

# **From Manual Inspection to Smart Manufacturing: How Quality Control Systems Are Transforming Carton Packaging Production**

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## **Introduction**

The carton packaging industry has undergone a profound transformation over the past decade. What was once a production environment heavily dependent on operator experience has evolved into a data-driven manufacturing ecosystem where quality, consistency, and traceability have become strategic business priorities.

Today, packaging manufacturers are expected to deliver not only visually flawless products but also measurable process stability, full production transparency, and near-zero defect rates. Meeting these expectations is no longer possible through manual control methods alone.

Quality control systems have become a critical component of modern packaging manufacturing, enabling companies to improve efficiency, reduce waste, and build long-term trust with customers.

Based on my experience in manufacturing operations, implementing integrated quality control systems can dramatically improve production performance while significantly reducing defects and operational risks.

## **Why Quality Control Has Become a Strategic Priority**

Packaging manufacturers face increasing pressure from several directions:

- stricter customer requirements;
- shorter lead times;
- higher production costs;

- growing sustainability expectations;
- increased regulatory demands.

A single production error can lead to:

- product recalls;
- customer complaints;
- financial penalties;
- reputational damage;
- production downtime.

Therefore, quality control should no longer be viewed as an inspection activity. It must become an integrated part of the entire manufacturing process.

The objective is simple:

**Prevent defects instead of detecting them after they occur.**

### **Ink Management: The Foundation of Print Quality**

Many quality issues originate long before the printing process itself.

Ink selection directly influences:

- colour consistency;
- machine performance;
- finishing operations;
- inspection accuracy;
- customer satisfaction.

Modern packaging production combines process colours (CMYK) with Pantone spot colours to achieve precise brand identity requirements.

However, colour management has become increasingly challenging due to:

- sustainability regulations;
- reduced use of heavy metals;
- environmentally friendly pigments;
- food-safe printing requirements.

Successful ink management requires close collaboration between packaging manufacturers and suppliers.

Critical parameters include:

- substrate characteristics;
- Delta E tolerances;
- varnish compatibility;
- lamination requirements;
- foil stamping specifications;
- chemical and mechanical resistance.

A stable production process starts with a stable colour management process.

### **Moving Beyond Human Vision**

For many years, the printing industry depended heavily on operator experience.

Exceptional press operators were often described as people who could "see" colour differences instinctively.

Today, technology has fundamentally changed this approach.

Modern inline spectrophotometric systems continuously compare production output against approved digital files and automatically adjust printing parameters in real time.

The benefits are significant:

- reduced setup time;
- fewer make-ready sheets;
- lower material waste;
- stable colour reproduction;
- increased production efficiency.

In our experience, automated colour management reduced make-ready waste to approximately 20–50 sheets per job while maintaining colour consistency throughout the entire print run.

The role of the printer has also evolved.

The industry is moving from craftsmanship to data-driven process management.

Operators are becoming production technologists who supervise intelligent systems rather than manually controlling every parameter.

### **Post-Press Quality Control: The Missing Link**

Many packaging manufacturers still underestimate the importance of post-press quality control.

Errors occurring during finishing operations can remain undetected until products reach customers.

These errors may include:

- inaccurate die-cutting;
- foil misalignment;
- varnish defects;
- embossing inconsistencies;
- registration errors;
- structural defects.

Installing inspection systems directly on every machine is often expensive and may negatively impact production speed.

A more effective approach is to centralize quality verification through dedicated inspection lines.

### **Inspection Systems: Building a Zero-Defect Environment**

Inspection systems have become one of the most valuable investments for packaging manufacturers.

These systems compare every package against the approved customer artwork and automatically detect deviations.

Modern inspection technologies can verify:

- CMYK colour accuracy;
- Pantone Delta E values;
- foil positioning;
- varnish application;
- embossing;
- die-cutting quality;
- overall artwork integrity.

Defective products are automatically separated without interrupting production flow.

In addition, these systems generate detailed reports, providing valuable data for continuous improvement initiatives.

From an operational perspective, inspection systems offer two major advantages:

**They improve customer confidence while simultaneously reducing internal costs.**

From my own experience, implementing an inspection line has been one of the most impactful operational decisions we have made.

### **Folder-Gluer Quality Control: Eliminating Sorting Errors**

Packaging mix-ups remain one of the most expensive mistakes manufacturers can make.

Even a single sorting error may result in:

- financial penalties;
- customer dissatisfaction;
- damaged business relationships;
- reputational losses.

Modern folder-gluer systems can integrate several intelligent sensors without reducing production speed.

Examples include:

#### **Barcode verification systems**

These systems prevent mixed products within a production batch by verifying each package against predefined specifications.

#### **Glue presence sensors**

These sensors ensure that adhesive has been correctly applied, especially on high-speed production lines.

#### **Glue path monitoring**

This technology verifies the adhesive application trajectory and prevents improperly glued cartons.

Investing in these systems often costs far less than repeatedly repairing damaged customer relationships.

### **Technology Alone Is Not Enough**

Although automation continues to evolve rapidly, technology cannot replace manufacturing discipline.

Even the most advanced systems cannot compensate for:

- poor process management;
- lack of standardization;
- inadequate training;
- weak operational culture.

Sustainable operational excellence requires three elements to work together:

### **People. Processes. Technology.**

Only when these three components are aligned can manufacturers achieve world-class performance.

### **Final Thoughts**

The packaging industry is no longer competing solely on production capacity or price.

The future belongs to manufacturers that can deliver:

- consistent quality;
- operational transparency;
- process stability;
- sustainability;
- customer trust.

Over the past decade, manufacturers in Eastern Europe have significantly improved their competitiveness and manufacturing capabilities.

The expertise already exists.

What many organizations still need is greater operational systemization.

Once that happens, the opportunities for growth are virtually limitless.