Published in cav – edition 03/2022
https://prozesstechnik.industrie.de/wp-content/uploads/c/a/cav_03_2022.pdf

Engineering 4.0 as a competitive advantage

The race for the future is on, and it is already being run at a breakneck pace. Building Information Modeling, adding additional data dimensions to graphical plant design, drone technology, laser scanners or virtual reality applications allow plant design projects to be implemented quickly and efficiently.

At VTU, experience in process simulation, experimental execution and industrial plant engineering intertwine. The company focuses on innovative, new working methods such as Building Information Modeling (BIM). BIM is a process for creating information models that contain both graphical and non-graphical information in a common data environment (known as CDE) - a shared repository, so to speak, for digital project information. The information that is created becomes ever more detailed as a project progresses with the complete dataset then handed to a client at completion to use in the building's In Use phase and potentially on into a decommissioning phase.

By adding additional dimensions of data you can start to get a fuller understanding of your construction project - how it will be delivered, what it will cost and how it should be maintained etc.

3D is not enough

3D BIM is perhaps the BIM we are most familiar with - the process of creating graphical and non-graphical information and sharing this information in a Common Data Environment (CDE). 4D BIM adds an extra dimension of information to a project information model in the form of scheduling data. This data is added to components which will build in detail as the project progresses. This information can be used to obtain accurate program information and visualizations showing how your project will develop sequentially. Time-related information for a particular element might include information on lead time, how long it takes to install/construct, the time needed to become operational/harden/cure, the sequence in which components should be installed, and dependencies on other areas of the project. Drawing on the components of the information model being able to extract accurate cost information is what's at the heart of 5D BIM. Considerations might include capital costs (the costs of purchasing and installing a component), its associated running costs and the cost of renewal/replacement down the line. These calculations can be made on the basis of the data and associated information linked to particular components within the graphical model. This information allows cost managers to easily extrapolate the quantities of a given component on a project, applying rates to those quantities, thereby reaching an overall cost for the development.

The benefits of a costing approach linked to a model include the ability to easily see costs in 3D form, get notifications when changes are made, and the automatic counting of components/systems attached to a project. However, it's not just cost managers who stand to benefit from considering cost as part of your BIM process. Assuming the presence of 4D program data and a clear understanding of the value of a contract, you can easily track predicted and actual spend over the course of a project. This allows for regular cost reporting and budgeting to ensure efficiencies are realized and the project itself stays within budget tolerances. The construction industry has traditionally been focused on the upfront capital costs of construction. Shifting this focus to better understand the whole-life cost of assets, where most money is proportionately spent, should make for better decisions upfront in terms of both cost and sustainability. This is where 6D BIM comes in. 6D BIM involves the inclusion of information to support facilities management and operation to drive better business outcomes. This data might include information on the manufacturer of a component, its installation date, required maintenance and details of how the item should be configured and operated for optimal performance, energy performance, along with lifespan and decommissioning data.

Drone deployment

Some construction companies have already jumped on the professional drone bandwagon. The use of drones throughout a construction project provides an unparalleled record of all activities; cuts planning and survey costs; increases efficiency and accuracy, and eliminates disputes over the status of a project at a given point in time. No wonder a drone program is currently a terrific investment for construction companies. A drone is mainly used in the construction industry for surveying and inspection purposes. Drones are equipped with downward-facing sensors, such as RGB, multispectral, thermal or LIDAR, and they can capture a great deal of aerial data in a short time.

During an aerial drone survey with an RGB camera, the ground, its features and buildings are photographed multiple times from different angles, and each image is tagged with coordinates. First, these highly detailed geotagged images can be used for assets and inspections, for example, of building roofs or hard-to-reach areas. They can also be used to monitor areas across long distances, such as vegetation rows, roads and railroads. Drones take images from multiple angles. From these images, photogrammetry software creates 2D and 3D maps with geolocation information. Taking the technology a step further, photogrammetry software can combine the images to generate geo-referenced 2D maps, elevations and 3D models. These maps can be used to extract information such as precise distances, surface and volumetric measurements. Drones can also open up new applications that were previously very hard or costly to access or closely track. Think of monitoring or inspecting hard-to-reach areas or of analyzing and optimizing rapidly changing environments such as construction sites.

3D laser scanner technology

Data collection technology was once a slow, labor-intensive operation with multiple technicians collecting field data using manual tape measuring devices, and pencil-to-paper data recording. Handheld 3D laser scanners are becoming increasingly popular for a variety of applications thanks to their short acquisition time, portability, and ease of use compared to coordinate-measuring machines (CMMs). Handheld 3D scanners are often based on stereoscopic vision and triangulation: the device consists of at least one but often two cameras triangulating what they are seeing and processing it to create a 3D reconstitution. With the laser technology, one or several laser lines are projected on the target, and their deformation is monitored by the cameras so that the scanner can establish the spatial location of the deformed lines. Once the acquisition is complete, a point cloud or a mesh representing the scanned object's surface is generated. Today, using 3D laser scanning technology, a scanning technician can collect substantially more information, more accurately, and have it completed in a greatly reduced timeframe, delivering powerful advantages to industrial engineering companies and project owners.

VR and smart glasses

Virtual reality (VR) is a hot topic in architecture and for good reason. A VR architectural presentation provides you with a full 360 view – enabling you to get a feeling for space and design and perceive the actual scale of a project. With virtual reality, you create an immersive 3D experience that touches clients emotionally and presents architectural ideas in the best way possible. Since everyone gets to engage and experience a model in a life-like simulation, it's easier to discuss details that may not be so easy to see and comprehend in another format.

Virtual Reality can be used also as a tool for training and in this way it is possible to create training that is not only more engaging but also more effective than traditional training methods. Virtual Reality is an artificial environment in which the user is fully immersed in an experience. Putting on a VR headset transports a learner to a new location where they can look around themselves, walk up to close computer-generated objects, and interact with items and people. Custom VR training simulates any world you can imagine, enabling your learners to encounter true-to-life scenarios without facing real-world risk. You can develop a shared experience for your remote team, let learners interact with virtual scenes and hazards, and provide a safe space to practice technical and hands-on work.

By wearing Smart glasses, operator can perform his routine activities hand-free and has the possibility to interact with an engineer who can be in a completed different place! That means dialogue and share an issue for instance: the engineer from office can see what the engineer on the field is watching at or following some instruction steps to perform a particular technical activity or document navigation by sharing an image. Traditional features can also be performed, like taking a picture which can be added to a testing phase for example or register a video.

Combining technologies

For VTU that has seized the opportunity, Engineering 4.0 is fast becoming a competitive advantage and because digital technologies advance at accelerating speeds, the leads that these companies open will only get wider. In the recent past, VTU won an important project from an European customer who had to deal with an important manufacturing expansion of his facility and, as often happen, ideas might change from the starting point, especially if project takes several months. So VTU decided to get advantages from technology by using from the beginning (that means from basic design) 5D of BIM model, which includes existing and future building themselves, parking, internal streets and interior spaces (equipments, HVAC ducts, piping, cable trays, rooms, aisles, etc), plus time and cost impacts.

Then a short video has been created, including also drone images, and technical team and managers could have a sit together and speak the same language to make decision faster and with a higher awareness of the project. In this way certain issues like possible clashes or lack of space for future implementation have been immediately detected and avoided from the first project steps and technical solutions has been easily evaluated from time and cost perspectives.

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