Executive Summary

When contemplating a production improvement - whether by increasing speed, capacity or quality – the first step is to determine feasibility. A bottleneck analysis and capacity study by Valmet is tailor made to match your existing equipment and goals in order to thoroughly evaluate your production line from the perspective of capacity, efficiency and quality. The resulting upgrade possibilities are then ranked in terms of bang for the buck, in order to prioritize your capital investments.

When performing the actual rebuild, Valmet has experience across all grades and equipment. Of course any successful rebuild requires strong teamwork between the mill and capital equipment manufacturer.

This paper looks at a few such rebuilds, starting with a coated fine paper rebuild of an existing BelBaie former at a North American mill to reduce coating cost. The next rebuild reviewed is a capacity increase on a paper machine in Mexico with a very large scope including forming, press and dryer sections plus finishing equipment and machine clothing. An upgrade of an Austrian uncoated mechanical paper machine is presented that involves the rebuild of a press section with a new shoe press. The final rebuild discussed was the first ever totally ropeless fine paper machine in Finland, including customized modifications throughout the line from stock preparation to winding.
When, how and whether to rebuild an existing machine line are constantly changing questions. Markets are in continual flux, customers move their business based on changes in loyalty and cost, and equipment that works well one year may have undiscovered issues that present themselves next year. Determining the cost effectiveness of a production upgrade – whether a small or large rebuild, or simply a change of consumables – can be a daunting task for mill personnel.

Typically, when looking at an increase in speed and/or capacity, the first step is to analyze your needs and corresponding options. After prioritizing multiple investment options, proceeding with the appropriate rebuild is then often a multi-year process of capital budget submission, resubmission, paring down the project to the essentials, and hopefully finally proceeding with a rebuild. This paper will look at the initial rebuild analysis process and a few examples of rebuilds that Valmet has performed which resulted in production improvements. We’ll start by looking at the pre-rebuild analysis phase…

**Bottleneck Analysis and Capacity Studies - unlocking the future**

Continuously increasing demands are forcing mills to push their machine lines to their maximum limits. This makes it hard to keep a balance between high productivity, good quality and running into breaks that cause unnecessary downtime.

A tissue, board, paper or pulp machine is very complex and when considering investments to increase the machine capacity it is hard to determine where to put the focus to gain maximum output. Valmet has developed a service product called Bottleneck Analysis, where each unit process of a machine line is thoroughly evaluated in order to define the most critical bottlenecks. The importance of each identified bottleneck is ranked and actions to improve the machine performance are evaluated. Finally, the most interesting investment options are gathered into machine scenarios with different scopes.

**Tailor-made study with focus on capacity, quality and efficiency**

Each analysis is customized to fit the circumstances at the specific machine. The focus of the study can either be capacity, efficiency or quality, or, as in most cases, a combination of all three. For instance, the task for a study in Korea was to evaluate what actions were needed in order to convert a board machine from WLC to SBS.

The study showed that the main areas that needed to be reinforced were the stock preparation and the finishing part of the machine. Extra capacity for both softwood and hardwood bleached kraft pulp was needed in stock preparation. SBS board puts much heavier demands on the printing surface than WLC. Therefore, the finishing area is of high importance and the results showed that modifications were needed in the calendering, coating, reeling and winding sections.

Another example is a study of an SBS machine in the USA, where the focus area was efficiency. When benchmarking the machine performance, the study
showed that the momentary production was considerably above average but the annual production was still at an average level. The reason for this was inordinately high downtime due to breaks, which had a negative impact on time efficiency.

It turned out that the main issue that contributed to the high number of breaks was a poorly performing wet-stack calender. Replacing the wet-stack with a conventional hard nip calender, together with closing the open draws in the press section, was estimated to increase the efficiency corresponding to a production increase of 7,000 ton/year without increasing the machine speed.

A third example is for a tissue machine in Kuwait. A capacity study was carried out to evaluate the actions needed to increase the machine speed by 25%. The study showed that the machine was dryer-limited, and that management would have to modify the hood and air system in order to reach the speed target. Other bottlenecks restricting machine performance were the fan pump, refiner capacity and insufficient functionality of the bale pulper.

It was concluded that formation levels could be an issue, and recommendations were made to improve paper quality. The vibration analysis showed high vibration levels for some of the rolls in the felted section. It is important to consider a machine's dynamic behavior when planning for a speed increase, since vibrations in machine equipment can cause severe problems in the papermaking process and can limit both machine speed and efficiency. The results of the capacity study were used in planning a rebuild proposal to speed up the machine.

**Relieving bottlenecks and ranking investments**

Most of the bottleneck analyses Valmet has performed have had a capacity focus in one way or another. A typical situation is that a mill already has predefined production targets, but needs assistance to create the best possible roadmap to realize their plans.

Many mills are quite aware of where their major bottlenecks are located in the machine, but the tricky part is how to relieve them in the best way. For instance, most machines are dryer-limited for heavyweight products. There are several ways to increase the drying capacity directly or indirectly. Examples of direct modifications to increase the drying capacity are to add drying cylinders, increase fabric tension, change felt configuration and increase steam pressure. Indirect ways to increase the drying capacity are to strengthen the dewatering capacity and modify the press concept to increase the after-press dryness.

It is not difficult to come up with investments that improve capacity. The hard part is to rank how different investments affect the overall capacity and performance of the machine line. This is systematically evaluated and explained in a bottleneck analysis, which is one of the main reasons why dozens of mills all over the world have performed a bottleneck analysis with Valmet. The remainder of this paper will describe what some mills have done once bottlenecks were identified, upgrade options were prioritized and a rebuild was given the green light by corporate.
Rebuild of BelBaie former to OptiFormer (SB) is "excellent"

In October 2011 a coated fine paper manufacturer in North America placed a fast track order for an upgrade of their existing BelBaie former to a BelBaie V concept; otherwise known as OptiFormer SB (SB stands for Shoe and Blade). The main reason for the rebuild was to improve formation and reduce filler two sidedness so that the mill could apply less coating at the coater. The project’s ROI was based on reduced usage of expensive coating.

Mill management approached multiple vendors to propose a solution to their formation and two sidedness problems. According to David Nelson, Director of Sales for Valmet in North America, Valmet’s OptiFormer upgrade was preferred due to the mill’s comfort level with the difficulty of reliably fitting all the needed equipment into a small space. Since Valmet is the OEM for Beloit BelBaie equipment, all original drawings and Valmet personnel’s corresponding experience with many BelBaie installations and upgrades would guarantee an on-time startup with minimal unforeseen problems.

After extensive discussions on scope, with the intention of reducing the delivery to just the essentials and avoiding "luxury" items - the mill and Valmet reached an agreement. All areas were designed to have good operation and maintenance access. "This required a tremendous amount of engineering and modeling, due to the extremely limited space for all the new equipment, large drainage compartments and piping,” says Nelson.

The equipment (Figure 3) included: inner and outer fabric conditioners and showers, suction unit with movement mechanism, loading unit, curved suction box and dual doctor on the couch roll. Design speed of the new equipment is 4,500 fpm running a basis weight range of 60-120 lbs/3300 ft².

A successful field acceptance test was undertaken where key components were assembled and checked out ahead of time with mill representatives in order to ensure an efficient installation.

**OptiFormer SB concept**

The OptiFormer with shoe blade rebuild places a stationary porous shoe, a VacuShoe, at the jet landing area that acts like a vacuum forming roll. The resulting better formation is due to the gentle initial dewatering and loadable blades. The higher drainage capacity provides the potential for increasing production capacity if desired. White spots and other defects associated with jet impingement are eliminated. Better runnability and smoother CD profiles are achieved due to improved jet impingement stability, insensitivity to process variations and better fabric support.
The superior cleanliness strategy of OptiFormer is combined with the BelBaie former, thereby reducing breaks and improving overall efficiency.

**Dewatering on OptiFormer SB**

The stock coming from the headbox is couched on the OptiFormer SB forming section and roughly 98% of the water in the stock suspension is removed.

Initial dewatering and web formation take place at the VacuShoe chambers of the loading unit. Water is removed in the VacuShoe chamber area through both the inner and outer fabric. This two-sided dewatering produces good retention and symmetric filler distribution in the paper.

After the paper surfaces have been formed, the dewatering continues in the suction unit and loading unit loading element area. The loading elements are located against chamber 1 of the suction unit. The shear forces produced by the loading elements improve formation and increase dewatering.

After the suction unit, the web has practically been completely formed and the purpose of the following process phases (curved suction box, couch roll and high-vacuum suction box) is to raise the dry content sufficiently high for the press section.

Drainage from the stock suspension is affected by various dewatering elements (loading unit VacuShoe chambers and loading elements, suction unit, curved suction box, couch roll and high-vacuum suction box). **Figure 4** shows the dewatering by each of the forming section dewatering elements. Approximately 45 to 55% of dewatering occurs through the outer fabric on the OptiFormer. Dry content after the forming section ranges from 22% to 25%. Sufficient dry content after the forming section is important for the runnability of the sheet at subsequent process stages, e.g. dewatering control at the 1st press nip.

**Loading Unit VacuShoe Chambers**

The VacuShoe chambers of the loading unit have been dimensioned on the basis of process requirements (speed, stock, paper grade, etc.). In the forming section, 60 to 70% of the dewatering taking place occurs in the VacuShoe chamber area, i.e. initial dewatering area.

The dewatering pressure through the outer fabric is generated by the slice jet impact energy and the pressure caused by the fabric tension in the area of the curved VacuShoe chambers. The volume of water removed through the outer fabric can be controlled by redirecting the slice jet and through fabric tension, outer fabric gap roll position and fabric type. Water removed through the fabric is led by means of guide plates to the outer fabric saveall pans. As the openness of the fabric surface increases, dewatering at the jet impact point is enhanced.
Dewatering pressure on the inner fabric side is primarily produced by the vacuum used in the VacuShoe chambers, but also fabric tension has an increasing effect on the dewatering pressure. The volume of water removed through inner fabric can be affected very strongly by the vacuum of the VacuShoe chambers.

There are two VacuShoe chambers. Dewatering at chamber 1 is moderate, the maximum vacuum being 10 kPa (3 inHg). At chamber 2, a higher vacuum can be subjected to the web, maximum 25 kPa (7.4 inHg), in order to continue dewatering effectively and to affect the bottom side density. All of the water removed through the inner fabric is led into the VacuShoe chambers and further through the inner fabric dewatering channels from chamber 1 to the saveall pans through the droplegs and from chamber 2 to the water separator and the white water tank.

**Loading Unit Loading Elements (Blades)**
The loading unit is located in the inner fabric loop above the outer fabric gap roll. Loading unit element dewatering is pulsating in nature. It is produced by the loading blades located on the inner fabric side and by the opposing suction unit cover on the outer fabric side. Due to these pressure gradients mainly in the machine direction, flow variations are produced in the web, which again create shearing forces. The loading unit has two loading elements. One of the loading elements has two loading blades and the other one has one loading blade. The blades are controlled by changing the pressure in the loading hoses located under the blades. Dewatering through the outer fabric can also be adjusted by means of the suction unit vacuum. An edge lubricating shower is employed to prevent excessive wear of the fabric edges and the ends of the suction unit and high-vacuum suction box ceramics.

The VacuShoe cover and suction unit lubricating shower lubricates the area between the fabric and the loading unit, VacuShoe cover and suction unit. Lubrication prevents damage to the fabric and the loading unit, top suction unit and VacuShoe cover ceramics during run without a stock web.

**Suction Unit**
The suction unit with two chambers is located against the loading unit on the outer fabric side above the forming roll. The loading elements are located against the suction unit’s chamber 1. This is why chamber 1 is of great significance to the quality of the paper produced. Chamber 2 is dimensioned for a higher vacuum. It is designed to increase the dry content of the web and to dry the outer fabric. The suction unit dewatering channels and lubricating shower connection are sealed with an air-loaded hose. For maintenance and ceramics replacement, the suction unit is moved to a service position and secured in place.

**Curved Suction Box**
A curved suction box is located on the inner fabric side between the loading unit and couch roll and is equipped with a ceramic slotted cover. The cover slots contain finger-like suction width adjustor blocks which can be set at the desired suction width. A shower is employed to decrease wearing of the fabric and the suction box ceramics. The shower keeps the support foil and loading unit trailing side clean.
Couch Roll
A small part of dewatering occurs through the outer fabric at the couch roll. This is caused by the pressure placed on the sheet by the fabrics and by centrifugal force. Due to the vacuum affecting the web at the couch roll, most of the water is drained through the inner fabric.

The couch roll is equipped with a beam-type CombiDoc doctor (Figure 5) which is locked into operating position with turnbuckles. The holder is loaded and released with one hose (LiteCompact blade holder). The first blade (ValDual) is a foil which removes water from roll shell grooves or perforations with the help of a vacuum created between the blade and roll. The second blade (standard doctor blade) removes water sucked out by the ValDual blade and cleans the roll surface.

High-Vacuum Suction Box
The high-vacuum suction box brings the web dry content to approximately 22-25%.

Installation was excellent - achieving ROI
The installation was completed in October 2012 and so far it’s been a big success. The mill reports that the former startup and learning curve were excellent and management feels they have a great former.

According to Mr. Nelson, “This was a very complex rebuild with regard to fitting all the components in place. The end result is a tight installation that has sufficient access for operations and maintenance. The mill engineering team and Valmet showed excellent cooperation in checking and rechecking everything to make sure new and old equipment came together properly. After a few typical startup issues, mill staff were happy within a few days of startup. Within a few weeks of optimization and fine-tuning, it was clear the mill was well on the way to achieving anticipated ROI by reduced coating cost. The mill is very satisfied with the project - no more two sidedness, better formation, and significant cost savings.”

Technical questions about the OptiFormer and rebuilding an existing BelBaie machine may be directed to Kari Lamminmaki (kari.lamminmaki@Valmet.com). David Nelson (david.nelson@Valmet.com) can provide more information on this rebuild.

Capacity increase rebuild on Pondercel Anahuac PM 1
Mexican Pondercel S.A. de C.V. selected Valmet to modernize their PM 1 papermaking line at the company’s Anahuac mill in order to increase capacity. As of late 2012 the rebuilt production line was currently in ramp-up phase having significantly increased speed and production capacity.
Pondercel’s PM 1 paper machine in Anahuac, Chihuahua in Mexico was successfully started up in December 2011 after an extensive Valmet-supplied rebuild. Valmet’s delivery comprised rebuilds of the forming, press and dryer sections, and modifications to the sizer, reel and winder. The scope of the rebuild was vast and also included paper machine ventilation equipment, a chemical system upgrade, a machine control system and process controls. Valmet also supplied clothing for the complete paper machine and took care of installation instructions of machinery and equipment, testing, start-up, production test runs and operator support after start-up. “One of the main reasons for selecting Valmet as the rebuild supplier was Valmet’s experience and expertise as a big player in both machinery and technical support,” says Guillermo Mendoza, Project Manager of Pondercel.

**Targeting 22% increase in capacity**

The 5.65-m-wide PM 1 produces printing and writing papers within a basis weight range of 40-180 g/m² at the production speed of 972 m/min. The production capacity of the Pondercel mill has increased from 140,000 tonnes of uncoated woodfree paper to 170,000 tonnes annually at the reel.

Pondercel is targeting a capacity increase level of 22% for the rebuilt PM 1. “This significant undertaking to rebuild the PM 1 at the Pondercel mill has once again proven the importance of teamwork and cooperation between a customer and a supplier. From the rebuild concept development, through the project design stage, equipment installation, start-up and production optimization, the Pondercel mill and Valmet have worked well together toward common goals. The rebuilt PM 1 production line, especially the new SymPressB press section, has raised the production capability of PM 1 to a new level. The paper machine’s speed has been significantly increased since the rebuild, and although further fine tuning continues, current operating parameters have demonstrated a potential for fulfillment of the project goals,” says Jarkko Marttinen (Figure 6), Valmet’s Sales Director of Mexico area.

**Good results by working together**

Smooth teamwork and intense cooperation are common factors behind every success story. The rebuild of Pondercel PM 1 is no exception. “We have had excellent cooperation with Valmet from the start of negotiations, to manufacturing and assembly of equipment. Technical support from the supervision of erection to the commissioning and ramp up has worked well, too. Of course there have been some setbacks during the project, but we have always been supported by Valmet. We have created great teamwork,” sums up Mendoza.

**Modernized press section improves dryness**

The press section rebuild of Pondercel PM 1 (Figure 7, next page) featured a new shoe press for improved dryness with good runnability. The 3rd press is a SymBelt extended nip press, which produces an up to 4-6 times longer pressing time than in conventional roll presses. An increase in the pressing time increases
the dryness level and a long dwell time also guarantees good dryness levels for flow-restricted paper grades.

The SymBelt press enables stable and vibration-free operation. The patented shoe design of the SymBelt roll permits an optimum pressure curve in the press nip and also extends the belt lifetime.

**Future prospects looking bright**

People in Anahuac believe that in spite of the current tough market situation, the future of fine paper markets in Mexico looks bright. "We now have increased production, and the end product properties such as bulk and strength have remained at a good level. Thanks to this project, we will definitely be able to stand up to the market, also in the future. We can reduce production costs and also serve our customers better," says Carlos Najar, Plant Manager of Pondercel Anahuac.

Pondercel is a subsidiary of the Mexican paper producer Copamex. The main activities of the company include the manufacturing, distribution and sale of consumer products, packaging products and products for writing and printing. The mill is located in Anahuac, Chihuahua, in the northwest of Mexico, 400 km from the border with the United States.

**Top production line gained through smart modernizations**

The papers produced at SCA Graphic Laakirchen in Austria are considered to be of the highest quality available in the uncoated mechanical paper sector. Laakirchen has also been a forerunner in environmental management. Its new technologies, efficient measurement processes and smart modernizations show the mill’s focus on sustainability. The latest addition is a PM 10 press section rebuild delivered by Valmet (Figure 8).

The rebuild of PM 10 comprised a press section modernization with a new SymBelt shoe press. The delivery also included mechanical drives for the entire press section and an automation system upgrade for the shoe press. The SymBelt shoe press significantly increases sheet dryness which, in turn, reduces
steam consumption, improves machine runnability, helps reach higher speeds and increases production.

The people behind this rebuild are not just a bunch of engineers and managers, but a team that shared a common goal. What targets were set, what results were achieved, and how does the future look? Let the participants speak for themselves.

**Andreas Vogel, Production Manager**

"The bottleneck of PM 10 in the past was the high draw between the 3rd and 4th press, which was the main reason we couldn't speed up the machine. Another main target was to reduce specific energy consumption, while maintaining the same quality level as before the rebuild.

The results of the rebuild were amazing, because we were able to reduce the draw significantly, speed up the machine and, at the same time of course, increase production. The quality level is excellent, which is a critical factor for our customers. And we also reached the target to reduce specific energy consumption.

The dryness after the press section increased by 3%. With the new high-quality shoe press we were able to increase energy efficiency due to lower steam consumption. And as we didn't want to take any extra risks, we again selected Valmet as the supplier of the rebuild.

The future of Laakirchen seems bright, despite the tight market situation with partial overcapacity and decreasing paper prices. The quality of the SC ++ grades produced by the very modern PM 10 is at a high level. Our aim is to be as efficient as possible and to make similar small improvement steps in the future. As benchmarking shows, we are in the very front ranks globally. Efficiency refers not only to the efficiency of the paper machine itself, but also to raw material efficiency and the skilled people who help us to solve challenges in daily production."

**Johann Stadlmayr, Project Manager**

"With respect to project management, our cooperation with Valmet has been a partnership right from the beginning. I believe that this is a very smooth way to manage projects. We had many deep conversations with well-known Valmet people in a spirit of mutual trust and true partnership. This is exemplified by Valmet's way to communicate. They always respond quickly.

The cooperation with Valmet concerning PM 10 started as far back as 1987, when Valmet originally delivered the machine. There have been several rebuilds by Valmet since then. In 1991 the 1st press and the 6th dryer group were installed, and in 1997 a rebuild with new former took place. In 2000, a new OptiReel reeler was installed and in 2009, Valmet modernized the dryer section. All these projects have been carried out in close cooperation and with good results."
Thomas Breiteneder, Mechanical Engineering Coordinator

"Installing the PM 10 press rebuild was very challenging, because we had to put a lot of new equipment in an existing machine within a tight schedule. Although staying on schedule was difficult, we reached the targets in the end, together with the Valmet people.

Cooperation between the Laakirchen mill and Valmet has always been excellent. We had a really motivated project team, which was a key reason why we met the targets set for this successful project."

Pertti Herranen, Project Manager (Valmet)

Pertti Herranen, a just-retired, long-term project manager from Valmet, has been working with the SCA Graphic Laakirchen PM 10 from the very beginning of its history; i.e. since 1987. "The new PM 10 delivery in 1987 was Pertti’s project, and ever since then he has been fully involved in all improvement projects. Customer success has been Pertti’s motivation during all these years. He is a symbol of true partnership," says Andreas Vogel.

Increased Output, Ropeless Threading and Vibration-Free Winding

Total customer satisfaction, higher machine speed and increased output are among the results that the Stora Enso Varkaus mill in Finland reached after a successful grade change project and a customized machine rebuild supplied by Valmet. The Varkaus PM 3 is now the world’s first totally ropeless fine paper machine, and also features a totally vibration-free winding process and a new shoe press installed with minimal changes to the press section geometry.

In 2007, Stora Enso’s mill, located in the small town of Varkaus in eastern Finland, tackled an exceptional challenge in carrying out a production realignment program involving not only a machine rebuild but also a total grade change from copy paper to envelope and preprint paper.

As a result of the major project, PM 3 now produces fine paper in the 70 to 120 g/m² basis weight range mainly for the European market. It has a production capacity of 315,000 tonnes per year, a maximum
speed of 1,150 m/min and a wire width of 8,470 mm. The machine had originally been built for producing newsprint back in 1961 and was converted for uncoated fine paper in 1985.

"It was all driven by the quality of paper, of course," says Mikko Nieminen, Production Manager (Figure 11, previous page). "Our primary goal was to keep our customers happy, given that changes always involve a risk for the customer when products are moved from one machine to another."

The grade change project was a well-planned and well-controlled exercise that was also supported by a lot of in-house benchmarking. The project’s process-related challenges included changing many of the process chemicals and fillers along with the technology.

**Customized modifications throughout the line**

Valmet’s customized rebuild brought new technology and modifications to nearly every machine section. They were targeted to improve the quality of paper while also boosting output. Stock preparation was upgraded with OptiScreen screens, new grinders and an OptiThick broke thickener. The forming section was updated with ValFormer technology (Figure 12) for good sheet formation and dry content. The 3rd nip of the press section was equipped with a SymBelt shoe press installed with minimal changes to the section geometry, while the size press was equipped with a TurnFloat sheet turning unit and an infrared profiler. The machine’s dryer section was adapted for the new production targets by means of runnability components and a ropeless tail threading rebuild. For winding, the mill chose a WinDrum Pro winder with excellent vibration dampening features and a WinDrum rewinder.

In an earlier Valmet rebuild in 2005, a RetroDilution dilution control system had been added to the machine’s SymFlo headbox and a new OptiSoft SlimLine soft nip calendar had been installed.

**The world’s first ropeless size press threading system**

The size press has long been the only paper machine section without automatic tail threading. The restart of Stora Enso’s Varkaus PM 3 began a whole new era, not only in its production history, but also in Valmet’s tail threading technology (Figure 13). After the rebuild, the mill was producing uncoated fine paper on the world’s first totally ropeless fine paper machine.

The ropeless tail threading is based on VacRolls and SymRun Plus runnability boxes at single-fabric locations and DoubleForce units at twin-fabric positions. The sheet tail is threaded through the machine calender and open draws of the size press with the help of six FoilForce units.
The operation of these tail threading units is based on the revolutionary use of foil technology for basic vacuum generation and compressed air for machine-direction vacuum control. The foil effect employed enables the system to reach very high negative pressure levels without an external vacuum source. Thanks to the foil technology, variations in the basis weight or width of the tail have no effect on the success of tail threading. Machine-direction vacuum control facilitates reliable tail threading by providing optimal tail adhesion exactly where it is needed.

The FoilForce system is fully automated and has been developed with operator safety in mind. The threading units can be located at the open draws of any machine section (dryer, size press, coater, reel, calender) depending on the customer’s needs. The system provides dependable tail threading which results in minimal downtime and maximal output.

**Much faster and safer tail threading**

The Varkaus mill saw this ropeless tail threading system as one of the potential trouble spots in restarting the machine. However, according to Mikko Nieminen, the concern proved unwarranted: "Some adjustments were needed in the pre-dryer section when restarting the machine after the shutdown, but, when we got to the size press, tail threading was fully operational in little more than 30 minutes and we haven't had any tail threading problems since."

The benefits of a fully automated solution are indisputable. "Threading the size press now nearly always succeeds on the first attempt, whereas earlier it took an average of two or three attempts," he explains. The cleanliness of the tail threading system in the challenging environment of the size press has not been a problem. "The machine's new ropeless tail threading system is a lot faster and, best of all, safer."

To sum up, after the rebuild sheet breaks were significantly shorter, the upgraded tail threading system clearly improved the machine's efficiency, and the mill was pleased with the end result.

**Quick and simple mini shoe press rebuild**

In order to improve the press section of the Varkaus PM 3, the existing SymPress II at the 3rd nip was rebuilt into a SymBelt shoe press (**Figure 14**), with only minimal changes to the press section geometry.

This new so-called mini shoe press rebuild solution is suitable for small and medium-sized paper and boardmaking lines. It has given PM 3 a dryness increase of 3 to 4 %, while preserving bulk and runnability.

**Minimal geometry changes, maximum benefits**

There are considerable benefits in replacing a conventional roll press nip with a shoe press. A shoe press increases dryness after the press section by several percentage units compared to a conventional roll press. This, in turn, results in better runnability at the beginning of the dryer section, higher speeds, energy savings and greater production on machines with limited drying capacity, increased web strength and improved moisture profiles.

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**Figure 14. The existing SymPress II at the 3rd nip was rebuilt into a SymBelt shoe press, with only minimal changes to the press section geometry.**
However, the scope of a press section rebuild greatly influences the investment cost. By minimizing the changes to the existing frame structure required to install a shoe press, there will be fewer civil engineering-related costs. The downtime will be shorter and the machine will go from paper to paper sooner. The investment payback time will also be shorter, as line production will quickly surpass the pre-rebuild level.

In a standard shoe press rebuild, the linear load varies between 600 and 1,000 kN/m, and the nip length between 180 and 290 mm. A mini shoe press rebuild applies a shoe roll with a nip length of only 90 to 120 mm and linear load of 250 to 400 kN/m.

**Optimal winding solution: WinDrum Pro**

As the paper grade produced was to be converted into envelope paper, the Varkaus PM 3 line was in need of a new winder – a winder that could produce up to 35 rolls in a set and, at the same time, have enough winding capacity to keep up with the paper machine.

"We chose Valmet as our supplier because Valmet was able to offer a good technical package," says Mikko Nieminen, adding that the sheet separation capabilities and production capacity of the WinDrum Pro winder were particularly persuasive. "When a high capacity paper machine is followed by only one winder, a lot is expected of it."

Uncoated woodfree paper is known to be a vibration-prone paper grade. Therefore, in selecting the new winder, a lot of attention was also paid to the ability to dampen vibration. The WinDrum Pro winder best met the mill's requirements (Figure 15).

**High capacity – a sum of many factors**

As noted, winder capacity was an important issue because of the small roll size and single-winder concept employed. Envelope paper rolls are extremely narrow and relatively large in diameter, while preprint rolls are a bit wider, but small in diameter. Both grades challenge the winding process in different ways due to these dimensions; envelope paper is challenging in terms of sheet separation and preprint rolls in terms of capacity.

The normal running speed of the Varkaus winder is 2,500 m/min. However, high running speed is not the only factor to consider when targeting high winder throughput. Of equal importance are winder downtime, set change time, reel change time, parent roll diameter, wound roll diameter, and winder operating efficiency. The movable rear drum of the WinDrum Pro winder enables exceptionally quick set change times. For the mill, the WinDrum Pro's 12-second set change time means several hours more capacity per day.
Unique vibration-dampening features

Valmet's WinDrum Pro winder is the first comprehensive approach to eliminating the wide range of vibration types occurring in two-drum winders. It has been achieved by simultaneously improving the vibration resistivity of all crucial winder components such as the core locks, rider roll beam and drums, by providing the possibility of coaxial winding, and by providing the option of changing the winding geometry during winding. The special dampening structure of the drums has more than tripled their dampening capacity. This is especially advantageous for winders running woodfree uncoated papers because the resonance vibration of the drums is effectively attenuated.

By changing the distance between the rear and front drum, it is possible to adjust the natural frequencies of the wind-up to avoid running in resonances. The maximum separation of the drums provides the highest natural frequency for the paper rolls in the machine direction and the best, or stiffest, support for the rolls against machine-direction movement. With uncoated woodfree grades, a typical strategy for moving the rear drum is to open the gap from the nominal 20 mm up to the full 250 mm linearly in the diameter range 300–600 mm, which effectively eliminates drum vibrations.

"We were convinced that WinDrum Pro's vibration dampening features would work. We further believed that Valmet's dual web separation and movable rear drum would compensate for vibration. And this also happened. We have no vibration or vibration-related problems in the WinDrum Pro winder," says Mikko Nieminen.

"With uncoated woodfree, winder vibration is a big issue. In our winder, everything was done to prevent vibrations – and very successfully. It doesn't vibrate. And what's more, our roll quality has been extremely high, and converting runnability has been excellent ever since start-up."

The grade change and rebuild: a 100% success

All summed up, the well-motivated and skilled Varkaus PM 3 team has embraced the rebuild with enthusiasm. The introduction of a new paper grade, new technology, new key quality parameters and new operating approaches has forced everyone to learn new things. They have been learned well, as Varkaus has gained the approval of a customer base that keeps a keen eye on quality.

"This is a major accomplishment for us; in practice a complete 100% success," Mikko Nieminen concludes. "We've greatly outperformed the expected start-up curve over the first few months."
Summary

Rebuilding a machine line is a complex task, starting with the necessary detailed analysis of existing bottlenecks and prioritization of investment options. After the rebuild project is given the go-ahead, building a working relationship with the selected equipment manufacturers is critical.

Having successfully accomplished a wide variety of rebuilds across all pulp, paper, board and tissue grades uniquely positions Valmet as a trusted rebuild provider. Valmet provides rebuild assistance from before project inception through to satisfaction of guarantees and warranty period, with a preference of developing a long-term partnership with papermakers.

Of course, in the end – it all comes down to teamwork. Therefore choose the rebuild provider who you know and trust will minimize your risk. Then maintain a strong relationship with them.

This white paper combines technical information obtained from Valmet personnel and published Valmet articles and papers.

Valmet provides competitive technologies and services to the pulp, energy and paper industries. Valmet's pulp, paper and power professionals specialize in processes, machinery, equipment, services, paper machine clothing and filter fabrics. Our offering and experience cover the entire process life cycle including new production lines, rebuilds and services.

We are committed to moving our customers' performance forward.