl.

***c) Pattern recognition***

In this method is the process of identification of arabica and robusta coffee beans, the identification process uses pattern matching techniques. The system will do grading techniques by reading the texture and size, size and texture will then be compared with a randomly sampled coffee bean on database

***d) clasification output ( Arabica,Robust, Defect)***

In this section the output of the system is arabica and robusta coffee data can be recognized by the system. data processed by Computer vision will give a marking mark on each object of coffee sample data used, the system will display visual data by displaying yellow markings for arabica is blue and for robusta is yellow and red color display coffee defects.

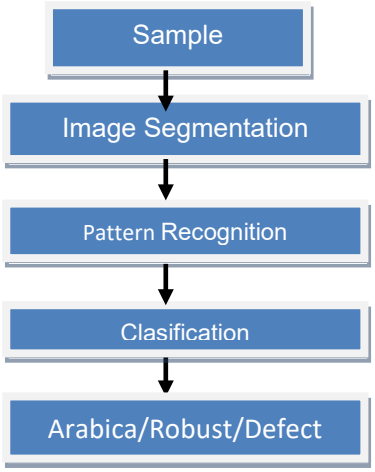
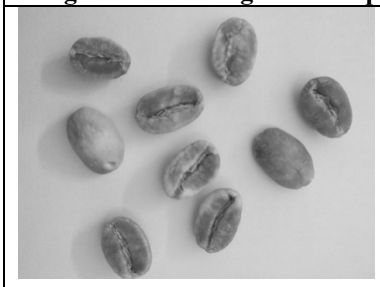



**Figure 1.** Metodology Research

## 4 Results and Discussion

In testing this system Greenbean samples are taken randomly, samples are taken from Robustan and Arabica coffee types, the purpose of the test is to test whether or not the system is capable of sorting with the help of computer vision.

**Table 1.Testing With The Position Of Arabica And Robusta Green Bean Types**

| Image of the coffee greenbean process | Information |
|---|---|
|  | In the picture beside are coffee bean samples taken at the initial harvest, greenbean samples taken from Arabica and Robusta types, the sample data will be tested by the system to see how much the number of defects or defects |

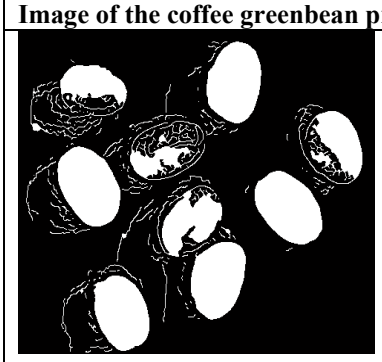
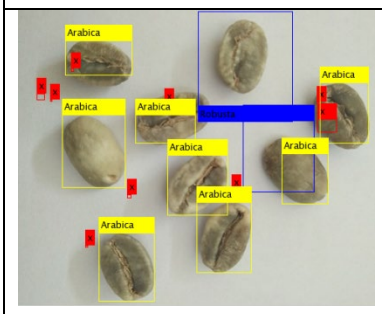
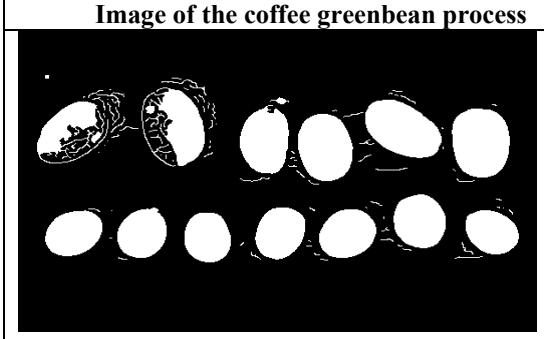
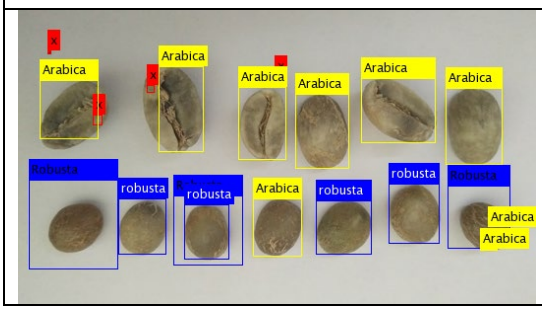
| Image of the coffee greenbean process | Information |
|---|---|
|  | In the picture beside is image processing of coffee beans with image processing techniques, this technique is used to recognize the type of coffee beans or greenbean, and measurement parameters seen from the diameter and size, the arabica coffee beans are generally larger in diameter and shape of the greenbean is more oval almost close to ellipses, whereas in robusta the shape of seeds tends more rounded and smaller. This pattern recognition system (Recognition) is done automatically by a computer, this method is useful for reducing data noise caused by taking unclear images. |
|  | In the picture besides the pattern recognition process by a computer, this system provides a colored marking mark to detection coffee varieties, coffee samples are taken randomly. The result is arabica coffee bean types read by a system with yellow marking while robusta types with blue marking.<br>While defects or defective coffee beans recorded by the system, the foreign objects carried or attached during drying, whereas in beans are broken bean by defects or pebbles during the drying process and system displays red cross red marks. |

**Table 2.** Tests on greenbean in a neat and organized manner

| Image of the coffee greenbean process | Information |
|---|---|
|  | In the picture beside is a coffee bean sample taken randomly from Arabica and Robusta types, the placement of the coffee bean sampling pattern is made sequentially, this is intended to test with a neat sorting position |
|  | In the picture beside is the process of changing from the sample image into the grayscale method, this change serves to read the main object data of the coffee bean is not affected by the background |

| Image of the coffee greenbean process | Information |
|---|---|
|  | In the picture beside is the pattern recognition of coffee beans by reading the unique characteristics and texture lines, a reading system is made in the ramdom sample |
|   | In the picture beside is the reading by the system computer vision method, a trial is carried out on a sample of coffee beans, from the visual results seen better results and quality of beans with a little defect, it can be concluded that the quality of coffee beans or greenbean robusta is better and there is less defect in arabica beans. |

## 5. Conclusion

Based on the above research it can be concluded that computer technology can be used to help a sorting process, this system will make it easier for farmers to evaluate and monitor yields on coffee plantations, that evaluation and improvement will continue to be done and can improve the quality and quality of sales, coffee drying process itself can be improved in order to produce a better quantity and quality of coffee. Neural-network algorithm is able to compare the number of coffee bean datasets, the data has previously been obtained with Image processing techniques so as to produce an accuracy value between 80 - 90%.

The ability and knowledge of coffee bean growers also increases with the use of technology systems in sorting coffee beans because they are faced with a computerized system that they must operate to produce the best coffee beans. This result support the statement Akkermans et al. (2003) that in the operational level, a gracefully chain bolsters three kinds of streams: monetary streams, material streams and knowledge streams. These streams require cautious arranging, cooperation and close coordination between the accomplices just as the effective utilization of IT by the individuals from the system to help those motions in supply chain system. The development of knowledge sharing in this research using training in six steps (1) identifying need assessment; (2) setting training goals and objectives; (3) establishing success criteria with measurement tools; (4) establishing training methods; (5) try out and revise; and (6) implementing and evaluating raised the bussines value by lowering the cost of rejected product and produce higher productivity between worker. The time effectively can reach by training facilititation, the role of knowledge worker to operate the new technology play as mediator that can made lower or higher the effectivity process in adopting technology, so this result also support the statement by Dwivedi et all (2009) managing material flows within a network, notably through logistics management to reduce the high costs associated with inventories and transportation, is also quite straightforward as firms can usually quickly identify what they buy from their suppliers and what they sell to their customers.

Suggestions for further research is to be able to add more varieties of knowledge sharing in training such as training for knowledge of coffee data types, it is intended that the type of coffee that is recognized is not only Robusta and Arabica types, but is able to recognize the types of defects and types of pests that attack seeds or plants.

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