Unmanned & optimized operation of dry bulk equipment
Unmanned & optimized operation of dry bulk equipment

FLSmidth® BulkExpert™ is a unique, patented solution that focuses on unmanned and optimized operation of dry bulk equipment, lowering cost tonnes and increasing returns for major dry bulk terminals around the globe.

Stockyard throughput up by 10-15%
The BulkExpert system has the most advanced automation technologies on the market. It is a profitable, fully-automated system that handles the challenges and requirements of transferring bulk materials, delivering capital efficient tonne.

Benefits
- Lower cost tonnes
- Higher returns
- Capital efficient volume growth
- Increased throughput
- Maximised output by increasing utilisation
- Utilisation of excess capacity

Proven value
With 10 years of onsite software development, under critical operating conditions at import terminals with multiple material types and grades, the BulkExpert system has proven its value. There are currently more than 30 BulkExpert systems in operation with various combinations of stacker/reclaimers, ship loaders/unloaders and train load-out stations.

Customers report that stockyard throughput can typically improve at least 10-15% using the BulkExpert system compared to manual operation or existing conventional automation solutions. This translates into a typical payback time within one to two years, but it can be as low as months.

Reduce operating costs through:
- Improved equipment efficiency
- Reduced labour costs
- More homogeneous flow rates
- Reduced maintenance costs
- Increased quality prediction
- Better energy utilisation
- A greener profile

Advantages beyond present industrial standards
Different operating methods, combined with the multiplicity of materials, have traditionally made it difficult to rely on anything but highly-skilled operators and to some extent semi- or conventional automated systems for transporting dry bulk material. However, these methods have variations in operator performance, operational errors (resulting in unplanned downtime) and insufficient or inconsistent availability of stockyard information.

The patented BulkExpert technology is unique. The system is installed on moveable machines and provides valuable, consistent data combined with high-level algorithms to optimise the transfer of bulk material in stockyards.

Features
- Centimeter-level accuracy derived from 3D-laser scanning systems combined with a dedicated RTK-GPS array
- Real-time, full-terrain information of the surroundings
- 3D-modelling with real-time re-conciliation by 3D-laser scanners
- High reliability with dedicated real-time kinetic GPS systems

Integrated on one platform
The FLSmidth BulkExpert system consists of a set of subsystems to manage and operate a stockyard. It is an integrated solution targeting the overall performance in and out of stockyards, always ensuring safe and reliable machine operation and making it possible to have unmanned, optimized operation of any type of stacker/reclaimer, ship unloader/loader and train loader system on the market. These individual machine technologies can also be fully integrated using one common stockyard management platform.

1Ship unloader and loader technologies are offered in partnership with the German technology company iSAM AG.
BulkExpert Stockyard Management provides an operator with full control and detailed real-time monitoring of the entire stockyard. Being able to keep track of exactly where different grades and quantities of materials are located is vital in order to schedule and optimize a combined stockyard operation. In addition, the operator can schedule and queue individual tasks for each autonomously operated stockyard machine.

**Features**
- Unmanned machine control
- Real-time 3D visualization with “walk in the stockyard” model
- Material tracking with stock accounting and blending possibilities
- Real-time inventory overview, constantly reconciled by the 3D-laser scanners (not only a mathematical model)
- Machine task scheduling
- Anti-collision and avoidance system (ACCA)

**Stockyard visualization**
Stockyard visualization offers a graphical view of the actual surface structure of the entire stockyard and the current stockyard machinery location, based on real-time data from the unmanned control technology on the stackers/reclaimers. Changes in the pile surface structure caused by external interferences, such as dozers, material settlement or pile collapses, are tracked and you can get a quick overview of the material type and quantities stored around the stockyard together with a more detailed analysis tool to zoom and view cross-sections and effective utilization information.

In addition, you can easily define and setup pad areas to be used for stacking/reclaiming.

**Material tracking**
The material tracking database keeps track of all material handled by the stockyard machines. Material properties, such as density, grade and type can be added and customized, and data can be exchanged with other information systems. Material tonnage, type, grade and discharge point are all utilized in advanced material flow calculations contained in the Stockpile 3D block models to calculate the precise end-up location in the stacked piles. Materials are color coded and graded for easy visual identification in the graphical overview.

A reporting tool means you can extract vital information about any material stored in the stockyard database, e.g. material quantity, location or grade, which is important when it comes to blending different grades of material to obtain a specified combined product.

**Task scheduling**
You can schedule and queue tasks to the individual stockyard machines operated by the unmanned control technology. Each scheduled task comes with a duration time estimate, which for the combined amount of scheduled tasks are summed to a total booked time for the machine. This allows the system operator to quickly work out the planned operation status. The operator can also grade manage the content of stockpiles by mixing material grades in different stacking patterns and varying amounts that are recorded in the material tracking database and can be used for both internal and external data handling.

**Anti-collision**
The Supervisory Anti-Collision and Collision Avoidance (ACCA) system uses the SIL2 rated RTK GPS receivers positions and automatically alerts an operator if machines are within the vicinity of the outer-allowed operations. It will perform a machine shutdown if a potential machine collision is pending. The ACCA system includes:
- Visualization of anti-collision zones in 3D
- Configurable and pre-defined zones

**Vital information at your fingertips**
Using the Stockyard Management system, an operator can easily answer these questions:
- Where are different grades and types of material located?
- What is the current stockyard utilisation?
- Which in- and outgoing material orders are next in line?
- What is the scheduled amount of outgoing material?
- What is the scheduled/estimated loading time, unloading time etc.

**Unmanned Control Technology**
- Stacker/Reclaimer
- Shiploader/Unloaders
- Train Loading Stations

**Machine Task Scheduling**

**Material Tracking**

**ACCA - Anti Collision & Collision Avoidance**

**Stockyard Management BulkExpert™**
Stacker/reclaimer automation

Real-time full terrain information about the stockyard is used to calculate operating commands for any stacker or reclaimer controlled by the BulkExpert™ system. High-level algorithms ensure the maximum utilisation of machines resulting in perfectly stacked piles, predictive slew control and the elimination of air digging.

Operational challenges solved
Stockyards around the globe face daily challenges operating stackers/reclaimers, such as variable operator performance or error, complex planning, manual tidying up of piles, high maintenance, insufficient stockyard information or interference from the weather.

The BulkExpert system produces real-time full terrain information, generated by the 3D laser scanner and used for replacing the commands normally given by the machine operator with centimeter accuracy.

Benefits
- Optimized machine utilisation
- Low standard deviation when reclaiming
- Centimeter accuracy eliminates air reclaiming and ground digging
- Collision hazards continuously monitored
- Low mechanical wear and tear

Using this system, only one operator is required in the central control room (CCR) to control a complete stockyard. The operator enters the job parameters (e.g. material, amount, location) for the relevant stacker/reclaimer and the machine automatically moves to the correct location and starts the job by selecting the most beneficial position and bench in order to achieve optimal results.

Specific stacker/reclaimer technology
The technology can be implemented on top of any conventional stacker/reclaimer PLC system. Original safety circuits and machine interlocks are left unaltered, leaving the machine vendor warranty/liability unaffected.

The 3D-laser scanner mounted on the machine apex provides a reliable scan range of minimum 120 m and covers 340° with more than 10,000 image spots per second – providing a 3D image with a resolution of max 10 x 10 cm for the complete stockyard. Two real-time phase differential GPS receivers are mounted on the pylon and near to the bucket wheel/boom top, giving a very precise determination of the bucket wheel’s position, without requiring additional angle or position transmitters.

Features
- Industrial IP67 3D laser scanner, class 1 (“eye safe”)
- Limited dust and shock influence by installation on apex (3D laser scanner)
- RTK GPS provides an accuracy of 2 cm + 1 ppm and a refresh rate of 20 Hz
- Synchronisation between GPS and laser scanner with a maximum latency time of 50 ms
- Special algorithms handle interference, such as dust, fog, or precipitation

Stacking benefits
Due to the 3D-data available, the system ensures a uniform surface even when stacking over existing material or with changing material properties. This ensures:
- More material stored in the same footprint (up to 20%)
- Existing material can be stacked over partly or completely while still maintaining a uniform bench height
- Avoidance of “pile gaps”, increasing storage capacity and reclaiming performance
- Significantly reduced longitudinal travelling with backwards Cone Shell stacking (up to 90%)  
- Piles reach full width starting with the first train or ship
- Predefined stacking methods, such as Windrow, Chevron and Cone shell

Reclaiming benefits
Complex piles can be reclaimed, without manual intervention, taking into consideration variable bench heights, gaps in piles and changes in bench width. The predictive slew control means:
- The slew speed can be adapted before changes in the bench can be seen in the bucket wheel power/torque
- Over-torque is prevented
- Landslides and compacted materials are handled with maximum performance

Results achieved
A recent performance test comparing the BulkExpert system with a conventional PLC mathematical model-based automation found that on average reclaiming is optimized by 10–15%.

Even higher results can be expected when compared to manual operated machines or for stockyards with highly complex operations and manual work from front loaders, dozers etc.
Train loader automation

Operational challenges solved
Train loading stations can be bottlenecks for bulk material. Throughput and wagon capacity utilisation are very important and can directly affect overall profitability. Wagon identification and condition, loading errors, incorrect information about wagon sequences and material distribution are some of the factors that can result in a conservative operation of a train loading station to prevent costly overfilling. This can result in reduced capacity and prevent optimal performance.

Unlike conventional automated train loading systems, the BulkExpert system takes into account the scanned actual load capacity of wagons and verifies volume utilisation for load optimization. In addition, the system can exchange data directly with existing railway planning systems, further reducing the possibility of human errors and simplifying the process.

Specific train loader technology
Durable, high-precision 2D scanners, combined with discharge weighing are used to efficiently load each wagon. Before entering the loading station, wagons are scanned and identified, and anything resulting in volume or weight abnormalities is detected (for example, damage, residual material, open hatch doors). The discharge chute position is dynamically adjusted for each wagon passing through the loading station where loading is done with dynamic mass flow control, and it is adjusted for the monitored wagon speed, to ensure proper material distribution.

Scanners placed immediately after the discharge chutes provide adaptive loading control, especially used for volumetric optimization. The full content of the loaded wagon(s) are scanned and verified after loading, and the information is used to provide valuable feedback for the predictive loading controller, which adjusts the filling of the weighing bunkers for the next-in-line wagon.

From a central control station, loading orders for a complete train are started, and the automation system takes full control of the loading process. The train is pulled through the loading bunkers by a remote-controlled tractor. The speed of the train is adjusted during loading for optimized throughput and precision.

The train loading system is a fully automated system, from first to last wagon, only requiring one operator in the CCR to control several train loading systems. The operator enters or confirms the job parameters (material, amount of wagons, wagon types etc) for the relevant train loading systems, and chooses corrective action if significant deviations are encountered between planned data and actual data.

Features
- Durable, high-precision 2D scanners, combined with discharge weighing to efficiently load each wagon
- Takes into account the scanned actual load capacity
- Verifies volume utilisation for load optimization
- Exchanges data directly with existing railway planning systems
- Adaptive and predictive loading controller

Benefits
- Reduced transport cost due to optimized utilisation of wagon capacity
- Shorter loading time per wagon as a result of optimized filling of weighing bunkers and adjusted train speed
- Reduced operator staff
- Automated load adjustment according to the actual condition of each wagon
- Full wagon utilisation without risk of overfilling
Optimise your stockyard

**BulkExpert is a unique product beyond what any competitor can offer.** It is a mature and proven solution designed to unleash the full potential of dry bulk stockyard equipment and is therefore a system that should be considered to keep your capital investments as low as possible while maximizing throughput, minimizing operating costs, and delivering a capital efficient tonne.

**Customized optimization**
No two stockyards are alike and optimizing a stockyard should take into account stockyard layout, mode of operation and the installed equipment. FLSmidth starts with a thorough analysis of the conditions prevalent at your specific site, including gathering data, observing the daily operation and inspecting installed equipment’s condition, suitability and performance.

Recommendations for optimization focus on:
- Areas of improvement
- Financial viability and estimated return on investments
- Specification of requirements of the installed equipment

Following a feasibility study, FLSmidth will specify a project scope and execution including implementation and commissioning of the BulkExpert application and adaptation of existing equipment if necessary. FLSmidth can undertake some or all of the tasks and will ensure minimal disturbance of the daily operation.

**Valuable return on your investment**
The FLSmidth BulkExpert system is a unique solution providing the unmanned and optimized operation of dry bulk equipment. The result is lowered cost tonnes and increasing returns for major dry bulk terminals around the globe.

**Overall benefits**
- Increase overall equipment efficiency
- Minimise operating costs
- Synchronised operations between unloading/loading and stockyards
- Easy and accurate overview of stockyard material types, volume and tonnage
- Additional safety features contributing to decreased machine downtime
- Tailor individual packages or a complete solution to meet your needs
- System availability greater than 98%