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IMPROVEMENT OF THE KANBAN SYSTEM FOR AN AUTOMOTIVE COMPANY VIA DISCRETE EVENT SIMULATION: OTOKAR

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ABSTRACT

This study aims to improve the available kanban system of an automotive company. Currently, a 2-bin kanban system is being used for nearly 700 frequently used supplies in the assembly of different types of vehicles. However, there are no well-defined procedures for sizing the kanbans or the warehouse stocks. Likewise, there is no policy for how often the availability of parts in kanban bins on the assembly line must be checked. Therefore, opportunities exist to reduce the inventory costs due to overstocking and to improve labor efficiency by correctly scheduling the mizusumashi. The current flow for 3 supply parts with different usage frequency, lead time, and critical and maximum stock levels has been modeled via discrete-event simulation and validated. Then, variable values that minimize the WIP, without stockouts were sought after. Arena and OptQuest were used in the modeling and optimization.

1 INTRODUCTION

Otokar has been manufacturing vehicles for public transportation, lightweight trucks for the logistics industry, and armored vehicles for the defense industry. As a result of the large-scale tenders received from the government, the company applies a push system on its assembly lines. However, due to the overstocking and pileups in the assembly line, the parts used in common in all vehicle types are controlled with a 2-bin kanban system. Recently, the company has keen interest in projects to develop digital-kanban and e-kanban systems too.

While the withdrawal kanban helps to avoid shortages and overstocking in the assembly line, if kanban sizing and warehouse (s, S) stock control policy is not integrated, the expected benefits in terms of WIP minimization could not be achieved. Therefore the focus of this study is to build a decision support system for Otokar, that can be used to support decision-makers in sizing the kanban bins and determining maximum and critical stock levels of parts. The review period of the mizusumashi is also considered to save labor.

The model comprises a single assembly line, one operator and one mizusumashi. To show the utility of the model for multiple parts, 3 different parts with different requirement frequencies, and lead times have been selected. Table 1 lists the current status of the part parameters and variables to assemble 35 vehicles in a day. Once a DES model of the current system is developed in Arena, optimum values of the variables that will minimize the WIP will be sought with OptQuest.

2 DEVELOPMENT AND OPERATION OF SIMULATION MODEL

There are 2 kanban bins for each part type. The assembly worker takes as many parts as he needs from the bin with less number of parts in it. If the number in the bin with fewer items is less than the requirement, the worker depletes the pieces in the first bin and moves on to the next bin.

Table 1: List of model parameters.

Part Type	Number of Parts/vehicle	Lead Time (days)	Variables		
			Kanban Size	s	S
Part 1	POIS(14.87)	1	2500	1,500	80,000
Part 2	POIS(12.56)	15	2500	15,000	50,000
Part 3	POIS(1) + 1	30	100	200	5,000
Vehicle Arrival		UNIF(30, 40) min			
Mizusumashi Review Period		300 min			
Assembly Time/vehicle		UNIF(5, 10) min			

An empty bin is a signal for the Mizusumashi for replenishment. Kanban bins are periodically checked, and if there are empty bins, they are replenished by the mizusumashi. If a bin is emptied while the mizusumashi is on his way to warehouse, he does not wait for the next review period and goes back to warehouse again for replenishment. After completing checks, he rests in the mizusumashi station until the next review period.

Warehouse stocks are checked every morning. If the warehouse stock level for a part is less than the critical stock level, an order size of *S*- *I*(*t*) parts is requested from the supplier, that is, the difference between the maximum stock level and the warehouse stock level. An order is assumed as arrived after a specified lead time (Table 1). If the warehouse inventory level is greater than the critical inventory level, no action is taken.

Figure 1 shows the animation of the current system.

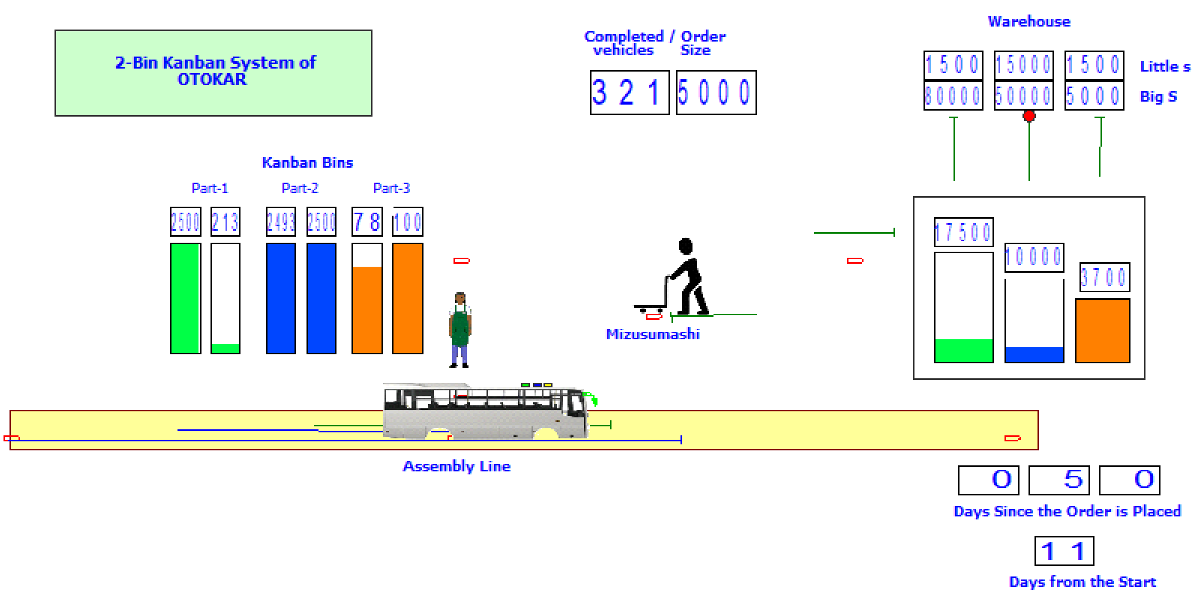

Figure 1: Animation of the simulation model.