

OPTIMIZATION OF OUTBOUND LOGISTICS SYSTEM OF ACEMENT MANUFACTURING COMPANY

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ABSTRACT

Outbound logistics management has always remained a perplexing problem to all organizations, especially to a cement manufacturing unit. Although its importance in the organizational performance has always been known, for several decades no serious attempt was made to unify and organize a body of knowledge on this subject.

Today organizations are facing problems of survival because of acute competition. In this context, it is worthwhile to make a study of the outbound logistics management system in a manufacturing undertaking for improvement. With this view, it was thought desirable to undertake a case study of a public limited cement industry which has been successful throughout its existence.

This paper focuses on the use of discrete simulation tool (EXTEND SIM8) in the outbound logistic system design of a cement plant. This study specified a proposal of using Discrete Event Simulation (DES) and innovative logistic methods for the better output of cement plant. The queue of the trucks in front of the loading station can be reduced and the output can be increased. Hence customer satisfaction can also be increased. This specification would then help the design phase of the whole plant and would contribute for the rationalization of the use of cement plant resources.

KEYWORDS: Outbound logistic system, discrete event simulation, EXTEND SIM8, optimisation, queue length.

1. INTRODUCTION

1.1 Cement Manufacturing Plant

Today, majority of the public and private sector has established their own logistics management system,

mostly on the lines of well established practices, with a view to have maximum output and customer satisfaction. Now a day's organizations are facing problems of survival because of acute competition. Only those organizations can meet the competitions effectively can have a hold on the market. With this end in view, it was thought desirable to undertake a case study of a cement manufacturing organisation which has been successful throughout its existence.

Cement is the key factor in the building and construction industry and it definitely influences many other industries. Hence cement manufacturing industry is one of the key industries in the world economy.

In this type of factory, the flow of cement (outbound logistic system) could be enormous; more than 120 trucks per day with more than 700 tons of cement are loaded by truck every day and more than 2400 tons of cement is loaded by wagon in every two days. The need for a great logistic system is then crucial.

1.2 General Outbound logistics system

The various entities come in the outbound logistic system under study include:

Parking area, where trucks wait for the registration of their arrival;

Entrance and exit gates – check zones;

Sales office where sales invoice number is given to the trucks;

Packing and Loading of cement product into bulk trucks and wagons in silos, where the truck and wagon are filled through automated equipment directly from the storage area.

It is then possible to identify problematic areas and respective aims which are discussed in the following paragraph.

Loading processes – the aim is to avoid errors in loading, making use of standard loading times;

Traffic Jam - Avoiding plant overcrowding and traffic jams inside of the plant;

Rationalizing the use of resources (gates, loading places or human resources) and allowing flexible reactions to specific customer requirements.

The main issue of this project will involve the integration of outbound logistics system and a discrete – event simulation software tool (EXTEND SIM8). This approach will help to find out a high performance configuration and control of logistic components in cement plants. These components include weighing systems in both entrance and exit gates, registering and managing customer orders and requirements, truck flow control, etc.

Our project focuses on the identification of bottlenecks in the system, finding a set of possible solutions and choosing the best one. Discrete Event Simulation (DES) is used for this purpose (Francis, McGinnis, and White 1992).

1.3 Discrete Event Simulation (DES)

DES is the act of imitating the behaviour of an operational system or process using an analog conceptual model on a computer. The arguments below will help understand why simulation would be a useful tool:

- All processes have stochastic behavior (Kulturel, 2007);
- It is a complex system with many resources and non deterministic conditional routing decisions (Pegden, 2007);
- 3D graphic and animation is relevant for easy demonstration and presentation;
- Need for simulating crashes and breakdowns in real processes (e.g. Printer breakdown, electronic

failures, human errors etc.);

- Need for analysis of time dependent patterns of demand and facilities/ resources availability.

1.4 EXTEND SIM8

EXTEND simulation software, a highly respected off – the – shelf discrete event simulation methodology that can rapidly develop a wide range of process models. Models in EXTEND are structured by connecting library block components that logically describe the process or system that is modeled. EXTEND is uniquely powerful in its ability to structure scenario input data within its own internal relational database. The behavior of the analytical model should match the one observed in the original entity (Susan, Gordan and John (2005). In order to ensure that the model is valid, a validation phase is required to check that the results given by the model match what we see in the original entity [4].

EXTEND simulations software is chosen in a perspective of a new challenge in this area (other simulation tools are discussed in Dias, Pereira, and Rodrigues 2007), and the issues below gained a great relevance for this project:

- Testing a new simulation tool for setting it as a part of currently used internal logistic system;
- Testing new possibilities for introducing this new simulation tool for educational purposes in our department (Vik 2010).

1.5 Integration of a Simulation tool and the Logistic system

According to mentioned issues, it is possible to identify why implementation of DES would be relevant in the context of a cement company:

- Currently used logistic application manages the flow of trucks in the plant;
- It helps answer what – if questions, checking (testing) the impacts of system changes;
- The plant processes and control logic are in the minds of managers and changes are made based on their knowledge (experience) and not on proved scenarios.

There are two approaches to make use of the integration of the tool:

The first approach can help in redesign tasks, testing different scenarios and suggesting confirmation changes. The simulation model gives answers to ‘what – if’ analysis and shows impacts and influences of tested changes in the overall performance.

The second approach is to make use of simulation for the implementation of a new logistic system in a new plant. In this case, simulation is a great tool and the 3D animation will help visualize a non – existing system and it is therefore possible to suggest and configure a complete system before its implementation in the plant.

According to the number of known projects, it is possible to say that redesign tasks are much more often than the design of completely new logistic systems (Kulturel 2007) (Vik 2009).

2. PROBLEM DESCRIPTION AND PROJECT STEPS

Our simulation approach included the steps proposed in Muther (1973), Taylor (2008), Zelinka (1995), and are illustrated below:

i) Definition of project aims

- Definition of exact project targets according to customer requirements;
- Setting of system's borders and level of detail.

ii) Processing of input data

- Technical data (facilities data, delay time, processing time, production areas, type of probability distributions followed in each station etc);
- Organization data;
- Business data.

iii) Creation of simulation model

- Conceptual model (schematic);
- Computer model.

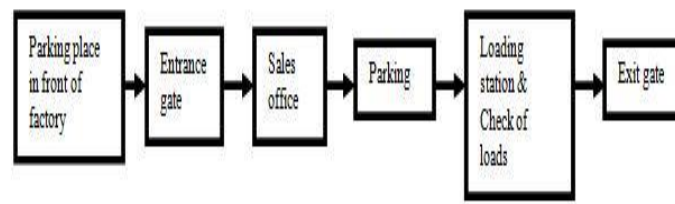
iv) Simulation run and experiments

- Validation and model verification;
- Setting of parameters, length of simulation run; □ Running of experiments.

v) Interpretation of results and implementation

- Data analysis;
- Interpretation of results, their presentation and comparing suggested alternatives and scenarios.

2.1 Short description and definition of project aims



In Figure 1, there is a schema of this system. There are several trucks which are outgoing trucks with final cement products. These trucks must go through the entrance gates where they are registered. After that they are sent into sales office where they are issued a sales advice. Then they are sent into correct location in the plant for loading cement products. Before and after loading, the trucks are weighed and final checking, they can leave the plant through the exit gates.

Through a preliminary analysis, some predictable problems would arise. Mainly, in this type of factories, the length of queues in some specific factory facilities – entrance gates, for example, always constitutes a relevant problem, causing long waiting times for trucks. Usually this problem is due to inadequate number of facilities/ resources available or too long loading times. Also, an inadequate control of work flows would lead to:

- Wrong destinations associated to trucks, once inside the plant;
- Trucks waiting even when facilities are available;
- Traffic jam inside plant etc.

Though, DES could be powerful tool to improve processes and draw suggestions for modern control

systems implementation (Benjaafar, Heragu, and Irani 2002).

2.2 Processing of input data

For a correct analysis and the creation of an adequate simulation model, it is necessary to use valid data such as:

- i) Definition of operations which includes which type of probability distribution followed in the entry gate, sales office and loading station, waiting times and processing times.
- ii) Layout specifications and truck routings.
- iii) No of workers.

These data are processed for making analysis and formatted to EXTEND SIM8 as it is shown in Figure 2 (Arrival pattern of empty trucks).

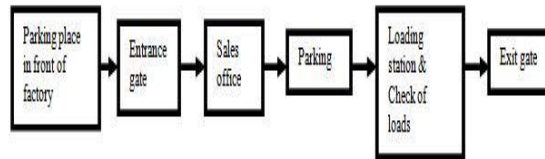


FIGURE 1. SCHEMA OF AN OUTBOUND LOGISTIC SYSTEM

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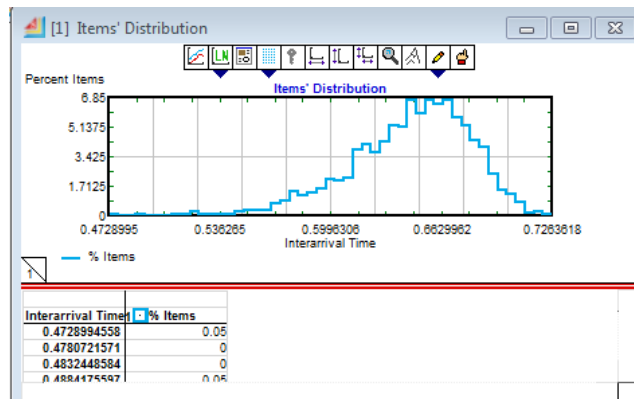
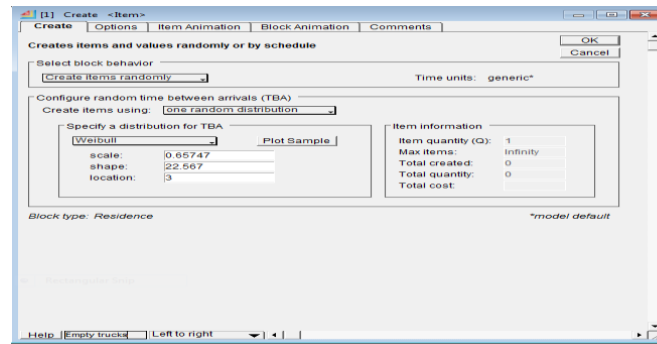


FIGURE 2: REPRESENTATION OF ARRIVAL PATTERN OF EMPTY TRUCKS IN ENTRANCE GATE IN EXTEND SIM8.

For each station, there is an arrival pattern. That is a type of probability distribution. The above figure shows the arrival pattern in entrance gate. Like that, there is an arrival pattern in sales office and loading station too.

2.3 Creation of the simulation model

Simulation is used for the implementation of a new logistic system in a plant. DES could be a powerful tool to improve processes and draw suggestions for modern control systems implementation in a process industry. Simulation modelling not only allows the company to understand the current business situation but also helps to understand and learn the “complexities of dynamic behaviour” thus, gaining insights to process improvement. Here the tool adopted is “EXTEND SIM8”.

2.3.1 Assumptions in the simulation model

- All processes have stochastic behavior, so for looping discrete event is taken.
- Entity is the empty trucks.
- Activities taking place are waiting in the queue, giving invoice number at the sales office and loading the empty trucks with cement bags.
- Resources are one person at the sales office, one person at the entry gate.
- Unloading of raw materials is not considering.

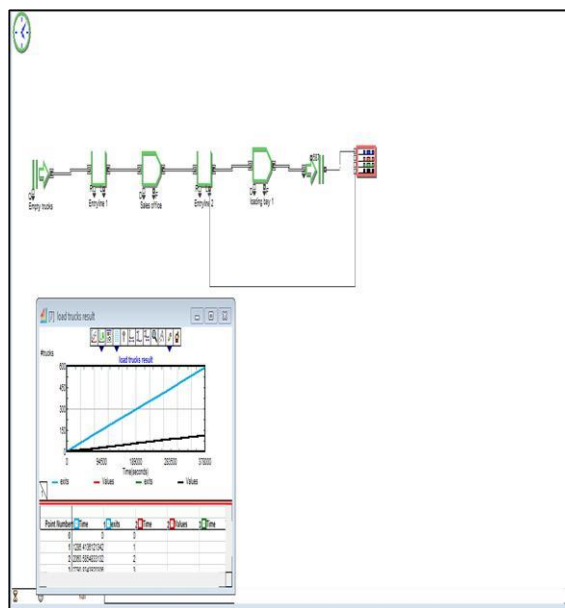


FIGURE 3: SIMULATION MODEL OF THE LOGISTIC SYSTEM

Figure 3 shows the Weibull distribution at the entry gate. Here the Weibull distribution is followed in the entry gate and the Uniform distribution is followed in the sales office and loading station.

The input parameters are:

- At entry gate, Scale parameter, $\alpha = 0.65747$ Shape parameter, $\beta = 22.567$

- Location parameter, $\gamma = 3$
- At sales office, Minimum value, $a = 540$ seconds Maximum value, $b = 600$ seconds
- At loading station, Minimum value, $a = 480$ seconds Maximum value, $b = 810$ seconds

In the simulation model shown in figure 3, (in the output graph), the blue line indicates the number of loaded trucks and the black line shows the queue at the loading station.

Output

Number of trucks loaded = 587
 Queue at the loading station = 113
 Queue at the sales office = nil

Number of trucks loaded in this model is 587. From the output, it is observed that there is a large queue in front of the loading station and there is no queue at the sales office. Large queue can be reduced by providing one more loading facility as shown in the below figure 4.

Here in this system, Weibull distribution is followed in the entry gate and Uniform distribution is followed in the sales office and 2 loading stations.

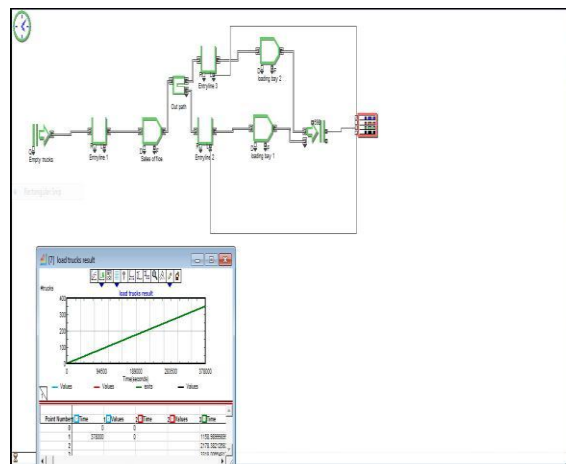


FIGURE 4: MODIFIED MODEL WITH WEIBULL DISTRIBUTION

The input parameters are:

- At entry gate, Scale parameter, $\alpha = 0.65747$ Shape parameter, $\beta = 22.567$
- Location parameter, $\gamma = 3$
- At sales office, Minimum value, $a = 540$ seconds Maximum value, $b = 600$ seconds
- At loading stations, Minimum value, $a = 480$ seconds Maximum value, $b = 810$ seconds

Output

Number of trucks loaded = 698
 Queue at the loading station = nil
 Queue at the sales office = nil

In the simulation model shown in figure 4, (in the output graph), the green line indicates the number of

loaded trucks. We can see there is no more queue at the loading station. The outflow of trucks is increased from 587 to 698 by adding one more loading station.

2.4 Interpretation of results and implementation

From the result, it is clear that with the present system in the company, it is possible to load cement at an average of 600 trucks per week. There is an average queue of 105 trucks. Major queue is at the loading station. But when the system is optimized by adding one more loading station, there is an average of 700 trucks is loaded with cement per week. There is no queue at the loading station too. The optimized truck loading system reduces huge queue in front of the loading station and hence increase the customer satisfaction.

3. FINDINGS

Various findings from the study of outbound logistics system of the company and the simulation models are detailed below. They are:

- From the survey conducted among the truck drivers, it is revealed that about 80% of them are dissatisfied with the company's outbound logistics management.
- More waiting time for trucks while wagon loading taking place due to absence of infrastructure.
- Inadequate number of facilities/ resources available.
- From the analysis, it is clear that with the present system in the company, it is possible to load cement at an average of 600 trucks per week.
- There is an average queue of 105 trucks. Major queue is at the loading station.
- When the system is optimized by adding one more loading station, there is an average of 700 trucks is loaded with cement per week.
- There is no queue at the loading station too.

4. RECOMMENDATIONS

The company under study is using old procedures in outbound logistics management. This is due to the unavailability of infrastructure as the company is situated in a forest area. Company could not survive with this limited infrastructure during the changing economic scenario of globalization and liberalization. The questionnaire survey reveals that the customers are not satisfied with the company's logistics management. So there should be a need for change. Some recommendations are given below based on the study for the future growth of the company. They are:

- Provide 2 loading stations including 2 packers for truck loading.
- If at a time 2 loading stations are working parallel, the outflow of trucks can be reduced hence the waiting time of trucks can also be reduced thereby increasing the customer satisfaction.

5. CONCLUSION

The study of the present outbound logistics management system of the company gives a clear picture about the company's performance and efficiency in respected areas. The usage of an internal logistic system and discrete event system simulation for the design of this type of factory seems to be a good approach. It is possible to virtually implement a logistic control system to an existing factory and analyze corresponding impact without any type of physical intervention in the real factory. It is also possible to completely design a completely new factory.

The present existing outbound logistics management system is studied and problems are identified. Using

- There is an average queue of 105 trucks. Major simulation software called “EXTEND SIM8”, the system queue is at the loading station.
- When the system is optimized by adding one more loading station, there is an average of 700 trucks is loaded with cement per week.
- There is no queue at the loading station too.

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