

**...COMMITTED TO YOUR PERFORMANCE**

**KSH CONSULTING**

**A CONSULTING CONCEPT**

**SOLVING PAPER  
QUALITY PROBLEMS**

**KSH**  
*Consulting*



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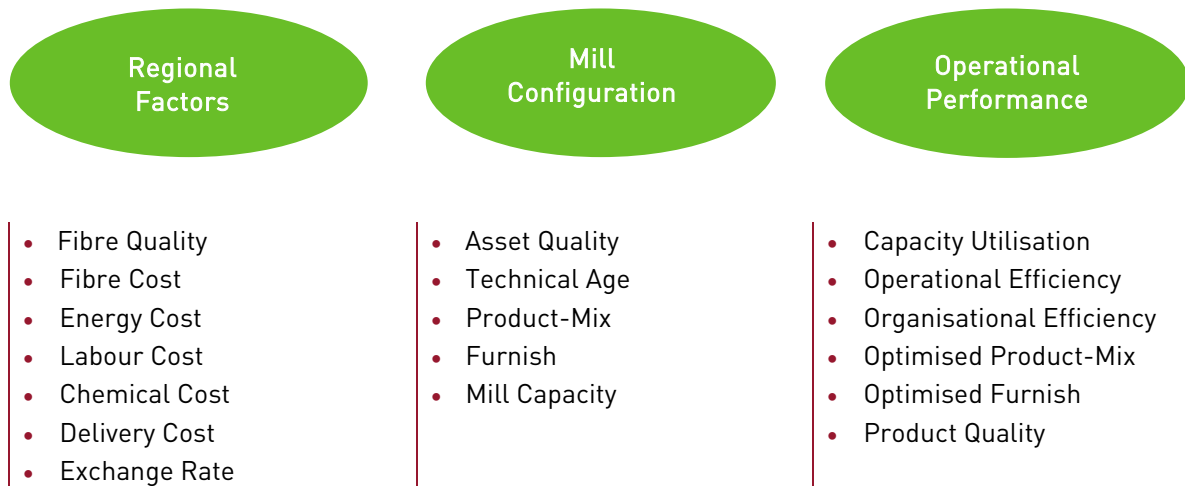
**Appendix 1 Typical Paper Quality Parameters**



## BACKGROUND

Three main drivers impact cost performance: regional factors, mill configuration and operational performance (Figure 1). Regional factors typically determine 15% to 25% of the cost variability between different operations. However, a company has little control on it since it is driven by the plant location. The biggest driver of cost performance is the mill configuration, which typically accounts for more than 50% of mill-to-mill differences. Operational performance is typically the smallest cost determinant. However, it is the only cost factor that can be managed and improved on the short-term since the mill location and configuration are largely determined at the time of initial investment and cannot be easily changed.

**Figure 1**  
Drivers of Cost Performance



The cost competitiveness of a mill generally deteriorates over time due to technological advancements at newer mills and to increasing maintenance costs. Global market developments are also impacting cost competitiveness.

When a mill ages and stops to be a value creator, its owner needs to take action by repositioning the asset. The ultimate goal is to optimise the asset with a long-term perspective by making the required modifications to the mill configuration.



However, at most mills, there exist opportunities to enhance asset operational performance with a short-term focus and only minimal investments. KSH Consulting has designed services to specifically focus on operational performance and an area requiring attention is paper quality. This consulting concept specifically describes an approach to solve paper quality problem such as dimensional stability, sheet curl, linting, sheet formation, basis weight variations in the machine and cross direction, moisture streaks. Very often, these paper quality problems can be related to the paper machine, the process control systems, or to the processes of paper making and pulping themselves.

## **OBJECTIVES**

KSH Consulting, as part of its consulting practice, offers technical audits and paper quality problem solving services. These services are designed to assist our customers in identifying the problem areas, showing where the operation can be improved and determining exactly what must be done to improve it. As such, a technical audit provides a potential method to increase productivity, improve product quality or reduce costs without large capital outlay.

## **SCOPE OF SERVICES**

### **Step 1 Set Objectives**

Focusing on the right objectives at the outset is crucial for the success of the study. A typical set of objectives for an audit might be the following:

- reduce sheet curl and improve paper dimensional stability with a view to reduce press room complaints;
- improve paper formation;
- reduce sheet linting in the press room;
- improve basis weight uniformity in the machine direction; and
- improve basis weight and moisture profiles.



## Step 2 Problem Definition

KSH will review with the mill's paper machine personnel, including operating and quality control personnel, the following:

- nature and severity of the problem (i.e. CD/MC shrinkage, sheet non-uniformity, etc.). Mill records, customer complaint records, mill data and mill measurement results will be reviewed and discussed; and
- the causes and effects of the problem and the effects on the end use (i.e. converting process, problem during converting, nature and frequency of complaints, etc.). If possible, the problem should be quantified as well.

## Step 3 Characterization of the Problem

At this stage, pulp and paper samples could be collected and sent to a mutually agreed research facility such as Paprican, IPST, Quebec Optics Institute etc. for analysis if the testing equipment is not readily available at the mill.

It is recommended to characterize the pulp and paper quality well ahead of the actual on-machine survey. This will help to focus on the right problems.

## Step 4 Paper Quality Benchmarking

The paper quality results will then be compared with the benchmark of the industry in order to assess the extent of the problem.

## Step 5 Review the Stock Preparation and Paper Machine Operation

KSH will review each step of operation, from the stock refining strategy to the final paper made on the reel. Areas may include:

- stock approach system;
- headbox;
- forming zone;
- press section; and
- dryer section.



Depending on the problem, effort can be made on a specific area of the machine. For example, for a typical sheet dimensional stability problem, headbox parameters and slice conditions in the wet end area will be assessed with regards to fibre orientation, jet to wire ratio, jet angle etc.. In addition, the pressing and drying practices along with mechanical configurations, will be carefully studied with regards to factors affecting dimensional stability.

### **Step 6 Establish Cause/Effect Relationship**

KSH Consulting will identify the cause(s) of the problem by establishing the cause/effect relationship between the test results and the paper machine variables or the paper making process.

### **Step 7 Selective Detailed Survey (optional)**

Once the problem is clearly defined and quantified, and if necessary, a more specific detailed study could be carried out. This study usually varies in scope and may include more than one of the aforementioned areas. During this phase, on-machine diagnostics instruments may be required.

### **Step 8 Corrective Program and Implementation**

Based on the findings during the previous phases, a corrective program will be developed jointly with the mill personnel. It should be emphasized that the audit by itself does not produce any benefits. The benefits are gained only by aggressive follow-up of the agreed upon action items as a result of the audit program.

### **Step 9 Evaluation and Follow-up**

Once the recommendations are implemented, an objective evaluation of the results will be carried out to assess the improvement obtained.

### **TEAM**

Usually, KSH Consulting's papermaking specialist will lead the project. Depending on the scope of the problem, he can team up with other specialists in other areas such as mechanical pulping or chemical pulping. All senior members of the team have long-standing experience in mill and process optimisation and problem solving.



## COMPANY PROFILE

### General

KSH Solutions Inc. (KSH) is a Canadian consulting, engineering and EPCM services company, founded in 1923 in Montreal, having global reach and extensive experience in the pulp and paper and forest sector. Operating world-wide, KSH has the skills, experience and organisation needed to assist clients improve their asset performance and to develop and execute capital projects of all sizes and complexities, with its consulting, engineering and construction management expertise. In addition, with its European partner and key shareholder, MAN Ferrostaal in Germany, KSH offers its clients the ability to implement their projects under a turnkey / EPC contract customized to the clients' needs.

Built from its long history and strong presence in North America, KSH has expanded its capabilities by providing expertise and services on projects in Europe, Asia, Australia and South America, giving the company a global perspective, as well as the knowledge, track record, and ability to execute projects anywhere in the world.

The entire group provides access to a vast network of resources and offices giving KSH the support to evaluate undertake and execute projects anywhere in the world.

### KSH Consulting

KSH Consulting is the consulting arm of KSH Solutions Inc. Our mission is to assist clients make positive, lasting and substantial improvements in their performance.

We have the global insights, consultants and tools to offer objective and sound solutions to various business problems for companies engaged in the pulp and paper and wood processing industries, governments, financial institutions, investors, lenders and sector organisations.

Our integrated services cover the whole supply chain, from raw material to end-use markets, and focus particularly on the following areas:

- ▶ ***Resource, Energy and Environmental Management:*** studies pertaining to resource supply, demand, cost, and end-use; regional resource comparisons; audits and benchmarking of forest, environmental and energy management practices; development of corporate strategies for sustainable development; development of regional resource management and master plans; and, government policy advice on sustainable developments.



- ✔ **Product Management:** rationalisation and optimisation of existing product-mix; product and manufacturing process design; process and product trial management and product launch assistance.
- ✔ **Marketing:** market analyses, market research, development of marketing plans and market launch strategies, customer satisfaction studies and introduction to key buyers.
- ✔ **Logistics:** distribution logistics planning and optimisation.
- ✔ **Mill Development:** performance audits, benchmarking, optimisation programs and long term development plans for existing assets and mills. Operations, maintenance, and plant management assistance.
- ✔ **Technology Management:** assistance in R&D activity planning, technology assessment and selection, strategic alliance/technology transfer assistance and technological risk management.
- ✔ **Investment Analysis:** opportunity and feasibility assessments, due diligence, asset valuations, business plan development, financial analysis and planning, lender's consultant, owner's consultant, strategic alliance identification, as well as economic and sector studies.

KSH Consulting has acquired strong expertise in consulting and strategic planning in the forest product industry with numerous completed studies. Some relevant optimisation studies involving KSH Consulting team members are described below.

## SELECTED EXPERIENCE

### ***Problems Related to Basis Weight, Moisture and Caliper Variations in the Machine Direction and Cross Direction.***

- ✔ Pressure pulsations caused by screen rotors and fan pumps. These pulsations can be amplified when they reached the fourdrinier and can cause basis weight and moisture and caliper variations in the machine direction. These pulsations were identified with a frequency spectrum analyzer and correlated with on-line measurement of basis weight and moisture. A dozen of such studies have been performed on newsprint, fine paper and liner board machines.



- Severe vibrations at the wet end can also cause basis weight variations in the machine direction. Vibrations could occur when a roll reached a critical speed or if the machine structure had a relatively low natural frequency. When the paper machine speed reaches that critical frequency, vibrations will occur, causing sometimes severe basis weight variations in the machine direction. In addition, vibrations from surrounding machinery at the wet end can also be transmitted to the headbox causing basis weight variations, particularly if the structure foundation of the headbox and of the forming section is not isolated.
- Basis weight variations can also be caused by out-of-tune liquid level control loops of various stock chests and white water tanks in the stock preparation area. Analysis of mill records can be used to correlate with basis weight variations.
- Non-uniform pressing and drying can cause moisture cross direction profile variations. Studies have been carried out on all types of machines and grades, such as newsprint, fine paper, liner board, corrugated medium machines. Several techniques were used in such studies, such as infra-red camera, humidity sensors, Scan-Pro to measure moisture profiles in the press section etc.

***Dimensional Stability and Sheet Curl.*** Sheet curl was reduced drastically after several recommendations with practically no capital outlay were implemented on a gap former machine. Paper samples were analyzed in terms of two-sidedness, fibre orientation, flocs, streaks and other non uniformity. Pulp hygroexpansivity was also measured. Several areas on the paper machine were investigated, such as headbox, forming section, pressing and drying sections.

***Linting Problem of Newsprint.*** Technical assistance to three newsprint mills in order to reduce linting problem. Several process parameters were investigated such as specific energy, ash and fibre retention, paper machine configuration etc. Specific recommendations were given to the mills.

***Impact of C-Former Installation on the physical and optical properties of paper.*** In order to assess the impact of the C-Former, paper samples collected after the installation of the C-Former were analyzed and compared with the ones before the installation.

***Sheet Sealing and Sheet “Crushing” on a Pulp Machine*** The pulp machine was producing both softwood and hardwood kraft pulps. The problem was more severe with one grade than with the other and was related to the difference in drainage behaviour of the two grades. The problem was alleviated by resetting the drainage fourdrinier table.

***Numerous Operational Problems of the C-Former and S-Former.***

***Dryer Section Efficiency and Performance Evaluation.***

***Sheet Formation Problem on Slow Speed Machines.***



## TOOLS AND MODELS

In addition to our global insights, analytical skills and database, the proposed study team has access to various instruments to support its analytical process. Some of the instruments that can be used are as follows:

- Off-machine Beta-Gauge Analyser (for basis weight variations analysis).
- Surface Anisotropy Measurement (SAM) Instrument (for fibre orientation analysis).
- Frequency Spectrum Analyser (for pulsation and vibration analysis).
- Infra-Red Camera (for basis weight, moisture and caliper profile investigation) etc.

## CONTACT

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## **Appendix 1** **Typical Paper Quality Parameters**

The paper quality parameters that need to be investigated and analysed are usually very different from one problem to the next. Some of the selected parameters are indicated as follows:

### 1. Dimensional Stability and Sheet Curl

- ✔ Nature of curl (i.e Diagonal, CD or MD curl).
- ✔ Degree of fibre orientation profiles.
- ✔ Off-axis angle profiles.
- ✔ Flocs, streaks.
- ✔ Sheet surface two-sidedness and Ink absorption differential on the two sides of the sheet.
- ✔ Pulp hygroexpansivity.

### 2. Basis Weight Variations

- ✔ Amplitude and frequency of machine direction basis weight variations (peak to peak, standard deviation, etc., results from frequency spectrum analysis)
- ✔ Level of cross direction basis weight variations and residual variations (analysis of variance results from off-machine beta-gauge).

### 3. Linting Problems

- ✔ Type of linting materials (i.e. shives, ray cells, etc.).
- ✔ Degree of linting on the two sides of the sheet.