



**Investment Considerations:
Medium & Heavy Duty Truck Technologies in
California**

*Dawn Fenton
Director, Sustainability & Public Affairs
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Global Portfolio of Strong Commercial Vehicle Brands



67%



19%



6%



3%



~300,000 vehicles a year
190 sales markets
19 countries with manufacturing

SUSTAINABLE TRANSPORT SOLUTIONS MODEL



ECONOMIC

High
productivity in
the transport
system



ENVIRONMENTAL

Energy
efficiency
and low
emissions



Safe and
secure
transport
solutions



SOCIAL

HYBRID

Volvo Commitment to Climate Action

VOLVO

Volvo Group North America

Press release

Volvo Group Joins American Business Act on Climate Pledge

Volvo Group North America today announced it has joined 153 other U.S. companies in support of the American Business Act on Climate Pledge, standing with the Obama Administration to demonstrate an ongoing commitment to climate action and to voice support for a strong outcome to the COP21 Paris climate negotiations.

The American Business Act on Climate Pledge reads as follows:

“We applaud the growing number of countries that have already set ambitious targets for climate action. In this context, we support the conclusion of a climate change agreement in Paris that takes a strong step forward toward a low-carbon, sustainable future. We recognize that delaying action on climate change will be costly in economic and human terms, while accelerating the transition to a low-carbon economy will produce multiple benefits with regard to sustainable economic growth, public health, resilience to natural disasters and the health of the global environment.”



PROUD U.S. BUSINESS
for **CLIMATE ACTION**

Technology Readiness

Ready or not?

- How do we measure it?
- What does it mean to the end user?
- How does a technology become "ready"?
- How long does it take for a technology to be "ready"?
- How much does it cost for a technology to become "ready"?

Technology Readiness Level (TRL) Process

NASA's quest to make jet engines quieter led to the development of chevrons, which moved relatively quickly through the TRL process to be deployed into the commercial marketplace.



TRL 8-9 (2005-now)

- Certification by the Federal Aviation Administration
- Deployed into market



TRL 7 (2001-2005)

- Validation of concept in flight
- Flight tests, final design



TRL 6 (1998-2000)

- Full scale tests for acoustics and aerodynamics
- Static engine tests

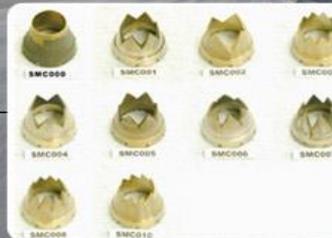
TRL 4-5 (1995-1997)

- Model tests for acoustics and aerodynamics
- Sub-scale model tests



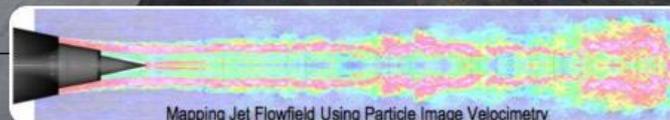
TRL 3 (Early 1990s)

- Applications to small nozzles and airfoils
- Lab tests, concept on paper

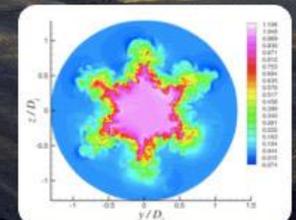


TRL 1-2 (1980s)

- Fundamental investigations of air-mixing devices (tabs, chevrons, etc.)
- In-situ specific effects in a specific flow field



Mapping Jet Flowfield Using Particle Image Velocimetry



Technology Readiness Levels

For Commercial Trucks



TRL 9

Product Launched

-

TRL 8

Customer Validation

-

TRL 7

Vehicle Verification

-

TRL 6

System Integration/Demonstrations

-

TRL 5

-

TRL 4

Component Evaluations

-

TRL 3

-

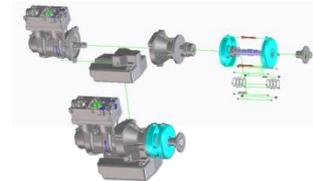
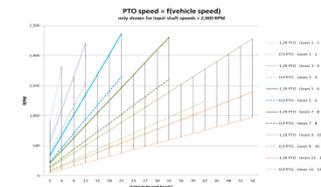
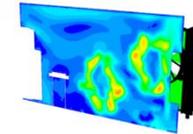
TRL 2

Concepts Formulated

-

TRL 1

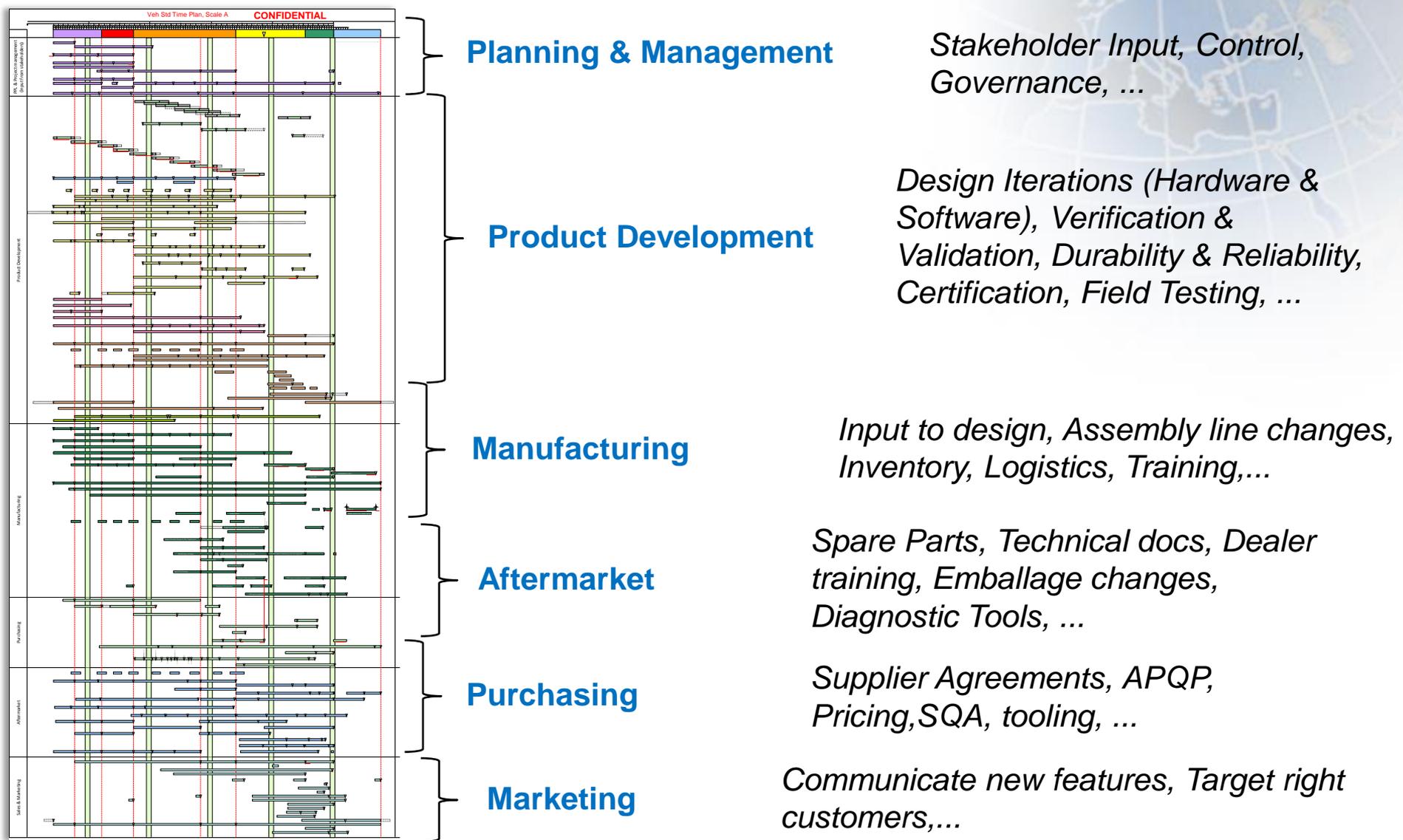
Basic Principle



Technology Readiness vs. Investments



Beyond TRL6: Development & Industrialization



Bringing New Technology to Market

Lessons Learned

- The risks are not just technical
- Customer solutions are brought to market, not specific technologies.
- A successful new technology launch requires a balance of customer business case, market acceptance, company investment priorities, etc.
- Differences in product applications, duty cycles, market volumes, etc. greatly restrict the direct application of technologies across products and markets