

Vom Lieferanten zum Partner

Digitale Integration in Fabrikplanungsprojekte für Anlagen- und Systemlieferanten

Markus Speiser
Director Central Europe Design & Manufacturing



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**Wie sieht die Fabrik aus, die sich
selbst steuert,
flexibel auf Marktanforderungen reagiert,
Ressourcen optimal nutzt?**

Macroeconomic
Volatility

Supply Chain
Disruption

Regulations,
Compliance & ESG

Treiber für Veränderung

-

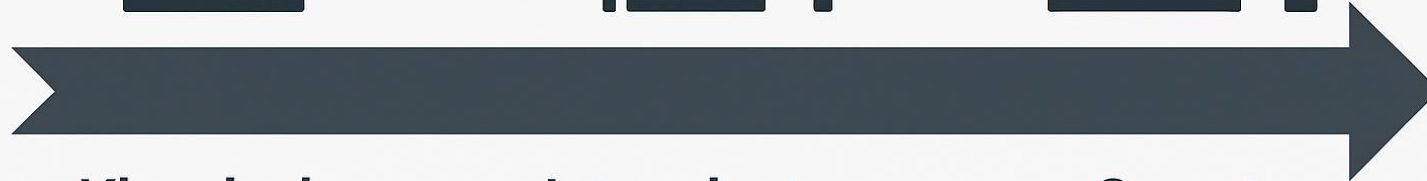
Digitalisierung, Effizienz, Nachhaltigkeit

Digital
Technologies

Talent

AI

Von der klassischen Fabrik zur integrierten Smart Factory



**Klassische
Fabrik**

**Integriertes
Fabrikmodell**

**Smart
Factory**

PROCUREMENT

MANUFACTURING

QUALITY

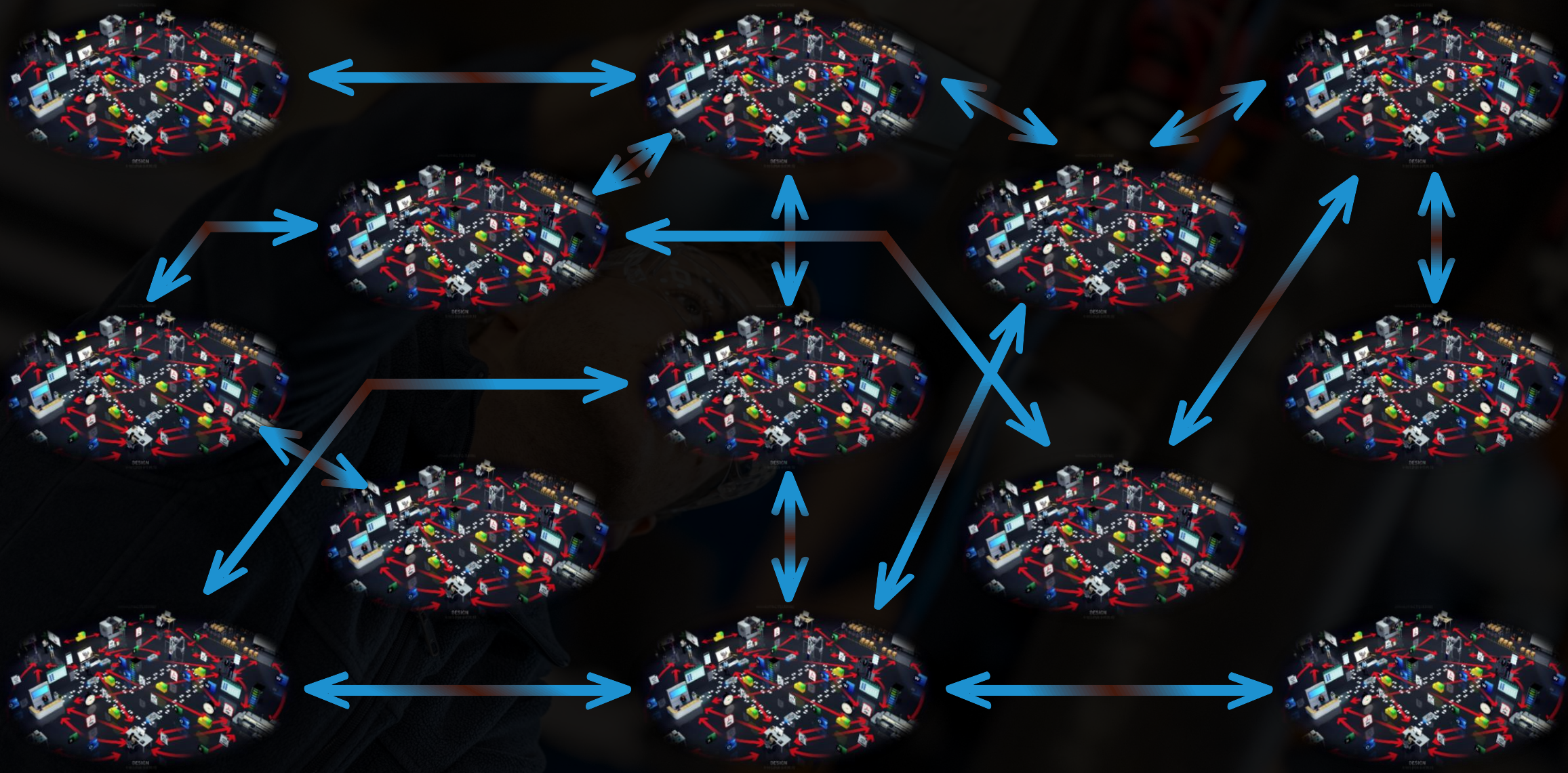
ENGINEERING

SUPPLIER

SERVICE

DESIGN







Building Information Modeling

BIM (Building Information Modeling) ist ein **modellbasierter Prozess**, der es Architekten, Ingenieuren, Bauherren und Auftragnehmern ermöglicht, Gebäude und Infrastrukturen zu **beschaffen, zu planen, zu bauen und zu verwalten**.

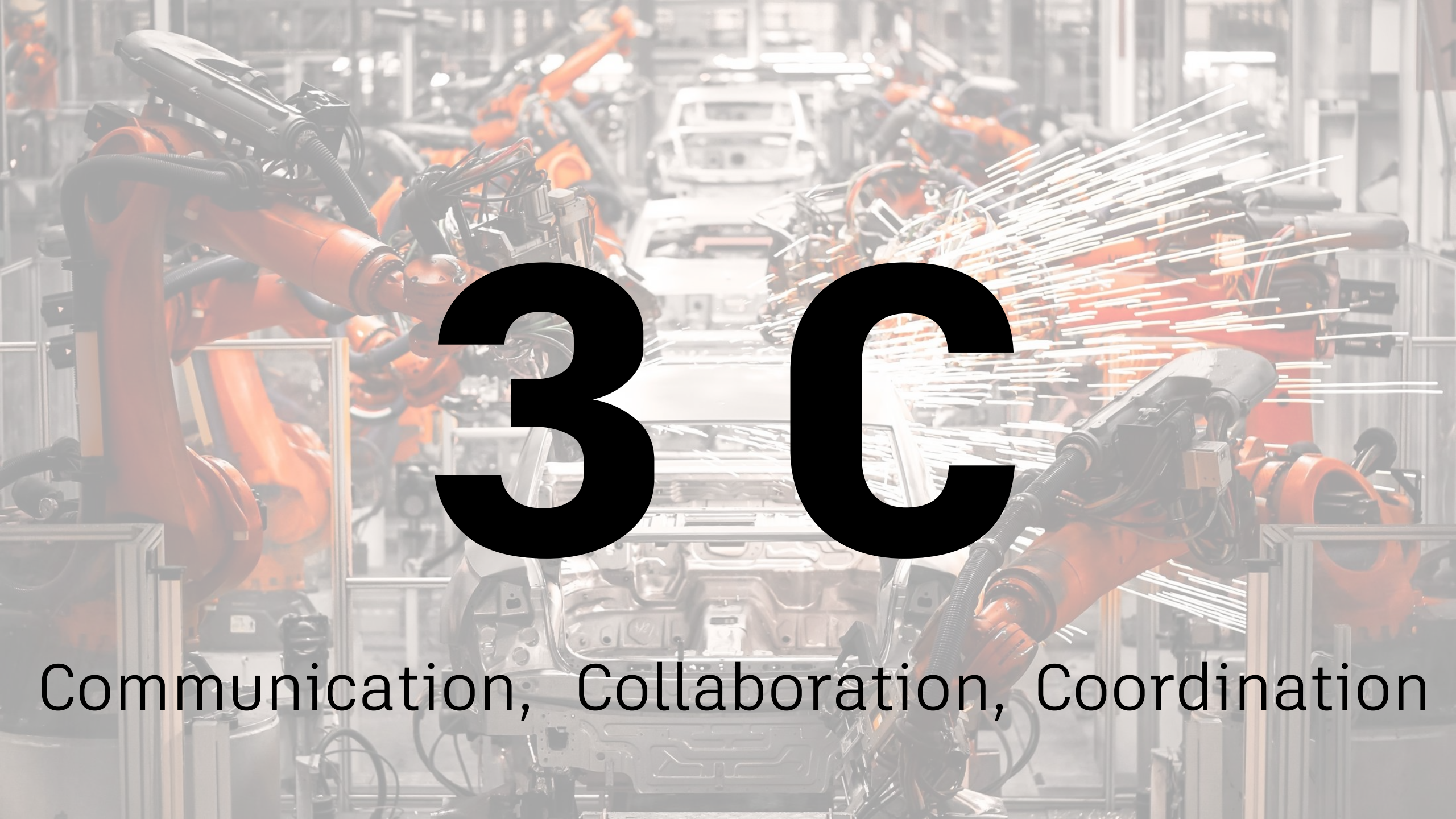
Der Kern von BIM ist eine **digitale Darstellung der physischen und funktionalen Merkmale** einer Immobilie.

Digital Factory

The image features a dark background with a semi-transparent wireframe overlay of a factory interior. The wireframe shows various pieces of industrial equipment, including robotic arms and conveyor systems. In the foreground, two people are visible: a woman on the left wearing a black top and glasses, pointing towards the wireframe, and a man on the right wearing a blue plaid shirt, a black hard hat, and safety glasses, holding a tablet. The overall scene represents the integration of digital data with physical manufacturing.

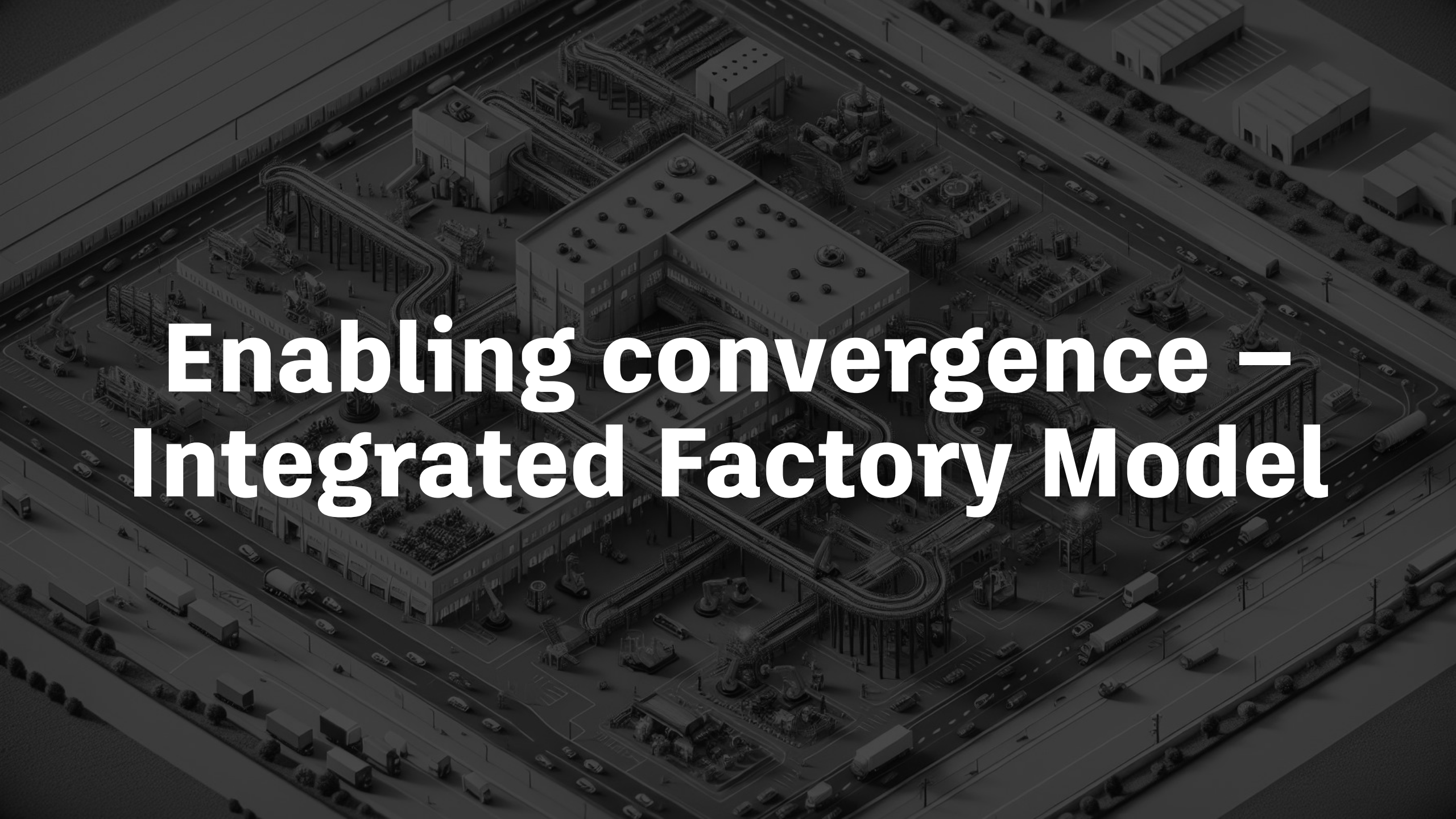
Eine digitale Fabrik ist eine **Darstellung der wichtigsten Fabrikmerkmale** wie Geometrie, Verhalten und Leistung, die digitale Informationen aus dem **gesamten Lebenszyklus der Fabrik** zusammenführt.

Die **digitale Darstellung** fasst Daten aus der Struktur, den Systemen, den Anlagen und den Prozessen zusammen. Dies gibt Aufschluss darüber, wie die Anlage zu **planen, zu bauen und zu betreiben** ist und wie sie bei Produkt- und Prozessänderungen neu konfiguriert werden kann, um die Effizienz und Produktivität zu maximieren.



3C

Communication, Collaboration, Coordination



Enabling convergence – Integrated Factory Model

Integrated Factory Modeling

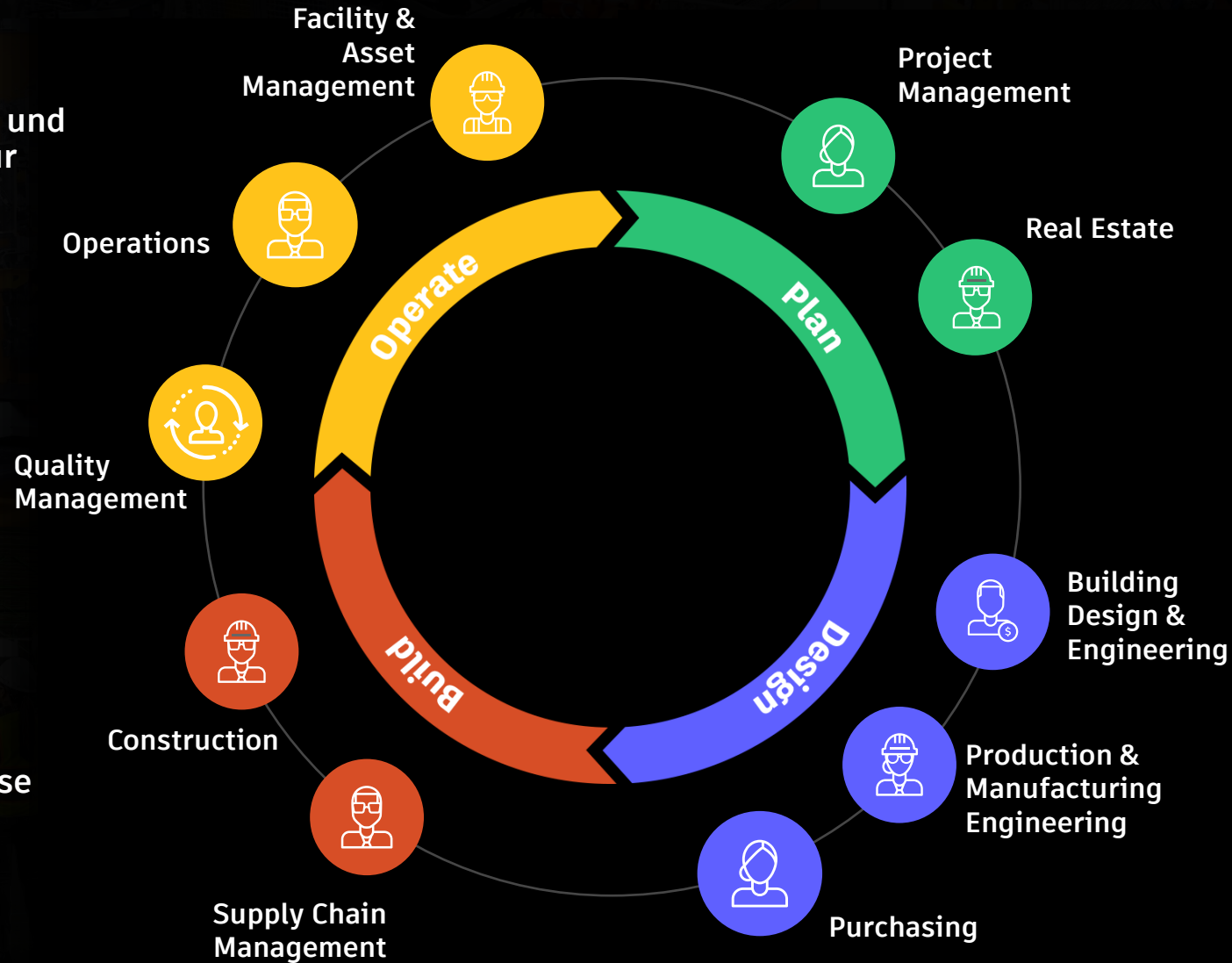
- IFM - Die Konvergenz von BIM und Digitaler Fabrik

IFM ist eine **Methode**, die verschiedene Projektbeteiligte in allen Phasen des Lebenszyklus einer Fabrik miteinander verbindet, um eine bessere Koordinierung zu erreichen, indem eine **aktuelle, zentral gespeicherte digitale Darstellung der gesamten Fabrik** mit **allen zugehörigen Informationen** von allen Lieferanten erstellt und verwaltet wird.

Dies umfasst alle Anlagen, die für einen wertvolleren und nachhaltigeren Fertigungsprozess in der Zukunft relevant sind.

The Challenge

Verbindung physischer und digitaler Systeme für Echtzeit-Einblicke



Fragmentierte Informationen aus verschiedenen Quellen kombinieren, um effektiv zu planen

Risiken und Abfall während der Bauphase minimieren

Durchführung detaillierter Entwürfe und Simulationen in verschiedenen Disziplinen

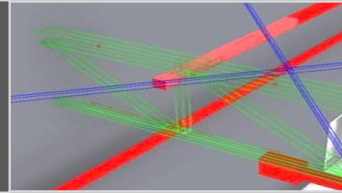
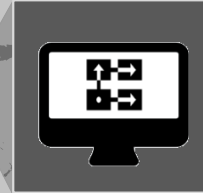
Zielbild - Integrated Factory Modeling (IFM)

Die Konvergenz von BIM und Digitaler Fabrikplanung

Smart Expert



Entscheidungs-
unterstützung



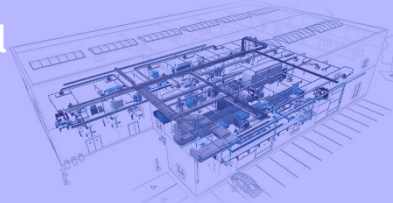
Zugriff auf
jedem Endgerät



Multimodaler Informationszugang



Ganzheitliches,
integriertes
Kollaborationsmodell



Integrated Factory
Model



Ein einzelner
Datensatz
über alle
Disziplinen



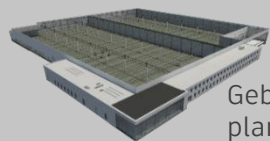
Aggregation und Synchronisierung



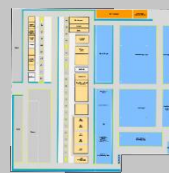
Fachplaner



Rohdaten &
Anwender-
Software



Gebäude-
planer



Layout-
planer



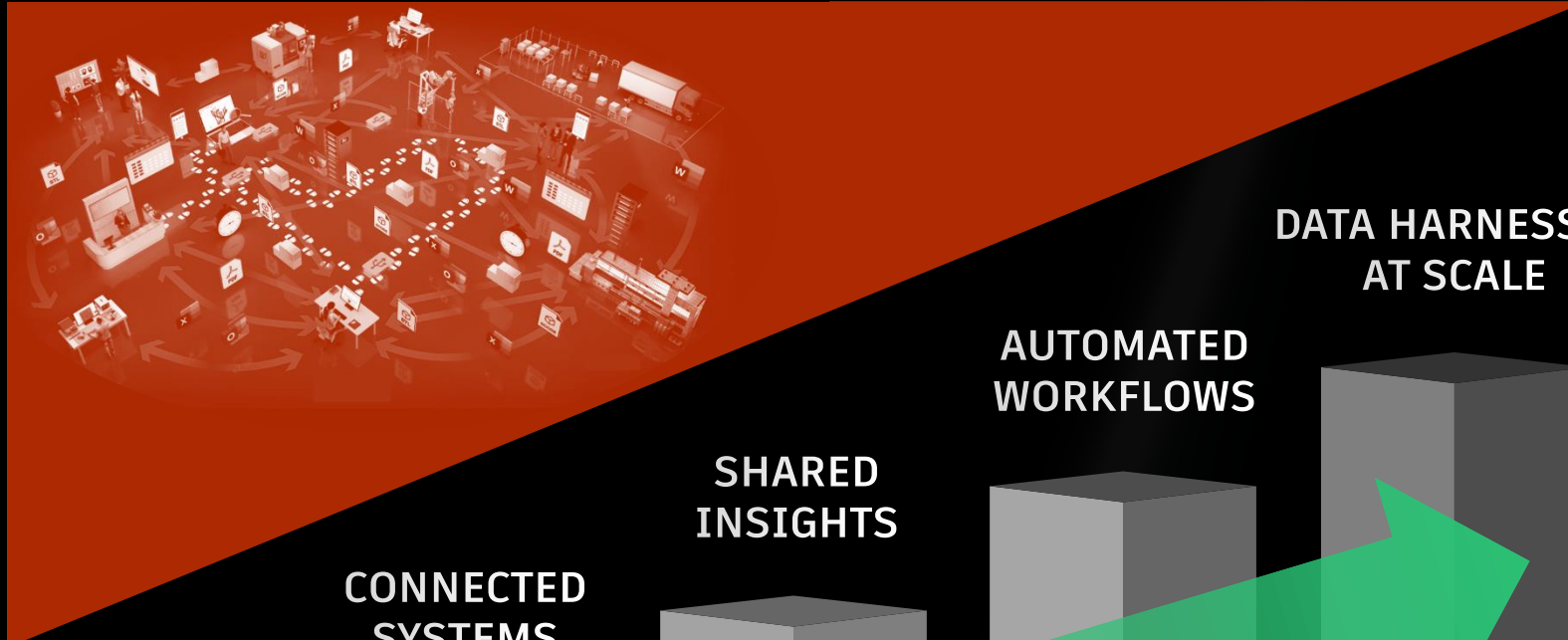
Betriebsmittel-
planer



Integration von
Experten &
Lieferanten



Data
Effort



Data
Value



SILOED
DATA

CONNECTED
SYSTEMS

SHARED
INSIGHTS

AUTOMATED
WORKFLOWS

DATA HARNESSSED
AT SCALE

From Silos to Synergies



The Autodesk Platform unifies data and connects workflows

Autodesk Platform Services (APS) powers the Design & Make Platform by connecting to all your business processes & systems.

Business Processes

Enterprise System Integration
ERP, CRM, Viewing, Planning, Scheduling, Cost, Fabrication, Maintenance, Purchasing etc.



Partner Ecosystem

Industry Alliances



Cloud & Desktop Partners

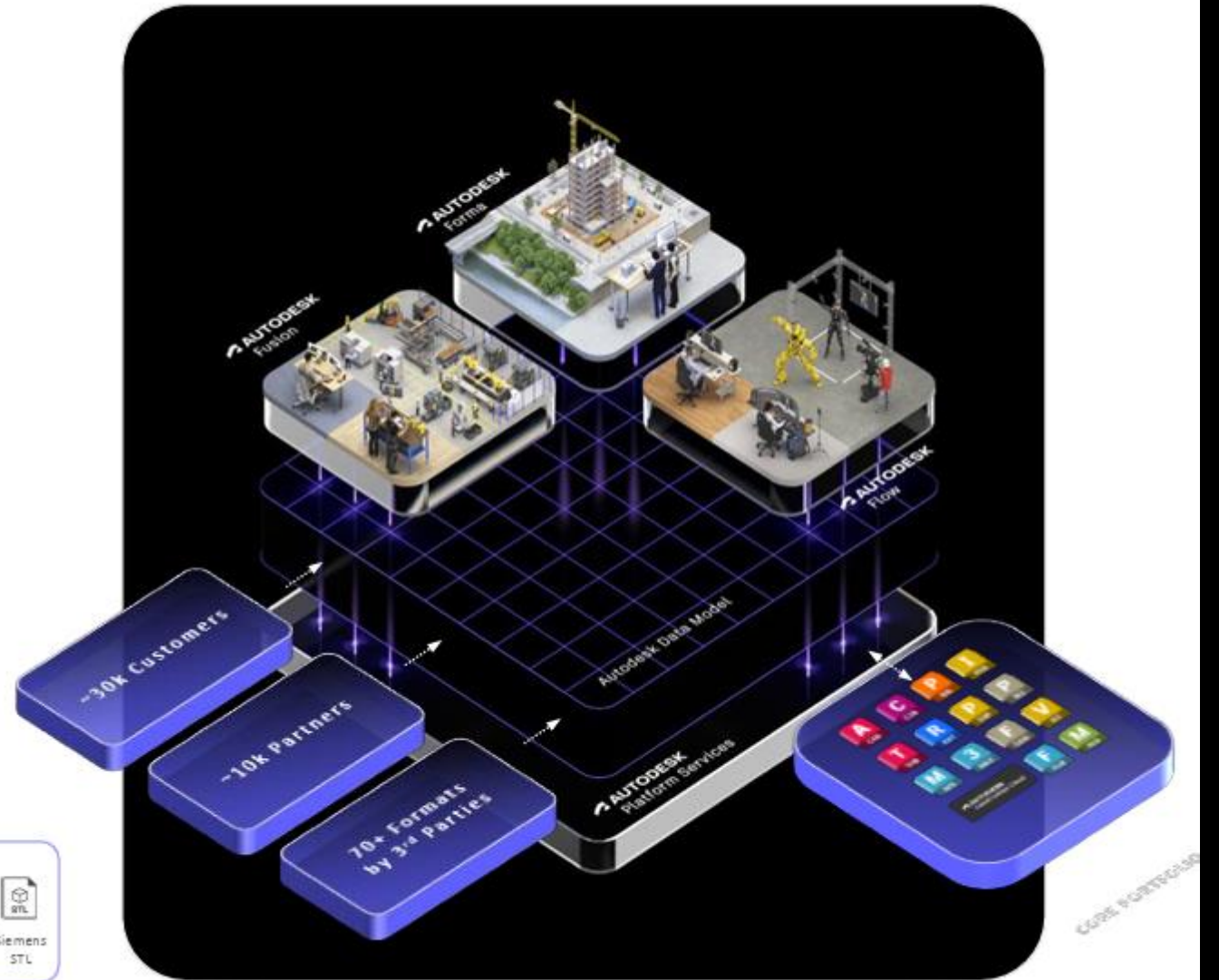
~10K members

70+ File Formats

Independent Formats



3rd Party Formats

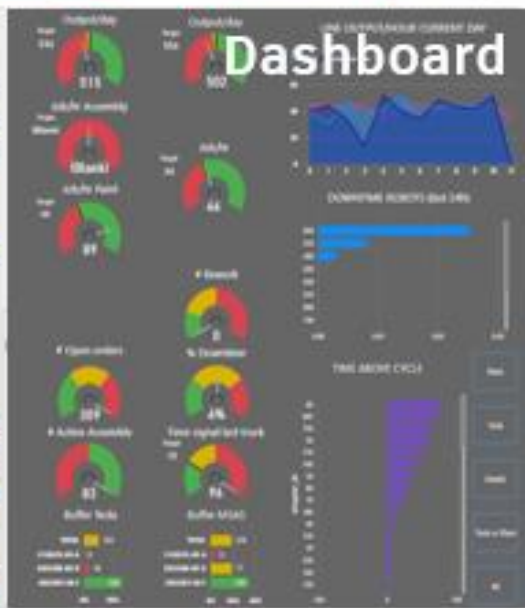
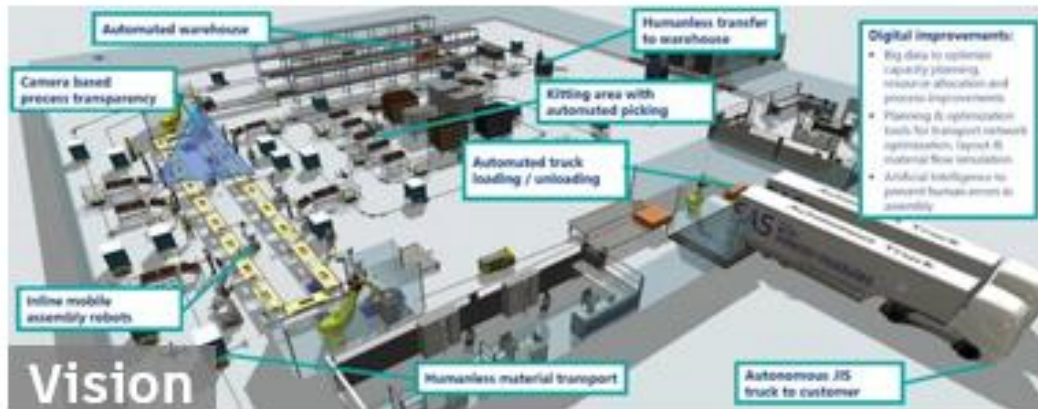




MOTHERSON SAS INTEGRATED ASSEMBLIES

Image: BEOS AG

Motherson SAS drives Operational Excellence with Autodesk Digital Twins



Outcomes

✓ Agile Decision-Making & Production Flexibility for Global Operations

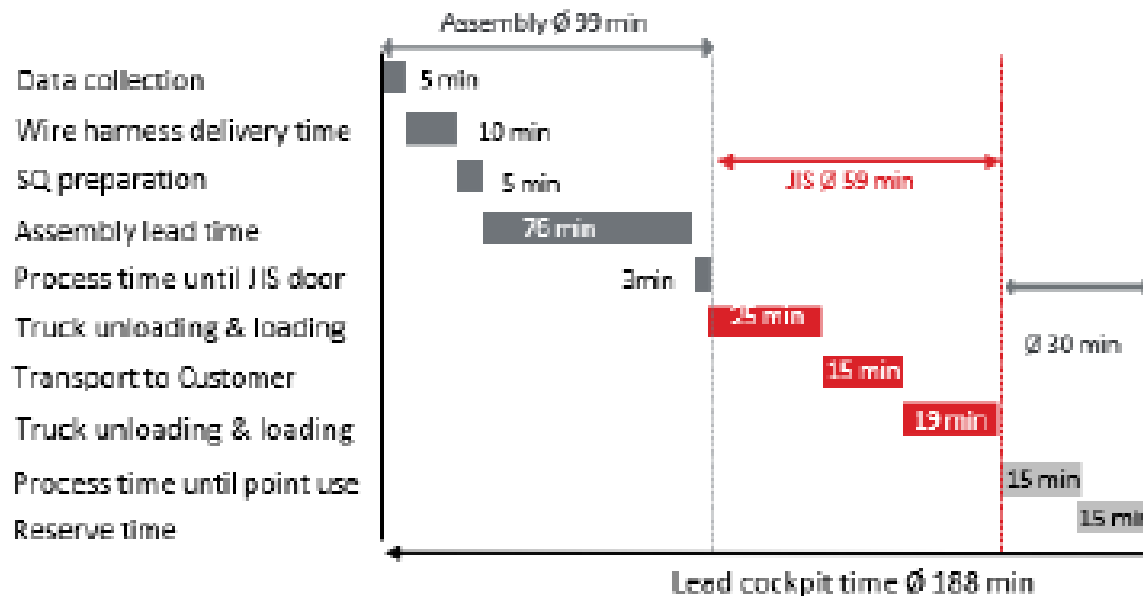
✓ Improved Energy Efficiency & Foundation for Resource Optimisation

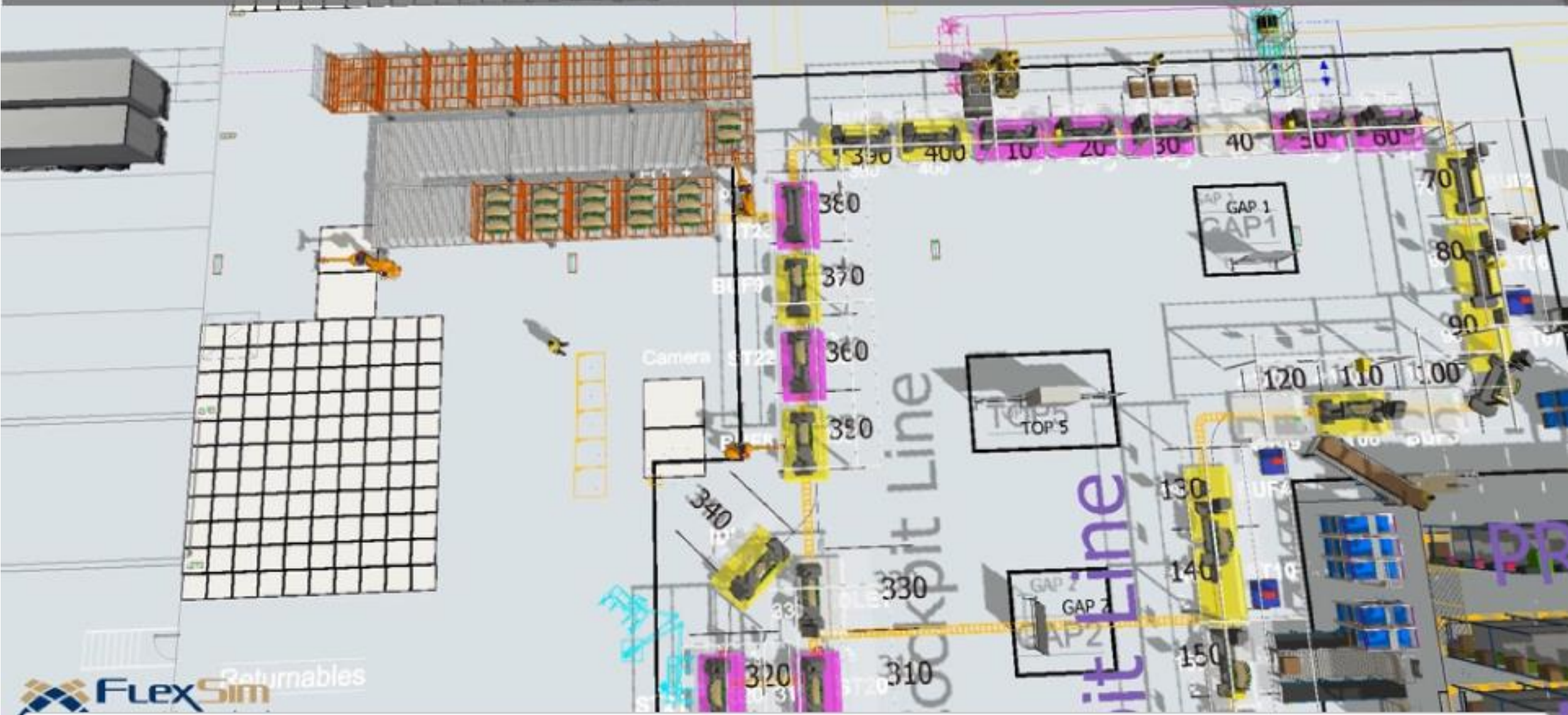
✓ Downtime Reduction & Continuous Improvement through Data Analysis

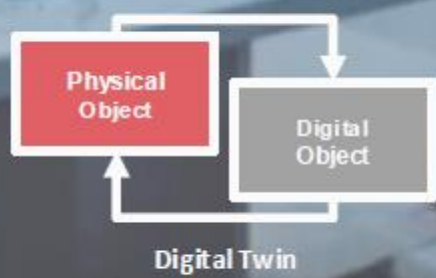
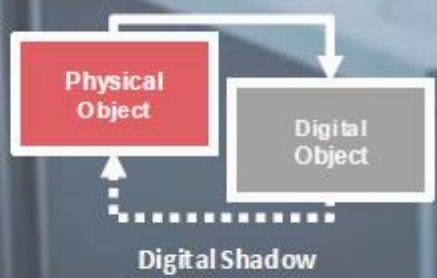
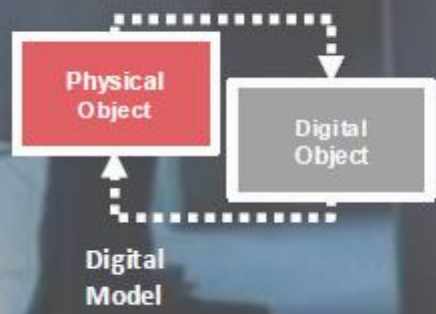
Operational Exzellenz durch digitalen Zwilling



Modules Assembly and Delivery Just-In-Sequence.







Benefits

Real-Time Monitoring & Process Optimization

Downtime Reduction & Continuous Improvement through Data Analysis

Energy Efficiency & Resource Optimisation

Agile Decision-Making & Production Flexibility for Global Operations

Simulation for Green and Brown Field

Lessons Learned

Start with the outcome

User stories first (KPIs, sensors, architecture, systems)

Allow time to test

Optimize for latency. System fast, reliable, and ready to scale

Key Take Aways

It is a cross-domain project.
Not an IT-project
Not a ME-project
Not a project to be delivered by external consultant

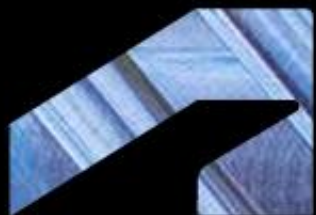
Step-by-step approach
Digital-Model
Digital-Shadow
Digital-Twin (*bi-directionally connected*)

Holistic End-to-End platform is mandatory to scale up solution to large scope (24 locations)

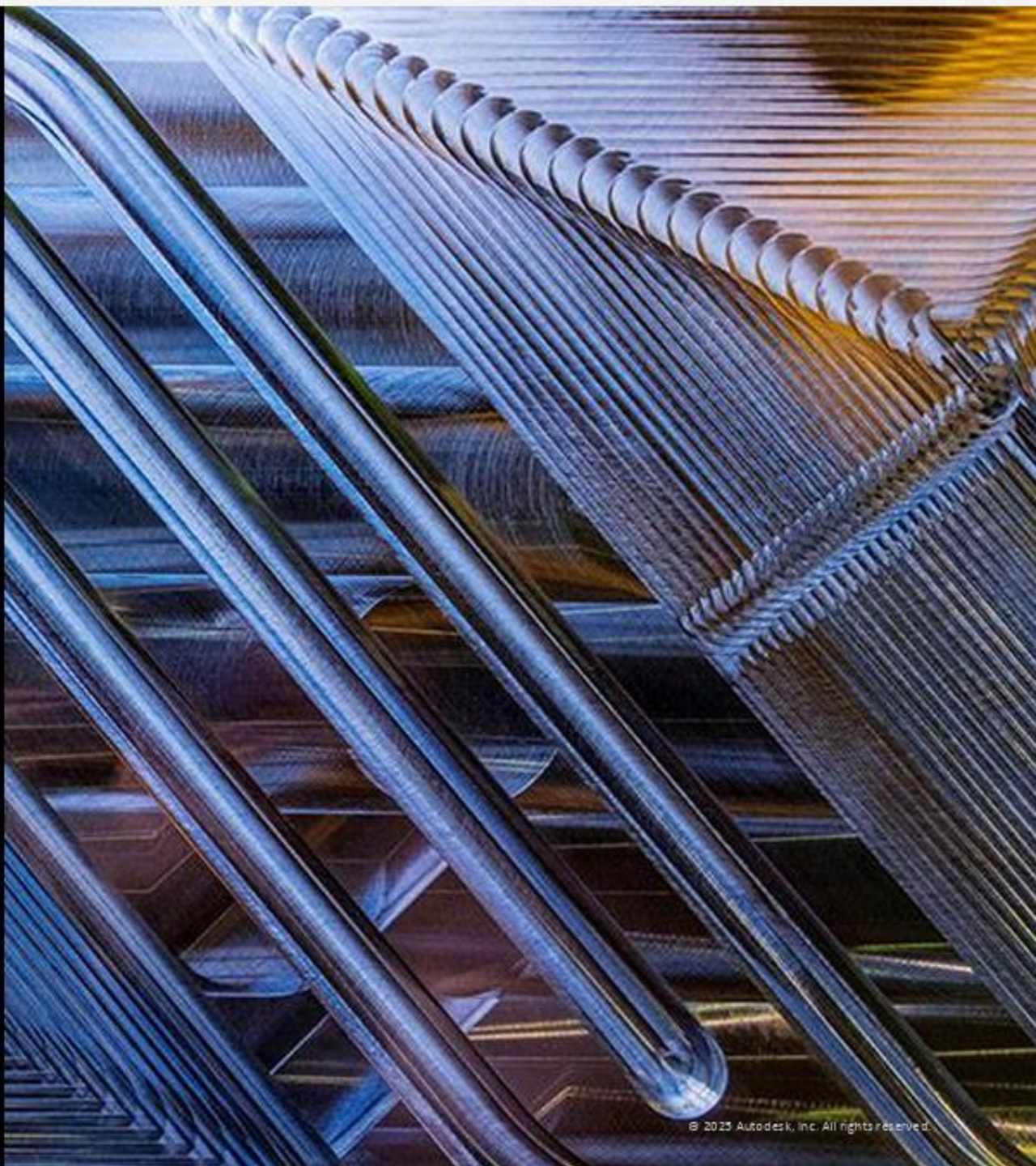
As we embark on a Transformation, People matter, too !

A worker in a factory setting is wearing AR glasses and holding a transparent, wireframe model of a car seat. The worker is positioned in front of a large industrial machine with a control panel featuring various buttons and a screen. The scene is dimly lit, with the worker and the AR model being the primary focus. The text 'Was bringt die Zukunft?' is overlaid in large white letters across the center of the image.

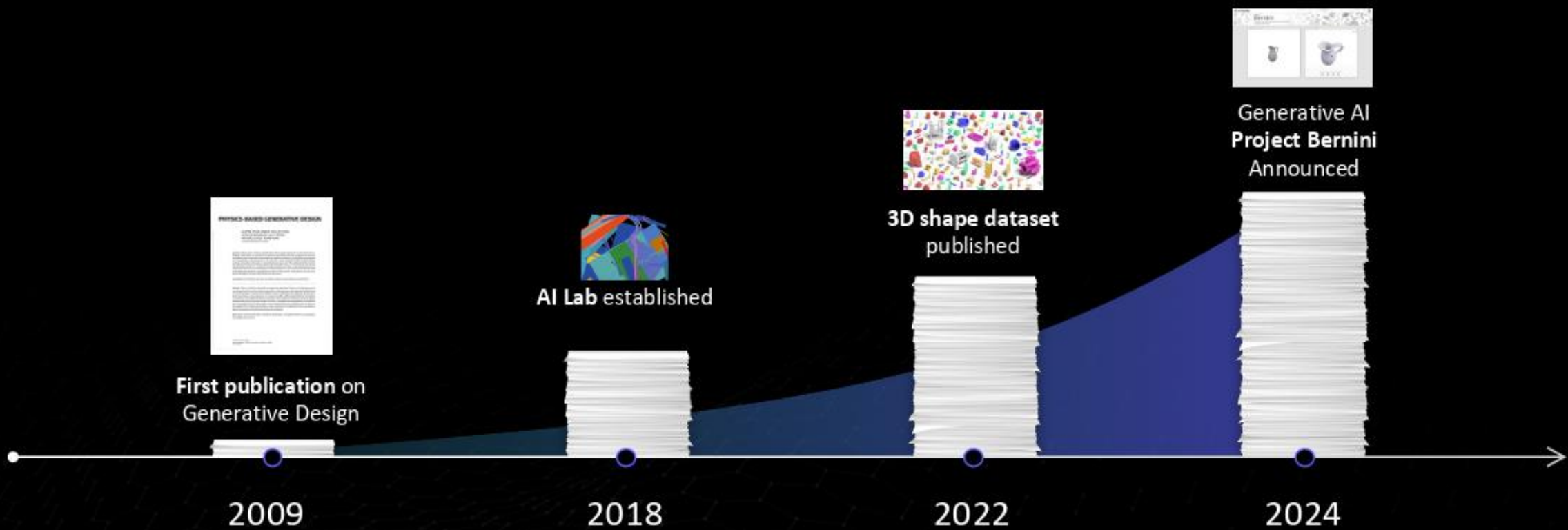
Was bringt die Zukunft?



Autodesk AI



History of Research



Since 2009

90+

AI Research Papers

World's leading publisher of AI research for CAD geometry

CAPRI-Net: Learning Compact CAD Shapes with Adaptive Primitive Assembly

Fengze Yu¹ Zhiye Chen¹ Muzi Li^{1,2} Aditya Sanghi¹ Thomas Stylian¹
¹Simon Fraser University ²Autodesk AI Lab ³Shandong University

Abstract

We introduce CAPRI-Net, a self-supervised neural network for learning compact and interpretable implicit representations of 3D computer-aided shapes (CAD) models, in the form of adaptive primitive assemblies. Given an input 3D shape, our network reconstructs it by an assembly of quadratic surface patches via constructive solid geometry (CSG) operations. Without any ground-truth shape annotations, we structure shape of nature of locally adaptive assembly shapes, resulting in a compact and interpretable representation of the input shape. We make ABC, the basis of our method, available to the community.

WorldSmith: Iterative and Expressive Prompting for World Building with a Generative AI

Haogang Deng
 haogang.deng@autodesk.com
 University of Bayreuth & Autodesk Research
 Bayreuth, Bavaria, Germany

Frederik Jersky
 frederik.jersky@autodesk.com
 Autodesk Research
 Toronto, Ontario, Canada

Tomer Anderson
 tomer.anderson@autodesk.com
 Autodesk Research
 Toronto, Ontario, Canada

Abstract

Creating a rich and diverse environment is crucial for virtual world building, but can be difficult to achieve since illustrating a world from scratch requires time and significant skill. We leverage the power of generative AI to assist in this process. In our system, the user provides a high-level prompt, and the AI generates a 3D scene. The user can then iteratively refine the scene by providing more specific prompts. We demonstrate the effectiveness of our system in generating diverse and high-quality virtual worlds. We make our system available to the community.

Figure 1: The workflow and high-level interface of WorldSmith. The user selects one of the top image files in the Global File View (A), and iteratively refines the file with text prompts, sketching, and region painting tools available through the Detailed File Editor (B). All generated images are collected in the Results View (C) which allows the user to view previous image results. Furthermore, the File View automatically captures such new image generation requests (D). After creating all files the user returns to the Global File View to visualize the file as a single image.

Exploring Generative 3D Shapes Using Autoencoder Networks

Nikhayil Usatov
 Autodesk Research, Toronto, Canada

Abstract

We introduce a novel approach to disassemble style from content in the 3D domain and perform unsupervised neural style transfer. Our approach is able to extract style information from 3D input in a self-supervised fashion, conditioning the definition of style on interactive issues inferred explicitly in the form of specific representations applied to the input. This allows, at test time, to select specifically the features to be transferred between two arbitrary 3D shapes, being able to capture complex shapes (e.g. combinations of arbitrary geometrical and topological transformations) with the data prior. Coupled with the choice of representing 3D shapes as neural implicit fields, we are able to perform style transfer in a cost-effective way, handling a variety of transformations. We validate our approach qualitatively and quantitatively on a dataset with four style labels.

Figure 1: Model overview: an input shape x_1 is augmented by a set of transformations which denote specific style features, but preserve content information, producing the augmentations x_2, \dots, x_n . Style is encoded in a latent vector space as a nonlinear function f of the latent features corresponding to the input shape x_1 and its augmentations, respectively. The latent features are composed by a twin encoder network E in a multistage fashion. At test time the style codes condition the generation of shapes in a preferred style, using a neural implicit decoder D .

1. Introduction

Being able to automatically synthesize shapes with a predefined style is a core task in computer graphics. Classical 3D style transfer techniques used to rely on a given correspondence

© 2023 M. Peters, B. Stamm, A. Sanghi & N. Usatov

Generative AI 3D shape creation

D&M

Design

Research

Project Bernini is a research effort focused on developing generative AI for Design and Make industries.

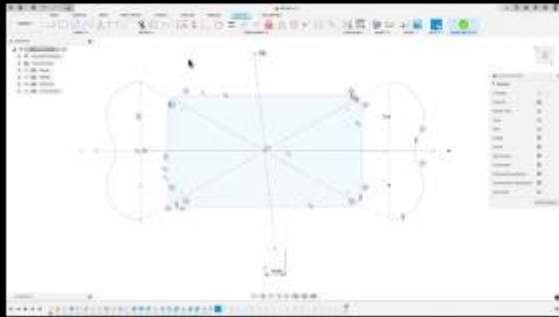
<https://adsknews.autodesk.com/en/news/research-project-bernini/>



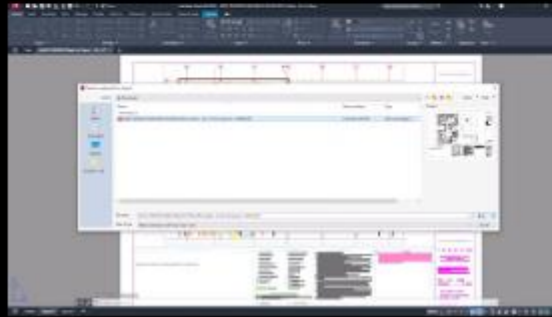
Autodesk AI – What is it?

40+ AI-powered features across many products, including...

Fusion AutoConstrain



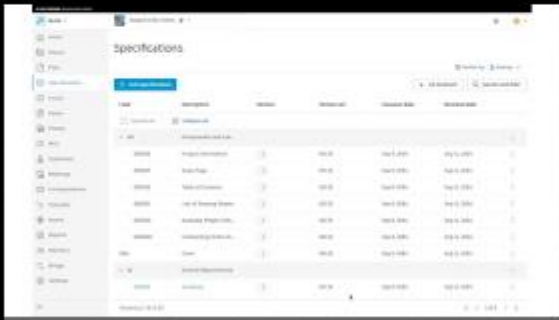
AutoCAD Markup Assist



Maya Motion Maker



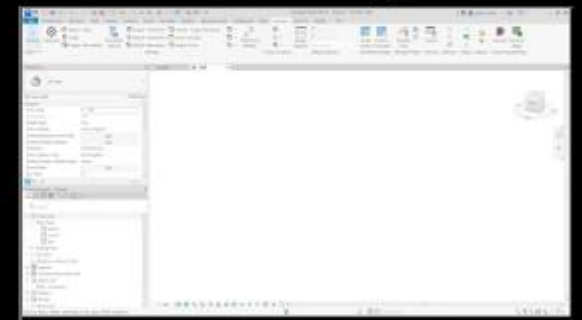
Autodesk Assistant



Autodesk Construction IQ

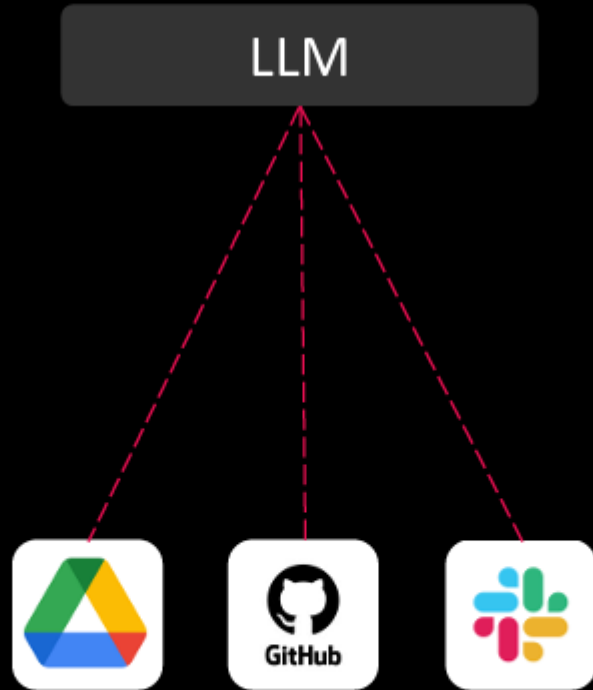


Revit Generative Design

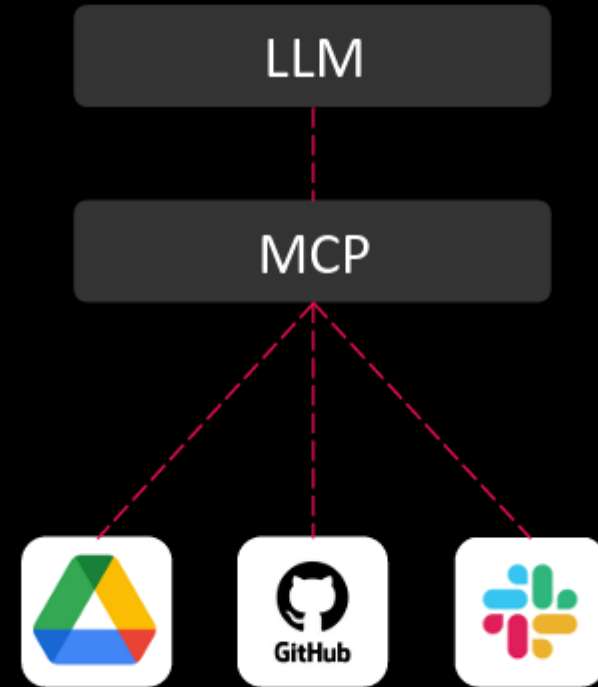


MCPs Changing the Platform Development

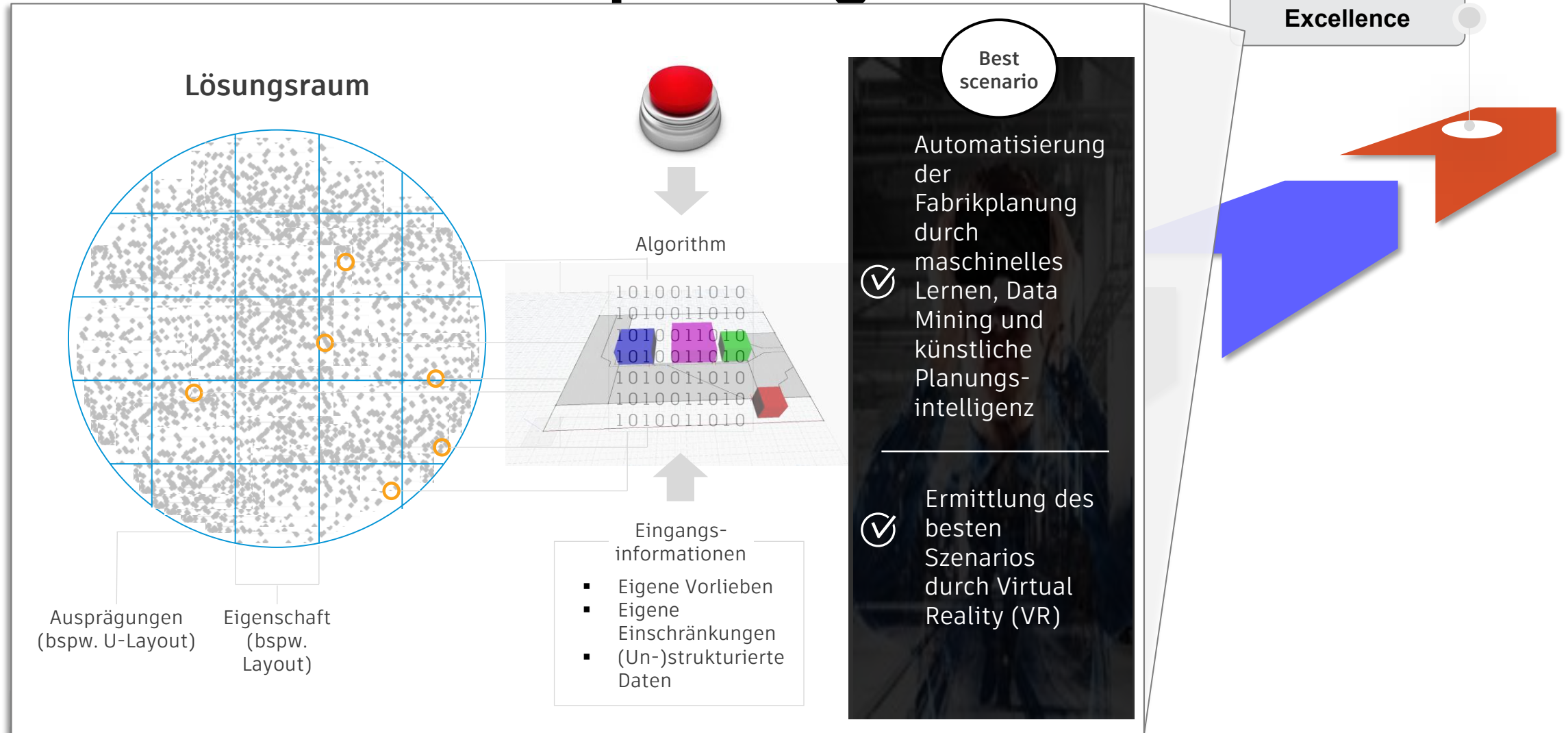
Before MCP



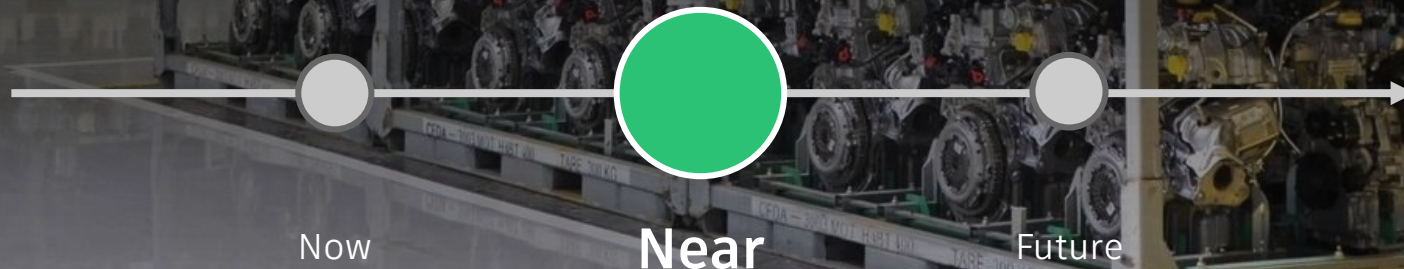
After MCP



Algorithmik bietet großer Potential für die Zukunft der Fabrikplanung



GENERATIVE FACTORY LAYOUT



Now

Near

Future

Requirement Definition

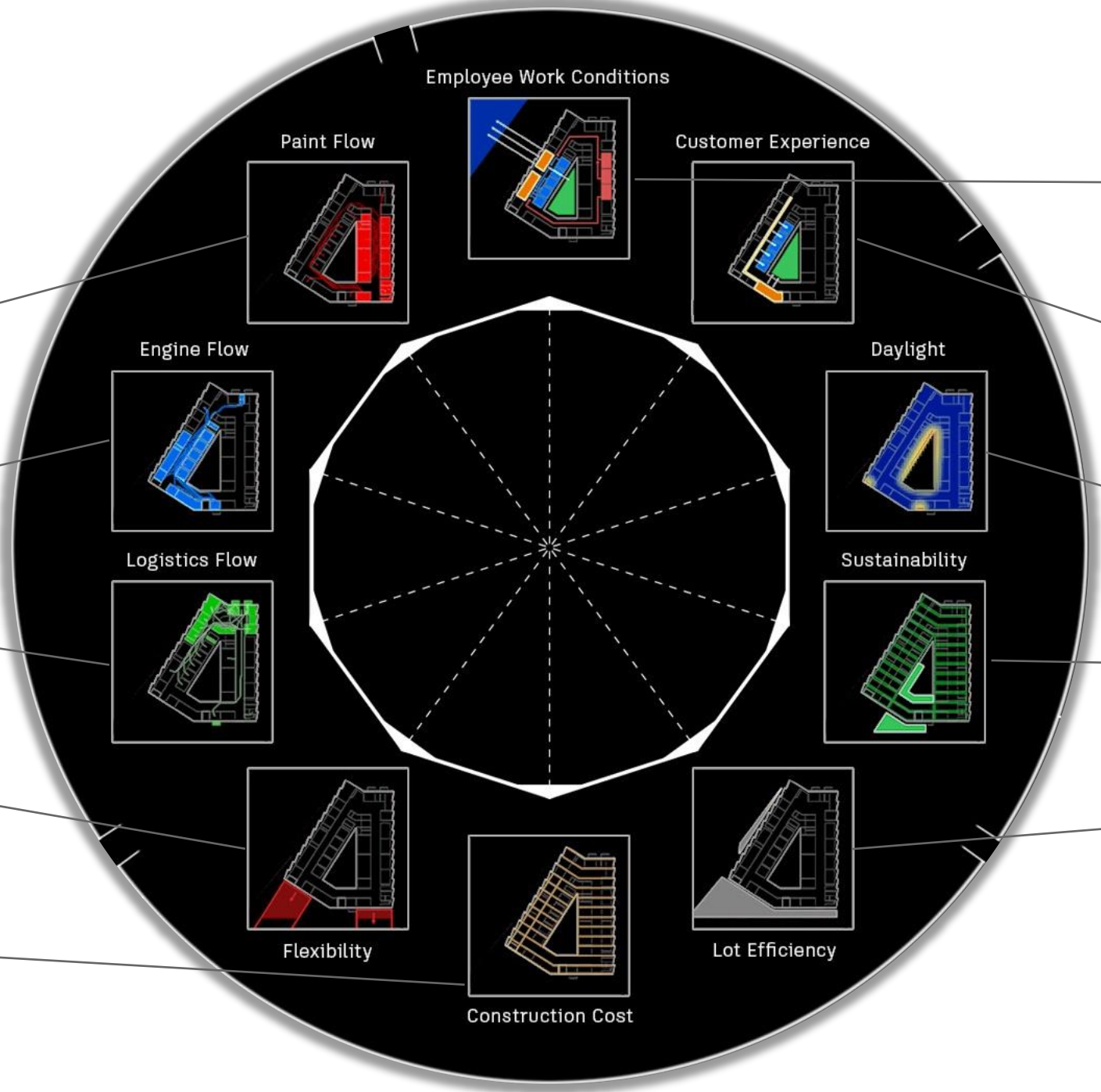
Paint Flow

Engine Flow

Logistics Flow

Flexibility

Construction costs



Employee Work Conditions

Customer Experience

Daylight

Sustainability

Lot efficiency

AIRBUS



Image courtesy of Airbus

AIRBUS

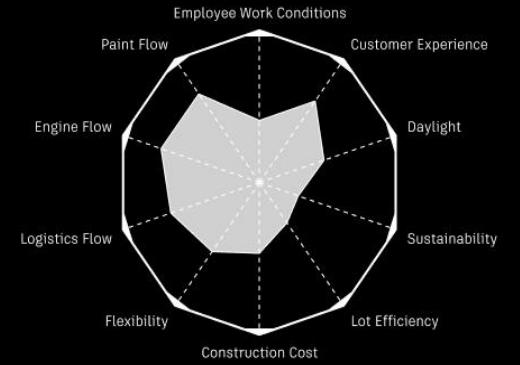
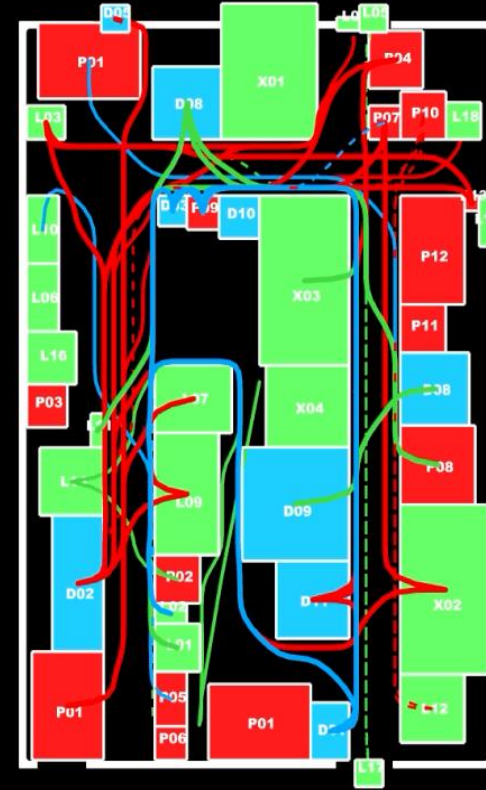
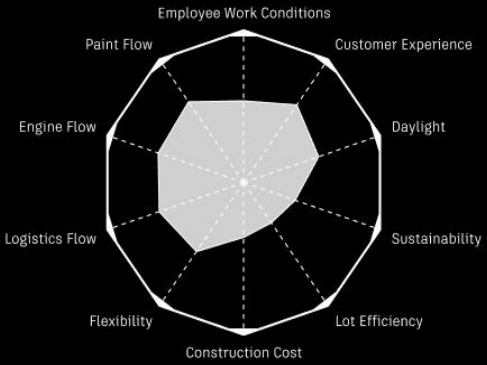


Image courtesy of Airbus

Ihr Start mit IFM - einfacher 3-Schritte-Ansatz

Schritt 1
Autodesk IFM Vision Präsentation & Identifizierung des Use Cases

The Vision of Autodesk's Integrated Factory Modeling

Integrated Factory Modeling
An integrated, digital factory model enables higher flexibility, agility and innovation

Outcomes
Time to market -25%

Integrated Factory Modeling
The Convergence of BIM and Digital Factory

Komplexe Industrieprojekte als kundenindividuelle Lösungen

DATEN UND PROZESSMANAGEMENT

Veränderung der operativen Effizienz

DESIGN FREEZE

Veränderung der operativen Effizienz

Schritt 2
Status Quo & Discovery-Workshop

IFM Alignment Workshop – Day 1
What can you expect from the workshop?

1. **Introductions**
 - Gather personal viewpoints
2. **Customer Strategy & IFM Overview**
 - e Go Use Case
 - IFM as innovation driver
 - target architecture
3. **Target Architecture**
4. **Future State**
5. **Summary**

3D IFM Maturity Cube
The Cube is an easy way to visualize the maturity of the Customer

Aspiration of Maturity Level

Maturity Level fully fulfilled

The Integrated Factory/Building Model Cube
Process & Results

Structured Process for discovering, analyzing and documenting current trades, parties, processes and tools

Common Understanding and definition of a planning, building and operating model across all trades along the entire lifecycle

Results are:
Milestone Plan
Responsibilities
Expected Outcomes
Solution Concept
Relevant tools

Schritt 3
Definition einer spez. Lösungsarchitektur & Roadmap

Integrated Factory Model Roadmap
IFM Vision – Major Milestones

- 1- Validated IFM
- 2- Enhanced IFM
- 3- Defined IFM
- 4- Fully Integrated IFM

How we deliver against Milestone 1
Objective for Milestone 1 – “Validation of IFM Framework”

- Team Engagement
- IFM Technology Upskilling
- IFM Workflows Definition

High level Solution Architecture (Polestar Example)

Factory Model Library

Equipment Supplier

Equipment Eng.

Project Management

Documents Management

Cost Management

Quality Management

Change Management

Equipment Eng.

Project Eng.

5 Key Take Aways

1. Die Industrie ist im digitalen Wandel und Sie können von dieser partizipieren
2. Daten sind das Öl für die ITF Umsetzung
3. BIM ist Schlüsselkompetenz und wird im Lebenszyklus gedacht
4. Das Zielbild ihrer Kunden sind digitale Zwillinge, aber sie brauchen SIE um diese zu erreichen
5. Digitale Zwillinge und Algorithmik sind keine Gefahr, sondern eine Chance





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