

Business Process Automation for Process, Productivity, Quality & Marketing Optimization at TNPL Board Machine Finishing House.



S.Nandagopal



V.Thirupathy



P.Prince Tholkappian



S.Senthil

SUMMARY:

While the Paper industry focuses more of Automation in the Paper Machines, seldom they realize that finishing processes make significant contribution to the overall quality of the product and the productivity of the Mill. TNPL, therefore, besides its latest state-of-the art Board Machine, conceptualized and established a state-of-art facilities for its Conversion, Finishing, Packing and despatch of reels & sheets with the latest automation technologies and Intelligent Warehouse management.

This paper gives all the details and strategies adopted in equipment automation from Winder to truck despatch and reveals how automation is becoming a determining factor for increased productivity, improved quality and consistency of process with ERP interface for intelligent product sales and marketing optimization. The paper emphasizes the extent of customized automation features enabled TNPL to achieve On time delivery (OTD) and On time Delivery in full (OTIF) for about 13000 possible combination of SKU's from the 600 TPD of Board machine production with diversified paper board grades manufacturing capabilities.

Keywords: Automation technologies, ERP interface, Barcode, Delivered Quality, Productivity, Equipment, PLC, Traceability, Knowledge management, IOT, Capital cost

1. Introduction

Within the last few decades, technology has changed the nature of manufacturing of paper and paper board. In olden days, conversion and finishing house operations were mostly manual or with semi-automatic machines. Now that computers and technology have penetrated the paper industry, automation has become the competitive advantage in today's manufacturing world. Automation has allowed mills to produce, convert and despatch large volumes of paper board products at higher speeds and with great repeatability and quality. Automation has become a determining factor in whether or not a company will remain competitive within the manufacturing or process industry.

Often many Paper mills, focus more on implementing modern technology for the main Paper/Board machine during their green/brown field expansion and seldom prioritize for a modern Finishing house. Finishing house for a paper/board machine do so much for so little. Comparing to the size and speed of

the paper machine, the converting and finishing equipment are much smaller and slower. Finishing processes are closer to the end user. They are the last steps in the sequence of Board manufacturing and despatch processes, but can add value to the product at very low cost that determine the product life cycle and salability in the market. Optimized work flow, speed of processing with accuracy, low wastage and less human involvement for better productivity (output/input) will determine the Effectiveness of Automation in Conversion and sheet finishing equipment for any Paper/Board machines.

Visualizing the huge potential, TNPL, proactively taken steps during Board machine Project phase, by conceptualizing and implementing a Business Process automation (BPA) model to establish a modern finishing house within the Board Machine complex to achieve the following key objectives:

- Ensure safety
- Select the state of the art equipment

- Industrial automation with latest automated technologies
- Interface to Enterprise resource planning (ERP) & Management information system (MIS).
- Product traceability
- Layout with less foot print
- Efficient operation and maintenance
- Intelligent Ware house and its management eliminating manual storage and retrieval.
- Productivity at work and delivered quality of the finished goods.
- Avoiding satellite conversion centers near the customer end.

The mill project team have successfully established a modern finishing house in 2016 for its 600 tpd board machine to enhance its agility and productivity. The modern finishing house has automation and control solutions for Consistent process with improvement in delivered Quality and Productivity. Automation

enabled to interface with ERP - MIS networks, to get closer to the information, on the machine, where the decisions need to be made.

1.1 Benefits of ERP interface and Automation

A) Customer requirement is taken care from Dealer portal (Order punching) to

despatch.

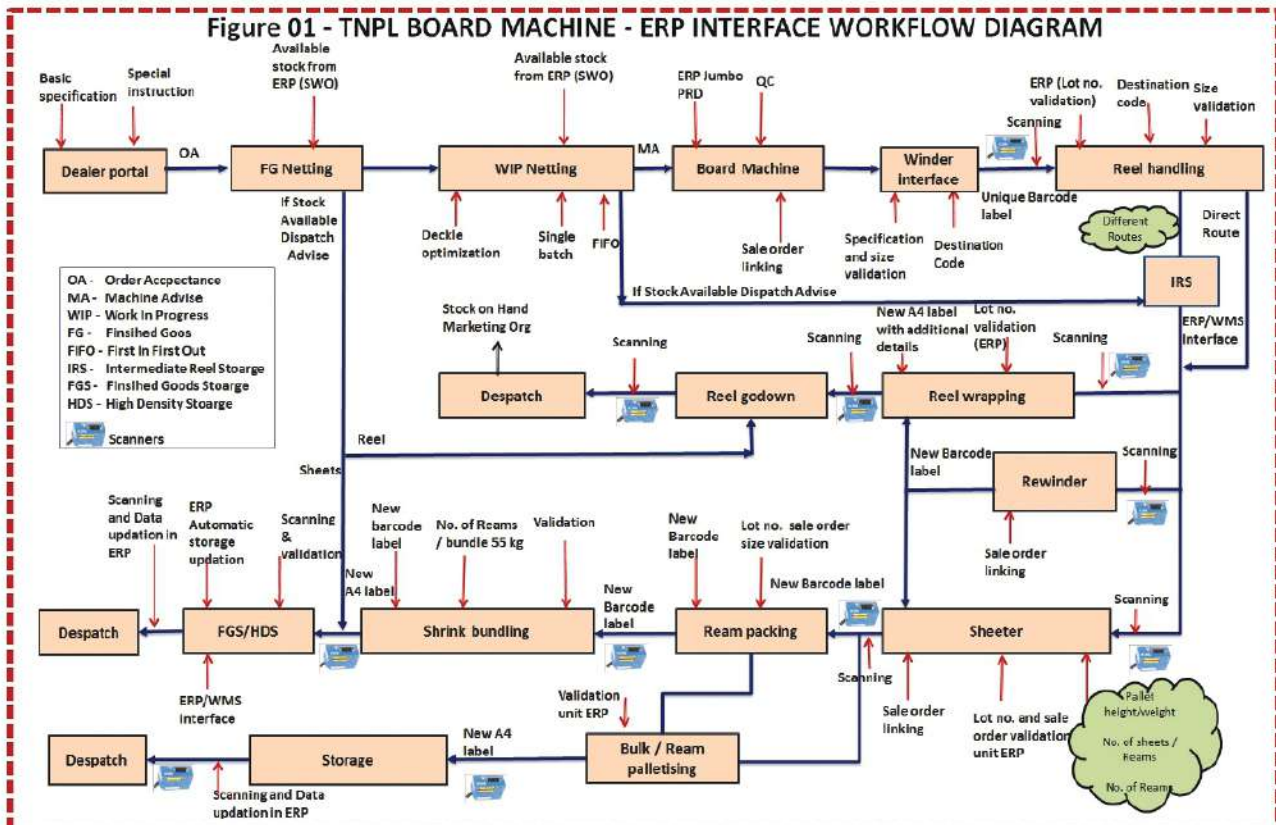
B) Facility to track the status of the sale order at any stage

C) Complete tracking ensures that the customer gets the right product with right quality at right time.

D) Faster service(OTD)

This paper will briefly describe the automation journey from “Sale order receipt to Conversion and Despatch”. The sale order processing starts from Mill conversion at Winder, processed at Sheeters and Packing machines and despatched from automated Ware house.

An illustrative master work flow and networking diagram is given below:



2.0 SALE ORDER TRACKING WITH AUTOMATION & ERP INTERFACE:

Whenever a Sales Order is placed at the Dealer Portal, all basic information, specifications and special instructions demanded by the customer are captured in the computer network and a Sale Order number is allotted. Then the Sale order details are consolidated and automatic netting of finished goods (FG) stock is done. After FG netting, automatic netting of Work in progress (WIP) stock is done. After FG and WIP netting, Machine advice (MA) is generated for Winder, for the balance quantity. The Board machine determines the production grades and quantity based on the order flow. So the buffer inventory stock is fully reviewed and retrieved on First In First out (FIFO) basis and the stock out items are only

produced. Sale Order Tracking (Winder to FG despatch) is available as sale order linking and scanning of product at every stage is done using unique barcoding system.

3.0 AUTOMATION AT WINDER

Once a Jumbo produced from board machine, the actual weight of the jumbo are transferred to ERP using PLC. After capturing actual weight, jumbo barcode number will be created in ERP. In this jumbo barcode number, Machine No, Jumbo no, Year, date and month will be available. The jumbo number in the PLC and ERP will be same. The Board machine break signals are given to ERP from PLC. This will calculate Jumbo downtime. The High speed Winder is designed to follow the Board machine production.

Board machine production with several grade changes has an impact on winder operation and Board Machine productivity. So the need for winder automation is essential to enable the Conversion operations more productive to meet the following challenges:

- Utmost reliability
- Good runnability
- High quality rolls
- Reliability

The level of automation at Winder are limited to the purpose of improving the production, maintenance efficiency and ensure good roll performance at the printing house or converting plant. The benefits are

3.1 Productivity:

- Automatic slitter positioning, Automatic set change, Automatic core feeding and Automatic gluing completely eliminates manual intervention in winder and reduces the set change time, thereby productivity is improved. The set change time is 75 seconds and it is possible to produce 92 sets per shift.
- Double sensors, absolute encoders and Tempsonic Linear sensor with Profinet Connectivity are used to get high accuracy positioning.
- Automatic set change based on length counter and diameter avoids excess production and finishing loss in sheeters.
- Hot melt gluing system is used for automatic gluing which is eliminating usage of double side tapes.

3.2 Delivered Quality

- Automatic slitter positioning using Tempsonic linear sensor with profinet connectivity ensures exact size. Tension control, speed curve, drum load sharing and Choice of rider roll loading curves ensures winding quality. Shrinkage factoring and automatic core positioning helps to avoid core projection. For important measurements absolute encoder are used for positioning with high Accuracy.
- Integration with mill ERP and a dedicated module for QC ensures that customer gets the exact quality specified by them in the dealer portal. Additional remarks can be added which helps in further processing

- Destination code helps in further conversion process of the reels and selection of route.

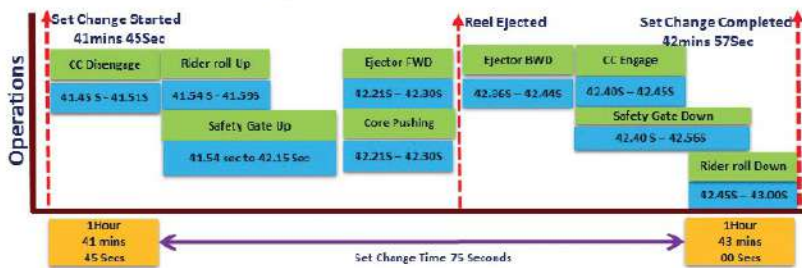
3.5 Customer Benefits from Automation at Winder:

- Quality winding without telescopic edges, no uneven winding/ earrings and no core projection
- Clean cut quality
- No dust /fluff and marks
- Accurate size and weight

4.0 AUTOMATION AT REEL HANDLING SYSTEM

The reel handling system is fully automated using PLC and ERP. Automatic route selection from ERP data base will reach PLC based on Bar code labels information. The latest PLC and ERP are integrated with handshaking mode. The conveyor PLC will send data to ERP only after the reel reaches the scanning conveyor. The PLC will initiate the communication to ERP, In case of no reels, to ensure the communication Keep alive message (K1) are sent to ERP and reply will be received from ERP Keep alive message as K2. The auto calibration methodology will help to reduce down time. Each operational

Figure 02 – Winder Set Time



3.3 Safety and trouble shooting

- Automation with position sensors, Safety light barriers and control ensures absolute safety for men and machine. Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated. The manual operations are also permitted after satisfying the basic interlocks.

traceability of the product from production to despatch and status of the sale order can be given to the customer through Dealer portal.

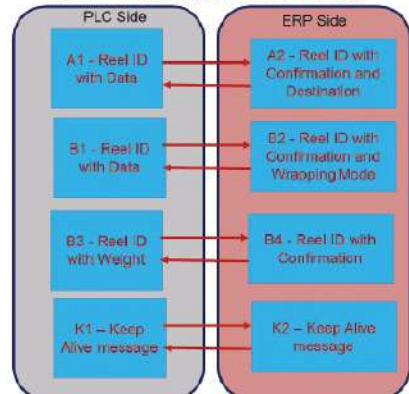
- A unique barcoding system also helps in Traceability and provides information for further processing till despatch and avoids mix-up. The jumbo barcode system contains Machine No, Jumbo no, Year, month. Additional information like Winder no, Set No, Reel No and Destination of the reels are added to the winder output reels barcode.

3.4 Interfacing with mill ERP

- Interfacing with mill ERP for Sale order, linking paves way for complete



Figure 06 – PLC ERP Interface Data Exchange



sequence is displayed in HMI, this helps the maintenance team to find out which step or sensors have problems.

Multiple routes are available which increases the flexibility and avoids reel jamming in winder area

- All reels for further processing at finishing house can be stored in Intermediate reel storage system (IRS) with an optional feature for stretch wrapping for packing reels.
- Packing reels can also be taken directly to the Wrapping machine
- Sheeting reels can be also taken directly to sheeters
- Sheeting and packing reels can be also retrieved from the automated storage system that can deliver the reels in front of that sheeter with ERP interface.

Advantages

- Optimization of cost by eliminating stretch film for sheeter reels (Automatically selected from destination code)
- Floor jamming in front of winder can be avoided.
- Correct and timely delivery of reels at the exact location

4.1 Productivity

- Automatic scanning and selection of route avoids manual intervention and delay time and improves the reel handling capacity. In an hour 45 packing reels and 15 sheeter reels can be handled.

- After changing encoders and sensors or power restarts, calibrations are required, here this will be done automatically. Concerned equipment needs to be operated from one end to next end, the calibration will be done automatically and important encoders/measurements are initialized for each cycle operations, this will ensure the accuracy of the movements.

- Trouble shooting will be easier because of the Error code displays using latest HMIs.

4.2 Delivered Quality

- The width and Diameter is measured and it will be cross checked with ERP automatically, thus avoiding mix-up.
- Online weighing station provides actual weight.
- Reel transportation using slat conveyors (No fork lifts) avoids reel damage.

4.3 Safety and trouble shooting

- Safety of the machine is achieved with two sensors methodology. Slower sensor and stopping sensor. In case encoders are used, additional sensor is used for safety purpose. Additional to the safety sensors, mechanical stoppers are provided.
- Where ever critical, two sensors or two measurements are used to ensure safety.
- To ensure man safety, in high speed moving machinery areas, safety curtains or safety barriers are used.

- The manual operations will also be permitted after satisfying the basic interlocks.

- Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated.

4.4 Interfacing with mill ERP

- A unique barcoding system also helps in Traceability and provides information for further processing till despatch and avoids mix-up.
- Laser printing on the reel helps in reel identification even if the barcode labels are missed

4.5 Customer benefits from Reel handling system

- Minimum physical handling so product hygiene is maintained and no reel damages
- Choice of either Kraft or Film wrapping

5.0 AUTOMATED INTERMEDIATE REEL STORAGE (IRS)

Practice of manual clamp truck operated warehouse was never an idea for TNPL for its modern finishing house as handling / storing / retrieval of the rolls by manual mode will increase the finishing loss due to surface damage. Given the board machine production capacity of 2 Lakh MT per annum comprising of 12 board grade varieties, 20 gsms/variety and about 60 gsms/variety, the mill strongly believed in establishing an automated intermediate reel storage (IRS) with multitude of Stock keeping units (SKU).

The automated ware house is installed with robotic stacker cranes to take production reels in 24/7 in random order as it comes from production, and to accurately identify the stored rolls and retrieve it as and when the specific reels are required for conversion on FIFO basis on demand. The need to respond to customer orders within days instead of weeks is very paramount in this competitive board industry.

IRS is controlled by PLC based Warehouse Management System (WMS) through intranet with two bidirectional conveyors for infeed and outfeed reels , infeed transfer car and two stacker cranes with steel racks and the building is rack supported without any concrete structures. The cranes are positioned using laser distance and additional encoders. IRS has 1272 bins. Each bin

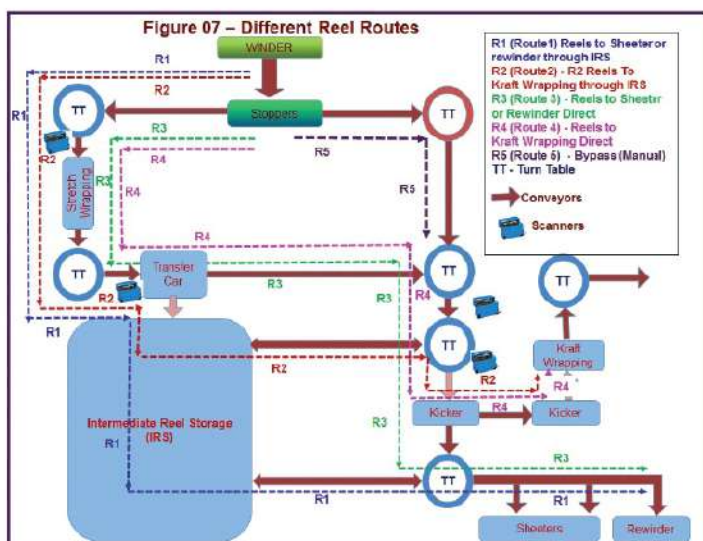


Figure 08 – IRS (INTERMEDIATE REEL STORAGE)



has the reflecting mirror for positioning. For stacker crane reaching particular bin, floating methodology is used. The Crane and fork movements are ensured by two measurements, which will ensure the precision positioning of the crane and crane safety.

5.1 Productivity

- Automatic storage and retrieval for handling 12000 SKU with a capacity to store 30000 T in an area of 4000 sq.mtr. (Conventional storage will require huge floor space besides a much less storage & retrieval rate. Further losses due to multiple handling will be more).
- Storage and retrieval based on SKU, Variety, Age, sale order at the rate of 15 Reels per hour and 15 reels per hour delivery for sheeter and 45 reels per hour delivery for reel wrapping machine.
- First In and First Out.
- Less foot print - Space saving due to vertical storage
- No handling loss, no stretch film

5.2 Derived Quality

- Storage in racks inside a self-supported building and using crane (No fork lift

movement) helps in retaining the reel condition even without stretch film wrapping.

5.3 Safety and trouble shooting

- Completely automated and manpower is not required inside the storage area, infeed and outfeed area.
- Protected with dry fire sprinklers sensitive to heat.
- Safety of the machine is achieved with two sensors methodology. Slower sensor and stopping sensor. In case encoders are used, additional sensor is used for safety purpose. Additional to the safety sensors, mechanical stoppers are provided.
- Where ever critical, two sensors or two measurements are used to ensure safety.
- To ensure man safety, in high speed moving machinery areas safety curtains or safety barriers are used.
- Automation with position sensors and control ensures absolute safety for men and machine. Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated.

5.4 Interfacing with mill ERP

- Unique barcoding system and scanning avoids mix-up and provides traceability
- Automatic report generation (Stock on hand, variety wise, Age wise, Fast moving, slow moving)
- Advantage of intelligent WMS

5.5 Customer benefits from IRS

- High level of protection from light and heat inside the IRS and FGS which add to the product quality in terms of sheet flatness, shade stability and Reel stability till the core end
- Biggest automated storage facility in India to store 30000 T which helps in OTD to the customer
- Possibility to hold inventory for better and faster service on pan India basis

Based on the destination from ERP, reels will transferred automatically to wrapping section or sheet cutter. Once the reel reach wrapping conveying system, initially it will measure the diameter and width of the reels. Online scanner connected to PLC will scan the reel and send Barcode along with Diameter and width. ERP will check whether the reels are approved by QC. Once the confirmation from ERP is received by PLC, it will process the reels.

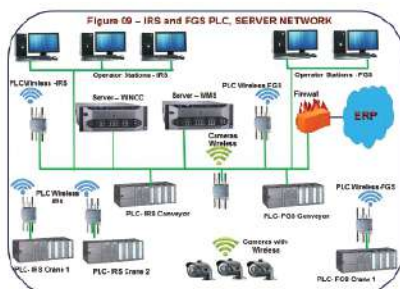
1. Based upon Width of the reels, wrapping mode is selected automatically, whether double band or triple band or Spiral wrapping.
2. Spiral wrapping for reducing wrapper consumption and inventory.
3. Once reel reaches the wrapping station, each reel movement is stored in PLC. After Kraft wrapping, PLC will measure the weight of the reel and send it to ERP along with barcode. ERP will generate auto labeling to avoid mistakes.
4. After generation of auto label, the reel information is moved to finished goods Org in ERP. Only finished good Org reels can be invoiced to customers or dealers.

6.1 Productivity

- Completely automated except side disc placement, Side disc to be placed manually on the arm outside the machine fenced area.
- Overlap and number of layers are automatically selected from ERP.
- Capable of packing 45 reels in an hour, possible only because of complete automation.
- Optimum wrapper consumption by auto selection of wrapper mode.

6.2 Derived Quality

- Tight and neat packing. Edge protection with additional layers in the edges.
- Hot melt gluing system is used for automatic gluing, which gives the better packing.



6.0 AUTOMATIC SPIRAL KRAFT WRAPPING MACHINE:

The reels from winder and IRS will reach the barcode reader section, PLC will read the barcode and send data to ERP. ERP will give the destination either Packing or Sheeting.

Figure 10 – KRAFT WRAPPING MACHINE



6.3 Safety and trouble shooting

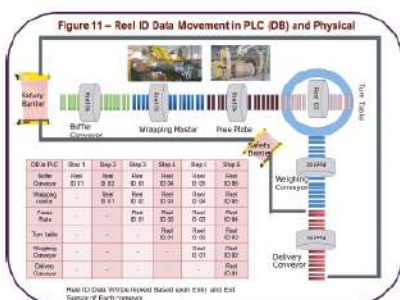
- Side crimping, side disc placement and pressing are done by heavy machinery movement and since these are completely automated manpower is not required inside the machine fenced area and accidents are avoided. Automation with position sensors and control ensures absolute safety for men and equipment. Manual operations are also permitted after satisfying the basic interlocks.
- Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated.

6.4 Interfacing with mill ERP

- The PLC is interfaced with ERP, the B1 message will be sent to ERP along with Reel ID and width and based on the confirmation from ERP, PLC will do the wrapping.
- When wrapping is completed PLC will send reel ID along with Weight. ERP will print the label with actual weight.
- Once the actual reel exits and enters next conveyor which is confirmed using sensors and encoders installed in the conveyors, the Reel ID is moved from one section/ conveyor to the other in PLC.

6.5 Customer benefits from Kraft wrapping machine

- Quality packing because of selection of best quality packing materials
- Moisture proof tight wrapping
- Accurate weight
- No human intervention so better product hygiene



7.0 AUTOMATED HIGH SPEED SHEETER

Sheet cutter are designed with Auto format changes, Auto pallet change and auto reel change. The Online web inspection system with auto reject gate is added to sheet cutter for better quality outputs.

7.1 Productivity

- Automatic format change reduces the time taken for size changes and increases productivity. Once size is selected Slitter positioning, overlapping, separating shoes positioning, side joggers positioning, end stopper plate positioning are done automatically.
- Automatic pallet change at slow speed without stopping the sheeter also increases productivity.
- Automatic decurler and Auto unwind stand breaking system along with antistatic bar ensures that the sheeter is operated at maximum efficiency to improve productivity



7.2 Derived Quality

- Automatic slitter positioning and syncrofly cross cutter ensures cutting accuracy of 0.1 mm and eliminates cross cutting.
- Overlapping station with suction box and PU coated stopper plates eliminates sheet edge damages.
- Automatic decurler and static eliminators keeps the sheets flat and provides better piling.
- Online Web inspection system is installed to identify and reject defective sheets automatically without stopping the sheeter. A comprehensive report with details of defect helps in identifying and rectifying the defects from the Board machine.
- Reel joints are detected using Splice detector and rejected in Automatic rejection system.

- Ream counting and Sheet counting with accuracy +/- 1 cut is achieved with Tab inserters.

7.3 Safety and trouble shooting

- Safety light barriers are installed the laybouy section which can be acknowledged locally only from the field. This ensure enhanced safety for men and machine.

Figure 13 – WIS REPORT IN SHEETER

Size	Batch	Date	Defect Size Occurred
770 X 1050	B	2108-02-15 17.01.58	67.79
770 X 1050	B	2108-02-15 17.12.09	65.54
770 X 1050	B	2108-02-15 17.13.09	31.7
770 X 1030	B	2108-02-15 17.15.17	48.77
770 X 1050	B	2108-02-15 17.15.18	31.58
770 X 1050	B	2108-02-15 17.18.31	1824.71
770 X 1050	B	2108-02-15 17.25.25	63.32
770 X 1050	B	2108-02-15 17.26.16	79.26
770 X 1050	B	2108-02-15 17.26.18	613.71
770 X 1050	B	2108-02-15 17.2.6.19	85.55

- Manual operations are also permitted after satisfying the basic interlocks
- Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated.

7.4 Interfacing with mill ERP

- Unique barcoding system, scanning of reels loaded on the sheeters and validation of the ERP data avoids mix-up and provides traceability.
- Automatic pallet change based on pallet height, weight and number of reams are done based on the information in the ERP
- Destination code for further Ream packing or Bulk palletizing is also added to the barcode.

7.5 Customer benefits for Sheeter:

- High level of dimensional accuracy(No size variation and cross cutting)
- Absolutely flat sheets
- Clean cut edges(No rough cutting)
- No dust
- Defect free sheets due to web inspection
- No edge damages
- Exact count of sheets

Figure 14 – REAM WRAPPING MACHINE



8.0 AUTOMATIC REAM WRAPPING MACHINE

The ream wrapping machine is completely automated along with auto labeler from ERP. Infeed Scissor lifts are hydraulic servo controlled system which are used for precise operation. Dual stacker with Auto pallet change facilitates pallet change without stopping the machine. Intelligent Robotic System with pneumatic and high precision positioning system is used in infeed conveyor to pick and place the ream sheets.

8.1 Productivity

- Completely automated wrapper size selection, wrapper length selection, folding, gluing, side tucking, with auto label pasting increases the productivity. Hot melt gluing system with faster bonding is used for pasting the wrapper. It can pack up to 12500 reams/day.

8.2 Derived Quality

- Tight packing, Better stacking of reams, better appearance because of uniform label pasting

8.3 Safety and trouble shooting

- In Stacking area, safety sensor with local acknowledgement is used to avoid human entry. Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated. Manual operation are also permitted only if the basic interlocks are satisfied.



8.4 Interfacing with mill ERP

- Unique barcoding system provides traceability and avoids mix-up. The PLC and ERP are interfaced. The pallets are scanned in the infeed and validated in ERP and number of ream labels

to be printed are sent to PLC. PLC will send the data to auto labeler and label pasting is done online automatically.

8.5 Customer benefits from Automatic ream wrapping machine

- Good quality tight and neat packing
- Neatly stacked reams with easy identification through properly placed labels

9.0 AUTOMATION IN SHRINK BUNDLING MACHINE

9.1 Productivity

- Bundle weight is restricted to 55 kgs for safe handling. Infeed scissors lift facilitates easy feeding of reams. Automatic stacker and delivery conveyor helps in improving in productivity.

Figure 16 - SHRINK BUNDLING MACHINE



- Optimization of conveyor length and bundle tracking ensures continuous flow of bundles.
- Automation helped to increase the machine performance to 8640 bundles /day.

9.2 Derived Quality

- Automatic temperature control of the Oven ensures the quality of shrink bundling and sealing.

9.3 Safety and trouble shooting

- Automation with position sensors and control ensures absolute safety for men and equipment. Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated.

9.4 Interfacing with mill ERP

- Unique barcoding system and scanning avoids mix-up and provides traceability. Scanning of pallets is done in the entry and validated in ERP. ERP provides information about number of reams per bundle.

9.5 Customer benefits from Shrink bundling machine

- Moisture proof packing
- Bundle weight restriction for easy handling(55 KGS)

10.0 AUTOMATIC PALLET WRAPPING MACHINE:

Pallet wrapping machine is fully automated with various options and auto A4 label printing and pasting.

10.1 Productivity

- Dedicated stations for Top lid placement, edge protector placement with turn tables for accessing all the corners from a single location, automatic film dispenser, automatic strapping with turntable to strap in both directions and automatic label pasting helps in improving the productivity. Automation has helped to achieve about 750 pallets/day.

10.2 Derived Quality

- Automatic stretch wrapping with edge protectors and automatic strapping gives superior quality packing with good appearance.

10.3 Safety and trouble shooting

- Safety light barrier are installed in infeed area with Local acknowledgement for ensuring safety for men and machine. Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated.

10.4 Interfacing with mill ERP

- For auto labelling, PLC and ERP are interfaced, once the pallet is scanned and validated in ERP the actual weight is captured and sent to ERP and Auto A4 label will be printed. Auto label will be pasted in the Pallet. Actual weight will be printed in the A4 label.

10.5 Customer benefits from Automatic Pallet wrapping machine

- Sea worthy packing
- Moisture proof packing with edge protection
- Top board and two way strapping for vertical stacking

11.0 FINISHED GOODS STORAGE AND DESPATCH

An automated finished good storage (FGS) with robotic stacker crane is installed. The FGS can store the finished goods as per sale order and retrieve and distribute the sheet pallets out to several truck loading stations according desired truckload combinations. On an average day 30-40 trucks will visit at the despatch sections. As the trucks arrival happens in random order, and system guarantees truck specific load, ready to be loaded within 1 hour after truck reports to the mill gate.

Finished goods (FG) are dispatched based on request date and truck planning. Stock is automatically deducted after scanning is done. Scanned goods are matched with Sale order and validated. Inspection reports are generated based on invoicing.

11.1 Productivity

- Automatic storage and retrieval for handling 12000 SKU with a capacity to store 4000 T in an area of 950 sq.mtr.
- Storage and retrieval based on SKU, Variety, Age, sale order, at the rate of 60 pallets per hour and retrieval of 90 pallets per hour.
- Conventional storage will need 10000 approximate sq.mtr space and much less storage and retrieval rate. FIFO

- Space saving due to vertical storage.

11.2 Derived Quality

- Storage in racks inside a self-supported building and using crane (No fork lift movement) helps in retaining the quality of the bundles.

11.3 Safety and trouble shooting

- Completely automated and manpower is not required inside the storage area, infeed and outfeed area.
- Protected with dry fire sprinklers sensitive to heat.
- Automation with position sensors and control ensures absolute safety for men and equipment. Diagnostic tools built in the PLC makes trouble shooting easy as specific alarms can be generated.

11.4 Interfacing with mill ERP

- Unique barcoding system and scanning avoids mix-up and provides traceability
- Automatic report generation (Stock on hand, variety wise, Age wise, Fast moving, slow moving)
- Advantage of intelligent WMS.
- Automated FG Godown Receipt - FG are scanned and automatically accounted in stock

11.5 Customer benefits from FGS

- Fast and accurate automated retrieval resulting in faster service
- Intelligent WMS avoids wrong delivery & improved accuracy of storage

12.0 RESULTS AND DISCUSSIONS:

With the above automation implements at the Mill finishing house, find below a short summary of the “benefits derived” and “lessons learnt” through our automation journey:

12.1 Benefits derived:

- Automated High speed sheeters provide High level of dimensional accuracy of the sheet output from the cutters (no Size variation and no Cross cut)
- ERP interface - add value to the Customers, for faster delivery and reduction of FG inventory.
- ERP interface - helps mill for product traceability, continual product quality improvement
- Automated Converting lines have the flexibility for Kraft packing as well as the film packing for the reels and various modes of packing for the sheets.
- High speed Sheeters & Packing machines definitely speeds up the production time with increased repeatability and less human error.
- High level of protection from light and heat inside the IRS and FGS, which add

to the Product quality in terms of Sheet Flatness and Reels stability till the core end.

- Increased safety for men and machinery
- Less physical handling of the manufactured good - Product Hygiene.
- Less finishing loss
- Better quality, Less complaints
- Better planning and service, better customer satisfaction
- Optimum use of raw material and consumables
- Energy efficiency
- Historical data for analysis and improvement
- Easy, correct and timely decision making due to availability of customized reports

12.2 Lessons learnt:

- Modern automated machines like Winders, Rewinders and Reel wrapping machines are necessary at finishing house to follow the high speed Paper/Board machine production to maintain less inventory.
- Concept to commissioning - pre defined clear road map with objectives and product data will enhance the basic engineering and detail engineering phase of the project for a successful use of the equipment.
- Higher volume production – investing in automated reel handling systems, high speed sheeters, automated ware houses, automated packing machines (ream packing, pallet packing etc.) creates a valuable resource for handling large conversion volumes, which in turn, will increase profitability, remain competitive and to get a return on the investment.
- Large initial investment is a deterrent – Mill has to choose its automation depending on the type and degree of automation required for the desired objectives.
- Extensive training for operating the automated machines and training the maintenance personnel are needed for quick trouble shooting and problem solving.

13.0 FUTURE PLANS:

TNPL continues to improve its finishing house operations, with further automation and computerization of the Work in Process. The work is already begun for moving from the “existing data interface through PLC” to “Integrated Automation with Internet of Things (IoT)”. Some of such future plans are:

- Sheeting plan based on TPA (Truck placement advice)
- Customized Deckle optimization program
- Automatic Sheeter size change through ERP

14.0 CONCLUSION

Automation technologies have become a resource for being competitive in the industry. With the advent of newest version of Programmable Logic controllers (PLC) and other latest control systems, the equipment automation with ERP interface at TNPL, has changed the complexion of the organization from design through implementation and efficient execution.

1. The effectiveness of the automation and its organizational impacts of our Mill conversion centre is seen from ease of On time delivery (OTD) and On time Delivery in full (OTIF) for about 13000 possible combination of SKU's from the daily conversion, finishing, packing and despatching 600 TPD of Board machine production. The Ontime Delivery (OTD) is progressively improved to 80%
2. Average service time for sheet conversion and despatch from the mill is 20 days in South India and 25 days on overall FOR delivery basis.

The key take away is that satellite conversion centre is not mandatory, if an automated mill conversion centre with ERP Interface is installed within the Board machine complex.

TNPL find this as a Knowledge management exercise, an opportunity given by IPPTA to share the knowledge gained through our Automation journey at our Finishing house. I am sure, it will be useful for mills contemplating to embrace automation for greater benefits.

“A lot of people really like to answer questions, and they really enjoy sharing their knowledge. Especially people who have valuable knowledge.” – Adam D’Angelo, founder of Quora

And we did...

15.0 ACKNOWLEDGEMENT

The authors are thankful to the management of Tamil Nadu Newsprint Papers & Limited for the full co-operation and guidance extended for publishing this technical paper.

16.0 REFERENCES

1. Discussions and knowledge gained during internal mill Project detail engineering.
2. In house ERP data interface protocol.
3. Operation and maintenance manuals of the Original equipment manufacturer (OEM) From Winder to Automated ware house.