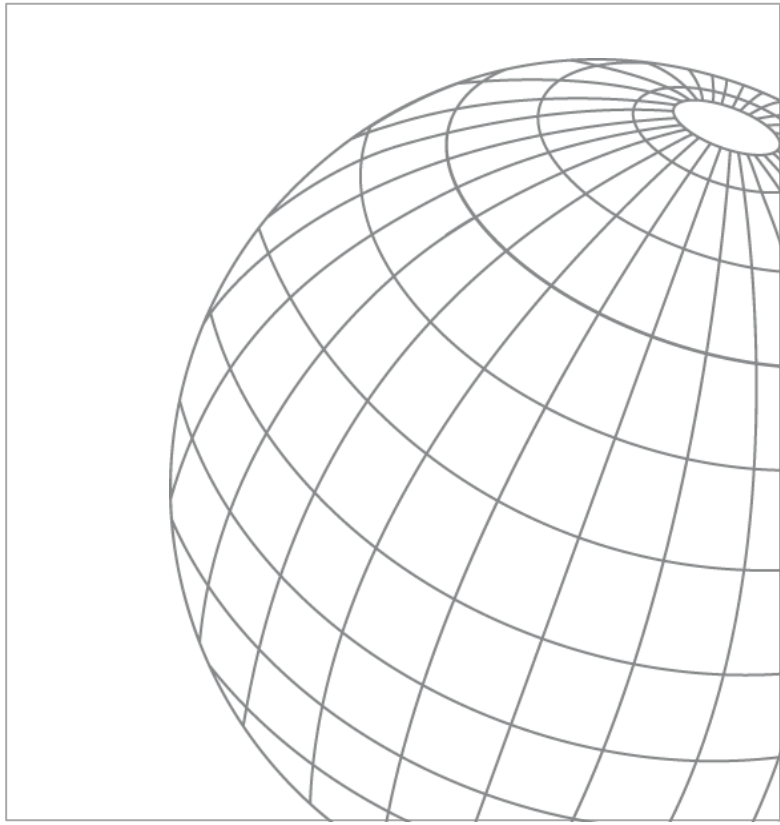
Powertrain and Vehicle Technology Management – The Role of an International Service Provider



prepared for:

OSEG 2016

Konya, May 25, 2016
Dr. Taner Göcmez, Managing Director FEV Turkey

Content

- Introduction
- Technology Strategy
- Conclusions

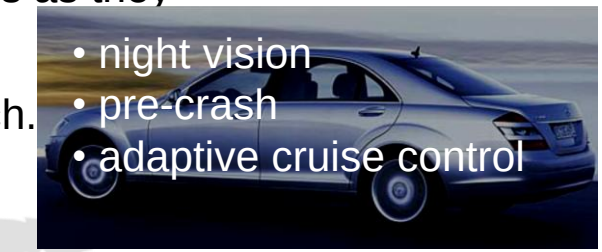
Motivation

New technological developments are of utmost importance for companies as they

- ❑ Secure long-term business success

  → differentiation, uniqueness, …

S-class as a tech. leader (safety)



- ❑ Render development of new business fields possible

  → (hybrid) electric vehicles, …

Hybrid technology of Toyota (USA, efficient SUV, city-car, clean energy,…)

- ❑ Can be elementary for the product's success

  → market acceptance, safety, …

A-class with ESP as standard equipment

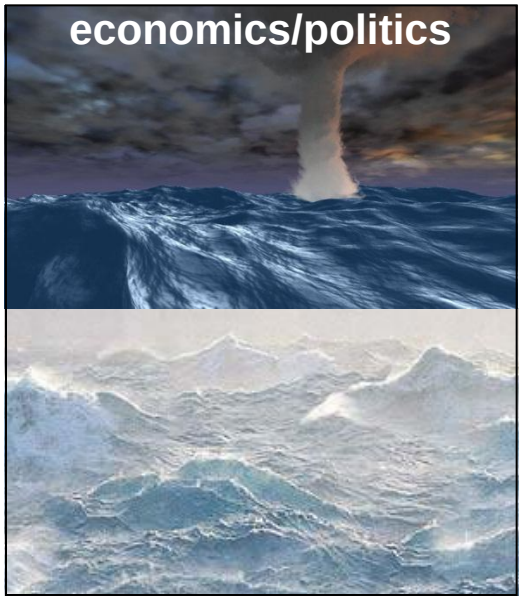
- ❑ Can include major risks

  → customer goodwill, company image, …

➔**Professional management of technology strategy is required to create competitive advantage**

“Big Picture” of Technology Management

Analogy to a high performance yacht & V6 turbo engine



engine model of technology

Core competencies

Proprietary Know-How

Process

Product

Supportive competencies

People

Processing of Information

Promise of Quality

➔**Compete via careful management of technology-related competencies**

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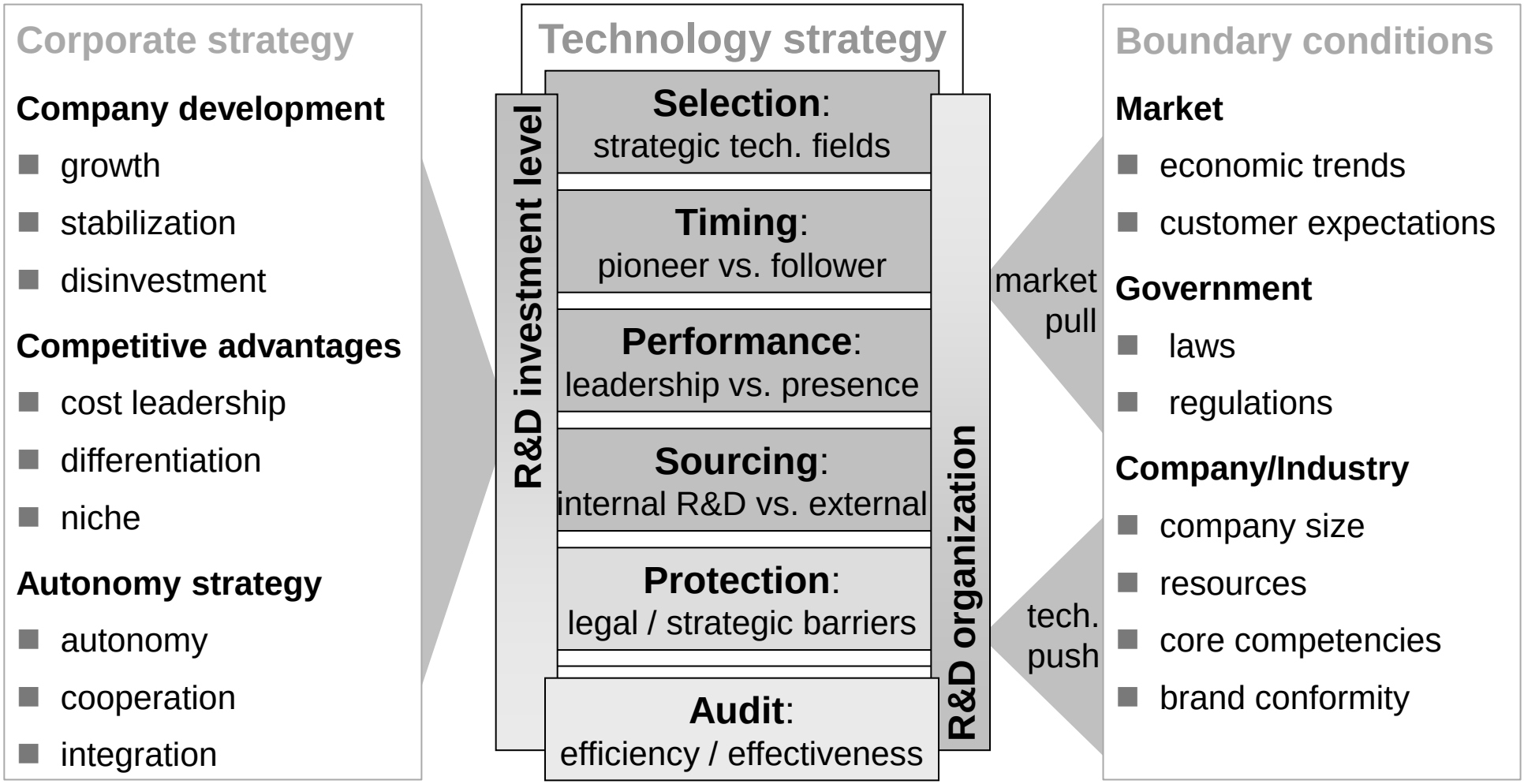
Technology Strategy



➔**Technology strategy answers questions as why, which/what, when, how, from where, for who**

Technology Strategy Example: European OEM

Corporate strategy	Boundary conditions
❑ growth ❑ niche ❑ autonomy	❑ market ❑ government ❑ company

Technology strategy

Selection: strategic tech. fields	**Timing**: pioneer vs. follower	**Performance**: leadership vs. presence	**Sourcing**: internal R&D vs. external
Brake technology 	**First Mover**	**Best in class**	**internal**
Variable valvetrain 	**Fast Follower**	**Best in class**	**internal**
Elec. traction control 	**Late Follower**	**Best in class**	**internal**
Diesel technology 	**Late Follower**	**State of the art**	**external**

➔**Technology strategy on rolling horizon (e.g., 2016 → 2019)**

Technology Strategy

Corporate strategy

Company development

- growth
- stabilization
- disinvestment

Competitive advantages

- cost leadership
- differentiation
- niche

Autonomy strategy

- autonomy
- cooperation
- integration

Technology strategy

R&D investment level

Selection:
strategic tech. fields

Timing:
pioneer vs. follower

Performance:
leadership vs. presence

Sourcing:
internal R&D vs. external

Protection:
legal / strategic barriers

Audit:
efficiency / effectiveness

R&D organization

Boundary conditions

Market

- economic trends
- customer expectations

market pull

Government

- laws
- regulations

Company/Industry

- company size
- resources
- core competencies
- brand conformity

tech. push

➔**Technology strategy answers questions as why, which/what, when, how, from where, for who**

Sourcing

Internal sources of technologies (»Make«)

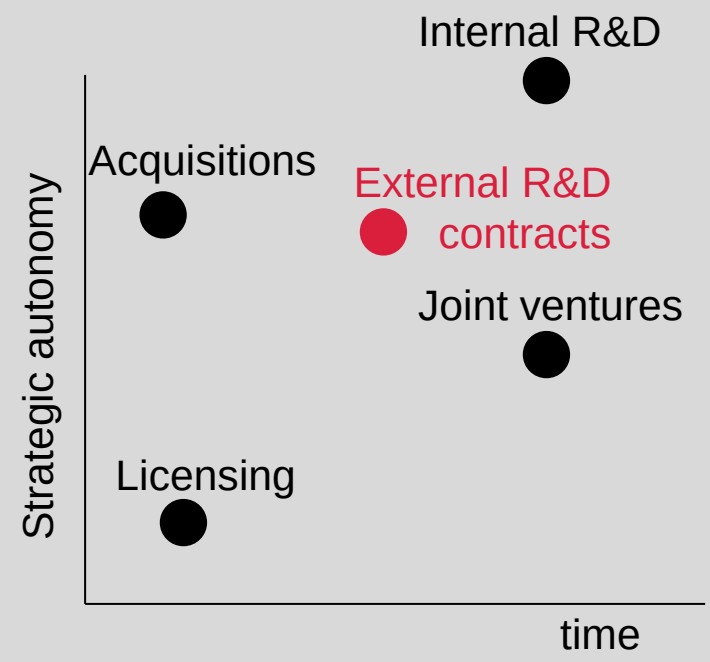
- Own research and development

Hybrid sources of technologies

- Cooperations / joint development teams
- Technology networks
- Joint Ventures

External sources of technologies (»Buy«)

- Subcontracting of R&D tasks
- Licensing
- Buying technology (patents etc.)
- Acquisition of companies owning technologies
- Acquisition of experts



Additional axis to consider:
costs, risks!

➔**Cost, time, level of competence and usage of a technology are influenced by sourcing**

Sourcing to FEV – Innovative Powertrain Engineering Company
… Turning innovative ideas into reality

➔**International service provider worldwide**

Founded in 1978

- working for major vehicle and powertrain manufacturers worldwide
- >4,000 employees
- >170 engine/powertrain test cells

Engineering Services & Products

- Powertrain engineering
- Test solutions
- Software products
- Consulting services

Sourcing to FEV – Innovative Powertrain Engineering Company
"Extended product development" partnership

Customers/ Markets		■ Ability to flex with OEM capability and demand ■ Ability to manage unpredictable demand in diverse markets
Technology		■ Continuous investment in research and technology development ■ Key to brand positioning and margin maintenance/realisation
Legislation		■ Ability to management of ever increasing technology on cost ■ Can satisfy multiple technology paths for regional market variation
People/ Resources		■ Team flexibility - continuously reshaping teams in line with demand ■ Investment into facilities to match forward technology demands
Key processes		■ Seamless working with partner/customer systems ■ Time to market reductions through process improvement and tools
Collaborative Models		■ Well proven approach to partnering (business, projects facilities) ■ Collaborative models for R&D and facilities in place, capability transfer

➔**FEV as lean and effective partner for development**

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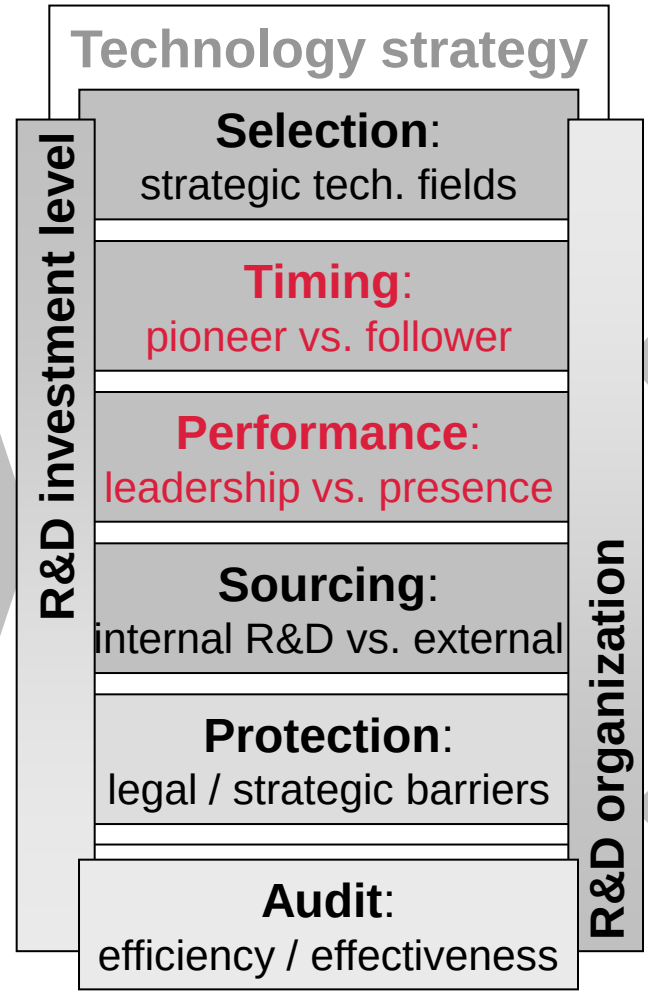

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market pull

tech. push

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Timing & Performance
Market Entry Strategies

First to Market

- Applied R&D
- High-risk approach
- Risk capital, temporary monopoly possible
- Full use of product life-cycle

Fast Follower

- Rapid development and engineering
- Lower-risk approach
- Fast access large capital
- Compete on price & performance

Cost Minimization

- Process knowledge and implementing new manuf. technologies
- Low risk
- Development capital
- Late entry to market

Niche

- Commitment to R&D
- Too small for more than one supplier
- Specialist service/ product
- Time not an issue

➔**Strong influence of timing on investment level and technology competence**

Reference project first to market – 1.0 liter EcoBoost engine
Courtesy of Ford Motor Company

From 2012 – 2015

INTERNATIONAL engine of the year awards 2012
Presented by engine technology international magazine

INTERNATIONAL engine of the year awards 2013
Presented by engine technology international magazine

INTERNATIONAL engine of the year awards 2014
Presented by engine technology international magazine

INTERNATIONAL engine of the year awards 2015
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Technical Highlights and Data

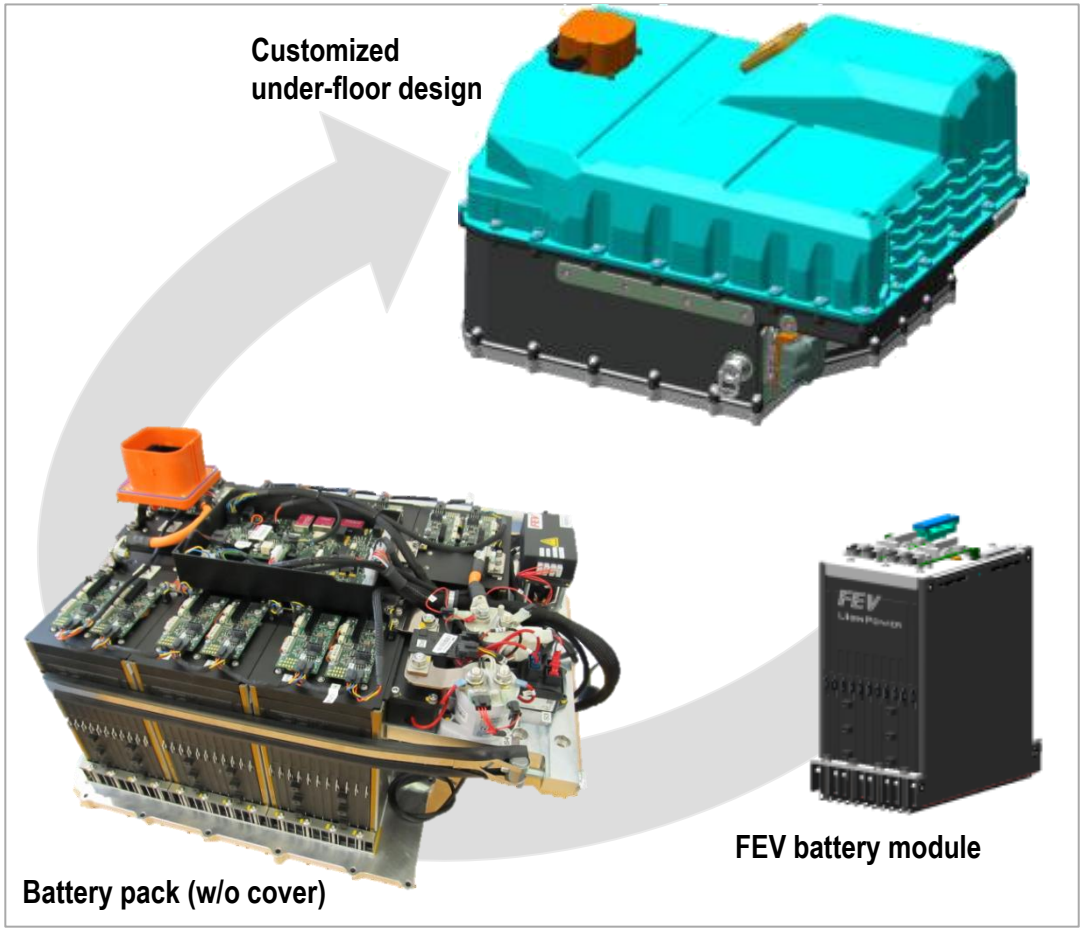
- In Line 3 Gasoline Engine with 92 kW / 170 Nm @ 1.300 – 4.500 rpm / overboost 200 Nm
- DI-VCT / Integrated exhaust manifold / Oily belt for timing drive and oil pump drive / Split cooling / Variable flow oil pump

FEV´s Project Involvement

- Design and CAE for Pre-XO
- Procurement and QS 1
- Engine built, comissioning, run-in and sign-off for 36 engines
- Combustion development for Stage 1

Reference project fast follower – Battery development
Courtesy of BMW AG

High power battery for PHEV prototype car



Work scope

- Turn-key development of a customized high power PHEV Battery pack for under floor vehicle package

Highlights

- Development, assembly, testing, vehicle integration and commissioning in just 2,5 months
- Using FEV standard battery modules and BMS
- Excellent performance in target vehicle
- Following BMW requirements specification
- Battery capacity > 9 kWh, discharge power > 100 kW
- Liquid cooling

Reference project cost minimization
Cost Minimization

Vehicle Calibration

Changan Z-Shine	Changan Quote
	**Changan, Internet:** To provide the complete vehicle with excellent operation and comfortable performance, it is accurately calibrated by **German FEV**, and the optimized matching is conducted at Lommel Test Ground, Belgium

Reference project niche – Premium hybrid development partner for BMW i8
Courtesy of BMW AG

Technical highlights

- Plug-In Hybrid Electric Vehicle with
  - 35 km eDrive
  - 4.4 s (0-100 km/h)
  - 250 km/h
  - 2.1 l/100 km
- Combustion engine: 1.5-liter I3 gasoline engine 170 kW / 320 Nm
- E-Motor: 96 kW / 250 Nm
- Axlesplit powertrain for dynamic AWD

FEV‘s project involvement

- Hybrid function development
- Hybrid calibration and OBD
- Calibration & validation eDrive system
- Functional safety for powertrain
- SW development battery management system
- Durability testing hybrid powertrain

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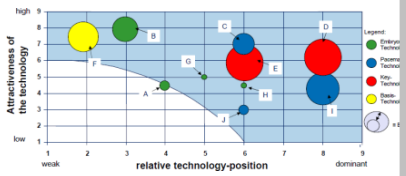
Technology Selection

INPUTS

"clean sheet"

Existing technology portfolio

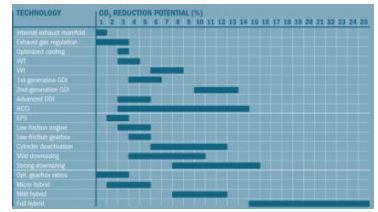


PROCESS

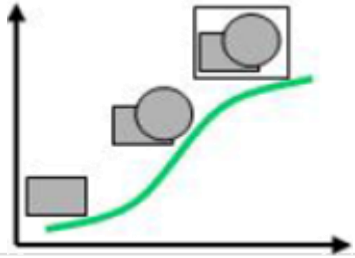
Forecasting / Planning / Assessment

Environmental scan

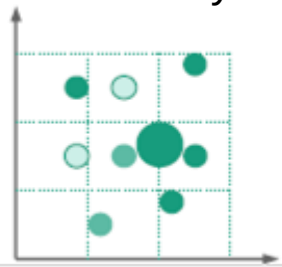
Techn. potential



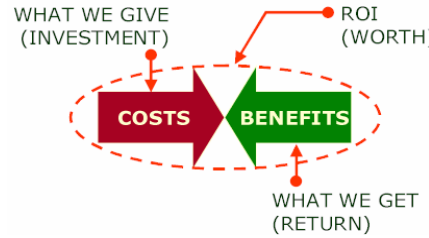
Techn. evolution



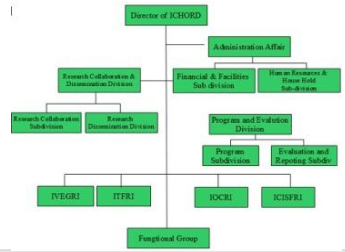
Portfolio analysis



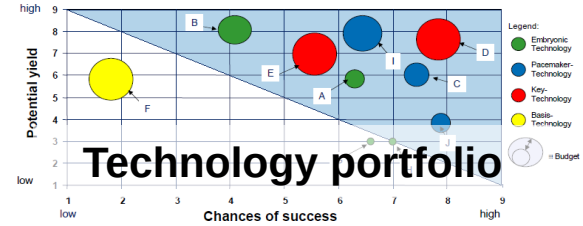
Financial return



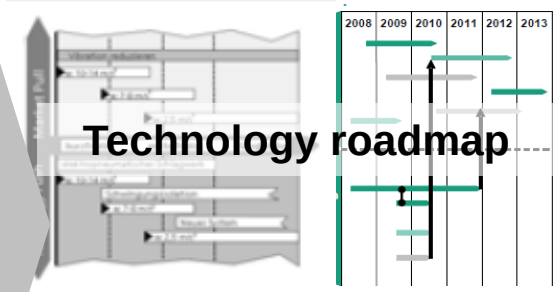
Organization aspect



OUTPUTS



Technology portfolio

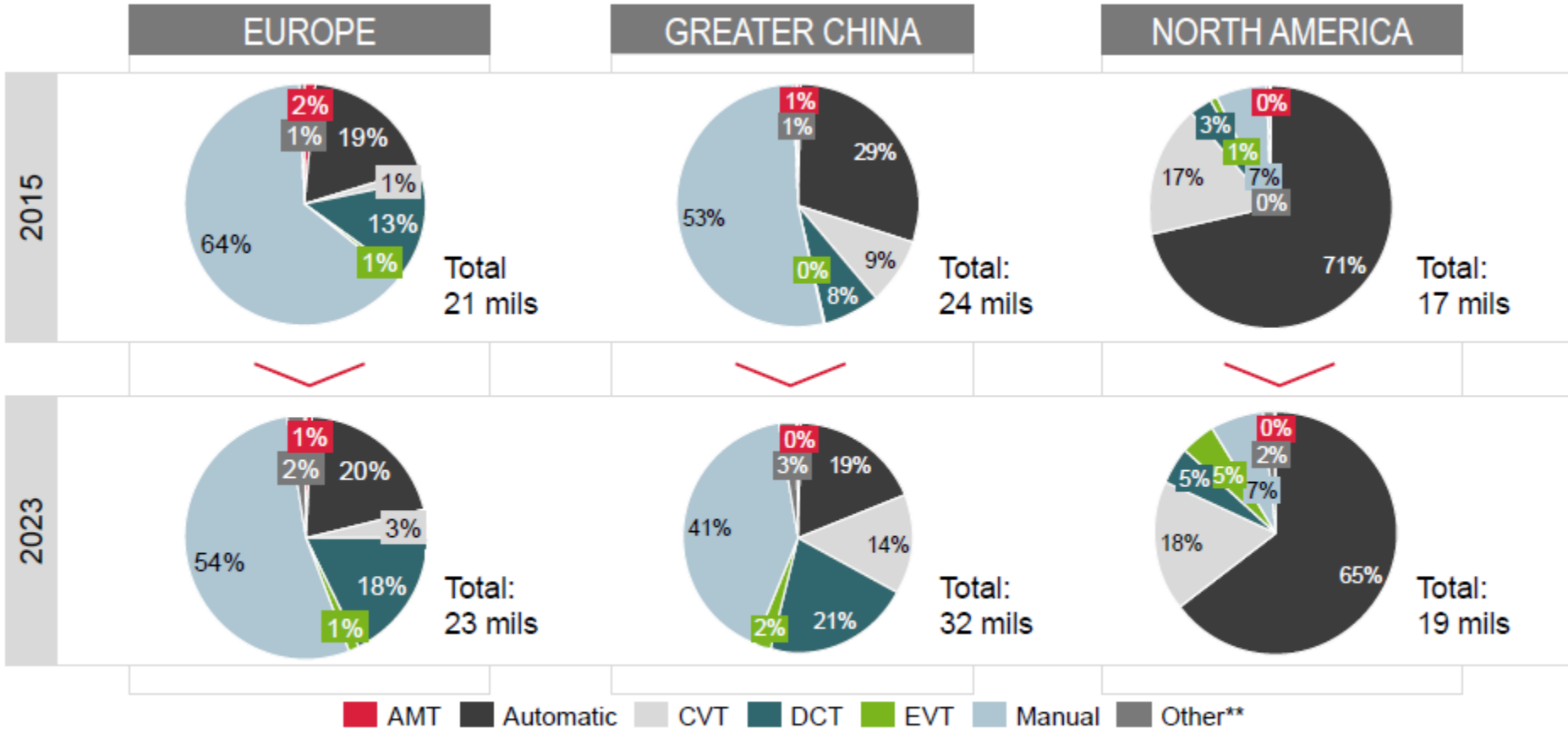


Technology roadmap

Technology datasheet

R&D investment level & technology sourcing

Technology Selection
Transmission market trends



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=> Much growth in automatic transmission business predicted for Asia and Europe!

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Conclusions

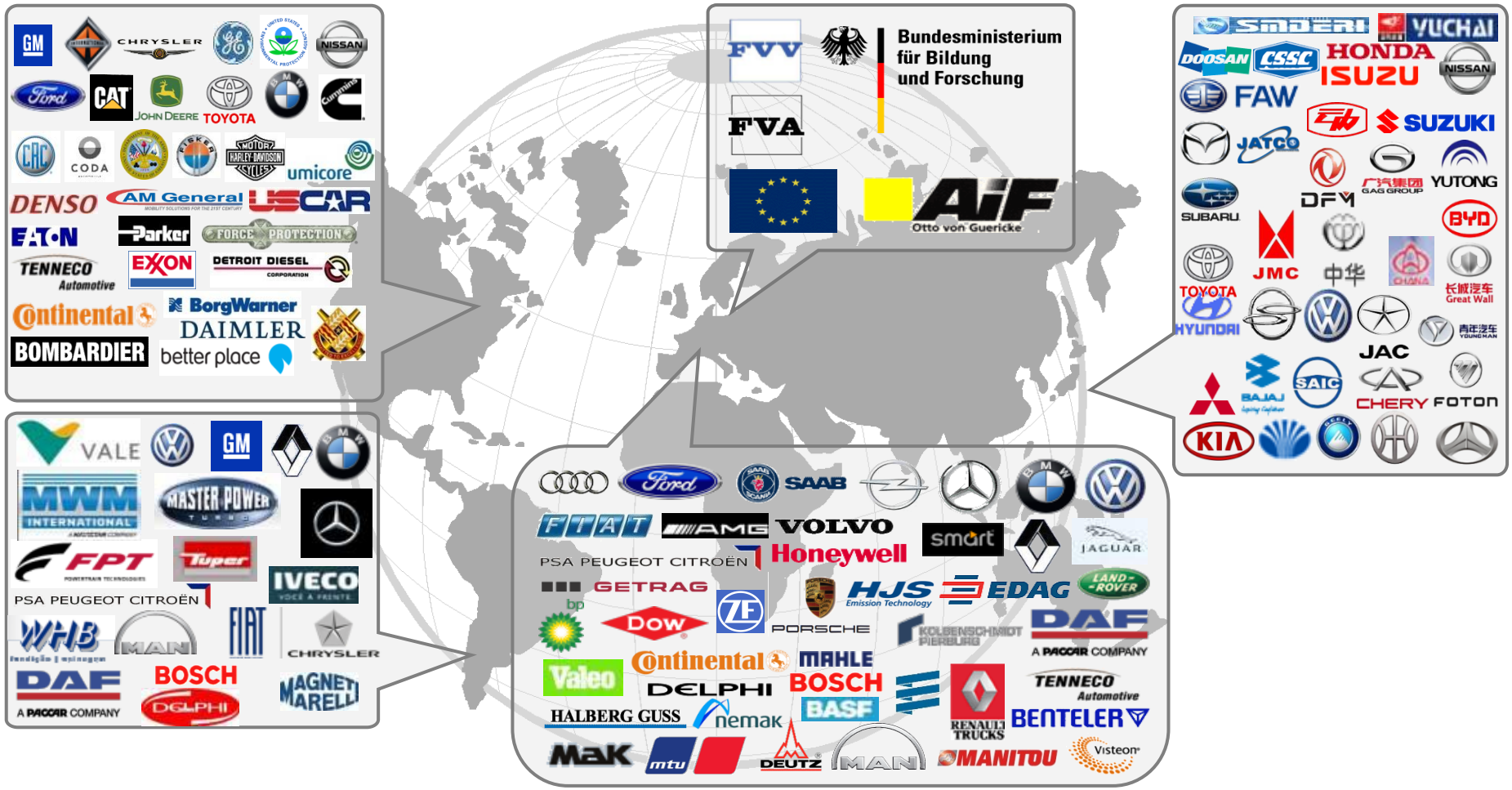
Powertrain and Vehicle Technology Management

- Technology is one of the main sources of competitive advantage, its management is the management of technological chances and risks
- Technology selection, performance, sourcing and timing to be within the budget and integrated with the corporate strategy!
- Effective product development requires technological expertise

FEV Your Propulsion Development Partner

- World’s leading powertrain and vehicle engineering service provider
- Supporting the present and developing the future for all market entry strategies
- Reliable partner as a unique source providing high performance solutions
- Proven quality, accelerated time schedules, competitive pricing

Extract of happy partners



Final words…

The Marriage of
Technology & Management

Joyful journey or Disaster