SRF We always find a better way

Digital Quality

Preparing for the New Era

J. Ravikant
Vice President and Head – Corp. TQM

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Presentation Outline

1. **Overview** of SRF and Businesses

2. **Experience sharing** - Digital Quality in the Value Chain

   Technical Textiles Business

3. **Experience sharing** – IoT and Warehouse Management

   Packaging Films Business

4. **Key Learning**

1. Overview of SRF

Company Overview

A chemical based multi-business manufacturing entity

- Established in 1970
- An Indian multinational

Operations

- 3 countries
- 15 manufacturing locations





- Revenue : ₹ 5,685 Cr (17-18)
- PAT : ₹ 462 Cr.
- Exports : > 75 countries
- Global workforce: 6300+

Deming Prize

2004: Tyre Cord Business

2012: Chemicals Business

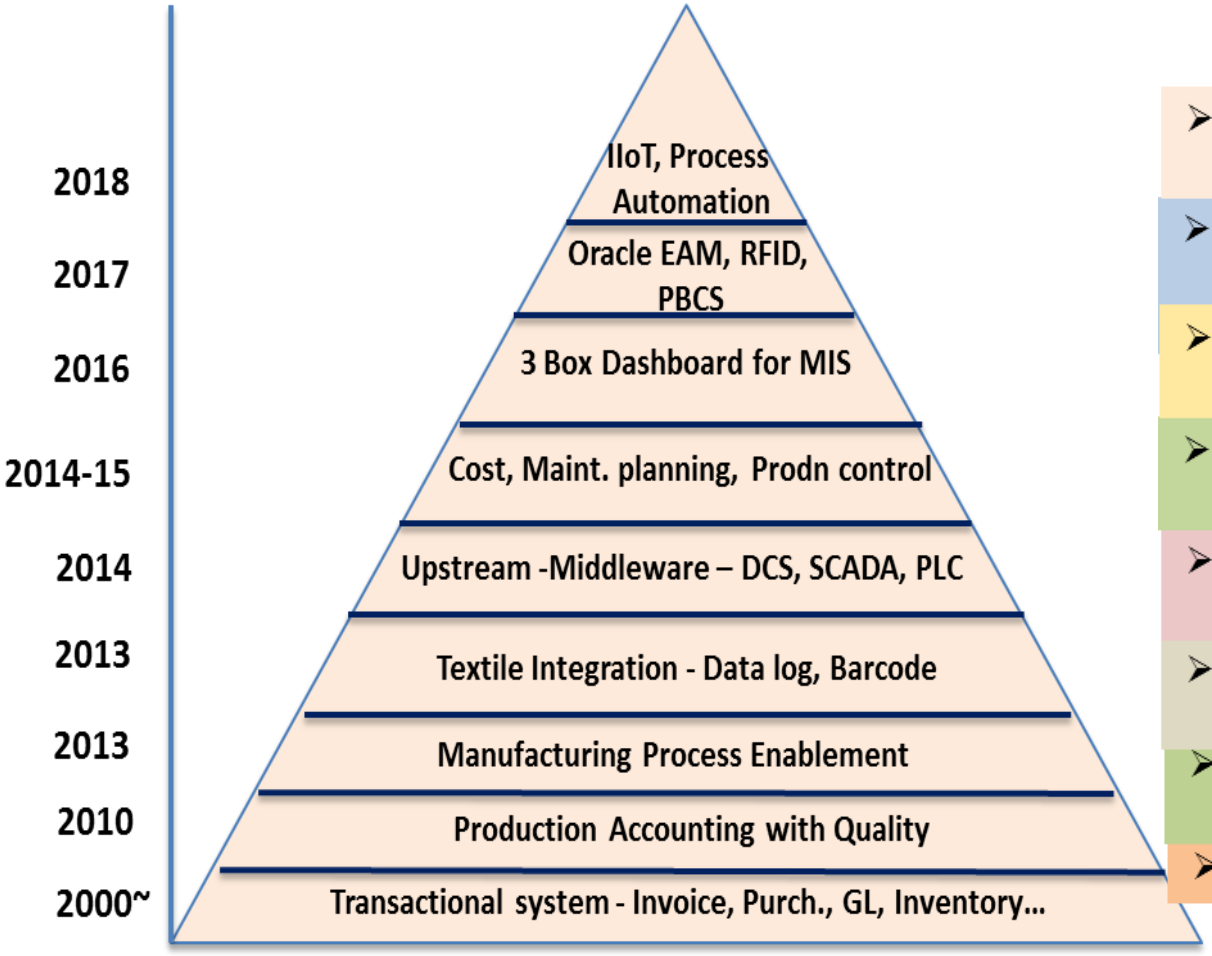
TQM adopted as management way (1991)

SRF Businesses

Business	Products	Market Position
Technical Textiles	Tyre Cord Fabrics: Nylon, Polyester	Global No. 2
	Belting Fabrics	Global No. 2
	Industrial Yarn, Twine	India No. 1 (FNT)
Fluorochemicals Specialty Chemicals	Refrigerants	India No. 1
	Solvents	India No. 2
	Specialty Chemicals	Global No. 1*
Chemicals Technology Group	R&D, design and pilot new technologies – 145 patents	
Packaging Films	BOPET Films	India No. 2
	BOPP Films	
Engineering Plastics Others	Nylon and other Engineering Plastics	India No. 1
	Coated & Lam. Fabrics	India No. 1, 2

2. Digital Quality in the Value Chain
Technical Textiles

Evolution of IT Systems in Technical Textiles Bus.



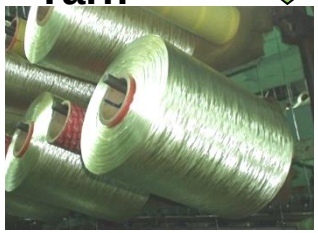
- Predictive analytics, problem solving using IoT, Automation using robots
- Budgeting and Planning System, Process
- Control Point Graphs
- Cost visibility and Production Control System – Transactional
- Poly, Spinning, Utilities control systems integration with online data, QA system
- Twisting, Weaving system – sensors, machine input
- Barcode (Yarn, Cord, GF, DF) Data log (Twisting, Weaving)
- OPM Accounting System Initiated

Commercial areas → **Production + Accounting** → **Mfg. flow, Dashboards** → **Product quality, QCD**

IT enables QCD in the Value Chain

Chips

Yarn



Griege Fabric

Dipped Fabric

Value Chain

DCS integration
- Q, productivity

Barcode
Q, Shopfloor traceability

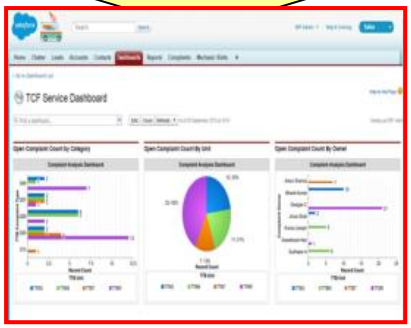
Data logger
Machine ŋ

RFID, IoT
Productivity, Accuracy, Analysis

Strengthen analysis, faster turnaround time on complaint resolution

3-Box: Dashboards

Customer facing



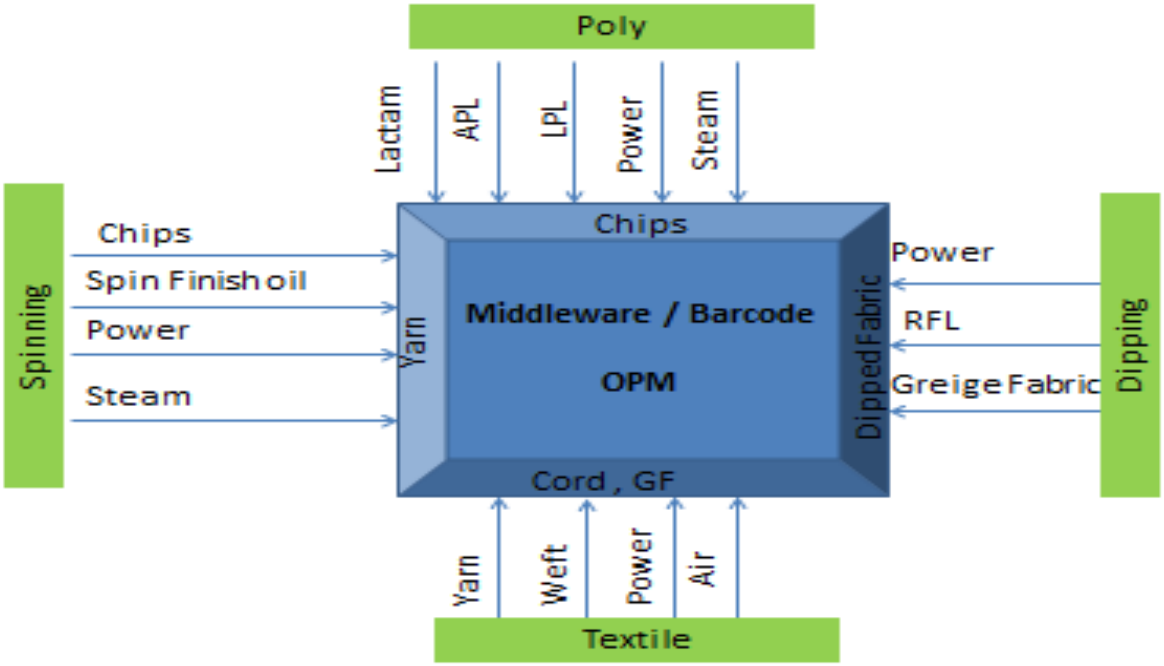
Customer portal
Complaints, Mobility apps
(Salesforce, Maint.…

Production Process Systems Integration with OPM

Using DCS, Datalog, Barcode

- **Purpose: Raise Quality levels, eliminate complaint phenomena, cost down**
  - Data and process integrity, Muda reduction, faster approvals for new products

- **Based on stage-gate based QA system Q0-Q13**
- **3-year phase-wise project (2012-15)**



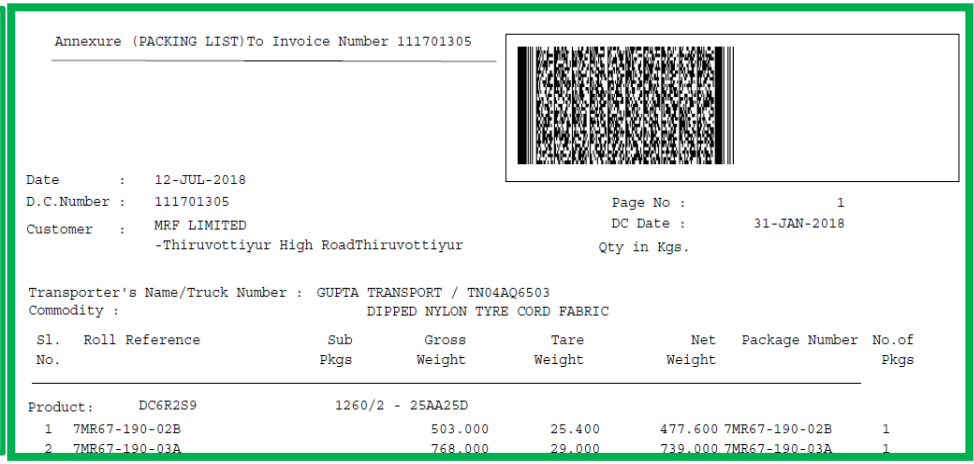
- **Involvement of Bus. Quality team in design: FMEA ++**
- **Product traceability : dipped cord ← batch of chips**
- **51% ROI annually (substandard reduction, textile efficiency)**

Building Product Traceability – Barcode + RFID

Final Product + In process barcodes

Needs:

- Each customer – unique product – Length of roll, Twist…
- High probability of operational errors, mix-ups
- Losses – Product Q, rework, consumption, tracking – lots of Muda



Annexure (PACKING LIST)To Invoice Number 111701305

Date : 12-JUL-2018
D.C.Number : 111701305
Customer : MRF LIMITED
-Thiruvottiyur High RoadThiruvottiyur

Page No : 1
DC Date : 31-JAN-2018
Qty in Kgs.

Transporter's Name/Truck Number : GUPTA TRANSPORT / TN04AQ6503
Commodity : DIPPED NYLON TYRE CORD FABRIC

Sl. No.	Roll Reference	Sub Pkgs	Gross Weight	Tare Weight	Net Weight	Package Number	No.of Pkgs
Product:	DC6R2S9	1260/2 - 25AA25D					
1	7MR67-190-02B		503.000	25.400	477.600	7MR67-190-02B	1
2	7MR67-190-03A		768.000	29.000	739.000	7MR67-190-03A	1

Operational Improvements

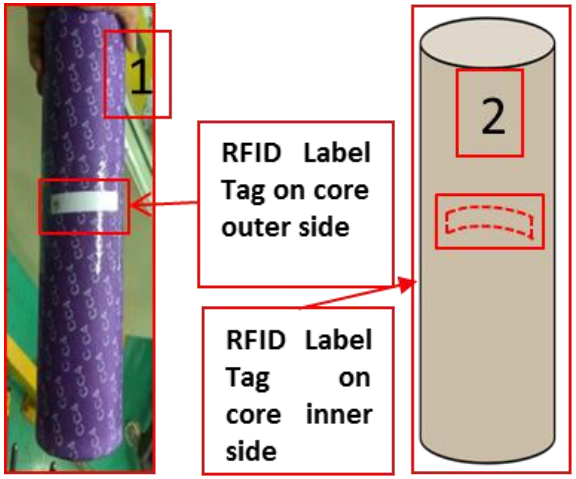
- FMEA on 42 possible human errors leading to Q issues (protocols for conditioning, rewound cheese trolleys)
- Barcode - Process Poka Yoke – assuring yarn and cord conditioning time
- Material traceability – FIFO based consumption, lot control at all stages
- Inclusion of lot details of customer supplied materials

Benefits

- Product quality, ↑ lower demerits
- Reduced manual errors
- FG stock taking time : 240→ 30 min
- Document preparation time (despatch) : 30→15 min
- Customer advocacy up

Building Product Traceability – Bar code + RFID

RFID tagging (Batch production)



RFID Tag in Paper tube

Core Spindle Mapping

Trolley Conditioning Validation

Key Information

- Yarn production
- Yarn, cord consumption
- WIP stock across process

Controls

- Eliminate Un-conditioned yarn trolley movement
- Trolley weighment with tag

Results

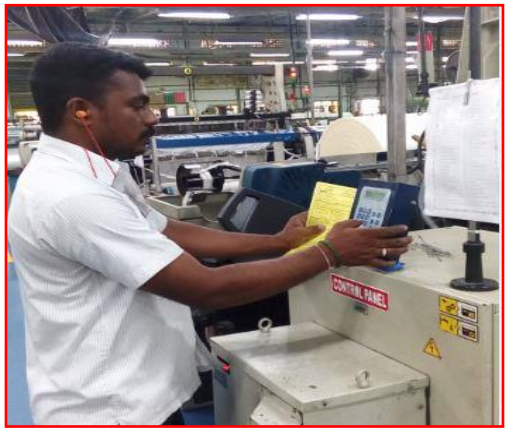
- **Tracking real time movement of trolley** lots from process to process and enhancing speed of delivery
- Reduced scanning time to weigh (Twisting) : 5 min→20s
- **Decrease in cheese scanning time 15 min→ 1min**
- **30% ROI**

Automating Production Data Handling - Textiles

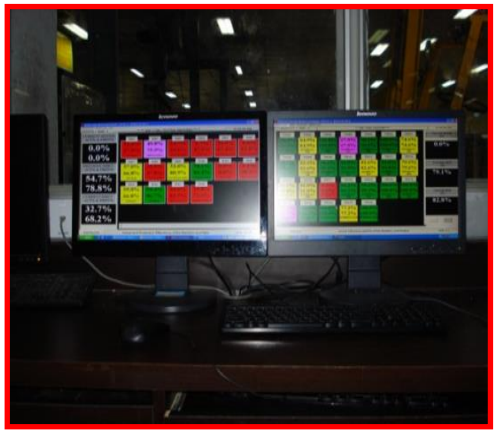
Implementing Data logging system – Unique design

Twisting Data Log Terminal

Warping Data Log Terminal



Weaving Data Log Terminal



Data Log Server Terminal

Key Information

- **Efficiency %, No of Breaks/Idle, Stoppage Report, Prodn Report.**
- Process parameters: Density, Speed, No. of Franz, Denier.
- Machine running status

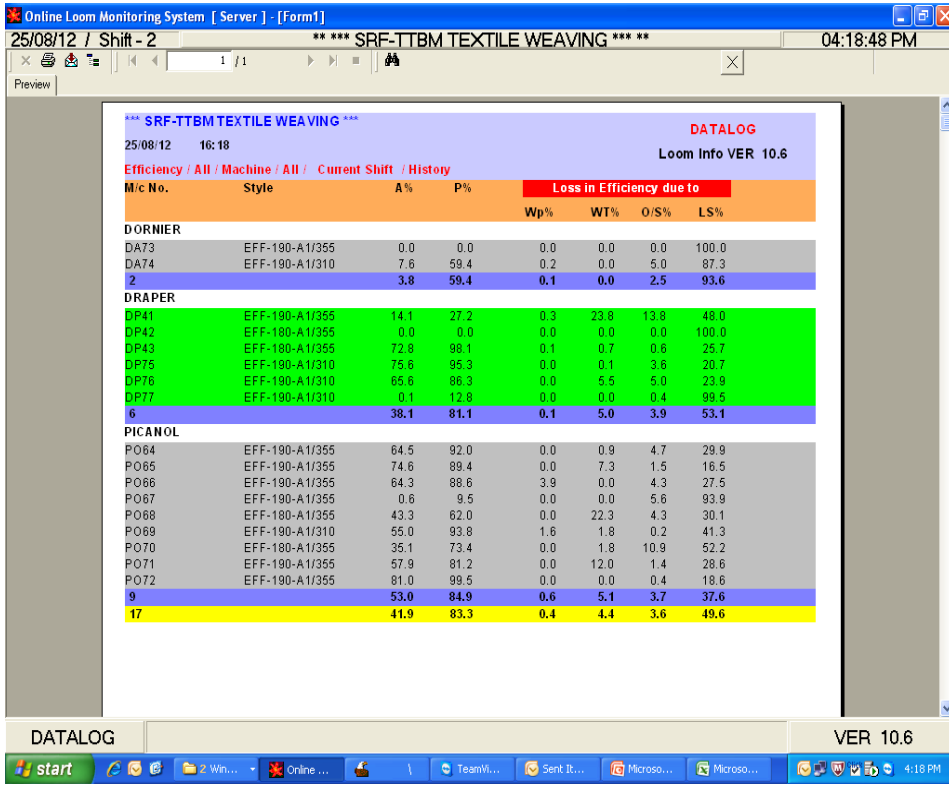
Controls

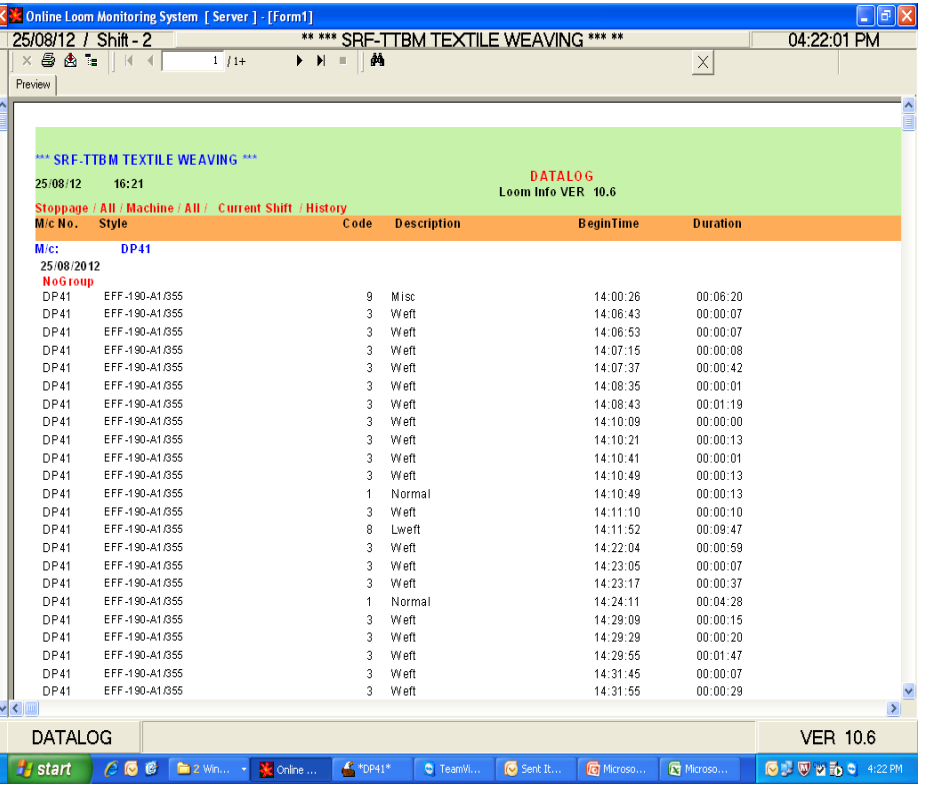
- **Data integrity → Product integrity**
- **Track Twister, Weaving, Operator efficiency.**
- **Stoppages - phenomena**
- **Tracking M/c setup time**

Improvements

- **Data extracted through machine signals without manual intervention.**
- Online information of running machines
- Reduced data collection time.
- Performance of Machines, Operators through mail alert and SMS.
- **Twister ŋ increasd from 60% →79%**

Analysis of Textile Plant data – Enabling DM





- **Loom, Style wise efficiency report by phenomena**

Adobe Acrobat Document

- **Machine wise stoppage report with phenomena**

Adobe Acrobat Document

Results - Twisting

Twisting Efficiency – 3 years

	15-16	16-17	17-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	YTD-17-18	YTD-18-19	Tgt-18-19
History	66.37	73.62	79.00	76.00	77.40	76.90	78.20	78.60	80.10	79.50	79.80	79.50	80.20	81.50	80.30			
Actual				81.60	83.20	81.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Target	74.50	84.67	84.00	84.00	84.00	84.00	84.00	84.00	84.00	85.00	85.00	85.00	85.00	85.00	85.00			
YTD																76.77	82.00	84.00

Information Assisted Equipment Management

Work Request Type	Today	MTD	YTD	Open Work Request (Nos)
Breakdown-Offline	0	28	28	14
Breakdown-Online	0	20	20	8
Condition Monitoring	0	7	7	7
Planned Shutdown	0	14	14	14
Process Routine Maintenance	0	1	1	1

Work Request Raised (No.)

Work Order Type	Today	MTD	YTD	Open Work Order (Nos)
Breakdown- Offline	0	50	50	21
Breakdown- Online	0	30	30	13
Condition Monitoring	0	1	1	0
Modification	0	2	2	0
Overhauling	0	2	2	1
PM Schedule Maintenance	0	12	12	4
Planned Shutdown	0	3	3	2

Work Order Created (No.)

Asset Number	Parent Asset	Department	Total Cost
MP & GR Inverter	MP & GR Inverter	INSTRUMENT	119089
Dornier Loom no. 15	Hole process under	TEXTILE	37873
Spg-2 Godet roller	Hole process under	ELECTRICAL	25043

Assets with High maintenance cost

Asset Number	Parent Asset	Department	Total Breakdown (HRS)
POLY LINE- C IN POLYMERISATION PLANT (POLY LINE-C)	POLY LINE- C IN POLYMERISATION PLANT (POLY LINE-C)	POLY	1320.01
1ST POLYMERISER PUMP (P-5317 C)	1ST POLYMERISER PUMP (P-5317 C)	POLY	385.05
CHIP CUTTER (M-5338 E)	CHIP CUTTER (M-5338 E)	POLY	45

Equipment Break Down in Hrs

Manual system 2002 integrates AM, PM, CBM, Spares mgmt.

Key Information

- Tracking break down hrs.
- PM Alerts
- Historical data
- Why-Why Analysis
- Calibration records

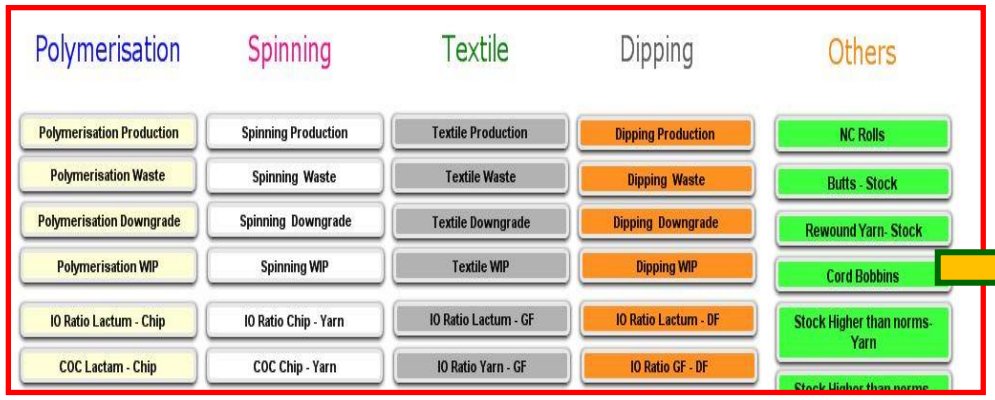
Controls

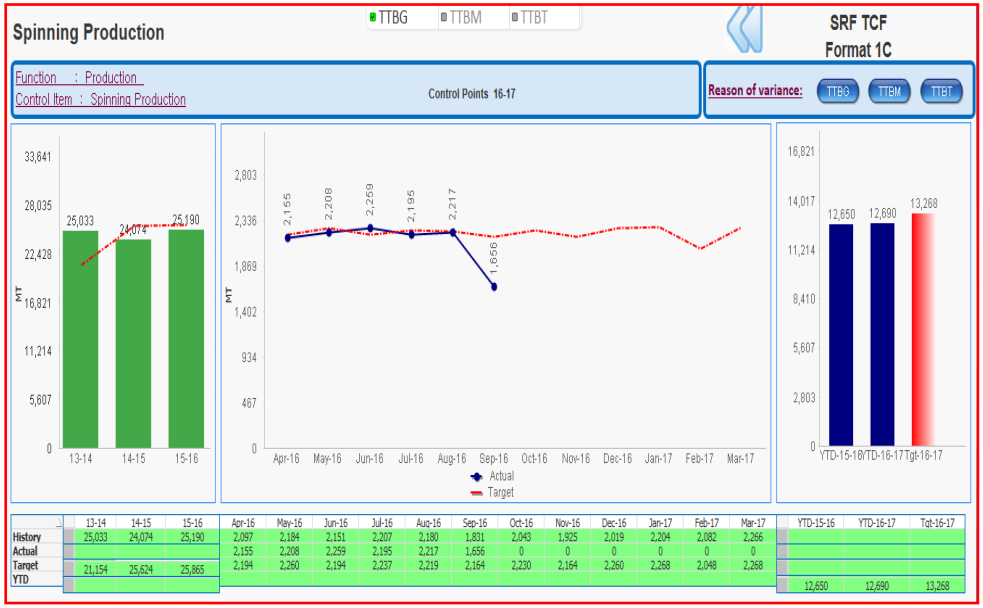
- Compliance with statutes
- E-Mail and SMS Alert

Results

- Reduction in inventory spares Working Capital
- Machine & work order level maintenance from mobile
- Maint. expense tracking
- 100% PM on time

Automating Management Reporting – 3 Box Format





Problems

- **Many deviations from standard (CP manual – 2000, 2006)**
- Graph and monthly report updation time consuming

Key Information

- **Process wise key data like Production, Waste, I/O, COC**
- History data, same period data
- Factors for variance identified

Controls

- **Source data populated from Oracle**
- **No manual intervention → Data integrity**
- **Revising standard format** for each control point and definitions

Benefits

- **Reduction in MIS preparation lead time from 7 to 2 days.**
- On line availability.

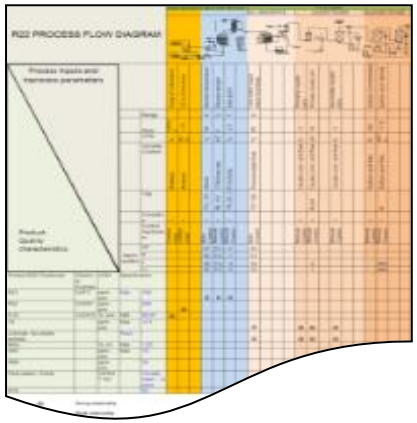
All management reviews happen through Dashboard

3. IoT and Warehouse Management

Packaging Films

Leveraging IoT - Improving Product Quality

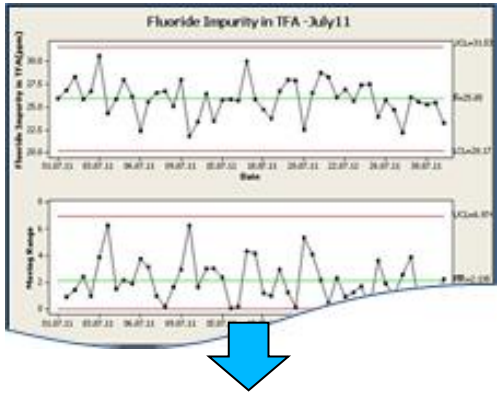
Quality Tables
Product quality characteristics Vs. Process parameters



QCPC
Key parameters, abnormality and actions

Control Charts

- **Final and intermediate product characteristics**
- **Resultant process parameters**



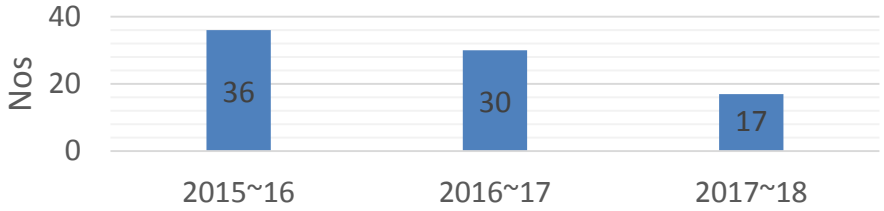
- **Choice of right "RPPs" or variables**
- **"Variables" data rather than yes/no outcomes for analysis**
- **Sensors, algorithms**

Applying IoT - Improving Winding Quality

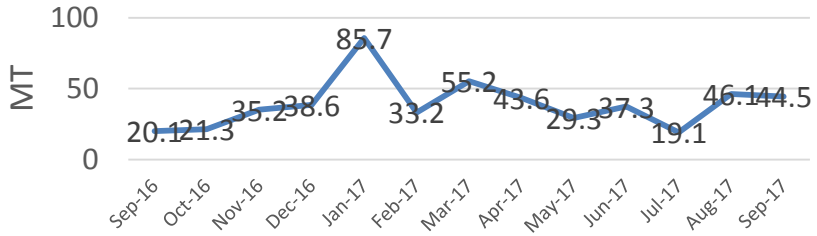
Improve roll appearance and winding quality (Packaging fllms)

Primary Slitter

Customer Complaints



Downgradation



Insufficient data for analysis

Only instantaneous data can be logged in log books manually

Objectives

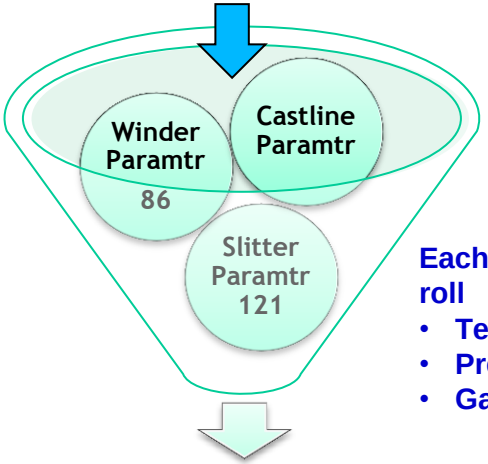
1. **Machine data (parameters) from Winder, Primary Slitter through server**
2. **Analyse data using Data Analytics Platform**
3. **Pinpoint events leading to winding defects**
4. **Troubleshoot using IOT platform**

Applying IoT - Improving Winding Quality

Improve roll appearance and winding quality (Packaging fllms)

Manual analysis and correlation all parameters impossible

Continuous data collection



Each arm, roll

- **Tension**
- **Pressure**
- **Gauge**

...

...

Pr. Slitter

Tension, Pressure profiles chosen

High Level Analysis for Side 1 - Faults

Fault	(Multiple Items)
Row Labels	Count of Fault
Arm 2	27
Arm 3	11
Arm 4	7
Arm 5	5
Arm 6	7
Grand Total	57

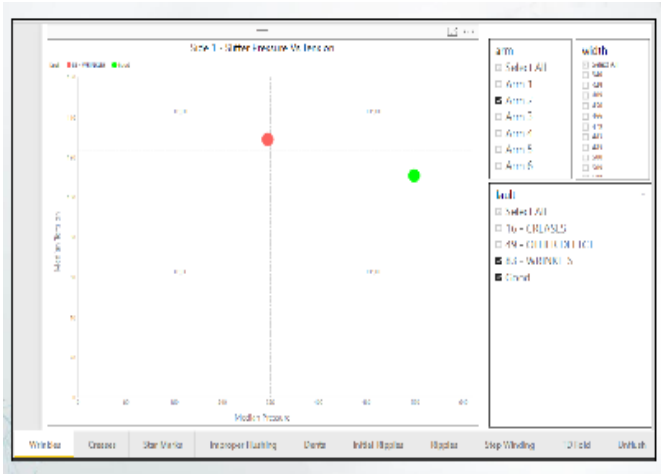
Row Labels	Count of Fault
83 - WRINKLES	18
67 - STAR MARKS	9
16 - CREASES	7
78 - UNFLUSH	5
70 - TD FOLD	5
71 - TELESCOPIC WINDING	3
53 - RIPPLES	3
17 - DENTS	2
69 - STEP WINDING	2

Row Labels	Count of Fault
83 - WRINKLES	9
16 - CREASES	5
67 - STAR MARKS	4
34 - IMPROPER FLUSHING	2
78 - UNFLUSH	2
69 - STEP WINDING	1
17 - DENTS	1
70 - TD FOLD	1
53 - RIPPLES	1
35 - INITIAL RIPPLES	1
Grand Total	27

- **Maximum faults reported on Arm 2**
- **Maximum faults reported on WRINKLES fault type on Arm 2**

Fault	(Multiple Items)
Arm	Arm 2
Row Labels	Count of Fault
999	5
808	2
719	2
2050	1
1231	1
1025	1
819	1
1660	1
849	1
760	1
899	1
1046	1
940	1
1419	1
945	1
1749	1
979	1
	1
	1
	1
	1
Grand Total	27

Classify faults → Arm, Width, Fault type



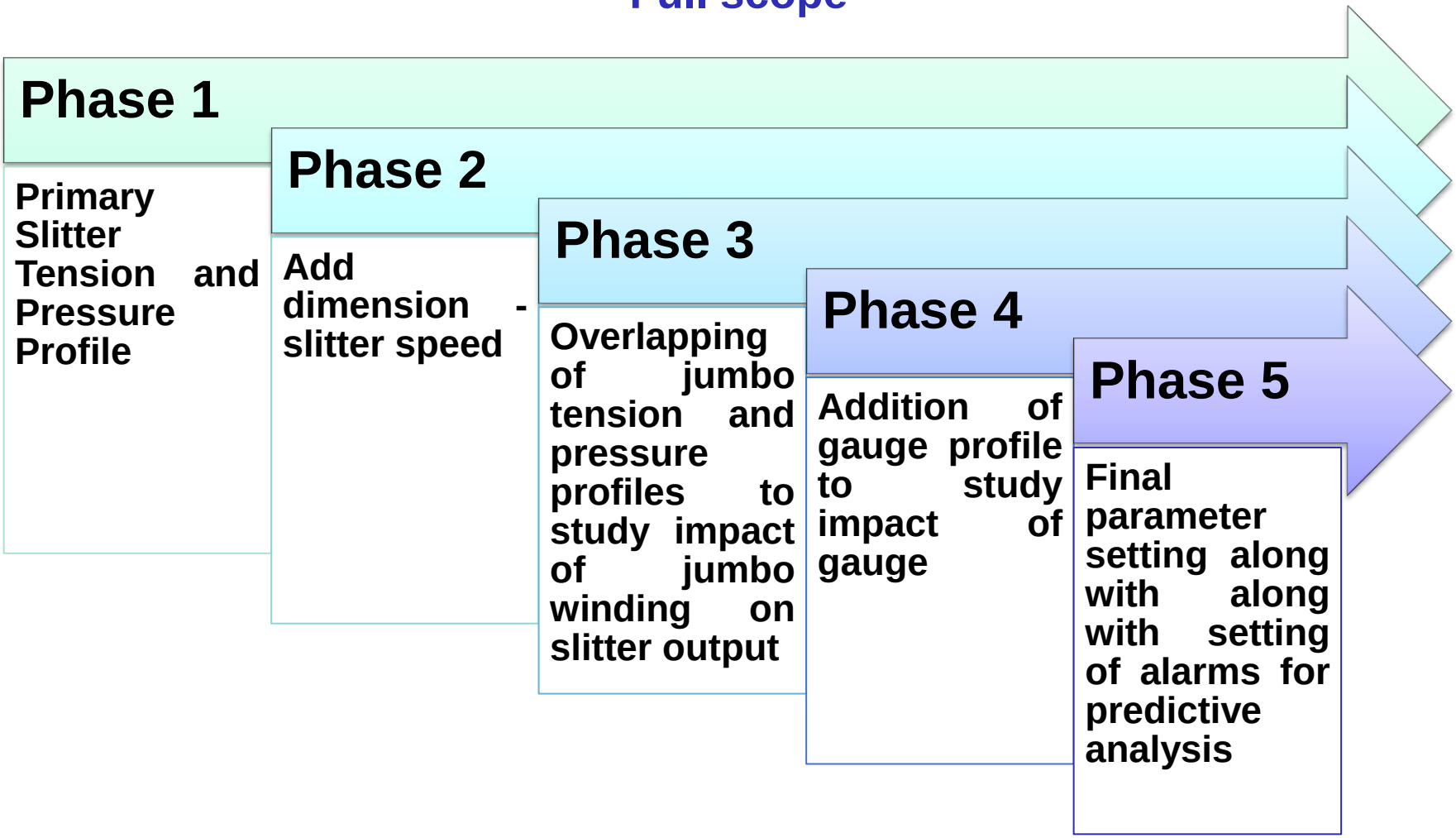
Predictive analysis

- **Pressure Vs Tension (median readings) plotted against good and bad batches (defets)**
- **shows significant differences in values of machine settings)**

Optimised parameters for reducing defect levels

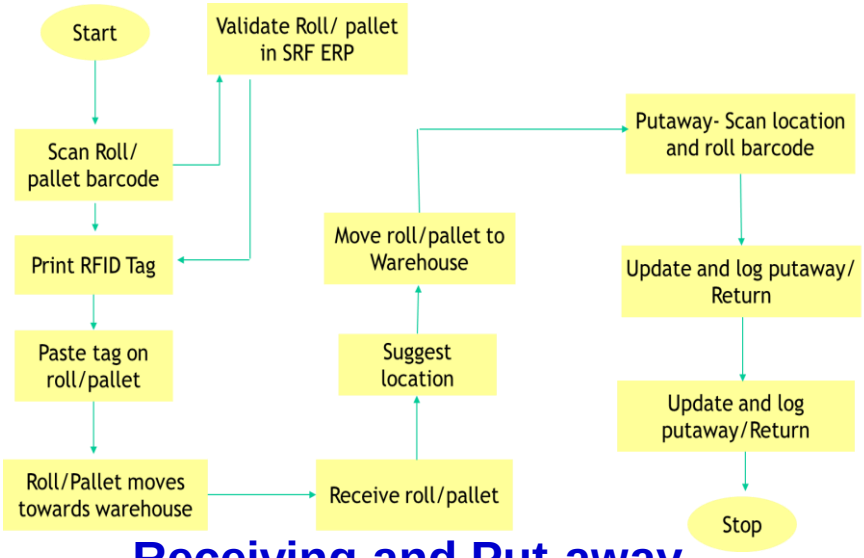
Applying IoT - Improving Winding Quality

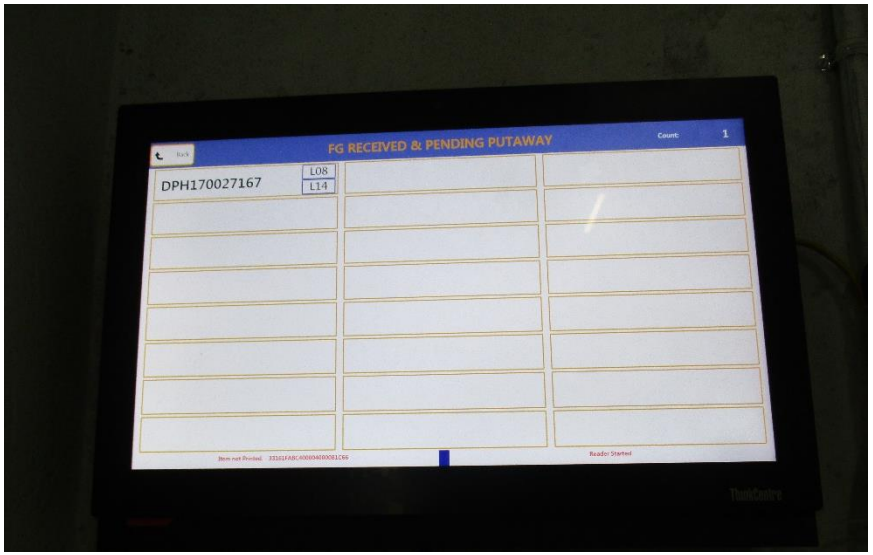
Full scope



Warehouse Management System – IT enabling

Semi-automated system using bar codes and RFIDs

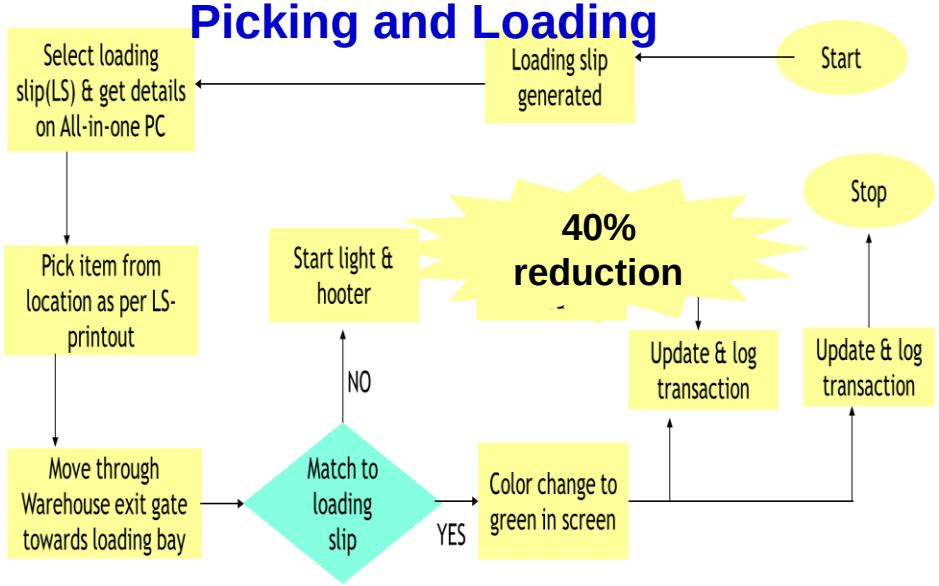


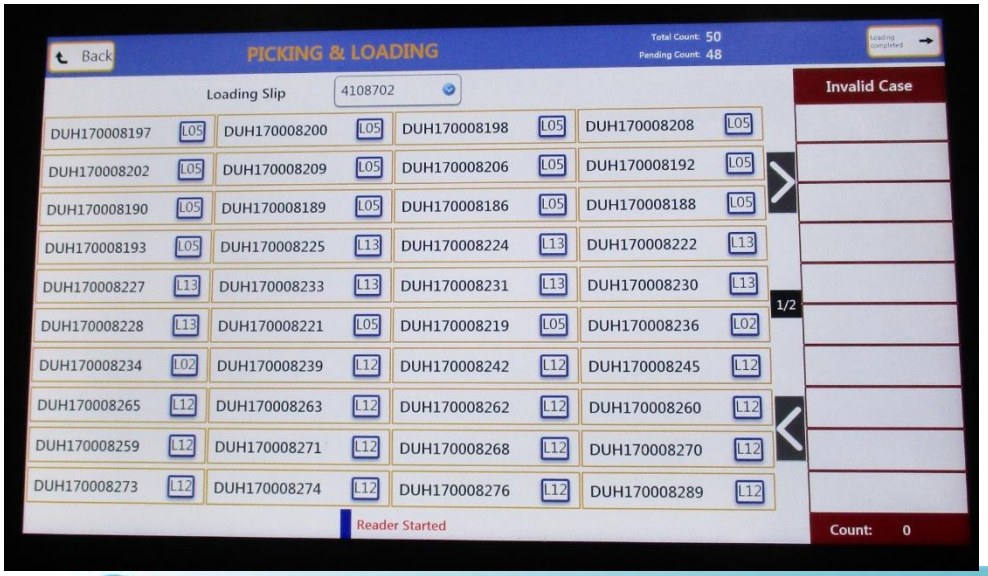


Receiving and Put-away

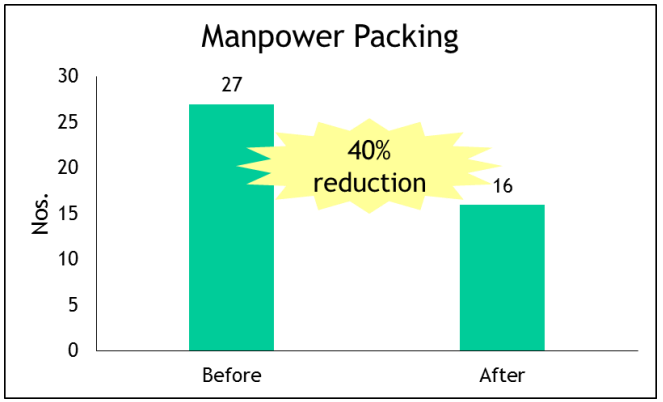
Warehouse Management System – IT enabling

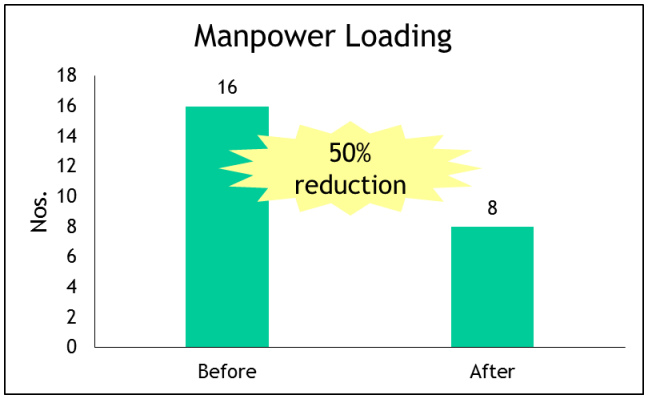
Picking and Loading

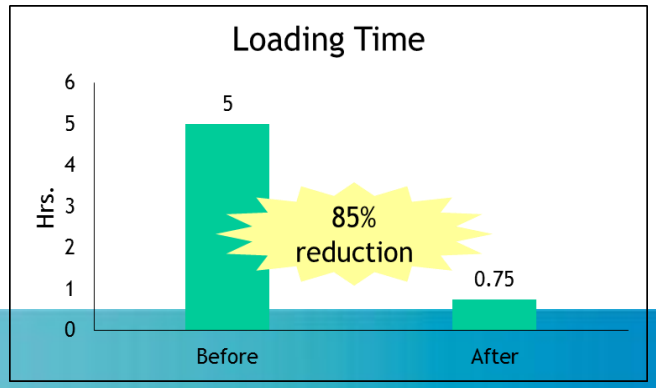




Results







Warehouse Management System – IT enabling

Results

- Human Error Prevention in Loading
- Reduction in Physical Verification time from 1 day to 15 mins.
- Reduction in human effort (Elimination of manual movement of pallet trolley)

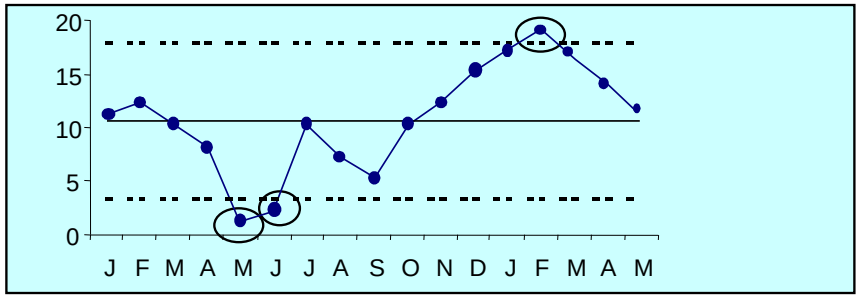
Further work

- Full automation of packing process
- Automation of invoicing process
- Horizontal deployment in progress at other units

4. Key learning

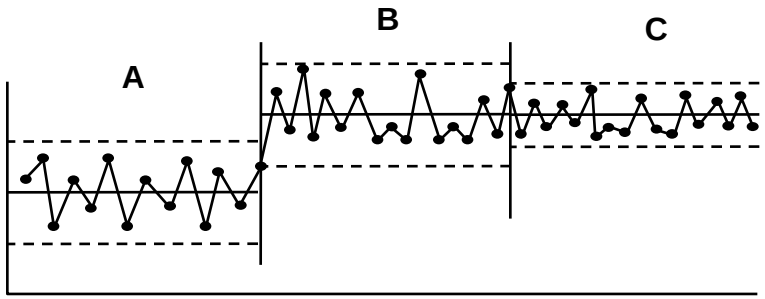
First Standardize, then Digitize

A. Instability removal



VS

B. Improvements in Q,C,D



- **Distinguish between maintenance and improvement activity**
- **Remove abnormalities in processes first!**

(cannot improve unstable processes)!

Learning: Digitization before standardizing will often yield sub-optimal gains, at high cost!

Process Control (and IoT) – Control Chart Troubles

Choice of Characteristic	• Lagging rather than leading indicators • Operational definition dubious
Control Chart preparation	• Plotting "knobs" (regulated directly) • Specification lines • "Warning Limits" used - tampering • Outdated limits • "Homogenizing" data by removing abnormal points
Control Chart usage	• Chart made, but nobody looks at it • Calculate Cpk, Ppk…from software, to give to customers – some of whom too don't understand this • New chart started each month • Runs ignored

Nothing is done more wrongly than control charts

Learning: First learn the correct way, then automate control charts

Choose characteristics for IoT carefully, in stages

Key Takeaways

Preparation for digitisation	• Grasp problems clearly (why digitize?) (technology is the *means*, not the goal) • Plan to handle obsolescence in equipment – in collecting process data • Educate thoroughly on basics – data, PDCA
Maturity and speed of digitization	• Process knowledge is critical to digitization • Strength of existing systems creates a strong backbone • Integrating the full value chain is key, piece-meal approach is sub-optimal • Possible to accelerate but not skip steps • Creating pilots first to experiment → design for scalability • Collecting too much data is Muda! Expensive too. Choose carefully, phase-wise approach • Use FMEA, PDPC, Pugh Matrix ++ in all IT enablement

Digital quality is a journey, not a destination

Skills for the Digital Era

Immersion in pilot projects

Complex problems VUCA!

Design Abilities

Synthesis skills (New)
Systems thinking
Solutioning skills

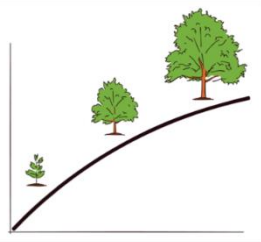
Data science Skills

Regression ++
Tools – R ....
Forecasting
Modeling
…

Problem Solving skills

Observation
Diagnosis

Old tools!



Organizational Capability

Mindset based on quality

Focus on fundamentals

Thank You