

Inventory Management at Rail Coach Factory, Kapurthala (Punjab)

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A project on optimization modeling in business analytics (O.M.B.A.)
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Abstract

This paper looks at how Rail Coach Factory, Kapurthala's stores department manages inventory by selective control, or the ABC inventory analysis. The stores recoup inventories by using an Annual Estimate System.

To demonstrate the Annual Estimate System, an A-category has been referenced, and metrics like Gross Requirement for the Interim period (GRIP), Net Requirement for Interim Period (NRIP), and buffer stock for that item have been calculated.

An increase in the store's service level from 85% to 99% results in a 25% increase in the buffer stock quantity for the shown item. Further investigation is required to analyse the trade-off between shortage costs and the inventory holding cost.

This cost benefit analysis could optimize the total inventory cost and bring in some serious cost savings for the Stores, in addition to improving the *inventory turnover ratio*.

Acknowledgement

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Overview

Rail Coach Factory, Kapurthala in the Indian state of Punjab, has manufactured more than 30000 passenger coaches of different types including Self Propelled passenger vehicles which constitute over 50% of the total population of coaches on Indian Railways.

The Rail Coach Factory (RCF) has produced a record number of coaches in FY14, as it reached the mark of 1701 coaches against an installed capacity of 1500 per annum. During the year RCF produced 23 different variants of coaches for high-speed trains like Rajdhani, Shatabdi, double-decker, and other trains.

On 17.08.1985, Hon'ble Prime Minister of India Late Shri Rajiv Gandhi laid the foundation stone of the Rail Coach Factory at Kapurthala. The goal of this project was to increase passenger coach production capacity to meet Indian Railways' (IR) growing demand while also providing job opportunities for Punjab's youth. The project was approved in 1985 with an initial cost of Rs. 423 crores, however, extra projects were added afterward.

The Indian Railways is aiming to improve its rail network and modernize its services. India's railways are witnessing huge changes as autonomous technology advances, as well as an inescapable policy shift. The Indian Railway Industry demands competitiveness, reliable transportation solutions, safety, and facilities that meet high-quality standards. RCF's mission is to investigate how it may play a larger role in rail transit. RCF has established itself as a forerunner in harnessing technology to modernize Indian railways during the last three decades. It has carved out a niche in the Indian rail passenger's life. RCF Kapurthala, being a leading coach manufacturer, has always been at the forefront of the industry.

RCF has the distinction to start the manufacture of World Class Stainless Steel Coaches more than a decade back under TOT contract with LHB of Germany. These coaches have higher speed potential, higher carrying capacity, aesthetically pleasing looks, better riding comfort with lighter weight, and above all superior safety features. Moreover, the manufacturing capabilities of RCF, Kapurthala have been established even in the International market, and in the past, RCF has executed many export orders for coaches to various Asian countries.

Other manufacturing units of Indian railways

S.No.	Name and location of Production Unit.	Product	Capacity Utilization During last two years and current year till Oct.,2015
1.	Diesel Locomotive Works (DLW), Varanasi, Uttar Pradesh.	Diesel Locomotive	149.6%
2.	Chittaranjan Locomotive- Works (CLW), Chittaranjan, West Bengal.	Electric Locomotive	131.1%
3.	Integral Coach Factory (ICF), Perambur, Chennai, Tamil Nadu.	Coaches	108.1%
4.	Rail Coach Factory (RCF), Kapurthala, Punjab.	Coaches	103%
5.	Diesel Loco Modernization Works (DMW), Patiala, Punjab.	Locomotive manufacture and rebuilding	196.8%
6.	Rail Wheel Factory (RWF), Bengaluru, Karnataka.	Wheels Axles	94% 119.8%
7.	Rail Coach Factory (RCF), Rae Bareilly, Uttar Pradesh.	Coaches	*
8.	Rail Wheel Plant, Bela, Bihar.	Wheels	*

Departments

RCF has the following departments.

- Administration
- Accounts
- Civil
- Design
- Electrical
- Information Technology
- Medical
- Mechanical
- Personnel
- Quality
- Signal and Telecommunication
- Stores
- Security

For the scope of our project we will be concentrating on the Stores Department in particular.

Stores Department

The Stores Department of RCF encompasses 2 Purchase offices and 2 stocking Depots (Shell & Furnishing) with their headquarters at Tilak Bridge/ New Delhi. The team is headed by the Principal Chief Materials Manager (PCMM) and presently consists of 22 other officers along with a battery of 379 staff employees.

The main objectives of this department are:

- To ensure availability of right material (Quality & Quantity) in right time at right place from the right source at the right price
- Transparency in Procurement
- Inventory management
- Material handling
- Vendor development
- Scrap disposal

To fulfill its basic objectives, the activities carried out by the department are :

- Coverage of Demands by the placement of Purchase Orders
- Contract management
- Regular follow-up with suppliers for ensuring timely supply of material
- Receipt, Inspection, and Account of incoming consignments.
- Stocking, Storage, Preservation, and Custody of stores

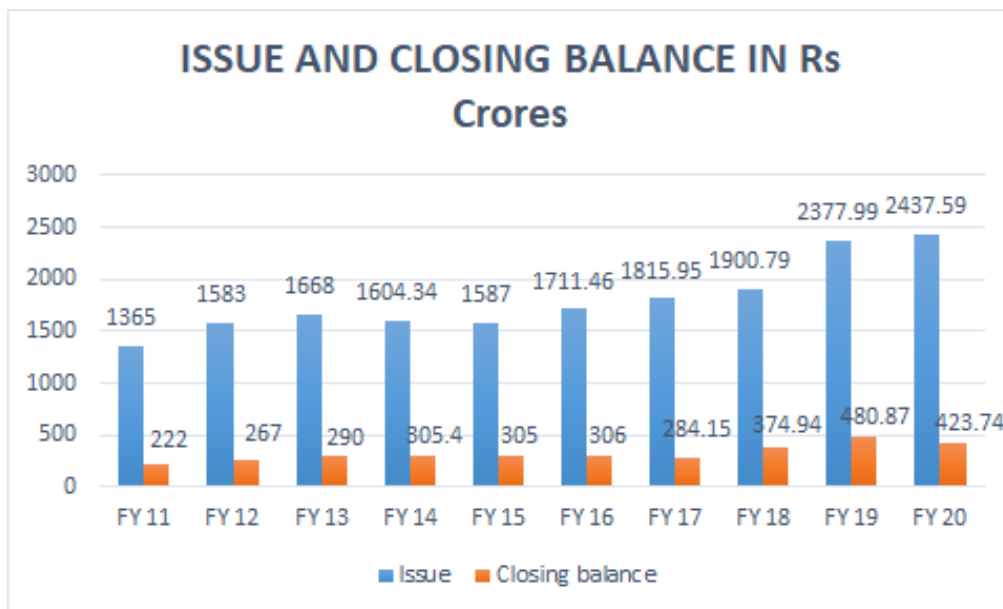
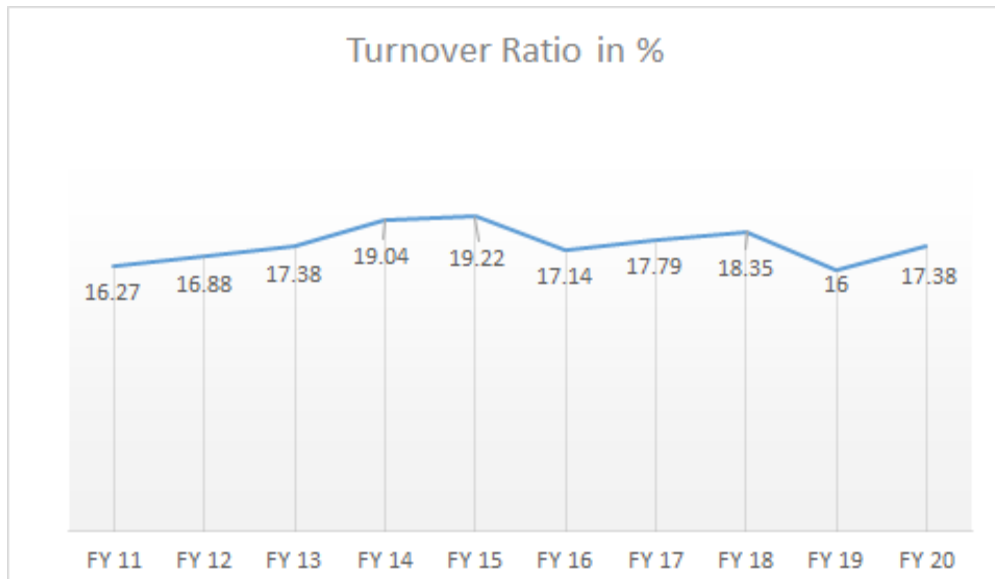
- Issue & distribution of material
- Registration / Approval of vendors
- Continuous review of requirements to avoid situations of flood (overstock) and drought (out of stock)
- Introduction of new Stock items and Non-stock items (Allotment of PL Number and Decision on Cut-in point)
- Coordination with various departments of RCF (Planning, Design, Quality, Finance)
- Coordination with various units of Railways and Inspection agencies of RCF (Railway Board, ICF/RWF/RSK, RCF/RBL Workshops of Zonal Railways, RITES/RDSO/DGS&D)
- Sale of Scrap through e-auction/tender

Procurements

There are mainly 3 categories of items purchased in RCF :

- i) Material Schedule Items: Coach components/assemblies, for which the Planning Department generates needs (procurement memos) based on QPC (quantity per coach) and Coach Production Plan.
- ii) SRM (Stock Recoupment Memo) items: Consumables and products (other than coach components/assemblies) in frequent demand by users/shops, for which Stores Depot generates Demands based on validated EAR (Estimated Annual Requirement) and consumption trends.
- iii) Non-stock items: Items of a non-regular nature or Adhoc necessity (such as M&P/Spares/Furniture/Computers, etc.) for which indentors of the consuming department write requisitions based on their needs.

Purchasing is carried out in accordance with the Railway Board's policy and the canons of public procurement, using competitive bidding achieved through tenders to achieve purchase economy and efficiency. Local purchases are made to address immediate needs and to purchase low-cost commodities. Tender Committees study and evaluate high-value tenders (consisting of 3 officers-Stores, Finance & Technical)for effectiveness & better quality of the decision. The e-Reverse Auction system is being adopted in all tenders having an estimated value of more than 5 crores.



Reasons for Inventory Control:

1. Maximising Space

Inventory control, according to SCORE, lets you make the most of your space by determining the fastest and slowest sales in your product mix. As a consequence, you'll be able to make room for greater sellers while eliminating slow-moving products.

2. Room For new merchandise

Being the first to carry the newest products on the market provides you an advantage over your competitors in a competitive business climate. By efficiently managing and maintaining your inventory, you may continually eliminate old and outdated products from your mix, ensuring that you always have room for the newest, most recent thing. When customers are looking for new things, they will come to your store first.

3. Inventory control guarantees that your goods are turned over at a faster rate. This lowers the costs of carrying excess inventory and keeps products flowing through your operation rather than sitting in your stockroom collecting dust. As a result, your organization will be leaner and more efficient, potentially leading to increased earnings.

4. Lower Production Costs

Because mass-produced goods have reduced production costs, most businesses attempt to buy and create in large quantities. If they create too much, however, the costs of manufacturing and storage may surpass any potential savings from bulk production. When refilling inventory, an inventory control system tells the company how many products it should order or make.

5. Prevent Theft

A strong inventory control system, in which each item is cataloged and given a barcode that can be scanned during transactions, will allow owners to trace any unaccounted-for items that may be the consequence of theft. A corporation can design a better plan to prevent theft by employees or consumers by looking for patterns.

6. Perishable Reasons

When dealing with perishable goods, it's critical to keep the right quantity of inventory on hand. They will lose money if they have too few things in their inventory since clients will be unable to purchase the items they desire and would have to travel to another store. If they manufacture too many things, however, they will have to discard them after they expire, resulting in a loss of the money spent on the inventory.

Inventory Control at RCF:

Total Inventory: Total Inventory refers to the number of raw materials, packaging materials, fuel etc. being held by the store.

At the time of our visit to the coach factory, the total inventory at the rail coach factory was 916 crores, and the total number of items in the inventory were 5012. It is not practical to ascertain the levels of 5012 items, and therefore we need to prioritize which inventory items to control.

ABC Analysis: It is widely used for spare parts, manufactured products, assembly items and finished/unfinished items. We will divide the items into three categories A, B, and C, in which A is the most important and valuable item and C is the least valuable.

ABC inventory analysis is based on the Pareto principle. According to the Pareto principle, the top 20% of items generate 80% of sales volume. This means that the top 20% of the things will earn 80% of the income for the company. It is also known as the 80/20 rule.

This strategy is useful for identifying the top inventory items that account for a large percentage of annual consumption. It will help to optimize inventory level and control over high-value items.

Item A: Items grouped under A in the ABC model of inventory control are those that have the highest annual consumption value. Only around 10-20% of total inventory goods account for the top 70 to 80 percent of a company's annual consumption value.

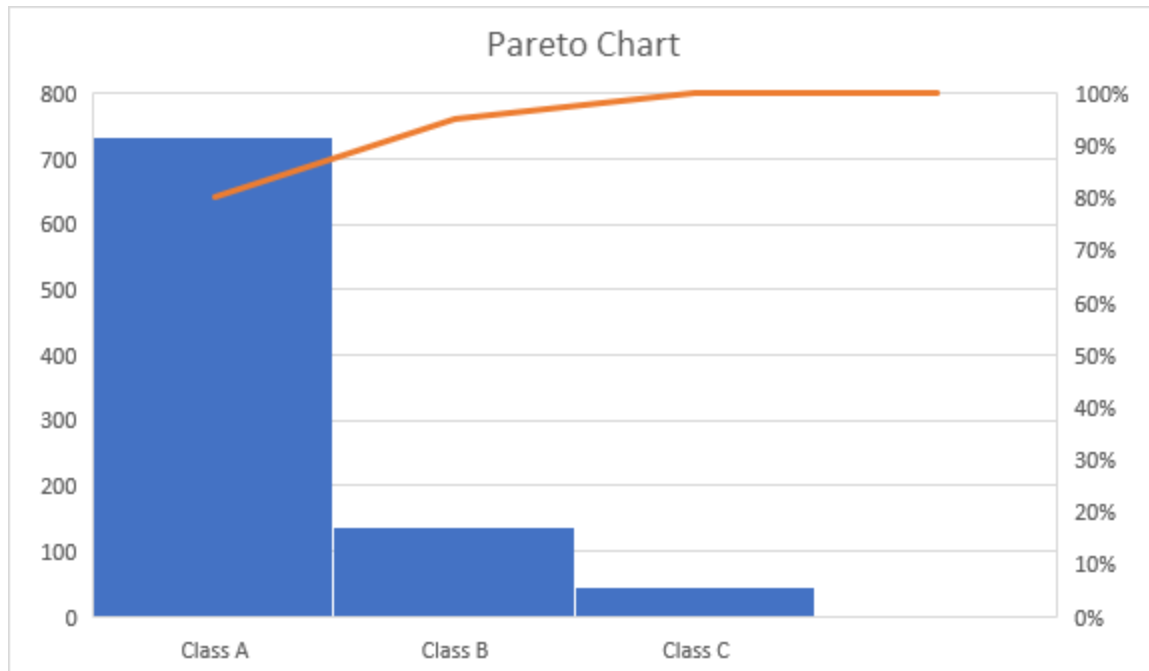
Item B: There are some goods with a moderate consumption value. These makeup roughly 30% of a company's entire inventory, which accounts for about 15% to 20% of yearly consumption value.

Item C: The products in this group have the lowest consumption value, accounting for less than 5% of annual consumption value, which comes from around half of all inventory items.

Total inventory items at RCF

Total Inventory items (Nos)	5012	916 cr.
Class A	$5012 * 0.2 = 1002.4$	733 cr. (80%)
Class B	$5012 * 0.3 = 1503.6$	137.45 cr. (15%)
Class C	$5012 * 0.5 = 2506$	45.81 cr. (5%)

In our Project we will focus on Item A products.



Recoupment of inventory at RCF

Annual estimate system

After demand for the upcoming year is forecasted based on the previous three years' demand, recoupment of materials is done by employing the *Annual estimate system*. In essence, if the forecasted demand for the year is Q units, we'll order 4 consignments of $Q/4$ units each throughout the financial year. This system has the following components:

- **Contract period**: This is the fixed period, throughout which items are recouped at fixed review dates. This contract period is generally 12 months. The purchase department reaches out through e-tenders to potential suppliers with the contract terms.
- **Interim period**: The period between two fixed review dates is called the review period. Usually, for high-value items, the interim period is 6 months. The interim period is 12 months for medium-value items.
- **Fixed Quantity contracts**: The quantity in definite terms, consignee, and delivery period/date is mentioned in the contract. It is important to note that in this system, a fixed quantity is ordered after every interim period. The overall requirement is divided into interim periods. This is done so as to minimize the inventory holding costs.
- **Buffer stock or lead-time demand**: A situation might arise wherein our demand may arise unexpectedly, and there's a stock-out within the interim period. This uncalled-for situation

necessitates the provision for a buffer stock in the system. As a rule of thumb, two months' worth of stock plus additional provision for variation in lead time is kept as a buffer for dealing with such situations, as the average lead time for delivery of special order is 2 months +/- the standard deviation of the lead time. For a service level of 95%, the value of z will be 1.64.

Let's now have a look at how, based on the annual requirements, we can ascertain the Net requirement for the interim period.

After introducing the formulas, we are going to take up an A-class inventory item; based on its annual requirement, stock, and dues, we are going to arrive at its Net interim period requirement, and its buffer stock.

Calculating Gross Requirement for the Interim period (GRIP), and Net Requirement for Interim Period (NRIP):

GRIP = *Interim period (in months) x Anticipated monthly consumption (MUF)+ Buffer stock + pending demand (if any)*

NRIP = *GRIP - (Stock + dues)*

Buffer stock = *lead time demand + 1.64 * (standard deviation of lead time demand)*

Description	Class	Unit of purchase	Unit rate	Stock	Value (Rs.)	Annual req.	Dues 21-22
BRAKE DISC FOR WHEEL SET	A	No.	74144	4000	12,97,52,000	16743	4168

**Source: Rail Coach Factory, Kapurthala*

Let's say, at the start of the financial year, we have the following information on one of our high-value inventory items. We want to calculate the NRIP and buffer for this particular item.

Let's state the values for the interim *period*, *anticipated monthly consumption*, *stock* and *dues*.

interim period = **6 mths.**

anticipated monthly consumption = Annual req./12 = 16743/12 = **1395 units**

stock = **4000 units**

Note: For the buffer stock, we have taken the average lead-time as 2 months, with a standard deviation of 2 weeks (0.5 months).

buffer stock = lead time demand + 1.64 * std. lead time

demand = 2*1395 + 1.64*1395*0.5 = **3944 units**

dues = **4168**

GRIP = 6*1395 + 4185 = **12555 units**

NRIP = 12555 – (4000 + 4168) = **4387 units**

This means, for the first six months of the financial year i.e., the interim period, we'll need 4387 units after making all deductions.

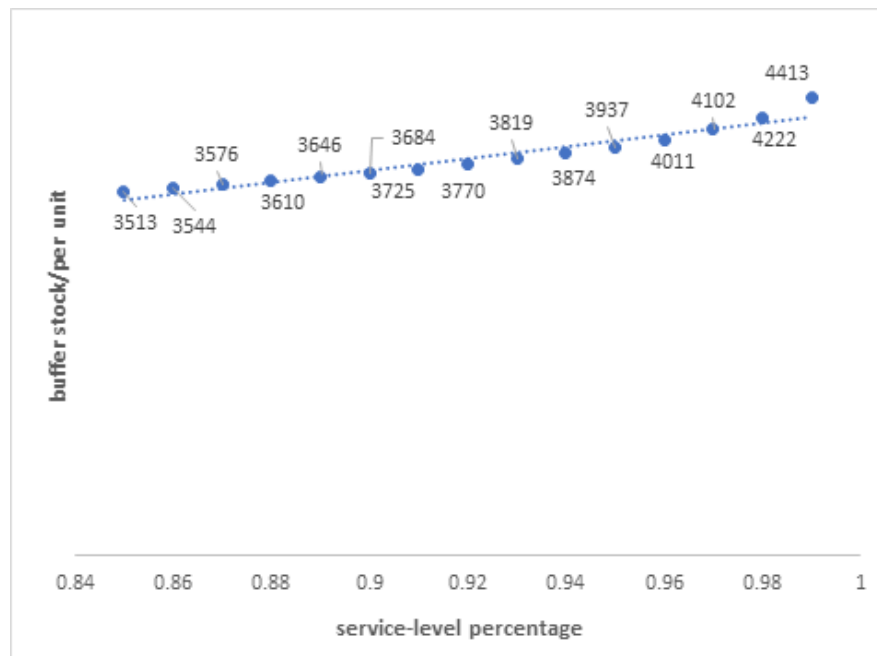
Generally, if NRIP is higher than 2-3 month's demand, it is a wise decision to arrange the item for a short period (say, 2 months inventory), until the scheduled supplies arrive. This transaction will be in a separate contract.

Relationship between service-level and buffer-stock:

An increase of 15 percent in the service-level results in almost a 25% increase in the buffer stock. Generally, RCF uses a service-level of 95-98%, as shortages could prove to be very expensive.

Implications:

- Further investigation is required to analyse the trade-off between shortage costs and the inventory holding cost.
- This cost benefit analysis could optimize the total inventory cost and bring in some serious cost savings for the Stores, in addition to improving the *inventory turnover ratio*.



Merits of using the annual estimate system for recoupment:

- The demands from more than one depots for the same items can be combined in the purchase office. This is possible because demands will be received in the purchase office at the same time as per the time table laid down.
- It is also possible to combine the demands of similar items into one purchase so long as the source of supply of the items is common. This will help in reducing the ordering costs substantially.
- Due to adequate buffers, chances of stockout may also be minimized.
- By taking deliveries in various installments, annual holding costs can be minimized.
- An EOQ system wouldn't work here, as ordering costs are usually 2000-2500 per order. However, inventory holding costs are way higher. For reference, holding costs are usually 20% of the cost of the item, per annum. Were we to recoup the inventory using the EOQ model, the number of orders would be in the 250-300 range, which is highly impractical for this industry.

Disadvantage of using the annual estimate system for recoupment:

- We cannot take advantage of the optimum economic order quantities.

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