Optimizing Paper Machine Clothing Selection

A Technical White Paper

Fiber support index · drainage capacity · fabric life modeling
Total cost of ownership comparison across PMC suppliers

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Executive Summary

Paper machine clothing typically represents 2–4% of a paper mill's operating budget, yet it directly influences over 30% of total manufacturing cost through its impact on machine efficiency, energy consumption, product quality, and unplanned downtime frequency. Despite this disproportionate impact, PMC procurement decisions are too often made on the basis of "price per square meter" — a metric that captures perhaps 25–30% of the total economic picture.

This white paper presents a structured, data-driven methodology for PMC selection that moves beyond acquisition price to a comprehensive Total Cost of Ownership (TCO) framework. The framework accounts for fabric life, energy efficiency, quality yield impact, and changeover downtime cost. Analysis of operational data from 35 paper machines across 12 mills demonstrates that optimal PMC selection using this TCO framework reduces annual clothing-related costs by 12–18% while simultaneously improving overall machine efficiency by 2–5 percentage points.

The methodology is applicable to forming fabrics, press felts, and dryer fabrics across all paper grades, machine sizes, and speeds. It provides procurement teams with an objective, defensible basis for supplier selection that aligns with both operational and financial objectives.

1. Introduction

The paper machine clothing market offers hundreds of product options from multiple global suppliers. For the mill procurement team, distinguishing between products based on supplier data sheets is challenging — manufacturers use different test methods, report different parameters, and naturally emphasize their own products' performance strengths. Without a standardized evaluation framework, procurement decisions default to the simplest comparison metric: purchase price.

This paper provides that standardized evaluation framework. It addresses the four key performance dimensions of PMC: (1) sheet quality — the fabric's impact on paper surface properties, formation uniformity, and defect rates; (2) dewatering/drying efficiency — the fabric's contribution to water removal or heat transfer, directly affecting energy consumption; (3) fabric durability — wear characteristics, chemical resistance, and expected service life under the mill's specific operating conditions; and (4) total cost of ownership — the comprehensive economic assessment that correctly weights all cost and benefit factors over the fabric's full life cycle.

2. The PAPTEX PMC Selection Methodology

The methodology consists of five sequential steps designed to be executed by a cross-functional team including production, maintenance, and procurement representatives. Each step produces documented outputs that feed into the next, creating an auditable decision trail that can be reviewed and refined with each subsequent fabric change cycle.

- Step 1 — Machine Audit: Document all relevant machine parameters: speed, width, furnish composition, chemical environment (pH, temperature, additives), cleaning system capabilities, and historical fabric performance data (life, failure modes, quality metrics).
- Step 2 — Performance Requirements: Define the Critical-to-Quality (CTQ) requirements for each fabric position based on the paper grade, machine configuration, and the mill's operational priorities (maximum speed vs. maximum fabric life vs. minimum sheet marking).
- Step 3 — Candidate Screening: Filter available products against hard constraints (e.g., minimum FSI to meet sheet quality requirements, maximum permeability to meet retention targets). Eliminate any product that fails a hard constraint — no amount of cost advantage compensates for not meeting minimum performance requirements.
- Step 4 — TCO Analysis: For all surviving candidates, calculate the projected Total Cost of Ownership using the framework described in Section 5, incorporating the mill's specific cost factors (hourly downtime cost, energy cost per tonne of steam, etc.).
- Step 5 — Trial Validation: Run a controlled trial of the top 1–2 candidates. Collect pre-defined KPIs over a full fabric life. Compare against the incumbent product using appropriate statistical methods (t-test or ANOVA on key metrics). Use trial results to refine and re-calibrate the TCO model.

3. Fiber Support Index — Deep Dive

The Fiber Support Index (FSI) is the single most predictive parameter for sheet formation quality on forming fabrics. Originally developed by Beran (TAPPI Journal, 1999), FSI quantifies the proportion of fiber length that is supported by fabric filaments rather than spanning unsupported across the open areas between filaments. Higher FSI values correlate strongly with reduced wire mark visibility, lower linting propensity, and measurably improved first-pass retention.

FSI is calculated from high-resolution microscopic images of the fabric surface, measuring the length distribution of unsupported fiber spans given the typical fiber length distribution for the target paper grade. Modern digital image analysis software automates this calculation, eliminating operator subjectivity and providing repeatable results across different laboratories.

Paper Grade	Minimum FSI	Recommended FSI	Beyond (Diminishing Returns)
Tissue (12–25 gsm)	0.72	0.78–0.85	0.88 — higher FSI may reduce drainage excessively
Fine Paper — Woodfree (CWF/UWF)	0.80	0.85–0.90	0.92
Fine Paper — Mechanical (GW/LWC)	0.78	0.83–0.88	0.90
Newsprint	0.72	0.78–0.83	0.86
LWC Paper	0.80	0.85–0.90	0.92
Liner / Testliner	0.65	0.72–0.80	0.84

Paper Grade	Minimum FSI	Recommended FSI	Beyond (Diminishing Returns)
Corrugating Medium	0.60	0.68–0.76	0.80
Kraft / Sack Paper	0.62	0.70–0.78	0.82

4. Total Cost of Ownership (TCO) Framework

The TCO framework calculates the comprehensive annual cost for each fabric position. This is the most important section of this white paper — mastering TCO analysis transforms PMC procurement from a cost-minimization exercise into a value-maximization strategy.

Cost Component	Calculation Method	Typical Weight in TCO
Acquisition Cost	(Fabric price × installed area) ÷ fabric life (years)	25–35%
Installation Labor Cost	(Installation hours × hourly labor rate) ÷ fabric life (years)	3–5%
Changeover Downtime Cost	(Downtime hours × machine-hour contribution margin) ÷ fabric life (years)	20–35%
Energy Impact (Steam/ Electricity)	Annual Δ steam or electricity cost attributable to fabric performance difference	10–20%
Quality Yield Impact	Δ annual broke/reject tonnage × (selling price − broke value per tonne)	10–25%
Chemical Cost Impact	Δ annual retention aid or cleaning chemical consumption	2–5%

Annual TCO = Sum of all six components. The fabric with the lowest annual TCO is the economically optimal choice — provided it meets all quality and operational hard-constraint requirements. Note that the lowest acquisition cost fabric frequently has the highest TCO due to shorter operating life, greater energy consumption, and higher quality losses. This counter-intuitive result is the central insight of TCO-based procurement.

5. Case Studies

Case Study 1 — Fine Paper Machine, Southern China: A 3.8 m fine paper machine producing 120 gsm copy paper at 1,100 mpm was running a competitor's SSB forming fabric with an average life of 95 days. After switching to PAPTEX SSB-4500, fabric life increased to 135 days (+42%). Concurrently, steam consumption decreased by 4.2% (attributed to improved sheet dryness entering the dryer section), and sheet broke rate decreased from 2.8% to 2.1% of production. The combined impact — longer life, lower energy, higher yield — resulted in an annual TCO reduction of 16.8%, equivalent to approximately €148,000 per year on this single fabric position.

Case Study 2 — Recycled Linerboard Mill, Central Europe: A 5.6 m board machine producing testliner (100–180 gsm) at 750 mpm was achieving 85 days average life on BOM press felts. After implementing PAPTEX's TCO-based selection methodology and switching to BOM-2600 with an optimized cleaning protocol, felt life increased to 110 days (+29%) and press section dryness improved from 44.0% to 46.5%. The 2.5 percentage point dryness increase reduced dryer steam demand by 5.8%, saving an estimated €187,000 annually across the machine's 3 press positions — far exceeding the modest increase in fabric acquisition cost.

6. Recommendations for Procurement Teams

- Adopt a TCO-based procurement framework as standard practice. Never select PMC on purchase price alone — the lowest-price fabric is almost always the most expensive when all costs over the full life cycle are properly accounted for.
- Request standardized test data from all suppliers: FSI (Beran method), CFM (ISO 9237), caliper (ISO 9073-2), tensile strength (ISO 13934-1). Reject supplier data that does not reference a recognized, published test standard.
- Run controlled, instrumented trials with pre-defined, measurable KPIs. One complete fabric life is sufficient for a directional comparison; three fabric lives are needed to establish statistical significance at $p < 0.05$.
- Implement systematic fabric inspection (see PAPTEX Inspection Checklist, DOC-MAINT-INSP-2026.1) to capture degradation curves. This historical data becomes increasingly valuable with each fabric cycle — it enables evidence-based life predictions and continuous refinement of fabric specifications.
- Engage PAPTEX application engineering early in the planning process — ideally at the annual maintenance planning stage. Early engagement provides sufficient lead time for custom fabric design if the standard product portfolio does not precisely match your machine's requirements.

7. References

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