

Improving Just – in –Time Manufacturing in Voltage Regulator Assembly Line using RFID System

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Abstract

In a progressively digital world, manufacturing innovativeness are deal with with a complex, dynamic and reasonable environment due to globalization and a prompt progress of information and communication technologies. Just in time (JIT) manufacturing is one of the most important tactics used to increase manufacturers’ effectiveness through lead time, SAP conformation and inventory reduction. This paper deals with the material management strategy that uses production Kanban to signal the need for replenishment of selected product from prefers suppliers to site and also to optimize the flow of work through the RFID system to increase the business value delivery and it is also an evolutionary change approach for an organization to be adequate for its purpose in service delivery.

Keywords: Just – In – Time, RFID, Lead time, Inventory..

1. Introduction

“The Just-in-Time or JIT is an inventory management system where in the material, or the products are produced and acquired just a few hours before they are put to use. The Just-in-time system is adopted by the firms, to reduce the unnecessary burden of inventory management, in case the demand is less than the inventory raised”. It pulls inventory as it is needed. The RFID production Kanban system is used to produce semi-finished and finished goods through Kanban signals. They use this as a production control tool, to achieve the objectives. RFID Production Kanban is a production control tool which triggers production activities only when it is required as per the pull principle. A RFID production Kanban card contains material or product details such as part number, order date, order quantity, lot size, routing process, and container type and container capacity. This ensures just in time production and helps reduce wastages to achieve the lean way.

known for its Enterprise Resource Planning (ERP) and data management programs”. SAP is an acronym for system, applications and products. Most of the companies considered that SAP solution has the extremely vital factor for their businesses. Many companies widely use the SAP system for daily operations and reporting. SAP brings systems, modern and extremely efficient.

2.2. RFID Reader



Fig 2: RFID reader

2. RFID System

2.1. System Application Program (SAP)

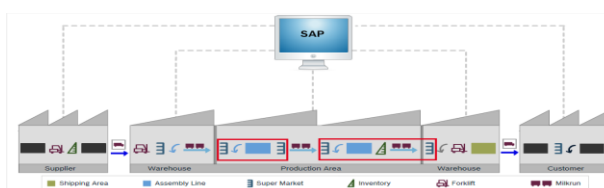


Fig 1: SAP system

“A German software company whose products allow businesses to path customer and business dealings. SAP is especially well

Table 1: Characteristics of RFID

SYSTEM CHARACTERISTIC	UHF (860-960 MHz) passive TAG's
Range	maximum 6 m
Recognition of transponder groups	Up to 500 Transponder
Data storage	Read-Only / Read-Write
Influence of metal	High
Influence of liquids	High
Lifetime	Read-Write: up to 100.000 Writing cycles
Data transmission rate	Very high

A basic RFID system consists of three components: An antenna or coil, a transceiver (with decoder), and a transponder (RFID tag) electronically programmed with unique information. The antenna emits radio signals to stimulate the tag and to read and write data to it. The reader emanates radio influences in sorts of everywhere from one inch to “100 feet or more”, contingent upon its power output and the radio frequency used. When an RFID tag permits through the electromagnetic precinct, it become aware of the reader's triggering signal. The reader decodes the data encrypted in the tag's integrated circuit (silicon chip) and the data is distributed to the cloud computer for handling.

2.3. RFID Production Kanban System Architecture



Fig 3: RFID production Kanban architecture

“An RFID system consists of three components which include: an antenna, a transceiver and a transponder (the tag)”. The antenna and the transceiver are often incorporated into one reader. “The antenna uses radio frequency waves to transmit a signal that activates the transponder”. When triggered, the tag conveys data back to the antenna. The RFID can read the tag using Radio Frequency, significance that the RFID reader can be read from a space, right through your clothes, bags etc. An RFID tag consists of inimitable ID for each tag. Cross Talk is a Middleware for the communication of RFID readers and the SAP-system. The RFID tags which are read by the Reading device are handled by the Crosstalk Engines on the Windows server. The data of the read RFID-tags is edited and sent as a Portable Markup Language message to the SAP-system or other systems. The answers of the SAP-system are received by the Cross Talk processes, prepared and the result is signaled at the device (e.g. green light). A connection of the Kanban card with the tag-ID is done by a pairing device, which includes the functions of a barcode scanner and a RFID-reader.

2.4. RFID – Tag

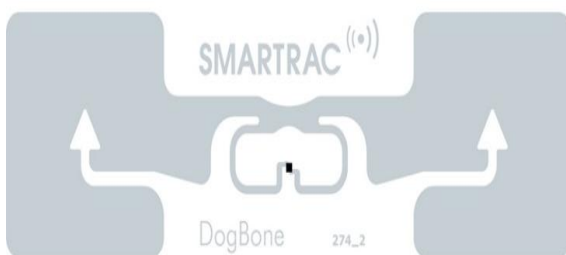


Fig 4: RFID tag

A RFID tag is a very trivial electronic device, frequently the magnitude of a pit or as tinny as a piece of paper, which is capable of putting away data and conveying that data up to numerous meters. The interpretation device conveys a query signal. When the RFID tag sanities the signal, it communicates the matters of its memory to the reading device. Many tags are not self-powered. Instead, they get their power from the query signal. The data acknowledged by the reading device is transmitted to a server for processing.

3. Working Procedure

3.1. Process Flow of Voltage Regulator: Kanban Movement

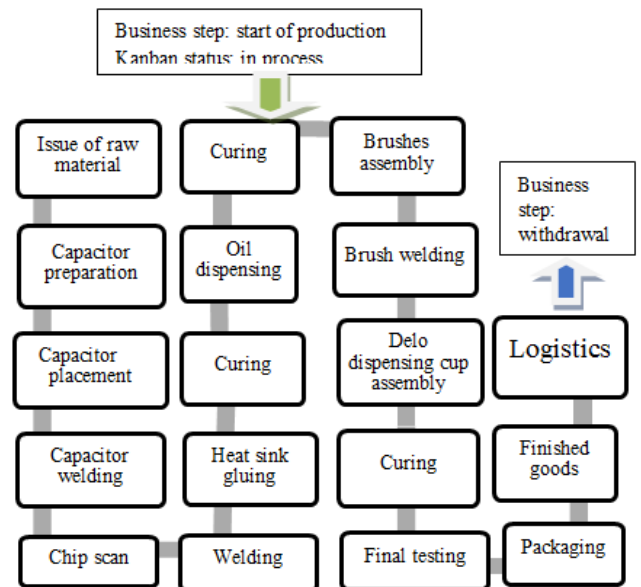


Fig 5: Process flow of voltage regulator

3.2. Working procedure of RFID Production Kanban

- Pick up the Kanban cards from the leveling board with respect to the Time slots present near the Voltage Regulator team leader table.
 - Scan the Kanban cards on RFID reader (sln. XXXXX) present near the VR1 TL table to start the production.
- Green light –scanned
Red light - errors due to:
(i). Kanban cards are not emptied in the logistics. (ii). Shortage of material and order.



Fig 6: Scan of Kanban card

- Scan the Kanban cards for 10digit confirmation on RFID reader (sln. XXXXX) present near the packaging station at VR1 line, after the completion of production process. Green light -scanned, Red light – due to (i). Not achieved the minimum time span. (ii). Sequence of reader is not achieved.



Yellow – Order in progress/realization
 Green - KANBAN “FULL”, Production back flush 10 dig. OK
 Red – KANBAN “EMPTY”
 Violet – KANBAN not active

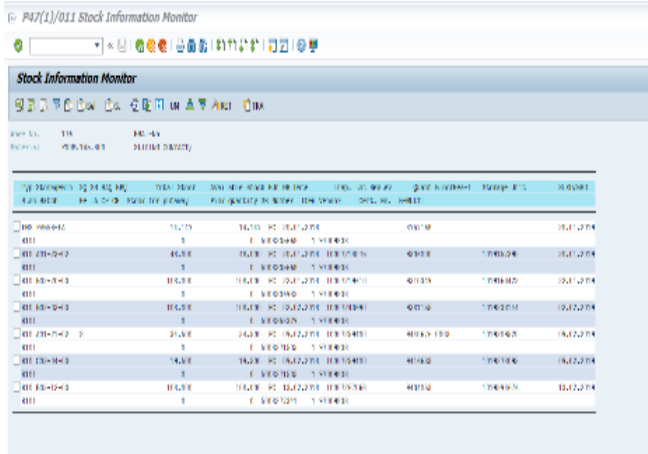


Fig 7: Stock Information

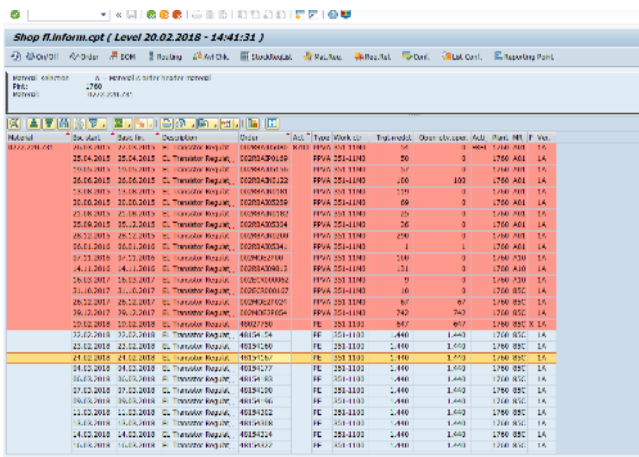


Fig 8: Information of material order

- Place the Kanban cards on FG box and move the parts to 10 digit supermarket.
- Take out the Kanban cards from the FG box and scan the Kanban cards on 10digit RFID empty Kanban reader (sln. XXXXX) in logistics.
- After emptying the 10 digits Kanban cards, the cards are placed on Kanban monitoring board, then the responsible person Pick up the Kanban cards from the monitoring board with respect to Time slots. Then the Kanban flows back to the production.

4. Data Collection

TIME STUDY – “It is a technique to estimate the time to be allowed to a qualified and well-trained worker working at a normal pace to complete a specified task by using specified method”.

Table II: Time required for process in line before & after RFID Implementation

Process of voltage regulator	Time required in minutes	
	Before RFID	After RFID
Capacitor preparation	40	40
Capacitor placement	40	40
Capacitor welding	42	42
Chip scanning	35	35
Welding	45	45
Heat sink gluing	30	30
Curing	35	35

Oil dispensing	45	45
Brush assembly	60	60
Brush welding	20	20
Delo dispensing + cup assembly	17	17
Curing	40	40
Final testing	30	30
Packaging	6	6
SAP confirmation	15	4.1
Total time required	500	488 minutes and 50 second

5. Results and Discussion

5.1. SAP Conformation before & after RFID Implementation

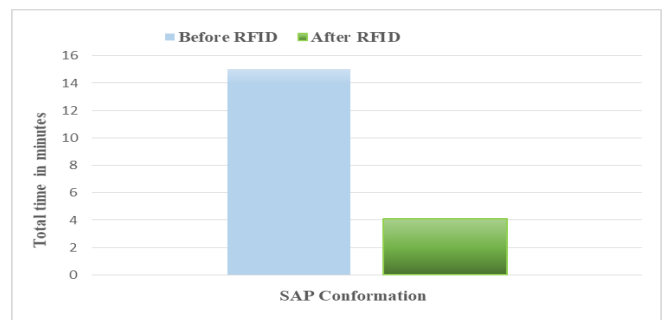


Fig 9: SAP Conformation before & after RFID implementation

The above Fig. shows the total time required for SAP confirmation using manual and RFID in production Kanban. Here for completing one process it consumes 4 minutes 10 seconds in RFID and therefore it consumes 12 minutes 30 seconds for confirmation of all the process in SAP i.e. at start of production in line, at end of production in line and at logistics for emptying therefore by implementing RFID it approximately conserves 22 minutes. Hence it requires about 8 hours and 13 minutes for completing entire process in line. By RFID implementation the material is immediately recorded in the system and can be processed without further delay. In the past, the manual booking process meant that up to 9 hours would sometimes elapse between the actual completion of the production process and the corresponding booking in the SAP system.

5.2. Lead Time before and after RFID Implementation

Lead Time	Total time in minutes
Before RFID	500
After RFID	488.10

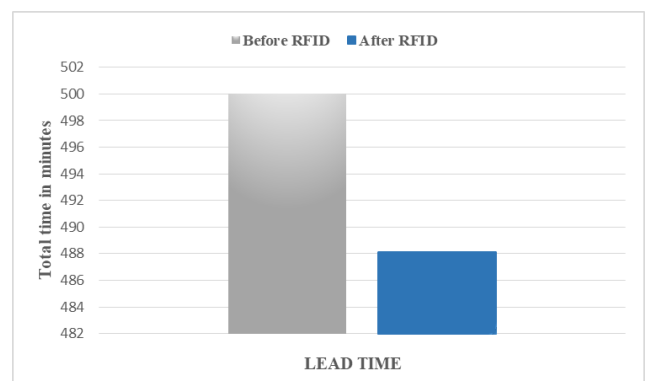


Fig 10: Lead time before & after RFID implementation

The reduction of lead time shows that it could response to customer need. Thus efficiency increases and production process

became easier by producing based on Kanban signal. The lead time has been reduced from 500 minutes to 488 minutes and 50 second. Therefore, quantity of finished goods to store also has been reduced as well as their area.

5.3. Inventory Before and after RFID

Inventory level is calculated based on cycle time difference and Relowisa calculation.

$$\text{Average cycle time} = \frac{\sum_{i=1}^n \text{Job completion time}}{\text{Total number of jobs}}$$

Relowisa calculation:
 $K = RE + LO + WI + SA$
 Where, K = Total Number of Kanban cards required
 RE = Replenishment time Coverage
 LO = Lot Size coverage
 WI = Withdrawal Peak Coverage
 SA = Safety Time Coverage

Table 3 (a): Levels of Inventory (Before Lean)

Inventory(type)	Quantity(tons)	Time(days)
Raw material	349	4.8
WIP	1026	14.3
Finished goods	470	6.6
Total	1845	25.7

Table 3 (b): Levels of Inventory (After)

Inventory(type)	Quantity(tons)	Time(days)
Raw material	300	4
WIP	800	11.2
Finished goods	400	5.6
Total	1500	20.8

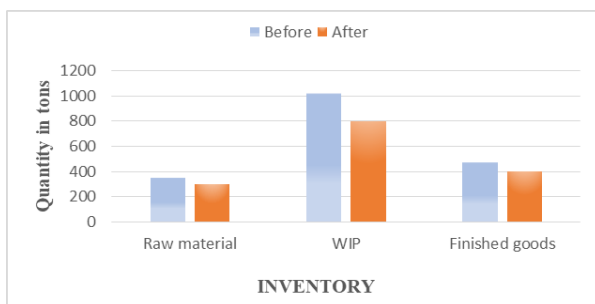


Fig 11: Inventory before & after RFID implementation

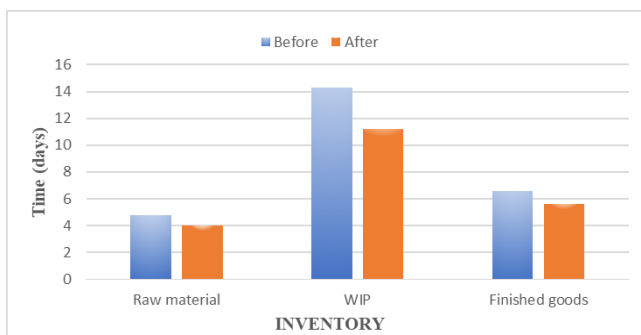


Fig 12: Inventory process time before & after RFID implementation

The inventory level is condensed to 1500 tons from 1845 tons that primes to productivity improvement. Also the number of days for inventory is compact to 21 days as compare to 26 days that speed up the production process. The motivation of lean tools and techniques was pretty perceptible as the instance company had a big problem of high work-in-process inventory and it was ruminant to a fact that has been reduced by lean tactic.

6. Conclusion

The anticipated RFID-based Kanban is capable to recover Just in time production by being fast, precise and real time. Inventory level rate would be affiliated with actual ingesting as well. The results of implementing RFID production Kanban,

- Decreased manual effort by implementing Automatic production order creation and production order confirmation.
- Decreased inventory levels: A Kanban system allows a company to reduce inventory levels which reduce the cost associated with stocking and storing material in the organization. Cost reduction occurs in the expense of the inventory itself as well as the cost of ware housing and maintaining inventory.
- Over production abolition: As a petition pull system, Kanban is less likely to consequence in over production because of the need to create barrier inventory to address astonishing delays ensuing from quality problems with suppliers or minor distractions in transportation network.
- Decreased lead time system: For the reason that the Kanban system emphases on in progress condition, production levels are intended to take into excuse idle time, scrap, and changeover time of equipment to make certain that production schedule is encountered and hence lead time is also reduced.
- Auto SAP confirmation and order creation: Now the material is immediately recorded in the system and can be processed without further delay, by scanning the RFID Kanban tags on RFID reader automatically changes the Kanban status. Hence the lead time between the processes will be reduced.

References

- [1] Attaran, M. "RFID: an enabler of supply chain operations, Supply Chain Management": An International Journal, 12(4), pp. 249-257, 2007.
- [2] J. K. Visich, J. T. Powers, and C. J. Roethlein, "Empirical applications of RFID in manufacturing environment". International journal of Radio Frequency Identification Technology and Applications, 2(3), pp. 115-132, 2009.
- [3] Zhang, Y. F., Huang, G. Q., Qu, T., & Ho, O. "Agent-based workflow management for RFID-enabled real-time reconfigurable manufacturing". International Journal of Computer Integrated Manufacturing, 23(2), 101-112. 2010.
- [4] Guo ZX, Ngai EWT, Yang C, Liang X., "An RFID-based intelligent decision support system architecture for production monitoring and scheduling in a distributed manufacturing environment". International Journal of Production Economics, 156, pp16-28, 2015.
- [5] Zhang YF, Huang GQ, Sun SD, Yang T., "Multi-agent based real-time production scheduling method for radio frequency identification enabled ubiquitous shop floor environment". International Journal of Computers and Industrial Engineering.; 76: pp 89-97, 2014.
- [6] Poon, T. C., Choy, K. L., Lau, C., "A real-time shop-floor control system: an integrated RFID approach" International Journal of Enterprise Network Management, 1(4): 331-349, 2007.
- [7] Jadhav J, Mantha S, Rane S. "Analysis of interactions among the barriers to JIT production: Interpretive structural modelling approach". Journal of Industrial Engineering International. 11(3): pp331-352, 2015.