PAPER MILL AUTOMATION FOR CUSTOMER SATISFACTION AND PROFIT MAXIMIZATION - CASE STUDIES OF PAPER MILLS IN INDIA

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Abstract:

In India and across several parts of the globe, the printing and packaging technology has grown much faster than what Paper Mills cared for (leaving rare exceptions) . Mills have been busy in absorbing the manufacturing technology better. This gap has created a vacuum between customer expectations and what Mills delivered in terms of quality and service, forcing some of the high value customers to iterate between Mills and finally import some grades of paper. This paper therefore examines the ways and means adopted by customers and Mills to cope with the changing situations to experience how the quality, service and profits of mills have increased with customer-centic automation. The study identified Automation as the central theme around which Mill Development took place in Mills which went in for investments in Automation , which was considered secondary to adding machines , in the previous era . This paper would not go into the details of technology but tries to bring out how Mill profits increased with Automation geared to customer-satisfaction, through the published literature of Mills . This paper also highlights the specific priority areas where investments must go.

Keywords: *Customer-satisfaction, Profit-maximization, Mill-Automation, Investments in automation*

1. Introduction

Indian pulp and paper industry has witnessed disruptive and innovative technologies that have threatened the very existence of those who did not automate.. Many companies in pulp and paper industry went out of business because of their slow reflexes on adopting new technology. With a lot of capital investment in machinery that, in some cases, is decades old, plus the old idea that there will always be a need for paper, perhaps it is no surprise that paper manufacturers were hit hard by the digital revolution. With the help of automation and software upgrades, companies are making their existing assets more effective.

Automate or perish seems to be order of the day! . Automation projects generally focused On;

- Electrical panels for Paper making/ finishing/processing equipment for winders, coaters, super calenders & cutters
- Drive equipment from large motors (thermal mechanical pulper, chipper) to small motors
- Power distribution system, High/Low voltage distribution system
- High and low voltage motors/energy saving inverter systems
- Instrumentation and control systems for pulp mill and paper machine
- Mill Automation control system for finishing process/ logistics/warehouse automation
- Utility monitoring system to save energy (Load Shedding and load management
- Instrumentation and electric control integrated system/Manufacturing control system(SCADA/DCS/HMI)
- Application of Software, Sensors, IoT, Robotics Etc

Infact automation opportunities exist at each stage of the paper making process. There are many obstacles though. Paper Mills have not only survived industry obstacles, but they are thriving—and are now teaching other industries a thing or two with what we call – The Indian Jugad - weathering the disruptive technology storms. This is a 100-year-old industry, and most of the technology processes we utilize today were designed and built 50-100 years ago when energy and raw materials were inexpensive.

Now, the new mantra in this energy-and raw-materials-intensive industry - Make more product with less energy. "There is nothing new in the overall process. There is not a new way to make paper—it is a tried-and-true process ," experts say. The real opportunity is around efficiency—investing in new processes, new technology and new capabilities that will reduce consumption and make more product with less energy. With the help of automation and software vendors, some companies are proving their technology prowess and serving their customers better to gain more profits .

Some people predicted the digital age as a death knell for paper, but paper is growing, with newer new opportunities in the paper industry. Traditionally paper mills are positioned for growth in new product areas such as industrial packaging, food containers, corrugated boxes, tissue and fluff pulp—used in

diapers—which is big in the expanding Asia-Pacific market. It's just a matter of rethinking, repositioning, retraining and some equipment retrofitting. Let us see an example.

Automation Example :

Paper Mills generally go for Distributed Control System (DCS) in the first phase.

The key attribute of a DCS is its reliability due to the distribution of the control processing around nodes in the system. This mitigates a single processor failure. If a processor fails, it will only affect one section of the plant process, as opposed to a failure of a central computer which would affect the whole process. This distribution of computing power local to the field Input/Output (I/O) field connection racks also ensures fast controller processing times by removing possible network and central processing delays.

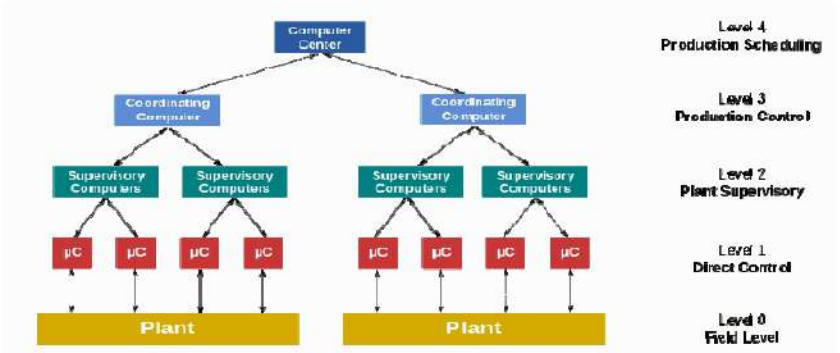
The accompanying diagram is a general model which shows functional manufacturing levels using computerised control. Referring to the diagram;

- Level 0 contains the field devices such as flow and temperature sensors, and final control elements, such as control valves
- Level 1 contains the industrialised Input/Output (I/O) modules, and their associated distributed electronic processors.
- Level 2 contains the supervisory computers, which collect information from processor nodes on the system, and provide the operator control screens.
- Level 3 is the production control level, which does not directly control the process, but is concerned with monitoring production and monitoring targets
- Level 4 is the production scheduling level.

Levels 1 and 2 are the functional levels of a traditional DCS, in which all equipment are part of an integrated system from a single manufacturer.

Levels 3 and 4 are not strictly process control in the traditional sense, but where production control and scheduling takes place.

ITC BPL introduced DCS long ago, among the Mills that went in for automation in pulp and paper industry. DCS model diagram :



Source : https://en.wikipedia.org/wiki/Distributed_control_system

Automation and Paper Mills

Automation technology vendors are seeing their pulp and paper customers asking for new tool-sets that will enable them to monitor the health of a machine and make adjustments online.

For example, the linerboard of a box will have different strength characteristics to meet performance requirements of customers. Mills should have the ability to measure things related to fiber orientation. Sensors measure everything online and make adjustments in order to achieve the specific strength characteristic of the board. Paper companies are also moving to advanced process control that can model a process and predict how it will respond to changes. In this scenario, operators can set a system to run at any level of consumption as long as the end product costs less It's about squeezing incremental productivity and additional cost to make existing assets more effective.

Paper manufacturers are looking for new ways to get more out of the machines. The focus is on measurement and control of the product that is made so that the quality is as good—or better—than the competition and increasing the tonnage produced each day.

Advanced processing tools like online spectrum analysis help engineers collect and measure data in order to make adjustments that will result in better performance. But companies want more expertise and support, as they expand plants and work with different operator skill sets.

For example, ABB supplies a ServicePort which is a data collection and measurement tool with a twist: The onsite toolset delivers information and ABB system experts who can remotely analyze and make changes anywhere and anytime . Further, the Rockwell Automation experts remotely keep an eye on some of its rural plants. In addition, the company is turning to its automation suppliers to connect its own subject matter experts internally.

An operator in India can be communicating with an operator in Russia and Brazil and helping them with the same [system] modification, thanks to automation advancements. This helps to apply technical resources and knowledge more effectively across multiple facilities worldwide.

In almost all industries, customer lead times are getting shorter and shorter . Historically, operators on the shop floor have relied on paper-based instructions that lead them to material pickup locations. When the information is tracked electronically and the operator is using a handheld device, turnaround on delivery and even changes to the order can happen later in the process but still be delivered accurately and on time.

Paper Mills manage large volumes of orders every day, arranging the required material for production and effectively monitoring the production process. They also have to keep an eye on business performance at any moment by visualizing the cost details of every individual situation. Without automation and real- time feedback in both directions, a company wouldn't be able to respond to the pressure of reduced lead times .

In addition, Mills enable all employees to share all types of information in real time. Social enterprise software discovers connections. This enterprise version like Twitter connects communications and business processes to help deliver relevant data to employees. Ultimately, it leads to faster decision-making . As decisions are made faster, products are produced more efficiently, and new markets are explored There has been a huge culture shift over the last 10 years . With new capital and

technology investments comes new training requirements. To help with that, the company is putting together collaborative online training for operators in multiple languages that can be applied while they are on the job or away from the job, in a common, systematic way. Ultimately, it's about seamlessly sharing information.

Finally our ability to sense a problem, assess the situation, and batten down the hatches has served paper-industry players well. Today's players are more innovative than they were decades ago, but in reality; much of the progress made is as simple as going back to the basics.

Thus the industry is making the resources more productive and customer focused.

CASE STUDIES:

1. ITC BPL

Valmet OptiFlo Fourdrinier headbox, OptiFormer Multi Fourdrinier forming section and OptiPress Linear shoe press with linear web run are important in high-quality board production. They enhance e.g. the end product surface and strength properties and productivity. In the calendering section, a new type of a calender from OptiCalender Compact was installed for reliable calendering results.

Valmet DNA machine control and Valmet IQ quality control systems were installed for accurate and reliable real-time data, which enables the optimizing of the entire production process and the end product quality. Source:https://www.valmet.com/media/news/press-releases/2016/

2. Nepa Ltd

Valmet IQ quality control system with scanning measurements and state-of-the-art multipredictive cross direction and machine direction controls. The scanning system includes new scanners with basis weight, moisture, caliper and ash measurements. Valmet IQ X-Ray Ash Measurement represents a new generation in ash measurement and is the first one to be delivered to India.

3. Khanna Paper Mills

Khanna invested in Metso's CORMEC Brightness and ERIC inline sensors at its 320 tpd DIP plant. The reported tangible results and savings include reduced Na2S204 consumption up to 15%, reduced H2O2 consumption up to 10%, and reduced brightness-variability beyond 20%.

4. Naini Group of Industries Kashipur (250 tpd) :

Metso Quality Control System with a Slice Profiler installed by the mill. Based on good experience with the equipment the mill has further automated and achieved uniform product quality-and-minimized-machine-downtime. Source : http://www.pulp-paperworld.com

What`s new – Two examples

1. Fibre morphology (fibre length, fibre width fibril perimeter, which correlates well with end grade strength., shape, fines content etc), is measured through image analysis.

2. L&W Crill, which is a non-imaged based method for detecting small particles in a pulp suspension.

Future Outlook:

New technologies are accelerating merger of the virtual and physical worlds, enabling the creation of new business models. Manufacturers are introducing new business models under which they sell digital services along with product. Examples include digital twins, which are a virtual replication of an as-designed, as-built, and as-maintained physical product. Manufacturers augment the digital twin service with real-time condition monitoring and predictive analytics. Customers use the equipment and products along with maintenance and operational optimization services based on predictive and prescriptive analytics.

Augmented reality (AR) technologies are used to connect virtual design to physical equipment for operator training and visualization, as well as for machine maintenance. Thanks to IIoT, cloud, Big Data, and operational analytics; artificial intelligence (AI), Blaockchain -based machine learning (ML) solutions can make operational changes automatically.

Benefits of Automation

The Benefits of Automation:

Reduce Production Cost - A quick return on investment (ROI) outweighs the initial setup costs. All of the following automation advantages reduce production cost.

Decrease in Part Cycle Time - A lean manufacturing line is crucial for increasing efficiency. Robotics can work longer and faster which increases production rate.

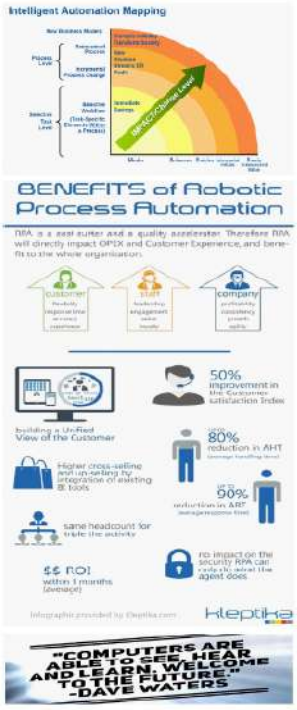
Improved Quality and Reliability - Automation is precise and repeatable. It ensures the product is manufactured with the same specifications and process every time. Repairs are few and far between.

Better Floor Space Utilization - By decreasing a footprint of a work area by automating parts of your production line, you can utilize the floor space for other operations and make the process flow more efficient.

Reduce Waste - Robots are so accurate that the amount of raw material used can be reduced, decreasing costs on waste.

Saves Local Jobs - Instead of moving your company to a location with lower labor costs, incorporate automation in a few key areas. This will increase your product through-put and increase your profit so you can keep your company in the current location.

Stay Competitive - Reduction in schedule and cost attracts customers. Automation helps provide the highest throughput with least amount of spending.



References

1. *Balchen J.G. and K.I. Mumme (1988). Process Control. Structures and applications, 540 pp. New York:*

2. *ISO 10303-227:2001, Industrial automation systems and integration -- Product data representation and exchange -- Part 227: Application protocol: Plant spatial configuration. 1299*

3. *2.Nissinen, A. (1999). Stability of wet end for paper machines with dilution headboxes. PhD thesis. Tampere University of Technology, Publications 278. Tampere, Finland. [One of the first studies of wet end stabilization with dilution headboxes].*

4. *3.Paulapuro & Gullichsen : Papermaking Science and Technology, in 19 volumes, (1998-2000). [This comprehensive book series covers all aspects of pulp and papermaking, including control issues].*

5. *4.Rantala T., Tarhonen P. and H.N. Korvo(1994). Control of paper machine wire retention. Tappi Journal 77(12), 125-132.*