Product innovation and customer engagement with Ferrari and Autodesk

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Agenda

01 Product engineering and development challenges

02 Embracing operational and product complexity

03 Hear it best from our customers:
   o Ferrari – Mauro Coletto and Giovanni Longobardi
   o Autodesk – Heather Kerrick
Product development challenges

- Performance and scalability
- Data friction
- Global collaboration
Model-based engineering (MBE) journey

Where are you today?

0 1 2 3 4

Models occasionally used
Models as official deliverables
Models automated and connected with Digital Threads
Model Based Engineering (MBE), complete product lifecycle

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Digital Thread, deployed on AWS Cloud, delivers the connected data architecture across the product lifecycle
Product engineering and development

EMBRACING COMPLEXITY

Strategic Planning  Product Planning  Product Design  Validation & Simulation  Production  Sales & Marketing  Service  Recycle & EOL

Planning Solutions & Knowledge base

Product Engineering Governance

Product Planning & Model-based Systems Engineering (MBSE)
Product Data & Lifecycle Management
Virtual Design & CAD
Electronic Design Automation (EDA)
Engineered For Service

Computer Aided Engineering & Validation
Manufacturing Planning and Execution Solutions
MarComm, Asset Management, and Customer Relations Solutions
Service Catalog, Deployment, and Usages Intelligence Solutions
End-Of-Life Disposition and Reporting Solutions

AWS Services (*)
Amazon AppStream
NICE DCV
Amazon S3
Amazon RDS

AWS Solutions (*)
Amazon SageMaker
AWS IoT Core
AWS Lambda
AWS ParallelCluster
Research & Engineering Studio (RES)
Scale-Out Computing on AWS (SOCA)
Twinflow

AWS Partners (*)
Siemens
Autodesk
PTC
Cadence
Synopsys
Ansys
Rescale
Vertex Systems

(*) Sample List

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Key technology enablers

- Black box
- White box
- Grey box

Secure global collaboration

Data lake/data mesh/Digital Thread

High-performance computation (HPC)

Automation & intelligence (AI/ML)

End-user computing (RD/VDI)

Spatial review/X-reality

Model repositories

Regs & specs

ERP

Resources & assets

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Artificial intelligence in product engineering and development

**CAPABILITIES**

- Speech to text conversion
- Advanced data search
- Ideation
- Design exploration
- Multidisciplinary optimization
- New materials

**BENEFITS**

- Productivity
- Innovation
- Quality
- Manufacturability
- Sustainability
Ferrari

Mauro Coletto
Head of Business Analytics and Data Science

Giovanni Longobardi
Cloud Operations Manager
The guiding principles

- Continuous learning
- Strong partnerships
- Internal collaboration
Continuous learning: Data-driven environment

DATA-DRIVEN DAYS
Inspirational and educational data-focused events open to all Ferrari employees
- Value of Data
- Machine Learning
- Data Visualization
1700 participants

ML BUSINESS EMBARK PROGRAM
For R&D, manufacturing, communication, marketing, sales, and lifestyle business leaders
- How to drive an ML project
- Applied ML projects
50 participants

ML TECH PROGRAM
Technical trainings
- Computer vision models
- Forecasting models
- Recommending systems
- Anomaly detection
- Predictive maintenance

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Partnership and strategic collaborations
Collaboration: Building an enterprise data experts community

FERRARI DATA SCIENCE HUB
- Connect data analysts, ML engineers, and data scientists across all departments
- Networking and support
- Training and regular workshops
The role of data at Ferrari
Ferrari federated platforms and analytics tools

APPLICATIONS

BUSINESS INTELLIGENCE TOOLS

DATA SCIENCE LAB

Digital Manufacturing Platform

Vehicle Data Platform

Connected Car

Customer Data Platform & NBA

Digital Channels Analytics

DATA SOURCES

ERP  HR  PLM  MES  SAT  CRM  ...

IOT

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Vehicle data platform infrastructure

**Data sources**
- Ferrari legacy
  - ERP
  - Metadata
  - CMS
  - Connected Car
  - Diagnostic data
  - PLM
- Unstructured data
  - Excel files
  - Car Reliability Data
  - Others

**Web services**
- Subscribers
  - CRM/CDP
  - ENGINEERING
  - DWS
  - CMS
  - Car photo shooting
  - PRE-OWNED

**Data lake**
- Analytics & ML
- Dashboard

**Ingestion**
- Elaborate
- Consolidate
- Store

**Processing**
- VDP

**Serving**
The role of CAE at Ferrari
Why computer-aided engineering

Research & Development and Digital & Data Synergy

Enable engineers to virtually assess new car design and performance

Business

Improve scalability for peak management
Reduce computational time
Enhance user experience

CAE users
Optical simulation
FEM
CFD
Multibody
Electromagnetic simulation

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Virtual prototyping examples

Simulations on cloud HPC
- Structural
- Computation fluid dynamics
- Electronic/electromechanical/thermal simulation
- Multiphysic simulation
- Optical simulation

Solution Time 0.05 (s)
Ferrari HPC hybrid architecture

Maranello data center

Ferrari HPC on premises

- Frontend
- Calculation nodes
- HPC storage

AWS Cloud – Ireland Region

- VPC
- AWS ParallelCluster
  - Head node
  - Scheduler
  - Queue
  - Compute node

- Direct Connect
- Router
- Direct Connect Gateway

- Amazon S3
- Amazon FSx for Lustre
- Amazon Aurora

CAE users

Amazon FSx for Lustre

Amazon Aurora
Benchmark results

AWS HPC SIMULATION PERFORMANCE (TIME)

- Conjugate Heat Transfer Transient: 76%
- Dynamic / Acoustic: 67%
- Fluid Dynamics Steady: 12%
- Explicit Dynamic: 22%
- Static Structural: 44%
Improvement

- 4x data transfer → Improved 75% of our use cases
- End user experience
- Scalability
Improvement

• 4x data transfer
• End user experience → Improved 91% of our use cases
• Scalability
Benchmark summary

Improvement

- 4x data transfer
- End user experience
- Scalability → Improved 100% of our use cases
Next steps

- **Operational overhead**
  - GUI development
  - Photorealistic simulation

- **UX**
  - New SW Experimentation
    - GPU focus
  - Extension of HPC usage in the cloud in respect of a cost efficiency strategy

- **Data transfer optimization**

- **Cost efficiency**

**Lower solver time**
Ferrari machine learning use cases
Machine learning architecture

Sources
- VDP
- S3 bucket
- Data storage

Workflow
- Build
- Train
- Deploy

Amazon SageMaker
- Amazon Personalize
- Amazon Rekognition
- Amazon Forecast
- Recommender system
- Computer vision image detection
- Forecasting regressions

Custom models +

ML environments
- Python
- TensorFlow
- Keras

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ML use case example: Friction coefficient forecast

**Challenge:** Estimate the friction coefficient between disk and pad to optimize the vehicle dynamics

**Solution:** An ML model built on test benchmark data that can be used as a vehicle control system

- Must deal with **50Hz sampled data**
- Must be suitable for **general vehicle usage**
- Simulation data useful to build a more robust model
- Must be **deployable on the vehicle**
Computer vision for content auto-labelling

**Goal:** Introduce an Automatic Tagger, with human supervision, to make unlabelled data from owned and earned media available for deeper analysis/indexing/consumption pipelines

**CAR MODEL CLASSIFICATION**
- Car Model: Ferrari Roma
- Car Model: Ferrari 458 Spider
- Car Model: Ferrari Portofino

**PIPELINE**
- Custom labels
- Label detection
- Face comparison
- Celebrity recognition

**OBJECT DETECTION**
- Cars: 6
- People: 6
- Settings: OUTDOOR
- ...
Generative AI: A potential game changer

EXPERIMENTAL PHASE: LEVERAGE GENERATIVE AI TO CREATE WEIGHT- AND COST-OPTIMIZED PARTS

Traditional approach

Part design takes weeks based on multiple iterative design and testing cycles conducted by engineers. No foundation models can currently perform this task. Algorithms available based on reinforcement learning.

Design ➔ Testing ➔ Adaptation

Generative AI approach

Algorithm creates several models and automatically tests them against constraints ➔ Best designs are further evolved until absolute best is found ➔ Engineers review results and finalize the shape for production and physical testing

Value at stake of generative AI

2–3x quicker design process of complex parts, accelerating overall product development process

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Autodesk

Heather Kerrick
(she/her)
Senior Manager, Fusion Machine Learning
Autodesk
Our software helps innovators design, build, and manufacture like never before

Our industries

Architecture, engineering, and construction

Manufacturing

Media and entertainment
Our company

- **Founded**
  - 1982

- **Headquarters**
  - San Francisco, CA

- **Employees (2023)**
  - 13,700+ worldwide

**In FY23***

<table>
<thead>
<tr>
<th>Total revenue</th>
<th>Total subscribers</th>
<th>R&amp;D investment</th>
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<tbody>
<tr>
<td>$5.01B</td>
<td>6.74M</td>
<td>$1.2B</td>
</tr>
</tbody>
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(up) 14% year on year  
(up) 11.6% year on year  
(20% of net revenue)

*Figures are from our fiscal year 2023, which began February 1, 2022 and ended January 31, 2023.
Autodesk is changing how the world is designed and made
Developer Requirements

- High performance
- Secure
- Reliable
- Flexible
- Scalable
Autodesk and Airbus show the future of aerospace design and manufacture in pioneering generatively designed 3D printed partition

1 DEC 2015
Multiple generative design technologies

**DIFFERENT TOOLS FOR DIFFERENT OBJECTIVES**

- **Form and function exploration with Automated Modeling**
- **Generative design for structural components**
- **Generative design for fluid paths**
Multiple manufacturing methods

Manufacturing-ready design

- Additive manufacturing
- Die casting
- 3 & 5 axis milling
- 2.5 axis milling
- 2 axis cutting
Multiple Manufacturing Methods

2.5 Axis Generative
Weight: 2.3 kg (-23%)
Safety Factor: 2.2
Cost: $

3 Axis Generative
Weight: 2.3 kg (-23%)
Safety Factor: 2.3
Cost: $

Human Design
Weight: 3 kg
Safety Factor: 2.7
Cost: $

Additive Generative
Weight: 2.2 kg (-26%)
Safety Factor: 2
Cost: $$$

Image courtesy of MJK Performance
Performance Improvements Summary

- Faster solve times: 1.7x
- 6 fully supported MFG Methods
- 22% increase in converged studies
- 50% reductions in failed studies

Generative Design for Structural Components
Autodesk Machine Learning Platform

ENABLE MACHINE LEARNING DEVELOPMENT AND DEPLOYMENT
Autodesk Machine Learning Platform

THE PLATFORM
Help engineers and researchers leverage data; develop and train new models; deploy, monitor and retrain models in production

THE VALUE
• Off-the-shelf ML models easier to use
• Access to increasingly powerful compute
• Train without copying data
• Control what data is where & who has access
Advancing the state of the art

JoinABLE: Learning Bottom-up Assembly of Parametric CAD Joints

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Abstract

Physical products are often complex assemblies combining a multitude of 3D parts modeled in computer-aided design (CAD) software. CAD designers build up these assemblies by aligning individual parts to one another using constraints called joints. In this paper we introduce JoinABLE, a learning-based method that assembles parts together in...

CLIP-Forge: Towards Zero-Shot Text-to-Shape Generation

Aditya Sanghi¹ Hang Chu¹ Joseph G. Lambourne¹ Ye Wang²
Chin-Yi Cheng¹ Marco Fumero³ Kamal Rahimi Malekshani³
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“a beocing” “an s-16” “a limo” “a round chair” “a square chair”

BRepNet: A topological message passing system for solid models

Joseph G. Lambourne Karl D.D. Willis Pradeep Kumar Jayaraman
Autodesk Research Autodesk Research Autodesk Research
Aditya Sanghi Peter Meltzer Hooman Shayan
Autodesk Research UCL, Computer Science Autodesk Research

Abstract

Fusion 360 Gallery: A Dataset and Environment for Programmatic CAD Construction from Human Design Sequences

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Blank AI
Accelerating product engineering and development with AWS

**Time to market**
Reduce time to market through effective digital thread throughout value-chain and across enterprises

**Innovation pipeline**
Increased ability to iterate on alternatives through efficient digitalization and smart digital validation

**Product and engineering capacity**
Improved throughput through collaborative engineering, knowledge reuse, effective digital thread

**Quality, iteration, and rework**
Reduce design iterations through cross-functional collaboration and new technologies like AI/ML
Thank you!

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