

The Reality of Virtual Testing

**The only constant is the change
Buddha**

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Introduction

"The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man. "
G. B. Shaw.

- Automotive industry (**The Impact**)
- Need to accommodate for environmental changes (**The change**)
- Which tools and what methodologies allow for progress (**The elements**)

Automotive Industry

- **Direct total income € 346 billion representing 8% of EU's total government revenues (2003)**
- **2,2 million employees (2004) , 10 million indirect jobs**
 - **Steel, chemical, electronics, glass, rubber, metals, IT, telecommunications, sales, maintenance, insurance, finance, logistics**
 - **Retail and repairs sector comprises 350000 SME's, Total of € 520 billion, employing 2,5 million**
- **7% EU's total manufacturing output, Total value added (2002) -> €118 billion**

Automotive Impact

Top 20 industrial R&D investors in Europe, 2005

Rank	Company	ICB Sector	Country	R&D Investment
				2005 €m
			Top 1000 Companies	112 876,47
			<i>number of companies for calculation</i>	<i>1000</i>
1	DaimlerChrysler	Automobiles & parts (335)	Germany	5 649,00
2	Siemens	Electrical components & equipment (2733)	Germany	5 155,00
3	GlaxoSmithKline	Pharmaceuticals (4577)	UK	4 564,13
4	Volkswagen	Automobiles & parts (335)	Germany	4 075,00
5	Sanofi-Aventis	Pharmaceuticals (4577)	France	4 044,00
6	Nokia	Telecommunications equipment (9578)	Finland	3 978,00
7	BMW	Automobiles & parts (335)	Germany	3 115,00
8	Robert Bosch	Automobiles & parts (335)	Germany	2 931,00
9	AstraZeneca	Pharmaceuticals (4577)	UK	2 864,51
10	Ericsson	Telecommunications equipment (9578)	Sweden	2 729,95
11	EADS	Aerospace & defence (271)	The Netherlands	2 367,00
12	Philips Electronics	Leisure goods (374)	The Netherlands	2 337,00
13	Renault	Automobiles & parts (335)	France	2 264,00
14	Peugeot (PSA)	Automobiles & parts (335)	France	2 151,00
15	BAE Systems	Aerospace & defence (271)	UK	2 108,88
16	Bayer	Chemicals (135)	Germany	1 886,00
17	Alcatel	Telecommunications equipment (9578)	France	1 792,00
18	Finmeccanica	Aerospace & defence (271)	Italy	1 746,00
19	Boehringer Ingelheim	Pharmaceuticals (4577)	Germany	1 360,00
20	Fiat	Automobiles & parts (335)	Italy	1 318,00

1st

4 of top 8

6 of top 15

Source: DG Research

Automotive Impact

· Sectoral aggregate R&D investment globally in 2004

The largest sectors by aggregate R&D investment from the world top *Scoreboard* companies, in 2004

Rank	Sectors	Total R&D investment (€ m)	Sector share (%)	R&D investment /company (€ m)
1	Automobiles & Parts (65)	58516	19.0	900.3
2	IT Hardware (169)	57351	18.6	339.4
3	Pharmaceuticals & Biotechnology (121)	56028	18.2	463.0
4	Electronic & Electrical Equipment (78)	34652	11.2	444.3
5	Software & Computer Services (80)	19625	6.4	245.3
6	Chemicals (80)	15656	5.1	195.7
7	Aerospace & Defence (24)	11718	3.8	488.2
8	Engineering & Machinery (68)	9015	2.9	132.6
9	Health (36)	6343	2.1	176.2
10	Telecommunication Services (18)	6329	2.1	351.6
11	Diversified Industrials (18)	5891	1.9	327.3
12	Oil & Gas (23)	4279	1.4	186.0
13	Personal Care & Households (15)	3646	1.2	243.1
14	Media & Entertainment (13)	3624	1.2	278.7
15	Food Producers (15)	3162	1.0	210.8
	Total 15 Sectors (823)	295835	95.8	359.5
	Rest of 16 Sectors (119)	12813	4.2	107.7
	TOTAL 942 companies	308648	100.0	327.7

Note: The number of companies (from the top 942) operating in each sector is given in brackets, after the name of each sector. The 942 companies are spread across 31 sectors.

Source: DG Research

The change

“It’s often too late to cover your ears when the thunder strikes ”

Sun Tzu (The art of War)

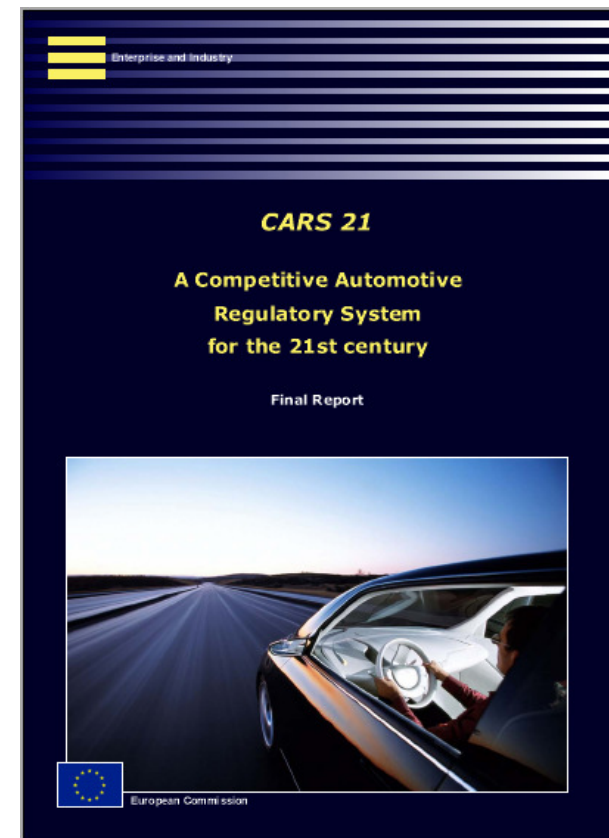
- Automotive industry is not infinitely scalable !
 - Limitations on resources and infrastructure
 - Fuels
 - Roads, Traffic
 - Pollution
 - Human interface to technology
 - Behaviours
 - Physical and Physiological
 - Social

A Common Vision - Industry

*“Nothing is permanent except the change”
Bouddha*

- **CARS21 (2006)**
 - Industry, commission, governments, consumer groups, parliament, syndicates
 - Introduce **self- or virtual testing** for 25 directives and UNECE regulations
 - Enable the legislator to improve the **quality of regulations** while minimising costs for economic operators
 - The **integrated approach** should aim at producing clear and quantifiable reductions in CO² along with improvement of vehicle safety (125 g/km by 2015)

<http://www.youtube.com/watch?v=OUfWu7H-G00>



2006

The Elements

- Challenges of the automotive industry in order to arrive at **integrated solutions** both for safety and environmental issues
- Role of **simulation technology** for **vehicles design**
- **High Performance Computing (HPC)** and advantages of Stochastic simulations for **vehicle certification**
- **Biomechanics** as a rising branch in numerical modelling allowing for **Human-Vehicle interactions** studies
- Environmental Challenges

Perspectives

- Any innovations or disruptive evolutions need to integrate the safety and environmental consideration in the **design and certification** processes
- **Integrated approach** -> Human-Vehicle interactions (technologies vs. industry sectors, decision support systems, “ecosystem” approach to vehicle design)
- Improve quality of life -> New design concepts for **sustainability**
- New technologies -> **Virtual Testing** and life cycle simulations
- **Stochastic modelling** , reliability based **quality rating**

Virtual Testing How-to

- **Evaluation** of **best-in-class models** (in-house and regulatory processes)
- **Generation** of models “**populations**” (need HPC)
- **Checkpoints** (experimental verification)
- Identification of danger zones (extrapolations or probabilities)
- Certification

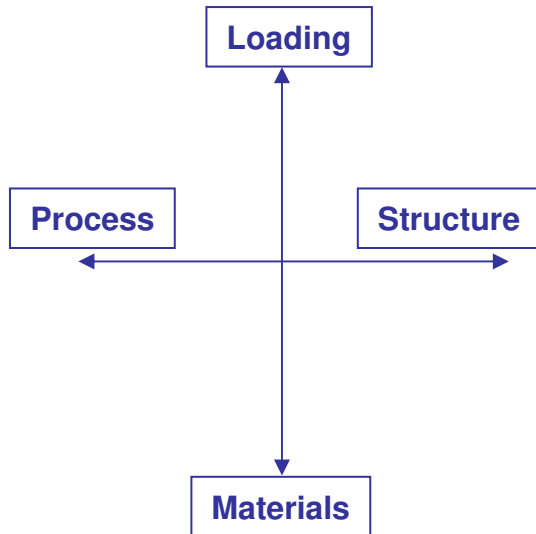
Virtual Testing Technologies

- **Physical testing** is per definition an isolated process (c.f. integrated approach)
- **Accident investigation** (Events, interactions, ergonomics, passengers' active vs. passive response, aging of vehicles)
- **Protocols** for Design vs. Certification (simulation vs. VT)
- **Simulation tools** (What can we model and how predictive is modelling?)
- **Statistics and optimisation** (Rating, Reliability, Robustness)
- **Bio-mechanics**

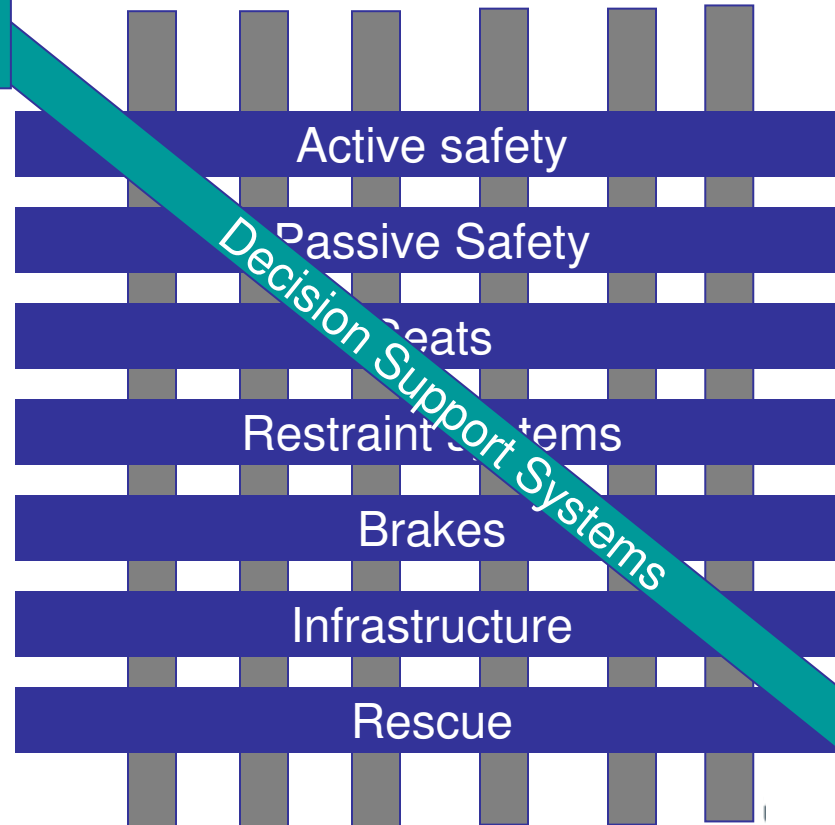
Integrated Approach

Simulation
/Virtual Testing
Crashworthiness/
Materials
Image recognition/
Data processing
Mechatronics
Bio-mechanics
Electronics/
telecommunications

Control strategies (analysis of
dispersions)



Integrated Safety Systems

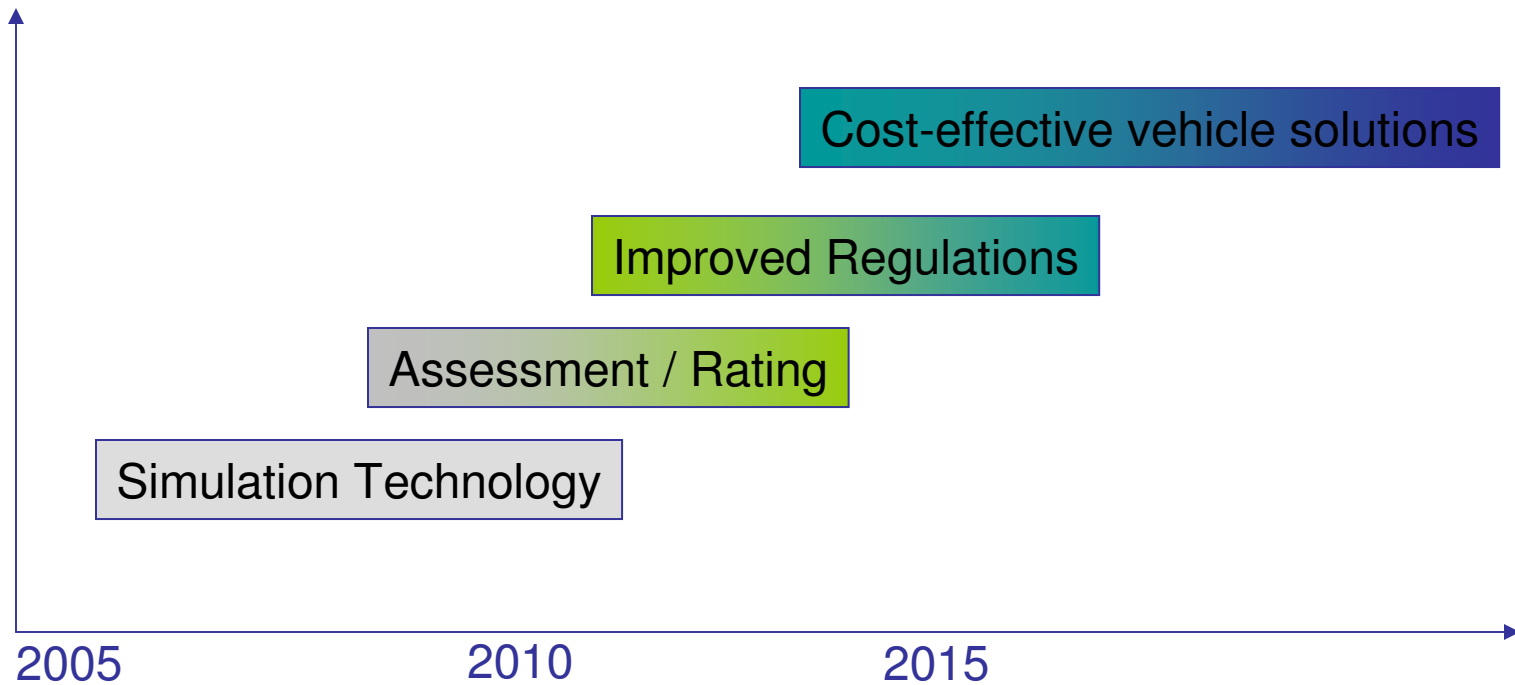


Virtual Testing Strategies

*“Sunshine is the proof of the Sun”
Persian proverb*

- **Definition of Scalars** (metrics)
 - How can we measure the « goodness » of a simulation?
- **Representivity**
 - Does our model represent the real world (average?) population or is it a « special case »?
- **Repeatability**
 - Can we obtain similar results from the model in another situation (dependence on Input)?
- **Rating** (how good?)
- **Reliability** (how spread c.f. real event?)
- **Robustness** (how controllable is the model?)

Virtual Testing Roadmap



The Reality of Virtual Testing

- **Regulatory**
 - **Competing with “zero-accident” vision**
 - **Complexity**
 - **Structures**
- **Manufacturer**
 - **No-change strategy**
 - **No market advantage**
 - **Technology barriers**
- **User**
 - **Real-life**
 - **Gain in safety and environmental advantages**

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