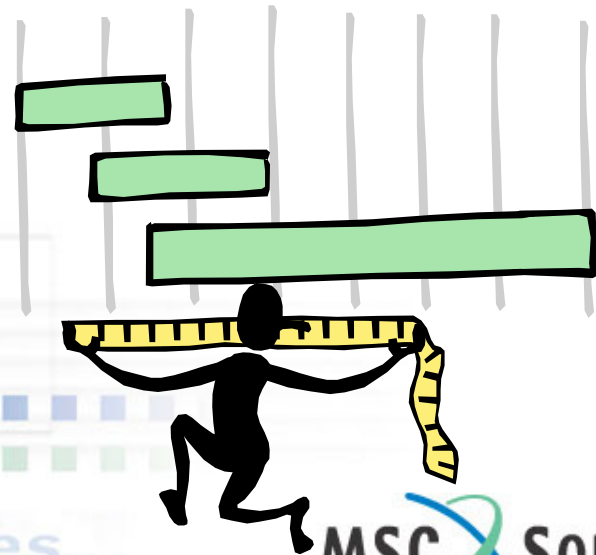


# A Framework to Measure and Improve Your Virtual Prototyping Process

Michael Hoffmann, Brian Cheung, Douglas Peterson



*Software... Systems... Services...*



**MSC SOFTWARE**  
SIMULATING REALITY

# **A Framework to Measure and Improve Your Virtual Prototyping Process**

- Introduction
- The Framework
- Industry Leaders
- Industry Trends
- Improving your Process

# A brief questionnaire

- |   | YES                              | NO                    |
|---|----------------------------------|-----------------------|
| ➤ In manufacturing  |                                  |                       |
| ➤ we constantly benchmark our capabilities                                | <input checked="" type="radio"/> | <input type="radio"/> |
| ➤ we know exactly duration of each assembly task and the associated costs | <input checked="" type="radio"/> | <input type="radio"/> |
| ➤ we have total quality control   | <input checked="" type="radio"/> | <input type="radio"/> |
| ➤ we have established a continuous improvement process                    | <input checked="" type="radio"/> | <input type="radio"/> |

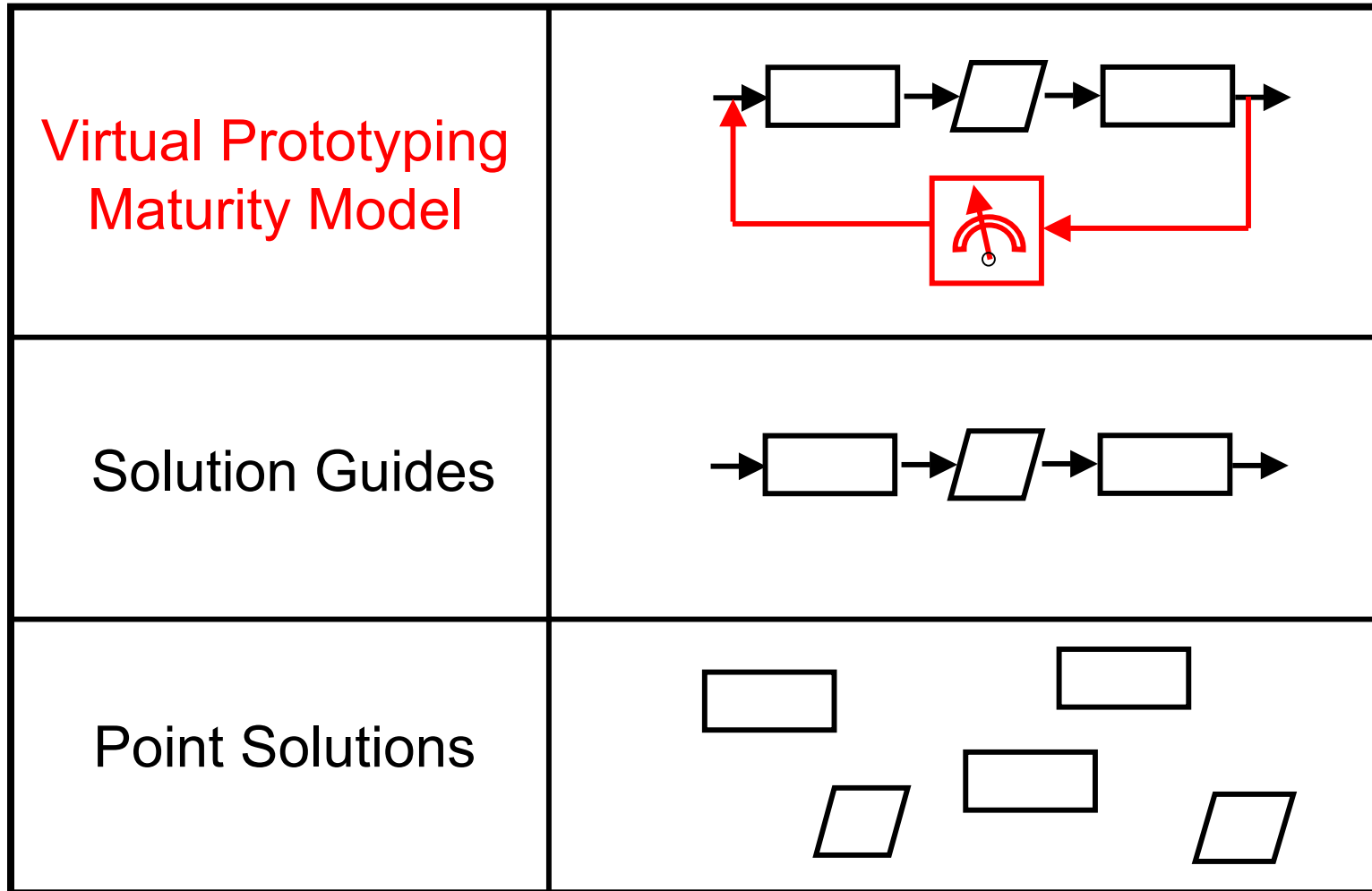
# A brief questionnaire

- |   | YES                   | NO                               |
|---|-----------------------|----------------------------------|
| ➤ In virtual prototyping  |                       |                                  |
| ➤ we constantly benchmark our capabilities                                | <input type="radio"/> | <input checked="" type="radio"/> |
| ➤ we know exactly duration of each modeling task and the associated costs | <input type="radio"/> | <input checked="" type="radio"/> |
| ➤ we have total quality control   | <input type="radio"/> | <input checked="" type="radio"/> |
| ➤ we have established a continuous improvement process                    | <input type="radio"/> | <input checked="" type="radio"/> |

- Virtual Prototyping has become mainstream
  - *Isn't it time that we apply tools for quality control and constant improvement to the Virtual Prototyping Process*

- Customers are asking for an objective way for benchmarking their Virtual Prototyping Process:
  - *„How do you rate our Virtual Prototyping Process compared to industry leaders“*

# From Point Solutions to a Continuous Improvement Process



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# Capability Maturity Model (CMM)

- De facto standard for
  - Assessing, and
  - improving software processes
- Effective means for
  - modeling,
  - defining, and
  - measuring the maturityof the processes used by software professionals.
- Developed by Carnegie Mellon - Software Engineering Institute

# Capability Maturity Model

**Optimizing**

**5**

**Managed**

**4**

**Defined**

**3**

**Repeatable**

**2**

**Initial**

**1**

Reference: <http://www.sei.cmu.edu/cmm/cmm.html>

# Capability Maturity Model

## ➤ Level 1 (Initial)

- *The software process is characterized as **ad hoc**, and occasionally even **chaotic**.*
- *Few processes are defined, and success depends on individual effort and **heroics**.*

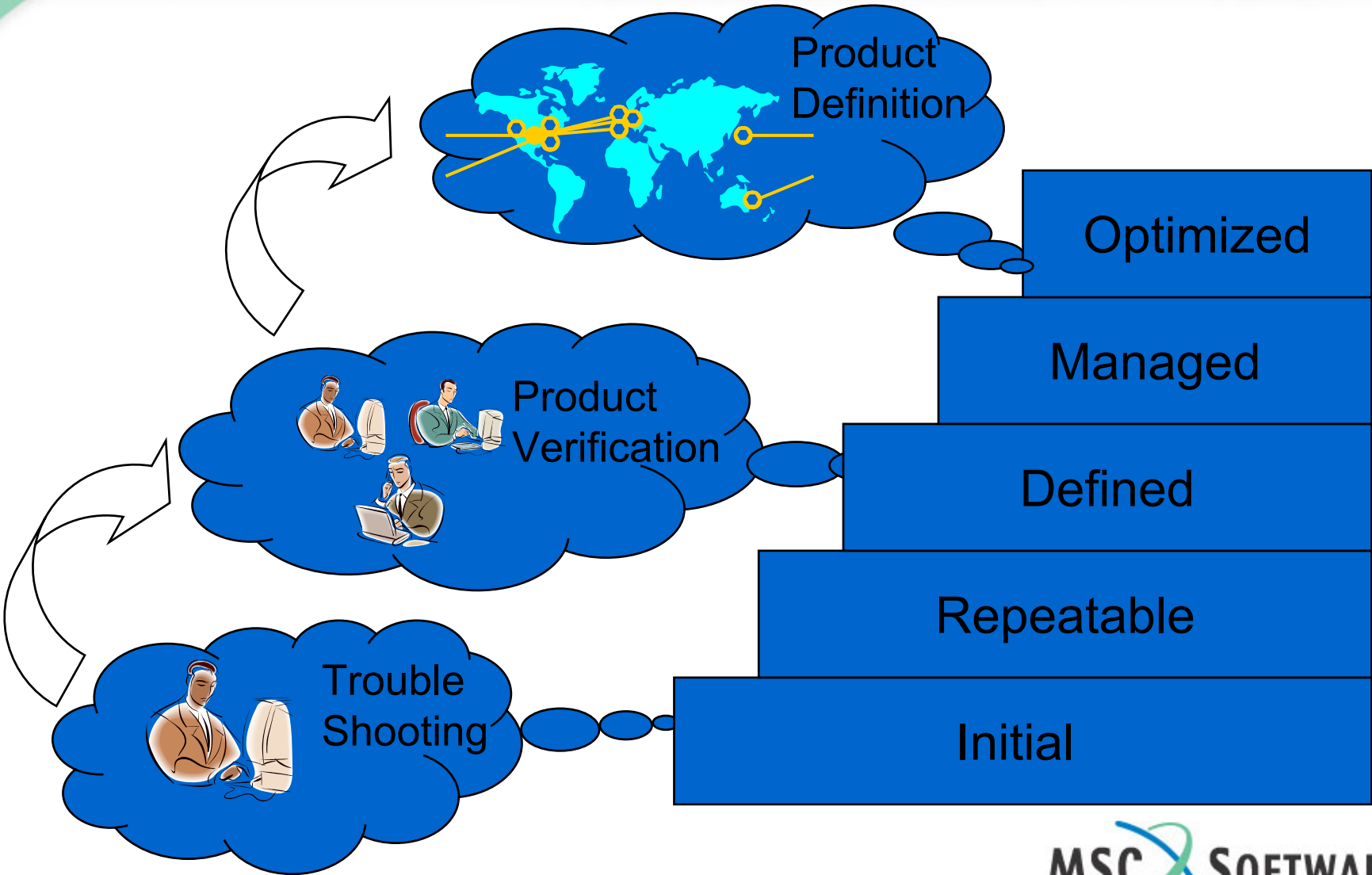
## ➤ Level 5 (Optimizing)

- ***Continuous process improvement** is enabled by*
  - *quantitative feedback from the process and*
  - *from piloting innovative ideas and technologies.*

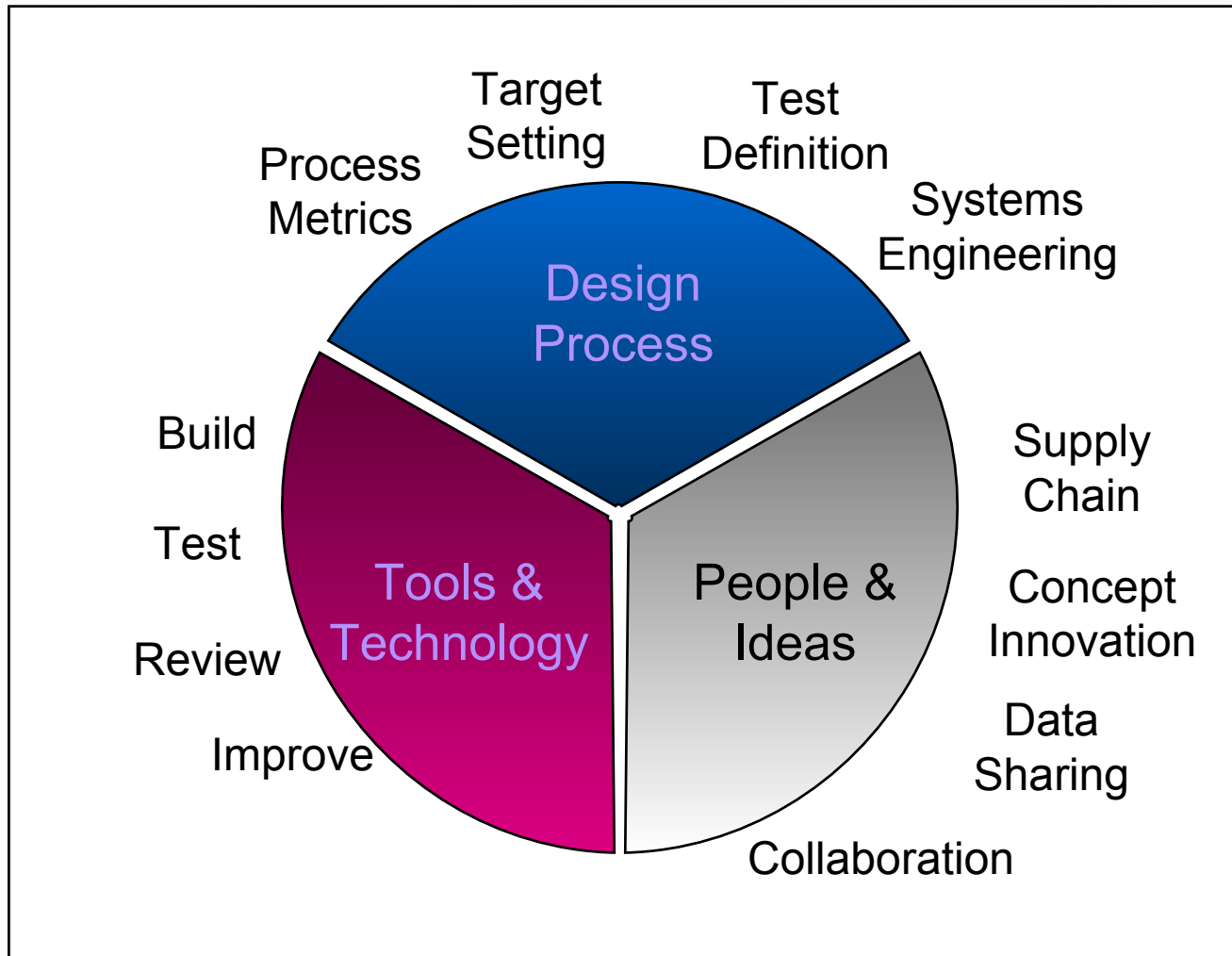
# Virtual Prototyping Maturity Model (VPMM)

- CMM adopted to the Virtual Prototyping Process by MSC.Software
- Effective means for
  - modeling,
  - defining, and
  - measuring the maturity ofthe processes used for virtual prototyping

# VPMM



# VPMM Components



# Level 1: Initial

## Product Troubleshooting

- Few defined processes
- Usage within specific departments
- Analysts typical users
- Data is scarce

# Level 2: Repeatable

## Standardized Testing

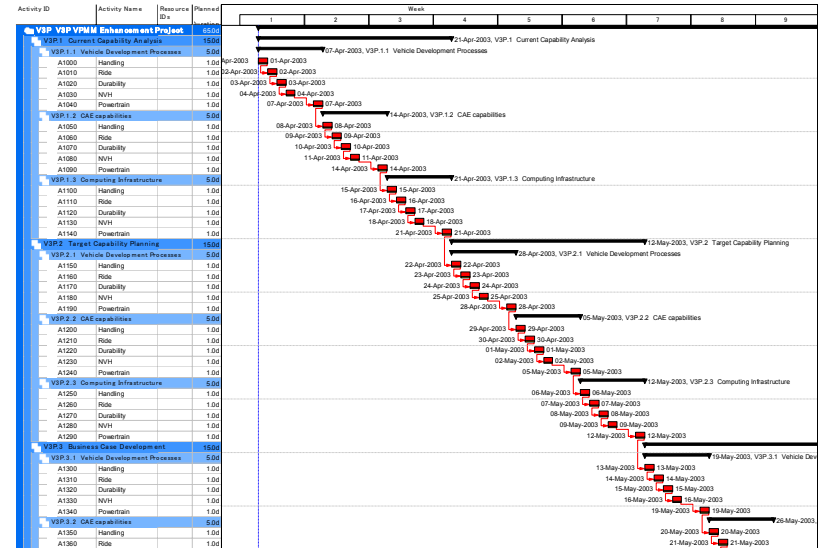
- Basic requirements are tracked
- Usage across divisions
- Analysts and test engineers typical users
- Data is planned



# Level 3: Defined

## Product Validation

- Well documented processes
- Usage across the enterprise
- Analysts, designer and test engineers typical users
- Defined Data Process



## Level 3: Defined

### ➤ Virtual Product Sign-Off

*„If you have not established a Virtual Product Sign-Off, you are not serious about Virtual Prototyping“*

Mike Racicot  
General Motors

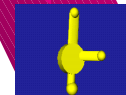
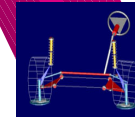
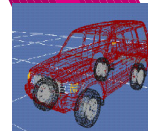
# Level 4: Managed

## Target Cascading

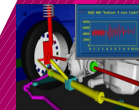
- Process measured and controlled
- Usage across the enterprise and supply chain
- Platform teams are typical users
- Standardized data methods

Design  
Synthesis

Targets



Design  
Validation



Con-  
firmation

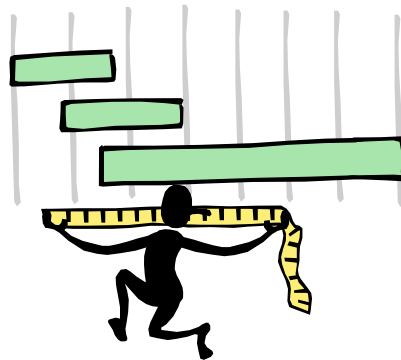
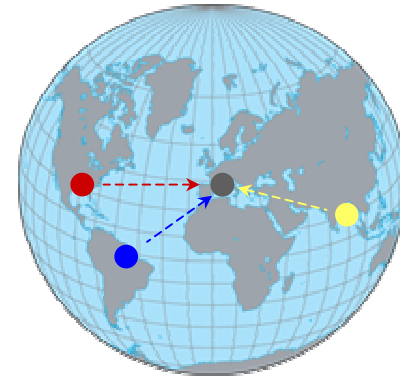
# Level 4: Managed

- Process metrics
  - Accuracy of predictions
    - Directional, relative, absolute
  - Duration to build model
  - Duration to test model
  - Duration to change model
  - Duration to re-test model

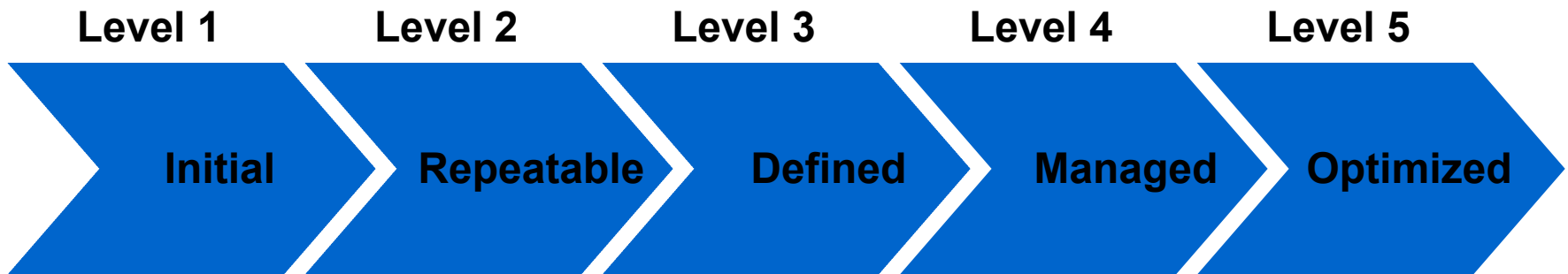
# Level 5: Optimized

## Product Definition

- Continuous process improvement
- Global team
- Platform and suppliers
- Innovation-driven Insight



# Virtual Prototyping Maturity Model

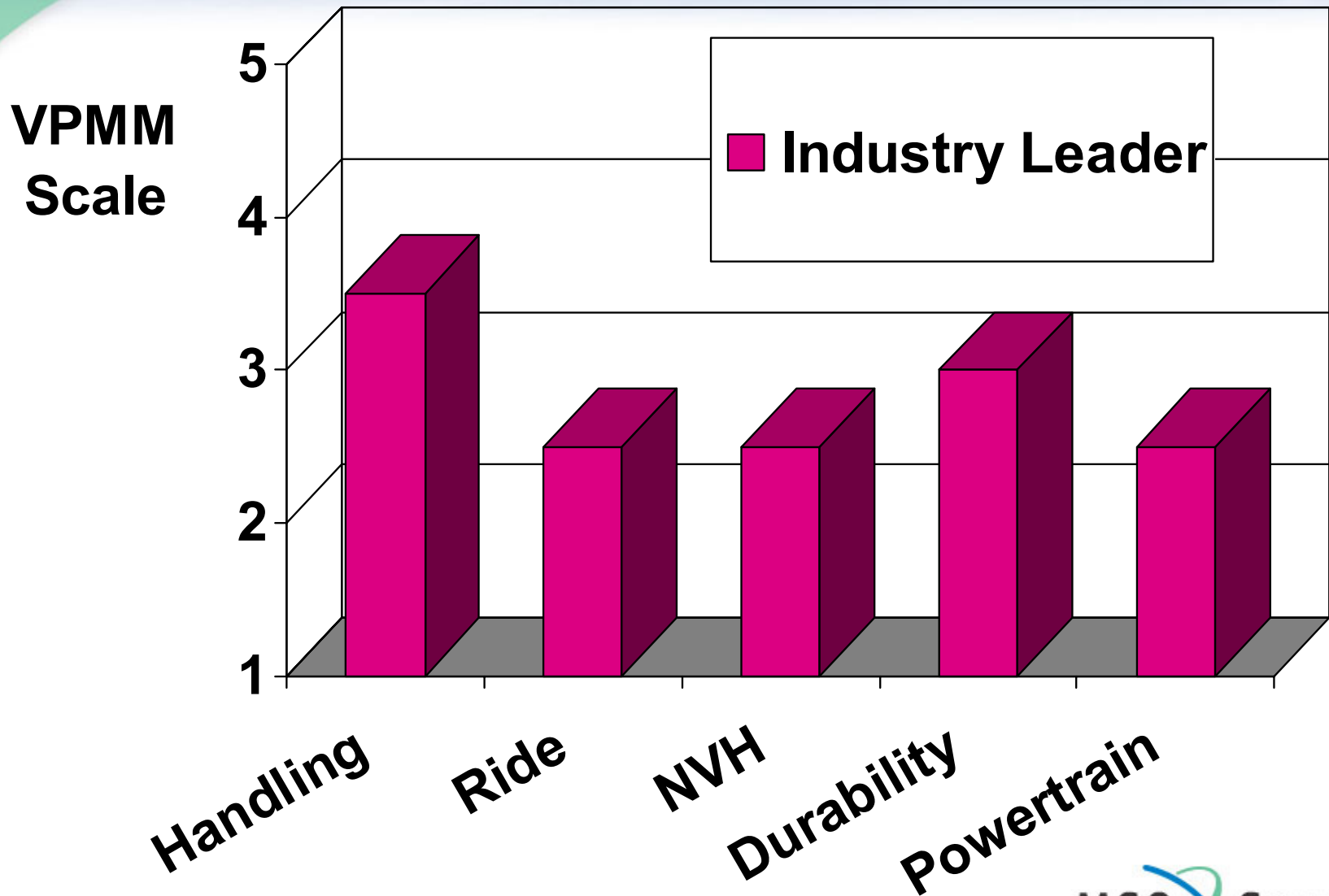


<b>Product Troubleshooting</b>	<b>Standardized Testing</b>	<b>Product Validation</b>	<b>Target Cascading</b>	<b>Product Definition</b>
Few defined processes	Track basic requirements	Well documented processes	Process measured and controlled	Continuous process improvement
Departmental	Divisional	Enterprise	Supply Chain	Global Team
Analysts	Analysts, Test	Design, Anal, Test	Platform Team	Platform, Supplier
Data Scarce	Data Planned	Defined Data Process	Standardized Data Methods	Innovation-driven Insight

# A Framework to Measure and Improve Your Virtual Prototyping Process

- Introduction
- The Framework
- **Industry Leaders**
- Industry Trends
- Improving your Process

# VPMM Assessment





# Industry Leaders

## ➤ Handling

- Require set of full vehicle simulations for design sign-off
- Perform robustness analysis and cascading at least in some areas

## ➤ Ride

- Have a standardized virtual test process
- Require some ride simulations for design sign-off

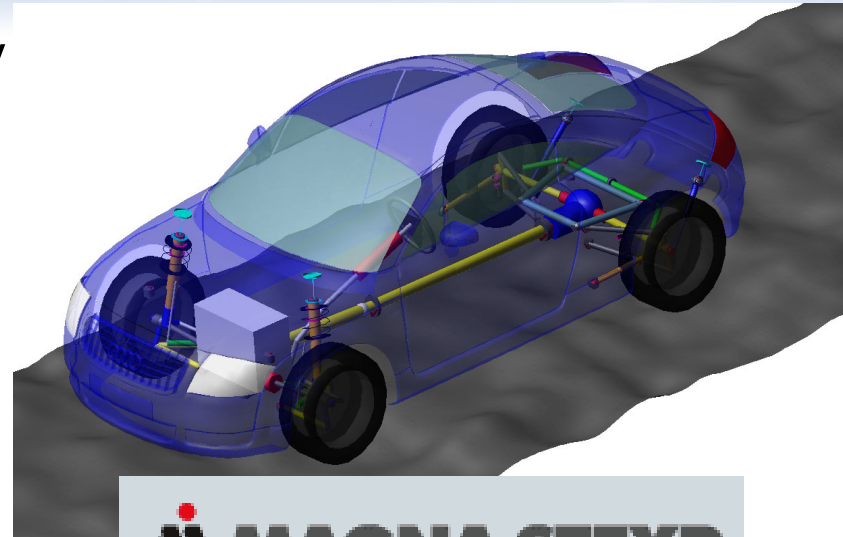
# Case Study: Magna Steyr

**Business:** Magna Steyr, Car assembly and engineering; powertrain components

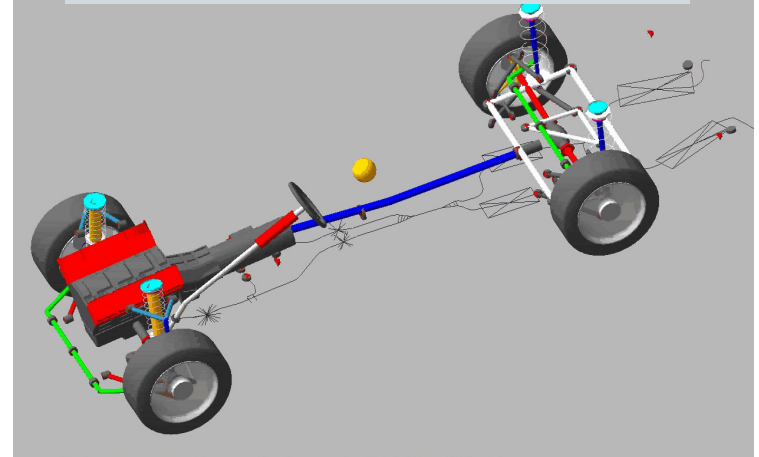
**Challenge:** Different prototypes used for each development step

**Solution:** Modular, template-based ADAMS/Car results in single virtual prototype

**Value:** Using single model results in cost- and time-savings



 **MAGNA STEYR**



*“Magna Steyr uses ADAMS/Car, due to its particular advantages for solving tasks in the areas of:*

- *Elasto-kinematics and vehicle dynamics*
- *Cross-sectional forces as input data for subsequent fatigue life estimation*
- *NVH calculation”*

-- Dr. Anton Riepl  
Magna Steyr

 **MAGNA STEYR**

**MSC SOFTWARE**  
SIMULATING REALITY

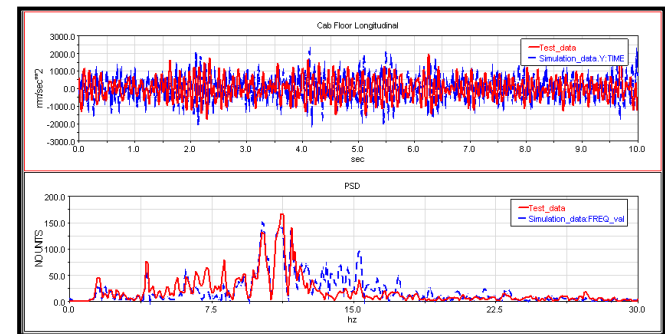
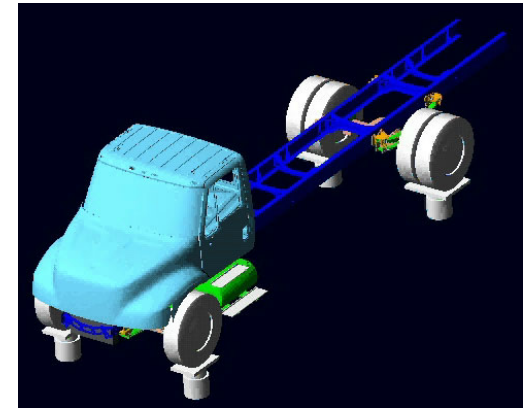
# Case Study: International Truck

**Business:** Worldwide service and parts for heavy- and medium-duty trucks

**Challenge:** Easily evaluate effect of configuration changes on ride quality

**Solution:** Using ADAMS/Car to establish a centralized modeling library for ride quality prediction of new trucks

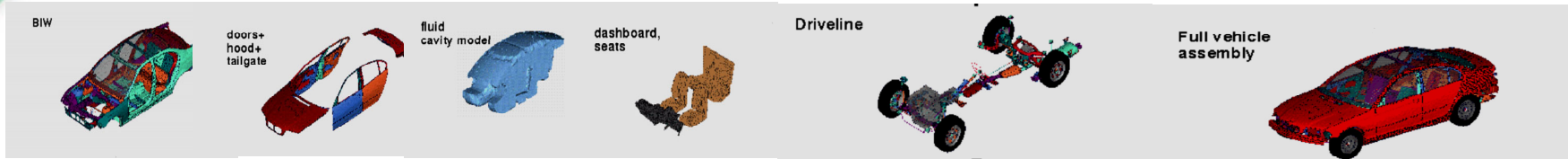
**Value:** Identified efficient configuration changes to optimize ride



*“We can efficiently model a variety of vehicle configurations, accurately simulating the ride dynamics and involving the design community in the analysis process.”*

*-- Dave Anderson  
Sr. Engineering Analyst*

# Case Study: BMW

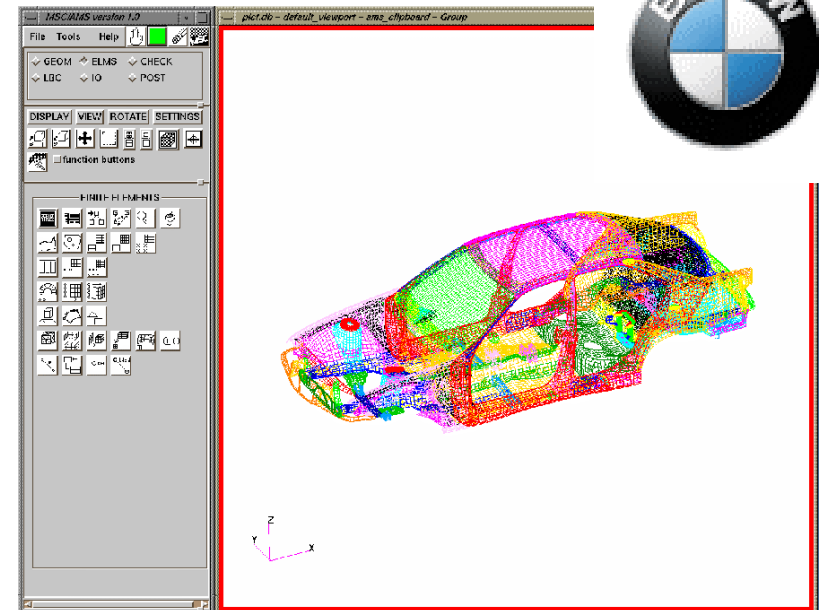


**Business:** BMW, Automotive manufacturer

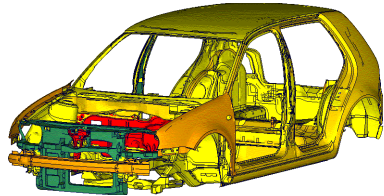
**Challenge:** Full vehicle assembly process takes too long time

**Solution:** Customized system for process automation

**Value:** 5 day process reduced to less than 1 day



# Case Study: Volkswagen



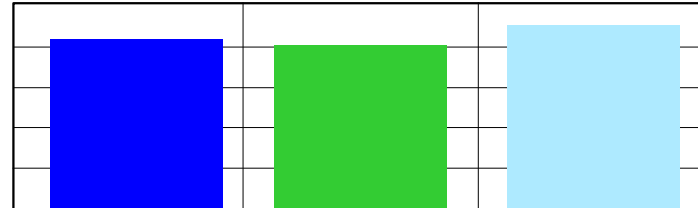
## Body in White Model from VW

- 3.712 CWELD Elements
- 3.562 connecting two parts
- 150 connecting three parts

- Test Result
- Old Spot Weld Modeling VW
- New CWELD Element

Courtesy of VW

## Static Torsional Stiffness

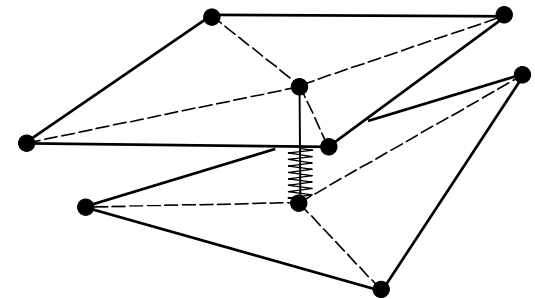


**Business:** Volkswagen, Automotive manufacturer

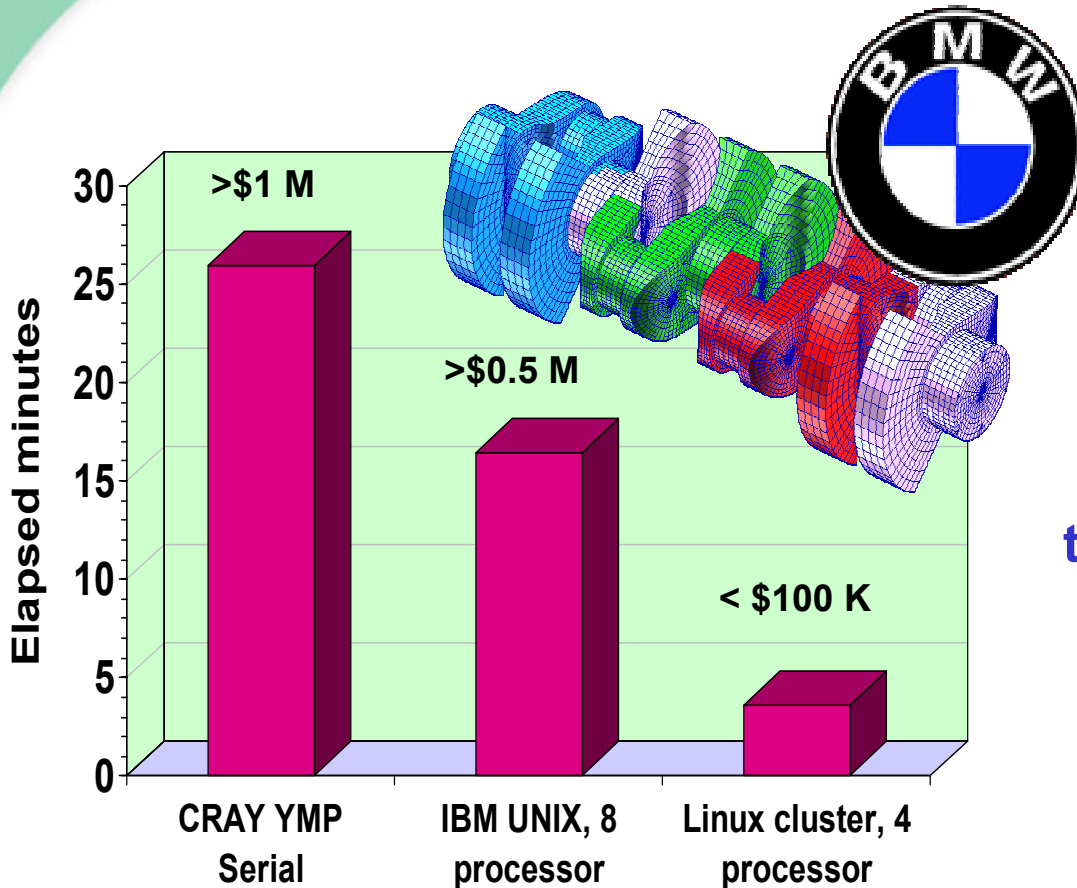
**Challenge:** Point to point connection of parts requires time-consuming re-meshing

**Solution:** Enhance NASTRAN to automatically connect non congruent meshes

**Value:** Overall process reduced by 30%



# Case Study: Compute Systems



**400% performance gain @ 1/3 the cost**

**“I recognized that Linux was the way to go... and that MSC.Software provided a stable, fully supported kernel.”**



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- Improving your Process

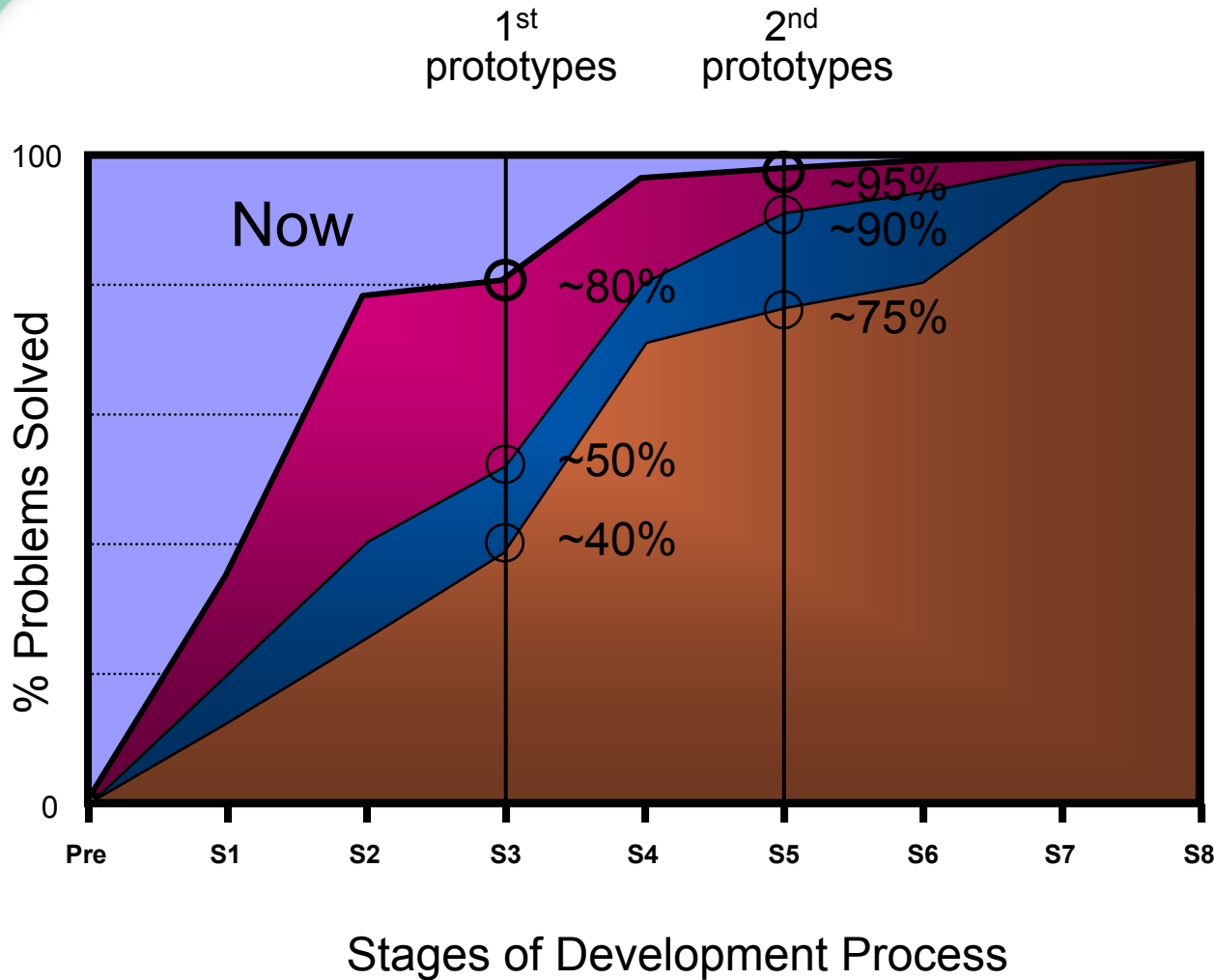
# Industry Trends




- Front-loading Analysis
  - More simulation within the CAD-system
- Design Synthesis
- Single Simulation Data Model



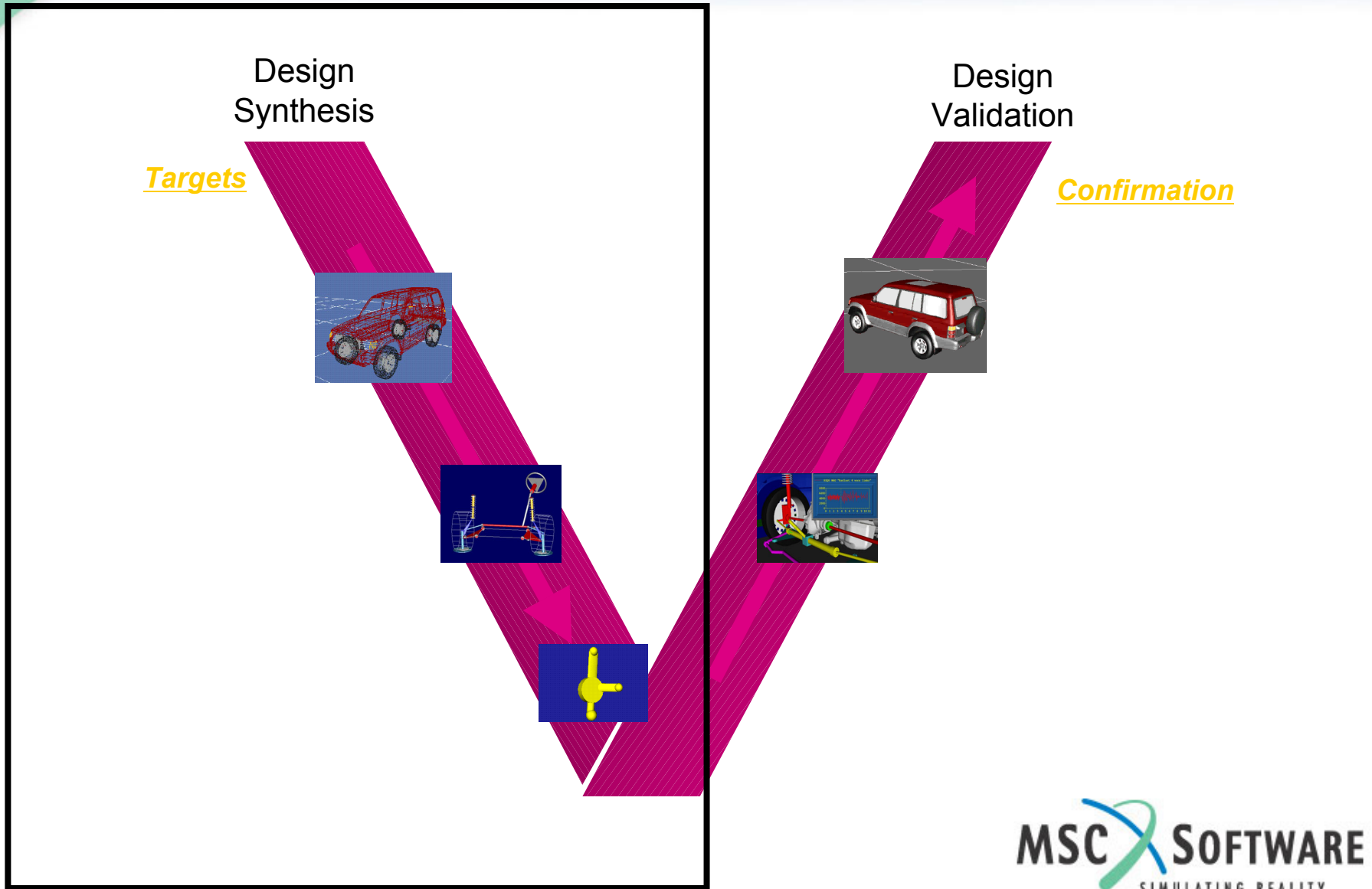
# Front-loading Analysis

Toyota's Front-Loaded Development Initiatives

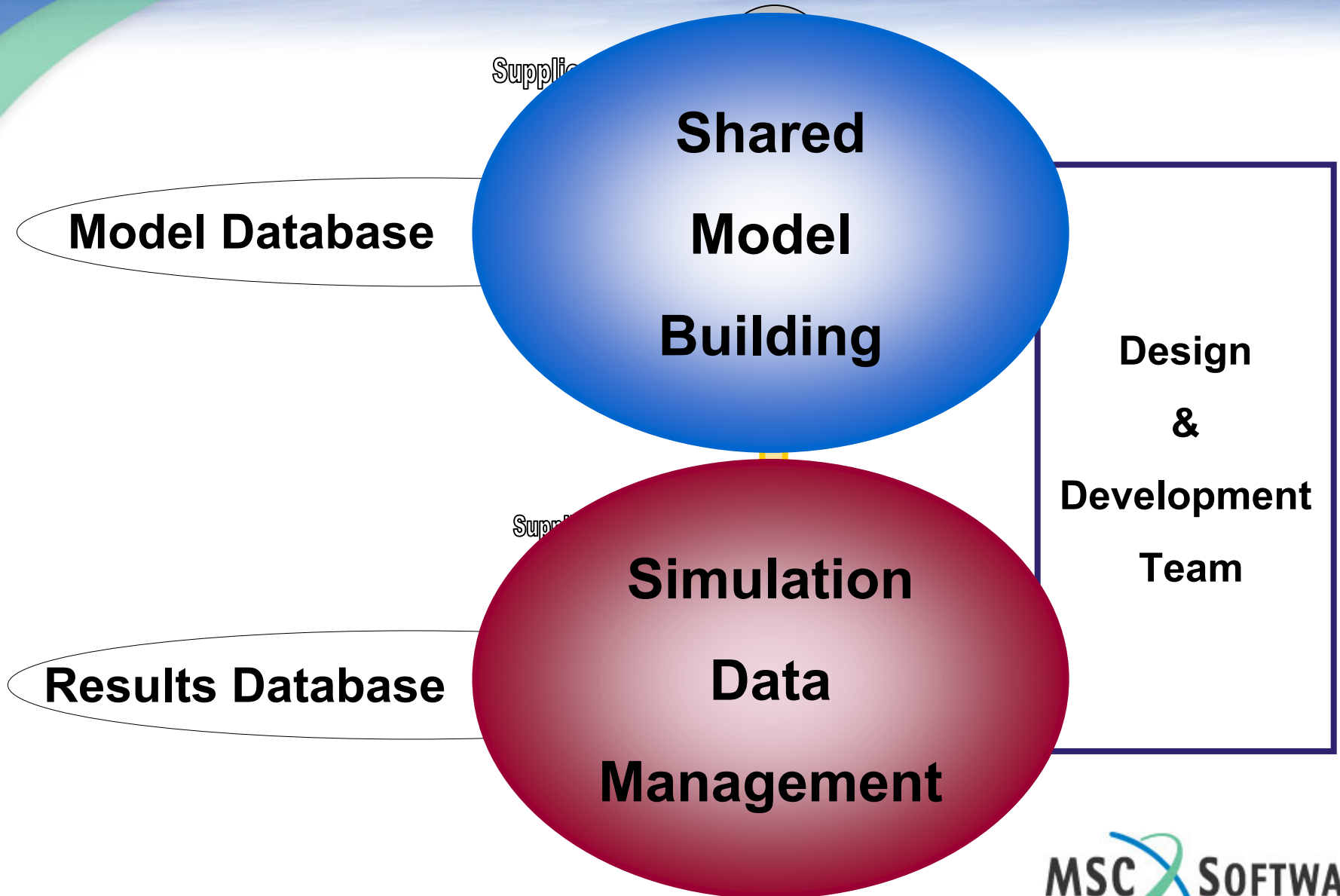


-  = Improved Communication
-  = Use of CAD
-  = Use of CAE

# Design Synthesis

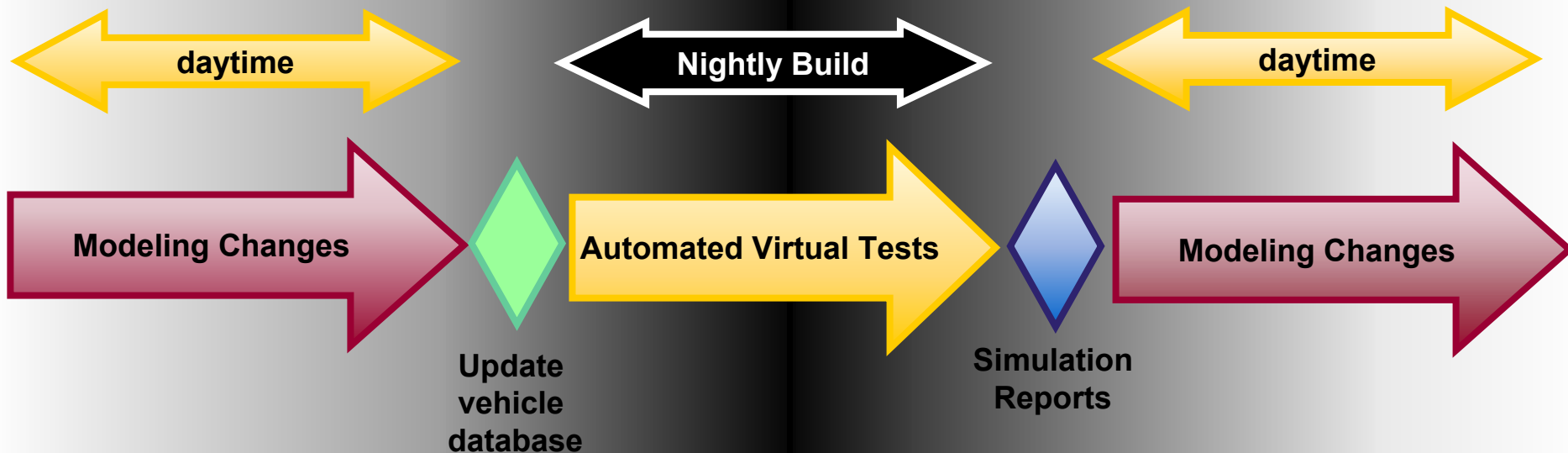


# Single Source Model Building



# Automation Vision

## ➤ Overnight Build



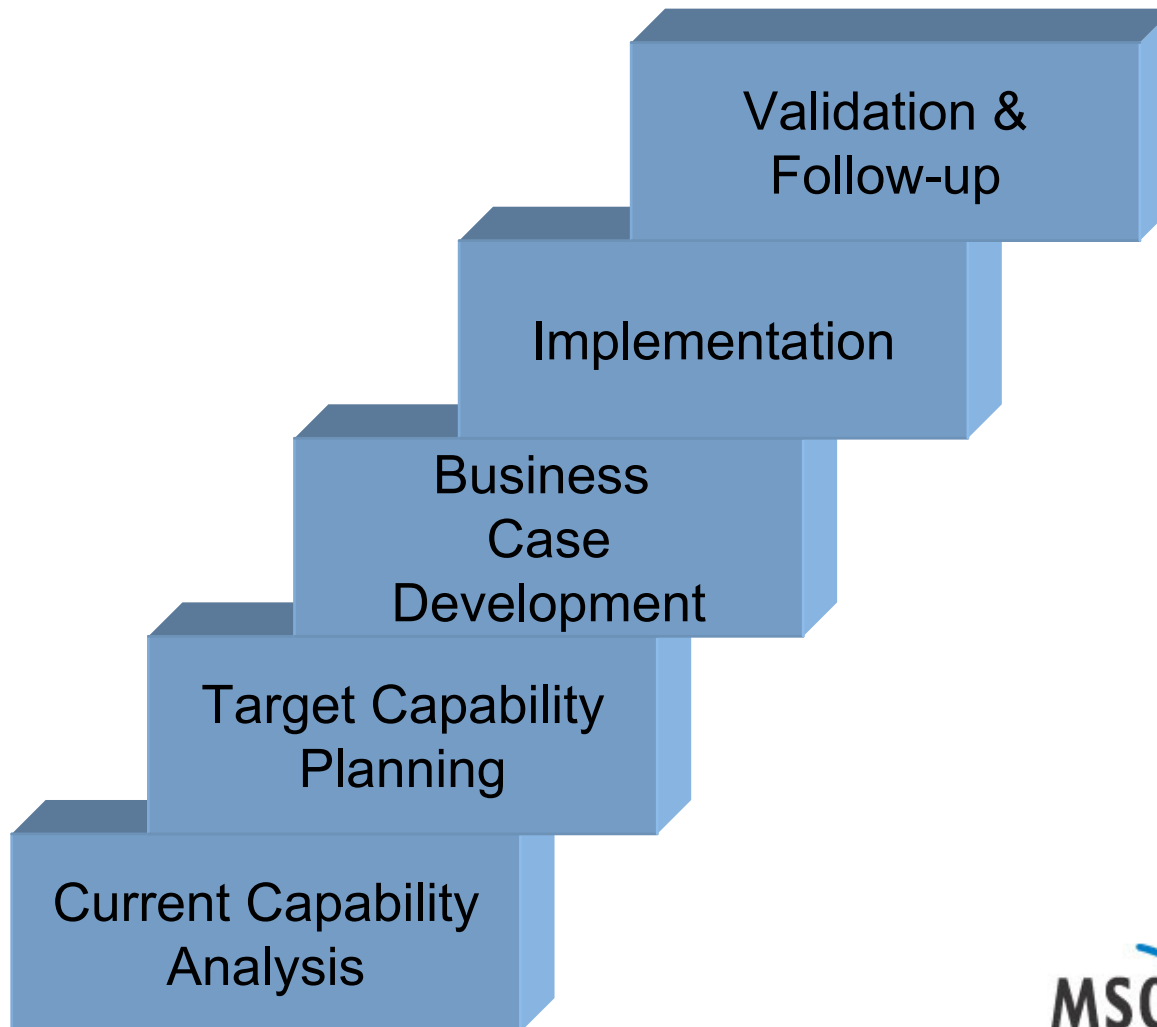
# A Framework to Measure and Improve Your Virtual Prototyping Process

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# Where are you on the VPMM scale?

- If you give a simulation job to 10 engineers in your company, how many different answers will you get?
- Are Virtual Prototyping process metrics available and in use to measure and manage the process? What is your process capability today?
- Is your Virtual Prototyping time spend improving the design?
- Are the Virtual Prototyping goals and the corporate goals closely linked?
- Do warranty problems consistently reoccur on new product models? Do you involve Virtual Prototyping early to avoid this in the future?

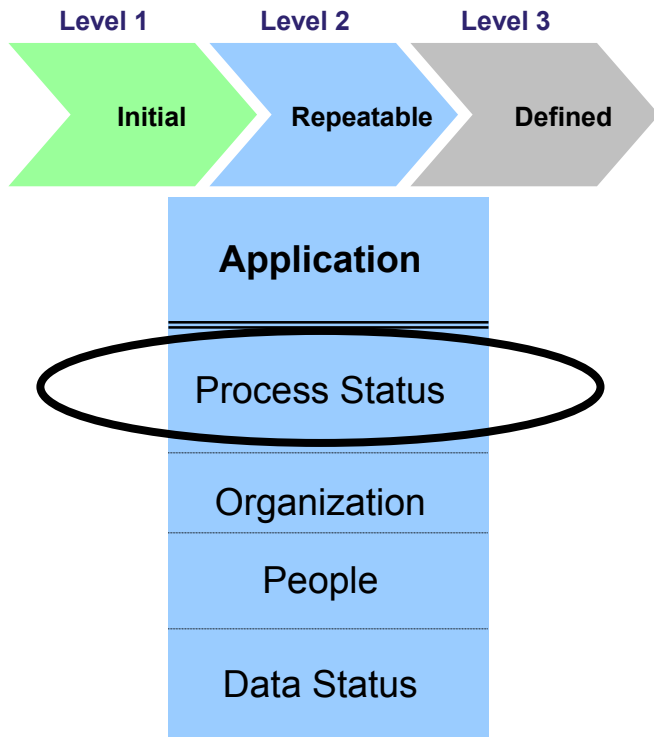
# Deployment Approach



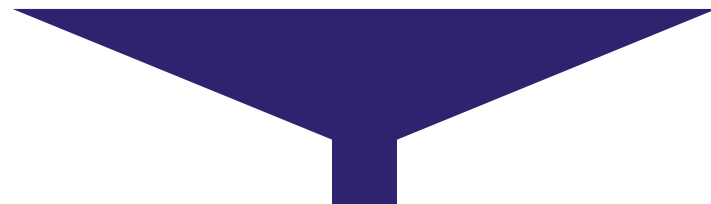
# VPMM Deployment

Current Capability  
Analysis

## ➤ Cascade VPMM metrics



1. Ratio of Virtual Sign off's to Hardware Sign off's
2. Number of Virtual Tests supporting sign off
3. Percent of active vehicle programs using Virtual sign off process
4. ...



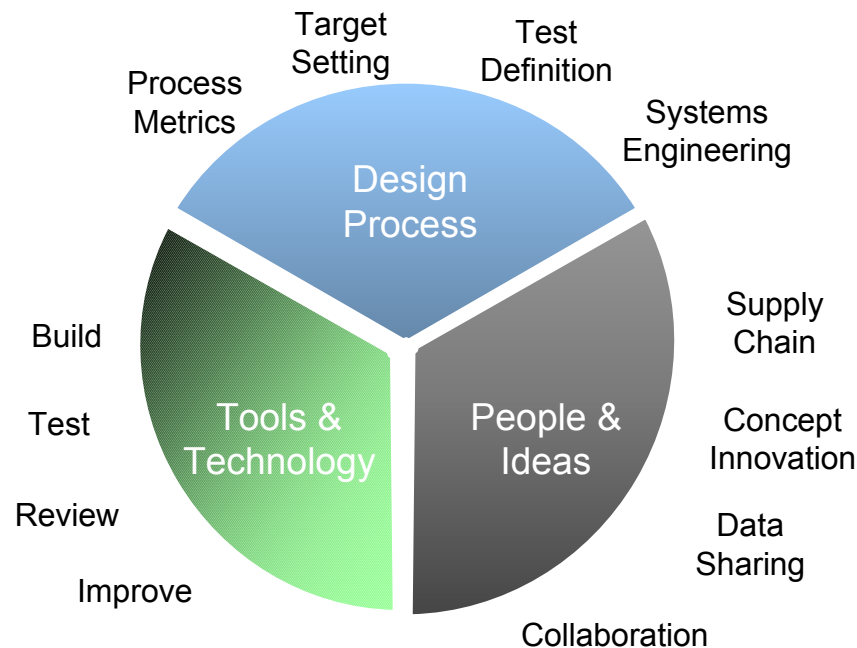
Process Metric



# VPMM Deployment

Current Capability  
Analysis

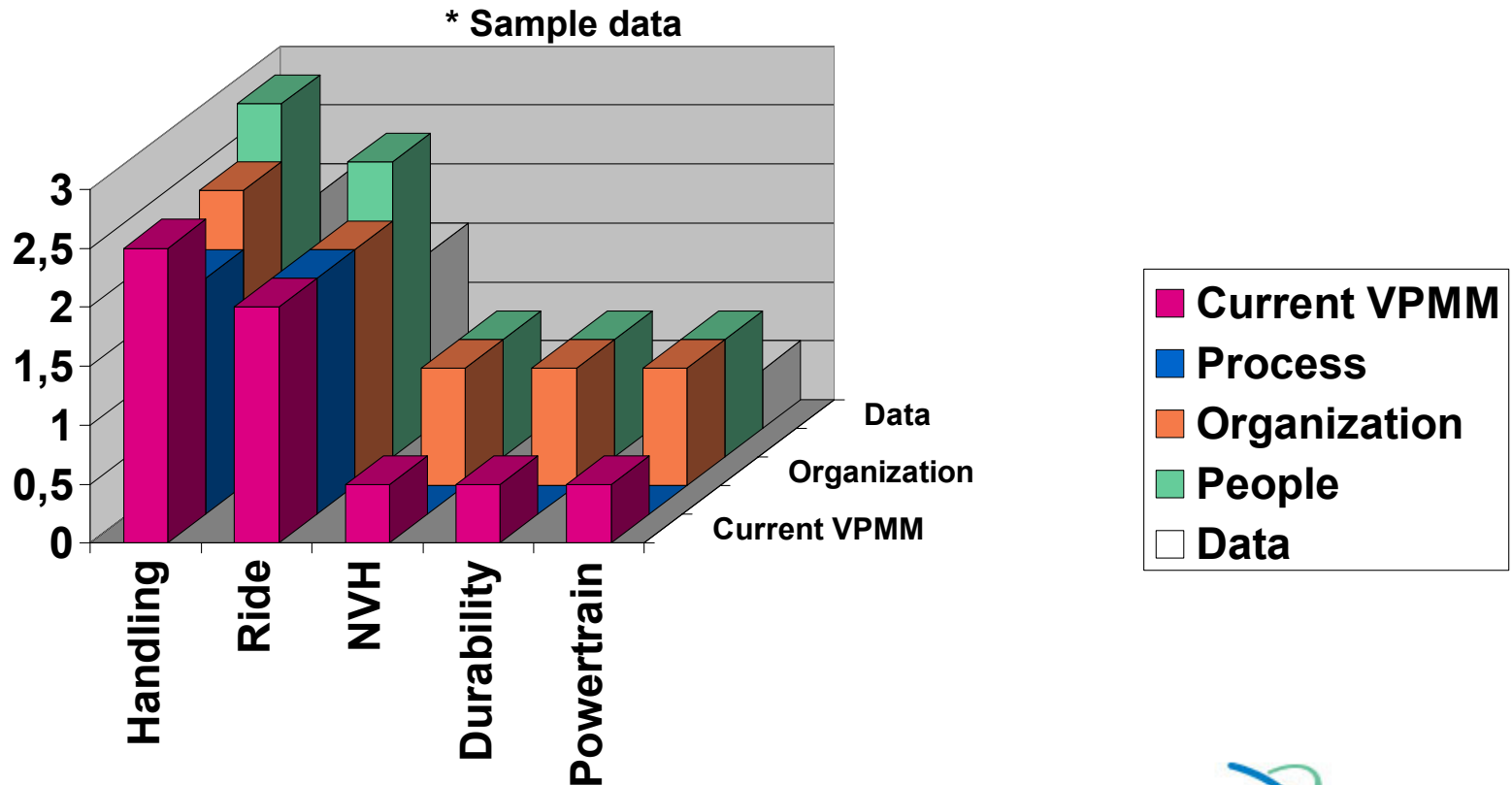
- Survey to
  - Measure metrics
  - Complete understanding of actual processes



# VPMM Deployment

## Current Capability Analysis

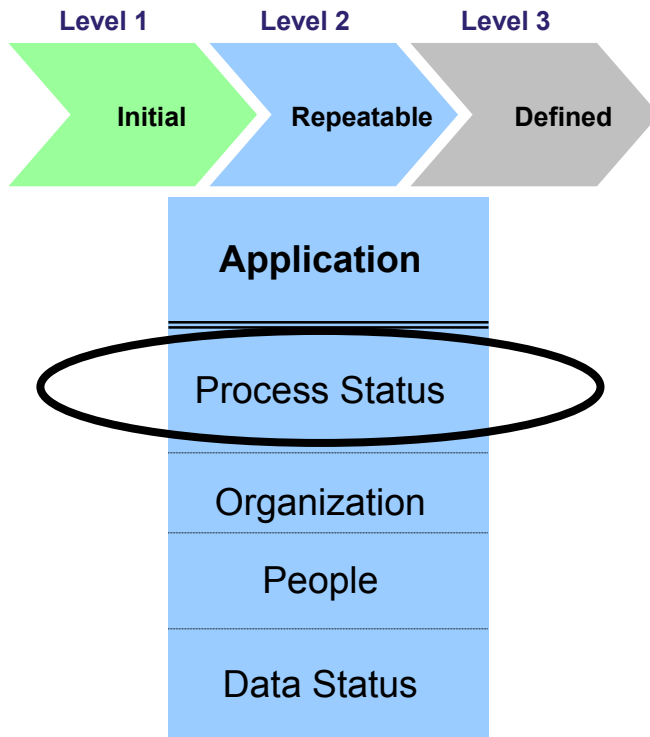
### ➤ Survey detailed metrics



# VPMM Deployment

Target Capability  
Planning

- Determine VPMM improvement opportunities



1. Ratio of Virtual Sign off's of Hardware Sign Off's  
**Create Virtual Sign off process**  
**Develop Additional Virtual Tests**
2. Number of Virtual Tests supporting sign off  
**Commonize Virtual Testing Tools**
3. Percent of active vehicle programs using Virtual sign off process  
**Distribute CAE tools, and train**
4. ...



Process Metric

# VPMM Deployment

Business  
Case  
Development

Develop specific project plans to support VPMM improvements

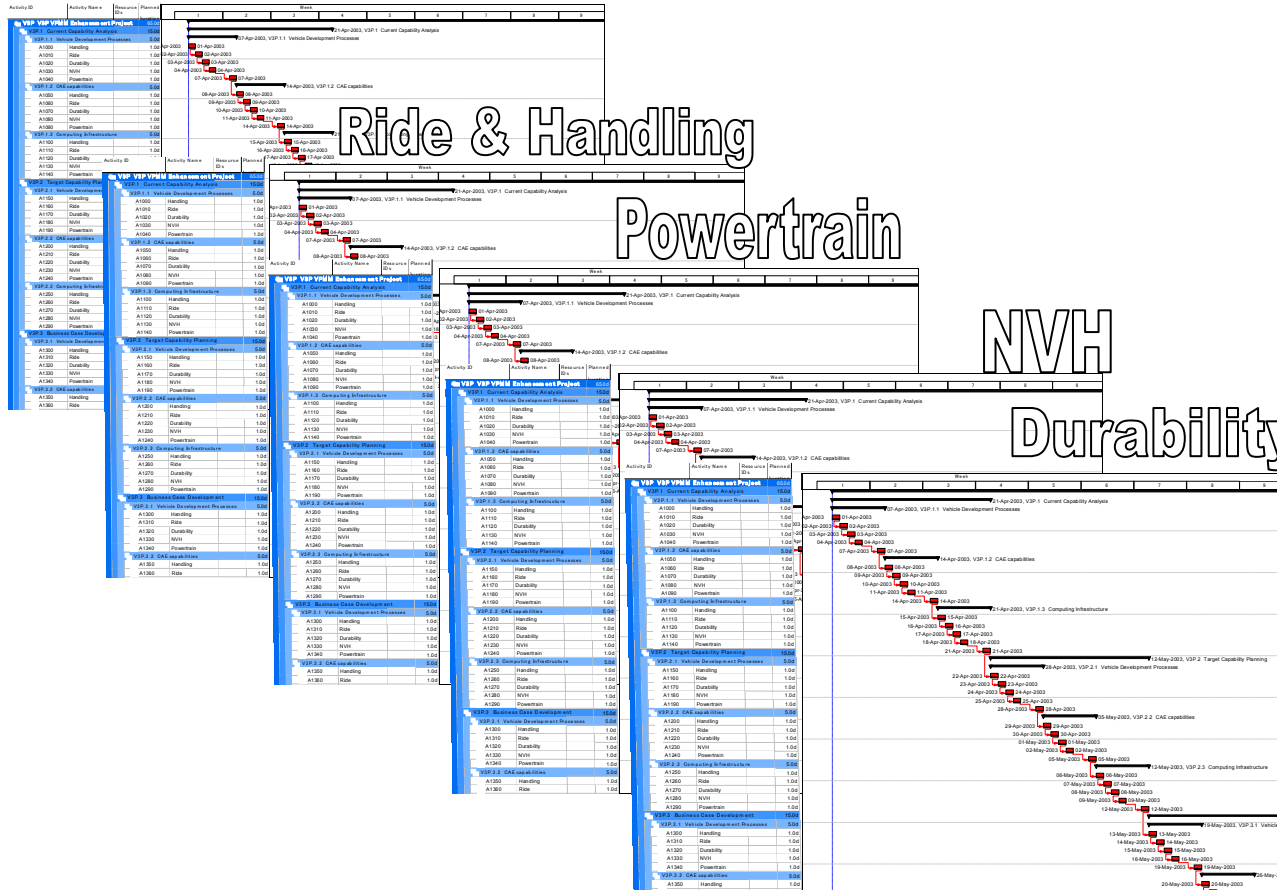
Infrastructure

Ride & Handling

Powertrain

NVH

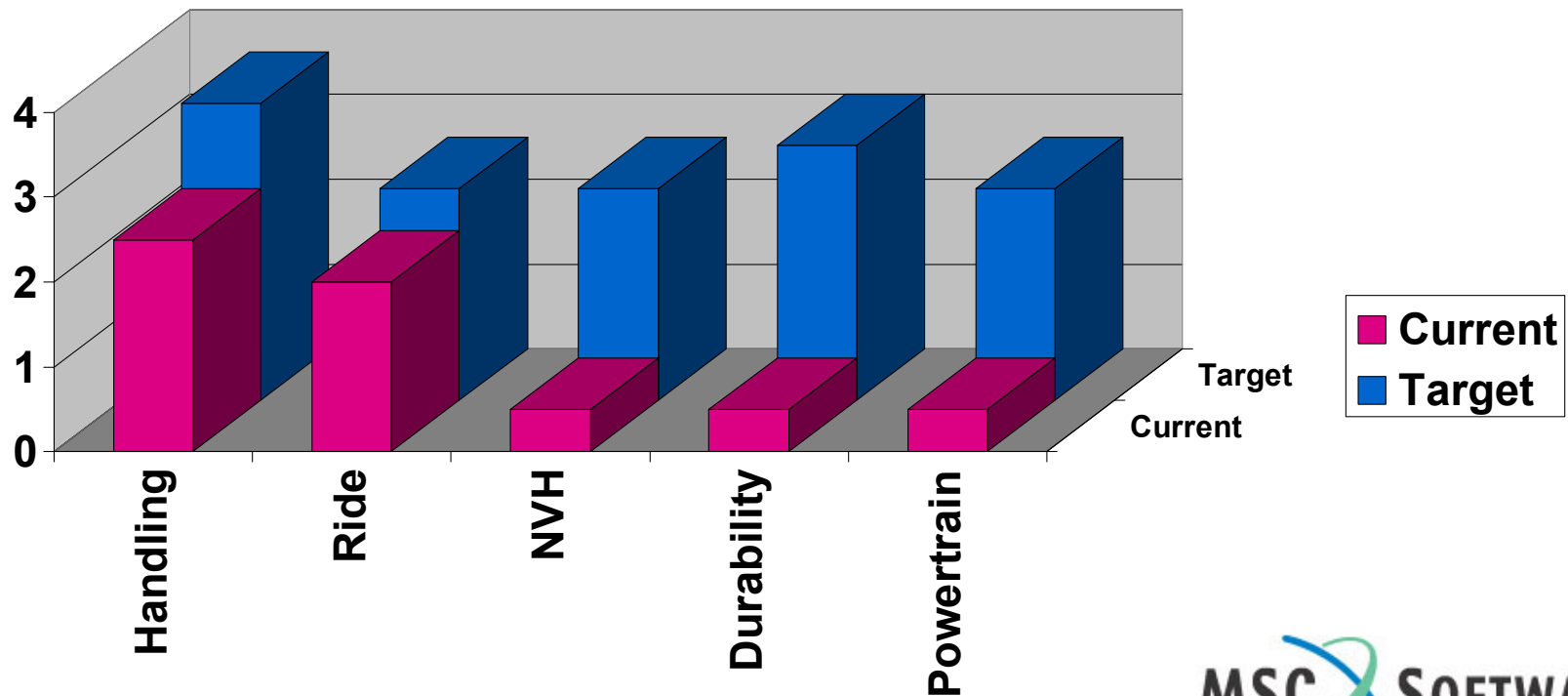
Durability



# VPMM Deployment

Business  
Case  
Development

- Determine potential
  - VPMM improvement and
  - financial benefits



# VPMM Deployment

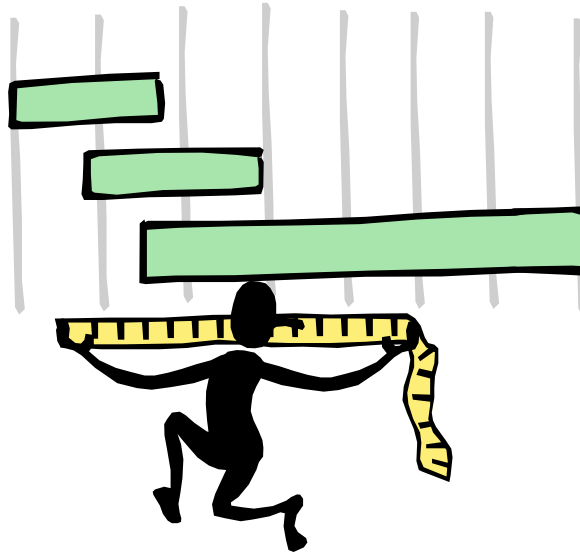
Implementation

- Project Execution

# VPMM Deployment

Validation &  
Follow-up

- Confirm VPMM Metrics
  - Did we achieve the expected VPMM?



# Let's Make Virtual Product Definition a Reality

