

A great opportunity
for the future
of land surveying,
infrastructure design
and construction.

BIM solutions for infrastructures



BIM (Building Information Modeling) is the set of processes, guidelines and technologies to manage and shape the information through the entire construction lifecycle: planning, design, construction and maintenance. The BIM for infrastructure deals with infrastructure such as roads, highways, bridges, tunnels, airports, ports, railways, undergrounds, water projects, topography works.

Thanks to the modeling of information, BIM allows for a more intelligent use of resources, optimization of workflows, improving productivity and profitability. BIM is already a reality in many countries. It is not always strictly required, but increasingly solutions via an BIM-based approach are being selected.

WHAT DOES BIM MEAN?

BIM is an acronym that has various meanings, including:

- **Building Information Modeling.**
- **Building Information Model.**
- **Building Information Management.**

These are three different meanings that are connected. There is much confusion about these three definitions and their meanings. Frequently it is possible to come across, both on the Internet and in publications, different incorrect or reversed definitions. It is important to clarify the various meanings precisely in order to avoid confusion and bad decisions.

B stands for Building.

We begin with the word "building", which is almost always translated as a noun meaning "building", forgetting that it **is also a verb that means "to build"**. The use of the noun is related to the birth of the term BIM with reference to the first software for architectural design (see Graphisoft®) in which the building was designed with virtual equivalents of real parts of the building (walls, windows, doors, etc.).

Over time the term Building has changed meaning to include all sectors of construction, not only as types (buildings, roads, railways, bridges, tunnels, etc.), but also as stages (planning, design, construction and maintenance).

We can therefore conclude that the term building currently refers to the verb "to build".

I stands for Information.

This is the easiest term to explain and it is also the heart of BIM. **BIM is information management, which is a set of organized data: meaningful, usable and exchangeable.**

BIM is revolutionary because it changes the way you manage and exchange information regarding the entire life of a project and each of its parts. **The information is not limited to the visual representation of the project parts, referring also to the physical and logical characteristics of their real-life counterparts, and including non-visible information.** This enables customers, designers, engineers, builders, manufacturers and owners to understand an entire project before its construction, refine the proposal to avoid errors and generate efficiency.

M stands for Modeling (but also Model and Management).

This is the most important letter since it changes the meaning of the term BIM.

- **Modeling is a process.** The definition is not simple, but in general a process is a network of changes, activities or actions, linked together to produce an object, structure, building or construction.
- **A Model is a representation,** reproduction or simplified version of an object, structure, building or construction.
- **Management:** organization and control of a process.

BUILDING INFORMATION MODEL

- “Digital” representation of a real object: virtualization.
- It is a set of organized data: model of information.
- It could be an archive or a database: BIM file.
- It could be a software: BIM software.

BUILDING INFORMATION MODELING

- It's a set of processes, policies and technologies.
- The aims are: sharing, communication and collaboration.
- It must ensure interoperability and the use of open standards.
- It has metrics to be measured.

Building Information Modeling is the BIM mentioned in the European directive, it is the BIM which is requested most often at the international level.

Building Information Modeling is a process for the creation and use of building information to plan, design, build and operate a building, infrastructure or something else.

BIM allows all interested parties to access the same information at the same time through the interoperability between different technological platforms. It is clear that Building Information Modeling (BIM) being a process is not software, nor a technology, nor a data format and it is not even a 3D visualization.

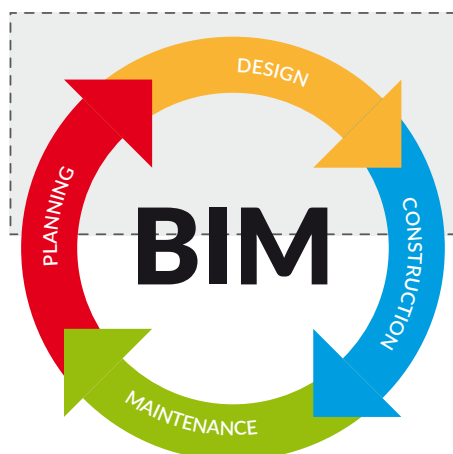
Having clarified the meaning of Building Information Modeling one can understand the importance that the adoption of this process has in the construction industry and the reason for which it will increasingly be in demand.

But to what do the other two meanings of BIM correspond?

The Building Information Model is a model of information about an object, structure, building or construction.

This meaning of BIM indicates an organized set of data, often in file format, which can be exchanged and shared to support the decision-making process on the construction of a building, infrastructure or something else.

Building Information Management is instead the organization and control of the process using the model information to share information about the entire life cycle of a building, infrastructure or something else. Building Information Management is very similar to Building Information Modeling.



The SierraSoft solutions for BIM are covering the design phase of the construction, but, partially, also the planning and building phases.

WHAT IS BIM?

Building Information Modeling is a process that allows people and information to work together effectively and efficiently through processes, policies and defined technologies.

BIM is therefore the process for controlling all phases of the building operation: planning, design, construction, and maintenance or management.

Forget the word building.

One thing must be clear, BIM does not refer solely to buildings, but to all sectors that have to do with construction, including: roads, railways, utilities, bridges, tunnels, structures, architecture, topography, etc.

Share, communicate, collaborate.

The aims of BIM are sharing of information, communication and collaboration, not coincidentally the European Directive 2014/24/EU on Public Procurement clearly expresses the indication to introduce Building Information Modeling in Article 22 which is entitled “Rules applicable to communication”.

THE 5 ELEMENTS OF BIM.

In order to function properly, BIM needs five elements to be present and perfectly integrated with one another.

The two most important are **people** and **information**, which need to work together in order to generate efficiency and effectiveness by managing all phases of construction.

The other three elements are the engine of BIM: **processes**, **policies**, and **technologies**.

The processes.

The process defines the specific order of work activities across time and space, with a beginning, an end, and a clear identification of the inputs and outputs of each stage.

The process is, in other words, a structure for the action.

The policies.

The policies are **principles and rules to guide the decision making process**. The purpose of the policies is to analyze and develop standards and best practices in order to safeguard benefits and minimize disputes between the parties involved in BIM. Within the policies we find: **reference standards, adopted standards, best practices, benchmarks, contracts**, etc.

For example, we specify the standards used for the exchange of information within the policies.

Technologies.

Technologies are defined as the software and hardware tools needed to create and manage the BIM process. Within technologies are **software and hardware tools** used to manage the various stages of the BIM process including model building, sharing, communication, and collaboration.

Information.

Information in BIM is **only digital**; paper is banned. To better understand the meaning of information, it is important to understand that in BIM there are **two types of information: models and documents**.

- **Models**

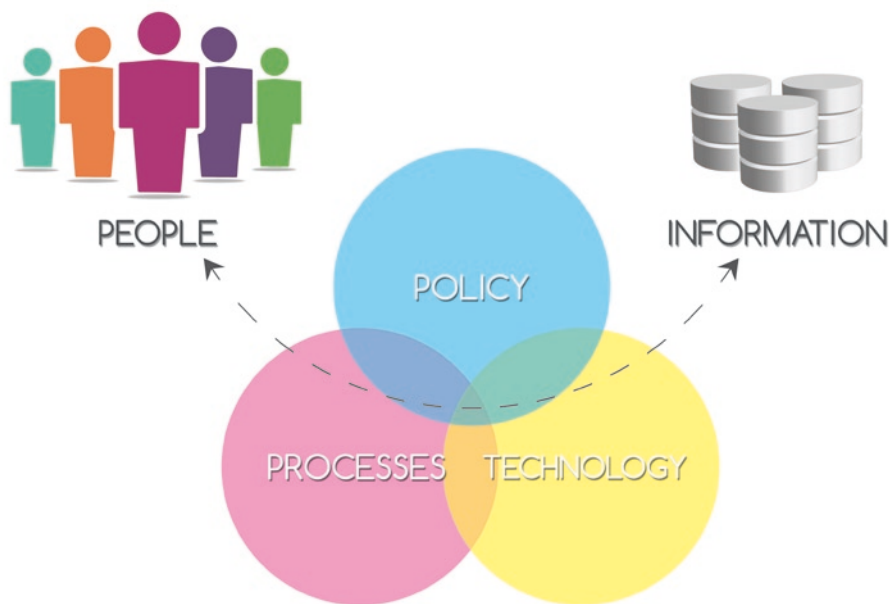
The models or “Information Models” are **digital data that are the representation, reproduction, or simplified version of an object, road, bridge, building**, etc. They are made using special modeling software such as Autodesk Revit®, Archicad® by Graphisoft®, ProSt, or SierraSoft Roads by SierraSoft. They are stored in a file format and **can be exchanged and shared** to support the decision making process for the construction of the infrastructure, buildings, etc. **An information model is therefore a set of organized data: significant, usable, and exchangeable.** These data **represent the virtual equivalents of real parts and have all the physical and logical characteristics of them.** Information models **can be shared using standard formats that allow the transfer of data without the loss of information.**

- **Documents**

To understand what documents are, we could say that they are the digital version of papers, drawings, prints, images, and video. **They are called “documents” because the information is stored within the file in visual format for the ease of the user, even though they don’t contain any BIM information, their data are only lines, arcs, or simple texts.** For example, the digital replacement for a paper drawing is usually a file in Autodesk® AutoCAD DWG format, and the digital substitute for a report or a paper printout is a file in Adobe® PDF format. Clearly, then, DWG and PDF are not BIM formats. In addition, a video with a three-dimensional representation of the finished project is not a BIM format and neither is a picture of a rendering, maybe the file that generated these results is, but videos and images are only documents in the same way a movie made with a video camera or a traditional photo is. Not even a laser scan is BIM. A point cloud is not BIM as it has no information about the elements, it is just a collection of colored points. The point cloud is then a document, as are orthophotos. **A BIM Author is needed to extract BIM data from these types of documents.**

People.

People are always the element that makes the difference and therefore the most important, BIM is no exception. **To have successful BIM, people are needed to manage it;** there are many definitions of people’s roles within BIM, some examples are: BIM director, BIM manager, BIM Champion, BIM Consultant, BIM Coordinantor, BIM Author, BIM Technologist, BIM Support, etc.. **For simplicity here we focus only on three roles that we define as the most important for understanding the system.**



- **BIM Manager**

The BIM Manager performs a wide range of activities, such as the development of company policies, processes, protocols, and technologies, as well as advice on strategic issues such as change management. The BIM manager is a person to whom one can address difficult questions and who acts as a problem solver and facilitator, a guide who helps team members to make the right decisions. The BIM manager defines project models and sets standards as well as protocols for BIM.

- **BIM Author**

A BIM Author is any individual or company that creates the information for BIM. Their contribution is related to the role of their area of expertise, the team to which they belong, and their position in the process. For example, BIM Authors are people (engineers, architects, etc.) that generate information models for buildings by using architecture, structural engineering, and infrastructure design software (BIM authoring tools). BIM Authors generate information in accordance with the processes, guidelines, and technologies defined for the BIM process in which they operate.

- **BIM Champion**

If you are just starting to use BIM, this role is crucial because the BIM Champion is responsible for encouraging and supporting others in the adoption and implementation of BIM. Implementing BIM in a company is a process that can be difficult and sometimes has the danger of failing, this manager will help you to complete your BIM process. The BIM Champion can come from different branches of the construction industry, but must be a champion of enthusiasm, adaptability, and determination.

SECTORS, LEVELS, DIMENSIONS OF BIM.

Complete or Partial BIM.

Understanding if the BIM we are handling is a complete BIM or a partial BIM is rather simple: the BIM is multidisciplinary by nature, which means that if we generate a model of information for a construction and this information is for the designer's exclusive use and is not shared with the engineer and/or constructor, we find ourselves with a partial BIM; **if the information is shared with the engineer and constructor and with other figures involved in the construction's building process, we find ourselves with a complete BIM.**

Opened or Closed (or proprietary) BIM.

The Building Information Modeling (BIM) must provide interoperability and multidisciplinary collaboration. This involves a massive management of different types of information from multiple subjects involved in the project (architects, engineers, constructors, etc.). It is therefore essential to use a model that guarantees access to information. This brings about two concepts related to the creation of the BIM: Open BIM and Closed BIM (or owner BIM). **An Open BIM refers to a model in which the various participants in the project, using different BIM software platforms, can share and integrate models, files, and data between themselves by using non-proprietary formats such as IFC.** A Closed BIM instead refers to a relatively restricted design environment in which all participants use a single BIM software platform. **An open BIM environment is flexible and actively encourages multidisciplinary collaboration between different teams preferring to use different software platforms, in order to use the best one for each phase.** On the contrary, a closed BIM requires that all teams use the

same software platform, limiting or preventing the collaboration with other software platforms. For these reasons, the open BIM represents the future of the BIM.

The BIM sectors.

As it is clear by now, the Building Information Modeling (BIM) applies not only to buildings, but to all the processes and stages of construction. In order to better identify the sectors, a subdivision was made that also aids in understanding the BIM's extensions. The following list is by no means exhaustive, but contains only the major sectors, which are:

- **BIM for Architecture:** design of buildings.
- **BIM for Structure:** structural design.
- **BIM for Infrastructure:** design of roads, highways, railways, bridges, tunnels, mines, aqueducts, sewer systems, etc.
- **BIM for Landscape architecture:** design of external areas and territory modeling.
- **BIM for Land Surveying:** topography, land survey.
- **BIM for MEP:** design of mechanical, electrical and plumbing services.

All these types of BIMs **should not be considered as separate entities; a complete BIM is created by collaboration, communication, and sharing of information between the different BIM sectors.**

The BIM dimensions.

The BIM dimensions refer to the types of information that can be managed, and are the following:

- **3D BIM:** geometrical models in 3 dimensions. Allows visualizations, interference detection, and various types of analysis.
- **4D BIM:** adds the management of "time" to the 3D geometrical models. Allows the geometry to be linked to the time information in order to manage the phases or sequences.
- **5D BIM:** adds the management of "cost" to the previous four dimensions. Used to connect the geometric elements and time constraints to the costs for the construction of a work.
- **6D BIM:** adds the management of everything that relates to the sustainable development of a building, for example, energy analysis.
- **7D BIM:** adds the management of all aspects of the work's life cycle. Generally released at the end of the construction, it contains all of the necessary information for the owner for the work's use and maintenance.

The BIM levels of maturity.

The BIM is divided into levels of maturity or evolution, which are:

- **Level 0:** 2D geometric models, no CAD management, data exchange through printed documents (paper or electronic). This level is not BIM.
- **Level 1:** use of 2D or 3D CAD with a collaborative tool, providing a common data environment with a standardized approach regarding the data's structure and format. The commercial data is managed by other financial and cost management softwares, without their integration.
- **Level 2:** use of 3D environments with management of additional annexed "BIM" information (material, suppliers, etc.). This data will then be managed by an external software. The data is transferred through dedicated interfaces (non-standard). This level can use and integrate the management of 4D and 5D information.

- **Level 3:** a fully integrated collaborative process, enabled for web services and compatible with standard services. This level of BIM will use 4D, 5D, and 6D information. There is also a **level 4**, where the entire BIM is managed in a Cloud.

The BIM and European legislation.

In the course of 2016, the use of BIM in Europe will become mandatory. But what level of BIM is required? For the moment, also as a function of the standards available, level 2 will be required, i.e. all projects will be coordinated with software that manage information models and information will be shared, where possible, with the standard formats that are already available. Where these formats haven't been defined, they will adopt other "common" or "familiar" formats, but especially open, with the aim of sharing, collaborating, and communicating.

TOOLS TO WORK WITH BIM

Software Tools.

BIM is a process which is implemented and managed across different technologies which, depending on needs, must interact together. **It is therefore not possible to buy a pre-packaged "BIM", BIM is deployed and managed to suit your needs by carefully choosing software and hardware.**

The market has a considerable amount of BIM software which can deal with and provide solutions in the management of various BIM stages. Software programs exist for the production of models, for cost estimation, for controlling models, for display and for planning. Various software can be very specific and focused on one topic or be able to handle a very large number of cases.

For orientation purposes, following is a non-exhaustive list of the main types of software.

BIM Authoring software.

Programs for the design and implementation of data models (Building Information Model) for different uses. Often they appear as three-dimensional design CAD systems; **they actually manage not only the graphic appearance of the project data, but also all non-graphic information associated with items included in the project.** What falls into this category, for example, is architectural design software such as Autodesk Revit, Nemetschek Allplan®, Graphisoft® ArchiCAD®; for the infrastructure sector, as an example, SierraSoft Roads and SierraSoft ProSt; for Tekla® structures. The choice of software has to go through evaluation and quality of the following features:

- **"Pure" design features:** the software allows the designer to do and to obtain that which he or she wants.
- **Data modeling capabilities:** the software allows you to manage not only graphic information but also non-graphical information which define in detail the elements being designed.
- **Interoperability features:** the software has to handle the import and export of project information (graphical and nongraphical) using standard and open data models such as IFC (Industry Foundation Classes).

BIM Analysis Software.

This category contains a whole series of **data analysis software**, obtained from different sources, pertaining to analyses which cover the entire life cycle of construction. These include energy performance analyses, vehicle traffic analyses, roundabout capacity analyses, etc.

File-sharing e Collaboration Software.

One must think about file-sharing, collaboration and document management as a whole. These tools are at the heart of the BIM field. The ideal system leverages the Cloud for storage of data which is then accessible from a desktop computer, the internet and mobile devices.

Construction Management Software.

This type of software is **more focused on the 4D aspects of BIM for execution scheduling management.** We can also place **software that turns project information into data which may be directly utilized by machinery** in this category, such as the machine control systems Topcon, Leica and Trimble.

Model viewers and checkers Software.

This type of software **allows you to view the models designed with BIM author software, to check information, perform clash-detection tests** (interference control and verification) and to validate model objects. Some of these types of software **can also create realistic images of the model and exploration videos of the model following freely defined paths.**

Quantity takeoff and Estimation Tools.

BIM authoring software has **features for exporting information for budget preparation and model and construction accounting.** This information is then used by BIM software specialized in the preparation of bills of quantities and job accounting and scheduling management. Software such as STR Vision CPM, Vico Office and Primavera Software fall into this category.



The SierraSoft BIM solution for **SHARE** **COLLABORATE** **COMMUNICATE**

BIM Exchange is an M3 Framework feature, available exclusively as part of SierraSoft Subscription, for managing BIM-based projects. BIM exchange is used to integrate topography works, infrastructure design and construction within the processes, guidelines and tools used for BIM.

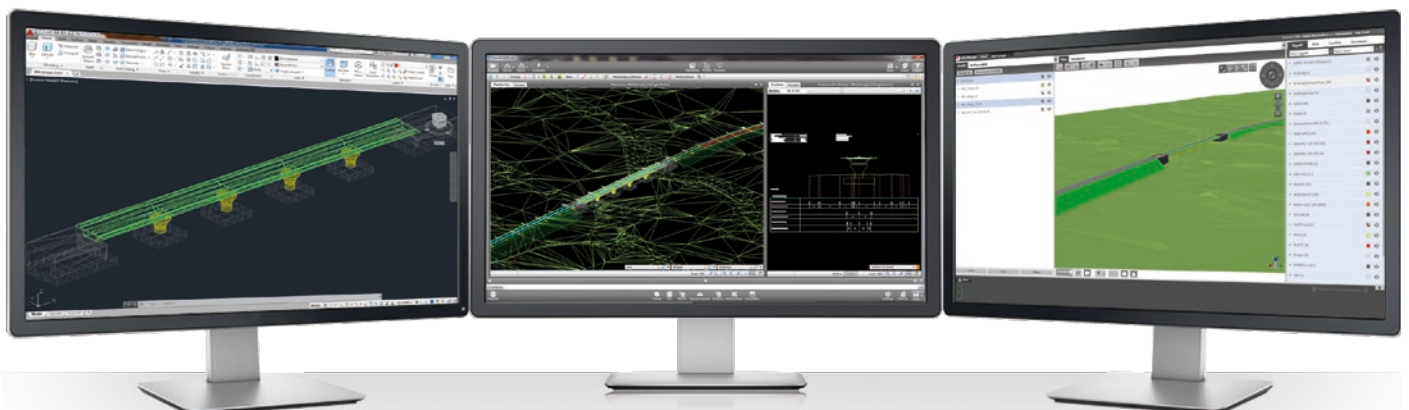
BIM Exchange is open and can be customized; it inserts your topography work into the BIM design process, adapting it to the workflow requirements and defined standards.

Interoperability.

Collaborate and share information with other software becomes simple; BIM exchange allows you to import and export data in several BIM standard formats as well as read other well-known formats. You can import, for example: information about the Tekla structures; information regarding buildings and artifacts by Autodesk Revit or ArchiCAD Graphisoft; Information about infrastructure projects from AutoCAD Civil 3D, etc.

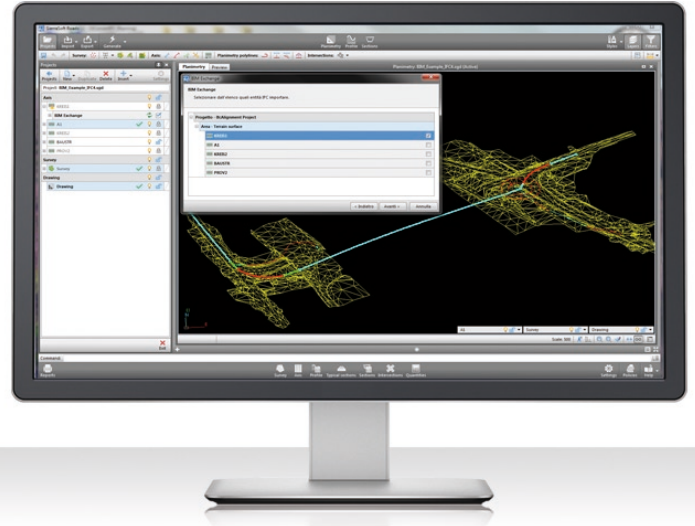
Open standards.

The range of managed formats allows levels of collaboration and sharing which covers the entire life cycle of a construction. Among the most common open standards are managed the IFC standard (till IFC4 version) and the LandXML format. Among the managed file formats we find file formats for topographic data and land surveying data, data project file formats, construction file formats, and file formats to manage the control of machinery such as: dozers, excavators, motor graders, scrapers, etc.



Modeling and remodeling of the information.

If the available information is stored in files that are non-standard size or not modeled, the BIM exchange modeling engine will alter the structure of the information and then restructure it through remodeling processes based on rules set out by the user. The re-modeled data can be easily used within the SierraSoft software or be shared with other third-party applications.

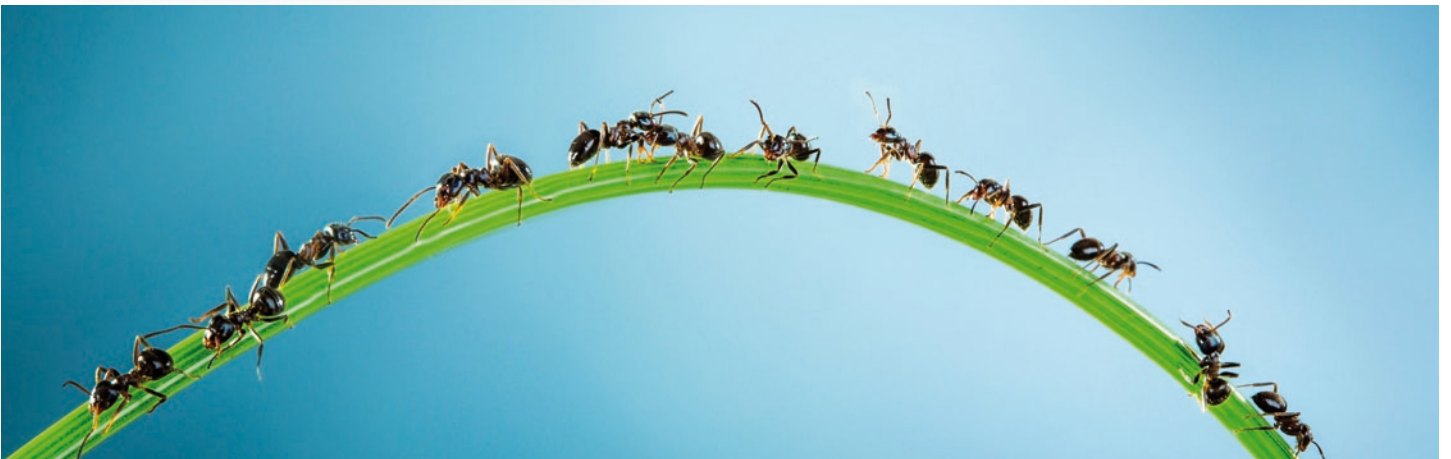
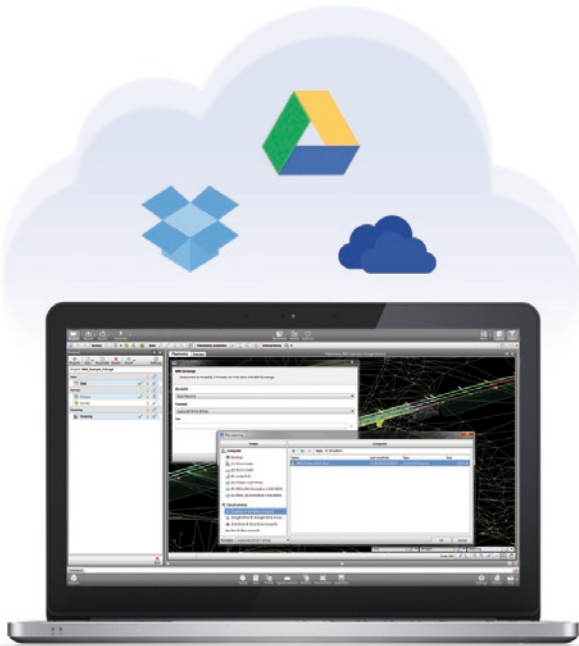


Cloud storage and cloud sharing.

Your data and information, handled by other processes, can reside either locally on your PC or on the Internet Cloud. You can configure access to both simple storage services or to file sharing services (Dropbox, Box, etc.).

Teamwork.

With BIM exchange, team working on a project is simple; you can divide the project into several parts and between different people, even in different places, and keep everything in sync by defining the rules of sharing and access. The approach to teamwork also includes teams working with third-party software by extending the collaboration and sharing with all the parties that manage the project. A notification system informs the user when information updates within the team, are available.

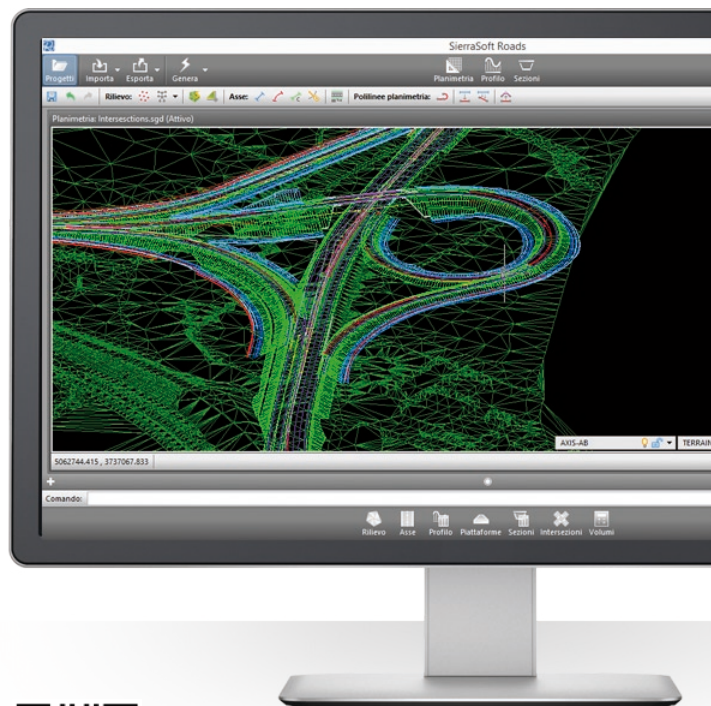


Discover more and watch how it works on BIM exchange web page!

SierraSoft Roads

BIM SOFTWARE
FOR THE DESIGN
OF ROADS AND HIGHWAYS

SierraSoft Roads is a BIM software for planning, designing and managing roads and highways. The ease of use, outstanding performance and functional design offered by SierraSoft Roads mean that the design of any kind of road, roundabout, junction, intersection, sliproad etc., is both rapid and precise. SierraSoft Roads automates entire stages of the design and makes everything extremely easy; the designer always has complete control over the design data and constant access to all its information. Based on a powerful BIM modeler with other applications and sharing information via open file formats. SierraSoft Roads complies with 2014/24 / EU Directive from the European Parliament.



Discover more and watch the videos
on SierraSoft Roads web page!

SierraSoft Land

BIM SOFTWARE
FOR LAND RESTITUTION,
MODELING AND ANALYSIS

SierraSoft Land is a BIM software for land restitution, modeling and analysis. With SierraSoft Land, you can handle any size land survey carried out with various types of tools, such as total stations, GPS, laser scanners, and drones. The entire flow of rendering acquired data, 3D surface modeling, and section and volume calculation is managed in SierraSoft Land in a simple and comprehensive way. Based on a powerful BIM modeler with other applications and sharing information via open file formats. SierraSoft Land complies with 2014/24 / EU Directive from the European Parliament.



Discover more
on SierraSoft Land web page!



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