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Project Fractal, FormIt, and Dynamo Studio: The Perfect Trio During Early Design Phase

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Learning Objectives

- Understand what Fractal is and how it works
- Learn how to conceive FormIt in a new way
- Learn how to use Dynamo Studio with both Fractal and FormIt
- Discover the link between FormIt and Revit—the other way around

Description

What do architects and engineers want in the early design phase? They want to explore all the possibilities, not to be stuck with the first option. They want to be able to change, try, and come back. They want to save time while having an overview of all solutions' alternatives. And that is exactly what Project Fractal, FormIt software, and Dynamo Studio software do for them. It is called generative design, and we will show you some workflows to help you understand how it can be useful for your work and what you can do with these software. We will show you how to improve your Building Information Modeling (BIM) process, and how everything can be connected to Revit software.

Speaker(s)

Elisa BONNAFOUS is a BIM engineer working for ARTELIA Buildings and Industry. She obtained her Civil Engineering degree and worked as customer assistant for a big project launch. Then, she specialized in BIM processes. She focuses on the early design phase and tries to find new workflows to help engineers getting involved in BIM process.

Jean-Hugues BONNET is working in France as a BIM manager for ARTELIA Buildings and Industry. Being part of the company Technical and Innovation department, he is in charge of the implementation of BIM processes and tools for the Building and Industry sector. He also used to manage BIM processes on projects as a client advisor or within design teams. He obtained a Civil Engineering degree with a specialization in building construction. He then put a first step into BIM processes through Revit in his first job as a methods engineer during 5 years for a major building company.

COMPANY'S AND BACKGROUND'S PRESENTATION

ARTELIA Group

ARTELIA is an independent engineering, project management and consulting group that operates in the following markets: building construction, multi-site projects, industry, water, maritime, environment, energy, transportation and urban development.



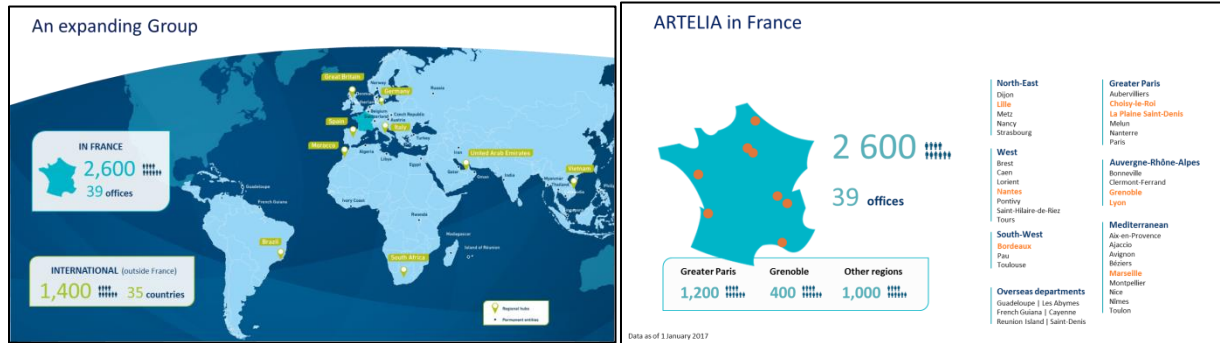
ARTELIA provides services to private clients (industrial groups, developers, investors, building contractors, banks, insurance companies, etc.) as well as public clients (government departments, local authorities, public bodies, international funding agencies, etc.).

To conduct projects efficiently and provide relevant solutions to highly technical questions, the Group's operational organization is based on four sectors:

- Building Construction & Industrial Facilities
- Water & Environment
- Urban Development & Transportation
- ARTELIA International (network of international subsidiaries and branch offices)

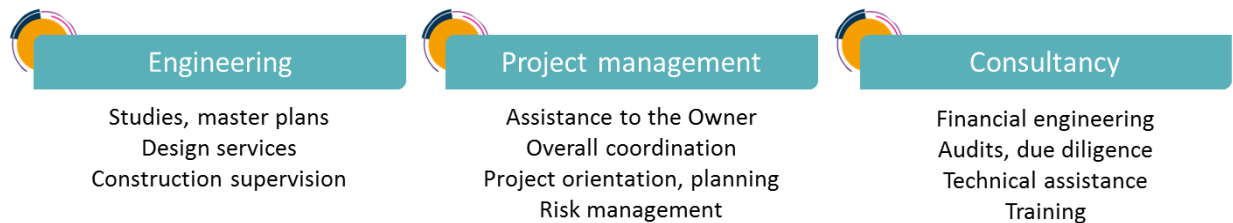


These four sectors are implanted through a regional network of 39 offices in France and an international network of 40 offices in 35 countries, employing more than 4000 co-workers.



Introduction through the angle of BIM revolution at ARTELIA

The business line of ARTELIA is to provide a comprehensive assistance to our clients from design through to works implementation, involving the following missions:



Regarding the implementation of BIM policies, ARTELIA's journey really started around 2010. Since then, the BIM processes management has been constantly improved owing to a wide training program and specific developments of tools and methods. Faced to the various missions that we undertake on our projects, the BIM revolution has clearly been impacting everyone within engineering teams, project management teams, and also in the management boards.

ARTELIA presented an [Autodesk University class](#) in 2016 about his BIM processes implantation in the firm.

Thereby the digitization of engineering processes is currently one of our main focuses at ARTELIA, especially by taking as many benefits as possible from BIM. Unlike other industrial engineering sectors, such as aeronautic for instance, the building engineering has not been that much innovating in its processes. We could easily make a list of tasks which are time consumers for our engineers and do not bring that much value to the project: quantity takeoff, 2D analysis of the project, coordination with draughtsman... In the meantime, it is obvious that computational methods can automate tasks and help engineers to focus more on "engineering" problematics: analyzing many different design solutions, justifying the solution choice, facilitating the tracking of project modifications, facilitating the coordination traceability within the project team... Furthermore if we consider now all of this in a BIM environment, as a database and as a collaborative process, it provides a powerful playground to engineers if tools and methods are well organized.

The following presentation explains a concrete case of engineering processes digitization by ARTELIA. The example is thought to allow the engineer to optimize his choices in the early design phase, by enabling him to study a very large number of combinations, and then to transmit all the elements of his conclusion to his BIM draughtsman. To do so, our approach is to use a combination of Autodesk solutions.

WORKFLOW PRESENTATION

Needs Analysis: How to support a quick answer from engineer during the early design phase?

During the early design phase, the project can change a lot and architects do not want to be stuck with a single solution. At the same time, engineers need to provide technical solutions which can impact the architectural project. These solutions take time to be designed: engineers spend hours to find the geometrical solutions which can completely change the day after. It is an iterative research.

While this iterative analysis is convenient for the innovation and design processes, a lot of time is lost in exploration of several solutions at every step and there is no way to know that the engineer studied all the possibilities.

Moreover, these possibilities are not tracked. Usually, they're written on paper and it's difficult to keep track of every solution studied by the engineer. The submitted solutions are tracked (on mails for example), but the non-submitted ones are often forgotten. And it's a pity to lose this kind of data because they can be useful later on for the project or to justify the chosen solution.

In addition, at this phase of the project, the collaboration between engineers and draughtsman is not usually efficient because of the way they exchange information and the different tools they use. In a BIM methodology, collaboration is essential.

To fix these problems, we searched a process based on Autodesk software. Goals of this process were to:

- Allow the engineer to calculate a huge number of possibilities really quickly,
- Help the engineer to justify the chosen solution's quality,
- Support the collaboration between engineers and draughtsman,
- Start the BIM process in early design phase.

To do so, four software are used:

- Dynamo Studio, a visual programming software,
- Fractal Project, a software which calculate every combination possible,
- FormIt, a 3D modeling software,
- Revit, a 3D modeling and database software.

GOAL: have the best solution for the project while saving time and do not lose any information thanks to the collaboration process

EXAMPLE: find the best air units' position in the machine room

To improve processes and collaboration between actors of the project, we decided to bet on boosted human intelligence rather than artificial intelligence. The software are tools used to increase the calculating capacity of human but the whole knowledge is from the person using it.

For each software, we'll explain briefly what the software is and what his purpose is. Then, we'll show you how we use it in our company thanks to an example.

Fractal Project Utilization: How to figure out every possibility to resolve a configuration problem?

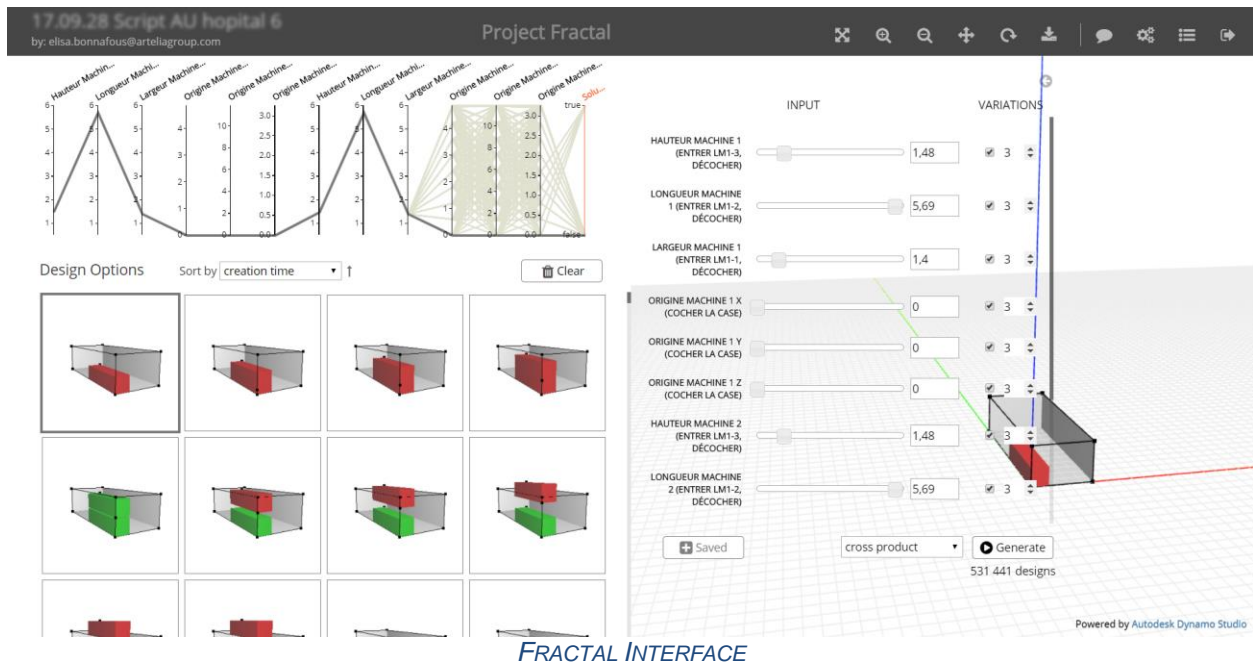
Software : Fractal – interface and use

Fractal is not yet commercialized but still an Autodesk project. The interface is on a web page and the whole subscription process is explained [on their main page](#).

The project's goal is to calculate every possibility for a given problem.

The interface is simple:

- On the right, the input values,
- On the left, the results from these combination.



The engineer can choose the input values he wants to test out and the number of value he wants for each input.

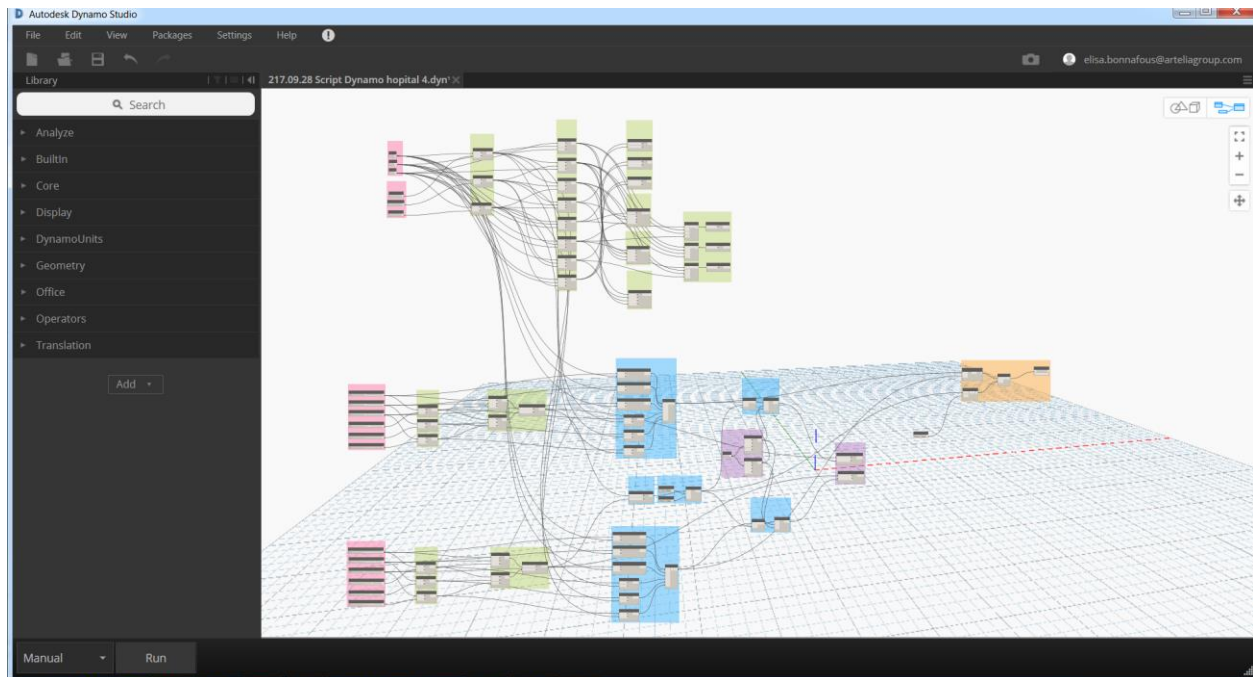
When he clicks on “Generate”, Fractal combines systematically these inputs and shows him every possibility on the left.

Where do these inputs come from?

Fractal is connected to Dynamo Studio via the AutodeskID on the Web.

So what is Dynamo Studio?

Dynamo Studio is a programming software for non-programmer. Scripts can be written with boxes only connected to each other: it's called visual programming.



DYNAMO STUDIO INTERFACE

Example: the air units' positions

GOAL: to save time while having more solution to offer

DELIVRABLE: the best position for two air units in a machine room

USER: Engineer

The first step to be able to use Fractal is to conceive a Dynamo Studio script based on the way engineers work. To write the script we use in ARTELIA, we studied the engineers' needs and objectives to be sure Fractal will be the extension of their mind.

We wrote a Dynamo Studio script that builds:

- A room (floor, walls, ceiling) with the dimensions offered in the architectural model,
- Boxes to simulate air units.

The goal of this script is to find the best position for each air unit in the machine room.

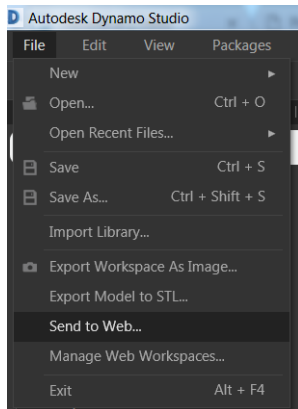
The script's input values are:

- The air units' dimensions,
- The air units' positions (x, y, z).

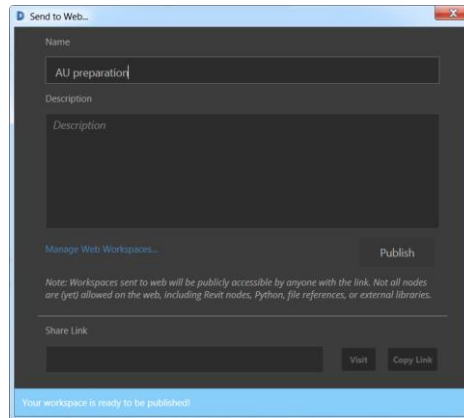
The output value is the fact that the solution can be used, meaning respecting two conditions:

- The air units are both in the machine room,
- The air units don't intersect.

When the Dynamo Script is complete, it has to be shared online. Then, the uploaded script can be found in Fractal in the "Workspace".



FIRST STEP TO SHARE THE SCRIPT IN DYNAMO STUDIO: CLICK ON "SEND TO WEB"

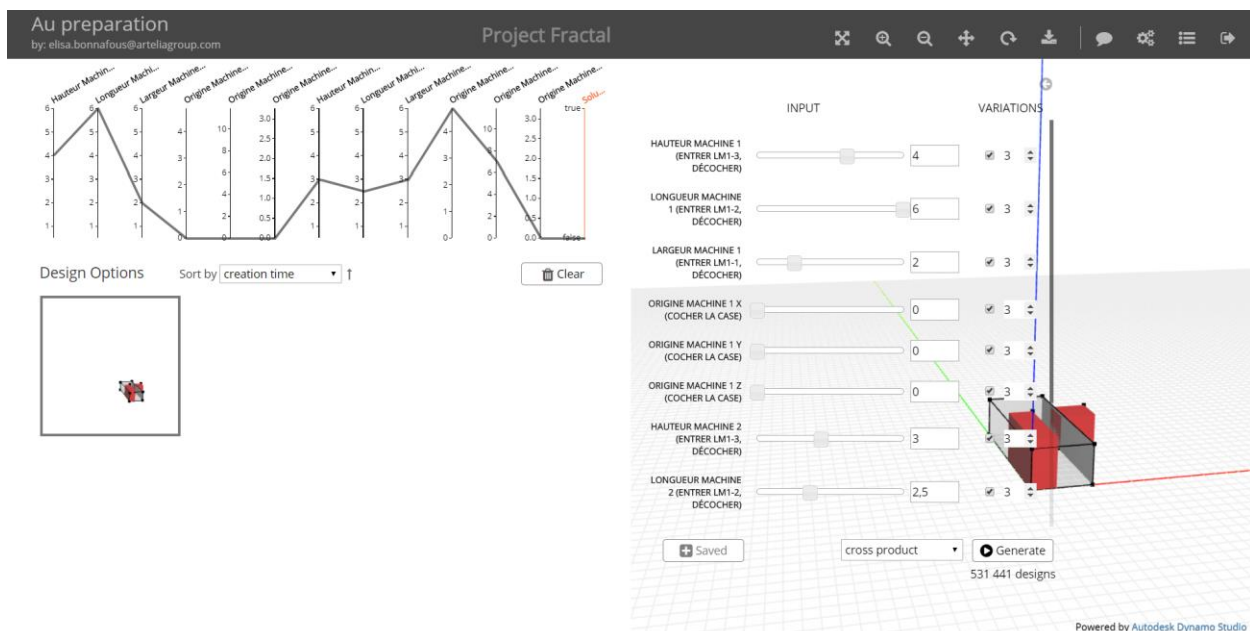


SECOND STEP TO SHARE THE SCRIPT IN DYNAMO STUDIO: NAME THE SCRIPT AND CLICK ON "PUBLISH"



THIRD STEP TO SHARE THE SCRIPT: CLICK ON THE WORKSPACE IN FRACTAL JUST SENT TO WEB

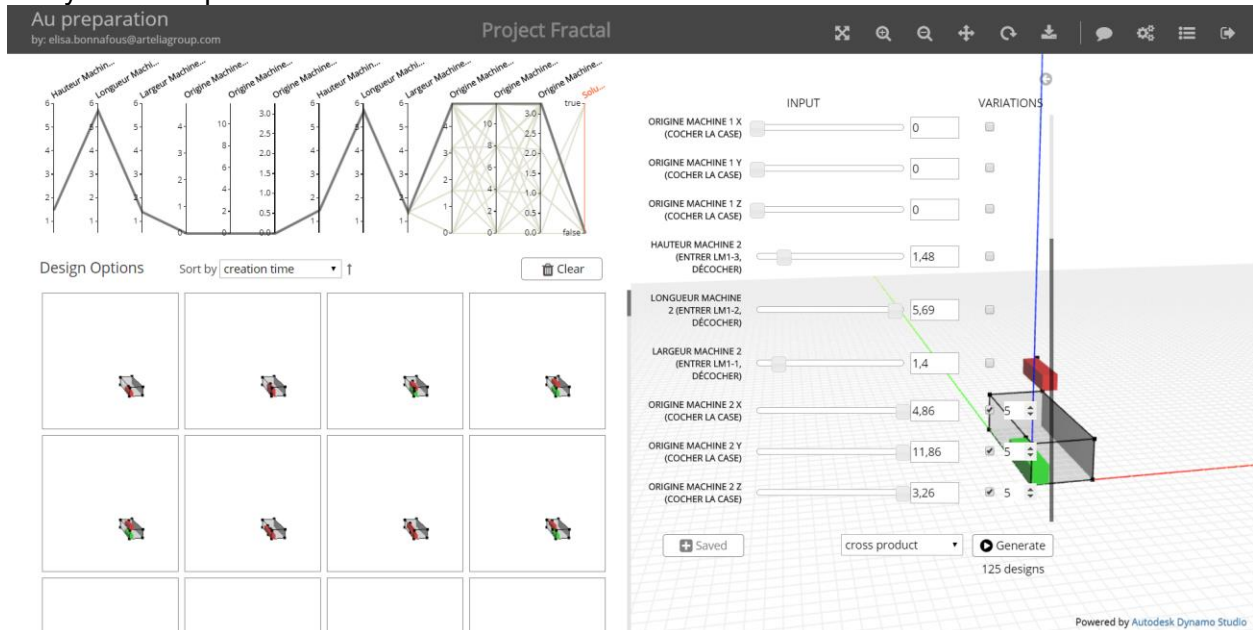
The engineer can now access to the script on the Fractal interface.



FRACTAL INTERFACE

Then, thanks to the technical data calculated by the engineer, the air units' dimensions can be added.

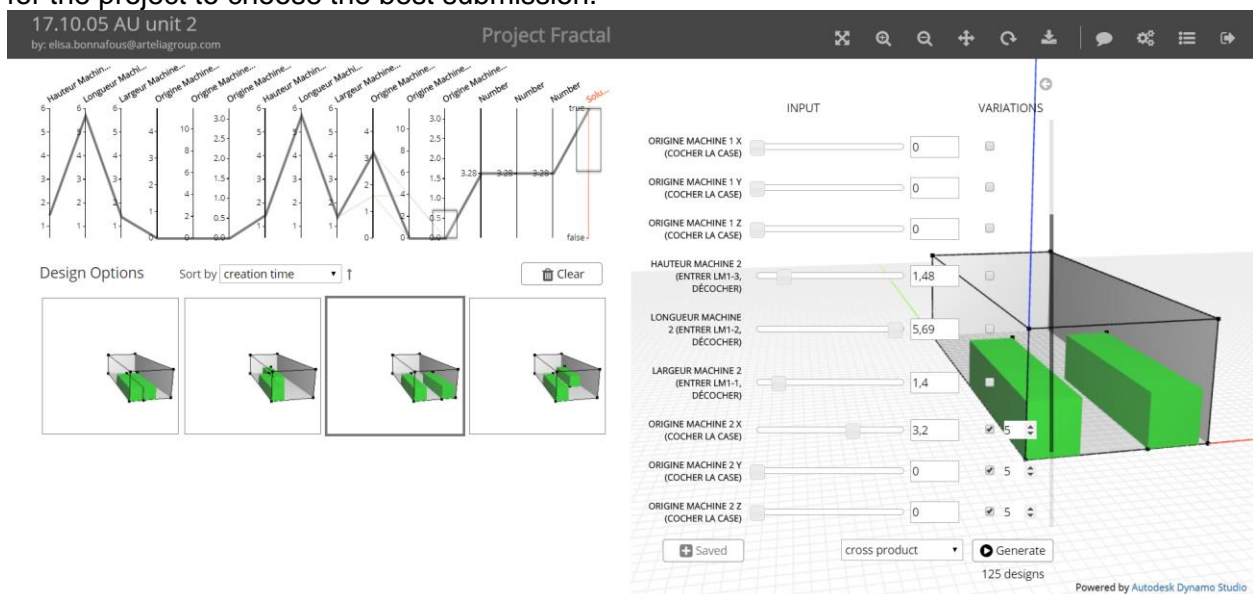
Finally, by clicking “Generate”, Fractal combines the x, y and z values for each air units to obtain every air units' positions.



RESULTS IN FRACTAL

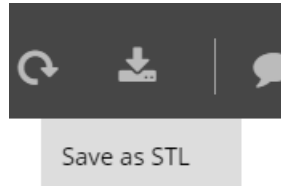
Thanks to the filters on the scales, the engineer can select only some results and find his favorite.

The engineer has a fundamental role in the use of the software: Fractal doesn't give the best solution, it calculates every viable position. So the engineer needs to have the expertise needed for the project to choose the best submission.



SELECTION OF THE BEST SOLUTION IN FRACTAL

Once the best solution is chosen, it can be exported it in a .STL file.



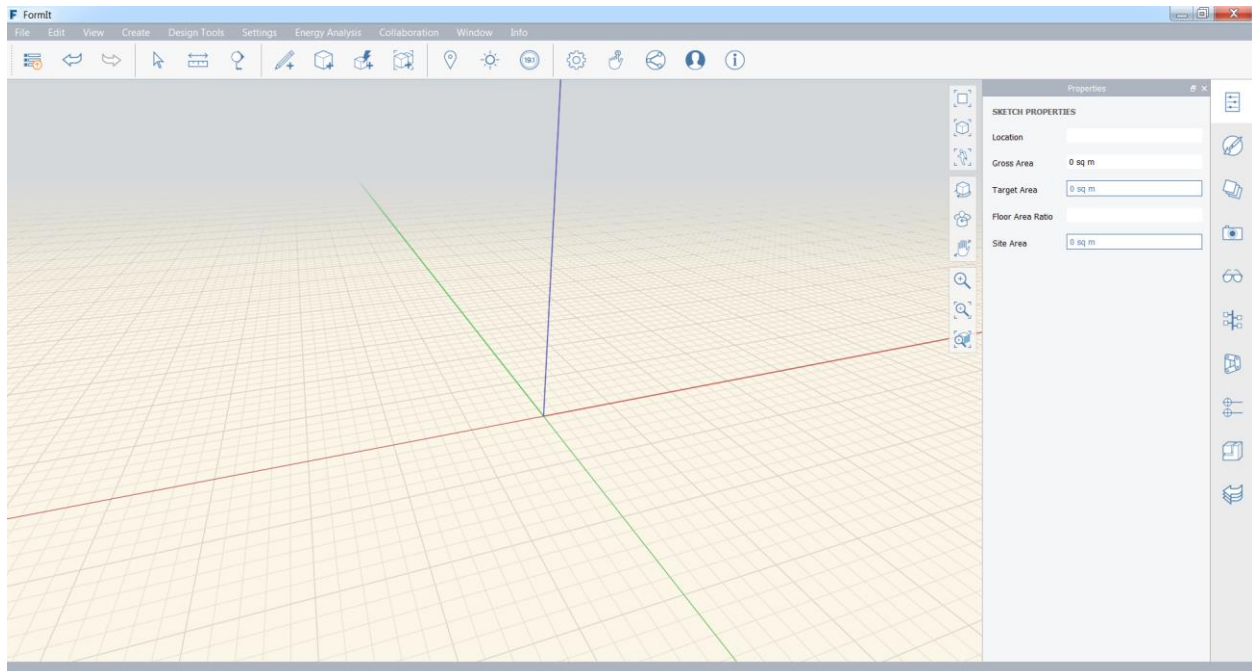
EXPORT AS .STL FILES IN FRACTAL

CONCLUSION: The engineer found all the viable position for the air unit with the help of FRACTAL, then he was able to choose the best position for his project thanks to his expertise and can perfectly justify his choice.

FormIt Software Utilization: How to adjust easily the chosen solution

Software: FormIt – interface and use

FormIt is an easy 3D modeling software. It can be found online or Desktop.



FORMIT INTERFACE

It mostly does geometrical modeling.

Example: add the machine room in its proper situation

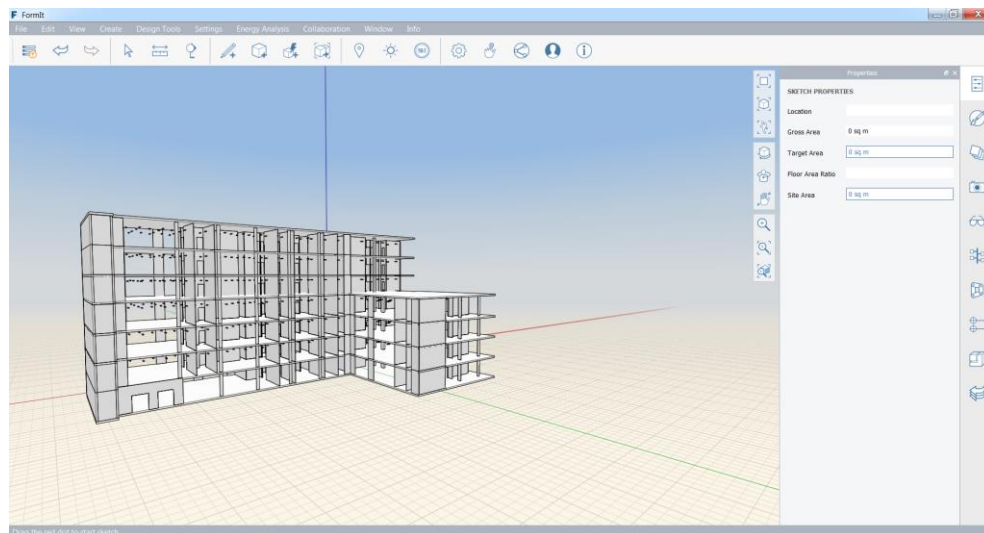
GOAL: to create a 3D synoptic in the building

DELIVRABLE: adjusted position of the air units in the building

USER: Engineer

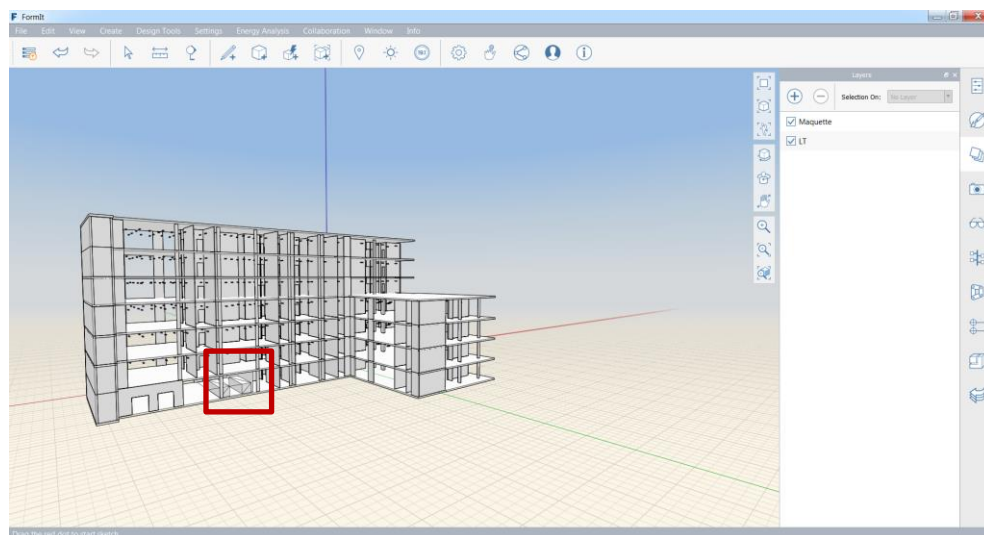
In our example, the engineer, now, wants to place the machine room at the right position in the building and do some small changes about the air units.

First, the building's modeling is imported into FormIt. To do so, the Revit modeling needs to be exported in a .SAT file from Revit and then imported in FormIt.



REVIT MODELING IN FORMIT

Then, the Fractal result needs to be imported and placed into the modeling.

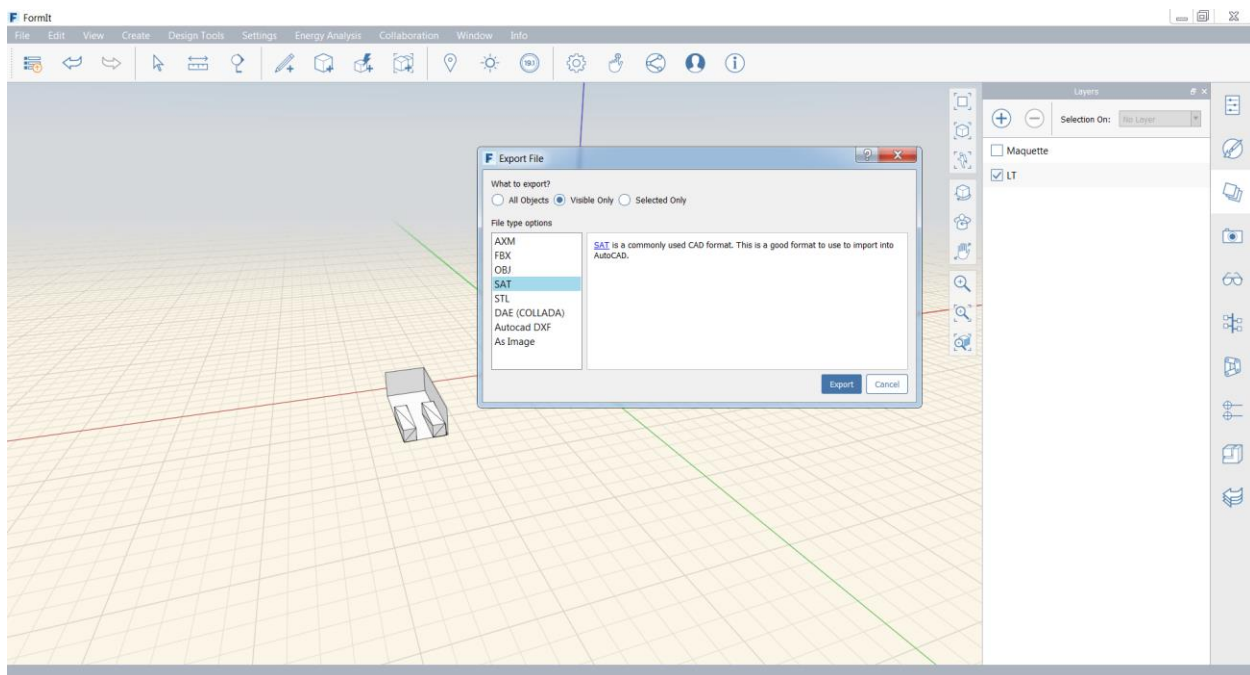


FRACTAL SOLUTION IN FORMIT

The engineer can do some small changes about the geometry.

He can also add some elements (cylinder for example) to create avatar of links between the several machine rooms: it's a 3D synoptic. The engineer is the only one who knows where to place the machine rooms and how to connect several devices together. He can use FormIt to draw the synoptic as he used to do on paper but now in 3D.

To collaborate with the draughtsman, the engineer has to export only the machine room. If the Revit modeling is placed into a layer, it's possible to un-select the layer. Then the engineer can export a .SAT file with only the machine room at the right place.



EXPORT OF THE MACHINE ROOM FROM FORMIT

CONCLUSION: The engineer added the machine room in the building environment and adjusted the air units' position in FormIt, he created a 3D synoptic that will help the draughtsman to model the system in Revit.

Revit Software: How to finalize the modeling

Software: Revit - use

Revit is a 3D modeling software and allows people to add a lot of information in the objects. The files are not only 3D modeling, they are database.

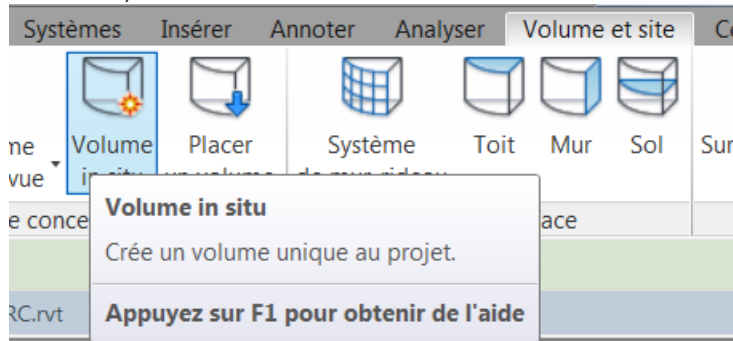
Example: to model the system in Revit

GOAL: to implement the machine room in Revit in a more accurate way

DELIVRABLE: REVIT file with the air units'

USER: Draughtsman

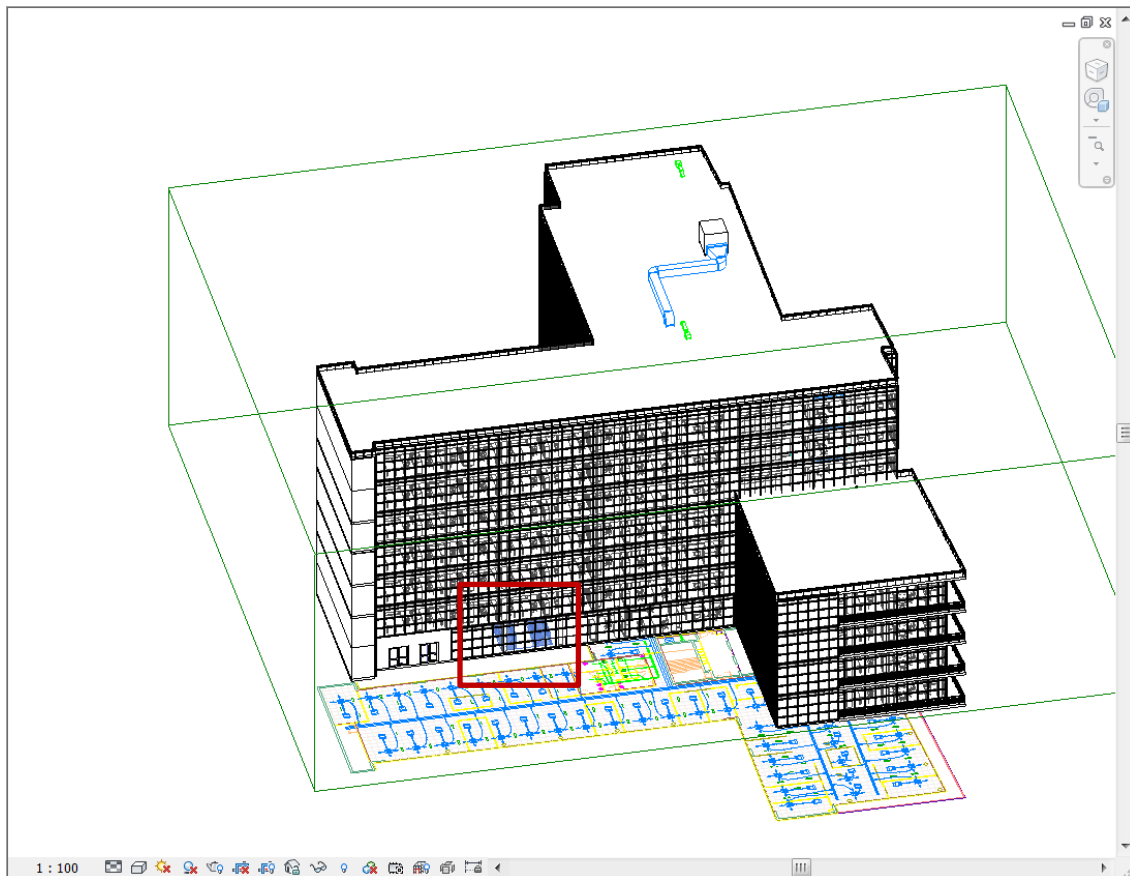
The draughtsman can now import the .SAT file to be guided on his modeling.
To do so, he needs to add a volume.



ADD A VOLUME IN THE REVIT MODELING



IMPORT FROM CAO

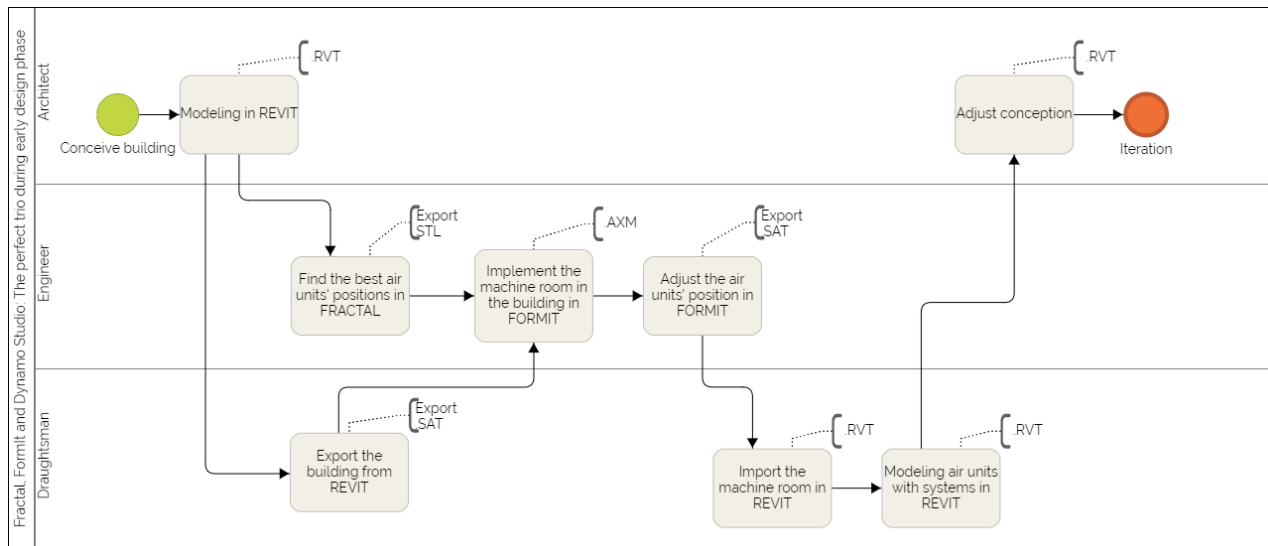


VOLUME PLACED INTO THE REVIT MODELING

The draughtsman can now model the air units at the exact place the engineer wanted and be sure he connected the right devices.

CONCLUSION: The draughtsman modeled the air units exactly as the engineer planned in Revit

CONCLUSION



We showed you here a rather simple example of using a combination of 4 Autodesk solutions together: Dynamo Studio, Fractal Project, FormIt and Revit.

These processes are not wholly ideal because all the software are not fully connected to each other. The export and import processes add steps to the collaboration between architects, engineers and draughtsman. But the good thing is this workflow allows engineers to take a step into boosted intelligence and 3D modeling.

It brings algorithmic solutions to assist the engineer in the engineering process. It opens new doors to manage differently the analysis, the results, the project designs and the team collaboration. This is maybe an opportunity to develop new engineering processes for our BIM projects.