A REPORT

ON

INVENTORY MANAGEMENT MODULE

BY

Sumanyu Kosuri	2020B5A42176H	Mechanical
Yash Purohit	2020B3A40946P	Mechanical

AT

STARFLEX SEALING INDIA PVT. LTD., Goa

A Practice School – I Station of

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

(July, 2022)

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Prepared on completion of the

Practice School – I (COURSE NO. BITS F221)

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ACKNOWLEDGEMENTS

We would like to thank BITS Practice School Division for this excellent opportunity to pursue my Practice School-I program at Starflex Sealing India Pvt. Ltd., Goa.

We would like to express our gratitude to the following people for their help in the work leading to this report:

- Dr Sudhy S. Panicker, PS – I Faculty in-charge for organizing and coordinating projects and for his valuable support.
- Mr. Sameer Govekar, Representative of Starflex Sealing India Pvt. Ltd. for guiding us and giving basic overview of the project, and allotting project mentors to us for project-specific guidance.
- Mrs. Harini Nerur, Assigned Project Mentor from Starflex Sealing India Pvt. Ltd. for educating us with the procedures of the company and helping us in the project aspects.

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE,

PILANI (RAJASTHAN)

Practice School Division

Station: STARFLEX SEALING INDIA PVT. LTD. **Centre:** Goa

Duration: 30-05-2022 to 22-07-2022(54 days)

Date of Start: 30-05-2022

Date of Submission: 22-07-2022

Title of project: INVENTORY MANAGEMENT MODULE

ID Nos. /Names of students/ Disciplines of the students:

2020B5A42176H	Sumanyu Kosuri	Mechanical
2020B3A40946P	Yash Purohit	Mechanical

Names and Designations of the experts-

- Mr. Sameer Govekar
- Mrs. Harini Nerur

Name of the PS Faculty: Dr. Sudhy S. Panicker

Key Words: Placement Order, TaskCard, Inventory and Quality Management, RCA, CAPA, 7 QC Tools, Check Sheet, Control Charts, Stratification, Bar Code

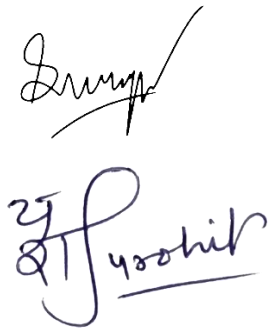
Project Areas: Using TaskCard and Tracking inventory by creating inventory management system, and implementing quality check automations.

Abstract: This project is aimed to get a record of the inventory in every successive process of manufacture and keep a track of them throughout the journey from the placement order till the material is handed over to the production.

The project is intended to build a quality inventory management system which helps the company to keep track of the flow of inventory right from the receiving of raw materials and consumables to semi-finished goods to finished goods. By this we make the work easy for management and ensure no loss in the raw material and improve the efficiency.

Inventory management needs to be done in this project at all the 3 levels, which are input, process, and output. Apart from that, the project also aims to reduce wastage, reduce defects and rejections, in order to increase the inventory efficiency.

Signature of Students **Signature of PS Faculty**



Date:

Date: 22nd July 2022

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1. STARFLEX SEALING COMPANY

1.1. Introduction

Starflex Sealing India Pvt. Ltd., earlier known as Flexitallic India Pvt. Ltd. began production in 1998 as a joint venture subsidiary of Flexitallic. Starflex is now independently managed from Flexitallic. A world-class manufacturing and technical infrastructure support the company's wide product range. Starflex products are supplied to various places including Europe and Asia.

1.2. Manufacturing Infrastructure

Starflex products are manufactured from a world class 55,000 square feet facility based in Goa, India. The manufacturing processes are atomised to allow for best controls in quality and adherence to the required standards.

1.3. Products

Starflex manufactures a wide range of products including the following:

1. Spiral Wound Gaskets
2. Sheet based and cut gaskets
3. Tooth Profile Gaskets
4. Jacketed Gaskets
5. Envelope Gaskets
6. Gland Packings

1.4. Markets Served

Starflex products are supplied to a wide range of industries. They constantly interact with customers from various industries. Following are a few of our customer industries.

1. Nuclear
2. Petrochemical
3. Chemical
4. Power
5. Pulp and Paper
6. Original Equipment Manufacturers
7. Pharmaceutical
8. Food Processing

1.5. Customers

Below are a few prestigious customers:

1. Bhabha Atomic Research Centre
2. Birla Cellulosic
3. British Gas
4. Hindustan Lever
5. Hindustan Petroleum
6. Indian Petrochemical Corporation Ltd.
7. Indira Gandhi Centre for Atomic Research
8. L&T
9. National Thermal Power Corporation
10. Nuclear Power Corporation of India
11. Oil & Natural Gas Corporation
12. Reliance Industries
13. Tata Chemicals

1.6. Approvals

Below are a few prestigious approvals:

1. Airforce
2. Department of Atomic Energy
3. Engineers India Limited
4. Nuclear Power Corporation of India
5. Kvaerner
6. Uhde
7. Jacobs (Humphreys & Glasgow)

1.7. Quality Objectives

Starflex is committed to offering best quality products. Starflex quality systems comply to and are certified by ISO 9001. The Starflex manufacturing infrastructure is supported by sophisticated quality testing equipment. They allow for conformance to quality parameters as per the relevant standards.

1.8. Gasket and Its Function

A gasket is designed to be placed between two static faces of a flange in order to affect a seal. The selection of gasket is defined by taking into consideration factors such as pressure, temperature, and type of media, etc. The gasket should withstand these parameters in order to maintain a seal.

Gasket function can be divided into two stages:

1. **Gasket compression during Assembly**

The gasket needs to be properly seated during assembly. In order to achieve this, the bolt stress should be sufficiently higher than the internal pressure, hydrostatic end force, and minimum required bolt stress for gasket seating.

2. **Gasket resiliency and recovery during a running plant**

In a running plant, the gasket needs to maintain resiliency and recovery properties in order to maintain the same initial bolt stress and fight against hydrostatic end force and flange movements due to pressure-temperature fluctuations.

An improperly designed, casually installed, or poorly manufactured gasket can lead to plant shutdowns, financial losses, plant capacity reductions, environmental damages and safety hazards that are sometimes fatal.

2. THE PROJECT: INVENTORY MANAGEMENT MODULE

2.1. Project Research

2.1.1. Inventory

Inventory is an idle stock of physical goods that contain economic value, and are held in various forms by an organization in its custody awaiting packing, processing, transformation, use or sale in a future point of time.

Any organization which is into production, trading, sale, and service of a product will necessarily hold stock of various physical resources to aid in future consumption and sale.

While inventory is a necessary evil of any such business, it may be noted that the organizations hold inventories for various reasons which include speculative purposes, functional purposes, physical necessities, etc.

From the above definition, the following points stand out with reference to inventory:

- All organizations engaged in production or sale of products hold inventory in one form or other.
- Inventory can be in complete state or incomplete state.
- Inventory is held to facilitate future consumption, sale or further processing value addition.
- All inventory resources have economic value and can be considered as assets of the organization.

2.1.2. Types of Inventories

Inventory of materials occurs at various stages and departments of an organization.
A manufacturing organization holds inventory of **raw materials** and **consumables** required for production. It also holds inventory of **semi-finished** goods at various stages in the plant with various departments. **Finished goods** inventory is held at plant FG stores, distribution centers etc.

Further both raw materials and finished goods those that are in transit at various locations also form a part of Inventory, depending upon who owns the inventory at the particular juncture.
Finished goods inventory is held by the organization at various stocking points or with dealers and stockiest until it reaches the market and end customers.

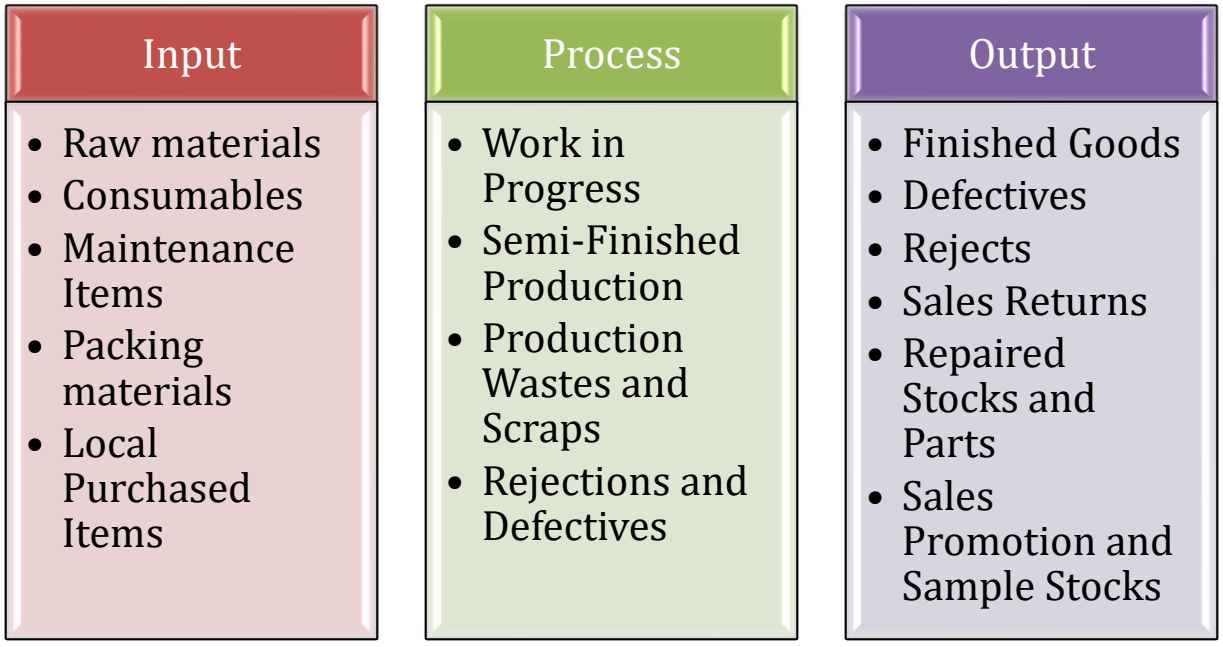
Besides raw materials and finished goods, organizations also hold inventories of spare parts to service the products.
Defective products, defective parts, and scrap also forms a part of inventory as long as these items are inventoried in the books of the company and have economic value.

Now let's see how we can specify types of inventories by function:

At the input terminal: The raw materials, the consumables required for processing (e.g. fuel, stationary, bolts, and nuts etc. required in manufacturing), the maintenance items or consumables, the packing materials, and the local purchased items required for production; all these are considered as inventories at the input terminal.

During the process: The work in process(WIP), the semi-finished production in various stages lying with various departments (like production, work in process, stores, quality control, final assembly, paint, shop, packing, outbound store, etc.), the production wastes and scraps, the rejections and defectives; all these are considered as inventories while the process is going on.

At the output terminal: The finished goods (the finished goods at distribution centers throughout supply chain, the finished goods in transit, the finished goods with stockiest and dealers), the spare parts, stocks and bought out items, the defectives, rejects and sales returns, the repaired stock and parts, the sales promotion and sample stocks; all these are considered as inventories at the output.



Caption: Types of Inventories at various terminals

2.1.3. Inventory Management

In any business or organization, all functions are interlinked and connected to each other and are often overlapping. Some key aspects like supply chain management logistics and inventory form the backbone of the business delivery function. Therefore these functions are extremely important to marketing managers as well as finance controllers.

Inventory management is an approach for keeping track of the flow of inventory. It involves overseeing the constant movement of items in and out of your organization's inventory. The process can be carried out manually or by using an automated system.

One of its top priorities is being in control of the transfer of units to ensure the inventory is neither too high nor too low as this can put your company's operation in jeopardy. Another important aspect you have to control is the inventory-associated costs from the total value of goods to the generated tax accumulated from the inventory value.

This means the process refers to supervising and controlling your stock items to ensure you always have the materials and products you need available. At the same time, you want to keep costs as low as possible. Each step of your inventory management flowchart results to a comprehensive functional unit.

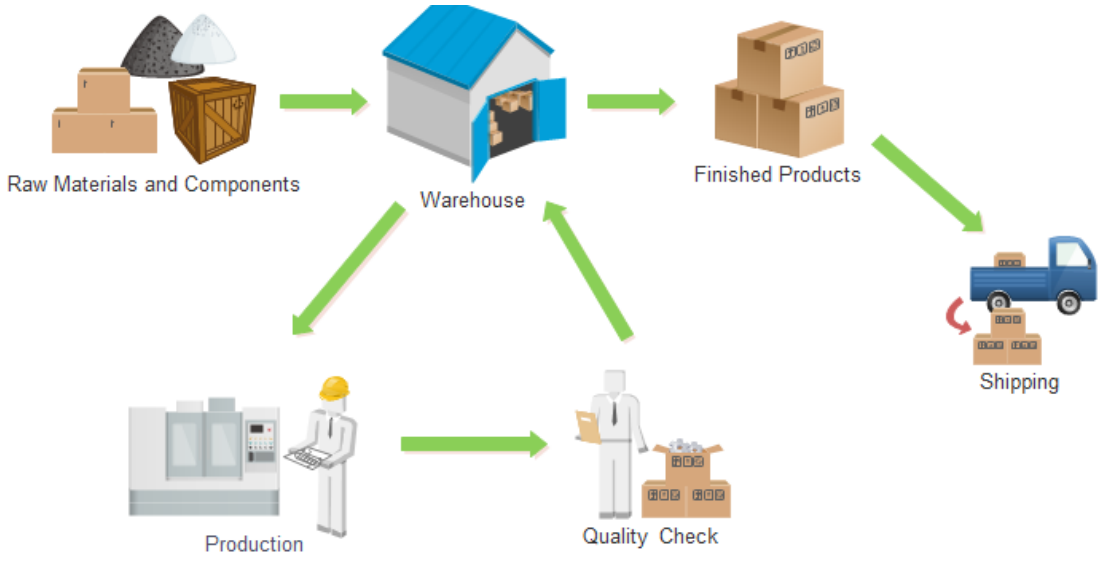


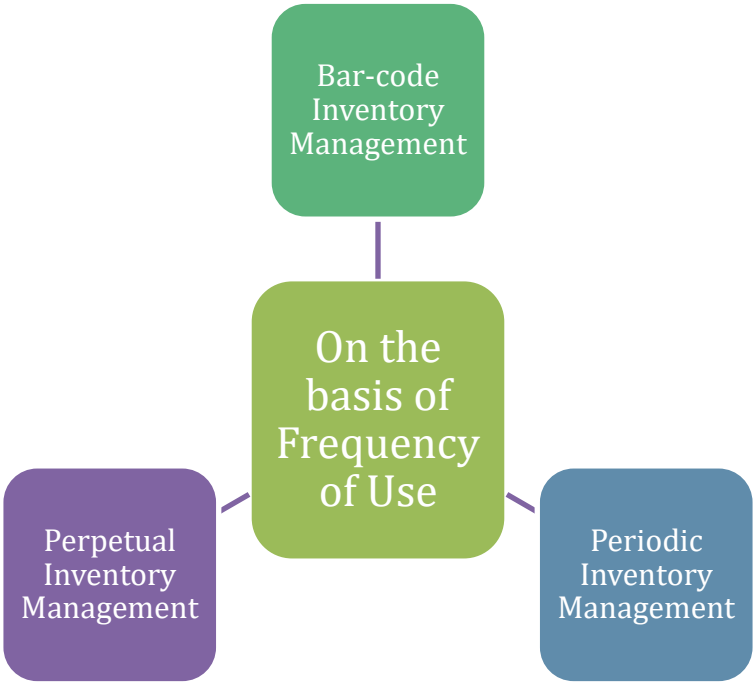
Figure 1: Basic Flowchart of Inventory Management Process resembling to processes at Starflex Sealing India Pvt. Ltd.

2.1.4. Why Inventory Management?

1. Tracking Inventory
2. Manage Planning & Forecasting
3. Control Your Costs
4. Improve Your Delivery
5. Reduce the Time for Managing Inventory

2.1.5. Types of Inventory Management

On the Basis of Frequency of Use



Bar-code Inventory Management

The barcode system is its automated and simplified version. The management can find out the stock remaining with just one click on a computer device. The scanned barcodes enable the software to maintain a track of all the purchases and the flow of inventory.

Continuous Inventory Management

It links the barcode and radio frequency identification with the accounting inventory system, inventory received, and point of sales systems along with the production system, to trace the path of inventory movement. It is mostly beneficial for accounting purpose. This is also termed as perpetual inventory management.

Periodic Inventory Management

It is a manual process, which is used for determining the closing inventory value, for putting it up in the ledger at the end of a financial year. Depending on the organizational need, it can also be analyzed quarterly. However, it is a time-consuming way, since the inventory has to be physically counted.

2.2. Process Mapping – Processes at Starflex

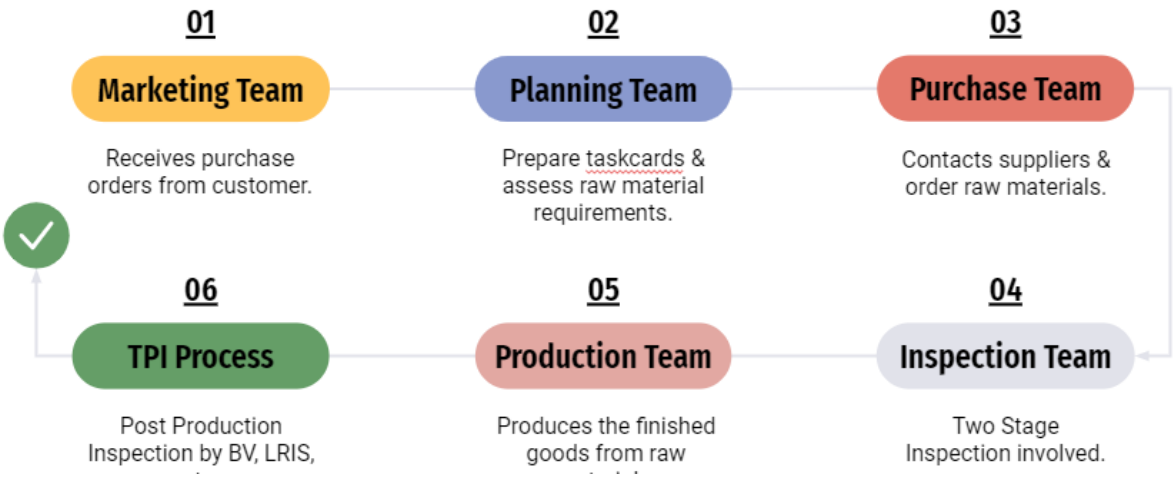


Figure 2: Inventory Management Process Mapping

The inventory management process starts from the marketing team, whose responsibility is to bring in customers. They apply tenders on behalf of starflex for various projects. For the tenders that gets approved, the customer sends the purchase order to the marketing team for what products they want. Then the marketing team forward this purchase order, i.e. PO to the planning team.

Usually this purchase order is clumsy making it difficult to understand the details provided by the customer regarding the products, raw materials and dimensions specified, terms and conditions, etc. So the planning team's task is to prepare a TaskCard from the PO, which is easier to interpret, and then assess the raw material required for the project.

Then the purchase team receives the information for raw materials from all the taskcards and contact varioius suppliers to purchase this raw material.

Before taking the raw material inside the factory premises, a quantity check and a basic quality check is done by the source person and the security and a material test certificate is approved. Then the raw material is taken inside the company's production unit and kept in stores with invoice and material test certificate.
It is then thoroughly inspected by quality management team regarding proper dimensions and quantity. This is done via sampling by QTIs, i.e. Qualtiy Test Inspectors because the quantities are large. e.g. sheet's quantity and dimensions like length are checked.
If it all turns out fine, a GRN(good receipt note) is issued, and then accountant makes the payment for this material purchased, and this material's entry is done in the company's inventory.

At the end, the material is handed over to the production team as per their requirements.

2.3. Purchase Order and TaskCards

2.3.1. Purchase Order

A purchase order is a large document received from the company from which we condense the relevant information and prepare a taskcard.

Few important information and conditions in purchase order except the details about products are:

- PO No. - Unique Number for whenever someone sends a purchase order. This no is unique for every purchase and so is purchase date.

- Late Delivery - Incase of a delay in delivery to due some reasons, the customer can impose late delivery charges which can be either cancellation of order or reduction of payment amount like 5% of the amount.

  Late Delivery is mentioned in POs under the Price Reduction Schedule section where the clause and the percent deduction is mentioned with respect to per week delay. The Govt companies and govt tenders usually mentions LD, but its not generally mentioned in POs by private companies.

- Inspection Clause – Some purchasers do the inspection of the received final products by themselves. While others nominate some third-party inspection agencies like LRIS, BV, DNV, etc. for inspection.

  These third-party agencies visit Starfelx's factory to inspect. So when Starflex have the products ready, they raise an inspection call to for e.g. BV and ask them to appoint one person for the inspection.

  He then visits the factory, inspects the products and give a confirmatory certificate called (IRN Certificate) that the material is ready to be dispatched.

  The third party agency then reaches to the customer and gives them this IRN certificate as the confirmation and then material gets delivered to the customer.

  Within this inspection clause, in case of TPI, TPI charges in % form are also mentioned.

PURCHASE ORDER

PO No : 9540018865 Rev. : 00
Date : 25.03.2022

Vendor Code	2100000403
Name & Address	Starflex Sealing India Pvt Ltd 15/B, Vinod Apartments, K.V.R. Naik Gowalia Tank, Mumbai400036 Maharashtra(India)
Attn	: Mr. D.V. Mokashi
Ph	: 022-23890904
Fax	:
Email	: accounts@starflex.net

Delivery Address : [redacted]
Bathinda151301
Punjab(India)

Pl . send acceptance of PO to [redacted] :-
Place :
Contact Person : Neeraj Kumar Kharwar
Ph :
Fax :
Email : [redacted]

Dear Sir ,

With reference to your offer dated 24-03-2022 against our tender for urgent gasket and all subsequent correspondences up to and including your email ref. dated 25-03-2022, we are pleased to place this Purchase Order for Supply of Gaskets at [redacted] Bathinda with the applicable Terms and Conditions as mentioned below:

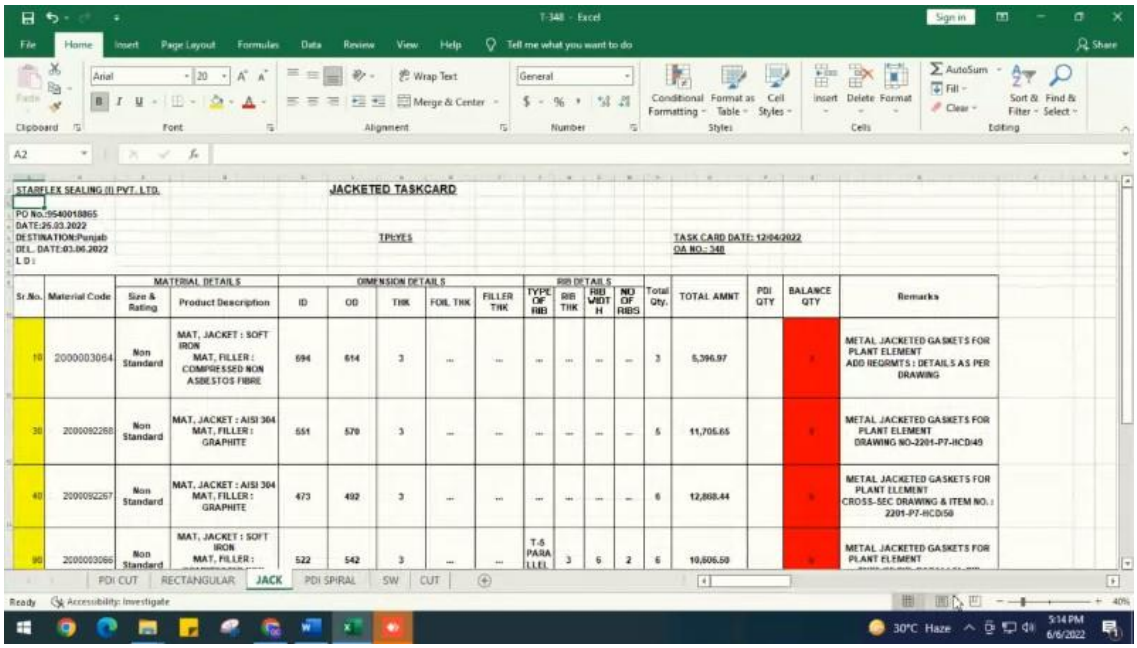
Figure 3: Sample Purchase Order

2.3.2. TaskCards

Making the TaskCard is a very important process as we analyze the purchase order and we take note of the relevant things and put it in the task card in a specific format, making it easier to understand for all.

The basic general information written at the top of task card is the name of the type of gasket for which taskcard is prepared.
Then PO No, Delivery Date, LD, Delivery Destination, TPI Agency Name, etc. are written as it is from the purchase order.
Apart from all this, an Order Acceptance No.(OA No.) is also added at the top which is also a unique no. attached by the marketing team whenever it accepts a new order.
All these nos. are important for the traceability of the inventory and the final products.

Then material spreadsheet is written.



STARFLEX SEALING (I) PVT. LTD.

JACKETED TASKCARD

PO No.:9540018865
DATE:25.03.2022
DESTINATION:Punjab
DEL. DATE:03.06.2022
L D :

TPI-YES

TASK CARD DATE: 12/04/2022
QA NO.: 348

Sr.No.	Material Code	MATERIAL DETAILS		DIMENSION DETAILS					RIB DETAILS				Total Qty.	TOTAL AMNT	PDI QTY	BALANCE QTY	Remarks
		Size & Rating	Product Description	ID	OD	THK	FOIL THK	FILLER THK	TYPE OF RIB	RIB THK	RIB WIDTH	NO OF RIBS					
10	2000003064	Non Standard	MAT, JACKET : SOFT IRON MAT, FILLER : COMPRESSED NON ASBESTOS FIBRE	594	614	3	...	...	...	...	...	...	3	5,396.97			METAL JACKETED GASKETS FOR PLANT ELEMENT ADD REQRMTS : DETAILS AS PER DRAWING
30	2000092268	Non Standard	MAT, JACKET : AISI 304 MAT, FILLER : GRAPHITE	551	570	3	...	...	...	...	...	...	5	11,705.65			METAL JACKETED GASKETS FOR PLANT ELEMENT DRAWING NO-2201-P7-IICD49
40	2000092267	Non Standard	MAT, JACKET : AISI 304 MAT, FILLER : GRAPHITE	473	492	3	...	...	...	...	...	...	6	12,868.44			METAL JACKETED GASKETS FOR PLANT ELEMENT CROSS-SEC DRAWING & ITEM NO. : 2201-P7-IICD58
90	2000003066	Non Standard	MAT, JACKET : SOFT IRON MAT, FILLER :	522	542	3	...	...	T-S PARA LLEL	3	6	2	6	10,606.50			METAL JACKETED GASKETS FOR PLANT ELEMENT

PDI CUT | RECTANGULAR | JACK | PDI SPIRAL | SW | CUT

Ready Accessibility: Investigate

30°C Haze 5:14 PM 6/6/2022

Figure 4: Sample TaskCard for Jacketed Gasket

2.4. Knowing a Purchase Order and Making a TaskCard

Given below is a sample placement order from a customer:

PO No / Date : 9540018865 / 25.03.2022 Rev. : 00

ANNEXURE-1 - [redacted]

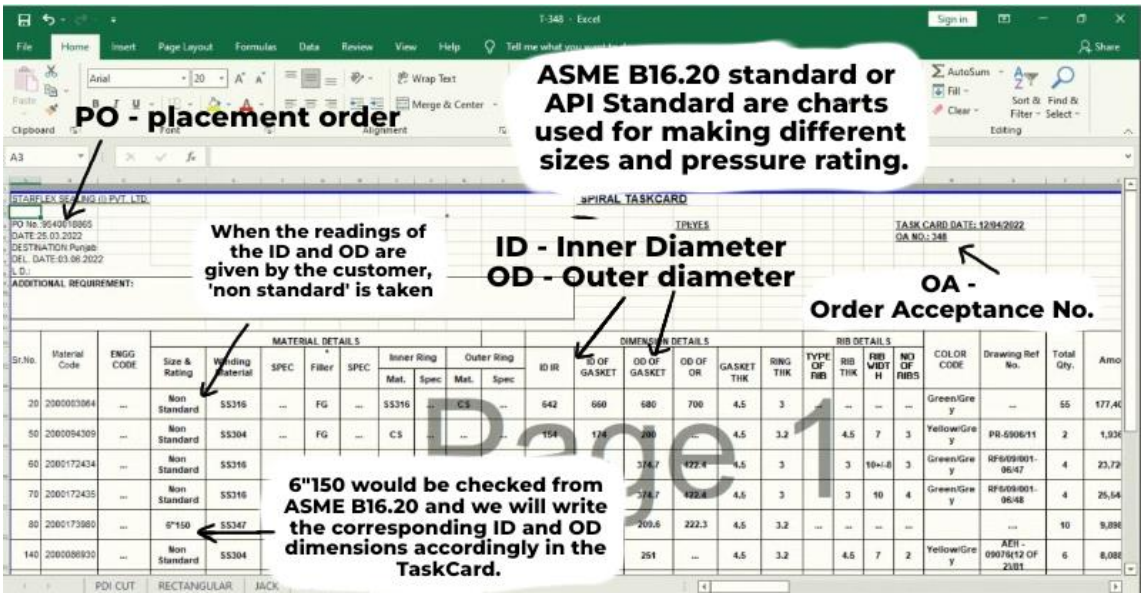
S. No	Item Code / Description	Order Qty / Unit	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Tax Apl	Delivery Date dd/mm/yyyy
10	2000003064	3 EA	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	N/A	03.06.2022
	METAL JACKETED GASKETS FOR PLANT ELEMENT MAT, JACKET : SOFT IRON MAT, FILLER : COMPRESSED NON ASBESTOS FIBRE DIMENSION, I.D. X O.D. : 594X614 THICKNESS, GASKET : 3 MM ADD REQRMTS : DETAILS AS PER DRAWING								
20	2000046366	55 EA	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	N/A	03.06.2022
	SPIRAL WOUND GASKETS FOR PLANT EQUIPMENT MAT, SPIRAL : STAINLESS STEEL 316 MAT, FILLER : GRAPHITE MAT, INNER RING : STAINLESS STEEL 316 MAT, OUTER RING : CARBON STEEL OUTER DIA, SPIRAL : 680 MM INNER DIA, SPIRAL : 660 MM INNER DIA, CENTER RING : 642 MM OUTER DIA, CENTER RING : 700 MM THICKNESS, SPIRAL : 4.5 MM THICKNESS, CENTER RING : 3 MM								

2.4.1. Assigning Dimensions in TaskCard

This includes listing of product requirements and their various dimensions and descriptions like Inner Diameter(ID), OD, Qty, Thickness(THK), Foil Thickness(FOIL THK), Total Qty(Not required generally), PDI(pre deliver

or pre dispatch inspection - also not generally required to write in TaskCard), Balance Qty, Remarks(anything apart from above details like specific requirements or special demands from the customer like different material grade requirement, etc.)

We take down all the information requirements and measurements into a task card. All the important readings from the taskcard are given below:



2.4.2. Material Grades for Different Gaskets

- **Metal Jacketed:**
  - For Jacket:
    - Soft Iron
    - AISI 304
  - For Filler:
    - Compressed Non-Asbestos Fibre
    - Graphite
- **Spiral-Wound:**
  - For spiral/winding material:
    - Stainless Steel(SS)
    - SS 316, SS 304, SS 304N & SS 304L, SS 316L, etc.
  - For Filler:

        - Same as above
    - For Inner Ring:
        - Stainless Steel(SS) grades
    - For Outer Ring:
        - Carbon Steel(CS)
        - Low Carbon Steel(LCS)
- **Cut:**
    - Various rubber types. E.g. Nitrile Rubber

2.5. Project Part - I: Barcode Inventory Management System

A barcode inventory system is a method that helps businesses track inventory faster and easier. When a product has a barcode, it's scanned with a handheld mobile device and synchronized with inventory management software in real-time.

Figure 5: Basic Barcode Based Inventory Management Cycle

2.5.1. Why Use Barcode Based System?

As Starflex's business is at a large scale and is more complex with wide variety of inventory at different levels of production, there are certain tasks that need to be automated in order to keep up with demand. Inventory control falls into this category for two reasons:

1. Manual inventory counts are tedious and take resources away from more profitable activities.
2. Keeping inventory levels by hand increases the risk of human error, which can result in costly miscalculations, oversights, and lost inventory.

Better Tracking of the Inventory: Apart from that, barcode based systems also helps us to operate more real-time inventory movements; this enables us to manage the whole supply chain which goes from the raw materials to the final distribution of the product.

Better Cost Control: The real-time barcode inventory management provides you the control over all records and allows the cost approvals at each stage, making it easy for accounting and tax reporting.

2.5.2. Process to Register for Barcodes

As a Starflex Sealing India has a large-scale business and big production units, it has to register for a for a barcode in the GS1 official websites since exports to other countries take place.

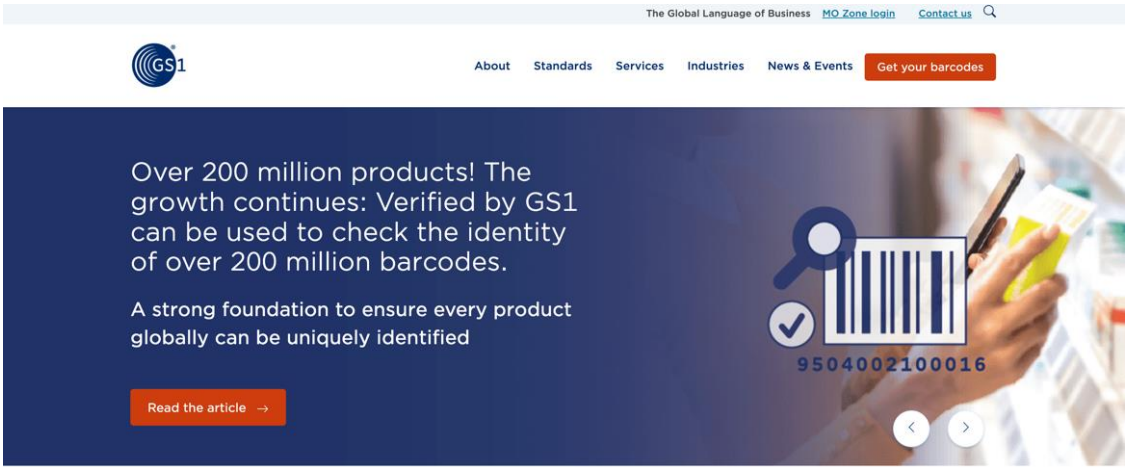


Figure 6: GS1 Official Website

We need to specify the requirement (i.e. not for selling but for inventory management, based on our requirement, the government decides the barcode type. The barcode will be titled ‘raw’, since it is attaches to the saw inventory obtained after proper physical shaping.

2.5.3. Usage of Microsoft Excel for Database

For this project, we decided to use Microsoft Excel as the database management tool where the information of the scanned items would be stored.

Undeniably, there are many other advanced accounting softwares such as Tally, A2X, NetSuite, Avid exchange and many database management tools like Access, SQL, Firebase, etc. but using MS Excel makes our life easier as:

1. It is comparatively more user-friendly.
2. It is accessible to multiple users online at a time by Office 360(similar to Google Sheets).
3. It can be easily shared as a link to multiple staff members with choice of edit access, they can access the excel files both on their PC as well as mobile phones.
4. Apart from that, it can be directly to the respective taskcards as they are also excel spreadsheets, which allows us to keep all the information regarding an order at a single place.

2.5.4. Working of this Inventory Management System

2.5.4.1. Investments Required

- Barcode Printers
- Hand-Held Barcode Scanners
- Mounted Barcode Scanners
- Database Management Software(MS Excel spreadsheet)
- CCTV Cameras for monitoring(useful while doing RCA for defects)

Figure 7: Essential Items Required for a Barcode Based Inventory Management System

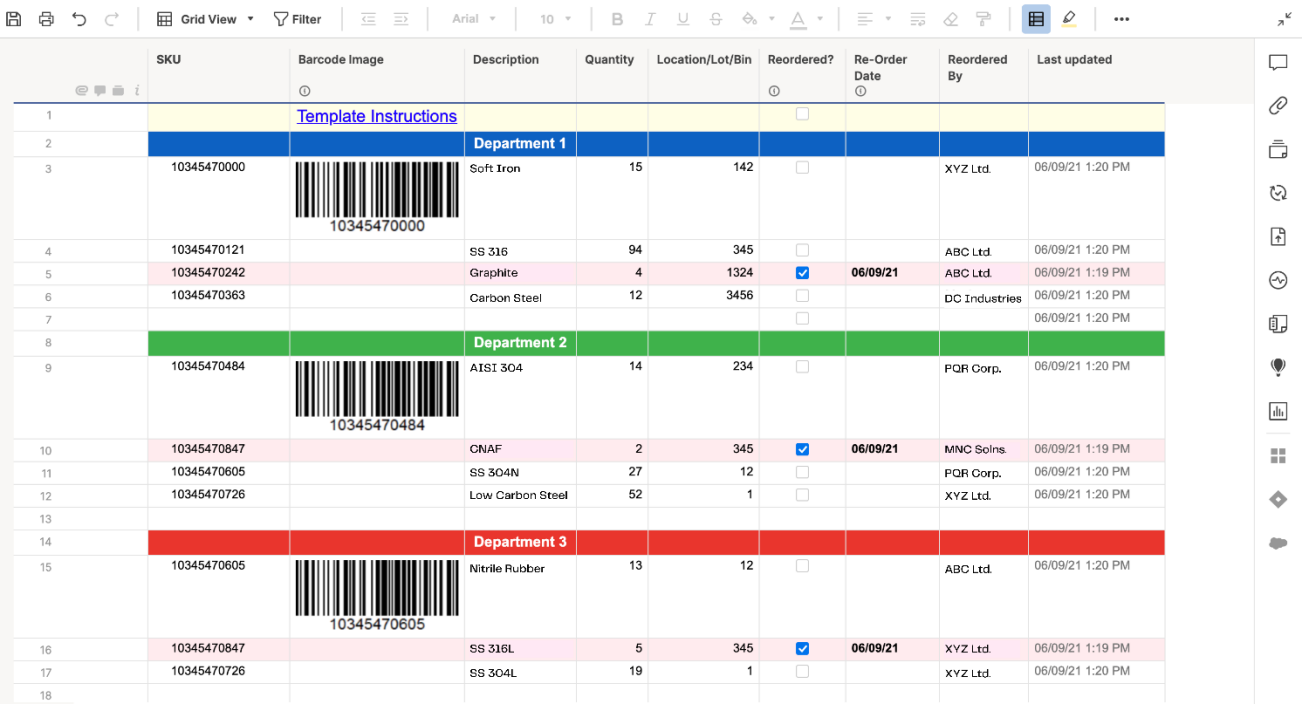
2.5.4.2. Working Process of the Physical Hardware

- We introduce the barcode scanners at multiple checkpoints.
- Initially, a barcode is printed on the raw material when it gets finally stored in the warehouses before being sent for production.
- During the production phase, as new semi-finished goods gets produced from those materials, new barcodes are printed on them on the conveyer belt itself.

- The material which moves on the conveyer belts are scanned by the mounted scanners on the conveyer belt.
- Some materials are manually scanned by hand-held scanners.
- The barcode scanners are linked to the company's server computer via LAN/Wifi.

2.5.4.3. Working of the Database

- The server computer has specific assigned excel spreadsheet columns for the respective barcodes as per the material and gasket types.
- As the material passes those checkpoints, it is read by the scanner, marked, and the data from that material is instantly transferred to the computer.
- As it keeps on scanning, each item falls as a successive entry in the columns of that excel sheet.
- We initially take the details of the input raw material went for the production and the corresponding number of outputs estimated.
- As the successive scans take place, the items automatically noted down and compared with the expected output.
- Similar process is done at all levels of inventory management, i.e. input, process, and output.
- Now we can find out for any losses in material(precisely how much at what stage) and calculate the efficiency of the production process.
- This can either be done by simply observing the data in the raw form as it is present in the excel sheet or can be done by using quality check tools.
- Then we can take further steps to minimize wastage and improve our efficiency.



	SKU	Barcode Image	Description	Quantity	Location/Lot/Bin	Reordered?	Re-Order Date	Reordered By	Last updated
1		Template Instructions				☐			
2			**Department 1**						
3	10345470000	10345470000	Soft Iron	15	142	☐		XYZ Ltd.	06/09/21 1:20 PM
4	10345470121		SS 316	94	345	☐		ABC Ltd.	06/09/21 1:20 PM
5	10345470242		Graphite	4	1324	☑	06/09/21	ABC Ltd.	06/09/21 1:19 PM
6	10345470363		Carbon Steel	12	3456	☐		DC Industries	06/09/21 1:20 PM
7						☐			06/09/21 1:20 PM
8			**Department 2**						
9	10345470484	10345470484	AISI 304	14	234	☐		PQR Corp.	06/09/21 1:20 PM
10	10345470847		CNAF	2	345	☑	06/09/21	MNC Solns.	06/09/21 1:19 PM
11	10345470605		SS 304N	27	12	☐		PQR Corp.	06/09/21 1:20 PM
12	10345470726		Low Carbon Steel	52	1	☐		XYZ Ltd.	06/09/21 1:20 PM
13									
14			**Department 3**						
15	10345470605	10345470605	Nitrile Rubber	13	12	☐		ABC Ltd.	06/09/21 1:20 PM
16	10345470847		SS 316L	5	345	☑	06/09/21	XYZ Ltd.	06/09/21 1:19 PM
17	10345470726		SS 304L	19	1	☐		XYZ Ltd.	06/09/21 1:20 PM
18									

Figure 8: A Template Database Prepared to suite Starflex's Requirements

2.6. Project Part - II: Quality Check and Analysis

2.6.1. QC Tools

QC tools are the quality control tools which helps in solving quality issues through Data Collection, Analyzing Data, Identification of Root Cause and Measuring Results.

The 7 Quality Tools are widely applied by many industries for product and process improvements, and to solve critical quality problems. 7 QC tools are extensively used in various Problem-Solving Techniques which are listed below:

- PDCA Deming Cycle for Continuous improvement in product and processes
- Lean Manufacturing for 3M Waste elimination from processes
- Various phases of Six Sigma-DMAIC to reduce process variations.

2.6.2. Why Use QC Tools?

The 7 QC tools are structured and fundamental instruments that help businesses improve their management and production process for achieving enhanced product quality. From assessing and examining the production process, identification of key challenges and problems to controlling the fluctuation present in the product quality and providing solutions for prevention of defects in future, the easy to understand and implement, 7 QC tools are very effective.

Some prominent benefits of using QC tools are:

- Provides a more structured, scientific, and logical approach for problem-solving and quality improvement
- Easy to understand as well as implement yet extremely effective
- Helps in identifying and analyzing problems during the process
- Enhance customer satisfaction and experience
- Reduce cost due to poor quality.
- Helps in investigating the potential causes and real root cause of the problem for taking effective countermeasures.
- Check sheet helps in data collection and recording for quality problem analysis.
- Fishbone diagram aides in root cause analysis and problem-solving.

2.6.3. The 7 Basic QC Tools

The seven basic tools of quality are a designation given to a fixed set of simple graphical and statistical techniques identified as being most helpful in

troubleshooting issues related to quality and process improvement. They are called **basic** because they are suitable for people with little formal training in statistics and because they can be used to solve the vast majority of quality-related issues. These statistical tools are very easy to understand and can be implemented without any complex analytical competence or skills.

The 7 tools of quality are generally used by quality control and quality assurance engineers to solve product or process-related quality issues on a daily/weekly/monthly basis and to reduce/eliminate non-value-added activities like product rework, repair, and rejection.

These 7 basic tools are:

2.6.3.1. Check Sheet

The check sheet is used for collecting, recording, and analyzing the data in real time and at the location where data is generated. Data collection is an important activity in the problem-solving process as it provides a basis for further action. Data may be numerical, observations and opinions, etc.

CHECK SHEET – COMPUTER RELATED PROBLEMS						
S. NO.	Problem	Weekly Status				Total
		1	2	3	4	
1	Network problem	𝍸	𝍸 𝍸	𝍸	𝍸	16
2	Server Problem	𝍸	𝍸	𝍸	𝍸	13
3	Email	𝍸	𝍸	𝍸	𝍸	18
4	Server Access	𝍸	𝍸	𝍸	𝍸 𝍸	17
Total		10	20	13	21	

Figure 9: Sample Check Sheet

- Helps to analyze the data for corrective and preventive actions.
- Helps to detect how often a problem occurs.
- Helps to detect how often a problem occurs.

2.6.3.2. Fishbone Diagram

Fishbone diagram is also called as Cause and Effect diagram and Ishikawa diagram. It helps to Identify all possible potential causes and select the real/best potential cause which contributes to the problem/effect. The brainstorming technique is used for potential cause identification.

In a brainstorming session, all 4M or 6M factors are taken into consideration to identify the potential causes. 4M or 6M factors are – Man, Machine, Method, Material, Measurement, and Mother nature also called Environment.

- Helps to determine the Root Cause of a Problem.
- To identify the Key Inputs variables – Primary, Secondary and Tertiary causes.
- Increases knowledge of a process and its factors.
- Helps to identify areas for data collection.

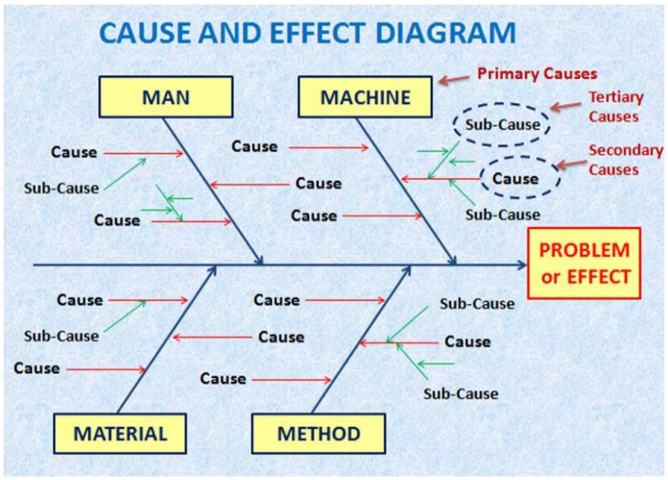


Figure 10: Sample Fishbone Diagram

2.6.3.3. Histogram

A Histogram is a pictorial representation of a set of data. The most commonly used bar graph for showing frequency distributions of data/values.

- Useful to understand the spread or variations, location, and shape of the data.
- To know whether a process is stable and predictable.
- To know whether the process produces within specification.
- Process monitoring and centering.

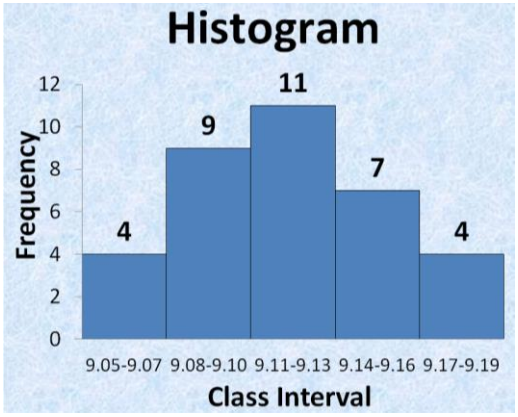


Figure 11: Sample Histogram

2.6.3.4. Pareto Chart

The Pareto chart helps to Narrow the problem area or prioritize the significant problems for corrective measures. The pareto principle is based on the **80-20 rule**. It means that 80 percent of the problems/failures are caused by 20 percent of the few major causes/factors which are often referred to as **Vital Few**.

And the remaining 20 percent of the problems are caused by 80 percent of many minor causes which are referred to as **Trivial Many**. Hence, it gives us information about Vital few from Trivial many.

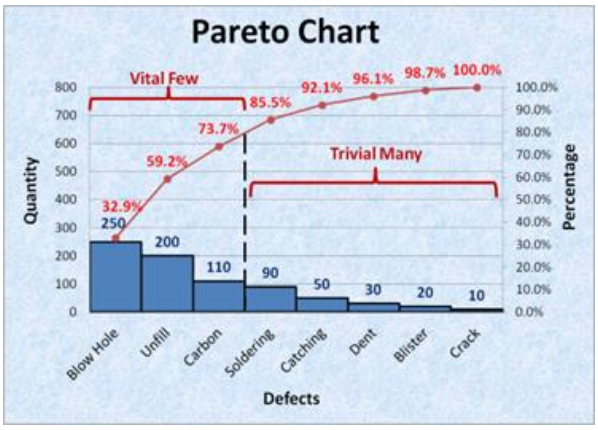


Figure 12: Sample Pareto Chart

2.6.3.5. Control Chart

Control chart is also known as SPC chart or Shewhart chart. It is a graphical representation of the collected information/data. It helps to monitor the process centering or process behavior against the specified/set control limits.

- Control chart is a very powerful tool to find/investigate the source of Process Variations present in the manufacturing processes.
- Tells when to take necessary action to eliminate the Common or Random or Chance variations and Special cause of variations.
- With the help of Control chart, Process Capability of the production process is measured by Cp and Cpk and Pp and Ppk study.

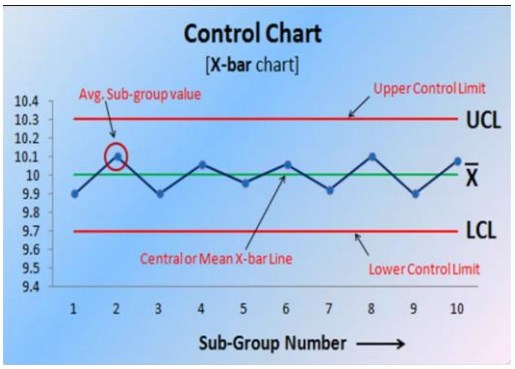


Figure 13: Sample Control Chart

2.6.3.6. Scatter Diagram

A Scatter diagram is also known as Correlation Chart, Scatter Plot, and Scatter Graph. A Scatter graph is used to find out the relationship between two variables.

In other words, it shows the relationship between two sets of numerical data. Scatter graph shows a Positive or Negative correlation between two variables.

- If the data points are scattered very close to the trend line, it shows strong correlation(positive or negative, depending upon the slope of the trend).
- If the data points are randomly scattered and are away from the trendline, it is a weak relationship, or sometimes no correlation.

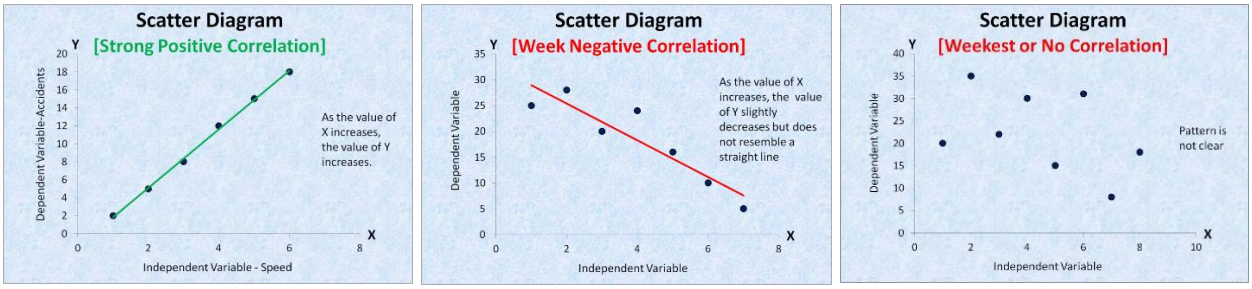


Figure 14: Sample Scatter Diagrams

2.6.3.7. Stratification Diagram

A technique used to analyze and divide a universe of data into homogeneous groups is called -Strata. Stratification tools are used when the data come from different sources or conditions, such as data collected from different shifts, machines, people, days, suppliers and population groups, etc.

Stratification helps in analyzing “Quality Cost”.

- Internal Failure cost
- External Failure cost
- Prevention cost
- Appraisal cost

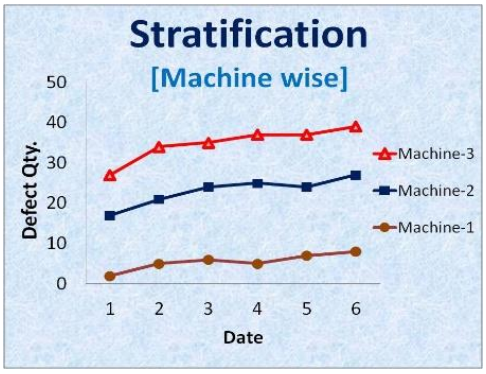


Figure 15: Sample Stratification Diagram

2.6.4. Root Cause Analysis(RCA)

Root cause analysis (RCA) is a systematic process for identifying "root causes" of problems or events and an approach for responding to them. RCA is based on the basic idea that effective management requires more than merely "putting out fires" for problems that develop, but finding a way to prevent them.

RCA can be decomposed into four steps:

- Identify and describe the problem clearly.
- Establish a timeline from the normal situation until the problem occurs.
- Distinguish between the root cause and other causal factors (e.g., using event correlation).
- Establish a causal graph between the root cause and the problem.

In this project, Fishbone Diagram, i.e. Cause and Effect Diagram is used for root cause analysis.

2.6.5. Corrective Action and Preventive Action(CAPA)

Corrective and preventive action (CAPA) consists of improvements to an organization's processes taken to eliminate causes of non-conformities or other undesirable situations. It is usually a set of actions, laws or regulations required by an organization to take in manufacturing, documentation, procedures, or systems to rectify and eliminate recurring non-conformance.

Non-conformance may be a market complaint or customer complaint or failure of machinery or a quality management system, or misinterpretation of written instructions to carry out work.
It is usually done after root cause analysis is done.

Corrective action: Action taken to eliminate the causes of non-conformities or other undesirable situations, so as to prevent recurrence.

Preventive action: Action taken to prevent the occurrence of such non-conformities, generally as a result of a risk analysis.

2.6.6. Implementation of Quality Check in the Project

In this project, we have used basic QC tools only for the quality check, root cause analysis as well as corrective actions.
Check sheets and histograms were primarily used for quality problem analysis whereas Fishbone diagrams were used for root cause analysis and problem-solving.

The data which gets stored in the excel spreadsheet via barcode scanning process is the data used for this quality assessments.

With the help of this process, we can get quality assessments and efficiency of our processes in real-time at the location where the data gets stored, i.e. in the same excel spreadsheet.

E.g. Monitoring and assessing the data of the defects found using Check Sheet and Histogram.

The data used in this process was from the defect's scans received during the production process.

On the basis of that data, suitable check sheets and histograms were generated to assess the problem.

CHECK SHEET - DAILY REJECTION MONITORING								
PART NAME :		PART NO. :				MODEL:		
S. NO.	DEFECT	Date wise Rejection						Total
		1	2	3	4	5	6	7	
1	Blow Hole	15	12	10	13	11	8	10	79
2	Non filling	5	10	8	2	5	6	4	40
3	Catching	8	5	8	5	7	9	6	48
4	Carbon	12	11	8	6	4	8	9	58
5	Crack	9	13	10	8	11	5	7	63
Total		49	51	44	34	38	36	36	

Figure 16: Check Sheet for Defects per Day

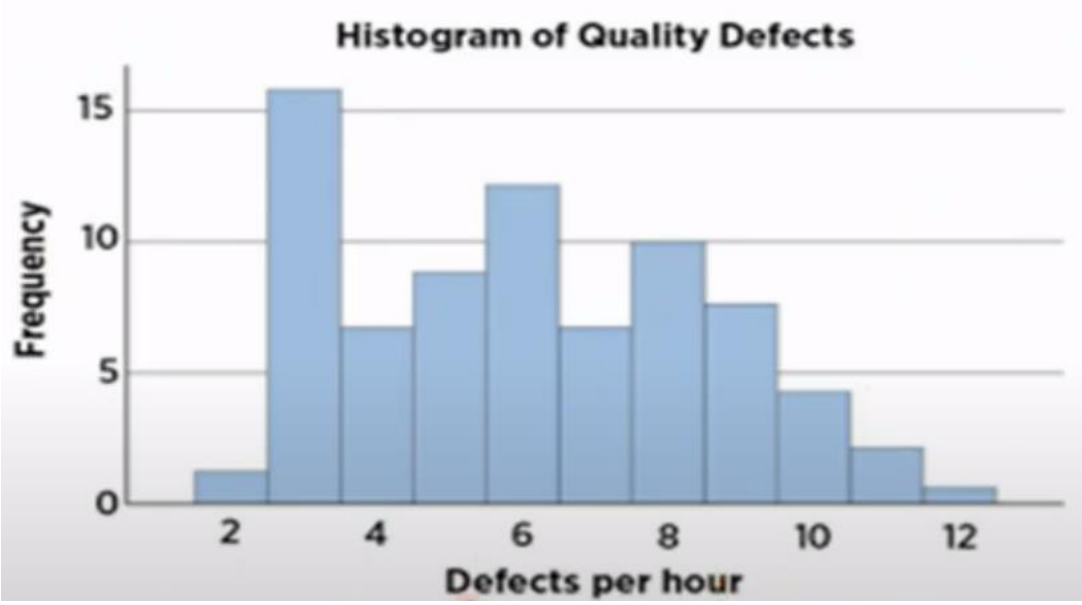


Figure 17: Histogram depicting Defects identified on Hourly Basis

On the basis of the above findings, suitable corrective and preventive actions were taken.

3. CONCLUSION

Starflex's manufacturing unit involves a complex process and managing inventory at least at a periodic rate is absolutely necessary to keep track of the flow of the inventory and keeping the costs controlled at the same time.

A barcode-based inventory management system suggested in this report would help Starflex would reduce the time for managing the above two tasks by keeping the records at single place at a large scale level without any wastage of time and resources

With the quality check and analysis suggested in the report, the company would also get benefitted in the efficient use of resources, lesser defects and rejections, and producing more customer-satisfactory finished goods.

At the end, we would also conclude that working as a part of Starflex was beneficial in learning how to navigate a corporate structure and interact with various organization members.

We now better understand the interpersonal dynamics and how an organization works.

The open learning environment that existed between the team members and within the organization was very encouraging. I adjusted well in the team I was assigned to and strike the right balance between work and life.

We believe that this PS-I assignment would be a valuable contribution to the organization.

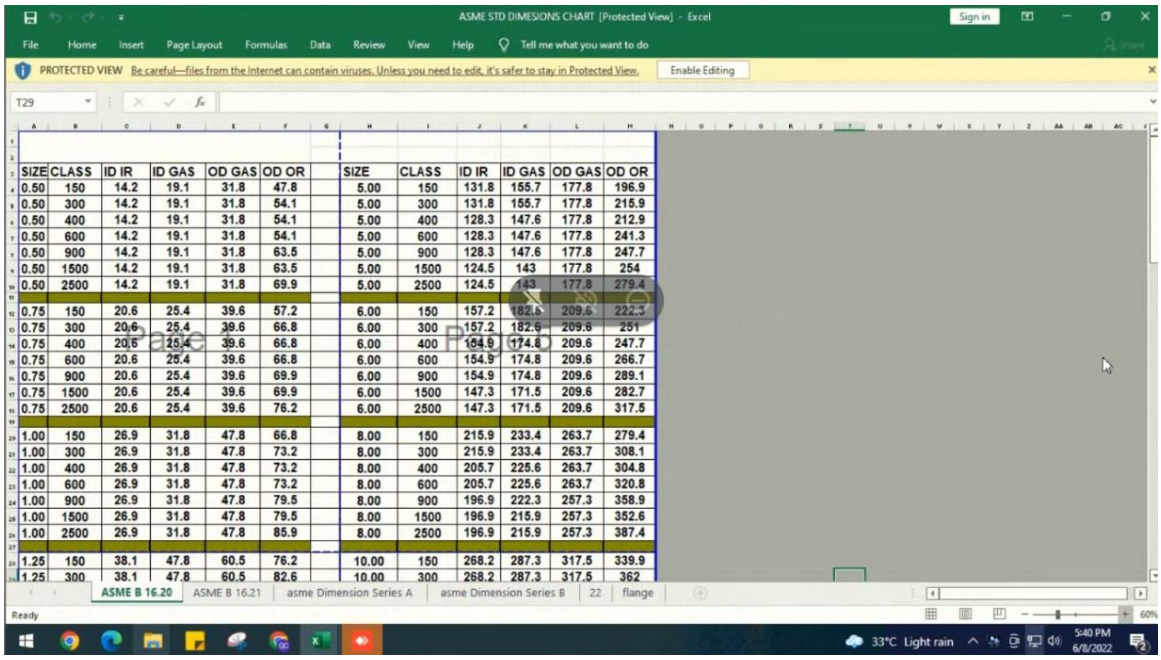
4. SCOPE OF IMPROVEMENT

A few aspects in which the project can be improved are:

1. The barcode-based system can be replaced by a GPS asset tag based system, which although being more expensive can be better in real-time tracking of the products as well as materials.
2. The QC tools used in the project can be replaced by some newer QC tools introduced recently like Affinity Diagrams, PDPCs, Matrix Diagrams, etc. which will definitely increase the efficiency of the data analysis.
3. The process of quality check can be further automated to build all these diagrams and charts automatically by using tools like Excel JS to instruct the excel application via a JavaScript code to automatically build and modify these charts as the data gets entered into the spreadsheet.

5. APPENDIX

5.1. ASME Charts B16.20 and B16.21



SIZE	CLASS	ID IR	ID GAS	OD GAS	OD OR	SIZE	CLASS	ID IR	ID GAS	OD GAS	OD OR
0.50	150	14.2	19.1	31.8	47.8	5.00	150	131.8	155.7	177.8	196.9
0.50	300	14.2	19.1	31.8	54.1	5.00	300	131.8	155.7	177.8	215.9
0.50	400	14.2	19.1	31.8	54.1	5.00	400	128.3	147.6	177.8	212.9
0.50	600	14.2	19.1	31.8	54.1	5.00	600	128.3	147.6	177.8	241.3
0.50	900	14.2	19.1	31.8	63.5	5.00	900	128.3	147.6	177.8	247.7
0.50	1500	14.2	19.1	31.8	63.5	5.00	1500	124.5	143	177.8	254
0.50	2500	14.2	19.1	31.8	69.9	5.00	2500	124.5	143	177.8	279.4
0.75	150	20.6	25.4	39.6	57.2	6.00	150	157.2	182.6	209.6	222.3
0.75	300	20.6	25.4	39.6	66.8	6.00	300	157.2	182.6	209.6	251
0.75	400	20.6	25.4	39.6	66.8	6.00	400	154.9	174.8	209.6	247.7
0.75	600	20.6	25.4	39.6	66.8	6.00	600	154.9	174.8	209.6	266.7
0.75	900	20.6	25.4	39.6	69.9	6.00	900	154.9	174.8	209.6	289.1
0.75	1500	20.6	25.4	39.6	69.9	6.00	1500	147.3	171.5	209.6	282.7
0.75	2500	20.6	25.4	39.6	76.2	6.00	2500	147.3	171.5	209.6	317.5
1.00	150	26.9	31.8	47.8	66.8	8.00	150	215.9	233.4	263.7	279.4
1.00	300	26.9	31.8	47.8	73.2	8.00	300	215.9	233.4	263.7	308.1
1.00	400	26.9	31.8	47.8	73.2	8.00	400	205.7	225.6	263.7	304.8
1.00	600	26.9	31.8	47.8	73.2	8.00	600	205.7	225.6	263.7	320.8
1.00	900	26.9	31.8	47.8	79.5	8.00	900	196.9	222.3	257.3	358.9
1.00	1500	26.9	31.8	47.8	79.5	8.00	1500	196.9	215.9	257.3	352.6
1.00	2500	26.9	31.8	47.8	85.9	8.00	2500	196.9	215.9	257.3	387.4
1.25	150	38.1	47.8	60.5	76.2	10.00	150	268.2	287.3	317.5	339.9
1.25	300	38.1	47.8	60.5	82.6	10.00	300	268.2	287.3	317.5	362

Figure 18: ASME B16.20

300# Gasket Sizes (ANSI B16.21)

Pipe Size	ID	Ring OD	Full Face Dimensions			
			FF OD	Hole Qty	Hole Size	BC
1/2"	27/32	2 1/8	3 3/4	4	5/8	2 5/8
3/4"	1 1/16	2 5/8	4 5/8	4	3/4	3 1/4
1"	1 5/16	2 7/8	4 7/8	4	3/4	3 1/2
1-1/4"	1 21/32	3 1/4	5 1/4	4	3/4	3 7/8
1-1/2"	1 29/32	3 3/4	6 1/8	4	7/8	4 1/2
2"	2 3/8	4 3/8	6 1/2	8	3/4	5
2-1/2"	2 7/8	5 1/8	7 1/2	8	7/8	5 7/8
3"	3 1/2	5 7/8	8 1/4	8	7/8	6 5/8
3-1/2"	4	6 1/2	9	8	7/8	7 1/4
4"	4 1/2	7 1/8	10	8	7/8	7 7/8
5"	5 9/16	8 1/2	11	8	7/8	9 1/4
6"	6 5/8	9 7/8	12 1/2	12	7/8	10 5/8
8"	8 5/8	12 1/8	15	12	1	13
10"	10 3/4	14 1/4	17 1/2	16	1 1/8	15 1/4
12"	12 3/4	16 5/8	20 1/2	16	1 1/4	17 3/4
14"	14	19 1/8	23	20	1 1/4	20 1/4
16"	16	21 1/4	25 1/2	20	1 3/8	22 1/2
18"	18	23 1/2	28	24	1 3/8	24 3/4
20"	20	25 3/4	30 1/2	24	1 3/8	27
24"	24	30 1/2	36	24	1 5/8	32

Recommended Bolting			
Qty	Size	Hex Bolt Length	Stud Length
4	1/2	2 1/4	3
4	5/8	2 1/2	3
4	5/8	2 1/2	3 1/2
4	5/8	2 3/4	3 1/2
4	3/4	3	4
8	5/8	3	3 1/2
8	3/4	3 1/4	4
8	3/4	3 1/2	4 1/2
8	3/4	3 3/4	4 1/2
8	3/4	3 3/4	4 1/2
8	3/4	4	5
12	3/4	4 1/4	5
12	7/8	4 3/4	6
16	1	5 1/4	6 1/2
16	1 1/8	5 3/4	7
20	1 1/8	6	7 1/2
20	1 1/4	6 1/4	8
24	1 1/4	6 3/4	8
24	1 1/4	7 1/4	8 1/2
24	1 1/2	8	9 1/2

Grey Cells = Gasket dimensions identical for 300#, 400# and 600#

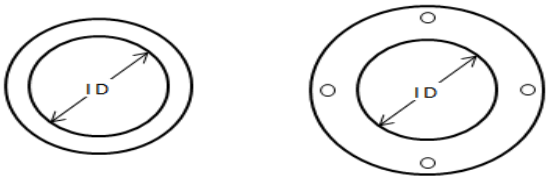
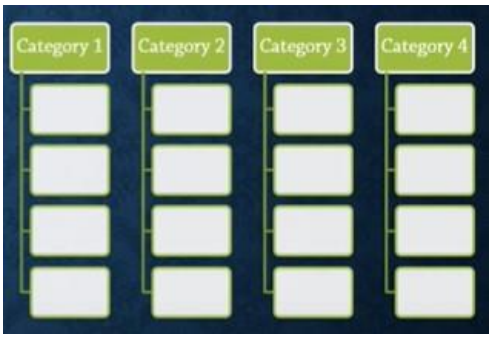


Figure 19: ASME B16.21

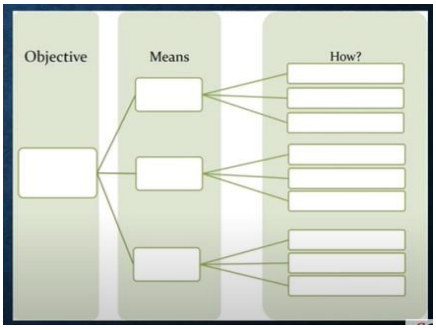
5.2. Quality Check Tools

7 New QC Tools:

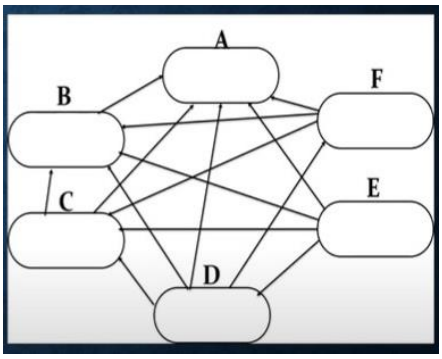
1. Affinity Diagram



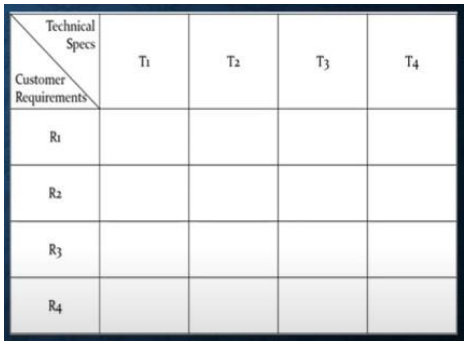
2. Tree Diagram



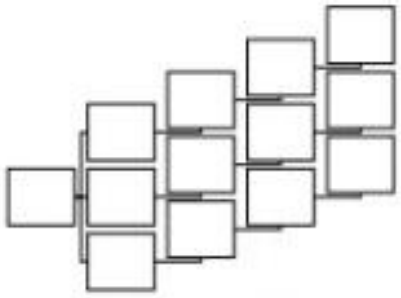
3. Interrelationship Diagram



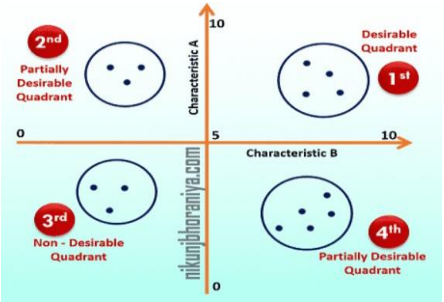
4. Matrix Diagram



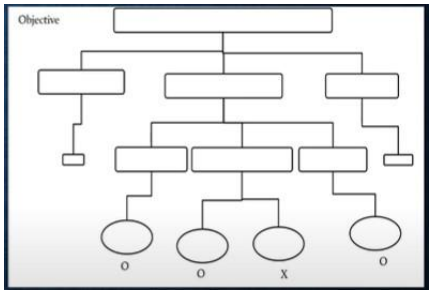
6. Arrow Diagram



6. Matrix Data Analysis



8. Process Decisions Program Chart



5.3 Excel JS

ExcelJS is a JavaScript library for reading, manipulating and writing spreadsheet data in XLSX format. It acts as an Excel workbook manager/

It is an extremely useful package which provides the following features:

- Creating workbook
- Creating worksheet
- Handling headers and footers
- Setting frozen or split views
- Setting auto filters
- Data manipulation on rows and columns
- Adding data validation
- Adding styles
- Inserting images to workbook

In addition, exceljs is frequently updated from time to time and available for free.

6.REFERENCES

http://www.starflex.net/

https://www.youtube.com/watch?v=MhfTBZhpBcI

https://theinvestorsbook.com/inventory-management.html

https://techqualitypedia.com/7-qc-tools/

PS-I session on Overview of QC tools

7. GLOSSARY

TaskCard

Purchase Order

Gasket

Inventory

Inventory Management System

Perpetual

Periodic

IRN Certificate

GRN (Good Receipt Note)

Invoice

Material Test Certificate