

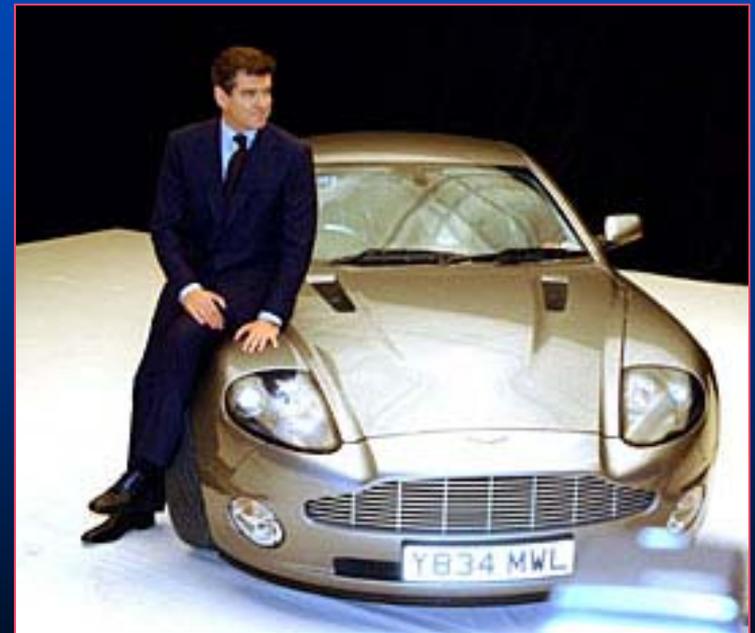
Ford Motor Company

**Naval-Industry
Partnerships – An
Industry
Perspective**



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Ford Research Laboratory

Mission

Ford Research will propel Ford Motor Company to world leadership in safe, environmentally responsible, and consumer-focused personal mobility through innovations in science and technology.



Outline

- **Similarities and Differences between Ford and the Navy**
- **Advantages of Navy-Industry R&D Non-Contractual Partnerships**
- **Potential Areas of Technology Insertion**
- **Strategy for Moving Forward**
- **Active Night Vision as COTS Technology**

Ford Research Locations



SRL



Aachen



THINK

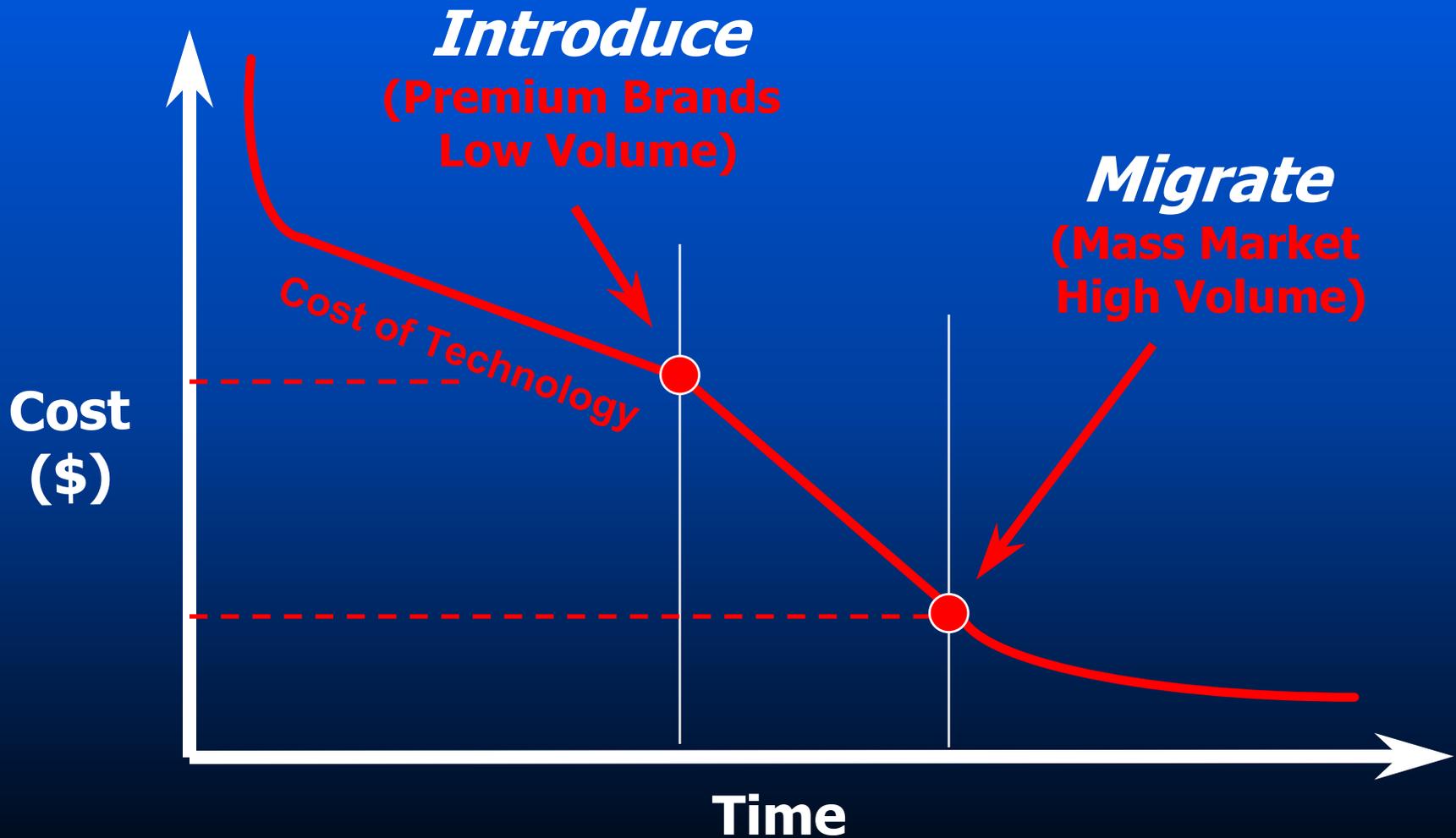


Adv. P/T



GTL

Introduce Technology on Premium Brands ... and Migrate to Volume Segments



Ford – Navy Differences

- Customer Base
- Supply base – Diverse vs. Limited
- Cycle Plan Duration
- Competition
- Regulatory Environment
- Financing
- Employment Options
- Product Mix
- Manufacturing Operations
- New Technology Implementation Cost Sensitivity

Ford – Navy Similarities

- Low-Volume Production
- Large and Diverse Product Plans
- Customer Expectations – Reliability, Durability, etc.
- Need for New Technologies
 - Fuel Economy (Range)
 - Weight
 - Powertrains (Diesel, Hybrid, Auxilliary)
 - Materials
 - Regulatory Environment
- Political Influence
- Need for Engineering Skills
- Outsourcing
- Organizational Complexity

Advantages of Navy-Industry R&D Non-Contractual Partnerships

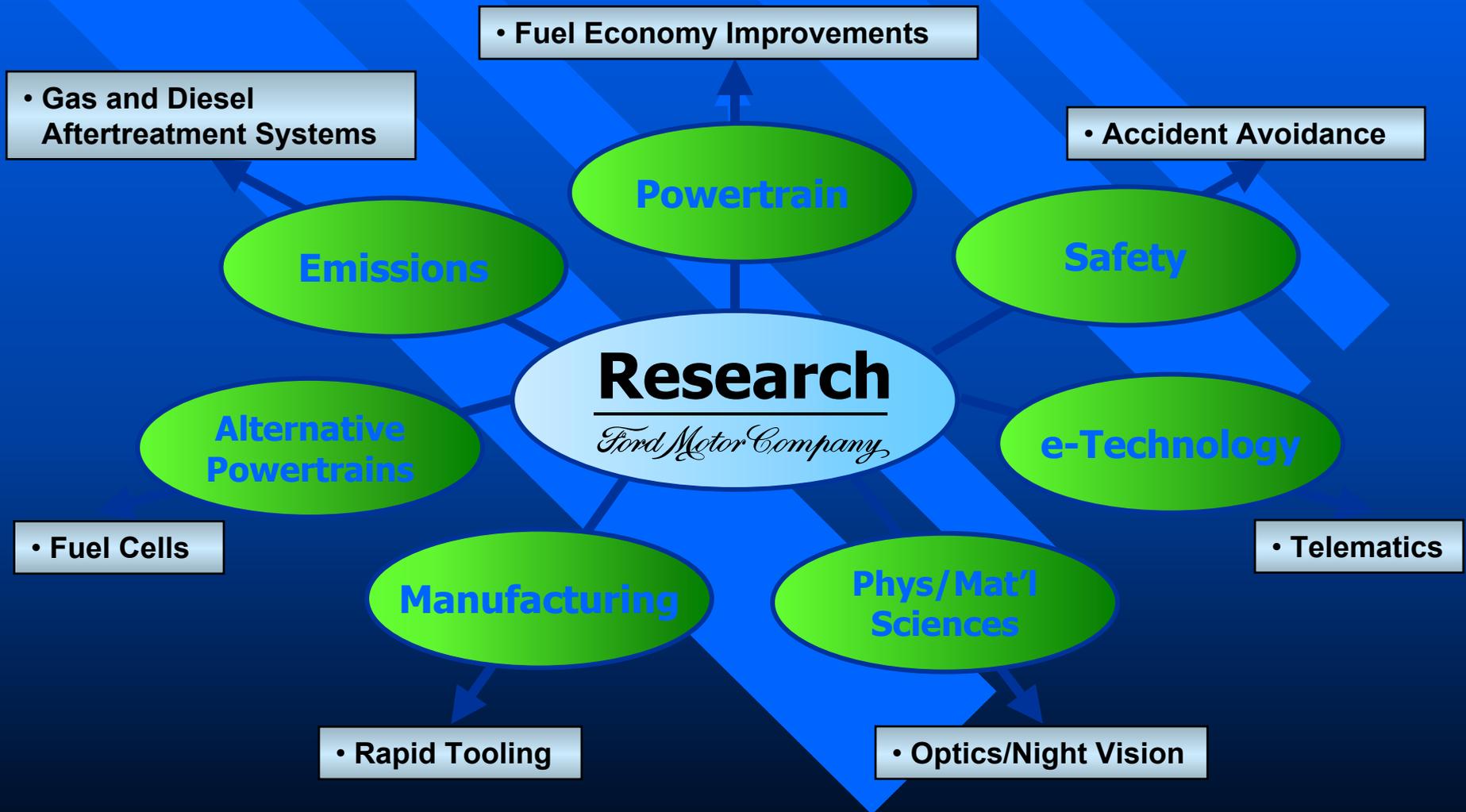
Ford

- Pre-competitive Interaction on Technical Challenges and Areas of Common Interest
- Patriotic Responsibility
- Dilution of First Implementor Cost
- Broadened Technology Base
- Licensing Potential to Navy Supply Base
- Spin-Off Technology Support

Navy

- Knowledge of and Access to Technology Outside of Usual Interactions
- Ability to Ride or Guide Incremental Technology Development at Market Price
- Leverage of Naval Technical Capability with that of Industry
- Avoid Up-Front Investment and Risk in Non-Sensitive Areas

Ford Research Focus Areas



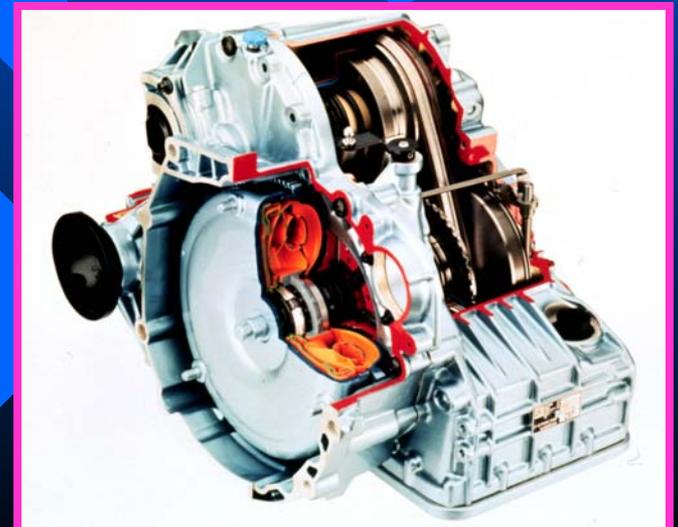
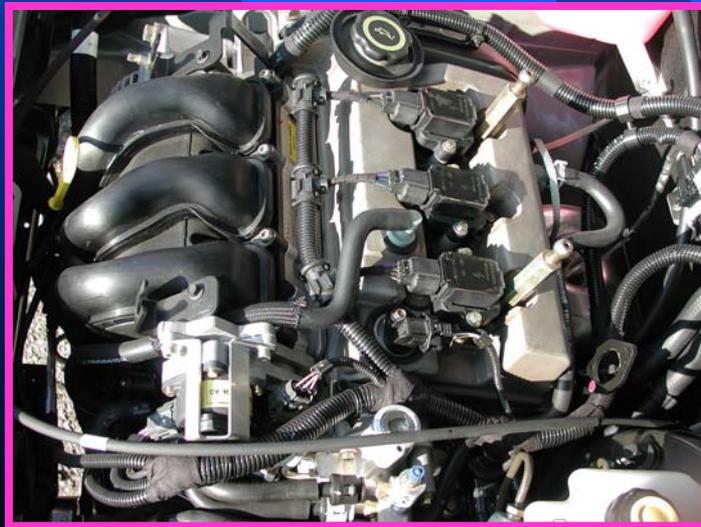
Ford – Navy

Potential Areas of Technology Insertion

- Alternative Power (Fuel Cells, Turbines, etc.)
- Hybrid Powertrains
- Diesel Engine Technology
- High End Computing
- War Gaming
- Rapid Tooling/Prototyping
- Light Weighting (Engines and Structures)
- Functional/Smart Materials
- Vehicle Safety
- Powertrain Control Systems
- Vehicle electronics
- Chemistry & Environmental Science
- Variable Compression Ratio Engine Technology
- Aluminum Structure & Adhesive Bonding
- Selective Galvanizing
- Products Produced Under Environmentally Friendly Restrictions
- Composite Structures & Adhesives
- Magneto-rheological Fluids
- Hydrogen IC Engine
- Structural Foam
- Fuel Cell Technology
- Catalyst Research
- Holographic Imaging
- Night Vision

Powertrain Fuel Economy Improvements

- Ford Research is working on important technologies to achieve our company's high fuel economy goals without sacrificing customer-driven performance attributes:
 - Variable Displacement Engines
 - Variable Valve Timing
 - Integrated Starter Generator
 - Continuously Variable Transmissions
 - Hydrogen fueled IC Engines



Hybrid Electric Vehicles



Ford Prodigy



Ford Escape



Fuel Cell Vehicles

- Vehicles running on hydrogen and producing only water as a by-product.
- Ford plans to have Ford Focus fuel cell vehicles available for sale in 2004.



Hand-held sprayer - Dymet, TDM



Selective Galvanizing

Cold-spray Manufacturing Cell - Ktech Corp.

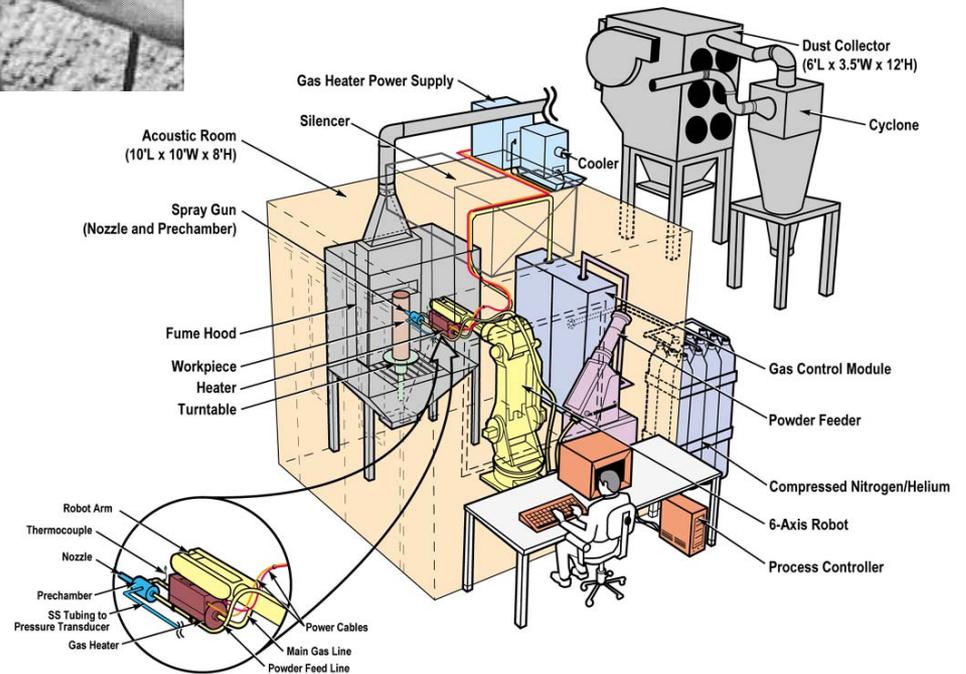


Illustration of Ktech's Cold Spray System

Rapid Tooling

- Tooling in days or weeks anywhere in the world
- Aboard ship prototyping
- Minimal facilities required
- License through Ford Research



Manufacturing Research



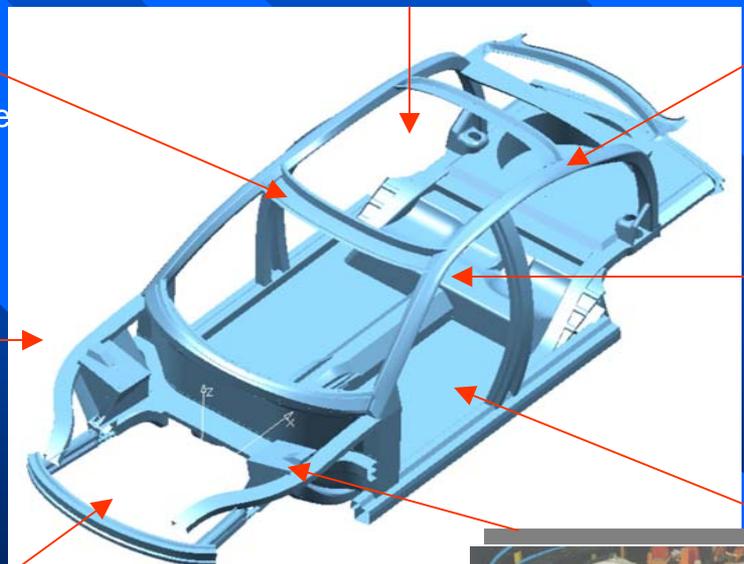
Advanced: Composite/Hybrid Aluminum Architectures



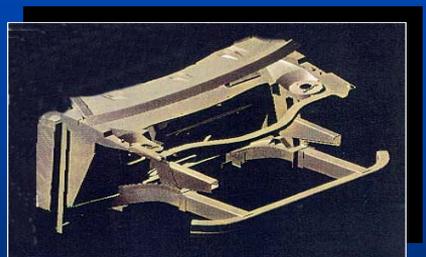
Lincoln LS / Jaguar x350/AM803 Seamless Braze & Epoxy Joints



Cost: Joining Low Cost Aluminum Sheet & Alternative Al-Pre-treatment



Advanced Joining (Automated MIG / Riveting)



Quality: Hybrid Aluminum Joining and Assembly



Adhesive Bonded Hoods, Deck lids, Doors



Ultrasonic Welding Closures



Craftsmanship: Dimensional Control & Process Monitoring (6 Sigma in Body Construction)

Ford Programmable Preforming Process (F3P™)

Automated robotic and computer controlled preforming process for fabricating glass fiber and carbon fiber preforms used in RTM/SRIM of composite automotive parts



Low Cost Raw Materials
*Structural Fiber and Surface Veil in
Lowest Cost Roving Form*

Fiber Deposition
*Structural Fiber, Surface Veil &
Binder Applied to Screen via Robot
Routines*

Consolidation
*Preform Compacted and Hot
Air Melts Binder*

Volume Production Capability
*High Volume Production of Fiber
Preforms for Composite
Components*

Demolding
*Fiber Preform is
Removed from Preforming Tool*

Stabilization
*Cool Air Freezes Binder and
Rigidizes Preform*

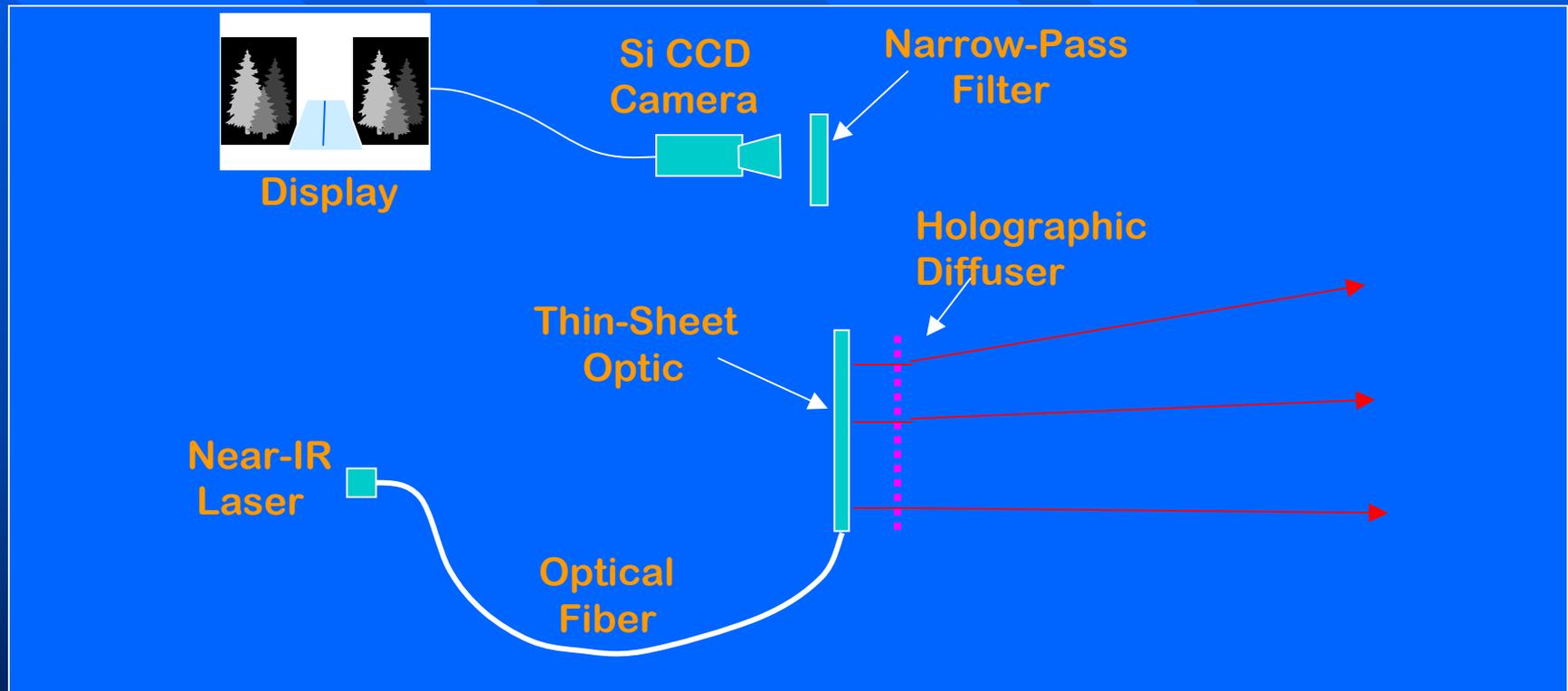
P4 Preforming Process



Active Night-Vision Using Diode Laser Illumination

- A diode laser illumination source permits the use of a narrow-pass filter centered on the laser wavelength in front of the CCD camera. This prevents 'blinding' of the camera due to the headlamps of on-coming vehicles.
- More compact, robust, energy efficient, longer lifetime than incandescent source.
- Daimler-Benz demonstrated laser-based night vision in a 1999 SAE paper.
- We developed custom optics that allows the diode laser illuminator to meet eye-safety requirements.

Schematic of Laser-Based Night-Vision System*



Thermal Night Vision



Cadillac Thermal Night Vision System

Comparison with Incandescent-Based Illumination System

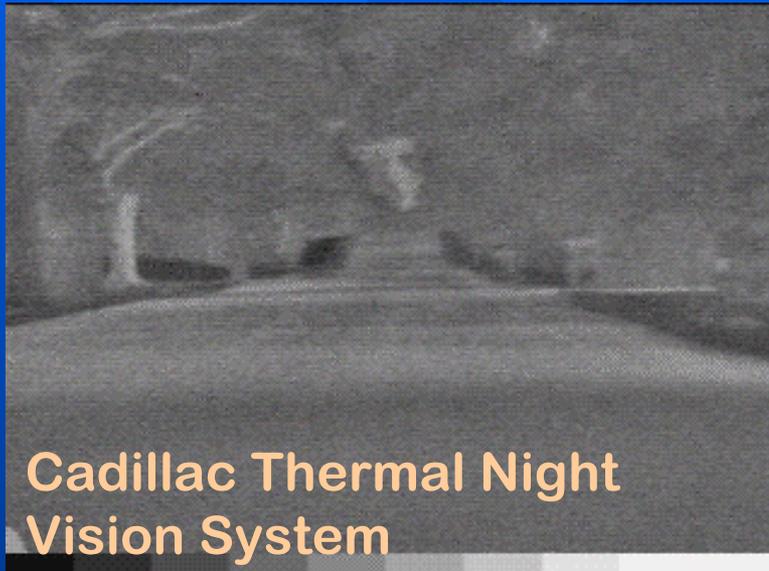


Incandescent Illuminator Night Vision System



Laser Night Vision System

Comparison with Cadillac System



Active night vision provides more intuitive images that clearly show lane markings, signs, and other roadside objects; i.e. mailboxes, posts etc...

Strategy for Moving Forward

- Industry has many opportunities for partnering with the Navy – We are not market competitors.
- Industrial portfolio of “bookshelf” and active technologies is large. We (eg. Ford) need a better understanding of your needs.
- Customer “pull” is a must for effective insertion. This is true in industry and is probably true in the Navy.
- Naval supply base should be part of the discussion.
- An ongoing dialogue is necessary (semi-annual).
- Naval or contractor funding of technology development and transfer to Navy operations and supply base (new option).