BLD322403

BIM and Forge Technology for Operation and Facilities Management a Real Use Case

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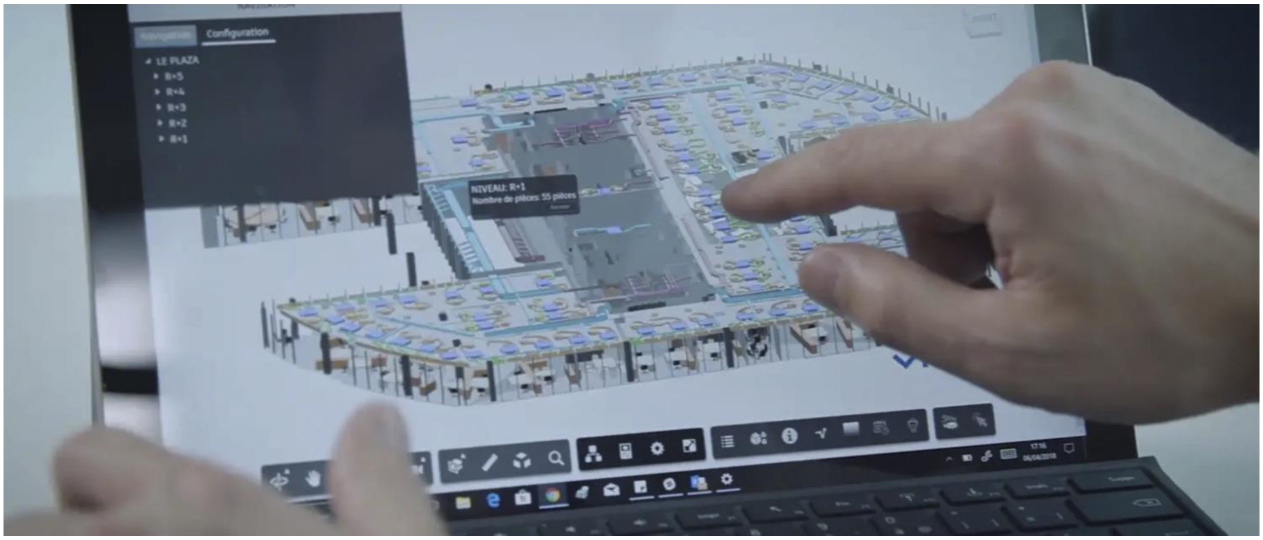

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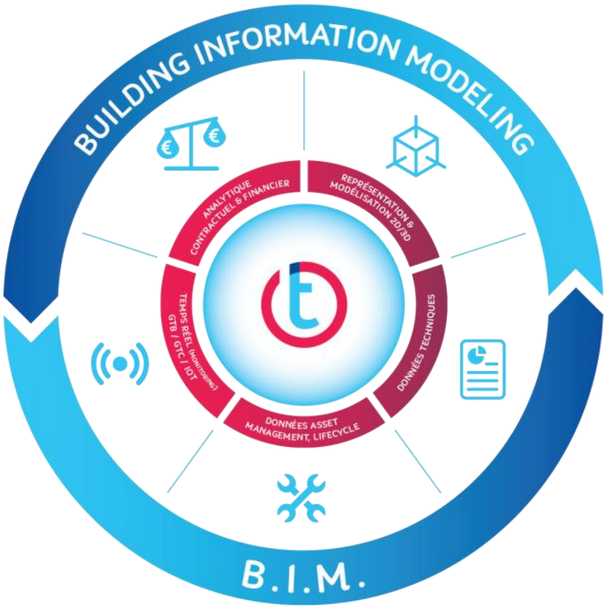
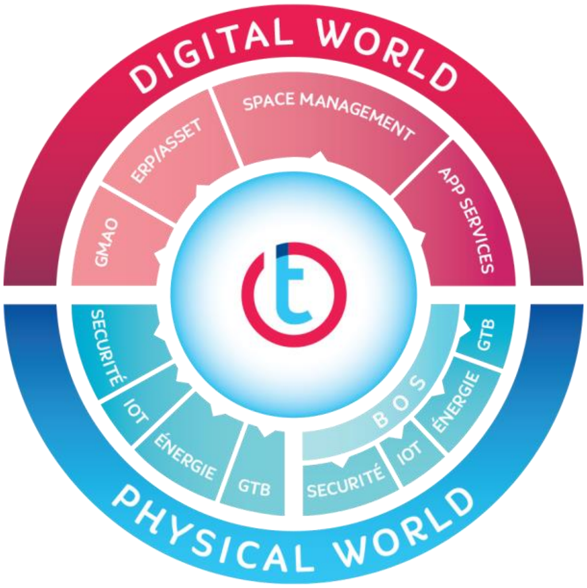
Description

VINCI Facilities, a leading provider of facilities management (FM) solutions, explores new methods for incorporating BIM data in smart-building site applications. Discover how the BIM referential can successfully improve building lifecycle management after the handover phase. We'll show you how we use BIM 3D referential to create a data network integrated with CMS, computer-aided facilities management, building managements systems, IoT, space management, and room reservation data. We use the Forge platform to manage FM workflow and process to give the best 3D modern data visualization and functionality from simple building information view with easy geographic or technical network navigation or more complicated elements like occupancy heat map. Facility management operators are given a holistic view of a building's internal systems, accessible on-site or remotely. This is technology that can be applied to both existing and newly constructed buildings, leading to greater operational efficiency, easier maintenance, and smarter buildings.


BUILDING INFORMATION MODELING
ANALYTIQUE CONTRACTUEL & FINANCIER
REPRÉSENTATION & MODÉLISATION 2D/3D
DONNÉES TECHNIQUES
DONNÉES ASSET MANAGEMENT, LIFECYCLE
TEMPS RÉEL (MONITORING) GTB / GTC / IOT
B.I.M.



Your Forge AU/DevCon Expert(s)

Mathieu Rigaud, TwinOps program Manager
He began his career in the transport industry in R & D, design and scheduling (Lean, SixSigma, MTM) for Airbus, DCNS, ALSTOM, PEUGEOT and their equipment supplier; He then specialized in Product Lifecycle Management (PLM) as a functional aeronautical architect before taking over the management of Impararia's R & D department on the transfer of PLM processes in the AEC with the arrival of BIM. He became a consultant for VINCI Facilities on the Thales project before joining internal VINCI Facilities and creating and lead since 5 years BIM FM TwinOps project.

Cyrille Fauvel got his first computer when he was 12 years old, and as he had no money left to buy software, he started writing code in assembly code. A few years later, he wrote code in Basic, Pascal, C, C++, and so on, and he's still doing that. He's been with Autodesk, Inc., since 1993, joining the company to work on AutoCAD software originally. He's passionate about technology and computers. At Autodesk he's worked in various roles, from the design side to manufacturing and finally to games and films. He is now an evangelist for the Forge API (application programming interface) and web services, and he has a desire to deliver the most effective creative solutions to partners using these APIs and web services.

Introduction

In this class, we will run through the TwinOps project from the initial discussion Mathieu and Cyrille had early in 2017 to the product launch phase. Since we cannot cover the entire development journey, we will only focus on the main challenges we were facing, and how they were addressed using the current state of the Forge API.

Context

The massive adoption of the internet of things (IoT), data-driven analytics and machine learning in smart building applications has paved the pathway for a transformative technology once used in the manufacturing sector called a digital twin. While the digital twins concept is not new, it is poised to revolutionize the way in which building owners and operators construct, maintain and analyze the uses of assets and occupants in their buildings.

A digital twin is a digital replica of physical assets, processes, people, places, systems and devices that can be used for various purposes. The digital representation provides both the elements and the dynamics of how the Internet of things devices operate and live throughout its life cycle.

Digital twin virtual representation of the physical building is embedded with rich information about spaces and assets and can offer significant benefits to building owners.

The immediate access to data and schematics about how a building is performing can enable owners and operators to manage assets, energy, space and comfort in a free-flowing manner inside of a single building or an entire portfolio of properties.

Some of the best use cases for digital twins have emerged in the often-disjointed design and construction process where a loss critical information creates many gaps.

During the design and construction of a building, a considerable amount of information is produced such as drawings, documents and notes, however maintaining and finding this information after construction is often very costly and time-consuming.
Imagine the amount of time it takes a building operator to sift through the documentation to identify how particular areas were constructed to identify an underlying problem inside the

building's infrastructure. While, in the meantime, the building or its occupants continue to suffer as the problem or failure persists.

The digital twin serves as much more than just a database or schematic and is a dynamic, expressive real-time system of record.

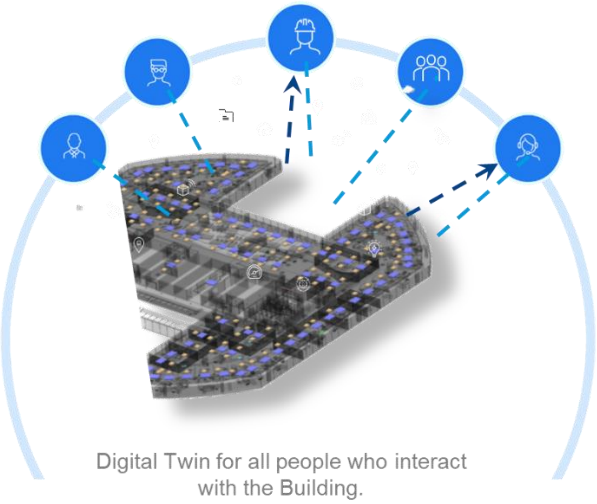
While an operator may know that a part needs to be replaced and space needs to be reconfigured, often times it impossible to find the data necessary to make cost-prohibitive decisions - with a digital twin, the process can be easy and reduced from weeks and months to hours.

Whether it is data generated by an asset, space, lease, maintenance management systems or data from IoT, a digital twin can act as the hub to integrate information provide context to it and generate insights that help to optimize building performance by eliminating silos.

As more builders create digital twins of properties, it eases labor costs related to the facility management. If an air condition system needs repair- using a digital twin the technician can not only find the fault location on smartphone or tablet but can also better troubleshoot the problem using data captured in the twin. In cases where on-site visits are costly a digital twin provides remote access and more transparency than an actual site visit. Owners can send a digital twin to vendors who can then create models based on its data and reduce the needs for costly visits.

When making capital improvements or deploying a single application across a portfolio of properties, digital twins enable the ability to forecast through modeling the impact in one or many buildings and drive data decisions that can significantly improve return on investment.

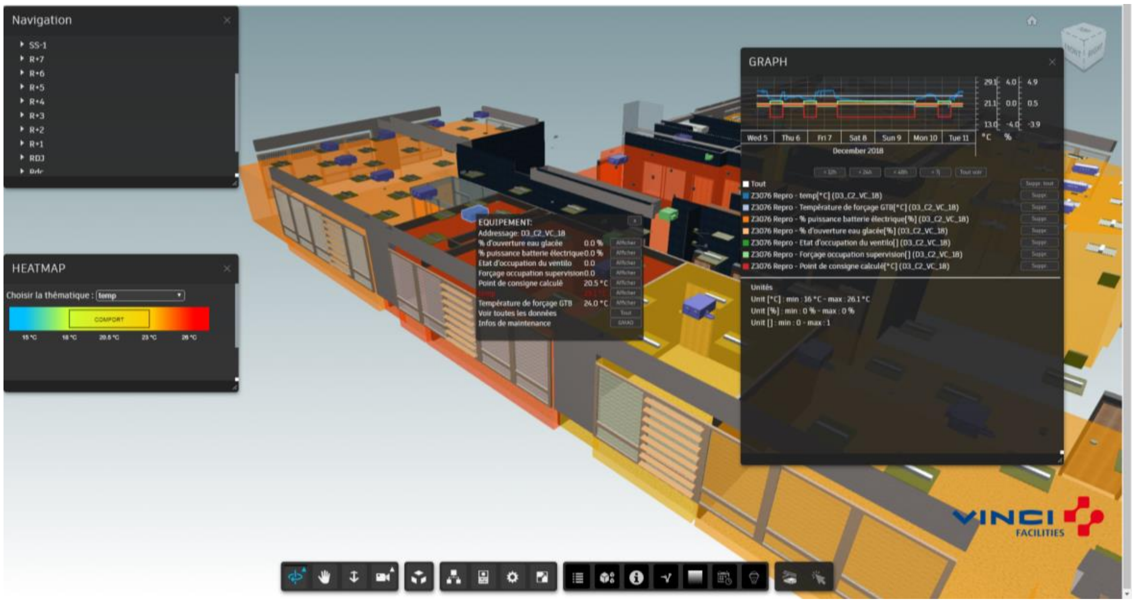
For example, now a simple deployment of conference room sensors or an entirely optimized environment in one property can then be replicated and modeled in other locations within a portfolio for owners to more easily quantify deployment and logistical costs.



Digital Twin for all people who interact with the Building.

In retail, hospitality and industry settings where replicating the same customer experience across all locations is crucial to a brand, digital twins provide a living schematic of how and where to deploy IoT devices and sensors. Imagine the number of IoT devices, cameras and sensors that are used a single Las Vegas property or a large retail store- having a digital twin can save significant technical labor costs by replicating the same environment while maintaining the customer's experience across all properties.

Quick Product Overview

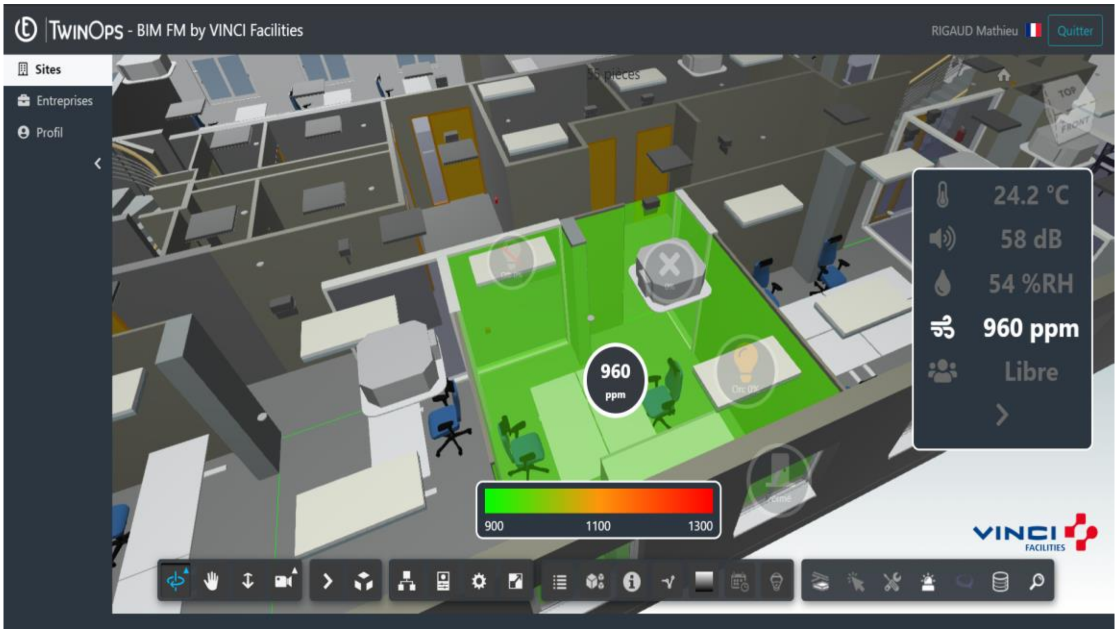


Choisir la thématique : temp

EQUIPEMENT:
Addressage: D3_C2_VC_18
% d'ouverture eau glacée 0.0 %
% puissance batterie électrique0.0 %
Etat d'occupation du ventilo 0.0
Forçage occupation supervision0.0
Point de consigne calculé 20.5 °C
Température de forçage GTB 24.0 °C
Voir toutes les données
Infos de maintenance

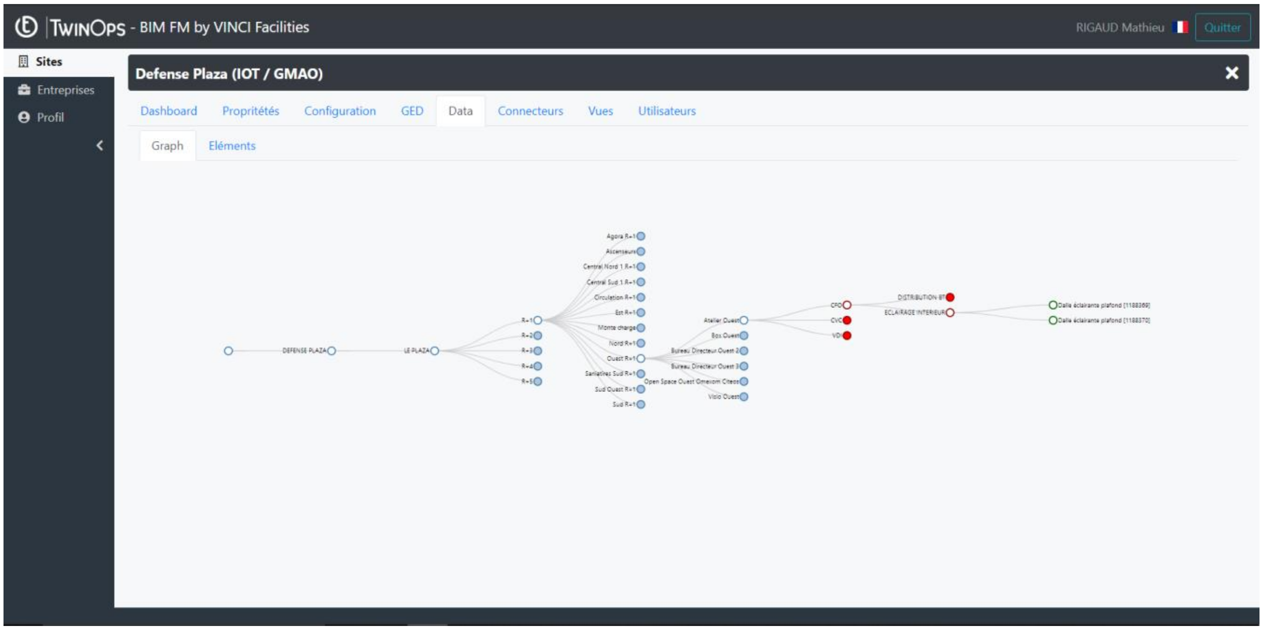
Tout
Z3076 Repro - temp[°C] (D3_C2_VC_18)
Z3076 Repro - Température de forçage GTB[°C] (D3_C2_VC_18)
Z3076 Repro - % puissance batterie électrique[%] (D3_C2_VC_18)
Z3076 Repro - % d'ouverture eau glacée[%] (D3_C2_VC_18)
Z3076 Repro - Etat d'occupation du ventilo[] (D3_C2_VC_18)
Z3076 Repro - Forçage occupation supervision[] (D3_C2_VC_18)
Z3076 Repro - Point de consigne calculé[°C] (D3_C2_VC_18)

Unités
Unit [°C] : min : 16 °C - max : 26.1 °C
Unit [%] : min : 0 % - max : 0 %
Unit [] : min : 0 - max : 1



The initial idea and discussions

When we first met, Mathieu had a vision of using the 3D models as the source of truth for facility management processes and aggregate all the other Information Systems data around the digital model and create a Digital Twin of the building. However, it turns out very quickly that the main challenge was around data access and reconciliation. Forge can help on extracting data from most of the CAD Design file format, but does not necessarily understand the data logic behind, and has no clue about possible external data sources.



We did agree on building first a PoC around data to prove that the Mathieu objectives could be achieved:

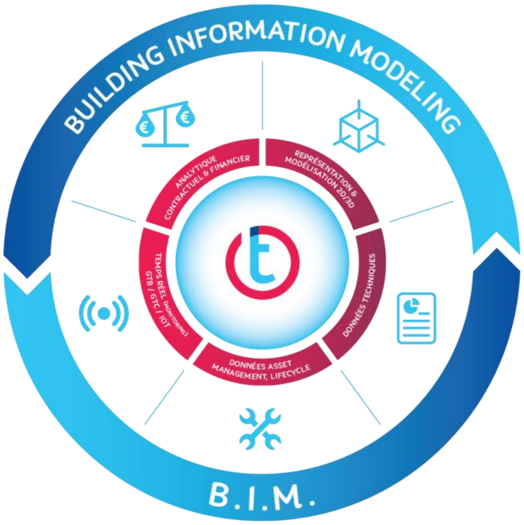
- Gain control on projects in real time
- Streamline and automate data processing and reconciliate physical and digital assets
- Optimize building operations with predictive maintenance
- Optimize space management
- Document the life of the building

Mathieu idea was to build a full Digital Twin experience to include all Facility Management processes, but to open the Front End to all users for large adoption from the different actors (gamification).

The PoC turns out to be fairly easy to develop but was requiring a lot of processing time. The nature of the date from the different sources were not immediately ‘compatible’. Forge can map Object IDs and their CAD Design file unique IDs when they exist, but other Information Systems are using different semantics to classify objects/assets. The CAD Design model may or may not reference these classifications natively. The first step was to clearly document to Building Owners, Architects, and Construction Companies what were the minimum requirements to create their Digital Twins – but even if everyone was putting the right information on the Revit model at the right place, there was still room for mistakes. It was decided at this stage to include a pre-process to verify the different standards and that the data can be fully reconciliated automatically. If not report errors to people automatically.

Other source of information covers all the FM & Asset Management ecosystem:

- 3D/2D graphics data
- Manufacturing data characteristics and technical workorder
- Lifecycle data from CAFM systems
- Live Data from BMS, HVAC, IOT and Building Operating Systems
- ERP and property cost systems
- Services portals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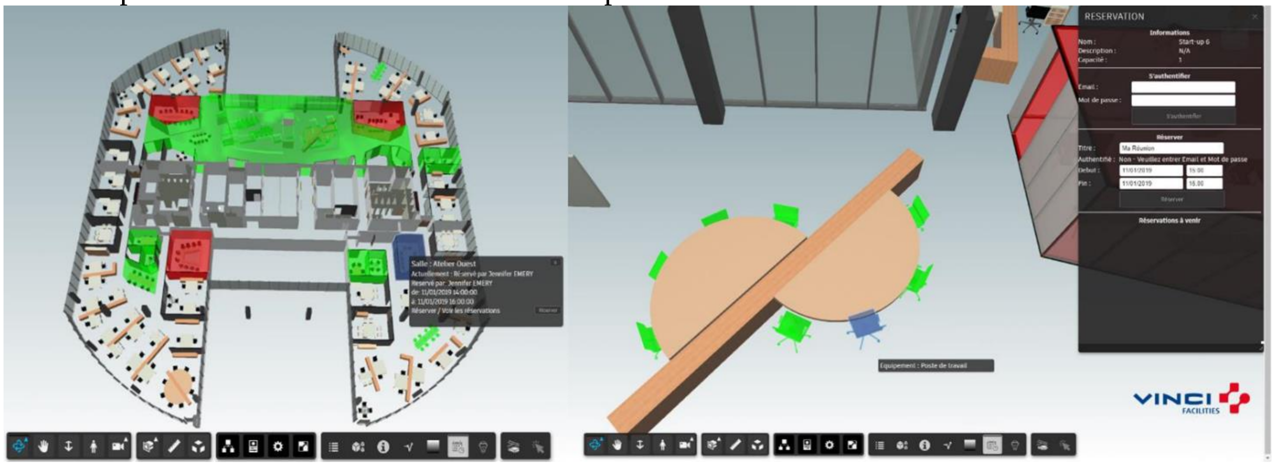
DONNÉES TECHNIQUES
DONNÉES ASSET MANAGEMENT, LIFECYCLE
TEMPS RÉEL (MONITORING) GTB / GTC / IOT
B.I.M.

Services portal data for room reservation example:


Salle : Atelier Ouest
Actuellement : Réservé par Jennifer EMERY
Réservé par: Jennifer EMERY
de: 11/01/2019 14:00:00
à: 11/01/2019 16:00:00
Réserver / Voir les réservations

RESERVATION

Informations

Nom : Start-up 6
Description : N/A
Capacité : 1

S'authentifier

Email :
Mot de passe :

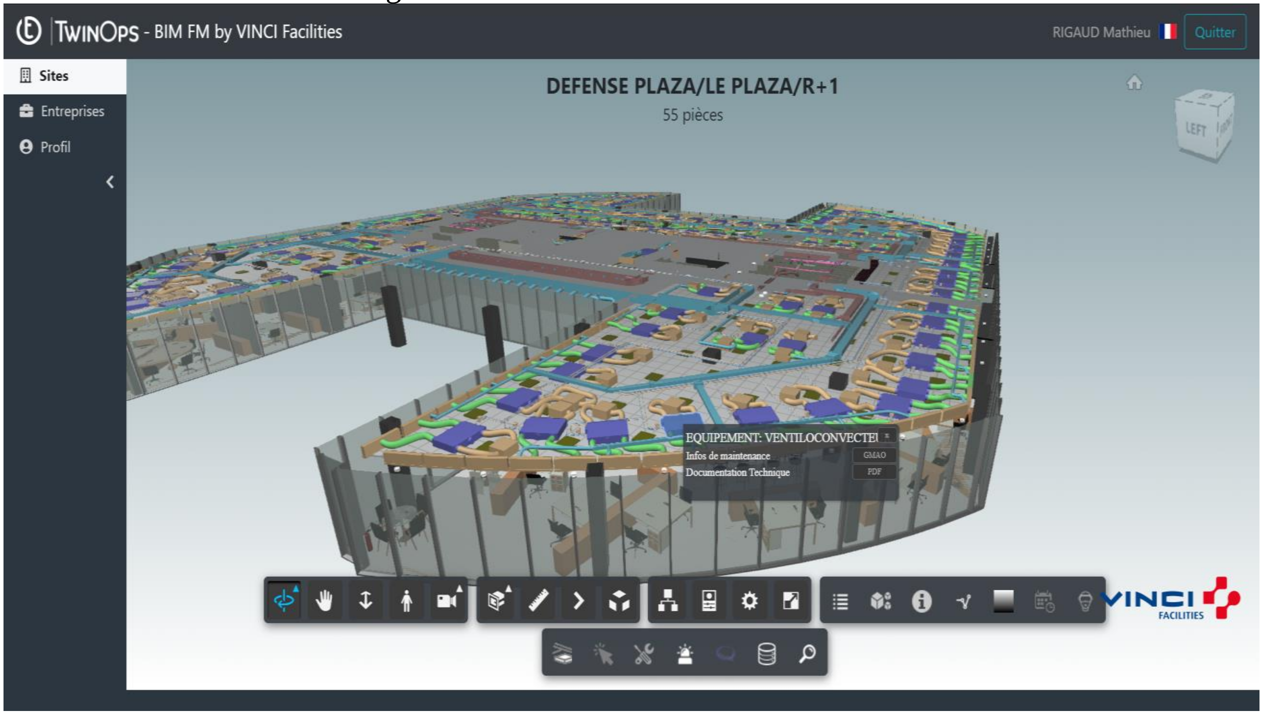
Réserver

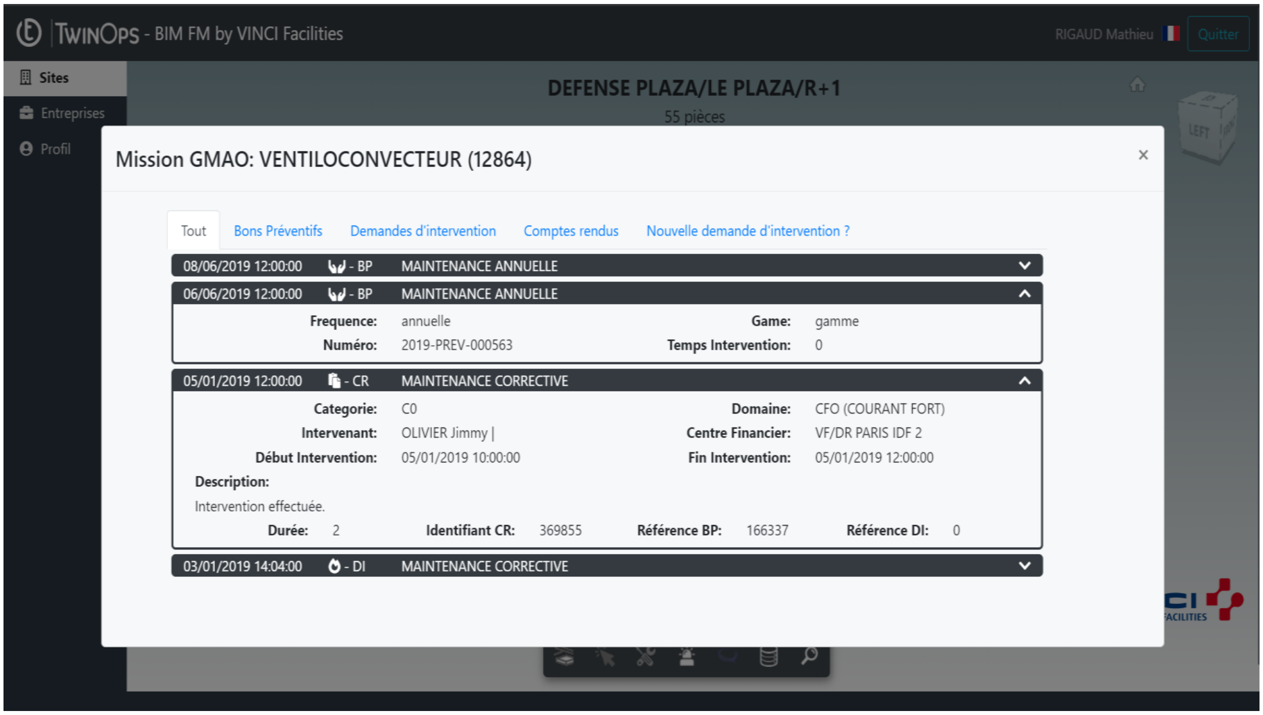
Titre : Ma Réunion
Authentifié : Non - Veuillez entrer Email et Mot de passe
Debut : 11/01/2019 15:00
Fin : 11/01/2019 16:00

Réservations à venir

Equipement : Poste de travail

CAFM Data and tickets management :




TwinOps - BIM FM by VINCI Facilities
RIGAUD Mathieu
Quitter
Sites
Entreprises
Profil
DEFENSE PLAZA/LE PLAZA/R+1
55 pièces

Mission GMAO: VENTILOCONVECTEUR (12864)

Tout | Bons Préventifs | Demandes d'intervention | Comptes rendus | Nouvelle demande d'intervention ?

08/06/2019 12:00:00 - BP MAINTENANCE ANNUELLE

06/06/2019 12:00:00 - BP MAINTENANCE ANNUELLE

Frequence: annuelle
Game: gamme
Numéro: 2019-PREV-000563
Temps Intervention: 0

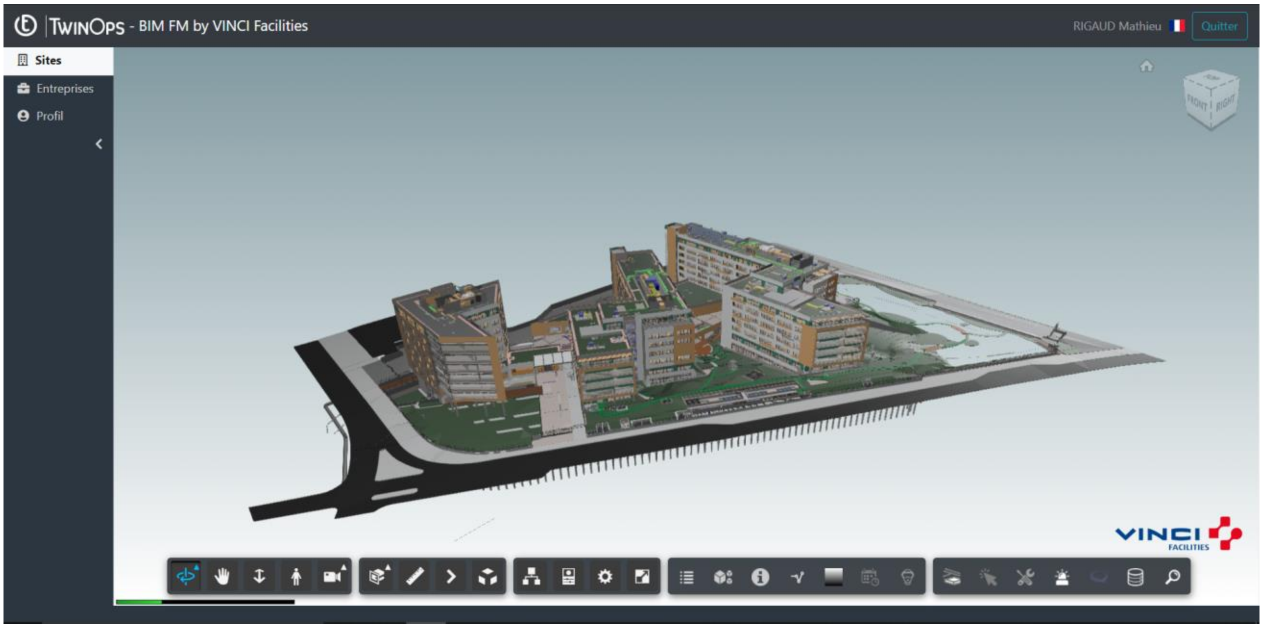
05/01/2019 12:00:00 - CR MAINTENANCE CORRECTIVE

Categorie: C0
Domaine: CFO (COURANT FORT)
Intervenant: OLIVIER Jimmy |
Centre Financier: VF/DR PARIS IDF 2
Début Intervention: 05/01/2019 10:00:00
Fin Intervention: 05/01/2019 12:00:00
Description:
Intervention effectuée.
Durée: 2
Identifiant CR: 369855
Référence BP: 166337
Référence DI: 0

03/01/2019 14:04:00 - DI MAINTENANCE CORRECTIVE

Later, when iterating on defining the application concepts and implementation details it became very clear that to meet Mathieu's objectives on having everyone adopting and using the application daily, the User Experience and ease of use was crucial. But rather than focusing on the typical end-user and trying to find a common denominator to all, we chose the approach to provide tools by disciplines and focusing on people discipline' habits. Funny enough, that challenge was largely addressed already by the data structure that was put in place, and we only had to developpe specific UI assistants in the Forge Viewer to leverage the data.

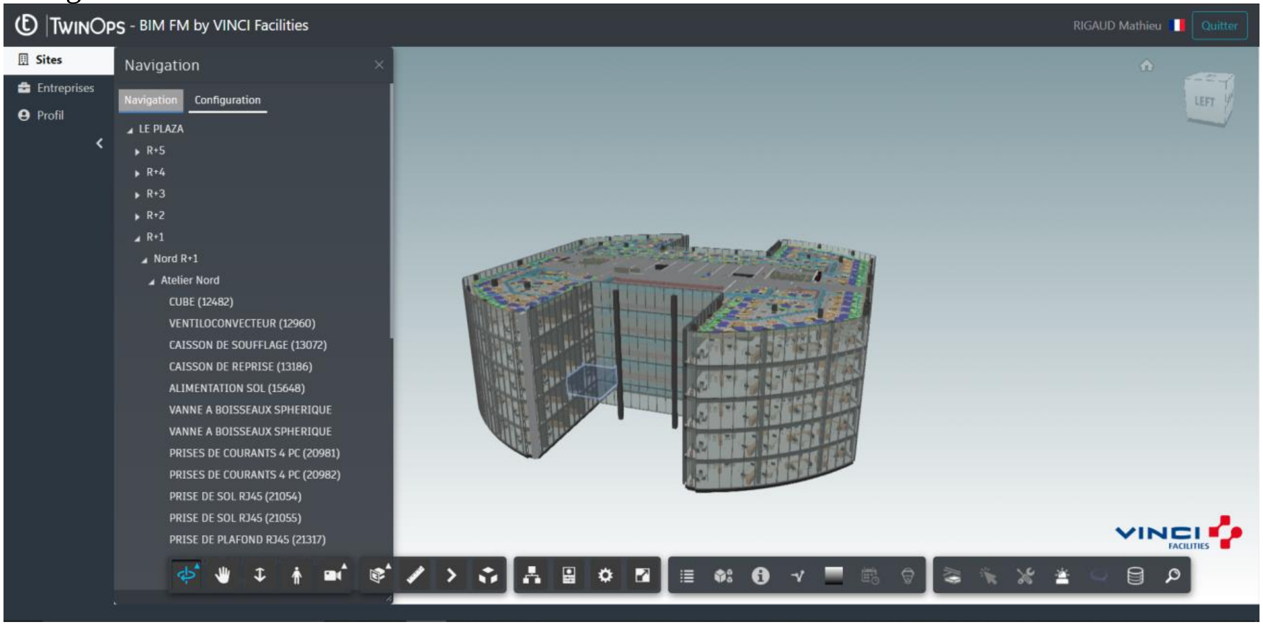
However, as we were approaching the end of the project, and starting using real customer buildings into the system, we were starting to see performance issues on both the data processing on Forge and rendering issues on the Forge Viewer. Forge can handle easily small to medium buildings, but when things start to become really big (Revit model single view as large as ~800Mb, or multi building sites) Viewer performances on loading as well as rendering makes the navigation very slow and hard. Since we all know nobody would like slow performances, and that most people will use limited capacity devices, we will review what are the options and solutions to this problem. If you never heard about the OTG format, the successor of the Viewer SVF format, you may want and listen how OTG can improve your experience. For example, a Forge partner was having an issue on a large model with a lot of rebar – the Viewer was actually crashing after more than 2 minutes loading time, and when using OTG, the Viewer was loading the model in 8 seconds and was still running at a 30fps.



To summarize, the main challenges we will go into more details during the class are:

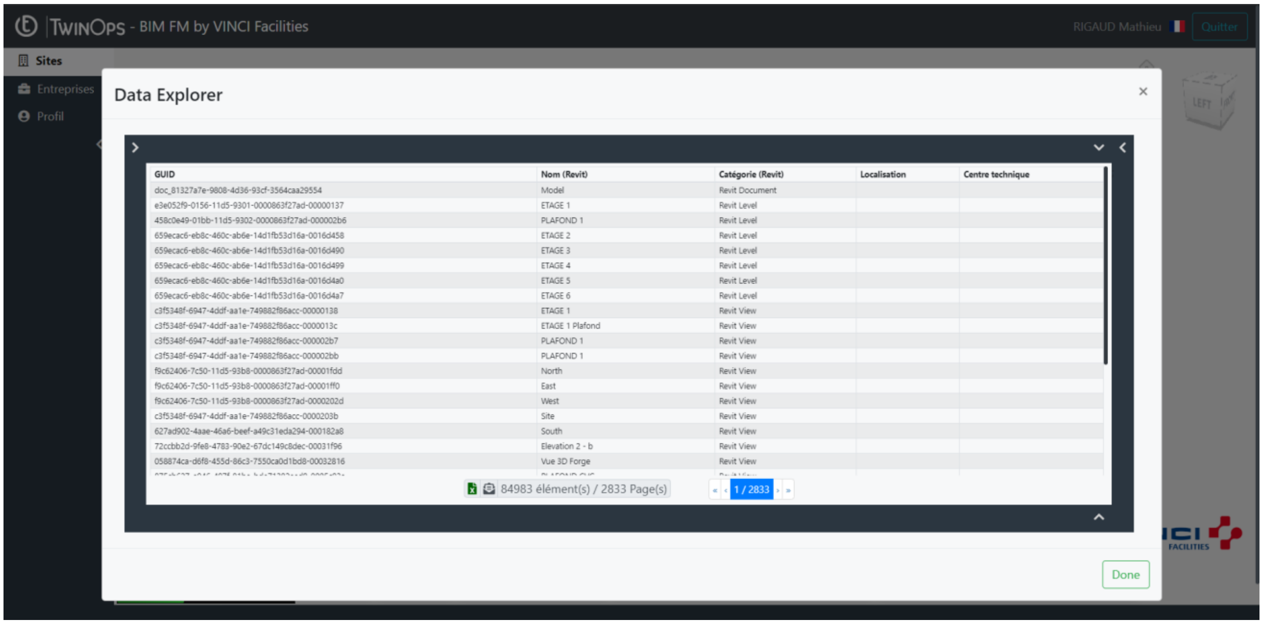
- Data reconciliation
- Navigation - Easy of us in 3D
- Performances - Heavy 3D models

Navigation tree:



- LE PLAZA
  - R+5
  - R+4
  - R+3
  - R+2
  - R+1
    - Nord R+1
      - Atelier Nord
        - CUBE (12482)
        - VENTILOCONVECTEUR (12960)
        - CAISSON DE SOUFFLAGE (13072)
        - CAISSON DE REPRISE (13186)
        - ALIMENTATION SOL (15648)
        - VANNE A BOISSEAUX SPHERIQUE
        - VANNE A BOISSEAUX SPHERIQUE
        - PRISES DE COURANTS 4 PC (20981)
        - PRISES DE COURANTS 4 PC (20982)
        - PRISE DE SOL RJ45 (21054)
        - PRISE DE SOL RJ45 (21055)
        - PRISE DE PLAFOND RJ45 (21317)

Data explorer and research:



GUID	Nom (Revit)	Catégorie (Revit)	Localisation	Centre technique
doc_81327a7e-9808-4d36-93cf-3564caa29554	Model	Revit Document		
e3e052f9-0156-11d5-9301-0000863f27ad-00000137	ETAGE 1	Revit Level		
458c0e49-01bb-11d5-9302-0000863f27ad-000002b6	PLAFOND 1	Revit Level		
659ecac6-eb8c-460c-ab6e-14d1fb53d16a-0016d458	ETAGE 2	Revit Level		
659ecac6-eb8c-460c-ab6e-14d1fb53d16a-0016d490	ETAGE 3	Revit Level		
659ecac6-eb8c-460c-ab6e-14d1fb53d16a-0016d499	ETAGE 4	Revit Level		
659ecac6-eb8c-460c-ab6e-14d1fb53d16a-0016d4a0	ETAGE 5	Revit Level		
659ecac6-eb8c-460c-ab6e-14d1fb53d16a-0016d4a7	ETAGE 6	Revit Level		
c3f5348f-6947-4ddf-aa1e-749882f86acc-00000138	ETAGE 1	Revit View		
c3f5348f-6947-4ddf-aa1e-749882f86acc-0000013c	ETAGE 1 Plafond	Revit View		
c3f5348f-6947-4ddf-aa1e-749882f86acc-000002b7	PLAFOND 1	Revit View		
c3f5348f-6947-4ddf-aa1e-749882f86acc-000002bb	PLAFOND 1	Revit View		
f9c62406-7c50-11d5-93b8-0000863f27ad-00001fdd	North	Revit View		
f9c62406-7c50-11d5-93b8-0000863f27ad-00001ff0	East	Revit View		
f9c62406-7c50-11d5-93b8-0000863f27ad-0000202d	West	Revit View		
c3f5348f-6947-4ddf-aa1e-749882f86acc-0000203b	Site	Revit View		
627ad902-4aae-46a6-beef-a49c31eda294-000182a8	South	Revit View		
72ccbb2d-9fe8-4783-90e2-67dc149c8dec-00031f96	Elevation 2 - b	Revit View		
058874ca-d6f8-455d-86c3-7550ca0d1bd8-00032816	Vue 3D Forge	Revit View		

84983 élément(s) / 2833 Page(s)

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The development experiences

Web application architecture

The web application has several components:

- The Front End provides a UI which allow users to visualize live information and interact with model. It also has several navigation components specialized for the industry and disciplines.
- The Back End communicates with other services, various databases or Information systems including Forge. This is where most of the business logic and data processing happens.
- Forge provides access to Revit models data.

The following Forge services are used:

- **Authentication API** is used to authorize the application to use the Forge API. The application is using so called 2-Legged authentication where there is no need of a user to authenticate. Therefore, the application can use Forge in the background without the user having to authenticate.
- **Data Management API** is used to manage files on Forge backend server.
- **Design Automation v3** is used to process Revit / IFC files to check standards and create extra information such as rooms, spaces, etc…
- **Model Derivative** is the API which extracts information from CAD design models. Information extracted contains most of the metadata contained in Revit / IFC files useful to implement the smart building / facility processes, as well as doing the data reconciliation with other systems.
- **Viewer API** is used to display 3D models, and eventually 2D sheets if needed. The Viewer API is also used for interaction with the model (i.e. query element properties, display phases etc.) in the WEB page/WEB application.

The Web application is deployed on Azure as Web App which provides several benefits:

- Pre-configured instances reduce time to setup new machine.
- Integration with Git allows deploy latest changes at any time.
- Scalability based on application needs (CPU, Memory).

Use of Revit API for data preparation

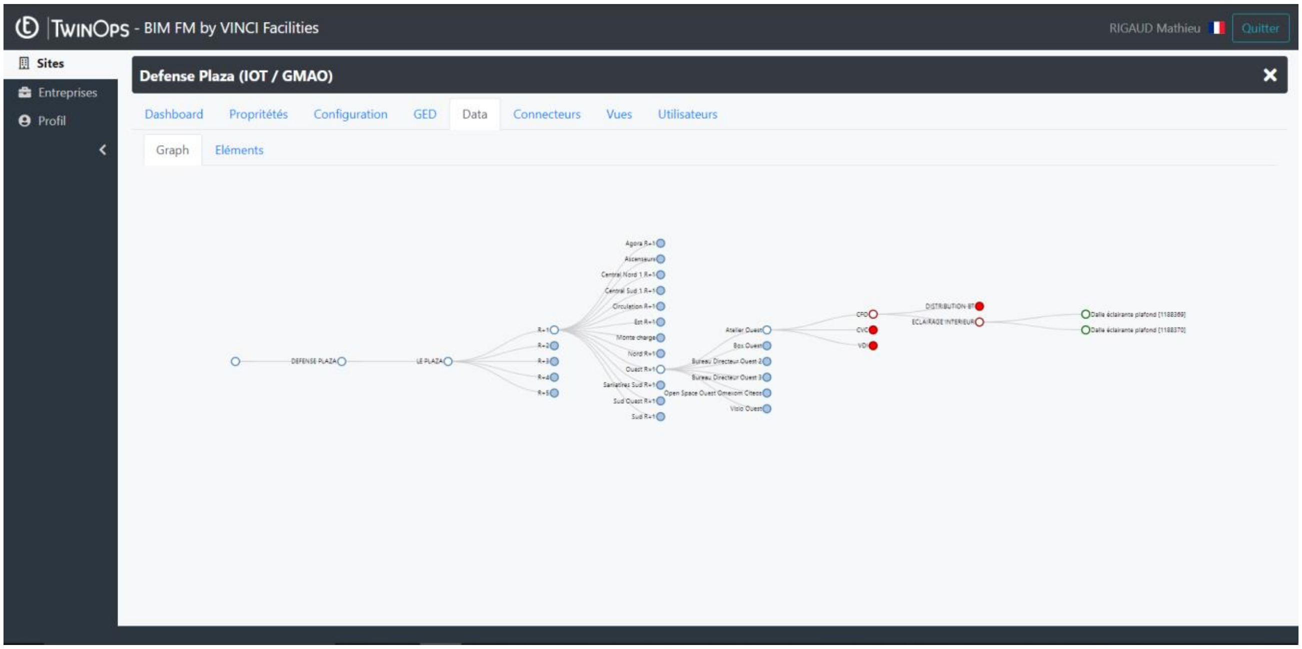
The Forge platform provides a Viewer with all the Revit information stored in the object’s properties. But the Revit database is by far more exhaustive and intelligent because it describes complex relationship between different objects in the model. So, a good understanding of the

Revit API can help you retrieve some information from Revit and send it to Forge. The following section describes typical examples where we needed to prepare the Revit data before exporting it to our Forge application.

We currently use the Revit API and design automation to generate the tree of navigations from standard room definition to tree of integration base on Site\Building\floor\area\room structure. Using revit automation lets us win lot of time from our Dynamo program who take 2H/3H with lot of crash to a couple of second on revit API.

Another use of the Revit API are to assign all asset in the room where they are automatically.

Both functions permit us to create the navigation and the structure of the CDE in the platform.



Disconnected mode

We do not necessarily have a stable internet connection on site, for example when going deep in the basement. Therefore, we need to implement a disconnected and offline mode for the application: this can be done for the viewer part with specific techniques. But the most difficult part is how to resolve conflicting values when updating the data back to the server. There was an interesting class on this topic at AU last year:

FDC196412 - Creating Flexible Offline Workflows Using Autodesk Forge

Resources

We hope that, by the end of our class, you'll have seen common themes with what you may be doing yourself and that gives you an idea how you could improve your own or your customers' applications/workflows.

And please come and talk to us after the class if you want to discuss your ideas. In the meantime, here are a few links to additional resources to get you started:

- For a general overview of Forge, visit https://forge.autodesk.com.
- The Forge APIs are documented at https://forge.autodesk.com/developer/documentation. The documentation includes an overview of each API, step-by-step tutorials, and API reference guides.
- Our 'official' sample library is available on GitHub - https://github.com/Autodesk-Forge?tabs=repositories.
- The Forge Partner Development team write a lot more samples than the official sample set. We typically publish the code for these on our personal GitHub repositories and write about them on our Forge Blog - https://forge.autodesk.com/blog.
- If you need help with using Forge, we offer support via StackOverflow and email. Find out more here - https://forge.autodesk.com/en/support/get-help. (Note - You must be signed in using your Autodesk ID to see all the information on this help page). However, since you took the time to read our handout, please don't hesitate to email one or both of us if you'd like to arrange a call to talk through how you can make best use of Forge. Our email addresses are: cyrille@autodesk.com and mathieu.rigaud@vinci-facilities.com.
- More information about TwinOps join us on linkedin : https://www.linkedin.com/company/twinops/; our website www.twinops.com ; need more video demonstration https://vimeo.com/search?q=twinops

We hope you enjoy our class.

Cheers,

Mathieu and Cyrille

External References

What are digital twins in smart buildings? Oct 31, 2018 by Urvashi Verma