Machinery Group
Machinery Group

BMT WBM has built a reputation for solving the more difficult and challenging problems facing machinery designers, manufacturers and operators.

Underpinning this reputation is an innovative, analytical approach, with a comprehensive measurement and analysis capability from a highly qualified, highly experienced team of professionals. From massive bulk handling equipment to small mass-produced machinery components, BMT WBM provides assistance in the acquisition or design of new machinery.

For operators of existing machinery, BMT WBM offers a range of services aimed at reducing costs, improving operational performance, efficiency and safety.

With specialists covering all engineering disciplines from mechanical, electrical, structural, civil and controls to fluid power hydraulics, BMT WBM provides a totally integrated service to address any machinery requirement.

The company has offices in Brisbane, Newcastle, Sydney, Melbourne and Perth in Australia, Denver, USA and Vancouver, Canada, providing a world wide service to customers with machinery problems. BMT WBM also offers specialist services in water and coastal engineering and environmental science.
Industries

BMT WBM serves a wide range of industries and typically these industries utilise capital-intensive plant and machinery. High plant availabilities are needed; and a high level of engineering skill is required to be applied to prevent and to solve operating reliability issues.

Surface Mining

Draglines

BMT WBM is a world leader in providing independent advice to dragline operators to assist with mechanical, structural or electrical problems. The company offers a range of specialist services including:

- Repair/replace advice and re-engineering for dragline tubs, revolving frames and booms, as well as roller circles and other components
- Modification of drive control – to extend operational life or allow increased payloads
- Suspended load test – to accurately quantify bucket loading under operating conditions
- Roller load test – after roller load tests on more than 160 draglines worldwide, BMT WBM can accurately assess the condition of dragline slew bearings, predict their likely life, identify the source of problems and advise on means to extend bearing life
- Spall detection – on roller circle rails to track progressive damage
- In-situ rail grinding – to quickly correct a range of slew bearing problems

Bucketwheel Machines

BMT WBM is a recognised authority on Bucketwheel excavators: their application, selection, design, maintenance and operation. In particular, the company is uniquely positioned to advise on the use of BWE’s in lignite mines and in similarly difficult digging conditions. BMT WBM’s experience includes:

- Maintenance practices
- Repair and refurbishment, including stability issues
- Design
- Condition assessment and inspection
- Automation and control of the digging operation
- Safety device checking
- Production, performance and structural testing
- Conveyors
- System design

Mining Shovels

Mining shovel problems, whether related to machinery, structure, slew bearings, hydraulics, electrics or controls are all areas where BMT WBM has expertise and experience. Through analysis, testing or design, BMT WBM can assist with specifications, troubleshooting, repair, re-engineering or maintenance.

Underground Mining

Longwall Roof Supports

- Specification and design audits for new supports
- Diagnostic measurements on operating walls
- Prototype test review
- Inspection and management plans for roof support cracking problems
- Quality management of fabrication and rebuilds
- Repair planning and supervision
- Optimisation of hydraulics and control systems to increase longwall productivity

Longwall Shearers

- Specification and design audits for new shearers
- Measurements of cutting loads and operating stresses to resolve machinery and structural problems
- Haulage drive trouble-shooting and design reviews to increase longwall productivity

Armoured Face Conveyors

- Measurement and analysis to solve recurrent problems with AFC drives, drive sprockets, flight bars, chains and line pans
- Dynamic modeling of start/stop behaviour to predict tensions and slack chain generation
- Optimisation of tail gate tensioning systems to increase chain life and reduce chain jamming problems

Continuous Miners, Crushers and Loaders

- Failure analysis, problem solving, re-engineering
- Diagnostic measurements of stress, loads productivity

Underground Conveyors

- Dynamic analysis and design for systems with booster drives, CSTs, loop takeups
- Troubleshooting and re-engineering
- Optimisation of control systems

Tunnel Borers

- Cutter head bearing assessment
- Structural problems
Ports and Bulk Handling
For companies operating bulk materials export and import facilities, container terminals and mine site or power station stockyards, BMT WBM provides assistance with the selection, operation and maintenance of machinery.

The company has developed special expertise in many areas and offers a broad-ranging service covering design, design audits, repair supervision, vibration testing, life extension, safety audits, inspections and re-engineering.

BMT WBM's experience includes:
- Shiploaders/Unloaders
- Reclaimers
- Stackers
- Stackers/Reclaimers
- Container Cranes
- Rotary Dumpers
- Conveyors

Power Generation and Process Industries
For downtime-critical process and power industries, BMT WBM's broad expertise and thorough technical approach delivers substantial benefits.

Clients include:
- Smelters
- Sugar mills
- Paper and pulp mills
- Oil refineries and petrochemical plants
- Power stations
- Chemical plants
- Abattoirs

Mineral Processing
BMT WBM offers design, auditing, troubleshooting and related services on a range of mineral processing equipment including:
- Ball, SAG and rod mills
- Vibrating screens
- Centrifuges

Railways
Clients include manufacturers and operators of locomotives, rolling stock and special purpose machines.

The company assists in design, product development, testing, reliability and performance improvement.

Materials Handling
Plant System Design
BMT WBM has the expertise and experience that delivers materials handling plant systems that are efficient and effective in meeting the demanding performance requirements of Port and Mine facilities.

BMT WBM provides experience in all aspects of the complete systems delivery cycle including planning, feasibility, concept, specification, project tendering, supply management, construction management, commissioning, operation management, maintenance engineering and through life technical support.

This detailed knowledge is built into our design and advice on plant and systems, resulting in systems that reliably perform, are compatible with project development requirements and are cost effective.

Typical services include:
- System design
- System Audit and Design Review
- Performance optimization
- Evaluation of alternative system options
- Complete system modeling and simulation
- System control philosophy design
- Conveyor system Design

Services
BMT WBM engineering services cover a spectrum of technical areas within mechanical, structural, electrical and controls engineering.

- Reliability assessment
- Risk assessment and risk management plans
- Major equipment performance specification
- Design for access and maintainability
- Design for System flexibility
- Interfacing systems performance and compatibility
- Component standardisation
- Capital cost estimation
- Life cycle cost estimation
- Staged construction or development
BMT WBM offers a total design capability for all types of machinery, ranging from complete bulk handling systems and machines to small mass-produced components. The company specialises in designing complex, special purpose, high-tech machines to suit a customer’s specific requirements.

Whatever the application, BMT WBM has the expertise to integrate all of the required skills to develop a cost-effective machine for the task. BMT WBM can manage the entire process or assist with particular aspects, from concept development, through detail design, manufacture, installation to final commissioning.

BMT WBM also specialises in the re-design and re-engineering of existing machines to eliminate recurrent failures, improve performance, increase capacity or reduce risks.

A world leader in auditing the design of large and complex machinery, BMT WBM has completed audits on more than 40 major machines for clients in many countries throughout Africa, Asia, North and South America as well as Australia. The company specialises in fast track audits, run in parallel with the original design of a machine, where the opportunity exists to find and correct design deficiencies and errors. This audit process can deliver:
- Improved safety
- Extended life of structure and machinery
- Verification of conformance with specification
- Identification of operational risks

In addition, the company has always maintained a large group of highly qualified, very experienced analysts, with a practical, customer problem focus.

BMT WBM specialises in mathematical modeling and simulation of all types of engineering problems. It uses leading edge software and computing hardware to provide rapid answers to complex problems involving stress analysis, fluid flows, heat transfer, structural and drive dynamics and control systems.

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**Analysis**
At BMT WBM, analysis is a key element in the overall approach to solving machine problems. It is an integral part of the design, troubleshooting, failure analysis, performance enhancement and life extension services which BMT WBM provides.

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**Services**
**Machine Design**
**New Machines**
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**Upgrade Existing Machines**
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**Stress Analysis and Finite Element Modelling**
The company uses a range of FEA software packages to analyse complex machine structures and components for stress, deflection, buckling, fatigue and related assessments.

**Structural Dynamics**
Vibration problems involving large machine structures are routinely addressed using FEA software.

**Specifications**
We advise clients on the essential requirements for planning and implementing the audit, to ensure the process delivers achievable benefits, without undue impact on cost or benefits or program. In particular, we specialise in writing concise technical specifications to define the standard against which the machine is to be audited and the procedural rules for conducting the audit.
Analysis
Heat Transfer, Temperature
BMT WBM specialises in analysing complex thermal problems, involving conduction, free and forced convection, using FEA or CFD and has used these approaches for many industrial problems.

Fluid Flow
We use powerful CFD software to assess fluid flow problems, with turbulent or laminar flow, either compressible or incompressible, as an aid to calculating flow rates, pressure drops, drag coefficients.

Drive Train Dynamics
BMT WBM uses a range of proprietary and in-house software to analyse torsional and associated dynamics of machine drive trains, including prime movers and multi-branched geared systems.

DEM
BMT WBM undertakes a wide range of Discrete Element (DEM) and Volumetric Modelling analyses. DEM modelling is especially beneficial for designing conveyor transfer chutes for improved flow of sticky material through complex transfers. DEM provides engineers with insights into problems such as blockage potential, spills, off-centred loading, and excessive wear.

Test and Measurement
Another cornerstone of BMT WBM’s approach in assisting clients with machinery problems is the use of diagnostic measurements under actual operational conditions.

Machinery Problem Diagnostics
BMT WBM has a very comprehensive range of sophisticated instrumentation and recording equipment for measuring critical parameters such as loads, stresses and hydraulic pressures. Measurements of this kind often provide the key to diagnosing the cause of machinery problems or failures and they provide the best possible basis for re-engineering to fix a problem.

Performance, Safety and Design Verification Testing
An independent testing service for customers wishing to verify the performance, safety or design of both new and existing machines.

Vibration Monitoring
Advice, interpretation, hardware or software supply, or total program management. For the more complex and difficult vibration problems, BMT WBM provides powerful multi-channel measurement and analysis to identify the source of problems and their solutions.

Long Term On-line Monitoring, Data Logging
For problems which only occur intermittently, and for capturing long term trends, BMT WBM provides on-line monitoring instrumentation, coupled to data loggers programmed for the specific requirements of each problem.

Remote Interrogation
For critical items of equipment, a low cost communication link to a site or to one of BMT WBM’s offices allows rapid, effective interrogation and very cost effective management of a condition monitoring program.

Testing of Rotating Machines
BMT WBM specialises in measurement of torque, stress and vibration on rotating machines, using radio telemetry links to transmit the measurement data to a recording station.

Special Purpose Test Instrumentation
The company maintains an electronic design and build capability. Where the constraints imposed by a particular machine require a novel approach, BMT WBM provides purpose-built transducers and instrumentation.
We specialise in assisting owners and operators of equipment to better manage and maintain capital assets over their operational lifetime, the company offers a comprehensive range of services including:

**Maintenance Support**
We have experience with the operation, repair and maintenance of large machine and machinery systems. BMT WBM can assist operating companies in making maintenance more effective and in reducing total life-cycle costs. At any level, from provision of advice to total implementation or management, BMT WBM can support operating companies in a number of areas including:
- Whole of life maintenance plans
- Repair-replace decisions for major equipment
- Strategic spares inventories
- Documentation
- Maintenance systems
- Vibration monitoring

**Risk Assessment, Reduction and Management**
Based on a long involvement in machinery failures and accidents, BMT WBM is uniquely positioned to provide machinery operators with advice on assessment, management and reduction of risk. Delivery of this service can involve measurements on an operating machine analysis to assess design adequacy, machinery inspection and condition monitoring; all key areas of BMT WBM’s expertise.

**Condition Monitoring**
An effective condition monitoring program is a primary tool for managing both risk reduction and maintenance. BMT WBM can assist at all levels of planning, implementing or interpreting condition monitoring programs or, where appropriate provide a total service, running and managing the entire program.

**Machinery Inspections**
BMT WBM has an extensive background worldwide in carrying out independent machine inspections: structural, mechanical and electrical. These inspections are usually undertaken to assess safety or operational risk, or as part of an overall risk management strategy.

**Life Extension**
In many cases, the operational life of a machine can be extended by some minor modifications to the structure of mechanical equipment. As a result, the life extension option often provides a cost effective alternative to replacing an existing machine. At BMT WBM, the process usually involves measurement or analysis to identify potential failure areas, prediction or component life, and development of appropriate structural or mechanical upgrade strategies consistent with the client’s objectives and constraints.

**Services**

**Project Engineering Services**
BMT WBM has a large, experienced and capable team which specialises in providing services in support of engineering projects.

**Project Management**
BMT WBM provides a full spectrum of project management services from project inception, through concept development, feasibility studies, financial projection, design, procurement, contract administration, construction, and commissioning. BMT WBM provides total project management and assistance with any specific aspect.

**Procurement and Expediting**
In the purchasing of technically complex equipment, BMT WBM assists customers in obtaining a better outcome in terms of cost and delivery, while meeting required quality standards.

**Quality Assurance, Inspection**
With a long history of equipment failure investigations and in subsequent re-engineering, BMT WBM is uniquely positioned to assist customers acquiring new or replacement machine components of better or guaranteed quality. BMT WBM writes detailed technical specifications, inspection and test plans and provides independent inspections to achieve the required product quality.

**Commissioning**
Specialists in structural, mechanical, electrical, controls or fluid power hydraulics are available to manage or assist with the commissioning of complex machines or machine systems.

**Accident Investigation, Failure Analysis**
The company has been involved in many accident investigations, especially with large bulk handling machines. These investigations often involve detailed analysis (structural modeling, fracture mechanics, accident dynamics) or measurements on similar operational machines.

BMT WBM can draw on a broad range of engineering or metallurgical skills which may be required to identify the cause of the accident or failure.

**Expert Witness Advice, Arbitration**
A large number of BMT WBM’s staff have experience as expert witnesses on legal matters covering a very broad range of technical issues, but mainly related with accidents and machinery failures. In some instances, the company has also provided experts to act as arbitrators/mediators in complex technical disputes.
Specialist Technologies

In response to customers’ needs BMT WBM has developed many innovative services and products. The depth of technical skill and wide range of technologies available within BMT WBM are apparent in the following selected cases.

Large Rolling Element Bearings
BMT WBM provides a unique service in the testing, assessment, troubleshooting and re-design of large rolling element bearings. Based on more than 25 years experience, both with open roller and ball races and with precision, hardened bearings, BMT WBM assists machinery owners by:
- Predicting the probable life of the bearing
- Designing, specifying upgraded bolt-hole compatible bearings to obtain increased life
- Providing advice on bearing change-out procedures and on support techniques for increased life

Gearing
- Design of gear trains, gearboxes
- Failure analysis
- Geared drive train measurements
- Rating of gearing for capacity or life to international standards
- Torsional dynamics analysis of geared systems

Weighing of Large Machines
BMT WBM specialises in the weighing of large machines to determine weight and centre of gravity. Using load cells and/or pressure transducers. BMT WBM has expertise in weighing draglines, bucketwheel excavators, stacker/reclaimers and shiploaders.

Conveyors
With over 40 years’ experience designing high performance conveyors and conveyor systems, BMT WBM has built a solid reputation as the premier consultancy for solving the more challenging issues facing bulk material handling mine and ports operators.

Our reputation is underpinned by a highly skilled and multidisciplinary team of professionals who are not only experts in design, but have faced the challenges as Operations and Maintenance Engineers in charge of materials handling plant.

Our skills include mechanical, electrical, structural and civil design and we have a full-drafting office capable of delivering small and large design projects from concept to detailed design. We also have specialist skills associated with electrical power distribution systems, control systems, overarching monitoring systems, water systems, civil infrastructure, fire protection, dust suppression, maintenance systems and all the necessary auxiliary systems essential for efficient conveyor operation.

We use in-house software developed over 30 years to provide reliable static and dynamic analysis for all conveyor types configurations. Our expertise also enables custom modelling and simulation of any unusual conveyor configurations and components.

Our experience and expertise covers every type of conveyors including:
- Long high capacity overland conveyors
- Mine conveyors
- Port conveyors
- In plant conveyors
- Underground
- Downhill regenerative moving mine conveyors
- Special purpose conveyors, plant and machinery

We have designed conveyors for almost every type of bulk material and our project team understands conveyor projects and can deliver feasibility studies, bulk transport option evaluation, concept design, design planning, value engineering, contract technical documentation and Capex/Opex costing of the most complex systems.

Difficult conveying problems are our specialty, whether it is an in pit crushing & conveying system (IPCC) handling sticky and abrasive materials, an underground conveying system with modular construction or a vessel mounted conveying system required to handle mineral concentrate in challenging marine conditions.

We are specialists when it comes to challenging conveying scenarios.
Robotic Wagon Vibrator

The Problem

Many high-capacity coal export terminals, which receive coal by rail in bottom-dump wagons, experience major delays due to discharge failure when handling sticky coal. These delays can have a serious impact on the capacity of the rail system feeding the port and on the terminal inloading capacity. For trains carrying about 10,000 tonnes of coal, sticky coal discharge problems often increase unload times from a nominal 2 hours to more than 4 hours, and sometimes to as much as 10 to 15 hours. The associated costs to the terminal through lost production can be substantial.

At Australian ports, the technique used to address sticky coal discharge problems has historically been to use manually-operated jackhammers, applied to the sides of the wagon. While moderately effective, delays with sticky coal can still be very long. Furthermore, the use of jackhammers is physically demanding for operators, and represents a significant OH&S risk, because of the need to work for long periods in a very noisy, often harsh environment, performing an ergonomically difficult task.

Specialist Technologies

The Solution

To address these problems of discharging sticky coal, BMT WBM has developed a fully automatic robotic wagon vibrator. A number of these are now operating in Queensland coal terminals. One or more vibrators are installed in a dump station, at fixed locations adjacent to the track. As the wagons roll past, at relatively constant speed, the vibrator lands on and tracks the lower sill of each wagon, retracting automatically at the wagon end. Failure of the coal to discharge when the bottom dump doors are opened is detected automatically, activating the vibrator, which dislodges the coal. The vibrator operates at high frequency, delivering an oscillating force of about +/- 1.5 tonnes to the side of the wagon. This is more than an order of magnitude greater than for manually-operated jackhammers. Because of the method by which the force is applied, however, wagon stress levels are relatively low, with no adverse impact on wagon fatigue life.

The vibrator system is equipped with sensors, controls, and logic to enable it to recognise and adapt to the geometry of different wagon types, and to recognise and avoid locomotives.

Benefits

Use of the robotic vibrator offers significant benefits to coal terminal inload operations including:

- Significant reduction in unloading delays when handling sticky coal, with a corresponding increase in throughput rates.
- Removal of operators from OH&S risks associated with manually operated jackhammers. Previous risks of hearing damage from high noise levels, and of shoulder and back injuries are eliminated.
- Opportunity to substantially reduce Manning levels. Dump station operations can now be controlled by a single operator, and the potential exists for total automatic control.
- Elimination of possible structural damage to the wagons.

All equipment on the vibrator is designed to IP67 or better, to accommodate the aggressive environment of the dump station, including hose-down requirements. Operation of the vibrators is monitored remotely by a single operator, located in an acoustically-treated, air-conditioned control room.

The vibrator’s control system incorporates a comprehensive system of self-diagnostics to facilitate the rapid resolution of equipment problems. The system is also connected to and integrated with site SCADA networks, to permit remote interrogation and the logging of vibrator performance.
Rope Shovel

The PULSE TerraMetrix RS Shovel Management System was developed to address the accuracy issues commonly associated with shovel based payload monitoring systems.

Unlike other payload monitoring systems which rely on electrical parameter measurements to approximate the payload as a quasi-static process, the PULSE TerraMetrix RS system employs a loadcell to directly measure the inertial and dynamic loads applied to the dipper.

As a result, accurate payload measurement is maintained even under severe dynamic loading conditions. Calibration trials completed at several mine sites in North America have confirmed that the PULSE TerraMetrix RS system repeatedly achieves accuracy levels exceeding industry norms. Proof of calibration data is available on request.

The net payload displayed by the system allows the operator to employ smart loading strategies: if the truck is under loaded by more than 1/2 a dipper load then an additional pass can be executed to achieve the target load.

With this ability, truck dispatch can be initiated by the shovel operator when the target load is achieved. Although truck dispatch has been introduced based on truck weightometers, due to strut friction, truck weightometers are not sufficiently accurate to implement this form of strategic loading control at the shovel in real time.

The PULSE TerraMetrix RS system repeatedly achieves accuracy levels exceeding industry norms. Proof of calibration data is available on request.

Dragline

The PULSE TerraMetrix dragline boom monitoring system was first introduced in 1995 at a coal mine in Australia. The mine wanted to understand what actions caused boom cracking. Further refinement of the product has continued in North America ever since with a general belief that reduced dragline maintenance and increase production can occur simultaneously.

BMT WBM’s long history with dragline maintenance and operational support facilitated the development of the product as our personnel were continually exposed to current problems and needs of owners/operators of draglines. The system provides instantaneous real-time feedback to the operator, key performance indicators and information dashboards to managers and supervisors, and sophisticated diagnostics and trending tools for reliability personnel and maintenance engineers.

Health Monitoring
- Continuous fatigue stress calculations, comparison to acceptable levels
- Statistical stress information - max, min, mean, etc., comparison to acceptable levels
- Structural “Peer” Alarms based on performance against other operators
- Structural “Design” Alarms based on durability of the structure
- Differentiation of side loading events and excessive payload events
- Inertial swing rate detection vs. structural stress
- Pad grade detection and monitoring of pitch/roll/swing angles vs. structural stress
- Email/Test alert notifications based on configurable parameters (i.e. “DL99 has sustained more than the allowable number or Design Alarms in the last 15 minutes”).

Production Monitoring
- Advanced payload measurement using system strain gauges calibrated with highly accurate load cells.
- GPS machine location and heading, dig and dump locations
- Down time, dig times, swing times, cycle times, propel times, etc.
- Operator Logins, crew schedules, delay codes
- KPI’s such as buckets per operating hour, Tons per operating hour, Utilization, %RSL (average and instantaneous). Overall Dragline Effectiveness, Operator Effectiveness and others.
- Advanced cycle counting algorithm with false bucket rejection
- Email/Test alert notifications based on configurable parameters (i.e. “DL99 has stopped operations with less than 5 buckets in the last 30 minutes”).

Centralized Information
- Web-based DataCentre “Portal” available on mine network to provide all information necessary
- Fleet Manager
- Machine Specific Dashboards
- Real-time views of the operator’s HMI
- Graphical, historical database querying and planning tools based on industry standard MS-SQL platform
- Training documentation, Report Archives
- Daily distributed reports.

Specialist Technologies
BMT WBM has a proven record in addressing today’s engineering and environmental issues.

We aim to continue to enhance our services, capabilities and areas of application to meet the community’s future development and environmental protection needs.