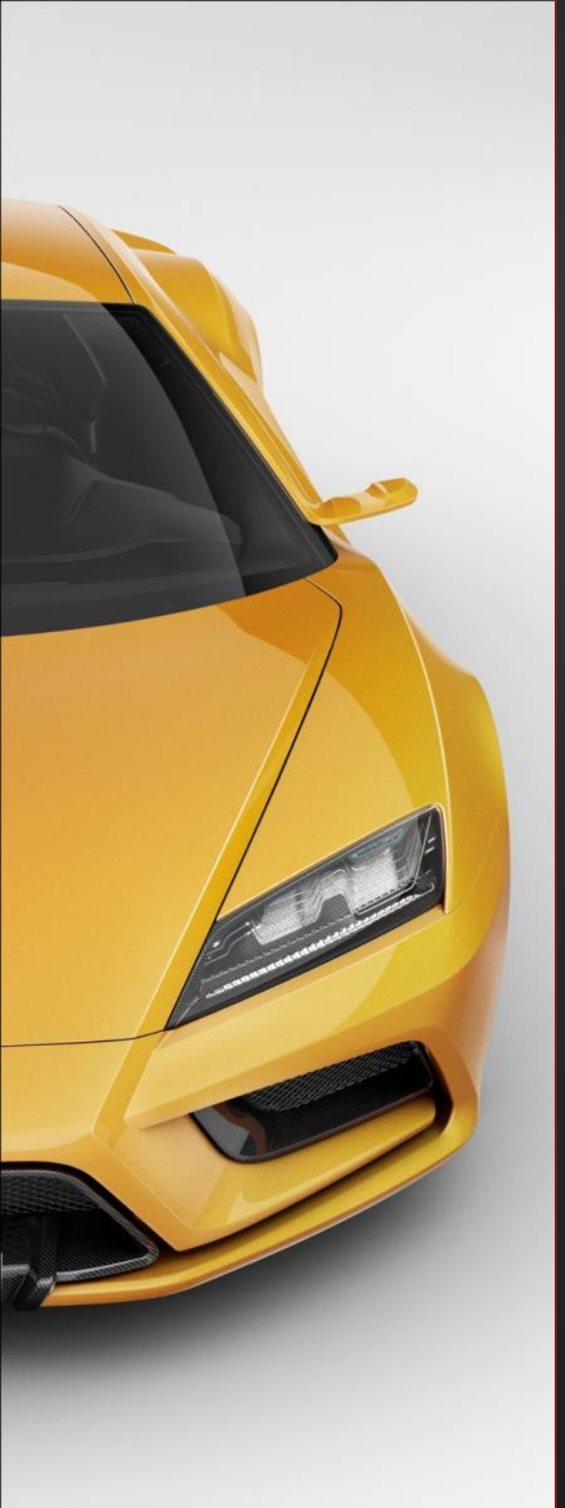

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challenging reality

At the Verge of Change

How HPG drives industrial Decision-Making

Cornelia Denk, Manager Technology & Innovation at RTT

Abstract

Beyond the film and gaming industry, High Performance Graphics has found its way into industrial decision-making processes on a broad scale – from the first design up to the point of sale.

These industry applications, however, come with a different set of challenges:

_ Where to draw the line between high performance visualization and simulation?

_ How to find the balance between required process optimization and freedom of creativity?

_ How to combine different specialized algorithms to meet divergent requirements?

_ Which new data models and asset standards have to be developed as a result?

I will give you insight on how to solve these challenges and share our vision about opportunities to take high performance visualization to the next level of enterprise applications.

RTT Offices
International Presence for global Support

_ Founded in 1999 / Munich, Germany

_ Headquarters: Munich, RTT AG

_ Subsidiaries: RTT USA, Inc. (Pasadena), RTT Asia-Pacific, Inc. (Seoul), RTT Japan K.K. (Tokyo) and RTT China (Shanghai)

_ Offices in Royal Oak, Pasadena, Sao Paolo, London, Paris, Brussels, Milan, Valencia, Stuttgart, Hamburg, Shanghai, Tokyo

_ 500+ employees

RTT Business Model

RTT Software

RTT DeltaGen: Photorealistic realtime 3D visualization for design and styling

RTT PictureBook & RTT PowerHouse Collaborative workflow and asset management of 3D data and visual assets; Connector to PDM/PLM

Remote, realtime & offline services

+

RTT Solutions

CONSULTING:

3D process, optimization of concepts, data integration services; best practices industry

Design & Engineering VP, Immersive, PQ; PoS (Show-Room product configurators), launch events

+

RTT Creative

CREATIVE DIRECTION

Story board creation; creative direction

CONTENT PRODUCTION:

Data Preparation (services and know how); CGI for print and web, TVC and other media

RTT Approach – Increase Efficiency
The Leitmotif of every Product History

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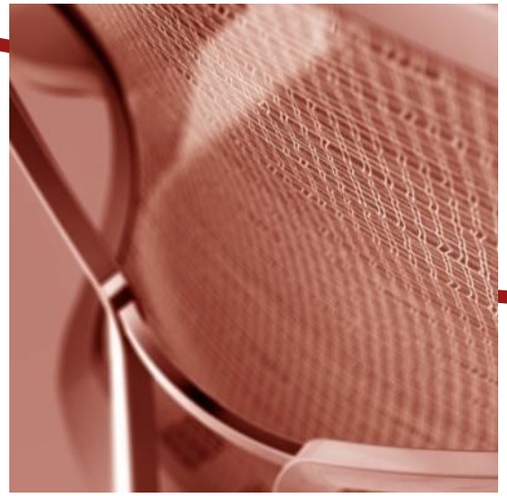
Seamless Transition between Virtual Prototyping and Virtual Marketing

Design



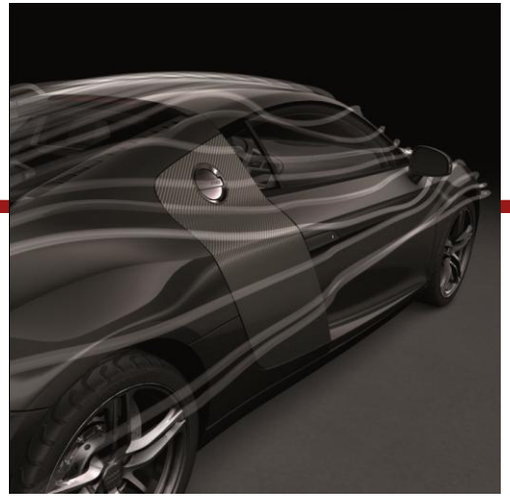
Realistic Design Preview

_ *Form and material design*

_ *Design reviews & decisions*

→ Realistic and plausible but performance matters

Development



Reliable Analysis

_ *Analysis & Simulation*

_ *Immersive Experience*

→ From plausible to physically correct

Marketing

Raise Emotions

_ *Print images*

_ *Movie productions*

→ Realistic but also emotional

Sales

Reach end Customer

_ *Mobile & web applications*

_ *Point of sale solutions*

_ *Entertainment*

→ Performance is key

Replace physical prototypes with virtual ones

Accelerate creative processes

Virtual Model Applications
Design, Development, Marketing and Sales

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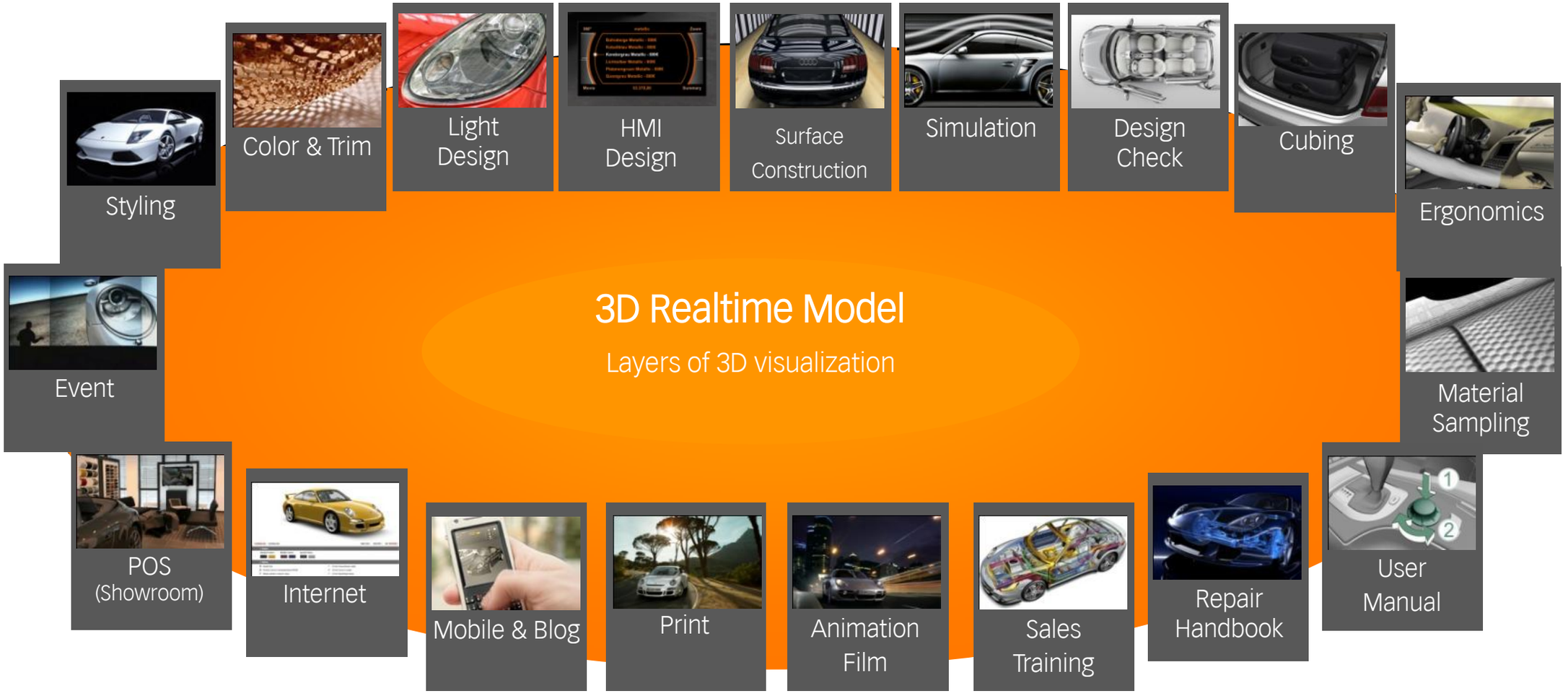

One 3D Realtime model is the basis and used in any use cases

Games vs realtime Industry Visualization

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	Games	Industry Visualization
Data size:	_ Less than 1 million triangles _ Optimized textures _ 1 shadow texture per scene or screenspaced approaches	_ Up to hundred million triangles _ Many large textures _ Shadow textures per shape
Visual quality:	_ Artistic _ Emotional (dust, scratches, etc)	_ From physically correct to realistic _ Clean look (no dust, no scratches)
Flexibility:	_ Configured once before start → Highly Optimized	_ Fully configurable
Performance:	_ 60 FPS @ HD	_ 15 FPS @ HD / 4K / 5 x 2x2K

Offline production vs realtime Industry Visualization

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	Offline	Realtime
Visual Quality:	_ Optimization for 2D image _ 2D image as background	_ High quality for any camera view _ 3D environment necessary
Flexibility:	_ Fixed camera view _ Tuning and variations via post	_ Fully configurable
Post Production:	_ Manual tweaking and painting	_ Very limited possibilities
Performance:	_ Render time not that critical	_ 15 FPS @ HD / 4K / 5 x 2x2K

Market Trends
Scene Complexity

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Within the last 5 years:

Number of polygons, variations, texture size increased by factor 10

Market Trends
Workflow

Increasing model variety based on a common model

- Longer life-cycle of a VR-model
- Reuse of model components

→***Customization and reduce cost***

Global collaboration

→ ***Server based deployment***

Market Trends
VR data usage throughout the whole enterprise

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Decision-making based on virtual models

_ High demand for reliability and correctness

_ Longer life-cycle of a VR-model (30 years)

_ Boundaries between visualization and simulation start to blur

→ ***Shorten time to market and reduce cost***

Demand for fully integrated processes

– Standardized data models

– Scene assembly

– Demand for automation

→ ***Shorten time to market***

Challenge: Divergent Requirements

Performance	⟷	Visual quality
Physically correct	⟷	Emotional
Automation	⟷	Freedom of creativity
Ease of use	⟷	Flexibility
Generalization	⟷	Optimization

Our Goal

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1. **Flexible, scalable and consistent rendering system**

   _ Rasterization & raytracing
   _ Material definition

2. **Industrialization of VR**

   _ Process integration
   _ Material definition
   _ Server based deployment

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Flexible, scalable and consistent Rendering System

Rasterization & Raytracing

Rendering System
Increasing Complexity

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Shadow Mapping

Pathtracing

Noise Reduction & Sampling Optimization

Offline Shadow Import

Precomputed Radiance Transfer

Ambient Occlusion

Lightmaps

OpenGL Renderer +

LOD Generation Tool

OpenGL Optimizer

OpenGL Renderer

Based on NVSG

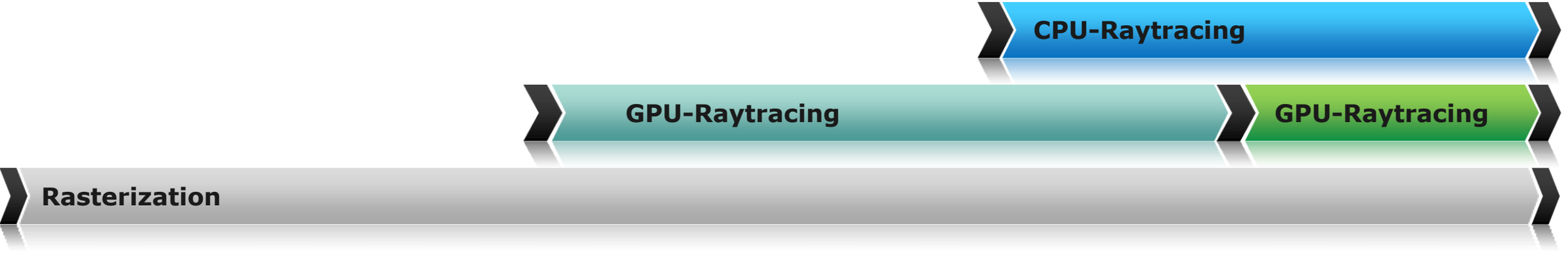
1. Realtime GPU Raytracer

Based on GLSL

Realtime CPU Raytracer

Realtime GPU Raytracer

Based on CUDA



2001 2003 2005 2007 2009 2011

Rendering System

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Rasterization – great in performance but not enough for decision-making

_ Approximations and tricks (SSAO, Shadowmapping, blending modes,...)

→Photorealistic visualization in realtime

Raytracing & GI – new reference

_ Correct visualization – basis for simulation

– Memory and texture handling challenging on GPUs → Hardware flexibility required

→Reliable visualization – but full global illumination still too slow for all use cases

→ Rasterization will stay (at least the next 5 years)

→ Need for Raytracing and GI is increasing

→ Consistent rendering system a must


ec145
eurocopter
Open GL


ec145
eurocopter
Ray-Tracing


EC 145
eurocopter
Global Illumination

Consistent System
Physically based Rendering

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Reference = Reality

Rasterization

GPU Raytracing

CPU Raytracing

GPU Global Illumination

CPU Global Illumination

→ Physical world to be the reference to achieve realistic results

→ Reason: Reality is not defined by rendering algorithms or hardware restrictions

Beyond Physics

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Pro physically based rendering...

_ Reliable, photorealistic quality can be achieved with physically based rendering

→ ***Allows for automation and thus acceleration and scaling of the processes***

→ ***Decrease the necessity for user intervention***

But:

– Laws of physics should not restrict the ability to steer rendered images

– Allowing for emotive images and mood adjustments

→ Calls for new, innovative editing metaphors

What we want...

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Realtime light-simulation...

- For any materials (any BSDF, measured, spectral...)
- For any scenarios (indoor, outdoor,...)
- For high resolutions
- For large, complex and dynamic scenes
- Write once – be flexible to run on latest hardware
- Intuitive editing to fullfill marketing & sales needs

Hey, Researchers ....

- New global illumination algorithms highly appreciated
  - But need to be combinable and consistent
  - No need for special solutions with many limitations
- Find ways to enrich physically based rendering

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Flexible, scalable and consistent Rendering System

Material Definition

Material Definition

Real Material

Digital Material

Material Definition
Increasing Complexity

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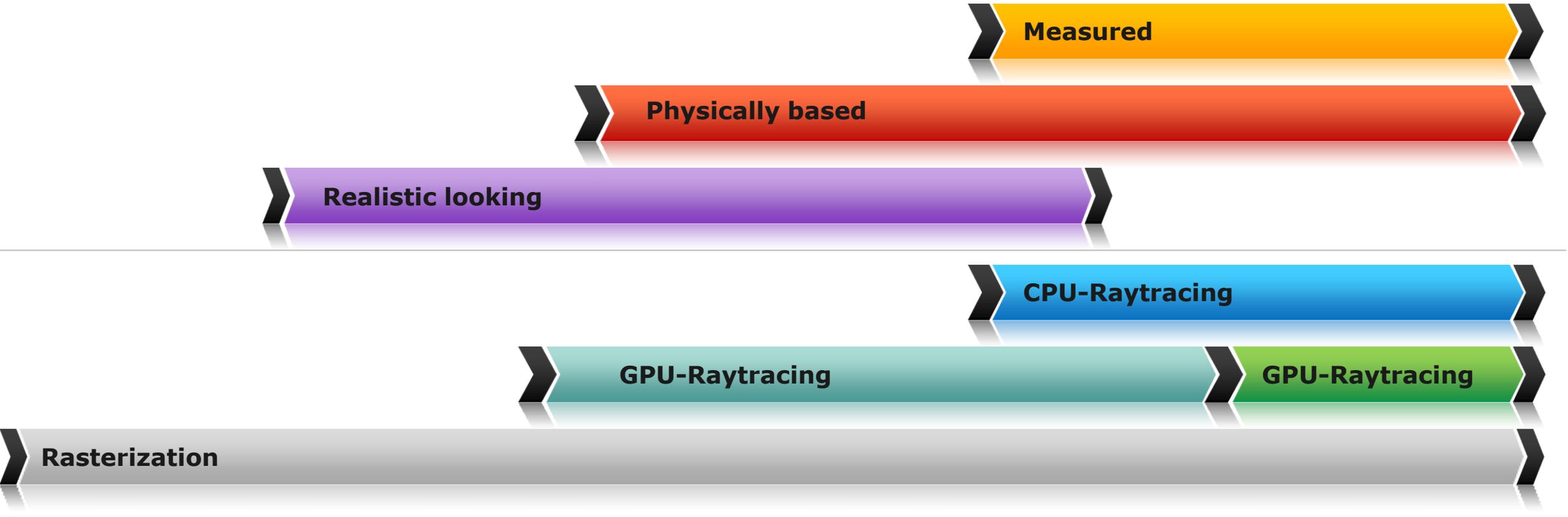
Textures

CgFx-Shader

Unified Uber-Shader

Measured Materials



2001 2003 2005 2007 2009 2011

Material Definition

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A Material should be

- Hardware independent
- Renderer independent

→Can hardly be defined with existing shader languages

→Very accurate representation: measured / captured data

Material Measurement

- Finds it's way into the industry
- Not all material properties can be measured yet
- Exchange of measured data still a challenge

What we want...

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Standardized material definition ...

- That is renderer independent
- That is hardware independent
- For all measurement devices

Hey Researchers...

- We'd love to have a unified and standardized shader language that:
  Generates efficient shaders for any platform
- New measurement devices and methods for sophisticated materials are very welcome
- Standardized formats for materials and measured data (BRDF, BTF, ...)

→ we highly appreciate research in that direction and contribute actively

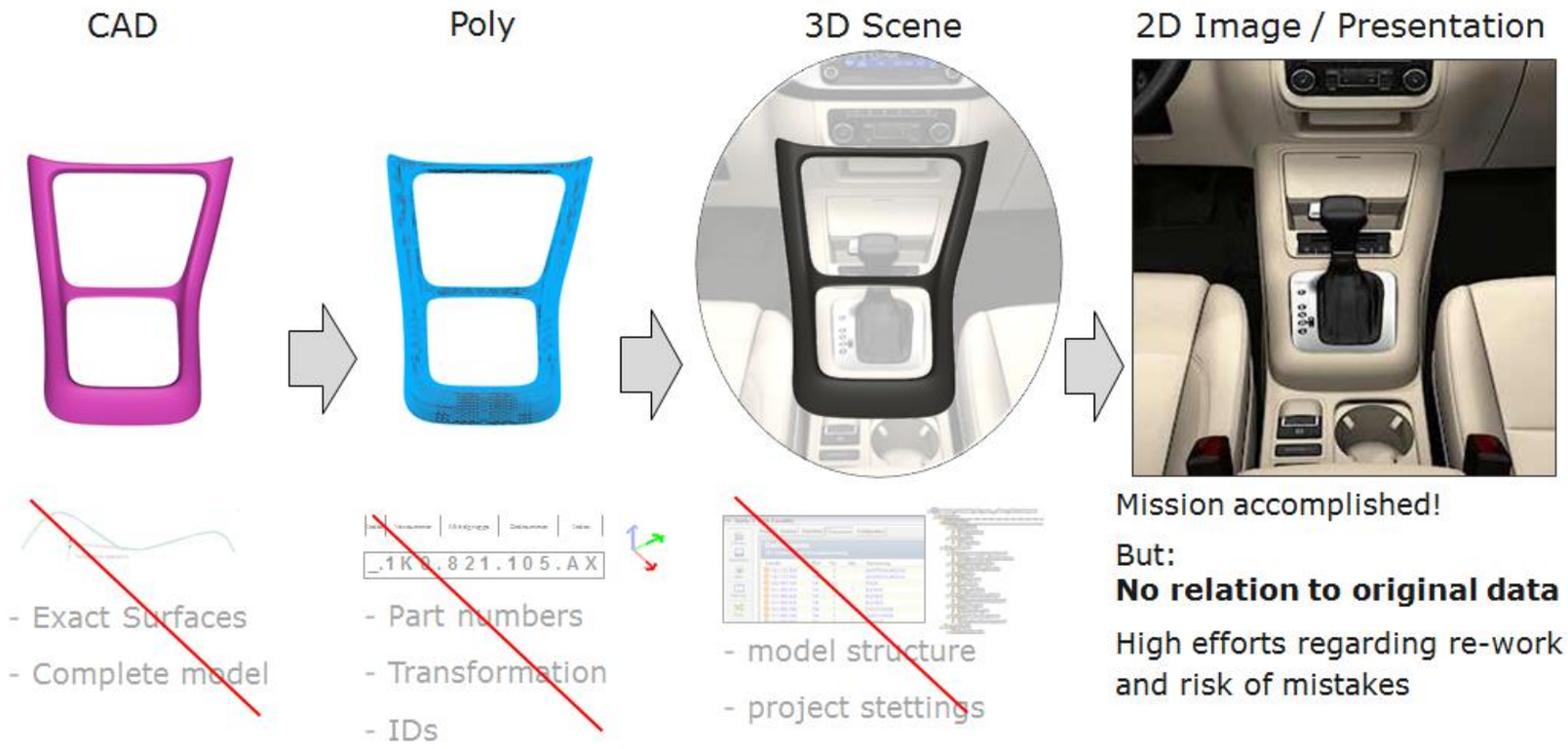
Industrialization of VR

Process Integration

Challenge

Today: Destructive data handling prevents interoperability

_ Currently no interoperability between different tools

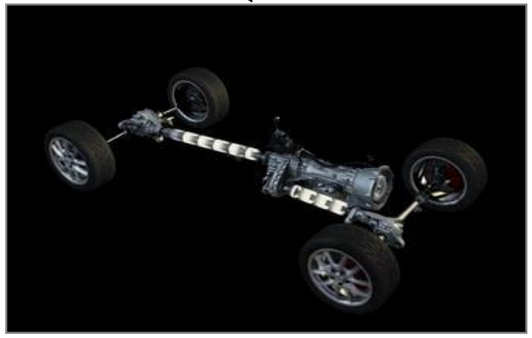


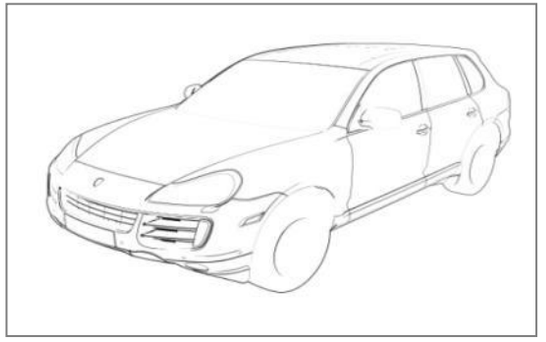
Beyond visualization

Our Goal: reuse and share Assets

- _ Change todays data handling
- _ Define new data models
- _ New scene handling (assembly)
- _ Create asset libraries

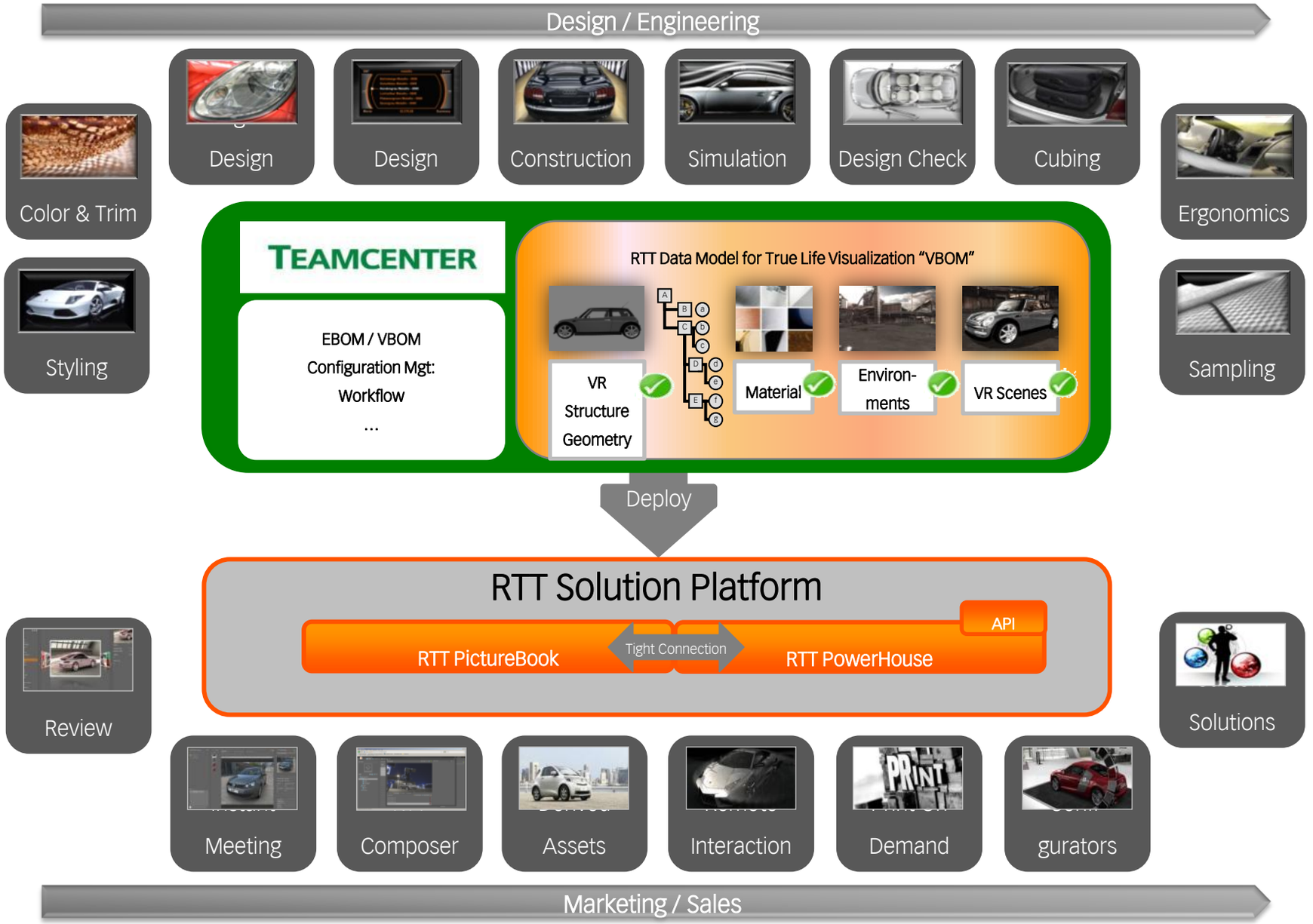
VR Data Pool





Beyond visualization - Integrated Data Model

Visualization Data implemented as TC data model extension



Proposal: Automated Material Mapping via unique ID
Global unique assignment of data (e.g. Materials)

VR Data Pool
Parts (JT-File) managed in PDM System

Reference Material Library
Measured / Captured materials as reference + OpenGL Fallback

Automated material mapping

Automated material mapping

Automated material mapping

SIEMENS PLM SOFTWARE
Quick engineering visualization

RTT
True photo-realistic rendering

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Industrialization of VR

Server based Deployment

Server based approaches

Asset sharing

Entertainment

Collaboration

Online / mobile configurators

Reviews

Global Collaboration

- Confidential, large, complex data
- No standardized data formats yet

Distribution

- Availability / robustness required
- Browser plugins not accepted

Success factors for server based approaches

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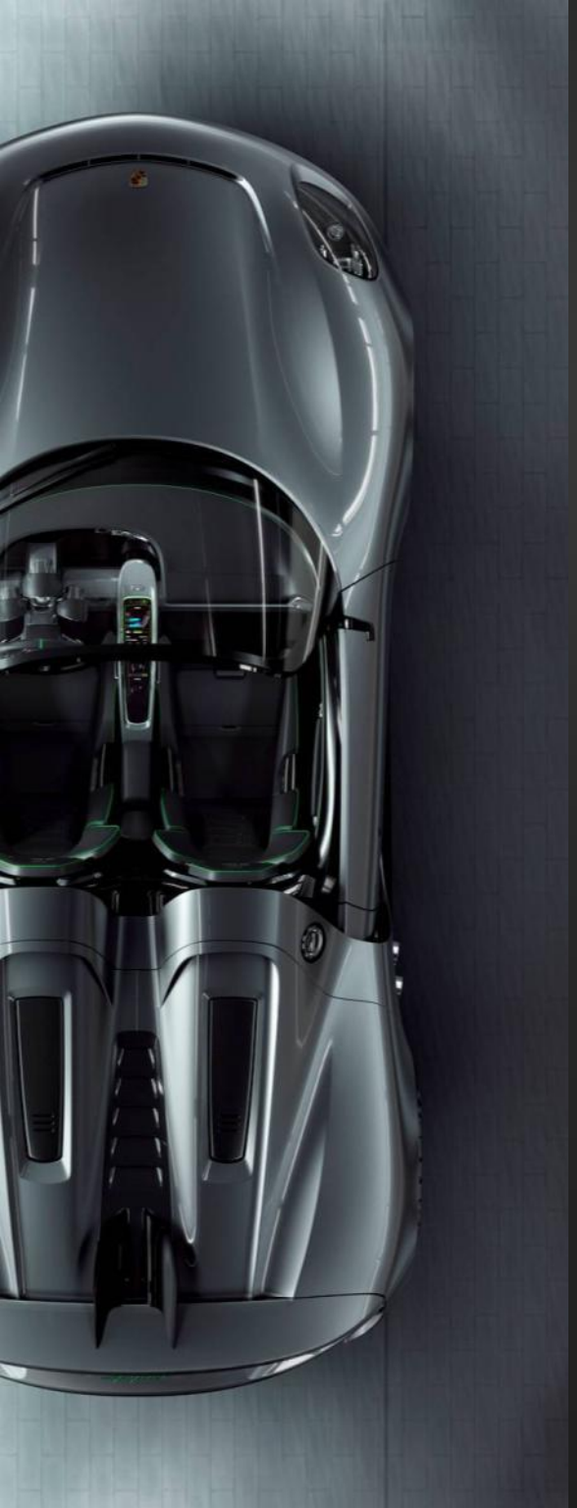
1. Security / trustworthiness
2. Availability / robustness
3. Performance
4. Support for large data sets
5. Quality / no artifacts
6. Negligible administrative effort
7. No browser-plugins
8. Mobility / device independent
9. Standardization

Summary

Summary

- **Reality** is the **reference point** to provide value and reliability over the years
- Boundaries between **visualization** and **simulation** are starting to blur
- There is no „best" hardware solution, thus RTT will have **a flexible answer**
- **Usability concepts** for **artistic enhancements** is a critical success factor
- **Measured materials** find their way into the industry and serve as reference
- For a **full process integration** data management and workflows have to change

→ Enterprise-wide accessibility of VR is on its way



Thank you!

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For any further information, access to presented videos, cooperation or job opportunities please get in touch:

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