Taking a lead in pulp and paper as technologies and trends converge

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INTRODUCTION:

There is a group of industries often referred to as process industries. These include mining, steelmaking, battery, cement, and food and beverage to name a few. Pulp and paper is considered part of this grouping by wider industry and indeed at ABB. But, to the layperson, their perception is that these industries happen in the background even though their materials or manufactured products touch our lives in every moment. ABB understands how important strong leadership of this industry is. As the technologies of today converge with trends and landmark moments, the evolution of the pulp and paper industry is occurring right before our eyes.

Figure 1: Technologies and expertise combine to ensure ABB enables customers to meet end demands at scale.

Papermaking and the use of pulped materials have a long history. Paper can be produced from a range of fibrous materials such as wood, fruit and vegetable waste, cotton, flax, wool and other animal products. During the world wars, Europe returned to using grass and straw to produce paper because more exotic materials were unavailable, which harks back to the very first papers that used fibers and cellulose from reeds. The word paper comes from one of these reed plants, papyrus, widely used for writing materials by the ancient Egyptians. Such was the quality of this paper that examples still exist today, 4,000 years later. Paper production processes can also be traced back to Imperial China, when it was produced from strong, cellulosic natural fibers and plant waste, gradually spreading west through Asia and Europe.

Step forward in time to the beginning of the Industrial Revolution. Guidance and methods for manufacturing paper from wood pulp were documented in a bid to lower dependency on materials like cotton and other plant fibers. This was a time in the 1800s and 1900s when levels of literacy rose in line with much higher levels of publishing, leading to mass production of a range of more modern papers for print. Often unexpectedly, human development and trends arise, but industry must always be prepared for change.

This brings us to today, a time when print paper, including for newsprint, has decreased by more than 50% for some grades over the last 10 years, in line with paperless approaches to working and falling demand for traditional newspapers. While papermaking may appear to have taken a backseat, it remains essential to life. It is a key part of global manufacturing, providing essential products for packaging, publishing, hygiene and construction.

This article will explore the factors that a technology leader must understand and navigate to best advise an industry that stands at an inflection point where the internet age is paving the way for a digital revolution. Transformation must consider three areas: technological advancement in automation and quality control, including measurement and monitoring; environmental concerns around sustainable operations, such as energy and water usage; and effective leadership of people as generations change and skill sets shift.

Sustainability in sharp focus

This ancient, now modernized process of making paper products is responsible for just under 2% of global CO_2 emissions in 2022. When compared to some of our neighbours in the process industries, cement, mining and steelmaking, which are responsible for up to 10% of global CO_2 emissions, it may not sound significant. However, pulp and paper industry emissions are equivalent to that of all the Nordic nations combined. It also utilizes a significant volume of water and manages forest environments, with factors including tree numbers and biodiversity. With demand for the likes of packaging and tissue forecast to increase over the next decade, it is important that we scrutinize our working practices at every stage. For a technology leader like ABB, it is about staying ahead of the curve to best support our customers.

ABB's pulp and paper team stands alongside counterparts in other industries by focusing on where we can make a difference to customers' operations through sustainability and digitalization solutions. These customers want productivity and machine availability, energy and raw resources efficiency, high output yield and low waste. Pulp and paper is considered to be stable and mature – it is going through constant evolution rather than revolution. Nevertheless, management teams must be cognizant of many external push and pull elements impacting on the industry.

The ABB team also provides industry-specific products and expertise to meet these goals. For example, the provision of sensors to monitor the properties of paper as it is being produced, allowing real-time adjustments in the operations to ensure customer specifications are met while minimizing costs and waste.

Figure 2: (Above) Pulp and paper mills operate in a competitive environment with tight margins and must produce on-specification products with optimized energy and resource inputs. Image ABB.

There is a track record of technology development that allows the industries in which we work to make real progress. In response to post-pandemic challenges and global sustainability goals, ABB supports customers with both rapid and gradual transformations. From the adoption of digital tools for remote work to the shift from fossil fuels to clean energy sources, ABB remains dedicated to combining automation, carbon neutrality, electrification, and social progress as part of the overarching Sustainability Strategy 2030.

Our engineering teams have the power to lead by example to drive success. In pulp and paper, we are upgrading Stora Enso's packaging board mills in Sweden using the ABB Ability™ Manufacturing Execution System, streamlining production for greater efficiency and reduced environmental impact. We are also investing in research and development, exemplified by the ABB R&D Centers in Dundalk, Ireland, where we innovate the ABB Quality Control System, enabling paper mills globally to potentially decrease waste and emissions by two percent or more per paper machine. This can positively impact a mill's sustainability progress by also reducing annual emissions for each machine by the same two percent, or 1.1 kt CO_2, using the assumption of 57 kt CO_2 emissions for a typical paper/board/tissue machine.

Quality control for better process decisions

Bringing quality control, automation and electrification to the fore, and demonstrating its domain expertise in pulp and paper, ABB is focused in the short term on optimizing paper manufacturing to help customers produce products to precise specifications and do so while consuming the least possible amount of energy and resources. ABB Quality Control System (QCS) for pulp and paper uses scanners, sensors and actuators to monitor and adjust paper characteristics – such as weight, thickness, color and fiber orientation – as the paper is made. Computer-based controls automatically adjust targets and parameters to ensure that characteristics stay within the specified threshold. The QCS reduces both raw material wastage and unnecessary energy use, lowering the costs of production.

Based on the ABB Ability™ System 800xA distributed control system (DCS), it provides operators with visibility and precise control over output, for example, all while our variable speed electric drives and premium-efficiency motors minimize electricity use. Alongside customer Klabin in Brazil, ABB's expert team was able to provide visibility into every sheet when it was made and engineer uniformity across more than 20 sites, combining QCS, the System 800xA DCS, electrification and power distribution. Typical machine uptime reached 99 percent, making it possible to produce a ton of packaging paper in just 29 seconds.

Figure 3: (Right) ABB's Quality Control System expertise and technology development takes place at a global research and development center in Europe. Image ABB

Automation combined with advanced process control (APC) is frequently deployed for more consistent operations, improved production, energy savings and reduced costs. There are multiple and interconnected variables that need to be considered in the pulp and paper making processes, too many to measure and react to manually. For example, if water is increased, the basis weight of the paper product is also affected. Therefore, by dynamically adjusting to multivariable process changes, ABB's APC helps stabilize pulp and/or paper machine operations and helps reduce variability, enable energy savings and improve productivity.

Modern drives and motors are also installed by ABB for reliable operations, energy efficiency and process performance. To maximize production, pulp and paper processes need to run reliably every single day. ABB drives are designed to provide reliable control over the speed and torque of motors so that they can run according to the precise demands of the process. From pulp processing to paper, board and tissue machines, using ABB medium and low voltage drives and motors means more efficient energy use, cutting operating costs.

Staying on electrification, ABB recently contributed to a major decarbonization effort at Vafos Pulp in Norway, to power its energy-intensive drying process with green electricity rather than fuel oil. Replacing the plant's nine-megawatt oil-fired boiler with electric heaters will remove 14,000 tons of CO_2 from its emissions every year. Critical to the new plant design, are ten ABB DCT880 power controllers which manage the power supplied to the elements of the air heaters, ensuring efficient and optimized operations, and maintain a steady load that minimizes disruption to the local electricity grid. To achieve the overall integration of systems, our engineers worked closely with Norwegian energy system integrators, EAS and Actemium Electro. Actemium preassembled and housed the entire electrical system in two shipping containers, which eliminated the cost of a new building, and paves the way for other industrial operations to cost effectively electrify.

The biggest barrier to widespread electrification is the availability of green electricity because most countries are still transitioning their power systems to renewables. One of the basic aims of paper making is to transform fiber as it comes from the wet-end with 99% water content, to the final product with about 5% water content. Mechanical draining and the application of heat to remove water require a substantial amount of energy, often from non-renewable sources.

Making a difference for generations

Looking into the longer term, ABB is also part of a paper industry research project in Germany known as Modellfabrik Papier, Society for the Research Promotion of Sustainable Paper Technologies. We're contributing – with our knowledge of digital solutions, the papermaking process, and data analytics – to the design and development of an energy efficient, circular paper factory of the future. We have positioned ourselves in favour of open standards, the ability to work with others and the seamless integration of our equipment and technologies with third-party systems, including in and around some of the world's most modern paper machines.

Together with some of our customers and competitors, we are pursuing research into making paper with far less water, and therefore far less energy than is required for traditional drying. One challenge here is to achieve inter-fiber bonding without the presence of water, and to recycle paper in the absence of water. The pulp and paper industry is already an industrial leader in terms of recycling; that is, it has made real progress over the years, to attain recycling of around 60% of its product. European producers lead the world in taking this even further, with many producers pledging to raise this number to 76% by 2030, near a current theoretical limit, given that a proportion of paper will remain in circulation as books or documents; while other coated or treated papers are not yet able to be reprocessed.

Figure 4: Some of the world's largest paper machines can be optimized using a wide variety of automation, electrification and industry-specific technologies. Image ABB.

It is also hoped that future-looking initiatives like this can help to attract people to the pulp and paper industry. It is currently facing a skills shortage that must be addressed if manufacturers hope to operate from a position of strength in an increasingly competitive, digitalized marketplace.

Attracting a new generation of digitally literate, eco-savvy workers to an industry that is mistakenly perceived to be behind the curve on sustainability and digitalization is just one of the challenges operators face. There is a misconception that pulp and paper operations are wasteful and polluting, when in fact the industry continues to be proactive around recyclability and circularity, developing sustainable solutions such as recyclable mono-material films and compostable packaging that provide a valid alternative to fossil-based materials and can even directly replace single-use plastics.

Digital technologies are transforming the pulp and paper sector – but just as valuable is the expertise and experience gained over a career spent serving customers and collaborating with colleagues. We cannot allow this vast store of knowledge to exit the industry when people retire. Instead, we must establish succession plans to ensure that knowledge from senior specialists around best practice is successfully captured and integrated with new skills and perspectives from the younger generation.

Certain specialist technical skills only apply to specific industries, but 'soft' skills such as curiosity and creativity are universal and can be transferred to great disruptive effect from one industry sector to another, replacing entrenched thinking and business as usual with new, innovative ways of working.

That is why, at ABB, our search for the best engineers extends beyond the pulp and paper industry to encompass a host of other industries. Aerospace (where I began my career before making the move to pulp and paper) and electronics are two compelling examples, where expertise in optics, electronics, signal analysis and detection, for instance, can be used to solve issues in paper mills.

At ABB, we often recruit from non-engineering backgrounds; in fact, some of our most experienced engineers have a background in physics and chemistry and learned engineering at ABB.

ABB is also exploring how digitalization trends like machine learning can help bridge the skills gap by enabling less-experienced operators to operate equipment more effectively and efficiently, while also reducing the need for onsite technical support. We have global operational centres that feature training hubs for skills development support for ABB and customers alike, enabling more cross-industry collaboration.

The pulp and paper industry must recognize and invest in the talent it has, as well as attract and retain a new generation of employees who see contributing to a more sustainable society as a key driver. This, coupled with digital and automation technologies, can help plug the skills gap and ensure the sector continues to flourish in the future.

Leading to further optimize the industry

Pulp and paper is traditionally known as a conservative industry, but the progress it has made in the last few years and since the turn of the century have been remarkable. Around the world it is known for the use of clean energy where available, putting infrastructure and initiatives in place to leave the environment how it was found, or in a better condition, and for supporting the move away from more harmful materials. However, there's still more work to do and everybody I work with at ABB wants to leave a legacy of positive change for future generations. We can do this, but we need more talented people from diverse backgrounds and skill sets to drive significant, long-lasting evolution.

Accelerating real progress towards the sustainability of paper products is a fascinating technological and business challenge, but however energy efficient and cost effective we make it, a great deal of power also lies with the consumer. For example, they can make conscious choices in favor of fiber-based materials instead of plastics. As an industry, we must communicate the provenance of sustainably produced paper, using a universal and reliable certification system, so that consumers can make informed choices. If they were willing to switch, and perhaps pay a premium for more environmentally sustainable paper products, it would advance the business case for manufacturers to invest in lower-emissions equipment and processes.

Pulp and paper has opportunities throughout the value chain, starting from forestry all the way down to recycling and waste. ABB's work with customers today focuses on optimizing processes and energy use – a first step in reducing emissions and preparing to electrify – while our future-focused R&D projects include the longer-term goal of totally reinventing pulp and papermaking to all but drastically reduce water from the process.

As we've said, improvements in industry metrics often go hand in hand. Implementing QCS in a pulp and paper plant has the potential to reduce annual production losses and have a positive knock-on effect on yearly emissions. Radically reducing the water content in paper manufacturing will have a similarly transformative effect on the energy currently required to dry pulp during its metamorphosis into paper, tissue and packaging.

The ongoing energy transition and the need to decarbonize operations will continue to drive businesses long into this century. ABB, as a long-term partner in automation, electrification and digitalization, is ideally placed to support customers with expertise and technologies to reach their safety, emissions and production milestones.

One of the most important approaches is to maintain a pioneering spirit, to push the boundaries of what is possible from a technological perspective. We have quality in everything we do at ABB, backed by decades of expertise and technology development. Our people will continue to enable us to compete within our markets through their efforts and results every day.

Figure 5: ABB will continue to explore how digital technologies can support the retention of pulp and paper industry knowledge and attract new talent. Image ABB.