



Vulcan Module Descriptions for Version 8.02 Release

Module	Component	Description
Base Modules	Vulcan 3D-CAD	This forms the basis of the Vulcan 3D Software System and is the fundamental pre-requisite for all Vulcan licenses. The basic CAD tools of Envisage are found in the first four menu items: File, Design, View and Analyse. These functions allow the user to create, interrogate, manipulate and store design data in Vulcan and to control the interactive 3D workspace.
Primary Modules	Data Transfer (not a "Saleable" module)	This menu allows you to import and export data to other 3rd party software packages including Datamine, Minesight, Surpac, Gemcom, Micromine and Minex.
	Triangulation Modelling Toolbox (not a "Saleable" module)	Vulcan has a complete set of tools to quickly create triangulations from CAD data. This includes both surface and solid triangulations and has a comprehensive set of tools for editing and analysis of the triangulations.
	Block Model Viewing (not a "Saleable" module)	Vulcan's Block Model View-only tools allow visualization of model slices dynamically and viewing of blocks based on user-defined colour schemes.
	ENVIEWER *	Vulcan's Envisage with read-only viewing capability
	ENVIEWER with Plotting *	Vulcan's Envisage with read-only viewing capability PLUS the ability to generate and output plot files.

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Engineering Modules	Mine Design Upgrade (UG or OP)	Open Pit Design – Vulcan has a complete set of design tools that allow the user to quickly create pit and dump designs constrained by user-defined parameters with or without ramps. Parameters, such as face angle, can either be entered or derived from variables in a block model, allowing for flexible design in different areas of the pit. Slot cuts and switch backs are inserted with ease. Enclosed volume and pit topography models can be created during ramp design.
		Underground Mine Design – The Vulcan underground design module combines all aspects of underground design into a single menu. This menu features easy-to-use tools to quickly design centerlines and cross cuts then use these to quickly generate wall outlines and triangulations. Wall outlines are automatically relimited to other walls and intersections automatically snap together to improve modelling. The stope design option allow the user to generate stope triangulations while taking into consideration tons and grade from a Vulcan block model.
	Drill & Blast Design (UG or OP)	Open Pit Blast Design – The module provides tools for the blast engineer to set out drill patterns on pit benches. The collars can be located on a flat bench or an undulating seam surface and holes can be designed bottom-up to allow equilateral pattern drilling on top of structures. User-defined specifications allow complex patterns, with each row having different attributes (hole angle, diameter, explosives loading, etc.), to be laid out quickly. Timing and blast animations can be easily created and customized reports may be generated.
		Underground Ring Blast Design - The underground ring design and blast package allows engineers to layout offset or radial blast patterns, then load and report on individual or groups of rings. The customizable drill rig library graphically displays whether holes are feasible for drilling based off the relationship between rigs and drift outlines. Patterns can be copied from one ring to others and the software automatically adjusts holes based on the orientation of the section. Reports are customizable and can include information such as explosives product weight and footage drilled.
	Dragline	The Dragline module offers a powerful set of tools for the creation, manipulation and reporting of section-based range diagrams. It can be used to: <ul style="list-style-type: none"> • Simulate the operation of a dragline, cast blasting, bulldozing, truck & shovel operation or any other kind of material movement. • Optimize the mine plan to fit equipment/material parameters. • Create detailed PMT designs.

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Engineering Modules	Drag-NAV Interface	The Drag-Nav interface allows you to export the information from the Vulcan – Dragline module into a format which can then be directly used by Leica Geosystems’ DragNav application.
	Dozer2000 Interface	The Dozer2000 interface allows users to convert Vulcan data such as design objects, triangulations or grids into a format which can be directly read in by Leica Geosystems’ Dozer2000 application.
	Surveying Upgrade	The Survey module allows the mine surveyor to: <ul style="list-style-type: none"> • Interface with many data collectors and total stations. • Reduce raw instrument files (in either radiation or coordinate form) directly into graphical objects on the screen. • Automatically apply graphical attributes to feature coded raw data. • Upload graphical design data directly to the survey instrument for set-out. • Maintain a survey station database. • Perform survey network adjustments using the least squares variation of co-ordinates method. • Calculate transformations between coordinate systems. • Calculate offsets to design lines or curves. • Perform manual entry of field book traverse data. • Calculate end area and triangulated volumes.
	Optech Interface	This option imports underground cavity profile strings from the Optech CMS system for presentation to the general solid modelling tools found in Vulcan.
	Whittle 4X Analyzer Interface	A module designed to output Vulcan block models in Multi-Element, Whittle 4X ASCII model file format (.MOD). After pit optimization is completed in Whittle, this module allows the import of Whittle 4X result files (.RES). There are additional functions included such as; export Vulcan phase variable as a pit list file, as well as export to Whittle Opti-Cut.

Module	Component	Description
Engineering Modules	Pit Optimizer: Lerch-Grossman (Single-Element)	Vulcan's Pit Optimizer can use either the Lerchs-Grossman (LG) or Floating Cone (FC) algorithms and allows users to create multiple pits based on a range of economic constraints, subsequently indicating the sensitivity of the pit to cost-price variations. Both single and multi-element options are available. Interactive tools are provided for creating subregions and definition of pit limit polygons. Pit Optimization using LG and FC are separate and independent saleable modules.
	Pit Optimizer: Lerch-Grossman (Multi-Element)	The C.O.G. Optimiser Editor allows you to obtain the most appropriate grade that maximises the net present value (NPV) of the mining business. This option uses the Lane's algorithm to calculate the different possible cut off grades for a deposit.
	Pit Optimizer: Upgrade LG from Single to Multi-Element	
	Pit Optimizer: Floating Cone	
	Cut-off Grade Optimizer	Tonnage-grade curves are the base information for each increment, which is a certain amount of material to be mined. It is also necessary to include economic parameters, such as prices, costs, investments, discount rates, etc. You will also need to indicate the different mine, concentration and refinery rates. The C.O.G. Optimiser Editor option has the ability to work with different elements, which provides the possibility to work with polymetallic deposits. The C.O.G. Optimiser Editor option also has the ability to export the results into charts as well as reports.
	MineMax iGantt Interface	Maptek provides sales and support of MineMax's iGantt scheduling software and have also developed an interface between iGantt and Vulcan. This interface allows users to quickly get reserve information into iGantt as well as provides the ability to directly view and plot the results from the schedule back in Vulcan.
	Interactive Polygon Reserver	A specific module for interactive short term open-pit bench reserving and accumulation. Is used as a simple short term scheduling tool.
Haulage Profile	The Haulage Profile module allows the user to calculate truck cycle times, distances to destinations such as dumps and crushers by bench, and equipment productivity. This option employs a very simple, user-editable equipment library, and multiple, digitized haulage routes. Users can define tonnages for each truck including a further breakdown by material. Results may be stored in a block model allowing haulage times to be "reserved" and schedules to be constrained by times and distances. Results can also be dumped directly to Excel and CSV files.	
Module	Component	Description
Engineering Modules	Oil Sands Module	The Oil Sands Module is a compositing and classification tool for use with block models and

		exploration drillhole database. The option provides methods to result in a series of top surfaces (structure roofs) and bottom surfaces (structure floors) for each of the possible mining horizons (ore benches). Waste benches are implied as overlying and intermediate horizons between benches. This option will also create an ultimate pit bottom surface defining the depth limit of mining according to the mineability, grade, and total volume of material:bitumen volume in place (TV:BIP) parameters used as inputs.
	Ventilation *	Vulcan's Ventilation Design software is based on the inter-relationships that exist between ventilation, strata control, drainage, material handling systems and mining methods. The Ventilation module: <ul style="list-style-type: none"> • Provides familiar tools for creating and editing network schematics. • Has powerful graphics for viewing schematics in 3D. • Allows the ventilation network to be viewed with all other relevant data.
Module	Component	Description
Geology Modules	Geology Tools (Including all current Geology Menus)	The fundamental and pre-requisite for geological modelling module which contains the basic geology functions in Vulcan. This module includes options for the loading and 3D display of downhole exploration data; compositing of exploration drillholes; the storage and display of composites or any user-definable sample data for visualization and presentation to model estimation routines; various database query and analysis routines; interactive cross-sectioning and geological correlation tools; fault projection and modelling tools; composite file manipulation for integrated stratigraphic modelling; geophysical data conversion, loading and 3D display; cell declustering tools; etc.
	Grid Modelling Toolbox (Grid Calc & Rsvute)	Vulcan has a comprehensive set of tools for creating stratigraphic grid models. Grid Calc provides an interactive interface, as well as a more sophisticated macro command-driven interface, which allows the user to automate the modelling process. Powerful grid arithmetic and logical expressions are combined to build simple and complex grids which can represent a variety of different structures.
	Statistics	The Vulcan statistics module allows users to perform statistical analysis of data values from Vulcan block models, triangulation, grids, databases or Envisage CAD objects directly in Envisage. These tools allow for quick output and viewing of the statistics in Microsoft Excel's popular graph types.

Module	Component	Description
Geology Modules	Block Modelling: Grade Estimation (IVD) & Reserves	<p>Vulcan block modelling allows users to create regular or sub-blocked models based on user defined dimensions and block sizes. A complete set of manipulation tools allows the running of scripts on the model, flagging of blocks based on solids, polygons, or other constraints, re-blocking, adding of models together, etc. Vulcan's viewing tools allow visualization of model slices dynamically and viewing of blocks based on user-defined colour schemes. This module also contains basic grade estimation through implementation of the Inverse Distance estimation method.</p> <p>A rich set of grade estimation parameters and controls are included with this module as well as a powerful option for the calculation and reporting of reserves. The block model reserving option includes analysis of product codes, weight average and sum variables, cut-off (grade-tonnage reports), and report formatting tools for output in custom ASCII and MSEXCEL-CSV files.</p>
	Block Modelling: Base Geostatistics	The Base Geostatistics module incorporates and provides a graphical user interface to the widely accepted GSLIB geostatistics code. The module includes GSLIB variography with auto-fit modelling options, directional and cube variography, Ordinary Kriging, Indicator Kriging, and Stochastic Simulation (with user definable random seed generation and distribution shape definition). This module also includes the contact profile analyzer option.
	Block Modelling: Sequential Gaussian Simulation & Co-Kriging	This module contains the geostatistical tools of Simple Kriging, Co-Kriging, Sequential Gaussian Simulation, Normal Score Transformation, and Mean Drift Analysis.
	Block Modelling: Upgrade Base Geostatistics to SGS&CK	As above, SGS & Co-Kriging.
	Geotechnical Toolbox	Vulcan's geotechnical tools allow users to set up a structural database and input data manually or download data from ASCII files. Structures can be digitized onto the screen and dragged or rotated to match features utilizing Vulcan's image registration tools. Data can be viewed on the screen, in a Stereonet or Rose diagram, or as a down-hole tadpole plot.

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Geology Modules	Grade Control	The Vulcan Grade Control module allows the use of blast holes or drill holes in the grade control process. These can be displayed on the screen and the samples from these used with a solid triangulation of the blast to generate a block model. Grade boundaries can then be digitized to block out the blast into individual solid grade blocks delineating the ore and waste. The module also contains other options that allow for editing of the grade blocks, reporting on the blast, exporting of grade control data and reconciliation functionality. Grade Control can also retrieve and write its data to external databases, such as Oracle and Access, using ODBC.
	Dig Limits	This option allows you to obtain a quality line for the grade control, in order to maximise the economic benefit obtained from a blast material zoning, always considering the operational geometric adjustment of the available load equipment
	TetraModelling	Tetra modelling is used in the grade estimation and variography of deformed strata bound deposits. Tetra modelling can be applied to deposits where mineralization is controlled by a structural surface which has been modelled.
	Channel Sampling	The Channel Sampling module allows the user to create and edit channel sample locations and orientations. A channel may consist of one or more samples which may be dragged or rotated on the screen. Channel samples are stored in a database as 3D samples.
	Sectional Resources	A simplified resource estimation module containing tools for polygonal grade estimation methods applied to geological cross-sections. The resource calculations apply the end-area influence method for resource calculations.
	Groundwater Modelling (Modflow Interface)	This module provides options for the import and export of ModFlow data for construction of meshes and the display of modelling (ModFlow) results
	ESRI ArcGIS Interface	This module facilitates data transfer between Vulcan and ESRI's ArcGIS products including shape files, TINs, and raster grids.
	Monitoring	The Monitoring module provides a database design and associated options for the storage and display of time based, sequenced monitoring data.

Module	Component	Description
Geology Modules	SIRO/AdamTech Photogrammetry Import	This module provides the tools required to convert SIRO formatted surface models, created in either SIROvision or AdamTech-3DM products, to Vulcan triangulations. The module also textures an associated photographic image onto the converted surface model with geo-referencing automatically calculated and stored in a Vulcan image registration file, or "ireg".
	Coal Washability	A module to manage the storage, manipulation and modelling of coal recovery curves used in coal preparation plants.
	Downhole Televiewer	This module creates fully 3D "virtual drillholes" by wrapping televiewer or acoustic imagery taken within a drillhole, around an automatically generated texture mapped triangulation representing the true size and location of the hole. This invaluable addition to our standard geotechnical module provides a powerful tool for interactive structural mapping.
	NGRAIN Interface*	The Export to NGrain option allows you to export Envisage data, such as design data, triangulations, grids and block models, to the NGrain format. Once exported, the resulting NGrain file (.ngw) can be inserted and viewed through Microsoft applications, such as Word, Excel and Powerpoint.
Scheduling Modules	Chronos Reserver *	Chronos Reserver offers an Excel spreadsheet interface to Vulcan allowing instant reserve calculations using grid models, block models or simple volume calculations. Any information entered into the spreadsheet from block model reserving or by calculated functions can be instantly queried in Vulcan by simply clicking on a polygon or triangulation. Attributes of design objects and triangulations can be changed by any field in the spreadsheet. For example, it is possible to colour all ore blocks based on grade and to hide all waste blocks.
	Chronos Scheduler and Resource Scheduling *	Chronos is an innovative scheduling program that connects the design and modelling power of Vulcan with the familiar environment and functionality of Microsoft Excel. The system allows dynamic analysis and feedback between the mine design, geological model, and schedule. Users can colour design objects and solids by attributes in the spreadsheet such as grade, or financial calculations. Period maps showing what blocks will be mined in what period can be quickly generated. Chronos' short term scheduling tool, IDS (Interactive Design Scheduler) allows users to design, edit, and schedule mining blocks bench-by-bench.

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Scheduling Modules	Chronos Optimization *	Chronos Optimization is an add-on module to the Chronos Scheduler system which utilizes ILOG's CPLEX optimization engine to solve complex scheduling problems across multiple periods. An objective function (e.g., Maximize NPV) is applied to a schedule subject to a set of user definable constraints such as production rate, stockpiling options, grade blends and cut-offs, equipment hours, etc. The resulting output is a schedule optimized to the object function within the constraints identified by the user. What-if scheduling is easy and fast using Chronos Optimization.
Floating License	Local Area Network (LAN)	Clients have the option of purchasing "floating" licenses which can be used by accessing the FlexLM server, subsequently eliminating the need for a dongle. These licenses can also be "checked out" by using the Pack-and-Go feature in FlexLM allowing the use of a license without having to be connected to the network and the server. The Local Area Network version is confined to a site or limited geographical region, usually defined as a "mine site" or local property.

* Module cannot be discounted through Volume or Corporate programs

