Combine project management and economic order quantity: Is it valuable on food industry?

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Abstract. The agricultural processing industry often face conditions, as delivery delays raw materials from agricultural land, poor post-harvest handling and distribution network that is affected by distance and time, no standard pattern selection of agriculture and there is no a way of storing a decent raw materials produce. This phenomenon led to the resulting end products, decreased taste or may not be utilized, so some people will be harmed, namely suppliers, producers and consumers. The main study should be noteworthy in ensuring, the availability of agricultural raw materials, which became supply the agriculture processing industries is determine the activity, which can be delayed and critical activity, which can be solved with the project management approach. Further activities that could be put on delayed and critical would be affect, on an effort to provide a decent amount of raw materials both in the amount of volume and the time provision, which can be guaranteed by the approach of economic order quantity. This paper seeks to approach a state of the art, of combining project management and economic order quantity, in order to ensure the smooth distribution of farmers to manufacturers, as well as the appropriateness of the amount of fulfillment of demand from producers to consumers

1. Introduction
Prepare some materials for food industry, facing many problem namely perishable raw materials, time delay [1] from farmer field to industry, poor harvest, distribution network which affected by distance and time [2], there is no exact standard in delivering raw materials[3], until the way of storing perishable materials. Another phenomena was performed by action of the actors with low commitment to keep their promise to deliver[4], but they ruled in distributing the raw materials which needs by food industry, this phenomena become a complex situation to be solved immediately in order to assure the condition of materials when begin to process, by food manufacture [5].

In this paper we proposed a way for coordinating some actors in order to obey the schedule of delivery some raw materials, especial in distributing a kind of raw material that used by food manufacture. Commonly we knew that some vegetables needs to deliver to food manufacture in the fresh condition, so how to keep the fresh condition of vegetables from field farm to food industry, it’s a kind of problem that must be solve. The idea to keep fresh vegetable according to many actors that involved in food industry have to be observed intensively.

The way in binding some actors that involved in distributing raw is made a schedule of volume that must be delivered, according to lead time [6]. How to unite lead time and actors, in the level of distributing is to build a network between points that value in the supply chain, of distributing some raw materials to food manufacture with project management approach [7]. The tools proposed to make the
relationship between the actors reality, is use network diagram to describe the relationship between the actors.

The actors involved in the line of food manufacture distribution, devide into three parts namely, micro level which actors to concern with provide raw materials, and process it into finished food. Meso actors which duty concern with packing and assure that materials distribute in the press condition to level micro actors according to time and distance. Finally macro level actors which have a task to keep quality and quantity a raw materials always in schedule to proceed the raw materials into from field farm [8].

The relationship will be affect by the lead time that include in the process of material in each actors, also the time to deliver the material to another actors, until finished material accept by food manufacture. Every actors must be consider the condition of inventory according to the rate of production, and inputs from another actor before [9]. The reason of using a kind of inventory method will be, logical in this way, because every actors try to accelerate their inventory with supply and demand that become among the actors.

There are two conditions must be observed in the chain of distributing raw materials, namely how inventory works in the line of critical activity, when action must be executed without lateness and how inventory works in the line of delayed activity when action have some alternative to execute. That condition will be valued for the actors in the supply chain of distributing some raw materials food among the actors that involved in the chain of food manufacture, beside every actors have to obey some commitment of delivering, to keep the supply chain can operate smoothly, according to requirement of food industry.

2. Methods
The research was conducted in studio of Logistics and Supply Chain Centre, Industrial Engineering Widyatama University. The research object take a case study from the actors that involved in food industry that need potatoe as raw materials. We limiting our study according to the actors in the level macro as potatoe farmer one object but could be able to deliver to two collectors, in the level meso. Finally we observed one food potatoe processor as level micro. The step of research devided into three parts namely initial study, follow by build networking by project management approach, and finally implement inventory method with economic order model, to find the quantity must be deliver among the point that include in networking. We observed also some journals and books concerning with discussion about project management and inventory methods implementation in food industry, perishable raw materials, and food industry. We used quantitative methods in this research, and used a data as demand from any actors in twelve months, and will be presented in sum. The first step is begin by observed the object, and find the fenomena in food industry, and find that there is a complicated rule about the relationship between farmer and collectors with no rule to obey. Second step concern with building the network among the actors that involved in food industry, and we find that lead time is the key to make the relationship between farmer and collectors become more harmonious, with the bridge of schedule. Finally, the third step concern with determine the quantity that needs by the actors involved, especially collectors and producers. The research step describe on figure 1.

![Figure 1. Step of the research.](image-url)
3. Results and discussion
In this paper we observe three actors that take the action, on potatoe distribution from farmer field until producers. We called a group of farmer (A) in the same area could be able to deliver any number with limited capacity to two different collectors. Meanwhile collectors (B) and (C) packing potatoes before send to producer (D). Table 1 give the information about capacity, time and requirement each actors.

| Abreviation | Lead Time | Capacity Cycle/production |
|-------------|-----------|--------------------------|
| A           | 1         | 2000                     |
| B           | 2         | 350                      |
| C           | 3         | 500                      |
| D           | 2         | 1500                     |

Information about demand from market to actor D per year, same with consumer need. the relationship between consumer will be construck on the form of networking beginning, from group of farmer (A) which connected to two collectors, and finished at producers. The net working completed with lead time which signed, the time to proceed raw materials. According to time we compute the time to proceed the raw material inorder that to appoint normal activity and delayed activity. The work of project management in this research presented in Fig 2. With the used of project evaluation and review techique which explained, four different time. Let say actor A as an example to explained the mean of value that lay on the box. We begin with the cell sign on the left, it means early start (es), in the middle as duration (d) and the right one was early finish (ef). Meanwhile in the left below it means latest sart (ls), in the middle slack (s) and inthe right was latest finish (lf). Latest in this contex has a meaning that the activity, can be postphoned without breaking the longest time (6).

![Figure 2. Relationship among actors.](image)

According to this information we can take a conclusion, that in the relationship of actor that involved to potatoe supply chain, we see that actor A, C, and D become a critical actor which sign with slack value as nil, where the activity can be delayed by time, space and distance, meanwhile actity B become delayed activity which slack value sign by more than nil. For Actor A, C, and D slack value will be nil it become from \( ls - es = lf - es \) (0-0 = 1-1) it show that the actors can be postphoned the task, where begin and finised on the exact time appointed on the schedule, meanwhile actor B can be delayed the activity, so that has two alternative activity to do i.e begin at 1 (es) for ended at (3), or begin in at 2 (ls) for ended
at 4 (lf) For clearly explanation about the relationship among the actors, in the networking, here we presented on Table 2.

Table 2. Summary of relationship among actors.

| Actors | d | es | es | ls | lf | s |
|--------|---|----|----|----|----|---|
| A      | 1 | 0  | 1  | 0  | 1  | 0 |
| B      | 2 | 1  | 3  | 2  | 4  | 1 |
| C      | 3 | 1  | 4  | 1  | 4  | 0 |
| D      | 2 | 4  | 6  | 4  | 6  | 0 |

Next observation we would like to know wether the inventory of an actor willbe effect to the activity critical and delayed. In order to test the ability of each actor we test the line with the demand become to actor D, as presented in Tabel 3.

Table 3. Demand actor D.

| Month      | Demand (Tons) |
|------------|---------------|
| January    | 1000          |
| February   | 1400          |
| March      | 1200          |
| April      | 1300          |
| May        | 1500          |
| June       | 1000          |
| July       | 1500          |
| August     | 1100          |
| September  | 1200          |
| Oktober    | 1400          |
| November   | 1300          |
| Desember   | 1200          |
| **Total**  | **15100**     |

In the next step we calculate the needs of inventory on each actors. The model used to determine inventory was Economic order quantity which need three component, namely demand per year (D), carrying cost (h), and ordering cost (O), according to this component we can build a formula for Economic Order quantity (EOQ) as follow [4, 10]:

\[
EOQ = \sqrt{\frac{2 \times D \times O}{h}}
\]

We give a dummy cost to test the EOQ as presented on Tabel 4.

Table 4. Dummy cost.

| Actor | Carrying Cost (h) | Ordering Cost (O) |
|-------|------------------|-------------------|
| A     | $0.1/ton/period  | $100/order        |
| B     | $0.5/ton/period  | $90/order         |
| C     | $0.5/ton/period  | $90/order         |
| D     | $0.6/ton/period  | $70/order         |

Applying EOQ formula in each actor will result a quantity as presented in Tabel 5.
Table 5. Result of EOQ.

| Actors | EOQ  | Order/ cycle | Capacity/ cycle | Expl  |
|--------|------|--------------|-----------------|-------|
| A      | 1338 | 2            | 2000            | enough |
| B      | 671  | 3            | 350             | not enough |
| C      | 822  | 3            | 500             | not enough |
| D      | 1877 | 8            | 1500            | not enough |

According to Table 5, we see that for actor A (critical activity the EOQ can be fulfill by the existing capacity (1338 < 2000), but there are some inventory in the farmer side as 661, that must be sold immediately. The inventory could be to cover another critical value on the line of supply chain i.e actor C because the capacity is less than EOQ (500 < 822) it needs amount about 322, and it can take from 661, so that the inventory at farmer side become 339. Furthermore we can add it to actor B which in delayed activity so that the capacity can be covered, and now the inventory at farmer side become 18 tons, and it can cover actor D who deficit 377 tons, and it must be solved by preparing a safety stock from another collectors and farmers.

Attention must be placed on actor C, because lay on critical side, so that the inventory must be focus on production rate of actor D, for determining volume of safety stock also volume when reorder point. Meanwhile actor B can be arrange the quantity of delivering to actor D with two alternatives, so that he could to find the amount of deficiency from another farmer, before delivering potato to actor D, so the important thing to plan for actor B is how to determine reorder point of raw materials.

4. Conclusions

According to numerical experience of case study that explain, we found that the role of actor of food industry can be depart in to two parts i.e. as actor in critical activity and delayed activity. For actor that placed in critical activity, the important thing that must get attention is how to keep the volume inventory not going lost based on reorder point and prepare safety stock. Meanwhile for activity placed on delayed activity, the alternative time to execute the job could be used to find another agent who could be able to prepare the deficiency of raw materials, with attention to permitted delayed time.

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