CONTROL
SYSTEMS TECHNOLOGY

A Control Systems Technology Whitepaper:

Why Radar and Laser Scanners Can’t Replace High-Accuracy Belt Scales.

INTRODUCTION

Volumetric laser and radar scanning systems are established tools in the bulk material handling industry, used to provide real-time volume data and monitor material flow.

There is an increasing misconception that a scanner can provide reliable, accurate mass measurement. Variable factors like moisture, compaction and particle size can affect the estimation, making the reading unreliable. Therefore, scanners cannot deliver trade-certified, high-accuracy mass measurement and belt scales remain essential for applications where precision and compliance are critical.

An integrated approach that combines volumetric scanning with CST's trade-approved belt weighers through the MaVIS-ARM WIM3 Integrator (WIM3), gives operators access to volume and mass data in real time, allowing operations to leverage a broader, more repeatable data set. This dual system supports better decision-making, improves operational control and ensures measurement integrity.

This paper clarifies the distinct roles of scanners and belt scales, and their value when integrated for a more comprehensive measurement strategy. It will detail how this technical synergy, facilitated by systems like the WIM3, optimises operational control and protects the business from the financial risks inherent in measurement uncertainty.

Scanners vs Belt Scales

Volumetric scanners use laser or radar technology to capture the shape and volume of material on a conveyor. They create 3D profiles and provide metrics such as cross-sectional area, surcharge angle, material height and estimated density. These insights help operators monitor flow consistency, detect misalignment and improve loading practices.

Scanners excel in:

- **Monitoring flow consistency**: By measuring cross-sectional area and material height, scanners help identify irregular loading patterns and flow disruptions.
- **Identifying misalignment or spillage**: Edge detection and proximity monitoring allow early detection of belt tracking issues and potential material loss.
- **Tracking material movement**: Continuous profiling supports throughput analysis and helps operators understand how material is distributed across the belt.
- **Enhancing safety**: Automated alerts based on proximity to belt edges can trigger shutdowns to prevent spillage and equipment damage.

Limitations of scanners:

- **Scanners do not measure mass:**
  - Volumetric scanners calculate volume from surface profiling, then infer mass by applying an assumed bulk density.
  - Bulk density is variable and influenced by moisture, compaction, particle size and the proportion of fines or lumps.
  - Small shifts in these factors can cause large errors in mass estimation.
- **Susceptible to environmental and operational factors:**
  - Belt speeds above 3.5 m/s
  - Dust and airborne particles
  - Material reflectivity
  - Steam, ice or heat distortion

In contrast, **belt scales** measure true mass on a moving conveyor. They are calibrated and verified to deliver certified accuracy for applications where compliance, commercial certainty and financial accountability are essential. They provide a direct, legal-for-trade measurement suitable for regulated transactions and reconciliation.

Belt Scales excel in:

- **Direct mass measurement:** Uses load cells and belt speed measurement to calculate mass flow and totalised tonnes without density assumptions
- **Stability over time:** Supports linearity and repeatability checks using test weights and documented procedures
- **System-level discipline:** Emphasis on correct mechanical installation alignment and high-quality tachometry to control dominant error sources
- **Certified accuracy for trade and compliance:** Engineered and calibrated to meet strict accuracy requirements for high-value operations

Limitations of scales:

- **Requires disciplined installation and maintenance:** Mechanical alignment and belt tracking must be controlled to preserve accuracy
- **Dependent on quality of speed measurement:** Tachometer selection and calibration are critical since tachometry is often the largest uncontrolled error source in typical systems
- **Site conditions can influence performance:** Excessive vibration or poor conveyor condition can increase uncertainty without proper engineering controls

Designed to Complement, Not Compete

Scanners and belt scales cannot replace each other because they are built for different roles in a conveyor system. A scanner improves visibility by showing how material behaves on the belt, while a scale provides the certified mass needed for operational and commercial decisions.

Together they create a complete picture that neither can provide alone. The scanner strengthens process control and flags issues early, while the scale delivers the verified tonnes that support compliance and accountability. Removing either technology leaves a gap. They are designed to work side by side, not as substitutes.

CST’s Approach: Integrated Technology

CST’s approach to integrating advanced technology with conveyor systems aligns real-time volumetric data from the volumetric scanner with mass data from CST's certified belt scales through the MaVIS-ARM WIM3 Integrator. Both data streams are combined within a single control centre to produce a consistent and high-integrity measurement set.

By correlating measured mass with scanned volume, the system calculates live bulk density without fixed assumptions.

The unified dataset supports diagnostics that are not possible with standalone systems. Operators can track changes in material distribution and blending uniformity by comparing volumetric behaviour against measured mass. This provides a structured view of process conditions.

Unlike scanner-only solutions, CST's integrated design retains certified mass while expanding visibility. Each component is engineered to operate as part of a coordinated measurement system rather than as an add-on.

Impact of System Unification on Operations

A coordinated measurement system improves stability in operational decision-making. Operators gain consistent reference points for throughput planning, shift comparison and loading control, with reduced reliance on manual checks across separate systems that can slow down production decisions.

Earlier identification of changes in material behaviour allows intervention before variability affects downstream processes, supporting steadier production rates and fewer reactive adjustments.

From a commercial standpoint, traceable and aligned volume and mass measurement reduces reconciliation variance and strengthens confidence in reported tonnes. In regulated or contract-sensitive environments, this improves reporting quality and lowers dispute risk, supporting stronger stakeholder trust and more predictable value at every stage of the bulk material handling journey.

Conclusion

Volumetric scanners and belt scales have distinct roles. Scanners provide real-time visibility of shape and flow while belt scales deliver certified mass for reconciliation, reporting and trade. Replacing belt scales with scanners risks accuracy and compliance; integrating both unlocks the full value of each.

CST designs are engineered with integration in mind. The CST Volumetric Scanner works with our trade-approved belt weighers via the WIM3 platform, synchronising volume and mass to calculate bulk density in real time, stabilise throughput and surface issues early.

On implementation, the result is clearer control, fewer disputes and stronger commercial certainty across all stages of the supply chain.