

From Field to Fiber: Enhancing In-Woods Chipper Performance with Automated Sampling and AI-Driven Quality Control

When a paper mill lost its debarking drum, management made the strategic decision to rely entirely on in-woods chips to avoid the high costs associated with chip mill chips. However, this shift introduced a host of new challenges. The in-woods chippers—mobile units operated by loggers deep in the forest—were outdated and had suffered from chronic neglect. As a result, the wood chips produced varied widely in size, bark content, and overall quality, severely compromising the mill's fiber yield. In an initial attempt to address these issues, the mill deployed teams of technicians in trucks armed with mobile chip classifiers to manually assess chip quality across hundreds of loads per day. This labor-intensive process quickly proved impractical and inefficient.

Faced with these challenges, the client engaged Wintermarch Group to develop a scalable, technology-driven solution capable of automating chip quality assessment and streamlining maintenance interventions in remote logging operations. Our team set out to design an innovative system that integrated a custom-built automatic sampler, an advanced IoT sensor suite based on high-speed imaging technology, machine learning analytics, and real-time satellite connectivity to deliver precise, actionable quality data from every load.

At the core of our solution was a purpose-built automatic sampler designed not to capture an entire bucket of chips, but to break up the continuous chip stream into smaller, well-dispersed segments. This dispersion was critical—it allowed our optical system to capture clear, high-resolution images of individual wood chips as they passed by. Manufactured locally for rapid deployment and cost-effectiveness, the sampler was retrofitted onto the mobile chippers operated by loggers in the field. Its function was to fragment the dense chip flow into a pattern where every chip could be imaged under controlled conditions.

We then implemented a high-speed imaging system equipped with a rugged, high-resolution camera paired with an array of structured LED lights. This configuration provided uniform, high-intensity illumination, ensuring that each wood chip was sharply imaged despite the challenging outdoor environment. The imaging system was mounted adjacent to the sampler so that as the chip stream was broken up, each chip could be captured in rapid succession. Advanced computer vision algorithms, running locally on a ruggedized Raspberry Pi platform, processed these images in real time. The deep learning model was specifically trained to evaluate critical quality metrics—chip size, shape, and the proportion of bark versus wood content—ensuring that even subtle variations could be detected.

Recognizing the connectivity challenges inherent to remote forest operations, we integrated a satellite modem into the sensor suite. This modem enabled the real-time transmission of quality data to an Azure cloud environment, ensuring that critical performance metrics were continuously available, even in areas with limited terrestrial network access. In the Azure cloud, data was ingested into an IoT Hub and processed using streamlined AI models that compared the incoming quality metrics against predetermined thresholds. When anomalies were detected—such as excessive bark content or irregular chip sizes—the system automatically generated alerts.

Instead of dispatching maintenance teams to every logging site, our system was configured to send targeted text messages directly to field crews. These alerts provided precise information on which chipper units were experiencing quality issues and the nature of the deviations, allowing technicians to focus their efforts only where intervention was needed—whether to adjust operational parameters or address equipment wear. We also had alerts that went out to the individual loggers when the system needed to be cleaned, which wasn't as often as one might expect, because our design incorporated a specialized, non-stick transparent coating applied to both the camera lens and LED light covers. This advanced coating, engineered to be both hydrophobic and oleophobic, significantly reduced particulate adhesion by creating a microscopic barrier that prevented dust from “sticking” to the surfaces.

The deployment of our integrated solution followed a rigorous, iterative process. Initially piloted on a single in-woods chipper, the system was meticulously validated under real-world conditions. Sensor calibrations were fine-tuned, deep learning model parameters were adjusted based on live field data, and satellite connectivity was optimized to ensure reliable transmission. Once the pilot phase demonstrated consistent performance and reliable data capture, the solution was scaled across the entire fleet of mobile chippers, establishing uniform quality monitoring across all operations.

The impact of this technological integration was transformative. By automating the chip quality measurement process and enabling real-time, data-driven maintenance interventions, the system elevated the quality of in-woods chips to match that of the paper mill's own chipper. Improved chip consistency translated directly into enhanced fiber yield, reduced waste, and significant cost savings. Furthermore, the innovative use of high-speed imaging, advanced IoT sensor technology, and real-time AI analytics ensured that the solution was both scalable and resilient—capable of operating effectively in even the most demanding forest environments.

Wintermarch Group's solution exemplifies how modern technology can revolutionize traditional, labor-intensive processes. If your operations face similar challenges in raw material quality or remote equipment maintenance, discover how our expertise can drive measurable, sustainable success.

Contact Wintermarch Group at info@wintermarch.com to transform your operations and unlock the full potential of your supply chain.