

CI501482

How Autodesk Platform Solutions Support the Rail Infrastructure Industry

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Learning Objectives

- Discover the available solutions for rail infrastructure business cases.
- Learn about the platform strategy implementation for the rail infrastructure industry.
- Learn about processes working across multiple Autodesk solutions.
- Learn about implementing innovation and creativity using the Autodesk platform.

Description

The rail infrastructure industry has large-scale challenges: design integration of many diverse engineering disciplines, asset combinations that bring together the entire building information modelling (BIM) lifecycle, and projects that have operations running for decades rather than a couple of years. These challenges need more than just one product; they require a platform solution that can grow and evolve over time. In the last decade, Autodesk has been investing heavily in improving specific railway infrastructure solutions in combination with a strong platform foundation. This class will give an overview of the entire rail lifecycle and how Autodesk supports its defining processes: measuring and modelling existing situations, feasibility studies, multidisciplinary/integrated design, site execution, project collaboration, and handover. This class content is based on Autodesk consultancy and product teams' rail infrastructure background and partnerships with industry leaders, resulting in a comprehensive rail overview.

Speakers

Wouter Bulens has been an active user of Autodesk AEC software solutions for more than 20 years. He holds a degree as a professional drafter and a master's engineering degree in industrial science-construction.

In his professional career he has been active on numerous civil engineering projects in Belgium, France, the Netherlands and some international tenders, as road-, rail designer and enterprise BIM Manager. He is currently a Sr. Implementation Consultant Infrastructure for Autodesk.

He has focused his career on:

- 3D modelling for multidisciplinary civil projects and process optimization for drafting
- render visualization
- 4D animations
- real-time applications
- project System Engineering
- design platform integration
- project/enterprise data strategies

As .NET developer API, he has made tools for 3ds Max, AutoCAD and Civil 3D. He is part of the Civil 3D Rail development group, helping to push not just rail design but transport and infrastructure design forward. Through his work and presenting at industry events, he hopes to help transform the industry to be more data centric and a true example of industry 4.0.

David Licon is a civil engineer with a master's degree in international infrastructure projects. Currently based in Paris, France but originally from Guatemala; he has several years of experience in the design, construction, and operation of linear infrastructures. Throughout his career, he has had the chance to participate in different phases of infrastructure projects (feasibility, design, construction) through various roles (Owner, Design Firm, Construction Company) and in different technical areas (Highway Design, Water Distribution and Rail Infrastructure). Before joining Autodesk in 2020, David was a Project Manager for the Rail Owner in France, focusing on infrastructure projects in the Paris area and surroundings.

Throughout all his experiences, he has always tried to make his work and life easier by focusing on innovative approaches. Today, as an Implementation Consultant for Autodesk, his job consists in applying this creative and innovative mindset to help clients increase the value they get from Autodesk's products, making their processes easier, and allowing them to focus on their goals and high value tasks.

Railway Infrastructure

When people start in the railway industry, they quickly learn that it takes a couple of years to really understand the ins and outs of a railway network. In general people are only educated in one of the many disciplines that are essential to make the trains drive. Over time they become experts in their field, but they also start seeing all the interconnections between disciplines, supply lines, network partners and how all of this influences their work. This leads to the conclusion that it is near impossible to achieve specific goals (the most perfect track design, balanced material supplying, ...) by just optimizing one part.

Railway infrastructure is a System of Systems and it requires another approach.

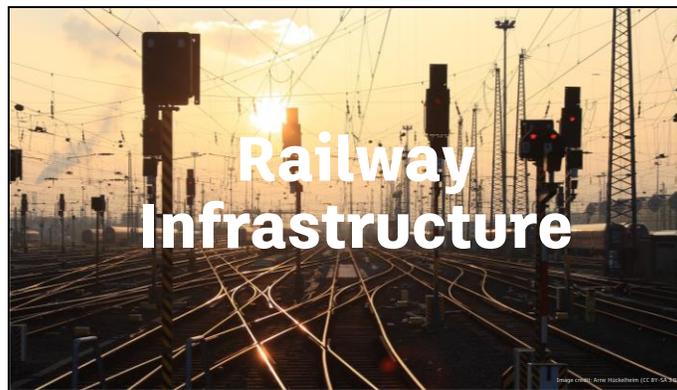


FIGURE 1: RAILWAY INFRASTRUCTURE

System of Systems

We design, build or maintain our railway network with specific goals:

- Do things quicker
- Reduce cost
- Insure certification
- Become more eco-friendly
- Deliver data requirements
- Connect to other infrastructure
- Automate processes
- Improve performance

... and many more. But achieving these goals or just one is not easy.

The first obstacle comes from the diverse **disciplines**. Many of them use completely different design methods, software, visualizations, .. making it extremely hard to connect and balance them in one total integrated design. Historically this was done by designing each component separately and connecting them in a sequential process (waterfall), often resulting in rework and/or deviations from the original goal.

Next, we add the layer of the **lifecycle steps** (concept, design, construction, maintenance). In many construction industries these follow one after the other and are relatively easy to define (start to end). This is not as simply in a bustling railway network, all lifecycle steps are continuously crossing, overlapping and blocking each other.

Last, we have all the **environment** influences that are outside our radius of influence but have a connection and influence on our infrastructure. Policy decisions, economic factors, local communities, project surroundings and general industry transitions. Some of these we can predict, but others simply happen.

These three obstacles (disciplines, lifecycle steps, environment) are continuously moving and changing, making advancing towards our goals like trying to navigate a shifting maze. Add to these the long project durations within the railway industry and we get even more change. The question is, how do we navigate this system of systems towards our chosen goals?

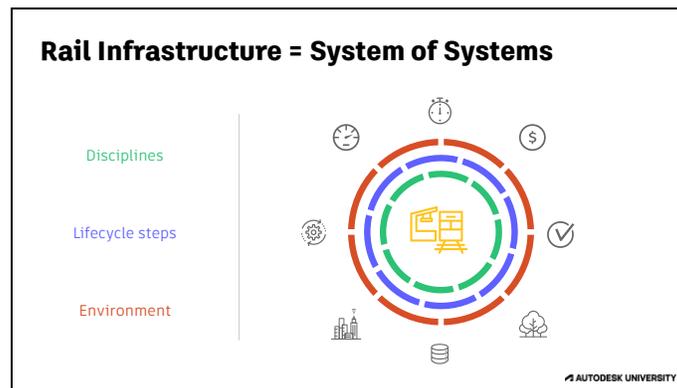


FIGURE 2: SYSTEM OF SYSTEMS

Platform Thinking

We need to shift our thinking from one system/discipline/software to the bigger picture, so that we can start to discover all the interactions that are needed or are already there. For Autodesk this means making the transition to platform thinking in our solutions, where the value resides in the interactions we can facilitate:

- Product portfolio
- Market standards
- Open-ended data

This means adapting and evolving our existing products to be more configurable, combine better and scalable to your needs (the needs of the system of systems). A great example of how value through interactions works, are off course Lego bricks. The seemingly endless combinations have led to the ability to build almost anything. The Lego System has even connected generations (bricks from 1958 still work today), without stopping the evolution and creation of new parts to grow even further.

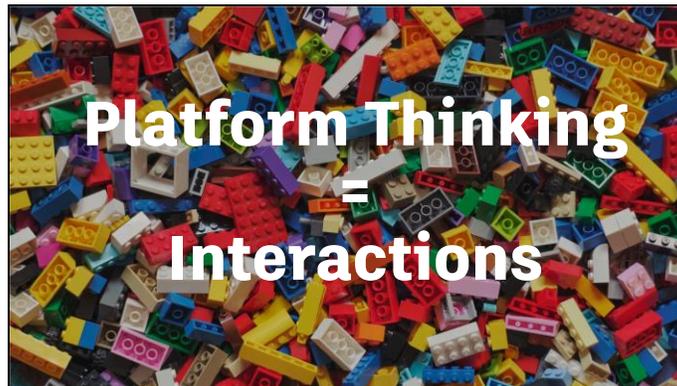


FIGURE 3: PLATFORM THINKING

Progress

There is a general objective that we all share. We want to find the path that ensures progress towards the goals we set, regardless of all the changes we will face along the way (and there will be many of those).

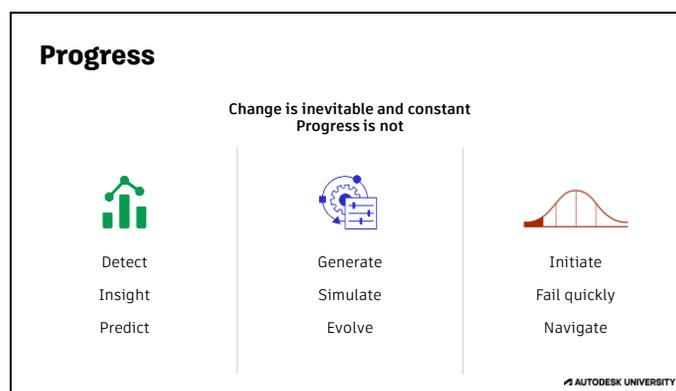


FIGURE 4: PROGRESS

To do this we need to start detecting the entire system of systems and from there our insight can grow to the point where we can predict what will happen given specific changes. Our digital equivalent of a crystal ball.

The tools we use need to shift from enabling us to “manually” create solutions, to enable us to generate solutions. Making them suitable to adapt to change, but also simulate multiple solutions at the same time. By simulating and testing more solutions we can start using the mechanism of evolution in our design methods, the true engine of progress.

This progress path means that we will have the option to choose some of the changes, initiate them on our schedule. Of course some will not work but even then, they give us the opportunity to fail quickly and learn. To enable us to navigate the shifting maze that we are in.



FIGURE 5: SYSTEM OF SYSTEMS CALL FOR PLATFORM SOLUTIONS

It is very clear where one product may support the goals for one system, a system of systems calls for platform solutions. In the coming sections of this handout, we will focus different aspects:

- Autodesk Platform Solutions
- Platform Implementations
- Platform Strategy

Autodesk Platform Solutions

In this section the core elements of the Autodesk Platform Solutions are presented in more detail. The exact platform offering will and must change over time, but its core will remain stable for a long time to come. Understanding these elements will also help in building your larger company eco system in which Autodesk is one contributing partner.

Products

The foundation of the Autodesk platform are our products, spanning across a wide variety of industries:

- Design & Manufacturing
- Architecture & Engineering
- Media & Entertainment
- Construction

These products have proven their worth in their respective domains and some even across several decades, but the whole is greater than the sum of the parts. By connecting our products, we are enabling users to extend their workflows further into other products that are already optimized for specific tasks.

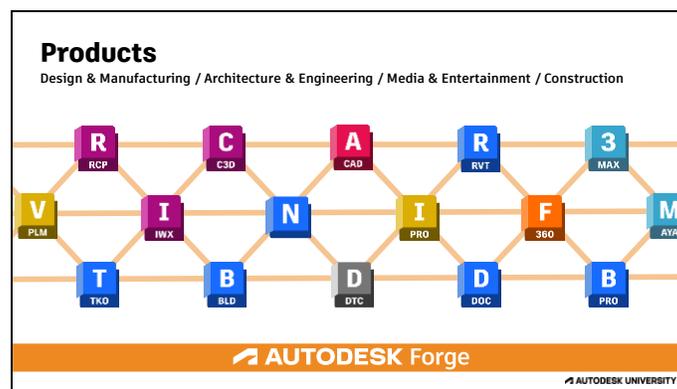


FIGURE 6: PRODUCTS

The goal is not to use one tool for everything, nor is it to develop one tool that does everything. The goal is to have the right tool for the job and be able to change when it is needed.

This connection is of course Forge or Autodesk Platform Services as presented in the 2022 keynote. As our product portfolio keeps growing so will Forge, enabling new workflows with every addition to our product portfolio.

APIs - Application Programming Interfaces

Everyone who has ever used an Autodesk product has made use of our Application Programming Interfaces or APIs for short. They are the connectable building blocks of digital logic in the background of everything our products do.

The standard **Tools** in our products are a first form of API use. They are used in a fixed workflow that can allow or require specific user configuration. As part of a specific product, they are available to a general market and follow a shared roadmap.

Many of our products make the ability to **Script** with API functionality available. Users can build their own custom sequence or workflow this way. Script can be created with a textual or graphical user interface depending on the product (Dynamo). With these scripts industries can vary their way of working from the general market. The supported logic of a script does have its complexity limitations, but many of them already start being connectors to other data sources.

Users that make use of complex logic due to regulation or simply the nature of their work, use the API to create new **Programs** to fully support their work. By doing this they formalize the company's way of working in a digital form and use the Autodesk API as an enabler or accelerator. Often this includes connecting more than one product from the company portfolio.

With the arrival of web technology new possibilities were and are being made available, now the company logic can be hosted online. Internal and external customers no longer need to install a specific product on their PC, they can use an online **Service** built with APIs. This brings new internal optimization opportunities but also potential new business models. Building a stronger direct connection to your customers.

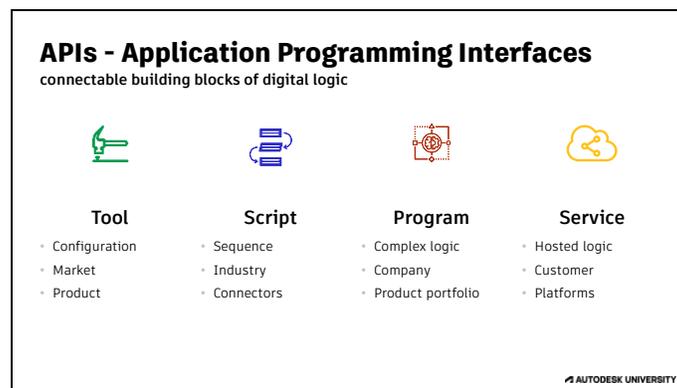


FIGURE 7: APIS

An important thing to remember is that there is not a wrong way to use the APIs. Whichever form you choose, it only needs to fit the problem of situation at hand. Over time it could very well be that you evolve from using a tool to creating your own program, but the reverse direction is equally possible (when a custom program becomes part of a general market product).

Data and Information

A big portion of our work today is the creation of digital individual facts and their organization/interpretation, something where our industry is not the forerunner. This so-called data and information take on different forms depending on the process that it needs to support (creation, utilization and distribution). A platform needs to support all of these, to ensure interconnectivity.

Data **Containers** in the form of files are still the predominant form of data exchange in our industry. This can range from propriety formats (.dwg, .rvt, .nwf, ...), open standards (LandXML, IFC, BCF, ..) and general data standards (.xlsx, .txt, .json, ...). They are still incredibly useful for the encapsulation of specific information on one topic and then allowing us to add metadata to this file (description, creator, date, status, version/history) or more traditional place them in a folder structure.

While the data might be grouped together in a file, the essence of what we make is the **Asset / Object** data. During its creation we define it through the combination of parameters, logic and resulting geometry. These objects can then be grouped into models for further collaboration and interaction. Viewers can visualize these models directly and make new workflows possible, reviews that are becoming more and more part of the model itself (Issues & Markups).

With the arrival of more data, there are also more requirements on how they should be structured. We are still creating the same objects (or more), but often that data needs to be altered to comply with many different **Classifications**. These classifications are created for a chosen domain, so they have a specific goal in mind (potentially different from the data creator). The creation, use and validation (lifecycle) needs to be supported and the change or transformation of the classification should be considered as best as possible.

While files may disappear at some point in the future, the combination of asset data/information put in a container that is compliant with a specific classification will be needed for a long time to come.

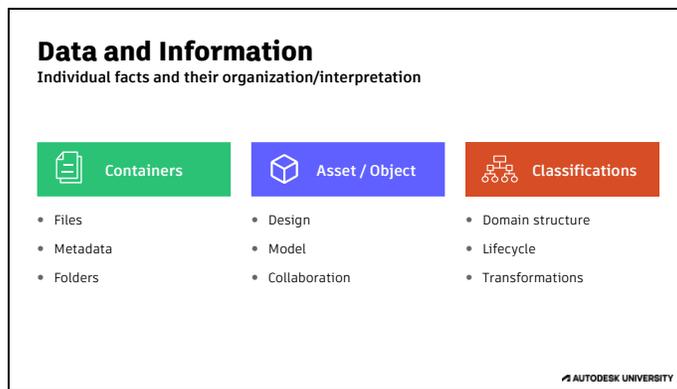


FIGURE 8: DATA AND INFORMATION

Platform Implementations

Rail Investment Strategy

Autodesk has invested recently in developing their capabilities for the Rail Industry, specifically targeting Rail Track Design. Two major categories can be differentiated:

- Upgrades - Upgrading the existing capabilities of our products to fit the needs of rail projects
- New Functionalities - Adding new objects and/or capabilities to fill current gaps

Numerous examples can be provided on recent upgrades that have been made. Most recently, the improvements have been focused on being able to display cant data in different Civil 3D objects/tools:

- Profile View Bands - Ability to read cant data in Profile View Bands
- Alignment Labels - Ability to read cant data in Alignment Labels
- Project Explorer - Cant information added to Project Explorer

New objects for rail have been added since the launch of Civil 3D's Rail Module in 2019. Rail lines, rail platforms, and rail specific assemblies have been provided and the recent addition of turnout objects that can be designed with a new turnout tool.

Whenever these new objects have been added, they've come shipped with some national standards, generally developed in partnership with rail owners. This was the case for the rail turn out, which was rolled out with the French catalog and contains a US catalog of turnouts since the latest release of Civil 3D. However, these new tools also come with the ability to customize these objects, with configurable JSON files. Giving you the possibility to modify and create your own objects or apply your own rules.

We have an example of how to use these configurable files to adapt to your needs in the [2020 AU Infrastructure Slam](#). These configurable files are located in the following path with the installation of Civil 3D:

C:\ProgramData\Autodesk\C3D 2023\enu\Data\Railway Design Standards.

Name	Type
Belgium_Absolute_Metric.json	JSON File
Belgium_Absolute_Metric.json.expr	EXPR File
China_Metric.json	JSON File
China_Metric.json.expr	EXPR File
France_Metric.json	JSON File
France_Metric.json.expr	EXPR File
Germany_Metric.json	JSON File
Germany_Metric.json.expr	EXPR File
US_Imperial.json	JSON File
US_Imperial.json.expr	EXPR File
US_Metric.json	JSON File
US_Metric.json.expr	EXPR File

FIGURE 9 CONFIGURABLE FILES FOR PLATFORM DESIGN

Whenever these new objects are added, there's work behind the scenes to provide the corresponding API's and allow for the development of your own automation solutions, programs and services.

Indirect Investment

Besides the direct investment on our rail capabilities, we have had other investment areas that have an impact on the rail industry and the delivery of rail projects. Some of the most important ones are the following:

Automation

Dynamo has been around for Revit since 2013, already well integrated in building and structure workflows. The addition of Dynamo to Civil 3D has unlocked huge opportunities for the civil infrastructure side of rail projects.

What Dynamo has done is democratize the development of automated solutions, because it is easier to create a script through visual programming than with a particular scripting language.

What's also great about Dynamo is that it's open source and anyone can add to the existing functionalities

There has been great growth in Dynamo for Civil 3D, with over 400% growth in the last year. There are also more and more users building on the out-of-the-box capabilities, with packages being added to Dynamo for Civil 3D and well over 1000 nodes and functions being implemented by users. This is only possible if the APIs are available, thus why they are the backbone of our platform strategy.

Some specific packages for Civil 3D:

- [Civil 3D Toolkit](#)
- [Camber](#)
- [Arkance Systems](#)

Interoperability

As part of our platform strategy, we've worked on interoperability, building connectivity between tools and our historical products as well as the ability to exchange data natively between them. The latest enhancements to workflows between Inventor <> Revit or between Civil 3D <> Infraworks <> Revit are an example of investment on connecting our products.

This is crucial for the rail industry, which as we have seen, is a system of systems and where we have convergence between AEC industry and the manufacturing world.

IFC

Autodesk is a strategic partner of Building Smart, contributing to develop IFC4.3, which focuses on infrastructure and includes rail infrastructure. A working implementation already exists for Civil 3D 2022 version and we are working thoroughly to add it to other versions.

Our partnership with the [Open Design Alliance](#), means that we are now taking a coherent standardized approach in building the classification of our IFC implementations, across products. It's no longer an individual strategy from each business lines but a consistent implementation all around our products.

BIM/GIS

We are connecting BIM and GIS through our strategic partnership with ESRI. Connecting both worlds, is essential for the rail industry, because we're talking not about a single project in a fixed location, but the whole network and a live environment.

Implementation Examples

Let's provide some concrete examples of the API steps described beforehand, to illustrate how they can apply to the Rail Industry:

Tools

We've mentioned the latest improvements to Civil 3D focusing on cant information that can be seen below:

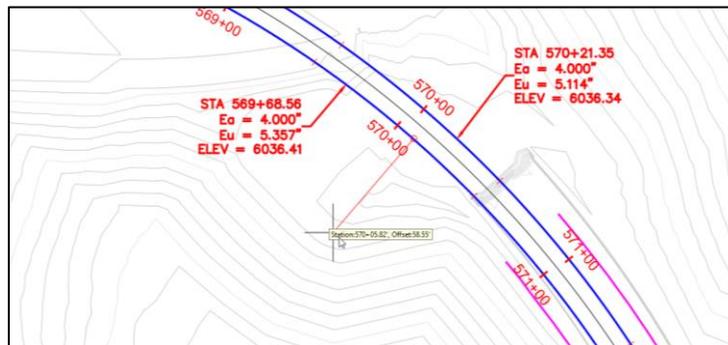


FIGURE 10: CANT INFORMATION ON ALIGNMENT LABELS

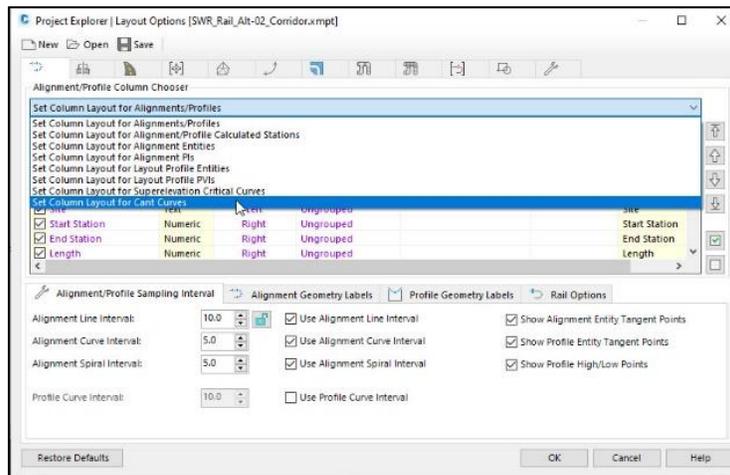


FIGURE 11: CANT INFORMATION ON PROJECT EXPLORER

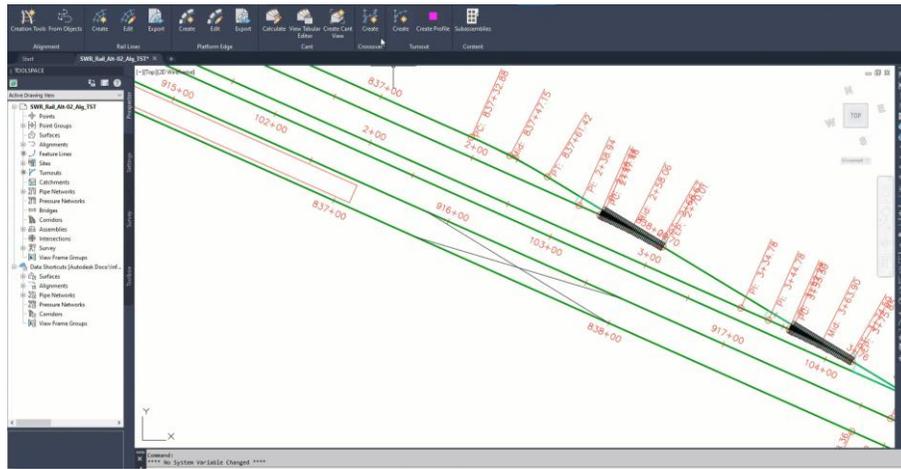


FIGURE 12: TURNOUT TOOL IN CIVIL 3D

The following videos give an overview of rail capabilities in our products for different disciplines and use cases:

- [Existing Conditions Modeling](#)
- [Track Design](#)
- [Structure Design](#)
- [Design Automation](#)
- [Collaboration](#)
- [Project Delivery](#)

Script

As part of the Autodesk Consulting team, we have been helping our clients to develop automation solutions:

- Allowing them to connect products and disciplines to have a system approach
- Helping them cope quickly with changes, softening the impact of the constant change and adapting to the life cycle steps in rail projects
- Developing the possibility to generate more design alternatives, so that the projects fit better to their environment

The images below all come from consulting projects we've done.

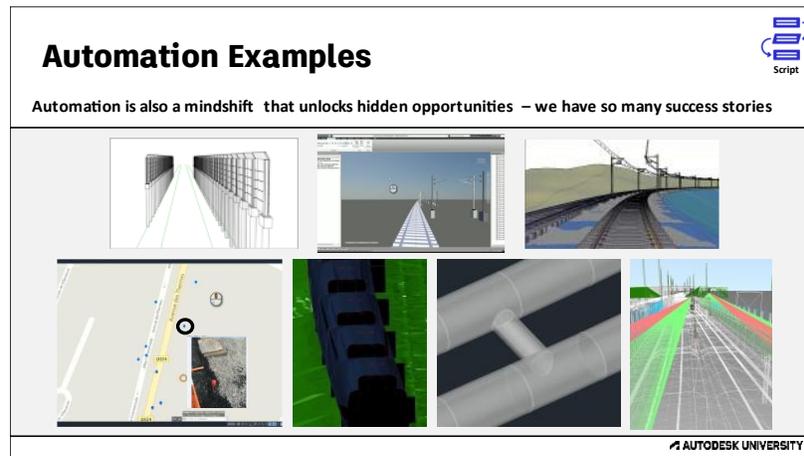


FIGURE 13: SCRIPTING IMPLEMENTATION RESULTS USING DYNAMO

We can highlight the following automation examples:

- We've connected Civil 3D and Revit, thanks to the development of the [Civil Connection](#) package by Paolo Serra, inside of our Consulting Team
- We've also connected both Civil 3D/Revit to other tools to expand information/data transfer:
 - Navisworks
 - GIS inputs
 - Excel
 - JSON files
 - XML files
- We've also worked with clients to develop automation solutions through different BIM Uses:
 - Automating repetitive tasks during the model authoring and drawing production
 - Improving Quality checks
 - Extracting bill of quantities
 - Applying information to assets
 - Performing clash detections
 - Developing BIM4D&5D

These developments within the Rail Industry have allowed us, together with our clients, to start imagining use cases that we hadn't even thought of:

- Checking for signal visibility and improving safety workflows
- Generating clearance profiles to check for potential classes
- Optimizing layouts of maintenance sites through generative design
- Connecting to historical databases to automatically generate existing conditions models
- Effectively using 20 plus years of historical drawings to come and enrich the 3D models of the existing infrastructure, getting closer to an eventual Digital Twin

Many of these examples have already been presented at AU or through other events. Here are some examples:

- [Getting Railway Signaling into the Third Dimension](#)
- [Infrastructure Design Automation with Dynamo for Civil 3D](#)
- [Computational Design for Civil Engineers](#)

Program

So now we're going to focus on the program side, with an example on information requirements and data classification. This example comes from the HS2 project, the high-speed railway project in the UK.

In this case, data requirements are part of the project deliverables demanded by the client. For rail owners, it has been historically difficult to keep track of all their assets and are thus starting to ask for data handovers at the end of infrastructure projects.

In this specific project we are talking of an 80 kilometer stretch with several tunnels, over 80 bridges, embankments, culverts, highways, utilities, fence barriers, etc. Basically, all the civil works of a rail lines.

Arcadis built their own classification system, based on the available standards from Network Rail, defining different levels to describe the assets:

1. Going from chainage blocks > a particular section of the rail line
2. To specific assets > a bridge for example
3. To objects in the assets > a pile in a bridge, with each object having a specific set of attributes

We are then talking about hundreds of thousands if not millions of attributes in a database. We as Autodesk Consulting, worked with Arcadis to define and implement one of our solutions to populate and manage this data. This is a custom solution available only through Consulting. but there are [standard tools](#) out-of-the-box that can help you with this.

Once the data had been populated, Arcadis checked its quality, make sure you have the correct information, and then used it to not only prepare the handover but also generate insights.

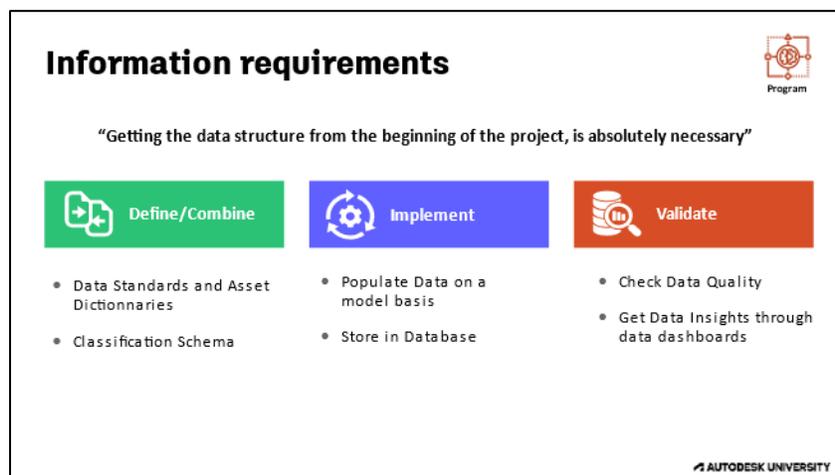


FIGURE 14: PROGRAM IMPLEMENTATION EXAMPLE - INFORMATION CLASSIFICATION AND DATA REQUIREMENTS

Service

The following example has already been presented on Autodesk’s Rail Summit of 2020 and is available [on demand](#) under the title “SYSTRA: How to promote eco-design in rail infrastructure projects”. It is a great example of the Services step, where you can use the power of Autodesk’s Platform Services to build new business models for yourself and your clients.

In this case, Systra developed a tool using Autodesk Platform Services (Forge) to connect the BIM models with GIS services and calculate the carbon footprint off any project. Considering not only the performance levels of the design (BIM), but also the supply chain (GIS).



FIGURE 15: SERVICES EXAMPLE - USING FORGE TO COMBINE BIM DATA AND GIS DATA

Platform Strategy

Our development of a platform strategy is a customer-centric strategy, where we take our client’s needs to determine investment areas and functionalities.

Rail Inside the Factory

When talking about the direct investment on Rail, this development has, you, the customer, at the heart of it, with a fundamental role defining the needed functionalities in our tools. This is done through the Rail Inside the Factory program ran by [Nigel Peters](#) on Autodesk Product.

Through this program, customers are actively participating in a coevolution approach. Today, it focuses only on track design and has over 40 rail designers involved from across the World. It started with annual in-person events, and later, monthly calls and technical working sessions were added by the participants demand.

The purpose of it is to inform attendees of the ongoing development efforts, get feedback from them, and drive/prioritize the roadmap. The new turnout tool that I showed before was created through this customer centric strategy.

Rail “Inside The Factory”

“The ITF rail event is not only a chance to speak with the people that make Autodesk a partner, but also with industry peers that have the same passion for our industry and a desire to move forward.” People

Customer Centric Strategy

40 Rail Designers
15 Countries
across the world

Rail Community

Monthly Calls
Tech sessions
Annual (In-Person) Event

Coevolution

Release validation
New functionalities
Roadmap priorities

FIGURE 16: RAIL INSIDE THE FACTORY PROGRAM DRIVING INVESTMENT ON RAIL CAPABILITIES

Rail Summit

We mentioned the Rail Summit before and this is an event organized by Autodesk and solely for the Rail Industry, with the main purpose of connecting industry leaders. It exists since 2014, attended by the biggest players in the industry and that has continually grown, doubling participants from year to year.

In it, we highlight our Rail strategy through presentations from our product teams as well as project success stories by our clients from across the industry. It is an invitation only event, but the content is then made available for free online. The cost of the event is covered by Autodesk.

This year, the Rail Summit, will take place in November in Amsterdam. Don't hesitate to request your account managers from Autodesk to be invited if you are interested in participating.

Autodesk Rail Summit

Boost Rail Digital Transformation

Autodesk Rail Summit
Insights on demand

VolkerWessels

Combining iTwin/BIM with GIS for deeper data integration to manage a successful project

ACCIONA Integration of BIM to design & construction activities in the Folio Line Project-EPC18M

What does accelerating digitalization in the rail industry mean to you?

buildingSMART International, Autodesk

B51, JFC and Autodesk investment in Open Standards

FIGURE 17: AUTODESK RAIL SUMMIT - EVENT FOCUSING ON THE RAIL INDUSTRY

Autodesk Consulting

Finally, lets discuss about Autodesk Consulting and who we are. Throughout the presentation we've mentioned how Autodesk Consulting has supported clients on the Rail Industry with some concrete examples. Both Wouter and David come from the Consulting team, so what exactly is Autodesk Consulting?

We specialize in supporting the digital transformation of our clients through our transformation services. Throughout our projects, we are focused on building trusting relationships with our clients and provide value to them by working on a daily basis with them, listening to their issues and challenges, by helping them solve them by finding or developing the right solution, adapted to their needs. Our main objective is helping our clients meet their goals and reach better outcomes.

Additionally, our consulting team is made from professionals from the different industries. We have a global team with expertise across products, industries, and markets, to work as strategic advisors or technical implementation experts. Both Wouter and me come from the Rail Industry for example.

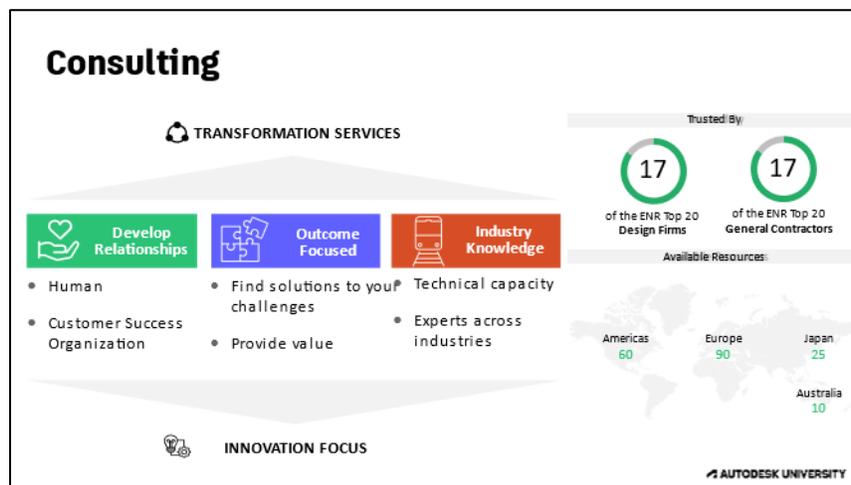


FIGURE 18: AUTODESK CONSULTING

As consulting, we are currently engaging with the biggest design and construction firms We are mainly focused on developing innovative solutions in five key spaces:

- Data to insights to for example make data-driven decisions
- Platform for new business, expanding your services such as development of Digital Twins
- Future of Work to strengthen your resilience through for example developing seamless on-site workflows
- Sustainability as a driver of your business and,
- Process Automation with the application of generative design for example

If you don't have contact with Autodesk Consulting at the moment, contact your Autodesk representative. We have service offerings for different market segments.

Summary

If you were not already convinced, then we hope this handout has shown you that railway infrastructure is a system of systems and “**System of Systems call for Platform Solutions**”.

Knowing the core components of the Autodesk Platform solutions (Products, APIs, Data and Information), you can evaluate the solutions for the railway industry today and in the future. With the given implementation examples and links, you can start defining your own cross product processes and implement the innovation/creativity your company brings to the industry. You can also assess how your company can connect to the platform strategy and help shape its future.

If you are interested in going deeper into our platform transition and its broader implications that we describe as the era of convergence, then please follow this link ([Era of Convergence | Autodesk](#)) or get in touch through the contact information below.

For more technical information or examples on the topics covered in this handout, we would like to recommend these AU2022 rail industry related classes:

- CS500946 | Reduced Risk and Improved Productivity on CAHSR Using Autodesk Build and Autodesk Takeoff
- CI502227 | Giant Steps: Advances in Seamless BIM, CAD, and GIS Integration
- CES502172 | Pushing the Limits of Design Automation for Railway Infrastructure
- CI501145 | IFC in Autodesk: The Next Generation
- TR501801 | BIM in SNCFR Digital Transformation: Engineering, Integration, and Operation
- CES502532 | Harnessing High-Resolution Scans for Critical Infrastructure Repair
- CES501505 | Speedup Railway Site Management: The Power of Automation and the Architecture, Engineering & Construction Collection
- CES501766 | A Case Study for Generative Design in Horizontal Infrastructure
- TR502410 | How to Automate Release Process with Upchain
- CES500878 | SYSTRA Digital Engineering Innovation Strategy

We would like to leave you with the following questions:

- Where are you in this shifting maze?
- What are your goals?
- How can we help?

If you wish to learn more or want to work with Autodesk on one of the discussed topics, then please contact your Autodesk Business Partner or Named Account Executive. You can also contact the class speakers with the contact information below.

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Figure 1: Railway Infrastructure	3
Figure 2: System of Systems	4
Figure 3: Platform Thinking	5
Figure 4: Progress	5
Figure 5: System of Systems call for Platform Solutions	6
Figure 6: Products.....	7
Figure 7: APIs	8
Figure 8: Data and Information.....	9
Figure 9 Configurable files for platform design	10
Figure 10: cant information on alignment labels	12
Figure 11: cant information on Project Explorer.....	12
Figure 12: Turnout tool in Civil 3D.....	13
Figure 13: Scripting implementation results using Dynamo	14
Figure 14: Program implementation example - information classification and data requirements	15
Figure 15: Services example - Using forge to combine BIM data and GIS data.....	16
Figure 16: Rail inside the Factory program driving investment on rail capabilities	17
Figure 17: Autodesk Rail Summit - event focusing on the Rail Industry.....	17
Figure 18: Autodesk Consulting	18