AUTODESK UNIVERSITY

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Going Full-Blown 5D BIM in the Largest MEP Project in Sweden's History

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Learning Objectives

- Learn how to identify possibilities of digitalization in your own projects
- Learn about implementing a multidimensional BIM platform with sources of data from different origins for design and build phases of your project
- Explore a cloud-based data management where you learn to how to bring different data sets together in one system.
- Discover how to implement design automation with clear ROI.

Description

Bravida is a 100-year-old mechanical and electrical installations contractor that has fully embraced building information modeling (BIM) and tools in the Autodesk Architecture, Engineering & Construction Collection, along with cloud technologies such as Autodesk BIM Collaborate Pro and Autodesk Forge, to achieve significant cost and time savings for the firm. This includes an ROI of 87% through implementation of Revit software and Dynamo. Digitalization is the future of the building and MEP (mechanical, electrical, and plumbing) industry, with BIM technology evolving every year. Bravida is innovating by putting design in the center of stakeholder management and enriching it with multidimensional data such as time management, procurement, logistics, cost estimation, and work orders. These are modeled in Autodesk Forge via Autodesk BIM Collaborate Pro along with 3D parametrical BIM that's empowered using multiple different authoring software within the AEC Collection. This session is good for any BIM enthusiast wanting to see a real-life example of a mature yet humble, sophisticated yet easy way to develop a BIM platform.

Speaker(s)



Kristoffer Flygare

Kristoffer Flygare is a techie and engineer that has worked with tunnel ventilation, mechanical engineering, and BIM. Today he is a self-employed BIM Consultant that help companies develop their design automation, BIM strategies, 5D Models, and more!

Kristoffer and his BIM team at Bravida managed to grab the ***'Best Industry Collaboration Award'*** at Nordic BIM Summit 22 with their multidimensional BIM platform they managed to develop for doing stakeholder management with central design model combined with logistics, procurement, project planning and time management under one big platform.



Firat Ergun

Firat holds a MSc. degree in Geodesy & Geoinformatics. He had the chance to start his career as land surveyor consultant using variety of measurement technologies (total stations, GPS, Reality Capture Technologies – Lidar, UAVs etc.) in global and local organizations in Scandinavia before he jumped into Product Management career in cloud based IoT/telematics software development within AEC domain.

Today, he is a Tech Sales Specialist responsible for Nordics AEC accounts at Autodesk trying to help customers achieve their business initiatives and reach their digitization strategies with use of Autodesk Solutions.

He is a firm believer and a big evangelist for multi-dimensional big data approach and API based cloud services for aggregating and making meaningful outcomes out of massive data we create, capture and interpret every second of our life.

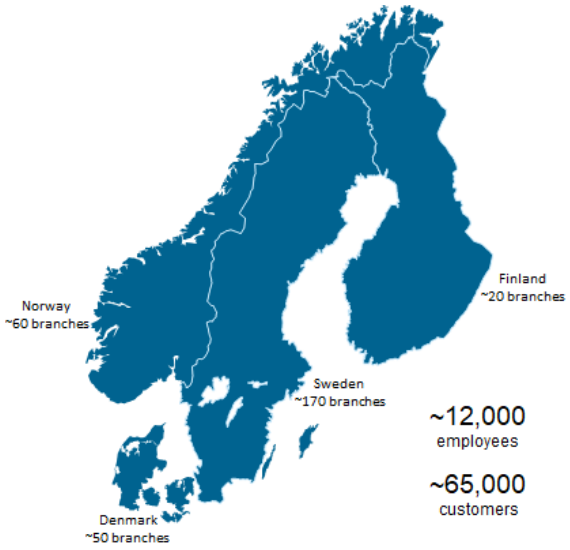
About Bravida

Bravida is a service and installation company with more than 12,000 employees in more than 180 locations in Sweden , Norway , Denmark and Finland. Bravida delivers specialist services and complete solutions in several technology and service areas. The service areas include design, engineering, installation, operation and maintenance. The head office is located in Stockholm .

To achieve their vision, Bravida guide their business towards key targets that reflect their ambitions on profitable growth, financial stability, being a sustainable company and having the sector's strongest brand.

This year Bravida is celebrating their 100th year anniversary and keep on working towards their company goals. As the Nordic region's leading provider of sustainable end-to-end solutions for electrical solutions, heating, HVAC and other technical functions in properties and facilities, they believe in a responsibility for sustainable development for the next generation





Find out more at: https://www.bravida.se/en/

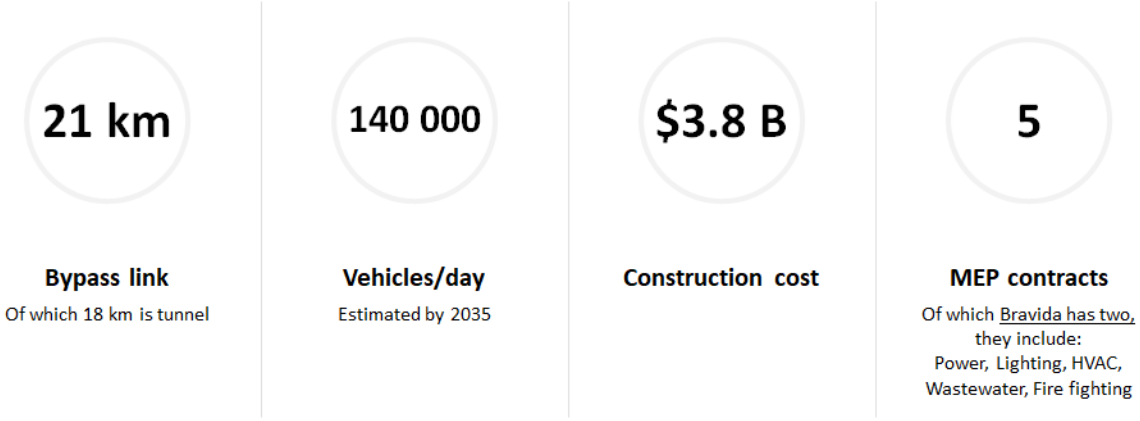


Learn how to identify possibilities of digitalization in your own projects

Background

Bravida won 2 big MEP contracts that made them the single biggest MEP contractor within E4 Stockholm Bypass Project, which is the biggest infrastructure project in Sweden in its history with a massive 21 km road of which 18 km is consisted of tunnels to bypass central Stockholm Traffic in north sound direction.

Below the image also summarizes further information about E4 Bypass Stockholm Project and Bravida's Involvement.



What the image above lack is the clear challenges and goals that Bravida had faced and eventually aimed to reach with a project this size with so many different components and data related to those components.

Challenges

Here are some examples of challenges that Bravida BIM Team wanted to solve with their unique and innovative way of executing BIM methodologies:

- How do we make sure all the members and stakeholders of the project are aligned at any given time of the project lifecycle regardless of their title, responsibilities, and their contribution to the project?

- How do we make sure our design cycles are optimized so that repetitive design changes are reflected in the most cost effective and most autonomous way possible with highest ROI possible?

- How do make sure that BIM starts with design but organically extends to build cycles of the project while seamlessly connecting Design data with field production data?

- Can we enhance and enrich our BIM data with extra meaningful data (time, cost, documentation, logistics, procurement, etc.) that will give us a bigger coverage of entire operations happening during the project?

Goals & Motivations

When Bravida looked at the challenges they quickly realized that there are coming to 3 main goals they wanted to achieve:

1. Informed Decisions:

Bravida wanted to enable every decisionmaker within project lifecycle in the quickest way possible. As they go through cycles of thoughts to make that a reality, they quickly realized that a transparent stakeholder management should be on the center of everything. One that breaks silos of data that are within bubbles of each decision maker and instead thrives for single source of truth. In other words, they wanted all the data available to get connected so that every decision maker regardless of their position & contribution to the project can make a data fueled informed decision while seeing the impacts of it on the project as well.

2. Efficient Design Process

On the natural lifecycle of MEP contractor projects designs might seem like trivial steps to follow with out of the box solutions available today. However, if you increase the number of elements to be designed (over 70k HVAC elements) and make their placements quite complex (18 km tunnel with vertical and horizontal alignment changes) and if you want to make those changes rapidly, then design becomes a process that needs to be optimized which was the second goal for Bravida. They quickly realized that any design process that is fueled by automation will have huge impacts on the project by means of operational efficiency, cost savings and environmental impact.

3. Perfect Execution

The final goal for Bravida was to make sure there is a perfect execution of the BIM system/environment they are building which communicates in between design and field productions teams while carefully aggregating meaningful data for all the stakeholders of the project. In addition, Bravida team thrived to reduce number of errors, made sure they reach higher Health and Safety levels for their installers while making an impact on sustainability simply by reducing rework and keeping digitized workflows instead of traditional paper-based workflows in the field.

Learn about implementing a cloud based multidimensional BIM platform with sources of data from different origins for design and build phases of your project

Cloud Vision

'Moving to cloud' terminology is widely accepted as of the most initial and common methods of digitization whether you are a private individual or a corporate giant. It indicates the intentions of companies or individuals moving away from traditional methods of file and/or database storage systems such as local servers or local machines to more cloud based collaborative cloud servers.

In today's cloud technology or server providers, the whole intention becomes more technological where cloud users seek additional services such cloud computing, backup services, ability to connect and communicate with other clouds / file servers / databases via API based technologies and more custom services that these technologies have to offer.

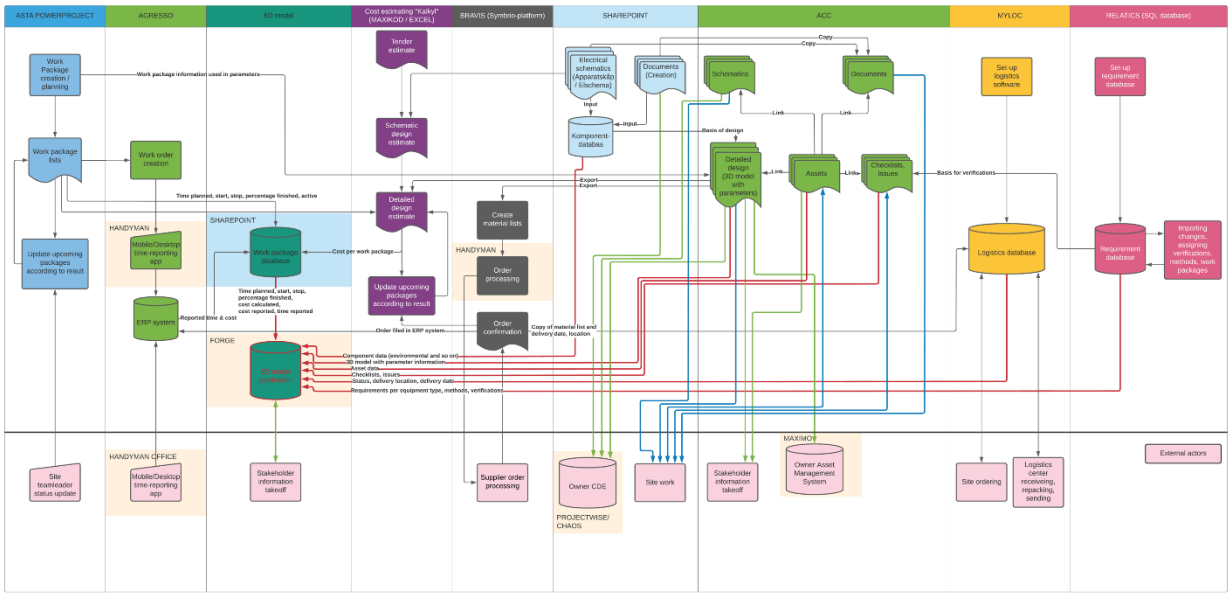
BIM technologies offer nothing less to their users. A 'Common Data Environment' (CDE) is the entry level cloud offering and is a natural/organic extension of any entry level BIM applications that most of Autodesk Technology and Solutions are ready to serve their customers.

It is very normal for company like Bravida to invest in variety of different file storage and database systems over the course of their digitization process since their foundation. This might easily result investing in physical local servers as much as cloud servers as the holders/origins of data most of the time depending on the 'type' of the data they are dealing with. Attempting to connect these databases are not the easiest tasks since each might come with their own propriety/unique set of rules which might make it harder to find commonalities among each other to make useful data.

In E4 Bypass Stockholm Project, Bravida faced similar challenges within their ecosystem of data handling. Already possessing different storage spaces and technologies they had to come up with ideation of how to connect their design data with field data while enhancing the BIM model with all the extra datasets such as time, procurement, cost and logistics. In addition, they had to maintain the project management cycles while being confident that they are either on time on their deliverables or even ahead of them by being more efficient the way they do their big data management that empowers their project and stakeholder management.

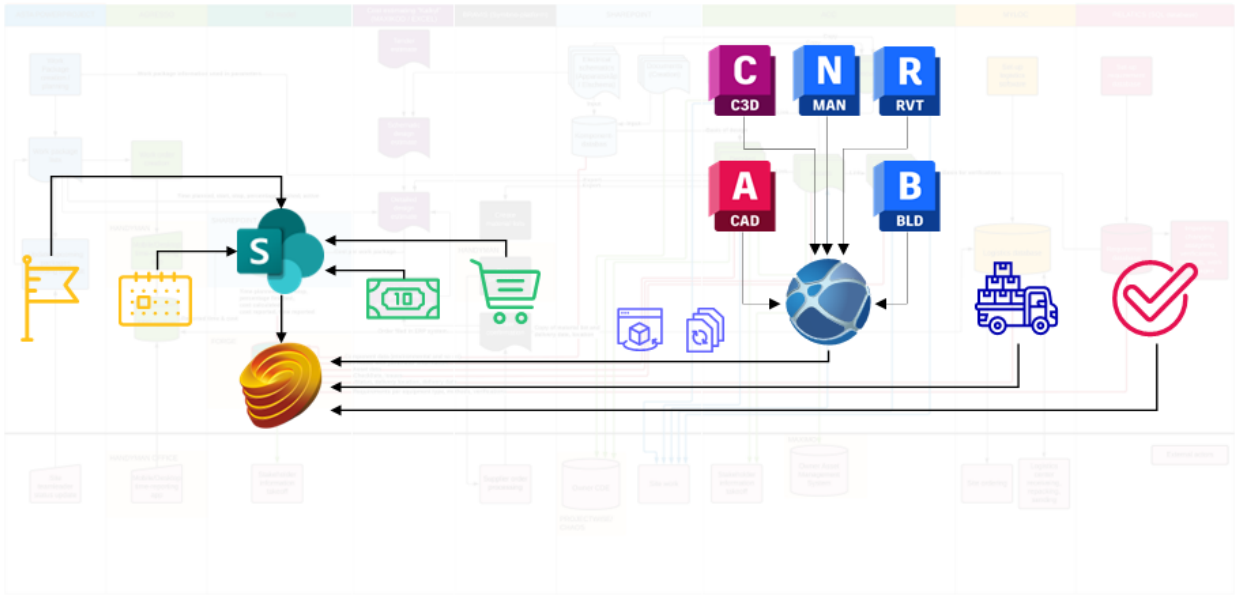
Platform Vision

Below is the schematics that explains the data flow of the big data BIM platform that Bravida managed to put together for coverage of their design and build cycles of their project.



Each column represents a different file / database system that holds and provides different sets of data that a particular stakeholder and decisionmaker is interested in during the project lifecycle to make sure project is being delivered within requirements and budget. One can see how different technological solutions were used to bring all the data under one roof to enhance the BIM data for meaningful aggregated interpretations.

To simplify things and also describe variety of different technologies used let's have a look an implied version of the same chart.



Bravida uses the power of Autodesk Construction Cloud (ACC) as their primary CDE for their design and build data and workflows. Utilizing ACC as the primary CDE of their project design and build phases give them lots of out of the box advantages for their BIM workflows. They use several tools from their Architecture, Engineering and Construction (AEC) Collection that helps to optimize their design processes. While they use Revit and Dynamo combination as the main authoring tools for their BIM design, they also use tools like Navisworks, Civil3d and AutoCAD to help them solve challenges more complex workflows within their design workflows. All of those tools use ACC as their main point of storage while also using other important features of ACC such as Revit work sharing, version control, viewer and many more.

Bravida also utilizes SharePoint as one of their main CDE where they communicate with some other unique databases, they are maintaining to aggregate some of the data such as planning (in forms of work orders), time reporting of field personnel, cost of work and material and procurement.

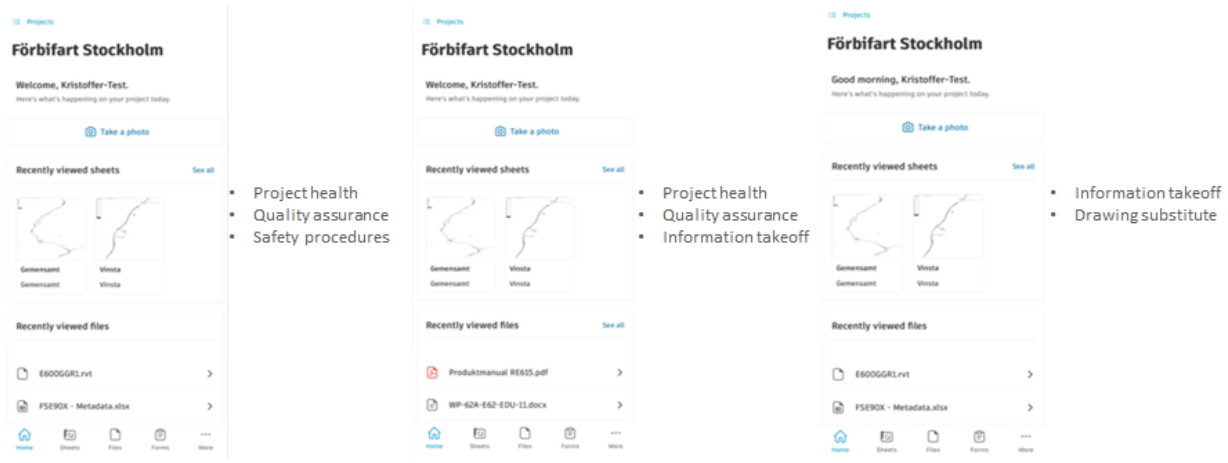
When Bravida BIM team wanted to combine those extremely valuable data for project lifecycle and stakeholder management with the design & build data from ACC, they explored the Autodesk Platform – Forge – to create the umbrella platform that aggregates everything together for meaningful presentations and interpretations using its different API technologies. Aside from communicating with SharePoint and ACC, Forge API was also used to bring logistics data along with installation requirements for production team by doing direct calls to their respective databases.

Using Viewer, Authentication and Model Derivative APIs, Bravida managed to create their customer User Interface that allowed them to directly interact with the design model that is enriched by multiple different databases at any given specific time.

Enhancing Platform with Field Ops

While being prototyped now, their latest installment to their ACC, Autodesk Build, is also connected to this ecosystem via Assets and Forge API for the purpose of tracking the changes on the actual ‘working model’ to visualize the work in progress from field production team. With production team using their mobile platforms to do their quality assurances, checking the requirements for HVAC components, capturing miscellaneous errors and raising issues about them. documenting their work via photos and checking in their time to do their work via cloud solutions instead of traditional paperwork, Bravida aims to have huge positive impacts on environment while utilizing state of the art digitized workflows.

With Autodesk Build part of bigger BIM platform powered by Forge to connect all relevant data, Bravida is aiming to extend their capture of design processes into building and construction phases of the project for years to come.



AUTODESK Construction Cloud
AUTODESK
Build

Future Vision and Potential Upgrades

While Bravida's multidimensional BIM platform with all its components is a definite example of innovation for a company that is a MEP contractor from origin, it is also not the endline for their BIM and Technology team to further innovate on the existing platform.

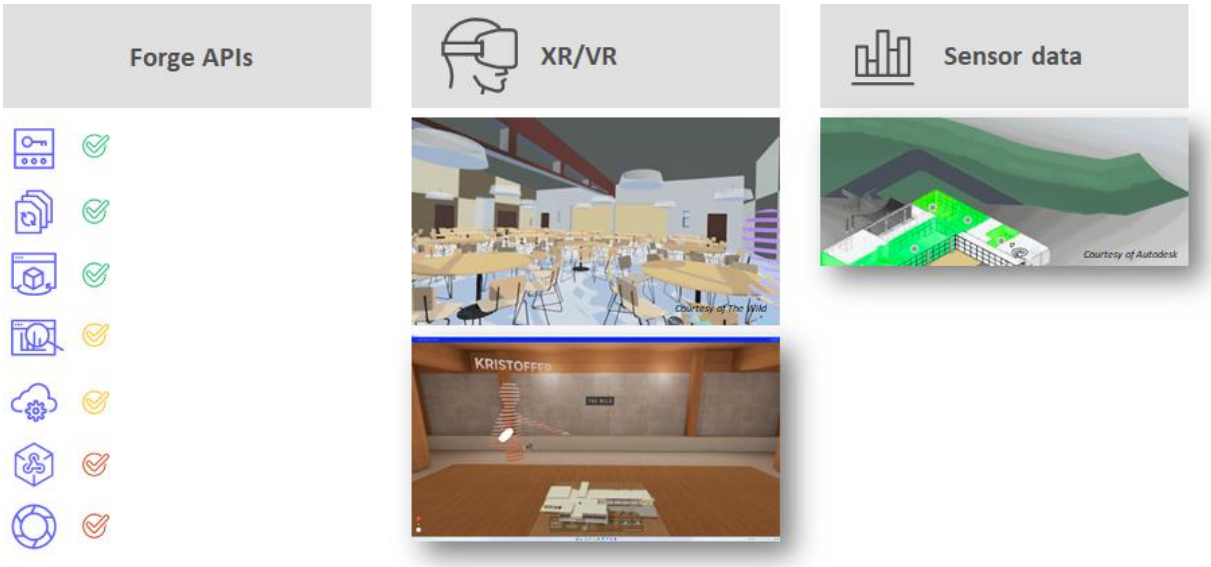
The team using only handful of Forge APIs as of today while already starting to scratch the surface of Data Visualization API which is going to be an organic extension to their existing platform when they can harmonize design and field data and potentially lay it out in their custom viewer to track progress of their installations once the construction cycles is up to speed with more than 500 daily users out in production.

While Revit and Dynamo workflows are already in place with clear ROIs, they are also not afraid of the idea of using Design Automation API to see capabilities cloud computing in their design processes for future initiatives.

Once the installations are taking place out in the field, Bravida is also thinking about enhancing the platform with capabilities of Reality Capture technology whether that is accumulating point clouds into viewer for as-built documentation or perhaps utilizing full on Scan to BIM workflows using Reality Capture API via photos and auto creation/processing of meshes and point clouds in the cloud.

Bravida team have already piloted Autodesk's Collaborative VR tool, The Wild, simply for experimenting with futuristic ways of collaboration for different stakeholders.

Last but not least, Team is definitely looking at IoT applications in the tunnel during and after installations to prototype their steps into Digital Twin world again inspired by Autodesk's Platform Vision.



Discover how to implement design automation with clear ROI.

If you hold 2 of the biggest MEP contracts of 18 km tunnel project that also happens to be the biggest infrastructure project of Sweden's history, it is inevitable that you will have your design engineers face challenges of doing repetitive tasks during the design phase of your project lifecycle.

For Bravida, this was nothing different at E4 Bypass Stockholm Project. Over the course of the part of the tunnel they were contracted to design of MEP installations objects, they faced challenges of placing over 70 thousand of different objects along a tunnel design that has vertical and horizontal alignment changes over its chainage.

Bravida team quickly realized that they need some sort of optimization in their design cycles so that the repetitive tasks of design changes didn't only take lots of human hours to complete – which would result in loss of project budget that can be invested in elsewhere. In addition, they wanted to make sure that they decrease human errors happening if they were to rely on technology on design processes rather than human skills. These motivated the BIM team to have a clear goal of 'automation' in their design processes that will have some metrics to be measured and some clear goals to be reached to prove their return of investment (ROI) into the technology of their choice.

Teamed up with Autodesk Tech Specialist team, they not only discovered different authoring software they have access to within their Autodesk Technologies invested for the project, but they also started to design a clear ROI study that captures the clear budget gains through operational efficiency.

Ideation of such ROI study was simple:

Measure the time it takes to do repetitive design tasks using different technologies and calculate the impact of that time on project budget by means of workforce needed and budget to be saved to complete those tasks using those different technologies.

So, let's look at the variables used & calculated to justify ROI in another way:

Time: Time it takes to complete a predefined task with repetitive design actions

How long it takes to place 2500 sprinklers on a 2 km tunnel stretch that constantly changes its horizontal alignment and vertical elevation depending on the chainage of the tunnel on different authoring/design software?

It is important that same task is executed using different technologies. In Bravida's case, investing in Autodesk AEC Collection, granted them access to many different authoring software to fulfill many different design workflows for their internal and external stakeholders.

For this study they ended up choosing AutoCAD, Revit and Revit with Dynamo combination to answer the question above.

Cost: How much will it cost do execute the activity above?

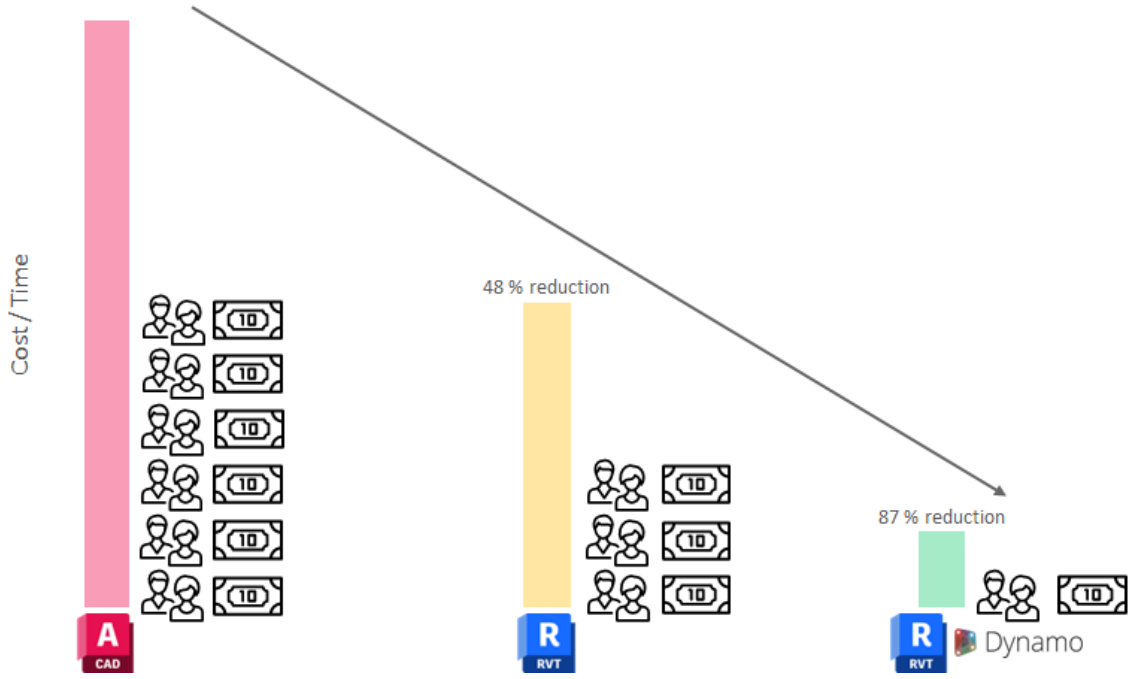
Since the project budget is predefined, it is important to calculate the impact of time spent on any activity to justify the cost of it. In addition, since no project wants to exceed its project timeline, it is necessary to have the workforce needed (number of employees with certain hourly rate/cost to company) to be able to finish the desired task with forecasted timeline. In other words, it is critical to see how many designers are needed to execute the same task (above) using different technologies. Depending on the technology used one might have to hire a greater number of designers just to be able to finish the job within the given budget.

Therefore, it is trivial to assume that at any given scenario, the most cost friendly technology/solution of choice is the one that will return the least number of workforce (humans) with least cost per hour (hourly rate) over a limited period of time (project timeline) preferably with the least time spent on the same task.

So, if we combine the 2 factors above together then you will have detailed ROI question which has direct impact on project budget spent therefore resulting in operational efficiency:

Which design solutions (AutoCAD vs Revit vs Revit + Dynamo) will give most ROI by means of number of hours it is needed to execute, number of workers it requires to execute and cost of those workers that results in the lowest possible budget possible executing the same task over time?

Once necessary time was measured to do the time with respect to number of people needed and cost those people were taken into account using simple algebra the chart below was reached with all the calculated values.



Notice: Icons used is not indicative of actual number of headcount or cost used but rather symbological representation to point out relative number of people, therefore cost - based on number of people and hourly rate - needed to perform the same task with respect to time. Just another method to clearly indicate the ROI in addition to bar charts that show clear cost over time difference. To be clearer, in Bravida's case, around 18 modelers were needed in case of AutoCAD design processes while only 11 design professionals in Revit and only 6 were necessary when they moved to Revit & Dynamo combination. Even if you were to take a flat cost for hourly cost of AutoCAD vs Revit vs Revit & Dynamo designer – which is definitely not the case in Scandinavia - and also neglect the technological advantage Dynamo gives you over other choice – which again is not the case – Revit & Dynamo based Design Automation was clear winner simply by number of headcount needed to do the same complicated task over a period of time.

As expected, using a Revit Dynamo combo with power of scripting around automating repetitive tasks delivered a clear win (ROI) of 87 % reduction in total costs of same task if it were to be done compared to using only AutoCAD. Even without the power of automation delivered by Dynamo, Revit only design had 50 % reduction in time it takes and therefore headcount and cost needed compared to using only AutoCAD.

Challenges / Improvements / Enhancements Ideas to ROI Study:

In the study above there are noticeable variable that might vary on different parts of the world. Some areas might have cheaper or more expensive labor, some areas might lack the skills to find the necessary headcount, or some businesses might not want to have a smaller number of hours reported simply because their business model is based on maximizing chargeable hours ex. Sub contractors, consultancy services, etc.

While these may look at challenges at first, it is important at the **impact** of each ROI study on the outcome desired to achieve.

In Bravida's case, team wanted to capture the impact of their design optimization and its clear wins for the project by means of budget.

If one wants to take the same or similar variables and wanted to derive more impactful outcomes, variables taken in this study – time & headcount & headcount hourly rate – can easily bring other impactful results if wanted. Here are few examples:

- One can calculate the environmental impact of having more work force over less for any given task simply by calculating many different variables/ there impact each headcount contributes.

- One can calculate the money saved over the initial calculated budget and can simply use that budget to innovate further that might result in another efficient method of working that has clear ROIs and impact to environment.

- Since ROIs can be replicated in other projects using same technology, projects teams can give more accurate budget calculations with respect of number of licenses, headcount, hardware required for design teams and time it takes to design certain complicated tasks which will ultimately result in flexible tender/bidding scenarios over competitive market situations.

- One can calculate time saved within project for pure profitability and its positive impacts on company and its visions – such as sustainability in Bravida's case – once that profit is invested in right components that makes the most meaningful impact for sustainability.

Additional Resources & Useful Links

Customer Success Story - Video
Customer Success Story - Paper
Get more familiar with Forge
Forge Showroom
Learn more about Dynamo
More about Bravida