

THE MOVE TO VIRTUAL... CHANGING HEARTS & MINDS

AVL

Simulation Meets Testing Conference

Mike Anderson

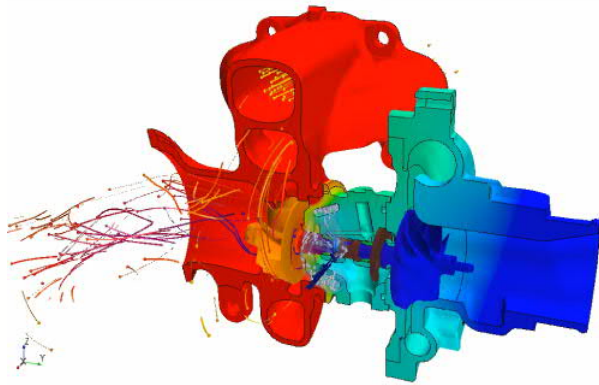
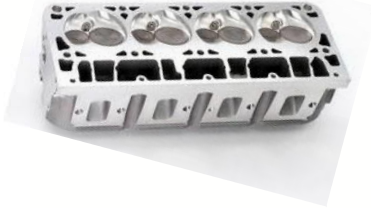
GENERAL MOTORS VDDV

November 5th 2019

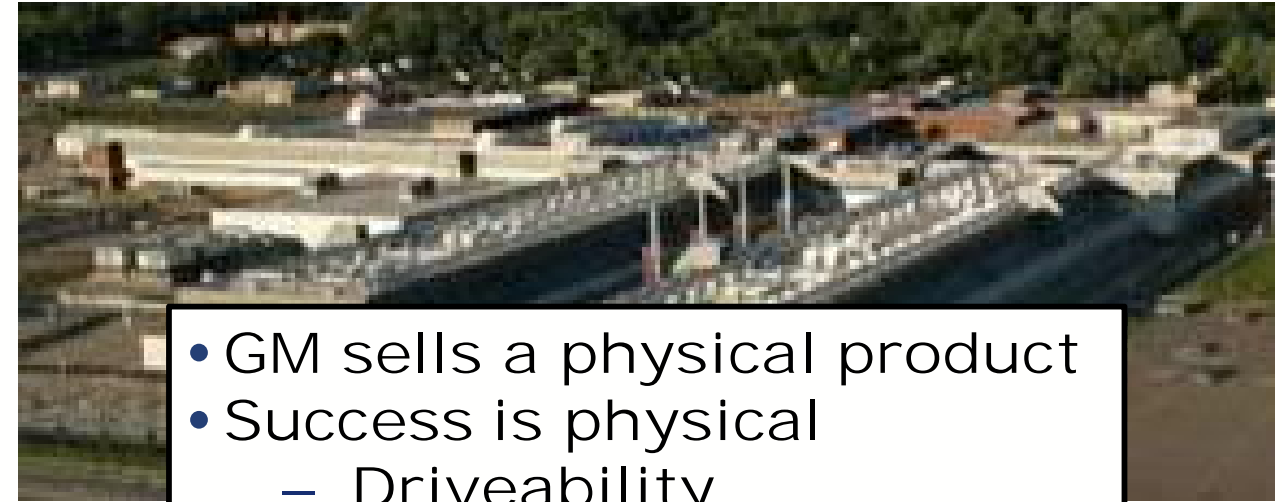
A LITTLE ABOUT ME...

■ 28 years at **GENERAL MOTORS**

■ "Engine Guy"



■ "Grew up in CAE"



- GM sells a physical product
- Success is physical
 - Driveability
 - Performance
 - N&V
- Certification is physical
 - Emissions
 - Fuel economy
 - Safety

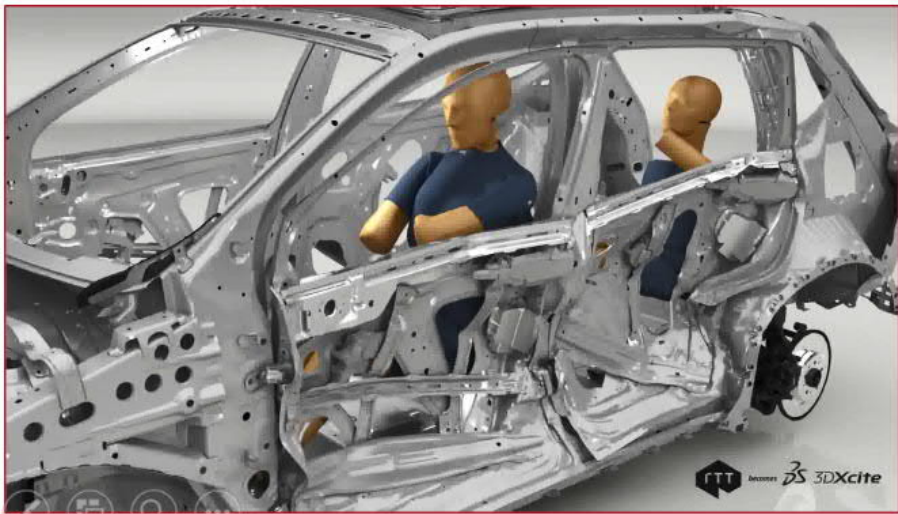
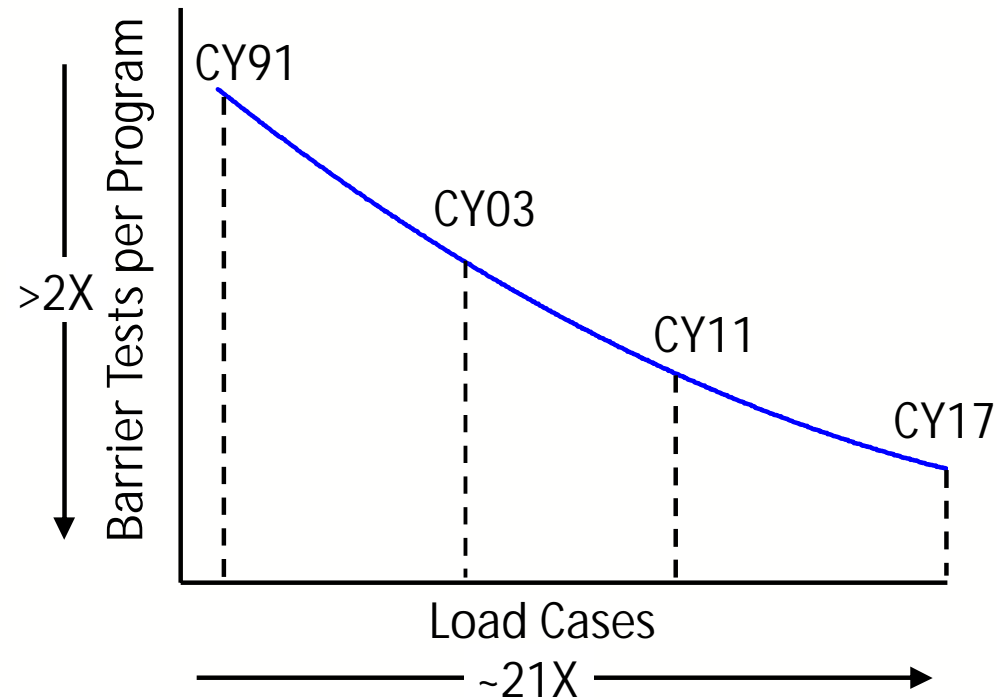


VIRTUAL DESIGN, DEVELOPMENT & VALIDATION

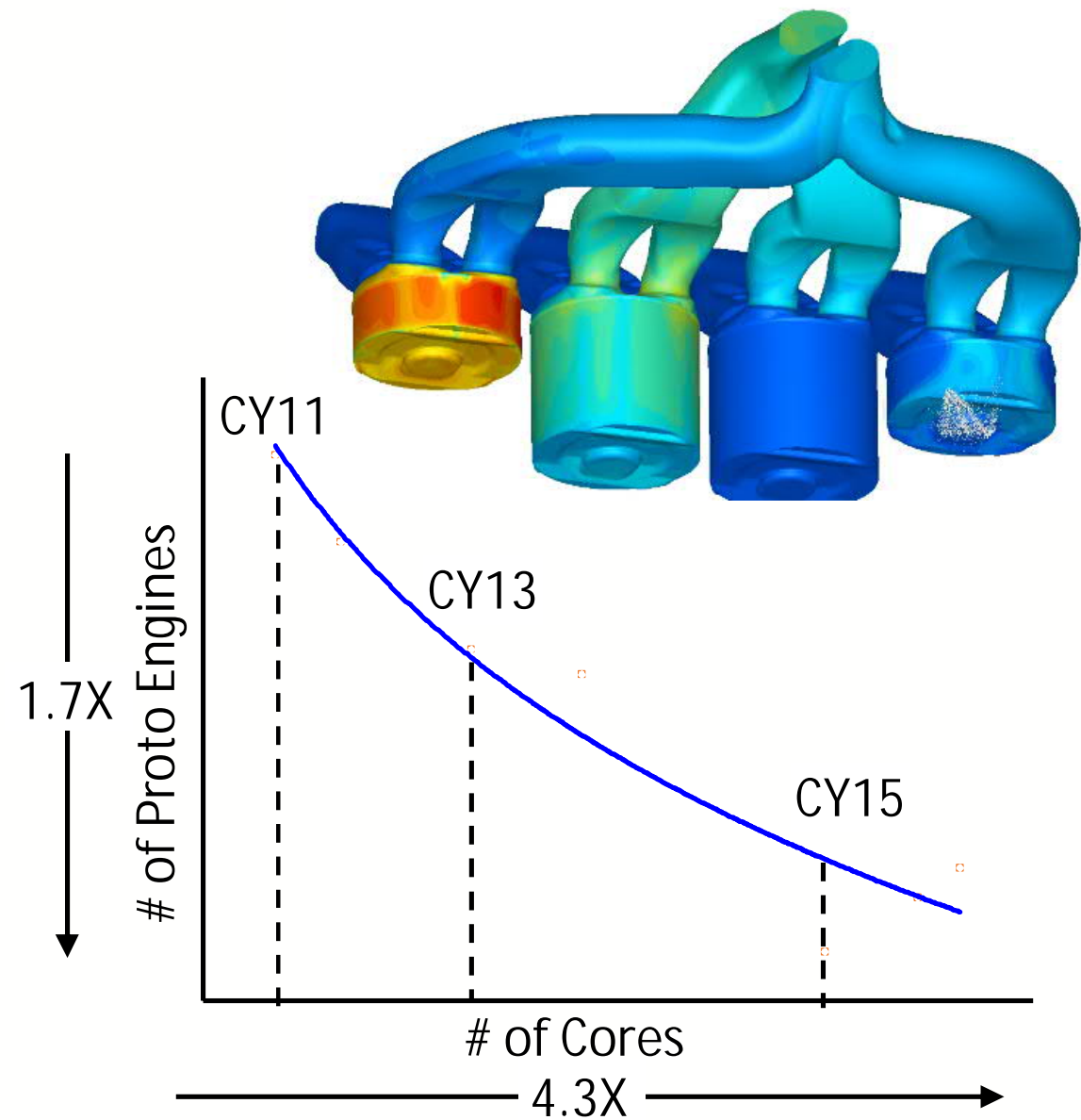
Our name is the vision



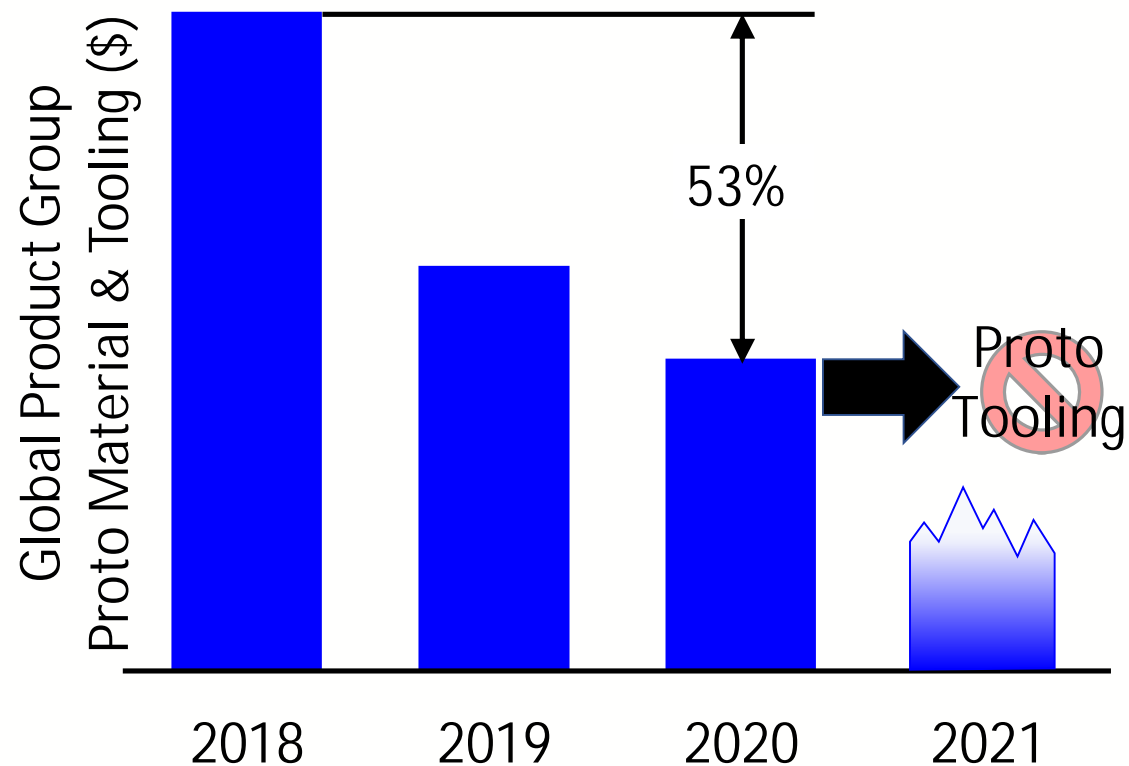
GM HAS BEEN MOVING TO VIRTUAL FOR SOME TIME...



GENERAL MOTORS



GM'S NEED...RAPID STRUCTURAL COST REDUCTION

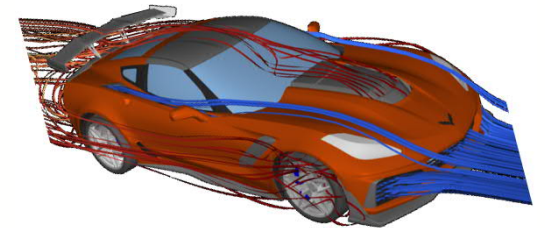


Great progress in 2019

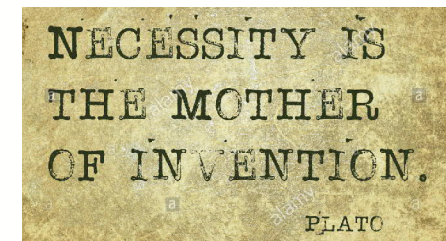
- Reducing/sharing properties
- Thrifting & eliminating tests
- Lower cost properties
- “Wringing the rag”

GENERAL MOTORS

- Some increased reliance on virtual



- Powerful new working connections across the transformed org
- Quick innovations – after all...



BUT...

How do we inspire a viral change that exploits the inherent strengths of virtual engineering to reimagine product development?

- Move left one to two years
- Variation
- Optimization
- Speed

THE MOVE TO VIRTUAL – GM'S CURRENT NARRATIVE

Too much risk...

We don't know what we don't know

CAE missed that on the last one

It's subjective...we need a vehicle to know

The CAE...

- Doesn't correlate
- Is not capable
- Told me it would break after it broke

I don't know the origin of that test – it precedes me...

WHAT HAPPENED ON SEPTEMBER 23rd 1992?

"We have a more fundamental understanding of how these weapons work today than we ever imagined when we were blowing them up"

Bruce Goodwin, LLNL, 2011

- The last nuclear explosion test was conducted by the U.S.
- The U.S. conducted 1032 nuclear tests between 1945 (Trinity) & 1992
 - 22/year on average...

 Lawrence Livermore
National Laboratory



National Nuclear Security Administration

- Stockpile Stewardship Program
- Gave rise to U.S. leadership in supercomputing

GENERAL MOTORS



CHANGING HEARTS & MINDS – A NEW NARRATIVE



✓ Re-brand virtual as lower risk & faster than physical.

➤ It has to be true. It has to be perceived as true.

✓ Risk or discomfort?

✓ Correlation or variation?

✓ Don't chase correlation ghosts.

Risk

✓ Good enough now, not perfect later.

✓ Speed is the value. Reduce the cost of a question.

Speed

✓ Reimagine product development.

➤ Recalibrate to virtual surrogates, not test replication.

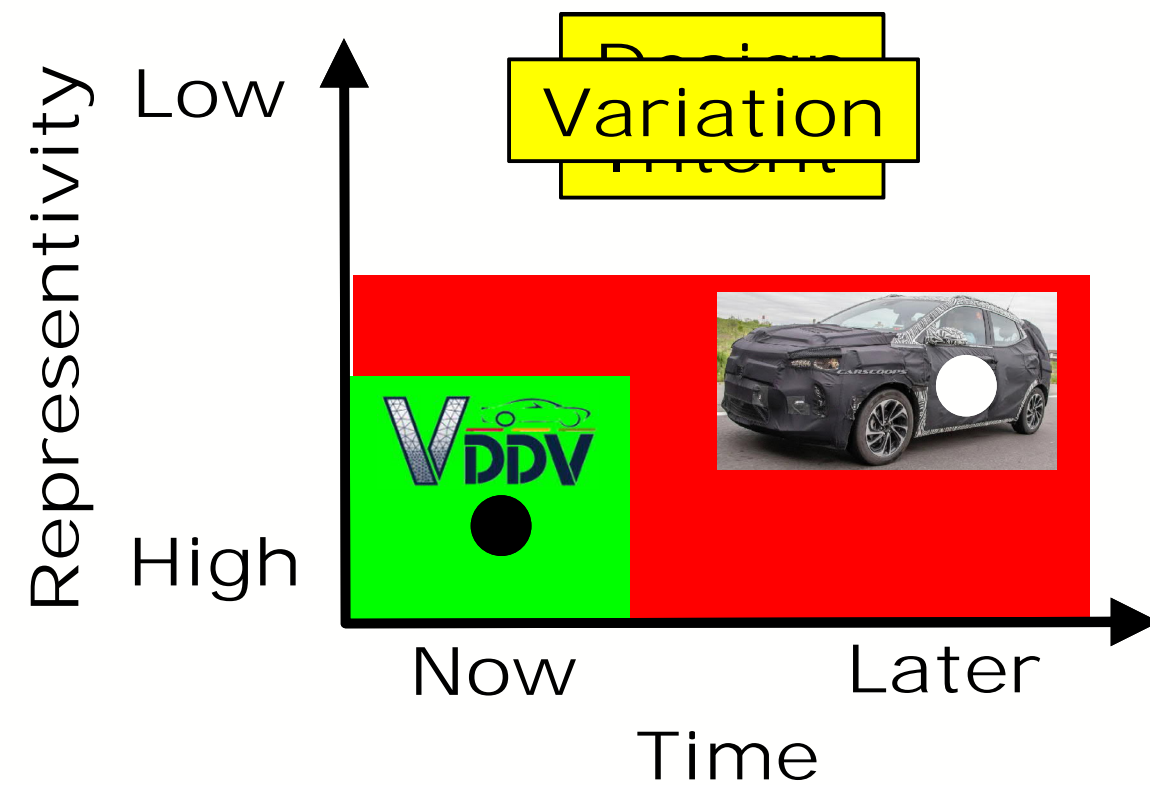
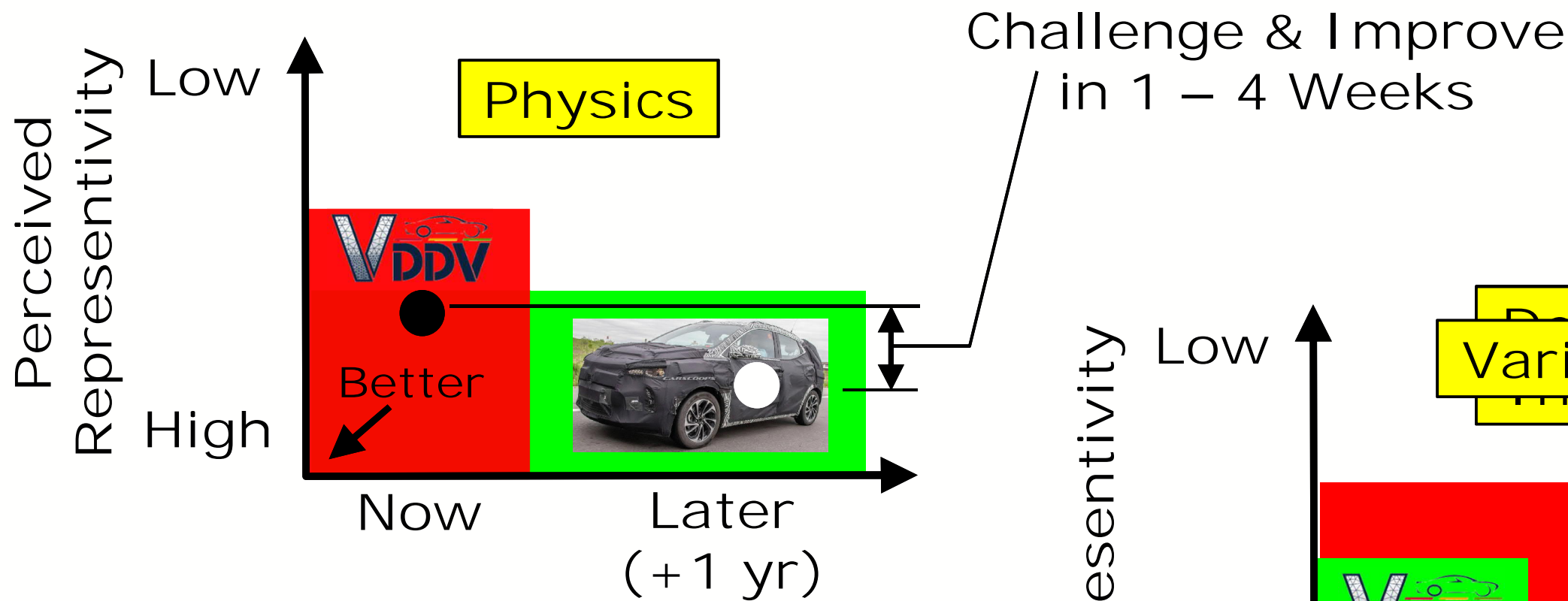
➤ System first.

➤ Make the subjective objective.

➤ Come left with us.

➤ Test the virtual.

IS VIRTUAL REALLY HIGHER RISK?

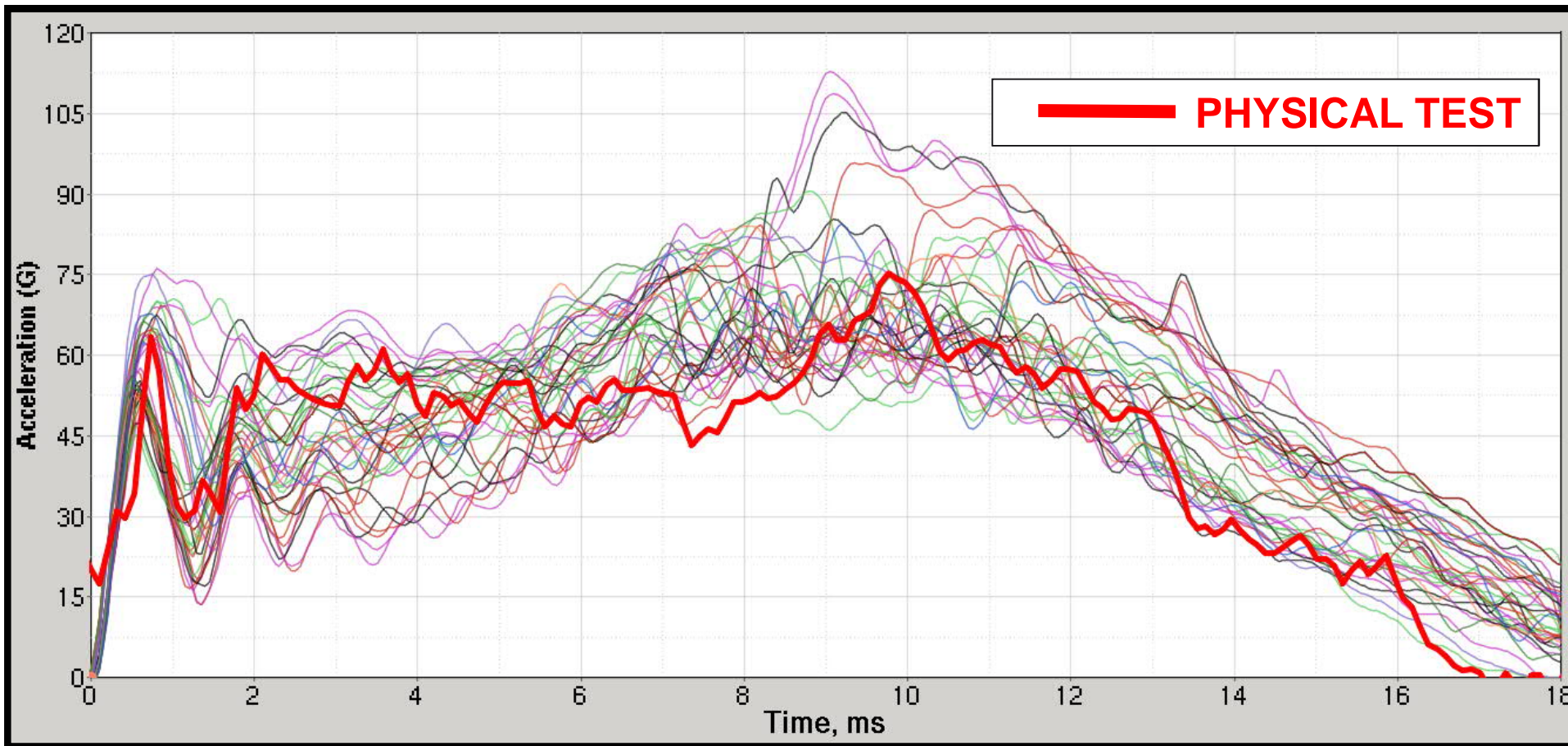


...or is it just discomfort?

GM can no longer afford comfort...

CORRELATION OR VARIATION?

Acceleration plot to determine head injury during seat head impact.



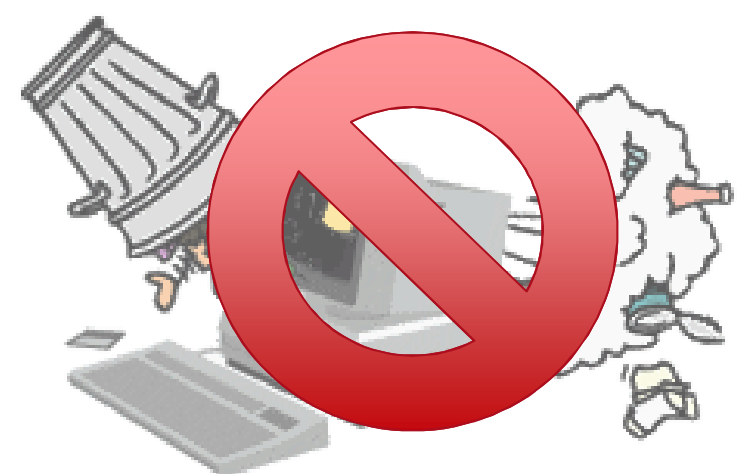
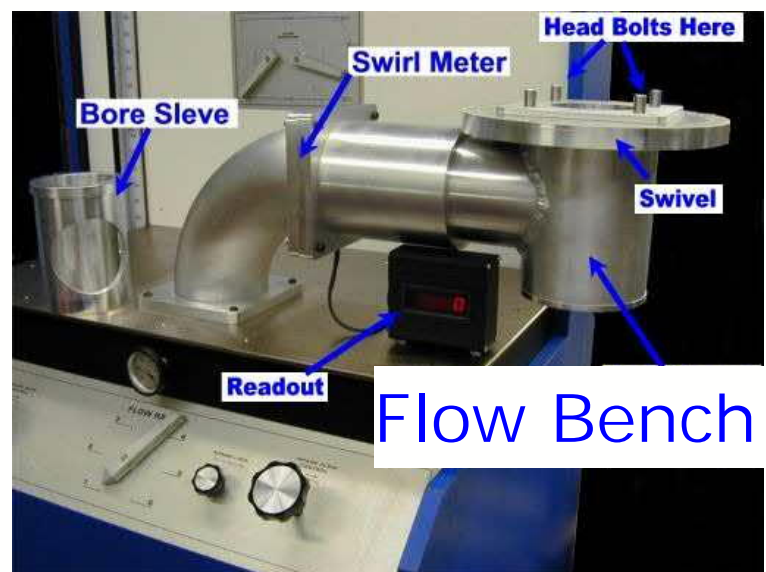
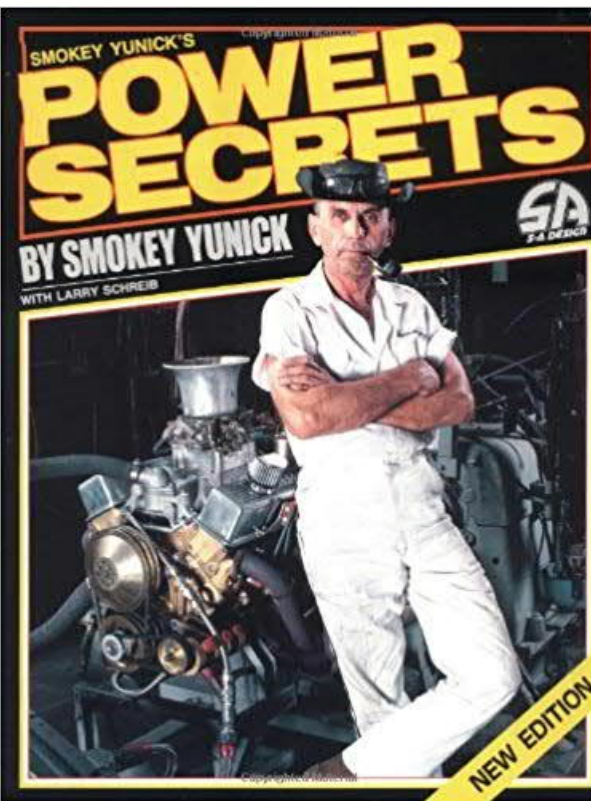
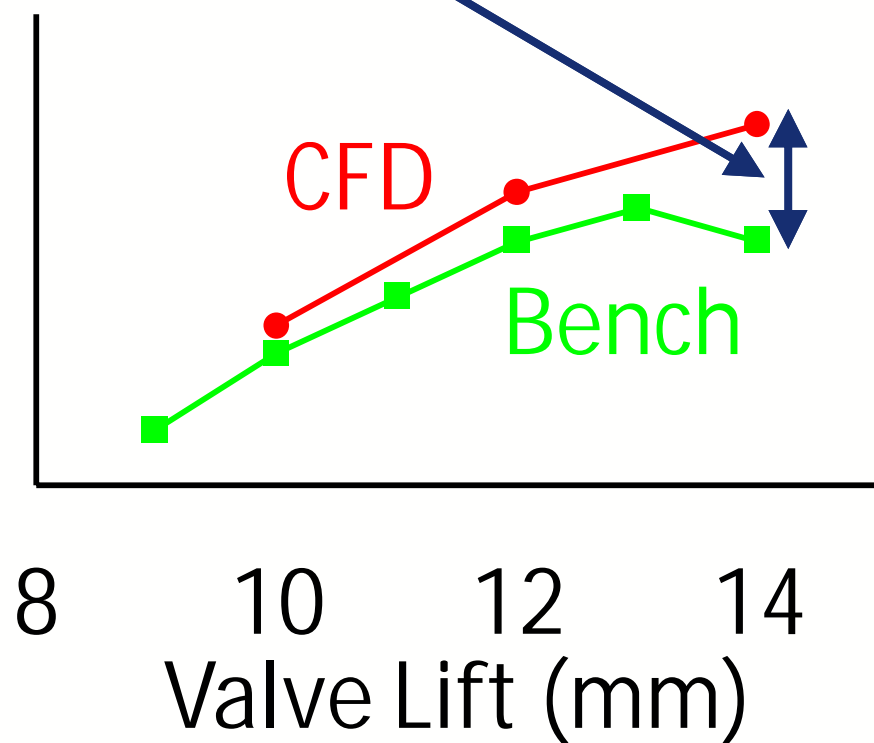
What are the two highest sources of variation?

CHASING GHOSTS... "HIGH-LIFT STALL"

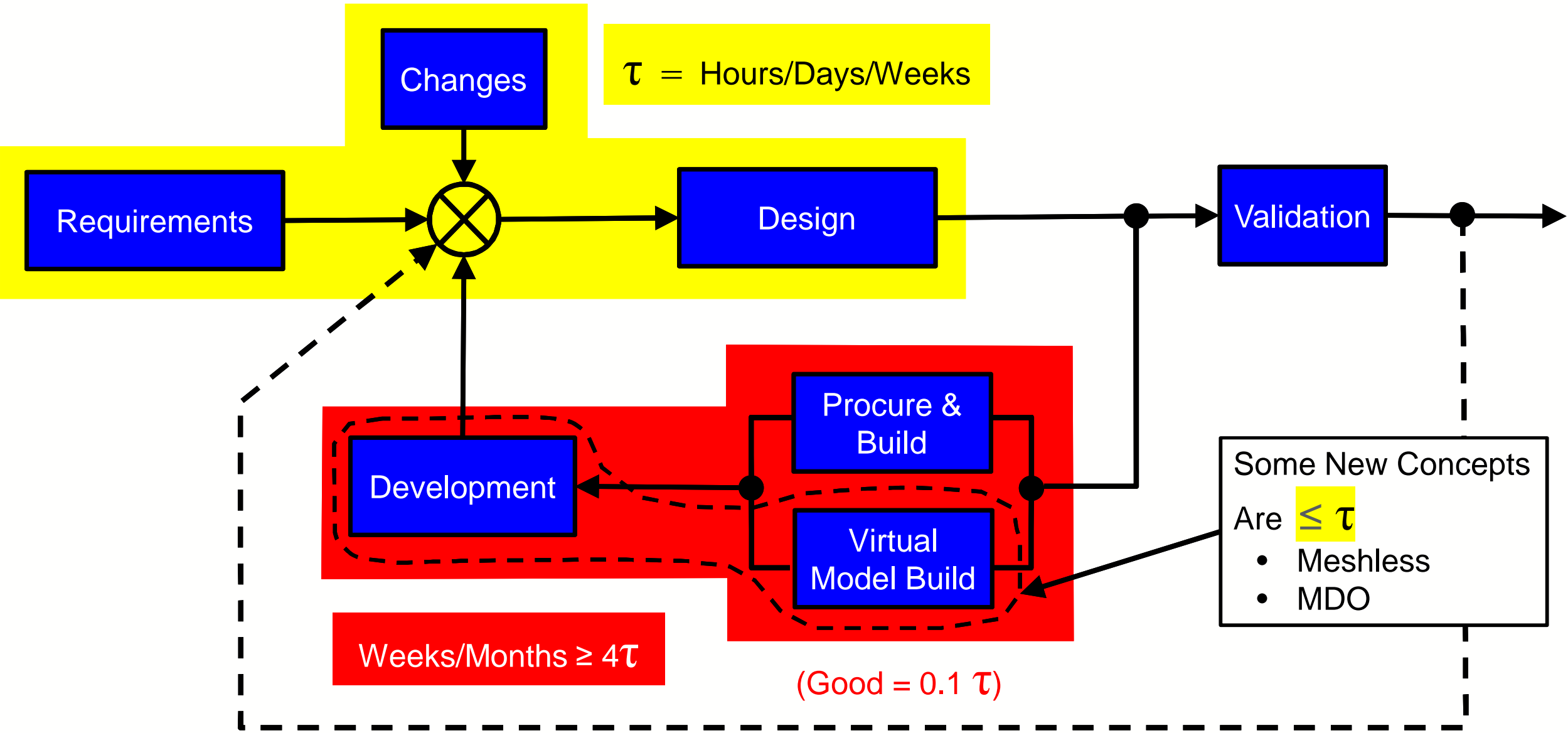


Porting cylinder heads for engine power long preceded CFD...

Mass Flow (g/s)



SPEED AS A VALUE...

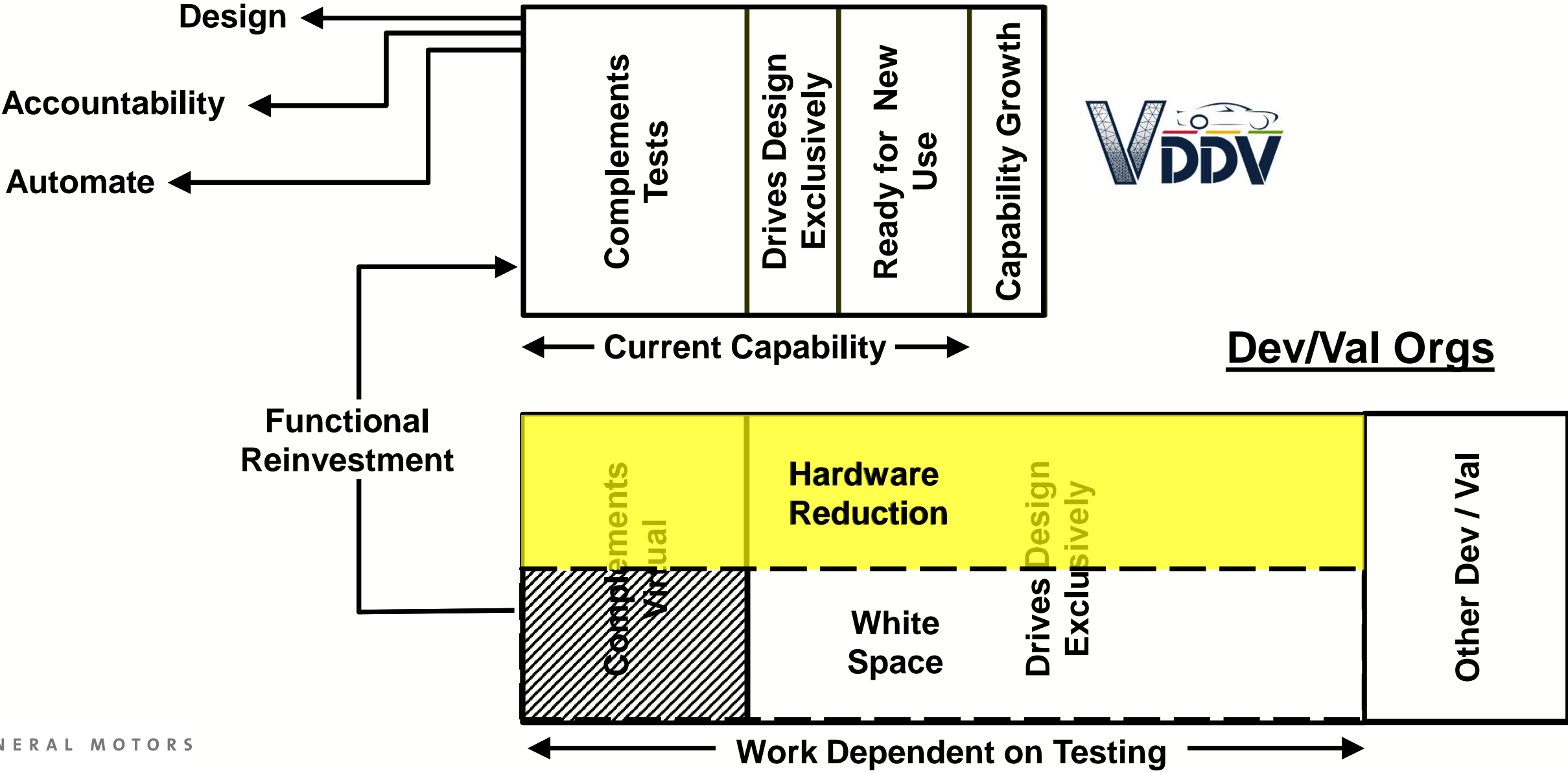


TWO COMMON QUESTIONS...

- How do we get that much virtual capacity so fast?
- What do I do if I'm a test engineer?

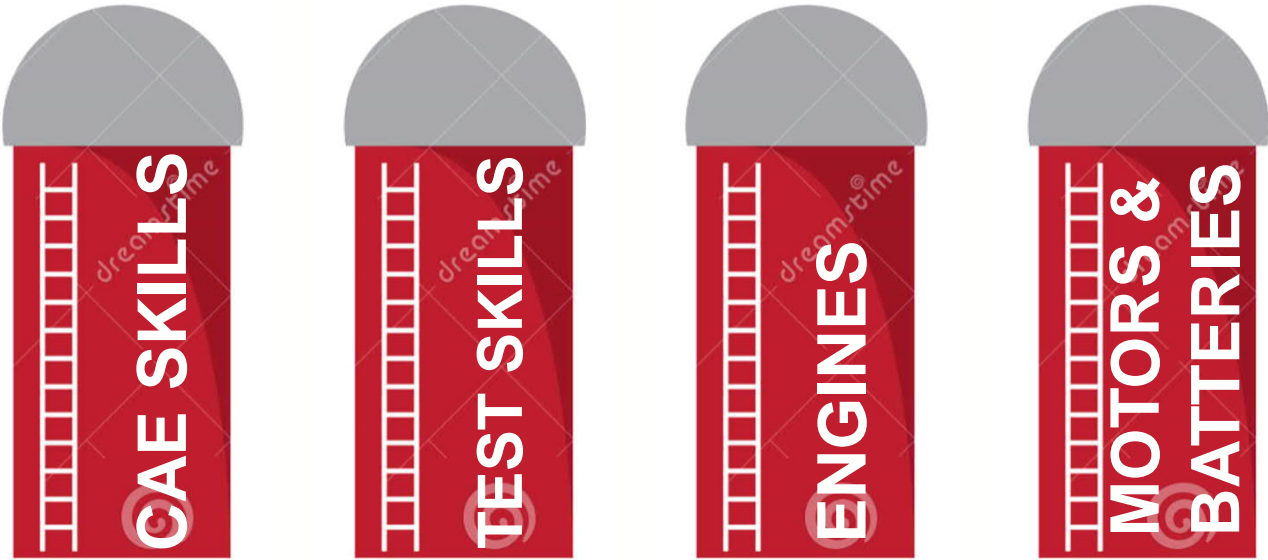


MOVE TO VIRTUAL: CONSERVATION OF TALENT...



ENGINEERS ARE FUNGIBLE...

If this is your model...the future is daunting

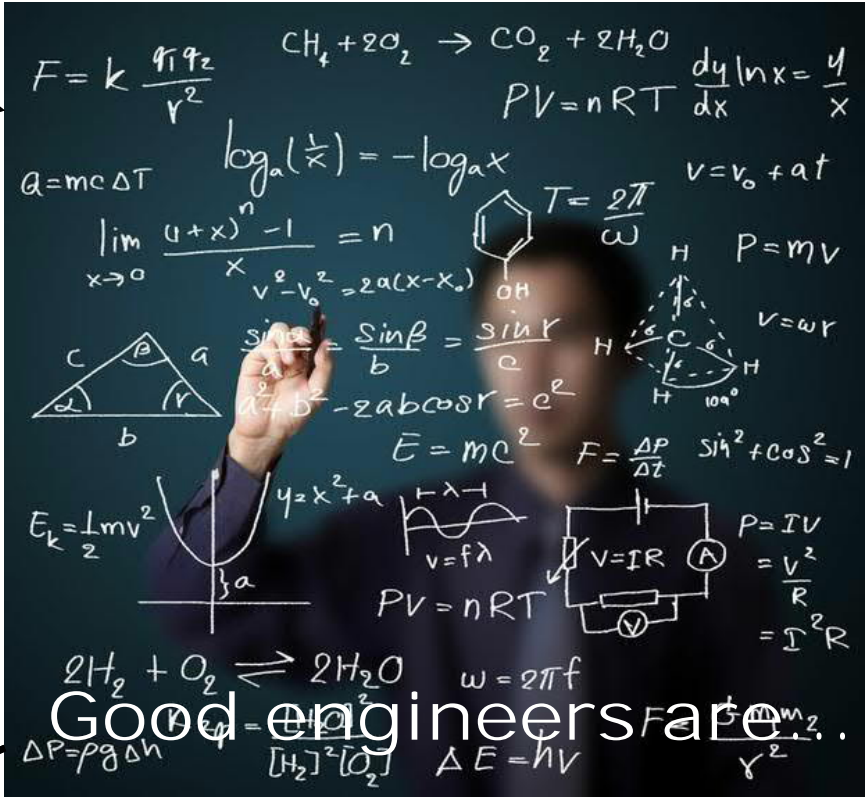


Methods &
Instruments

Groups of
Parts

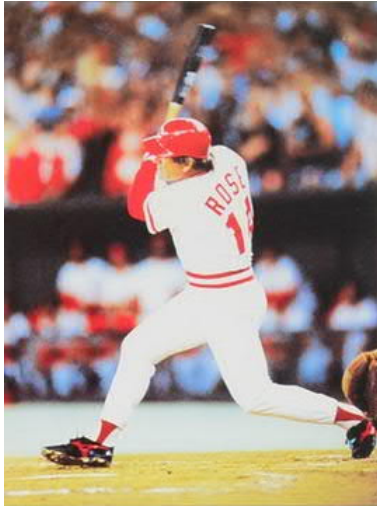
More Than...

- Expand on your skills & experience
 - Test engineers using virtual instruments are powerful



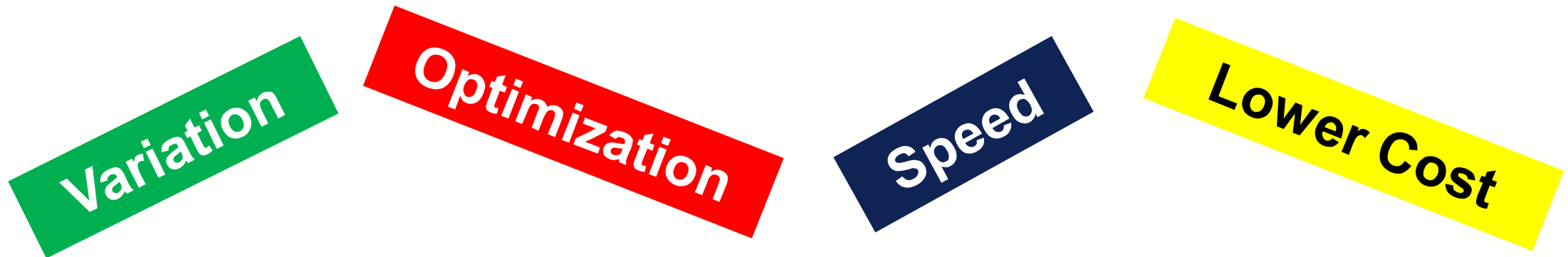
Good engineers are

Utility Players



SUMMARY

- Deeper reliance on current virtual capabilities is not the same as taking more risk.
- Fully exploit current virtual capabilities rather than dwelling on precise correlation
- New virtual capabilities can be developed very quickly by applying existing techniques to new domains
- The competitive frontier is always moving – product & process
- Reimagining product development to exploit the inherent strengths of virtual engineering is a new frontier
- The new frontier is not a “purge”, but rather an opportunity for all good engineers to grow





Q&A