The Prometheus Vision

Presentation of ITS Success Stories

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Brussels, May 4th, 2007
1985

The Vision:
Creating “Intelligent Vehicles” as part of an overall “Intelligent Road Traffic System”
Programme for a European Traffic with Highest Efficiency and Unlimited Safety

The Strategic Objective: “Prometheus is a European Research Program which will elaborate the technical base for advance in the development of road transport. The objective is to create concepts and solutions which will make traffic perceptibly safer, more economical, with less impacts on environment, and will render the traffic system more efficient.”
Programme for a European Traffic with Highest Efficiency and Unprecedented Safety

The R&D Objective: “Prometheus intends to fully exploit the potential of information and communication technology, micro-electronics, sensors and actuators and to adapt progresses in technology to the capabilities of human beings in order to create an optimum interaction between man and machine in road traffic.”
Strategic Approach: From the product “Vehicle” to the product “traffic”. Considering the high complexity of the program, it had been started and planned carefully and installed a new form of cooperation between industry, basic research entities and governments in order to integrate all relevant partner just from the beginning.
Pro-Net: Development of a communication network between vehicle-computers, enabling the vehicle to be driven safely by means of “electronic sight”, increasing the perception area of the driver.

Pro-Road: Development of a roadside communication and information system to assist the driver and/or the onboard-computer to enable higher level traffic management functions.
Prometheus – MMI and Safety concepts in Pro-Car

Pro- Car: Development of
- Computer-assisted systems in vehicles to assist and relieve the driver
- MMI- concepts to support safe interactions between driver and computer-assisted systems.
- Reliable, safe and high quality Hard- and Software and concepts for diagnosis, service and maintenance.
Pro-Chip: Development of the integrated microelectronics required for a Prometheus vehicle with advanced on-board automotive electronics

Pro-Art: Methodological investigations of applications of Artificial Intelligence for signal processing and decision making processes.
The Strategic Approach of Cooperation in Competition

Prometheus Success Factors

- **Strategic Element 1**: Strategic Opportunity for the partner to strengthen their position in a field of strong competition with the Japanese and North American Automotive Industry.

- **Strategic Element 2**: Operational Opportunity to participate in a significant broader approach of research activities in a completely new technology and product segment than it would have been possible when acting alone. Important was the agreement to restrict the activities to research topics of joint interest and not to enter in product development areas.

- **Strategic Element 3**: Tactical Opportunity to learn from others and to receive financial and political support to build up capacity and know-how in advanced automotive electronics.
Prometheus Success Factors

Management Element 1: The System Approach: A comprehensive project plan with detailed work break down structure covering the whole field of application was distributed at the beginning to demonstrate the importance and the attractiveness of the project and the competence of the initiator company.

Management Element 2: The Integration Approach: A step-by-step team building process was used, starting the next step only if the previous was stable: Inviting first the German Automotive Companies in order to build a strong core-team, than the French, than the Italian and the Swedish and British companies and than let these companies to form their national basic research and institutional programs.

Management Element 3: The Leadership Approach: Building a strong Steering Team of the Automotive Companies to manage the project of 11 Automotive Companies, 103 Supplier Companies, 124 Research Institutes.

Management Element 4: The Delegation Approach. Delegating well defined sub-tasks (Thematic Projects and Basic Research Tasks) to a team of „European Lead Researchers and Scientific Coordinators“, forming Special Committees for instance „Impact Analysis“, „Legal Matters“, „Public Relations“.

The Management Approach with A High Quality Top – Down Start Concept
10 years later

ATZ Automobiltechnische Zeitschrift 97 (1995)

„ Prometheus- Vision of „The intelligent Vehicle on
„The intelligent road“

Attempt of a Critical Assessment

„It is difficult to see even from the position of 1995
new strategic approaches, which may go beyond those
of the Prometheus vision“

The Objective of Prometheus is still fully valid
Prometheus Success Factors – What was missing?

A Completion of the Vision by

- **Feasibility Studies**, indicating „missing links“ in the short- to mid-term technological development.
- **Roadmaps** towards Commercialisation
- **Implementation Plans**
- **Committed Milestones**
- **Monitoring** Status versus Plan

The restriction to Joint Research activities was necessary in order to allow the application of „Cooperation in Competition“ but in course of time the necessity of well defined Roadmaps towards Development and Market Introduction becomes obvious and the definition of Milestones and Implementation Strategies were required.
### Milestones for the Implementation of PROMETHEUS Systems

<table>
<thead>
<tr>
<th>Research</th>
<th>Development</th>
<th>Market Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CED 1: Ultraviolet Headlights</td>
<td>1993</td>
<td>Product development</td>
</tr>
<tr>
<td>CED 2: Autonomous Distance Warning System</td>
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<td>Market surveys</td>
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<td>CED 3: Automatic Emergency Call</td>
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<td>Field tests</td>
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<td>CED 4: Fleet Management (Basic System)</td>
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<td>Standardization</td>
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<td>CED 5: Dual Mode Route Guidance (Basic System)</td>
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<td>CED 6: Traffic Information Systems (Basic System)</td>
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<td>CED 7: Friction Monitoring/</td>
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<tr>
<td>Monitoring of the Safety Margin (Basic System)</td>
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<tr>
<td>CED 8: Medium Range Pre-Information</td>
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<td>CED 9: Fleet Management (Extended System)</td>
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<td></td>
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<td>CED 10: Travel and Traffic Information System (Extended System)</td>
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<td></td>
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<tr>
<td>CED 11: Dual Mode Route Guidance (Extended System)</td>
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<td></td>
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<tr>
<td>CED 12: Autonomous Intelligent Cruise Control</td>
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<td></td>
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<tr>
<td>Need for Further Research</td>
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</tr>
<tr>
<td>CED 1: Vision Enhancement</td>
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<td></td>
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<tr>
<td>CED 2-1: Friction Monitoring/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring of the Safety Margin (Extended System)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CED 2-1: Vehicle Stability Monitoring</td>
<td></td>
<td></td>
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<tr>
<td>CED 2-2: Lane-Keeping Support</td>
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<td></td>
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<tr>
<td>CED 2-3: Driver Status Monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CED 3: Collision Avoidance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CED 4: Cooperative Driving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CED 5: Autonomous Intelligent Cruise Control</td>
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</tr>
</tbody>
</table>

Additional actions required:
- Transport technology
- Man-machine interaction
- System safety

From Vision to Commercialisation: The Roadmap Plan
20 years later

2005
MMC-Study: The growth of values in the next years in the automotive industry are estimated to be in average about 2,6%. The segment electric/electronic will be at the top with about 7,2 %.
Continuity of cooperative research

20 years later

The Cooperative Effort is still in place
20 years later: 2001-2005 Prometheus Successor Project INVENT

First Steps of the Pro-Net Concept might become reality: The Traffic Management Assistant. Communication via WLAN using mobile Ad-hoc Nets between Vehicles and GPS for determining position, speed, location within the traffic/road environment to allow validation of traffic flow and traffic safety.
Test Vehicle of MAN:
20 years later: Environmental Sensing Products and Projects

- Lane Departure Warning
- Lane Change Assist
- Blind Spot Assist
- Heading Control
- Parking Aid
- Enhanced Lane Change Support
- Heading Control

Enhanced Full Speed Range ACC
Enhanced Park Assist
Construction Assist

Parking Gaps
Obstacles
Vehicles

Driver Monitoring
Smart Airbags

View
Lanes
Vehicles

Obstacles
Parking Gaps

Parked Vehicles
Obstacles
Parking Gaps

View
Pedestrians
Tunnels
Obstacles

Vehicles
Lanes

SBL  Side Backward Looking
SL   Sideward Looking
BL   Backward Looking
IL   Inside Looking
FL   Forward Looking
20 years later: Vision Enhancing Systems are in the market
2005 DaimlerChrysler Night Vision System

2005 Series Production of Night Vision Systems enhancing the Vision of the driver at night of up to 150 meter.
20 years later: Feasibility of Pedestrian recognition systems in complex environmental conditions is demonstrated.

Perception and Interpretation of very complex situations is demonstrated allowing intelligent accident avoidance strategies including pedestrian protection systems.
20 years later: We are coming closer towards the Vision of Accident Free Road Transportation

DaimlerChrysler:
"The Vision of Accident Free Driving is focal point of our Research Plan and is given highest strategic attention"
20 years later

The Proof of Concept

The Fuel Cell Story
20 years later: Application and proof of “lessons learned” from the Prometheus Project

There are new Challenges which require cooperative strategic approaches between industry, research entities, governments and the public and we may use the “lessons learned” from the Prometheus/Ertico etc experience to contribute to this process.
The challenge is the management of the transition process from today's established Technologies to new ones. This was successfully done in the field of Communication-, Information- and Data Processing Industry in the last Decades and a similar process has to be managed by the energy and transportation industry now. A strong candidate for the role of the Microprocessor as driving technology might be the Fuel Cell technology in the Energy- and Transportation sector.
In the same way as done in the Prometheus project, the process of building up a joint effort of “Cooperation in Competition” was successfully established between key partner in the Fuel Cell area. The “California Fuel Cell Partnership” in Sacramento was founded as common platform from partner of the Automotive and Energy Industry, Technology and Research Companies and Governmental Agencies in order to promote the introduction of “Sustainable Energy and Mobility Concepts”.
20 years later: Joining Efforts and Talents to meet the Challenges and to strengthen the business perspectives of the automotive industry.

Applying the Prometheus Process to build the platform for joint Fuel Cell R&D activities.
20 years later: This time with a plan and roadmaps, milestones, success criteria.

<table>
<thead>
<tr>
<th>Year</th>
<th>Feasibility Demonstration</th>
<th>Controlled Fleet Demonstrations</th>
<th>Commercial Fleet Demonstrations</th>
<th>Commercialization Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Test FC vehicle performance and feasibility 1 (CaGOP) ≤50</td>
<td>Demonstrate use of FC vehicles under real-world conditions. 5-8; varying climates ~500</td>
<td>Demonstrate commercial viability of FC fleet vehicles. 2-3 states (networked sites) ~5000</td>
<td>Investment to establish manufacturing plants and sales/service</td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td>Onsite generation from multiple feedstocks</td>
<td>Sufficient stations to provide consumer convenience</td>
<td>Investment for 25-50% of all stations H₂ capable</td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td>Renewables and fossil fuels</td>
<td>Most cost effective sources 20-30</td>
<td>Legislated incentives to consumers &amp; industry</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td>Exercise capability for national energy security</td>
</tr>
</tbody>
</table>

**Government Role**
- Share management responsibilities
- Fuel Chain Analyses
- Education

**Infrastructure Objective**
- Demonstrate H₂ fuelling station
- Primarily trucked-in liquid H₂
- 3

**Hydrogen Source**
-

**Number of stations**
- Share management responsibilities
- Fuel Chain Analyses
- Education

**Industry Role**
- Do vehicle design, engineering & integ.
- Identify service requirements
- Gauge consumer acceptance
- Maintainability

**Success Criteria [achieved through parallel technology development]**

<table>
<thead>
<tr>
<th>Fuel Cell</th>
<th>Cost (at $50,000/year)</th>
<th>Durability</th>
<th>Onboard H₂ Storage</th>
<th>Cost ($/kg)</th>
<th>Energy Density</th>
<th>Specific Energy</th>
<th>Hydrogen Infrastructure Cost</th>
<th>Greenhouse Gases Cost</th>
<th>$40/GJ</th>
<th>$21/GJ</th>
<th>$12/GJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>$325/kW 1000 hrs</td>
<td>$125/kW 4000 hrs</td>
<td>$45/kW 5000 hrs</td>
<td>$5.00/kWh 2000 Wh/kg 1100 Wh/L</td>
<td>$3.00/kg km</td>
<td>$1.50/kg km</td>
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</table>

**Lessons Learned:** In the “California Fuel Cell Partnership” we have created a “Roadmap”, an Implementation Strategy, a Milestone Plan and a Monitoring Process in a timeframe from 2001 to 2012.
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Thank You For Your Attention