Digitalization is the key enabler for autonomous business operations and sustainable future

Antti Blomqvist, Industry Advisor,
Heikki Taskinen, Industry Advisor on Data, AI and Integration,
Jarmo Ropponen, Head of Sales & Marketing from TietoEVRY,
Alan Cheesbrough, Founder and CEO, I-Plan.

INTRODUCTION:

Continuous chase of efficiency, combating climate issues, ever more rapidly changing customer requirements, and retooling and restructuring within the industry are strong drivers for pulp, paper, and fibre manufacturers to look at how they could be more resilient and responsive in the face of change. The answer in most cases is increasing automation.

"The road to fully automated, self-learning production chains is still long and somewhat winding. It's a long race, but the prize is worth it. Digitalizing operations and making use of artificial intelligence and machine learning will help a lot to speed up the journey"

Carsten Henke, Head of Pulp, Paper and Fibre at TietoEVRY.

Sustainability adds to business challenges

Younger-generation consumers appreciate locally produced products and services while at the same time keeping a keen eye on sustainability throughout the supply chain. Local production based on best available technology needs to be developed further while reducing overseas exports for lower carbon emissions.

Legislative initiatives to curtail carbon will increase, but the strongest demand for change will likely come from retailers in the near-term and from end-users in the mid-term.

Seven out of ten global fund managers representing trillions in assets believe the pandemic would lead to an increase in actions designed to tackle climate change and biodiversity losses. As the momentum behind this movement continues to gain traction, the question is no longer a matter of if carbon will hit your bottom line, but when it will hit. Carbon costs are coming, and it is now evident that optimized sourcing in the future will require consideration of both traditional and environmental costs.

Continuous planning for quick market response

To maintain their competitiveness in a business environment characterized by rapid, often unexpected change, many companies today focus on their future digital core – "ERP version 2" – struggling with two topics:

Which business processes should be standard and which ones are industry or company specific?

Which services are run in the cloud, preferably as a service, and which ones are needed on-premises to provide business continuity?

Figure 1: TIPS Manufacturing Execution System is one solution – end to end – enabling business operations and people performing their daily tasks.

"Cross-border collaboration with ecosystem partners enables new innovations, efficiency and faster value creation for our customers and industry",

says Jarmo Ropponen, Head of Sales & Marketing, Pulp, Paper and Fibre, TietoEVRY, and Alan Cheesbrough, Founder and CEO, I-Plan.

There is no single correct answer. Every company needs to figure out what the best solution is for their strategy and operational efficiency.

"As business processes will be more and more automated, we are moving towards 'continuous planning' instead of the present 'plan and execute' model. Continuous and automated planning enable production in future to accept new orders in the middle of a production run or automatically re-optimize the run with the latest orders", says Henke.

This is important for architecture since continuous planning requires complex interfaces in an area where no integration standards exist. The optimization potential can be realized by combining information from several systems and integrating this into active production control.

Local Manufacturing Execution Systems (MES) relying on Edge computing enable automation to optimize production with full visibility into incoming materials and optimized settings to meet business targets. It then transfers the production outcome to the next production step with re-optimized targets.

Automating the supply chain resolves bottlenecks

Mill businesses are complex, with multi-site manufacturing, large numbers of products, global markets and complex distribution networks. These businesses have many choices in terms of which markets to serve, where to produce the products, where to hold inventory and how to move products through the network to their customers. Getting the answers right at the enterprise level, in terms of cost and sustainability, whilst maximizing profitability is as important as driving efficiencies at the factory floor level, through every process step. There's no point in producing the wrong product at maximum efficiency in the mill, when the valuable resources of energy, raw material and people could have been directed at making the right product in the right place and getting it to the market in the least cost, most sustainable way.

Optimizing mill operations at the enterprise level is complex, and it can be very time-consuming to create even a single feasible plan. In reality, there are many conflicting choices with both hard and soft constraints driving decision making. The business needs to be able to evaluate multiple operating plans in order to commit to a sales and operations plan for the coming weeks and months. Being able to create feasible plans very quickly is becoming increasingly important as supply chains become more volatile and markets more uncertain.

The ability to re-evaluate quickly and automatically implement revised optimal plans across the enterprise is the key to maintaining profitability and sustainability.

Supply chain automation, with smart algorithms and machine learning, is the answer to the problem. Starting from the demand forecast, automated processes and learning techniques can create high-quality forecasts automatically and quickly move the business to a consensus forecast, including market intelligence with low levels of sales team intervention.

Solving the supply optimization problem of balancing supply with demand can take several days with a conventional approach. Using an automated process and sophisticated algorithms the planner can get answers that maximize efficiency at every process step at every site, whilst maximizing profitability for the enterprise in minutes. Multiple scenarios can be created in a very short time and can be re-generated when conditions change. These automated processes allow the business to make informed decisions, affecting the whole enterprise, quickly and in synchronization with the changing market.

From demand prediction to real-time production plan

An enterprise-level balanced plan is only the starting point. The plan was generated to ensure we make the right products in the right plant, at the right time, and ship it to the customer in the most efficient way. What is needed in each factory and on each production line are detailed minute-to-minute production plans. Automating the creation of detailed production plans that follow Sales and Operational Planning (S&OP) and passing them to the plant operators via the shop floor execution systems is critical to achieving a rapid-response, autonomous supply chain. The aim is to react quickly to supply chain volatility whilst maintaining maximum efficiency, making best use of energy and raw materials using well-planned sustainable distribution options.

Automating the process from demand input through to minute-by-minute production plans, along with detailed distribution and inventory plans, requires interconnected systems at every planning level with direct inputs from the sensors in the production process, and updated minute-by-minute as sales orders arrive. Smart interconnected systems at every level and the correct use of artificial intelligence to assist decision making are today's reality.

The future will be even brighter as our business leaders and engineers continuously push the boundaries of what is possible with the emerging possibilities that artificial intelligence brings.

Can AI run a mill better than humans?

Many companies are developing data lake-based solutions, where they collect data from automation, mill execution and ERP systems. Data maintenance and modelling, however, need to be solved before the data becomes practically useful. Obstacles include unharmonized master data or missing domain knowledge. How to cope with vast amounts of process data from multiple automation systems is another issue.

Analytics scalability needs looking at. What works on one machine may not work on another. Therefore, models need to be self-learning, using long-term historical data to learn correctly. If the model, for example, does not know the quality of raw materials used, self-learning algorithms are missing essential information leading to wrong decisions.

While analytics services progress as IT initiatives from the top down, automation suppliers are approaching the issue from the bottom up. They typically focus on a specific machine or machines and usually do not cover the complete production line.

Quality controllers today are not designed to optimize both quality and cost, as they do not have the information to do it. This is where major cost savings potential is hiding: optimizers on various levels feed their information to automation to enable holistically optimized production.

Figure 2: Mills need to move away from running production business processes almost fully based on human decision-making. TIPS AI - Artificial Intelligence (AI) and Machine Learning (ML) help mills to improve efficiency and quality while enabling lower costs.

As artificial intelligence (AI) and machine learning (ML) go forward and start to provide reliable results, the next step is to hook algorithms into active process control. This requires standard API interfaces and services across multivendor environments.

AI and ML for efficiency, quality, and lower cost

Embedding AI and ML into manufacturing execution systems allows mills to improve three important aspects of meeting customer demand – operational efficiency, promised quality and lower cost.

The market demands constantly faster customer response, production profitability requires increasing flexibility, together with flexibility and efficient resource usage.

Manufacturing Execution Systems (MES) play a central role. To reduce costs, leading producers are going towards more automated mills, balancing between highly educated operators responsible for everything versus automated routines with operators only focusing on more demanding tasks.

Managing order intake (combined with automatic pricing, credit check, logistics and production planning) helps secure a customer's business; further automation in roll production increases efficiency; traceability in converting improves runnability and printability by providing feedback to roll production.

The pulp & paper industry needs to renew and look for major savings potential. This will happen by automating mainly manual business processes in the offices and enabling operator mobility at shop-floor level. AI and ML are the drivers of the change.

Future AI-based support for operators will drive production consistently in an optimal way, which calls for much deeper integration between automation and business systems. Mills need to move away from running production business processes almost fully based on human decision-making.

Data is the foundation of the autonomous mill and business operations

We live in a data-rich world with new technology, security and privacy concerns, increased demands, and broadened connectivity. This creates new challenges to follow global trends and to make the best use of technology innovations and making more value out of the data.

Today's and tomorrow's trend is to minimize cost, maximize operation efficiency, increase flexibility, and improve customer services.

Tomorrow's systems must be able to assume a more prominent role and more responsibility in decision-making. MES works at the crossroads between information systems, machines, and humans, while simultaneously having a central position in the architecture. It must be tightly connected with the environment and must optimize user interaction.

Contrary to what we might think, however, the operator will still have an important role to play.

The MES of tomorrow will help and "drive" people in their daily tasks. Human effort is re-focusing on value-added tasks:

- Anticipating deviations
- Eliminating time loss
- Reducing errors

This allows more time for operational managers to work on optimizing the value chain. Operators will be tightly integrated with all types of systems and partners (automation, mobile devices, customers, suppliers) that support business process improvement and enhance user experience by delivering real-time, optimized information.

It is still not possible to automate everything but when manual operations are needed, MES informs the operator with meaningful information about concerns and needed operations.
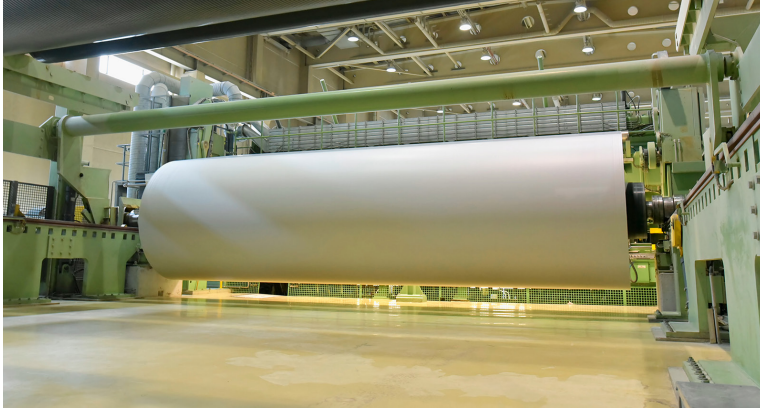
Figure 3: TietoEVRY's TIPS Industry Solutions and Services is optimized for the pulp, paper, board, packaging, tissue, and non-woven customers utilizing industry-proven best practices. It is the leading industry-specific ERP (Enterprise Resource Planning) and MES (Manufacturing Execution System) and has already been installed in more than 300 locations worldwide.

AI helps make data useful

Key to making AI work is collecting data in huge quantities – and keeping it stored to let AI work its magic.

Modern paper, board and pulp mills produce huge amounts of data. For example, there can easily be tens of thousands of data tags in their operational systems, measuring the properties of the product or the status of the machinery. The frequency of the measurements is typically seconds or even milliseconds, which leads to terabytes of data very soon.

In such an environment, it is a tempting idea to optimize OT/IT hardware capacity and delete the history data in the systems, or to aggregate the data in a data warehouse and similar solutions. This is definitely not a good idea. The value of data is many times more than the hardware cost to store it.

Process data is the raw material that the machine learning algorithms need to create mathematical models that help operators, engineers and managers improve mill operation. These models are used to detect anomalies in the sensor or equipment functioning, to predict product quality with virtual sensors or to avoid unplanned stops by predicting upcoming machine failures. They also help process engineers identify how they can achieve certain process or product targets.

History data helps cope with process changes and the introduction of new machinery, new devices, and sensors. That information can be used as additional contextual information by the mathematical models or at least to help process engineers and data scientists understand the origin of changes in the process data. Significant process changes may be a good reason to delete old process data, but even then, the data could still be useful for certain objectives, for example, predictive maintenance of old equipment still used in the new process.

Human involvement only where needed

The long-term target, besides continuous process optimization, now seems to be to enable operator mobility. In future, the systems take care of standard events without operator involvement.

Incoming raw materials are automatically identified, produced units are automatically labelled, optimal production sizes are automatically calculated and sent to automation, produced waste is automatically detected and connected to produced units.

Do we in future need full-time winder operators or can operators do something else while the machine does the routine work? Raw materials can be automatically transferred to the correct machines at the correct time. When something goes wrong or operator decisions are needed, the system will ask the operator for support through mobile.

Data and collaboration build a brighter future

Working in and for the fibre industry is an excellent opportunity to be part of the change journey and contribute to the greater good – and the future of our planet.

Increasing ambitions and united efforts to combat climate change have led to major steps in every company to implement a sustainability agenda for the benefit of planet, people, and profits. This, together with the recent pandemic challenges in both supply chains and workforce issues, has also resulted in increasing the speed at which positive, new, environmentally friendly, and more efficient solutions are created. The increasing capabilities of the industry are now even more fuelled by legislation and new emerging KPIs, such as carbon costs, emissions, and energy efficiency.

The speed of change is constantly increasing. Consumer behaviour is influencing many aspects of the industry. Good examples are the skyrocketing tissue and containerboard demand, anti-plastic sentiment, fresh fibre demand, recycled paper quality and availability, machine rebuilds, increased energy and shipping costs, home vs local vs global market changes and consolidation, new technologies, volume of data.

The challenge to manage it all requires new capabilities to support businesses and the industry. Beyond the profound need of having efficiency, profitability and customer services in place, there is a need to manage end-to-end processes, solutions, and people in the fully integrated digital value chain. This is required all the way from raw materials and supplier sources to end use, while balancing supply and demand.

All the needed data must be available at our fingertips to make optimal decisions instantly, and more automatically – hands and eyes free. This all requires new digital capabilities to enable business agility and scalability both up and down with end-to-end traceability and business optimization built in to be competitive in the marketplace.

Figure 4: Consumers drive sustainability and the tissue business

It is time for our industry to move on from silos and start collaborating, innovating, and together creating more new common capabilities and ways of working across borders, rather than continue pursuing individual interests. There are massive further efficiency gains possible for the industry and the planet when the wider ecosystem value and opportunities are recognized and acted upon.

"TietoEVRY is committed to actively driving and further developing digital capabilities together with our customers and extensive ecosystem network to bring even more value to the industry. A solid foundation exists already for taking further steps on the future autonomous journey", says Carsten Henke.

We can build a brighter future together.