ISSN: 0379-5462
IPPTA: Quarterly Journal of Indian Pulp and Paper Technical Association
Vol. 32, E2, 2020, pp.120-124

Implementation and enhancement of data management system using ERP-Automation in a Pulp and Paper industry

Abstract: ***Manufacturing in a Paper Industry is done through several stages like pulp management, pulp treatment, paper production, roll packing, sheet cutting, and packaging. All these processes should be carried out in a synchronized manner and in hierarchical order. No process can overlap or be left away without finishing.***

For a large integrated Pulp and Paper industry, Resource Planning software becomes inevitable. By using one such system, manufacturing/work orders are created for each process in a manner that ensures synchronized execution of the works.

As each process/work is carried out in a separate location, it becomes quite challenging for any Paper Industry to coordinate every location and process. TNPL tackled this problem with an ERP system, which helps in integrating various work locations, ensuring real-time communication transactions and maintaining the hierarchical order across all locations.

Driven by customer needs, various customization and automation takes place in synchronizing real time functional scenario with the ERP. This has helped TNPL in precise process planning enabling the business to track, monitor & collect accurate data about the production cycle.

Keywords: Paper Machine, OPM-MODULE, ERP-BATCH FPO's, oracle 11g-database, ERP Server, Client PC Station, PLC, Barcode Reader, Load Cell Indicator

S. Sharmily*
Shift Engineer, Chemical

R. Murugavel Ananth*
Assistant Manager, Instrumentation

Introduction

TNPL UNIT-1 produces 4 lakh MT paper products from all three paper machines. In TNPL we produce machine-wise, variety-GSM wise paper products, thus it leads to numerous paper products with specifications that match the customer needs.

Thus the machine-wise, variety-GSM wise paper products produced in JUMBO are being converted as bobbins in winder for further processing. These bobbins are checked & re-designated by QC, if necessary, for further processing based on the order type –viz. reel order or sheet order. If it was sheet order it reaches finishing house for further processing, if it was reel order it reaches packing stations to be packed before reaching marketing go-down. From marketing all the final goods dispatch process to their respective vendors takes place.

For the above said functionality, a lot of data are being generated and such data are needed to be retrieved now and then for the betterment of the firm. It involves production details, production planning, traceability of the finished products, scrutinizing the defects, forecasting the upcoming production events.

In order to aid the smooth functioning of such data-involved industrial activities ERP (Enterprise resource planning) acts as a tool in PULP & PAPER INDUSTRY for better performance and planning.

*Tamilnadu News Print Paper Ltd (TNPL), Kagithapuram (TN)

ERP in TNPL:

TNPL being one of the pioneers in paper productions have also maintained its accurate set of records and data using highly précised data-base management systems which has multi-modular functionality.

It consists of many modules such as process manufacturing, Inventory management, finance & accounting, sales & dispatch management etc. All these modules are inter-linked and related to one another, for appropriate flow of inventory & further cost calculations.

Oracle Process Manufacturing-OPM Module (in Paper Machine):

Process manufacturing module involves both production module and inventory management. In paper machine production module consists of both paper machine and marketing organization entity (PMG).The stoichiometry, Input = Output + Byproduct plays an important role in process manufacturing module. The accuracy of input and output depends on the appropriate weight management system, thus arriving at exact by-product.

By-product measure in an industry gives an exact picture about the waste management system.

Batch scheduling is vital for any process manufacturing and execution system.

Weight Management and Stock Arrival:

Soon after the jumbo being converted to small bobbins at winder terminals weight capture methodology becomes a challenge at this point. Due to high speed winder output, a large number of winder bobbins are produced in sets, thus we are unable to measure its actual weight. Whereas actual weight is essential at this point for precise calculation of the output, which in turn gives the actual floor stock present in the shop floor thus the actual finishing loss can be calculated accurately.

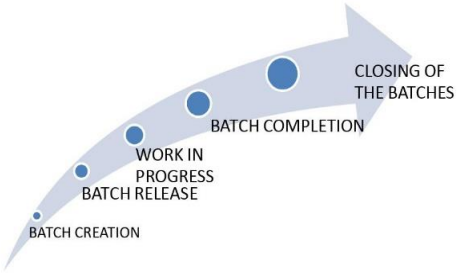
Issue Faced:

Winder reels were delivered to their subsequent destinations using calculated weight, based on the constant bulk density. Thus there were variations between the actual reel weight and calculated weight. It led to weight variation problems and excess or underweight problems.

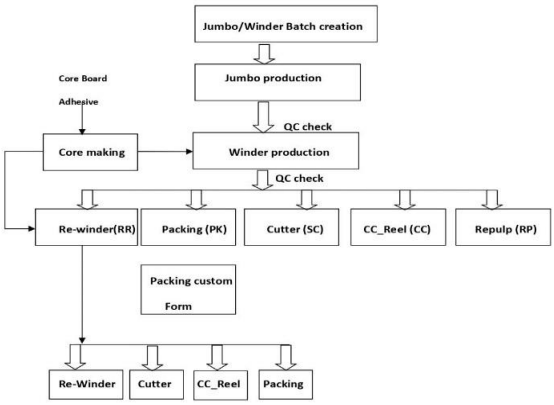
On detailed study it is planned to execute the project in the following sequence and the scope of the project is finalized as below.

- Software for interfacing the data exchange between the system & mill ERP server is handled by ICT Department – ICT Department Scope
- Study & execution of PLC logics shall be a part of this main project activity under this team – Instrumentation Department Scope
- A separate system to be installed to facilitate the data exchange between Mill ERP, Siemens PLC & Hardwares like Load Cell, Barcode – ICT Department Scope

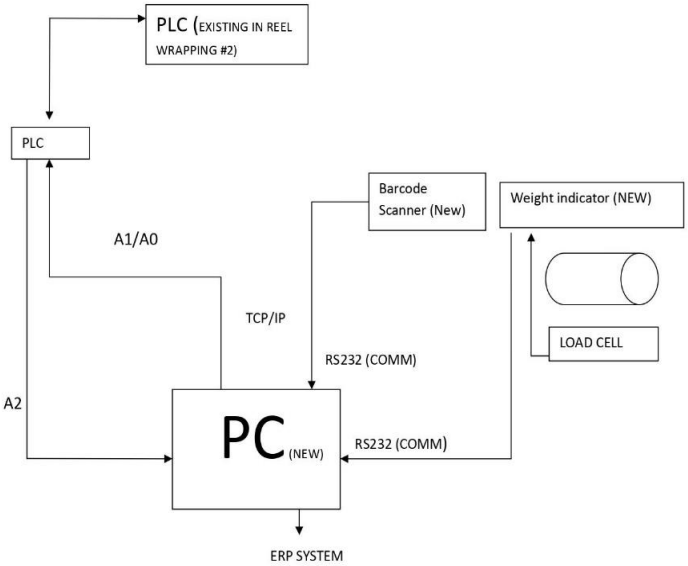
IMPORTANT BATCH SCHEDULLING STEPS:



OPM-PMG Work Flow Diagram



BLOCK DIAGRAM OF REEL WEIGHT AUTOMATION:



SOLUTION:

Complete testing and implementation of Incorporating actual reel weight was done initially in winder#2 using automation software from AIT and Project study carried out by incorporating a separate Siemens PLC for conveyor logics using hardwired signals. And Barcode & Load Cell data are communicated via Serial communication to the Client PC.

The scope of work includes:

- The reel is positioned in data read area then the PLC sends Data read flag (A2) to automation software.
- When the Automation software receives Data read flag (A2) from PLC, the Software reads the barcode data pasted on the reel.
- If the barcode is not scanned, the software sends Error message A0 to PLC.
- If the barcode is scanned, then lot number is validated with ERP either as valid reel or invalid reel lot as per conditions given by internal IT core team.
- If it's not a valid reel, the software sends Error message A0 to PLC.
- If it's a valid reel then the software reads the weight from weight indicator.
- Sends OK flag (A1) to PLC.
- If the weight is not taken then Error message A0 is send to PLC.
- If the whole process is done the entire data with actual weight is Inserted as new column into ERP-(winder ERP table)

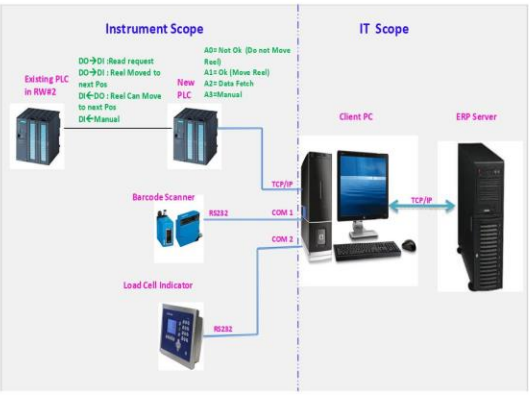
This scope of work was replicated in winder #1 terminal & DONE area after a trial period of 3 months in winder 2. Thus Actual reel weight gets captured in the winder table as a separate column for further studies and for reporting purpose. Actual reel weight enhances actual stock and inventory management in shop-floor level.

Ict Work Details:

PC with automation software acts as a client and ERP oracle-11g acts as a server with the aid of PLC communication system. With the existing batch and custom form structure in the ERP-work flow, any external data from the shop floor is fetched to the custom component-table and stored in the data base in a separate row and then transferred to the oracle-batch.

Once the data from the weight indicator and barcode scanner is sent to the workstation PC via RS232

IMPORTANT BATCH SCHEDULLING STEPS:



port, the automation software data reads the flag from PLC, and the software reads the barcode data pasted on the reel and the actual weight fetched from the load cell is inserted as a new row in ERP TABLE against the LOT NUMBER printed on the barcode label.

And example of the process is described below.

Lot number: W2220200300520600PK

Calculated weight: 671.4 KG

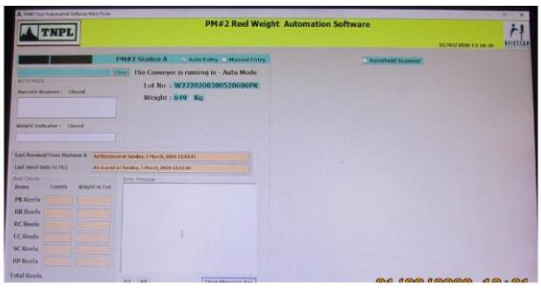
Actual weight: 649 KG

Difference: 22.4 kg

REEL ON THE DATA READ AREA:

ERP-BARCODE LABEL VIEW ON THE REEL:

AUTOMATION SOFTWARE FETCHING THE VALIDATED DATA :



Thus there was a weight difference of nearly 25 kg in the above mentioned sample reel itself. Thus measuring actual reel weight and incorporating the same is essential for accurate floor stock maintenance.

Not only in winder, but also in re-winders we have implemented the actual reel weight incorporation process via Load cell weight capture and in turn fetching the weight to the ERP-data base.

VIEW OF DATA RETRIVAL FROM ERP-DATA BASE:

TABLE NAME: TNPL_WR_PROD_DEC_DTL

ADDED COLUMN: ACTUAL_WEIGHT

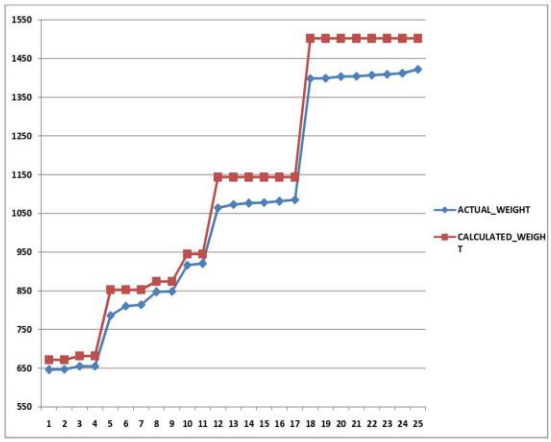
```
----------actual weight----------

SELECT prod_item_no,
       quality_destination destination,
       lot_number,
       REEL_WEIGHT CALCULATED_WEIGHT,
       ROW_ID,
       ACTUAL_WEIGHT,
       CREATION_DATE
FROM APPS.TNPL_WR_PROD_DEC_DTL
WHERE LOT_NUMBER LIKE 'W2%'
--and quality_status='ACCEPT'
```

PROD_ITEM_NO	DESTINATION	LOT_NUMBER	CALCULATED_WEIGHT	ROW_ID	ACTUAL_WEIGHT
W2NWSLS00540995	PACKING	W2220200300520200PK	671.4	753177	646
W2NWSLS00540995	PACKING	W2220200300520600PK	671.4	753177	649
W2NWSLS00540995	PACKING	W2220200300510200PK	671.4	753176	654
W2NWSLS00540995	PACKING	W2220200300510300PK	671.4	753176	647
W2NCEMS00470790	PACKING	W2220200300340600PK	533.1	753160	515
W2NCEMS00470790	PACKING	W2220200300340800PK	533.1	753160	521
W2NCEMS00470790	PACKING	W2220200300340400PK	533.1	753160	516
W2NCEMS00470790	PACKING	W2220200300340200PK	533.1	753160	524
W2NCEMS00470790	PACKING	W2220200300330200PK	533.1	753159	528

Using the above actual weight we have arrived an accurate finishing loss study report in all stages of paper process, which gave the clear cut picture of the by-products (mainly broke & re-pulp loss) produced across all stages of paper processing.

SAMPLE DATA FOR ARRIVING AT THE APPROPRIATE STOCK ARRIVAL AT WINDER TERMINAL:



The actual weight is being less than the calculated weight, thus there is a chance of excess stock being measured (in the above mentioned sample study). In some cases actual weight may even be more than the calculated weight thus it may end up in deficit of on-hand quantity for further processing, even beyond a tolerance limit.

Total number of reels taken for sample: 25 (5 sets)

Total calculated weight: 27771.7 kg

Total actual weight: 26255 kg

Difference in weight: 1516.7

Percentage of deviation : 5.77%

Out of the 25 reels produced 6 reels were unprocessed and kept on floor:

PROD_ITEM_NO	DESTINATION	LOT_NUMBER	CALCULATED_WEIGHT	ACTUAL_WEIGHT
W2NWWLS00471760	CUTTER	W2220200248520400SC	1501.6	1403
W2NWWLS00471760	CUTTER	W2220200248310400SC	1501.6	1404
W2NWWLS00471760	CUTTER	W2220200248610300SC	1501.6	1407
W2NWWLS00471760	CUTTER	W2220200248610400SC	1501.6	1409
W2NWWLS00471760	CUTTER	W2220200249110300SC	1501.6	1412
W2NWWLS00471760	CUTTER	W2220200249110400SC	1501.6	1422
		TOTAL	9009.6	8457

- Quantity of unprocessed reels on floor in terms of calculated weight: 9010 KG
- Quantity of unprocessed reels on floor in terms of actual weight: 8457 KG
- Difference in floor stock: 553 kg-for 6 reels.

INSTRUMENTATION WORK DETAILS:

It was planned to install the barcode reader & Load cell assembly in Reel wrapping#2 conveyor before lowerator (in Conveyor No.4) at 7-meter floor. This conveyor takes the output reel from Winder#2.

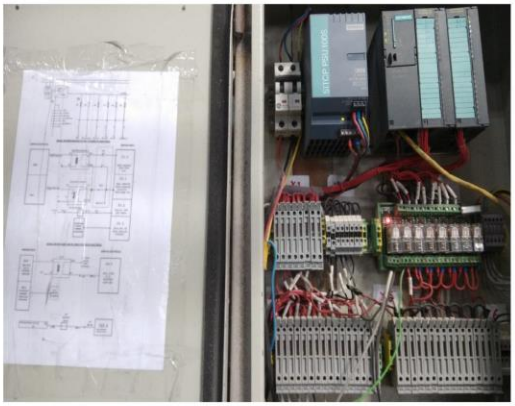
BARCODE SCANNER AT REEL WRAPPING#2

- Barcode reader is required to fetch/collect reel information from barcode label which is pasted in Winder having data about the Reel information (GSM, Size, variety, etc.). Sick Barcode reader is installed & commissioned to acquire the Winder#2 Barcode data.
- A new barcode reader (Make: Sick, Model: CLV 490-1) was installed and program was downloaded to barcode reader through SICK software (CLV Main) to activate the device. Then Barcode reader communication checked through hyper terminal. It was found working.

LOAD CELL INDICATOR AT REEL WRAPPING#2

- Load cells are required to collect the actual reel weight. Toledo make load cell were planned to install.
- Load cell assembly was installed & Commissioned with help of M/s Newton Scale Systems, Trichy in the existing conveyor No.4 with necessary mounting modification. Weighing checked through hyper terminal. It was found working.
- As per our project architecture, a separate Client PC station with two COM ports (Suits RS232 Communication) was put up by ICT department to acquire Reel Data from Winder#2.
- Both Barcode Scanner & Load Cell data is interfaced via RS232 Serial protocol with the Client PC Station. Communication with Client PC checked with hyper-terminal.
- Installed a new Siemens S7 300 series PLC along with Digital Input (DI) and Digital output (DO) card to provide data validation request to mill ERP system via Client PC Station.

NEW SIEMENS S7-300 PLC CABINET NEAR WINDER#2



- PLC logics were developed and communication was executed with Client PC Station through TCP/IP protocol

Alternate Method for Fetching Weight of the Reels Closer to Actual Weight :

Reel length based weight calculation involves less variables. And it is more closer to actual weight than bulk weight. It is easier to capture also. This length based winder reel weight capturing method is successfully implemented in UNIT-2.

This method is even more cost-effective. But there may be a variation up to 1-2% with respect to actual weight.

A study was done in unit-1 of TNPL to find the % of deviation nearly 100 winder lot weights were taken as a sample for case study and the deviation was found to be less than 2%. A sample winder-set with 4 lots are shown below to find the deviation in length weight with respect to actual weight.

SET.NO	PROD_ITEM_NO	LOT_NUMBER	LENGTH WEIGHT	CALCULATED WEIGHT	ACTUAL WEIGHT	%Deviation in LENGTH.WT	%Deviation in CALC.WT
SET 4	W3NTCRS00801205	W3320190722840100SC	1368.88	1409.8	1356	-0.9	-4.0
	W3NTCRS00801802	W3320190722840200SC	2047.072	2108.3	2025	-1.1	-4.1
	W3NTCRS00801205	W3320190722840300SC	1368.88	1409.8	1358	-0.8	-3.8
	W3NTCRS00801205	W3320190722840400SC	1368.88	1409.8	1356	-0.9	-4.0

Conclusion:

As mentioned, the stoichiometry, Input = Output + Byproduct plays an important role in process manufacturing module. Thus the actual weight measured through the automation process aids in measuring the exact production output data. Hence the floor stock and finishing loss calculation portrays the exact figure of the by-product produced

This in turn will allow businesses to track, monitor and collect accurate data about the production cycle. Such automation can be integrated with business process systems and ERP software to provide organizations with deep views of its production capabilities.

After this implementation, both reel weight and reel information is successfully captured in Paper Machine#1 and #2. Hence the above project is really helpful in calculating Finishing Loss against total production for both the areas and objective is met successfully.

Advantages of automation in erp at shop-floor:

- Reduction in data entry time
- Reduction in paper works & manual works
- Improves process planning
- Reduce wait-times
- Reliable & precise sequence planning.

Acknowledgement:

The authors sincerely thank Mr. S.V. R. Krishnan, ED (O), Mr. K. Thangaraju, CGM (Production), Mr. K. Manoharan , CIO(ICT), Mr. B.Mahesh, AGM (Production) and also the Management of Tamil Nadu Newsprint & Papers Limited, Kagithapuram & IPPTA for giving an opportunity to submit the Paper "IMPLEMENTATION AND ENHANCEMENT OF DATA MANAGEMENT SYTEM USING ERP-AUTOMATION IN A PULP AND PAPER INDUSTRY" in IPPTA Seminar.