

**SIMULATION MODELLING TO IMPROVE PRODUCTIVITY IN RICE
PACKAGING MILL**

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ABSTRACT

In this study, it discusses about bottlenecks occurs t the Rice Packaging Line by using the simulation to improve the productivity. The scope of this study is focusing on the packaging process in the Rice Packaging Line. The aim and objectives of this study is to identify bottlenecks and increase productivity in total. The time frame given to complete this project is one year starting from the year of 2012. This study is conducted by using the ARENA simulation software to simulate the modeled process in the simulation software. It is a quantitative study in which the performance is measured by the productivity for the whole system of production line. The altering of productivity and the resource utilization are able to provide an improvement of about 40percent in the current system which is 87 packs of rice per day.

Keywords: Productivity, Utilization, ARENA Software, Simulation, Rice Packaging line

ABSTRAK

Kajian ini membincangkan tentang produktiviti untuk Proses Pembungkusan Beras dengan menggunakan simulasi bagi meningkatkan produktiviti. Skop kajian ini memberi tumpuan kepada proses pembungkusan di Process Pembungkusan Beras. Tujuan dan objektif kajian ini adalah untuk mengenal pasti kesesakan dan meningkatkan produktiviti. Tempoh masa yang diberikan untuk menyiapkan projek ini adalah satu tahun bermula dari tahun 2012. Kajian ini dijalankan dengan menggunakan perisian simulasi ARENA untuk mensimulasikan proses dimodelkan dalam perisian. Ia adalah satu kajian kuantitatif di mana prestasi diukur dengan produktiviti bagi keseluruhan sistem pengeluaran. Yang mengubah produktiviti dan penggunaan sumber yang dapat memberikan peningkatan sebanyak kira-kira 40percent dalam sistem semasa atau 87 pek beras bagi setiap hari.

Kata kunci: Productiviti, Penggunaan Sumber, ARENA Perisian, Simulasi, Proses Pembungkusan Beras

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In this chapter, we will discuss on how the rice processing and packaging mill handle rice production process to fulfill the demand of their customers especially during festival seasons. Besides that, we also try to find out where is the bottleneck occurs in the production process that prohibit this rice mill to produce expected amount required.

The purpose of this study is to establish a practical tool namely simulation model to resolve production problem faced in rice production systems. As an investigation, many studies have reported about simulation. The common area been applied include the manufacturing industries and service industries. By using the method with refer to those reports so that we can propose a somewhat different solution that is, first built production system model simulator.

1.2 BACKGROUND OF STUDY

Rice milling is an essential stage in production of rice. The basic objective of a rice milling system is to remove the husk and the bran layers to produce an edible, white rice kernel that is sufficiently milled and free of impurities. Rice processing mill have play an important role in our daily life.

According to Food Frequency Questionnaire (FFQ) (2012) which is

conducted by Malaysian Adults Nutrition Survey (MANS) towards the eating habits for Malaysian, among 126 food items pattern that have been investigated in the year 2008, results demonstrate cooked rice is the most common food that consume daily with 97% of the population twice daily (average 2½ plates per day). Other food items consumed less frequently were marine fish, green leafy vegetables and sweetened condensed milk.

Addition information from Pan Properties (2013), forecasted population of Klang Valley in year 2020 would be 7.8million. It has shows an increase of 11% citizen as compared to 6.9 million of population in year 2013. Due to rapid population growth, increasing demand during normal or peak season and the rising number of competitors in the market, the rice mill are now aiming to have a higher production enhancement towards their packaging process by trying the ways such as import other countries/state rice, invest in a new machine center (with typically higher capacities) and even develop an additional production line to find out the bottleneck and alleviate the supply inefficient.

Because of the existing method used by the company are cost ineffective, time wasting and technically challenging, we suggested the use of simulation to take over the existing method so that management level can solve the problem more effectively. Our objectives now is to improve the rice packaging output, speed up the process by eliminating the bottleneck and maximizing the utilization of machines to produce rice in larger amount, faster speed, less mechanical stresses and in the better quality.

According to the information we get from the rice mill industries, the productivity improvement can be make in the aspect of total processing time, queuing and maximized machine utilization. Therefore, in this research we help this rice mill to improve the above requirement with the assists of simulation software. With simulation modeling, then there will have no

problem in interrupting the real operation.

Simulation is a tool that can be use to encompass interpretations in variety field. It is a problem-solving methodology for the solution of many real-world problems. It is used to describe and analyze the behavior of a system, ask what-if questions about the real system, and aid in the design of real systems. Both existing and conceptual systems can be modeled using simulation, says Lean. M (2010). The questions like: What could be the effective design for a new telecommunications network? What are the associated resource requirements? How will a telecommunication network perform when the traffic load increases by 50%? Can be solving by using simulation. As written by Kelton, Sadowski, and Swets (2010), simulation is a method of collection of data and applications of the theories that are going to mimic the behavior of real systems. It is a specific application of models to arrive at some outcome that enables us to have a clear vision through a computer with appropriate software for example Arena.

Simulation not only can be used for educational study purpose, it also provide a better understanding of a process, cost to setup approximation and determine potential challenges that the process may face upon setting up the design to industrial scale. This is different to what models do, which is only function in the form of mathematical, logical, or some other structured representation of reality.

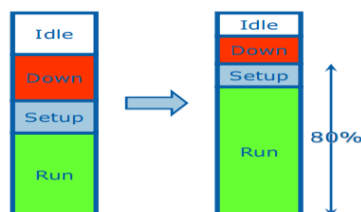


Figure 1.1 Increase of production run-time Anwar. A (2008)

By referring to Anwar. A (2008), he proposes that the development of model using simulation can be use as utilization improve tool. This tool can assists company in reduce machine downtime by reduce the assists, failure and save the awaiting time of operator/ technician to repair jammed machine. It also helps to reduce the ideal time because simulation can make a better forecasting that avoid material shortage and also avoid operator unavailability. Anwar, also claims that simulation helps to reduce yield loss/rework and reduce work pace/ skill variation.

The successful of implementing a predominant method for increasing the productivity is one of the major criteria to be concern in business. Problems that often faced by organization are related with decision on the appropriate number of machine, task assignments, and production plan. By reducing the bottleneck problem of some machine in the rice packaging line and finding appropriate setting of parameters at each operation in the system, the total processing time will be decreased.

In the past few years, there have been a number of researches study about varying aspects on how to increase productivity and it had achieved a significant success by using simulation model. With the help of simulation in various industries such as, manufacturing, healthcare, restaurant drive through, airport security and mining, companies have been able to design efficient production and business systems, troubleshoot potential problems, improve systems performance indicators, and can meet company requirement by cut cost, meet targets, and boost sales and profits. Simulation modeling has been playing a major role in designing, analyzing, and optimizing engineering systems in a wide range of industrial and business applications since its existence the last decade.

In the scope of our research, first step of the normal rice processing

mill that is husking stage will exclude, this is so because the rice mill that we study is a two step process, in two step process husking stage will be process by their supplier which comes from various places at Kedah such as Sungai Rengar and Pokok Sena. After harvesting, the paddy will undergo the process of cleaning, a machine called paddy cleaner will process the harvest rice where foreign objects like stones and tree stumps are remove. Then, follow by husking, this process brings the cleaned paddy after to the next step where husk is separated from it. After the husk is removed, the product is named as brown rice and is ready to send to the next process cycle. This clean and hull removed brown rice will be send to our rice processing mill. The following process will be continued explain at chapter 3.

1.3 PROBLEM STATEMENT

In this study, we will make an investigation at a rice processing and packaging mill. We try to solve some problem face by the rice mill such as unachievable amount of production due to appear of bottlenecks that make the company letting out the chance of getting more customers as they are not able to supply enough stock to customers. This has caused some of the customers to buy competitors rice as a substitute. With that, we also need to know what is the requirement needed to achieve to prevent the company reputation and profit affected.

Besides that, the management level of the company also hopes to increase accuracy and reliability of their operation system. Due to the rice mill are expanding their business recently, they have received increase order from their customer compare to before therefore, it is a need for the company make sure the reliability of the operation process so that production system can ensure they can provide their rice supply consistently. Therefore, there is need for us to implement simulation model so that it can help us to smoothen the production line.

Third problem is how to alter process so that it would be suitable for the use of rice mill. It is a difficult job to measure the detailed properties as the process may have too many different packaging formats, coupled with the frequent replacement in the process. Ineffective planning in production line may cause time and cost wasting. In this case, we have to determine which part is needed to alter in the process so that it could back into actual path.

The other problem is to define bottleneck for fully utilized machine and to maximize the return. Occurring of bottleneck may cause the total time to increase and decrease the productivity. The performance of a rice processing and packaging system is closely related to the performance of all the resource that will be schedule in the whole process. For example, an upstream bottleneck occurs due to the machine at the previous step cannot finish working on time this may delay rice supply on packaging. Consequently, the problem in this packaging production line may cause the silo jam at upstream production facilities, or even cause wasting of resources.

Modeler need to know what is the amount of rice situated at silo and the causes of process jam. This gives concern of the need to verify the design of facility to ensure the process will perform in accordance with expectations and any unforeseen issues are adequately addressed prior to approval of capital investment.

Lastly, we have to know, the specific speed for the line work and how much rice that each machine should have accumulated to ensure that minor stoppage profiles do not interfere with the operation of the upstream and downstream. For instance, if the upstream machine experience jam, we should continue the process by produce enough accumulated of input so that conveyor can continue production until the minor error in upstream machine is rectified. Similarly, it should have enough space on the out-feed conveyor

for the production, to avoid clogging if the downstream machines stop. The goal here is to design line, in order to maximize the use of key equipment, maximize and absorption of minor stop.

1.4 RESEARCH OBJECTIVE

This study discuss on the application of simulation on the production performance of the rice processing and packaging mill. The objective need to be achieved at the end of the study is:

- 1.) To model the rice packaging process using simulation.
- 2.) To propose a better strategy on how to increase performance of the packaging process.
- 3.) To identify bottleneck exists in rice processing and packaging plant.

1.5 RESEARCH QUESTION

- 1.) What would be the suitable model for rice packaging process and method to model it?
- 2.) What would be the strategy to increase the performance of the rice packaging process?
- 3.) What are the potential bottleneck occur at the operating process?

1.6 SCOPE OF STUDY

The scope of study for this research will be focus on one of the rice processing and packaging mill located at the industries area at Klang, Malaysia. This rice processing mill perform the job by collecting half process paddy (Brown rice) from supplier and this brown rice will be undergo a series of process in the production line to turn it into a white polished rice.

The production line consists of 7 stages and each stage may have their own responsibilities from the beginning to the packaging stage. The process may involve input stage, de stoner, dryer, polisher, color sorter to a silo, from a silo to auto scale and finally to the workers who package the rice according to the amount needed. We tried to increase the throughput of production by investigating the capability of the machine so that we can have a full utilization of the machine by building a discrete event simulation model.

We also collected necessary data through data collection method, that is observation, measurement of the capability and size, taking reading on the process and having site visit to the industries to look how the process operate. By dealing with simulation, we were using the software called ARENA to build our model.

1.7 SIGNIFICANT OF STUDY

In order for us to have a successful project, we need to identify what are the significant of this project? And how this project is going to benefit the company. The significant of this study is we can build a model using simulation method that can easily identify the bottleneck position in the rice mill process. Simulation can be analyzer where we can make assumption on different part of production line to see the result after make changes to the system. Furthermore, its flexible and easy understanding animation helps us to propose idea on how to make suitable changes to the process flow.

This simulation study can help industries to make comparison on the productivity before and after implementation of new machines/workers. The company management team which does not sure their decision making is correct or not can refer to the model as compare alternative designs to existing systems.

This project is also useful to the company as simulation becomes a good alternative for the rice process that cannot interrupt anytime as we can. Moreover, problem was solved as we can try the process on the simulator model for several times without worry of causing damage on the actual machine. In addition, management level can save the cost of replacing the new system and need not employed an expertise to fix the problem if the machine is damage during testing.

We sure that by propose this study, there would be a develop of a complete productivity improvement methods to smoothen the job queuing, processing time, maximize utilization at the rice processing line and find out causes that make rice processing time slow down during the operation because such simulation systems are commonly intractable to mathematical analysis.

Lastly, we can also remind the firms about the importance of productivity improvement of their product to generate a higher profit and to stay competitive in the rice milling industry.

1.8 OPERATION DEFINITION

- **Simulation.** Can be defined as the act of imitating the behavior of some situation or some process by means of something suitably analogous (especially for the purpose of study or personnel training)
- **Modeling.** A model also can be a representation of a process—a weather pattern, traffic flow, air flowing over a wing.
- **Discrete event simulation.** Can be defined as suitable for problems in which

variables change in discrete times and by discrete steps.

- **Continuous event simulation.** Can be defined as suitable for systems in which the variables can change continuously
- **Model.** A model is a representation of a real system.
- **Event.** An event is an occurrence that changes the state of the system.
- **System state variables.** The system state variables are the collection of all information needed to define what is happening within the system to a sufficient level (i.e., to attain the desired output) at a given point in time.
- **Process improvement.** Can be defined as taking a close look at how processes were performed, with an objective of improving efficiency and reducing equipment downtime.
- **Throughput.** User-measured processing speed of a machine expressed as total output in a unit period (usually an hour) under normal operating conditions.
- **Bottleneck.** Can be defined as the neck and mouth of a bottle, or an area where things become congested, caught or blocked, or a situation that causes a delay.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, we will discuss more on the previous research that have been done by other researcher before. By referring all the material such as journal, magazines, books or other information sources. We can have a clearer understanding to what is our study about and we can take the strength and weaknesses suggested.

2.2 INTRODUCTION TO SIMULATION

Simulation is most commonly used in places where actual environment is difficult or costlier to duplicate such as aviation and medicine (Shahbazi et al., 2012). It gives the user the flexibility to try new alternatives without actually having to modify the physical system and also study the outcomes. According to Craig. W (2006) simulation is the process of building a model of a real or proposed system to study the performance of the system under specific conditions. Simulation is especially powerful because it allows the observation of the behavior of the model as time progresses. Smith (2003) also claims that simulation as the “development of descriptive computer models of a system and exercising those models to predict the operational performance of the underlying system being modeled.

Computer simulation provides an extra layer of abstraction from reality that allows fuller control of the progression and interaction with the simulation. For example, a computer based airplane flight simulator may contain emergency conditions that would be too dangerous and costly in a physical simulation training scenario. This enables the new learner to tackle the challenge without facing any danger in life.

Application areas for simulation are practically unlimited. Today simulation can be used for decision-support with supply chain management, workflow and throughput analysis, facility layout design, resource usage and allocation, resource management and process change said by Ali. M (2003). Back to our study, simulation seems can be a good tool to be used as we can obtain many of the earlier research that have conducted before related to our research title.

Moreover, Hakan. A (2003) also make some analysis toward the ARENA windows based simulation software, he said that ARENA have made simulation modeling not only affordable but relatively easy for managers to initiate simulation studies of a variety of situations including operations and processes, feasibility studies, business processes, human resource deployment, call center staffing, capacity planning and others. He added, ARENA also makes the task of “what-if” analysis become easiest simulation software that can be run with minimal programming involved and equipped with scenario managers which are designed for the purposes of “what-if” analysis. Under varying input parameters and/or constraints “What-if” analysis can perform well with the ability to show how a system would behave.

For the convenience reason, simulation enable analyst to add or change variables in the mathematical or symbolic model and evaluate their effect on the entire syste. Rajashekar.P (2012), simulation is a useful tool to assist managers in evaluating different business options. Typically an accuracy of at least 99% of the throughput values is achieved with the simulation models in real-life projects

depending on the level of detail and accurate modeling capabilities and statistic analysis capabilities of simulation.

Jahangirian et al. (2010) has carried out a detailed review on the application of simulation in manufacturing. The authors have classified the use of simulation in manufacturing into 24 categories. Each of these categories has found enough applications in the industry and the authors have sample papers in each of these categories. One of the classifications is process engineering - manufacturing which deals with Design, evaluation, and implementation of new technologies; multiple changes to service delivery process including scheduling rules, capacity, layout, analysis of bottlenecks, performance measurement. The current work is an example of process engineering - manufacturing in which the bottlenecks are indentified and eliminated by using the best alternatives. The simulation cycle is repeated until a desired production rate is achieved.

In addition, simulation models which have successfully implemented in manufacturing and service industries was also published in a lot of articles. In fact, this shows the ability of modeling and simulation in diagnosis, identify problems and take preventive measures to generate ideas to improve the system and productivity. The modeling of interaction among the component of the system is inherent in simulation modeling because simulation intimates the behavior of real system (as closely as necessary).

Furthermore, the prediction of the future behavior of system is also achieved by monitoring the behavior of various modeling scenarios. Real world system is often too complex to experiment with directly therefore simulation model allow the modeling of this complexity and enable low cost experimentation to make inference about how actual system might behave.

2.3 DIFFERENCE BETWEEN MODELS AND SIMULATION

To ensure we are using the right technique in our study, we have to clearly differentiate the difference between model and simulation. There are some difference between simulation and modeling; model is a substance that used to indicate the clear purpose of other entity. Under normal circumstances, the model just display a simplified abstract which only embrace the scope and level needed to meet the required details of the specific learning goals. A model is similar to but simpler than what is done by a system, it represent construction and working of some system of interest.

People use model to predict the effect of changes to the system. Besides that, the results obtain should have a close approximation to the real system and incorporate most of its salient features. The model is usually being use when the actual system is impractical or prohibited. This might be because of the researcher feel expensive, slow, destructive, unsafe, or even illegal when having research on the actual investigation. Besides that, model only can be applied in the concept form of the system model that is used for educational purpose.

Simulation is a technology research and analysis of the behavior of a real world or an imaginary system by mimicking the application on computer. It is a mathematical model that describes the system works. Sometimes, simulation is also used to train people for some specific activities and react to unexpected situations. The simulation involves create a model to imitate behavior; experimental model to generate the observation of the behavior, trying to understand, summarize, and promote these behaviors. In many cases, simulation test and compare different design and validation, interpretation, supports simulation results and recommendations of the study. The simulation can help designers to optimize their system to make the necessary changes, and achieved good results. They can try different designs to change the attributes in a virtual environment, it saves time and money. The user can run to simulate slow or fast in the real world and may help to find out more suitable result.