

A Survey on Implementation of Kanban Concepts using Relowisa for High Pressure Assembly in CBx Pumps at Bosch Limited, Bangalore

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ABSTRACT:The High-pressure assembly for CBx pumps such as F019D01329 & F019D04045 are used in portable Diesel-powered commercial vehicles. The project was carried out at BOSCH, in which consumption control system which uses Kanban made inventory control easy by providing the demand per day and avoiding over production of parts. The supermarket for this HPA has to be maintained accordingly to supply the components to assemble in Cbx pump assembly. The data collected can be considered for a period of eleven days and this systematic approach improved the rates of production and reduced the delay time. A process that is both understandable and simple to the associates and gives information which is precise and quickly executable. The transfer of information is cost effective.

KEYWORDS:High Pressure assembly, Kanban, Relowisa, Upstream process.

I. INTRODUCTION

Today fuel injection pumps are utilized as a part of vehicles, generators, ships and so forth to pump the fuel into the Diesel engine. Fuel supply system is utilized to convey Diesel at correct time in right amount at right pressure to a Diesel engine for smooth and effective task of the engine. Fuel supply system is a nourishment pipe for the vehicle. Diesel is pumped from the diesel tank by a low-pressure pump. It is gone through a channel. The channel evacuates any undesirable pollutions in the diesel. Separated diesel is provided to the channel port of the fuel injection pump. The fuel injection pump pressurizes the diesel to the required level and supplies it to the fuel injector. The fuel injector powers the fuel into the barrel toward the finish of the pressure stroke, amid each cycle of task of the engine. The High-pressure assembly is a part of Cbx pump which includes camshaft and two HPA.

Classification of BOSCH diesel fuel injection pumps: -

1. CB 18 16
2. CB 18 18
3. CB 28 18
4. CB 28 20

Delivery pressure ranges from 1600 – 2000Bar. The diesel is forced to enter the engine at a high pressure which ranges from 1600 to 2000 bar. Fuel injected at this pressure results in fine atomization resulting in complete combustion of fuel. The robust design to cater a wide range of single cylinder pump. CBx pumps are designed such that the changes can be made easily, hence if there any changes in the future, like the changes from BS4 to BS6 can be implemented easily as required.

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RELOWISA Calculation

1. The Bosch Kanban Formula

$$K = RE + LO + WI + SA$$

Where, K= Number of Kanban

RE= Replenishment time coverage

LO= Lot time coverage

WI= Withdrawal peak coverage

SA= Safety time coverage

2. Replenishment lead time

The replenishment lead time refers to the time from the purpose of utilization or when the part is expelled from a store until the point that the moment that this correct Kanban re-enters the grocery store (closed loop). The recharging lead time comprises of the stream of data and the stream of materials.

$$RT \text{ loop} = RT1 + RT2 + RT3 + RT4 + RT5 + RT6$$

RT1= It is the time between the parts withdrawn from the supermarket and the Kanban's arrived at the production line.

RT2= Waiting time of Kanban cards on production line.

RT3= Material preparation time at the line.

RT4= Changeover/time/loss.

RT5= Production/time.

RT6= Transportation time into supermarket.

3. Lot time coverage

Lot size is defined as the production of a particular part or product which is manufactured in a single production run. It is also known as the quantity of parts ordered by the customers for manufacturing. Lot size is an addition to the replenishment lead time (RT loop) because of the delay of lot formation. The number of Kanban cards for lot time coverage is calculated by using,

$$LO = (LS/NPK) - 1$$

Where, LO= Lot time coverage

LS= Lot size, NPK= Number of parts per Kanban

4. Withdrawal peak coverage

It is the additional Kanban cards which are withdrawn when the customer withdrawals are not according to the customer takt time (TT) to cover the planned withdrawals made by the customer, or/if a withdrawal is made/outside the planned operating/time (POT) of the/supply process. Withdrawal is calculated by determining the maximum cumulative planned withdrawal quantity within the replenishment lead time (WA) and then reducing this by the number of Kanban that are already covered by RE and LO. The number of Kanban for WI is calculated as follows:

$$WI = (WA/NPK) - RE - LO$$

Where, WA= Withdrawal amount

NPK/= Number of parts per Kanban

RE/= Replenishment/lead/time

LO/= Lot/time/coverage

5. Safety time coverage

It is the Kanban which is added to cover the unknown external fluctuations and internal fluctuations and achieve stability in the process. The number of Kanban for Safety time coverage is calculated as follows:

$$SA = SA1 + SA2 + SA3$$

SA1= Fluctuations that are not predictable in lead time and the output of production process.

SA2= Fluctuations caused in customer demands.

SA3= Additional/safety (problems in the information flow, start-up etc.)

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II. RELATED WORK

Muhammad Ovais Ahmad et al. [1] investigated the scientific evidence to date regarding Kanban by conducting a systematic mapping of Kanban literature in software engineering between 2006 and 2016. The search strategy resulted in 382 studies, of which 23 were identified as primary papers relevant to this research. This study is unique as it compares the findings of these primary papers with insights from a review of 23 Kanban experience reports during the same period. This study makes four important contributions, (i) a state-of-the-art of Kanban research is provided, (ii) the reported benefits and challenges are identified in both the primary papers and experience reports, (iii) recommended practices from both the primary papers and experience reports are listed and (iv) opportunities for future Kanban research are identified.

Víctor G. Aguilar-Escobara et al. [2] investigated to measure nurses' satisfaction with Kanban systems in logistics of medical consumables and assesses possible advantages and differences among user groups through an anonymous survey at Hospital Universitario Virgen Macarena of Seville, Spain. Treatment of responses included an exploratory factor analysis, and a CAPTCA analysis. The results showed a high level of satisfaction for each aspect of the Kanban system. Moreover, it highlighted the differences of opinion between groups of individuals according to workplace, nursing units, job category, seniority, age and Kanban training. The exploratory factor analysis revealed that two factors underlie the collected assessments: the inherent advantages of a Kanban system, and the logistics system performance as a whole. Thus, hospital managers should promote the implementation of Kanban systems, since it increases nurses' satisfaction and provides significant benefits.

Chia Jou Lin et al. [3] first proposes a knowledge flow model in virtual R&D based on the analysis result of knowledge in virtual enterprises (VEs), and then designs the knowledge kanban model according to the knowledge flow model in virtual R&D and proposes the knowledge kanban Functional framework based on the knowledge kanban model.

III. PROBLEM DEFINITION

The high-pressure assembly production line at BOSCH had no proper control over the supermarket and the losses due to delay in material arrival to the production line was affecting the overall OEE of the line. This often-caused loss of production and high inventory costs leading to improper information and material flow.

IV. KANBAN LOOP FORMATION AND CALCULATION USING RELOWISA

The demand for a certain period is found out normally for a month. The system takes its name from the cards that track production within a factory. A goal of the Kanban system is to limit the build-up of excess inventory at any point in production. Limits on the number of items waiting at supply points are established and then reduced as inefficiencies are identified and removed. Whenever a limit is exceeded, this points to an inefficiency that should be addressed. Demand refers to how much of a product or a service is desired by buyers. Supply refers to how much the market can offer. Demand relationship is correlation between price and quantity demanded. Supply relationship is correlation between price and how much of goods is supplied to market. The number of parts required on each day is obtained from the SAP data. The milk run takes place for every 15 minutes. Usually this calculation is done for twelve days in a month. The planned operated time and the pull also depends on the calculation. A pull system saves a lot of time at the production and this time can be utilized to plan for the future projects and new production plans. This also increases the transparency and flexibility of the production line as this process can respond to customer demands at a quicker rate. Each of these steps or process integrated into production line reduces overall cost incurred by the organization, it could be indirect cost or direct cost, both are reduced to a significant decrease in the total cost resulting in the growth of the company.

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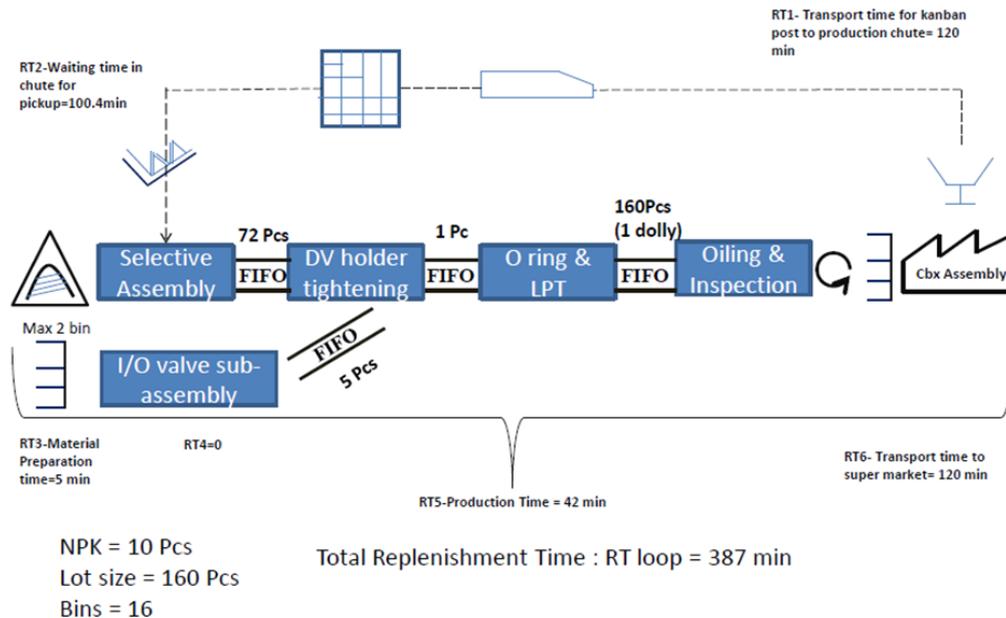


FIG 1 Kanban loop for high pressure assembly

Planned operated time (POT)= 1305 minutes/day
 Total volume/day = 2000 pieces
 Coverage pull = 80 -83%
 Share of volume under pull/day = 1667 pieces
 Calculation period = 12 days
 Here we are doing the calculation only for Cbx Hpa F019D01329
 NPK =10
 Lot size = 160
 Customer takt time = 62.6 seconds = 1.0433 minutes
 RT1 = Transport time from Kanban post to production chute = 120 min
 RT2 = Waiting time in production chute for pickup = 100 min
 RT3= Material preparation time = 5 minutes
 RT4= Change over time = 0 minutes
 RT5= Time to produce one Kanban quantity = 42 minutes
 RT6 = Transportation time to supermarket = 120 minutes
 RT Loop = RT1+RT2+RT3+RT4+RT5+RT6 = 387 minutes
 RE = RT Loop / (Customer takt time x NPK) = 37.1

LO calculation

$$LO = (\text{Lot size} / \text{NPK}) - 1 = 15$$

WI calculation

$$WA = 1092$$

$$WI = (WA / \text{NPK}) - \text{RE} - LO = 57.1$$

SA calculation

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SA1 = Fluctuations in output and lead time

SA2 = Customer pickup fluctuations

SA3 = specific to individual

SA = SA1 + SA2 + SA3 = 32.8

Total Kanban in Loop = RE + LO + WI + SA = 142

So, 142 Kanban cards are required.

The high-pressure assembly is a part of CBx Pump and if the certain amount of HPA s are present in the supermarket according to the calculations above the supply of parts to the major pump with housing will be smooth and the customer requirements can be achieved successfully.

V. CONCLUSION

The production amount for the HPAs was calculated using RELOWISA according to customer requirement and thus proper planning can be done. The new component super market could be maintained for each month according to the customer demand. The continuous improvement process in the company can be maintained by this method. The Kanban system gives information regarding what to manufacture, in what amount, when to manufacture, and by what means and its transportation which increases the productivity. Since the assembly mentioned here is a new one in assembly line, the actual material and Kanban can reliably move together, overproduction and underproduction will not happen. According to the demand from the customer for the high-pressure assembly with POT as 1305 minutes a day the number of kanban cards required will be 142. If we maintain this amount then there wont be scarcity of high pressure assemblies for CBx pumps and the production will be smooth and customer satisfaction is achieved.

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