Innovate2011
The Rational Software Conference
11th and 12th of October
Let's build a smarter planet.

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# More Great Cars Faster….
# ….in a Sustainable World

**Mark Stanton, *Group Chief Engineer***
**Vehicle Engineering & Attributes, Jaguar Land Rover**

# VEA Video

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VEA Video

# JLR: Key Facts

**Largest UK automotive employer**
approaching 19,000 UK employees, 45,000 in supply chain, supporting 130,000 jobs in total

**Largest UK automotive investor in R&D**
approaching £1.5bn per year in Product Creation
4500 Engineers in core Product Development,
6000 Worldwide and growing

**Only car company researching, designing and manufacturing in the UK**

**Ambition Business Growth Plan**
40 new product actions in the next 5 years

**Sell products in 174 countries**
In 2010/2011, China up 70%, North America up 21%, Russia up 32%

# 2011 Line Up

JAGUAR

XK

XJ

XF

RANGE ROVER

Range Rover

RR Sport

Evoque

LAND ROVER

Discovery 4

Freelander 2

Defender

# Our PD Sites: Whitley

**A former site for Whitley and Lancaster Bomber production**

**55 acres & 76,000m$^2$ of office space**

**3000 employees**

**Home to Powertrain Engineering, Electrical Engineering and the Jaguar Design Studio**

# Our PD Sites: Gaydon

**Converted from V-Bomber base in 1977**

**World-class R&D centre of the Automotive Industry**

**60 Km of Test Tracks**

**4500 people and rising**

**VR suite, climatic wind tunnels, rig test and engine test beds, electro-magnetic chamber**

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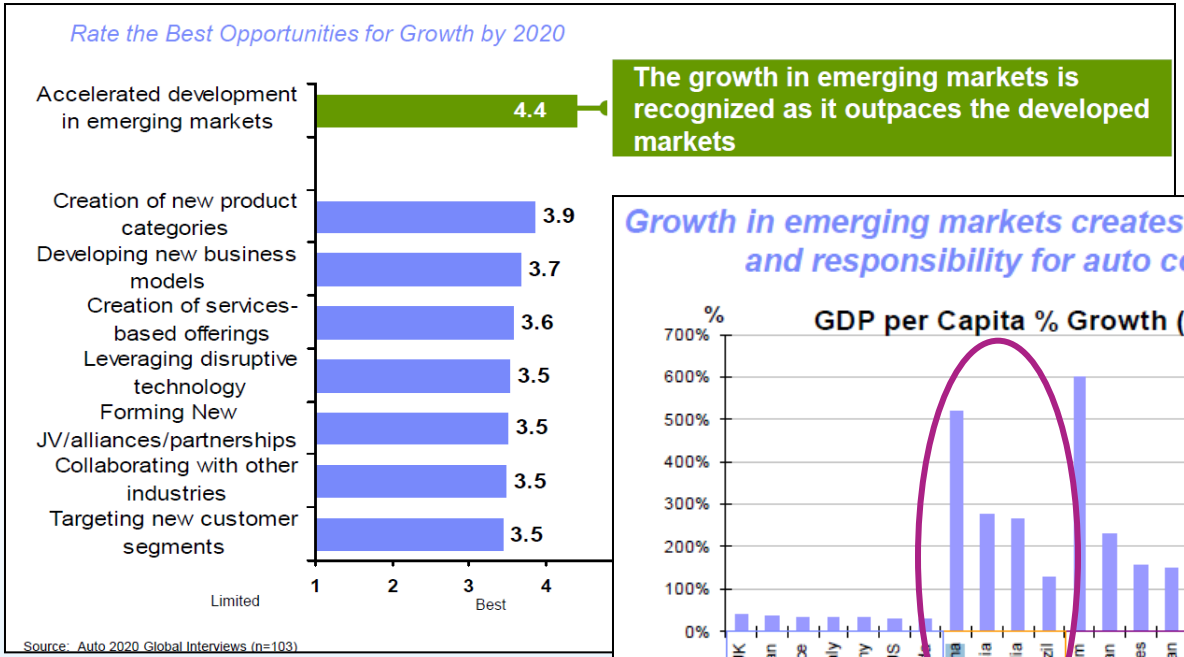
# The Challenges

| | |
|---|---|
| More Great Cars… | 40 product actions in the next 5 years |
| …Faster… | Reduced development lifecycles |
| in a Sustainable World | Corporate social responsibility |

| | |
|---|---|
| > Emerging Markets | Rise of the BRIC markets |
| Increased Complexity | Interconnected technologies |
| Robustness | Highest-ever quality expectations |

# Emerging Markets: Why are they important?

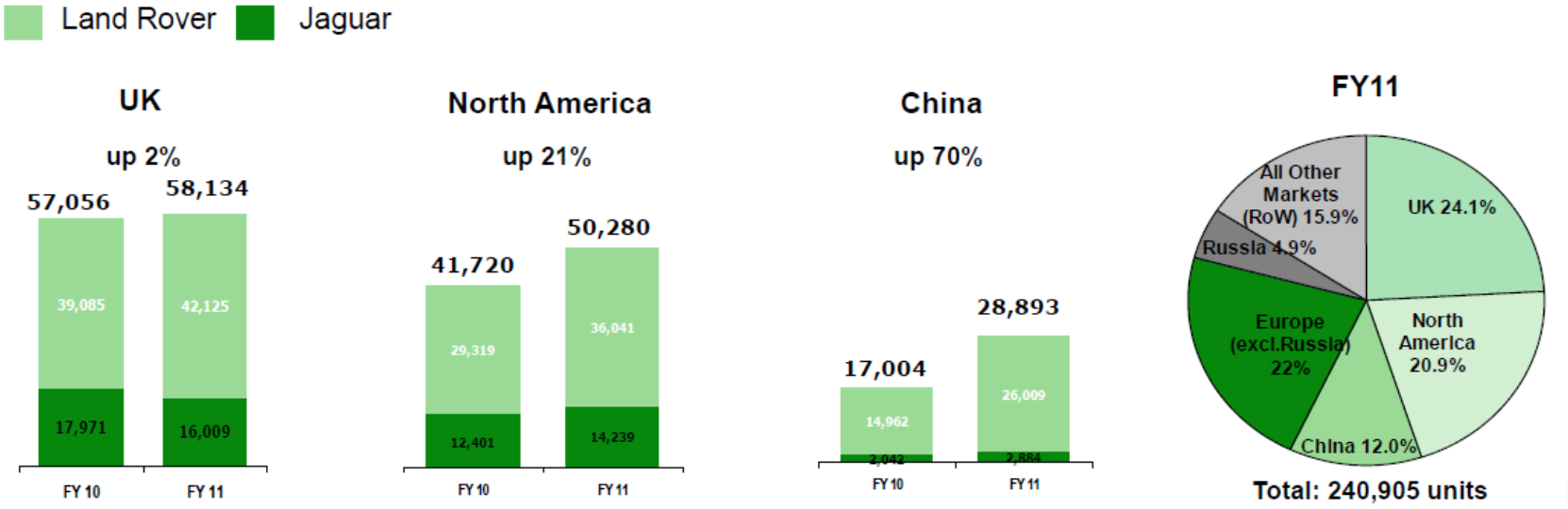



**The growth in emerging markets is recognized as it outpaces the developed markets**




From IBM Auto 2020 Global Interviews across Automotive Industry

# Emerging Markets: Our Sales




http://www.jaguarlandrover.com/pdf/Investor_Presentation_FY2011.pdf

# Emerging Markets: Understanding the Needs

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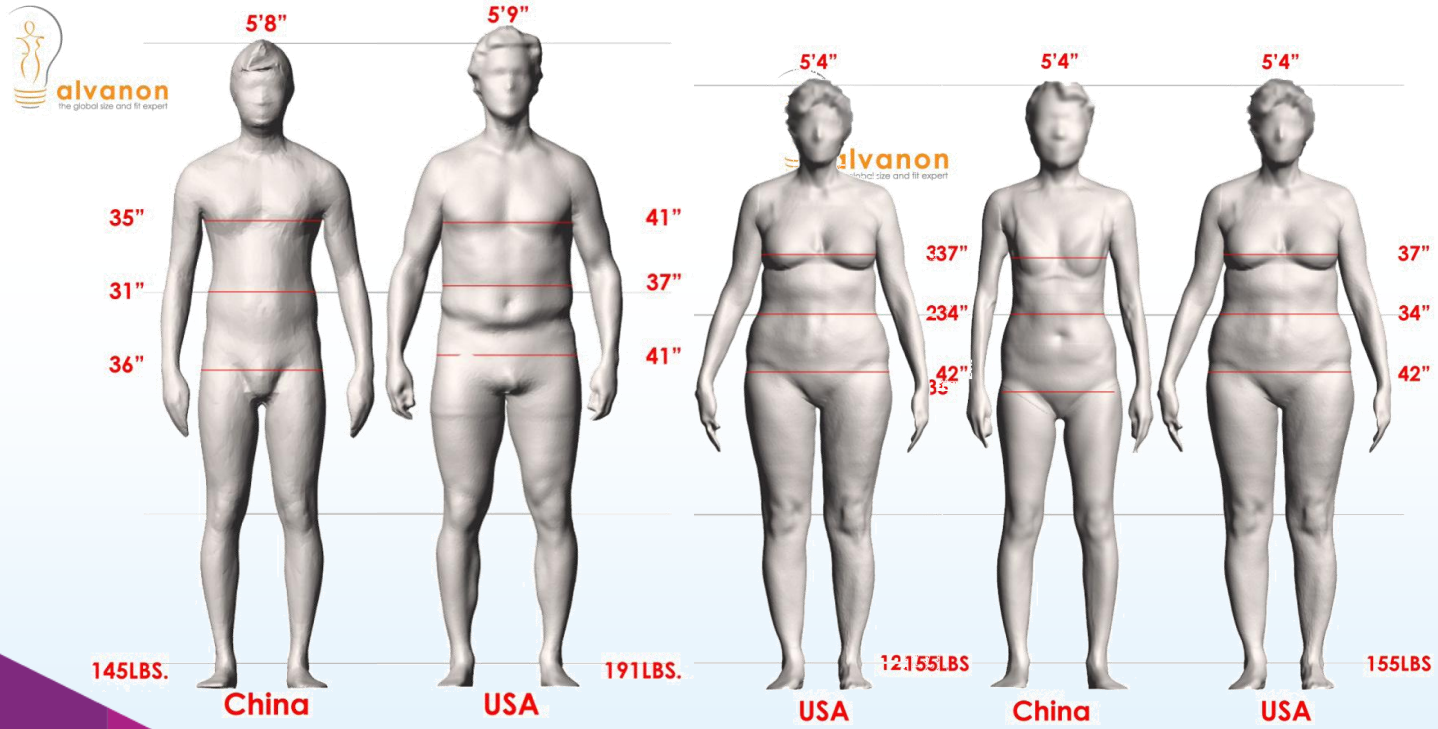
IBM

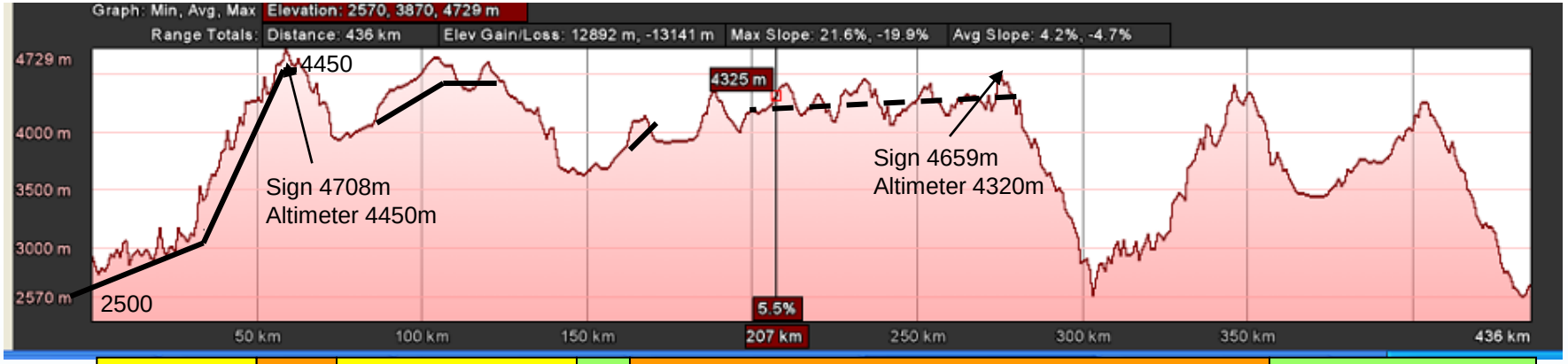
- Differences in anthropology of diverse cultures
- Owner-Driver vs. Chauffeur ratio in different markets
- Fuel quality and availability
- Electric charging points in the future
- Terrain, road surfaces and altitude
- Government legislation and environmental tax

# Emerging Markets: Understanding the People



# Emerging Markets: Understanding the Environment

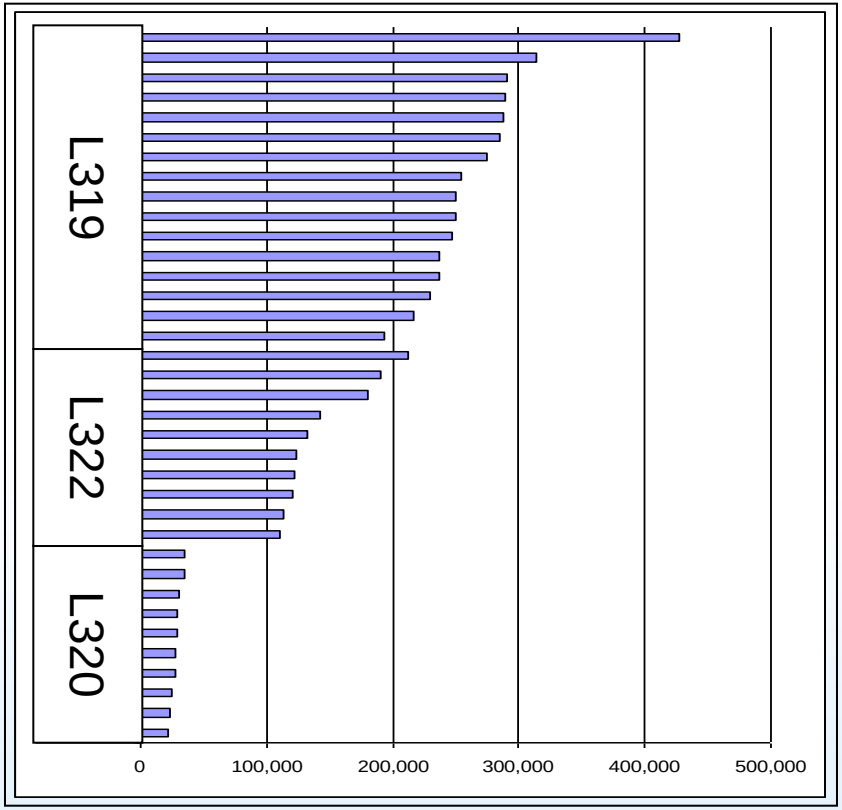
# Emerging Markets: Typical Test Route




| | | | | | |
|---|---|---|---|---|---|
| Single track, tarmac worn out sections. 60kph | Rough road. Warn out 40-60kph. | Single track, tarmac worn out sections. Average 60kph | | Rough road. Warn out road, in large areas especially hairpins no tarmac, large potholes, ruts, stones, road extremely poor. Average 40-60 kph | Good quality tarmac Downhill hairpins 100kph uphill and flat 60 kph downhill |

# A fleet of LR products in NW China

**Kurle Oil company, Kurle City, Xinjiang Uyghur Region**



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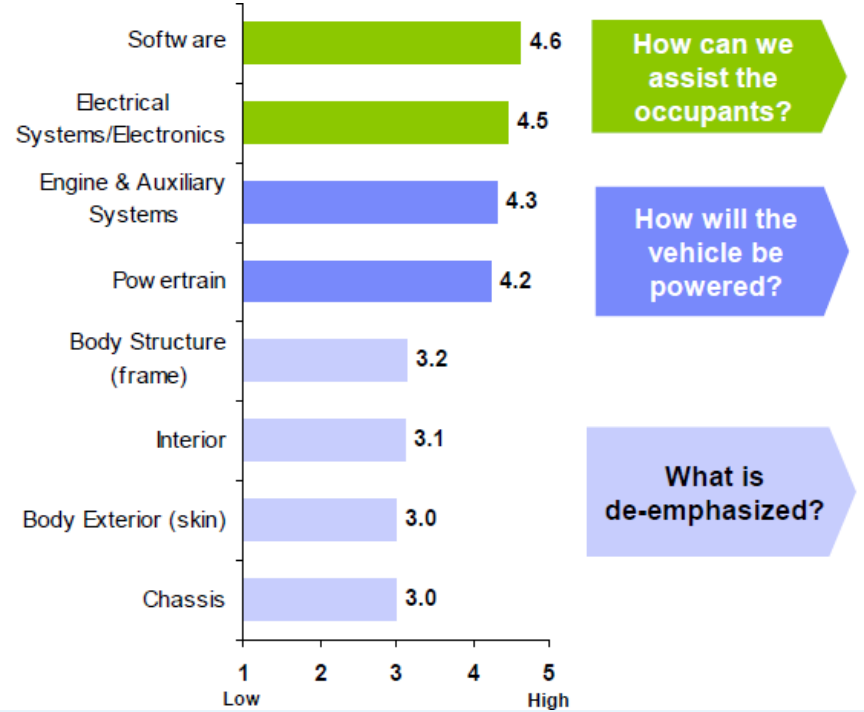
# Innovation is everywhere but software and electrical systems receive focus




From IBM Auto 2020 Global Interviews across Automotive Industry

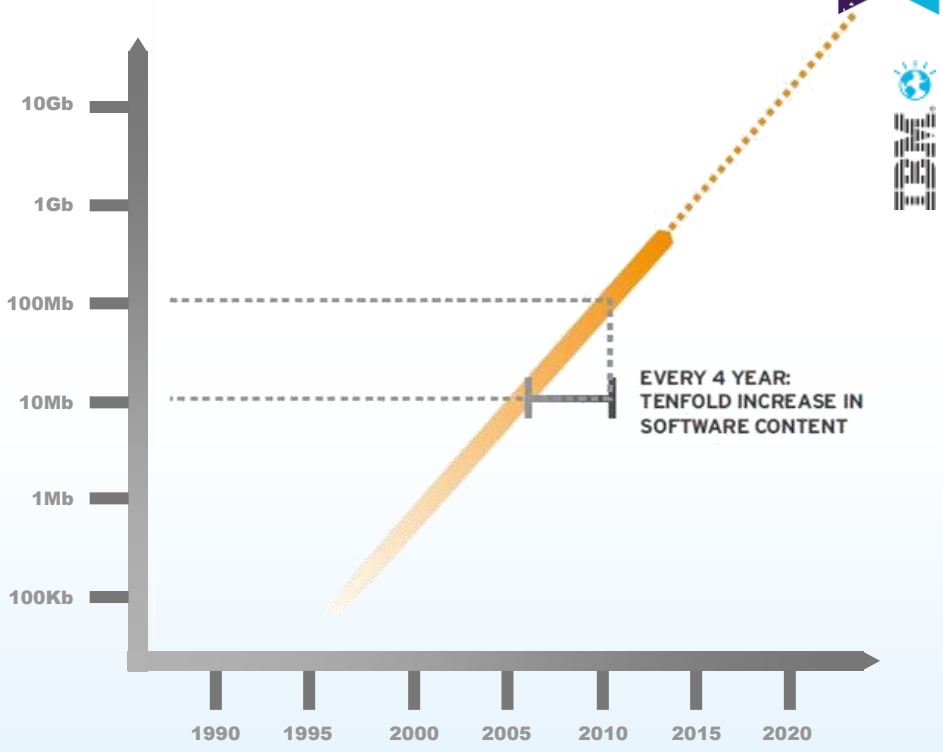
# Aero vs Auto Software Comparison

| F22 Raptor | Boeing Dreamliner | Modern Car | Boeing 777 | F-35 Joint Strike |
|---|---|---|---|---|
|  |  |  |  |  |
| **1.7 million SLOC** | **6.5 million SLOC** | **100 million SLOC** | **4 million SLOC** | **5.7 million SLOC** |
| The avionics system in the F-22 Raptor, Air Force frontline jet fighter | The avionics and onboard support systems in Boeing's new 787 Dreamliner | The control and comfort systems in a modern luxury car – which can contain up to 100 individual modules | Operation of the avionics and onboard support systems is split across 79 different systems | Operation of the onboard systems on an F-35 Joint Strike Fighter |

IN 2008 THE BUSINESS RESEARCH FIRM FROST & SULLIVAN ESTIMATED THAT CARS WILL REQUIRE **200 MILLION** TO **300 MILLION** LINES OF SOFTWARE CODE IN THE NEAR FUTURE

# Increase in Automotive Software

- It is widely acknowledged that 80% to 90% of vehicle innovations are based on software systems
- Current trends indicate that every four years there is a tenfold increase in the volume of software in high-end vehicles
- 50% to 70% of the development costs for an ECU are related to software

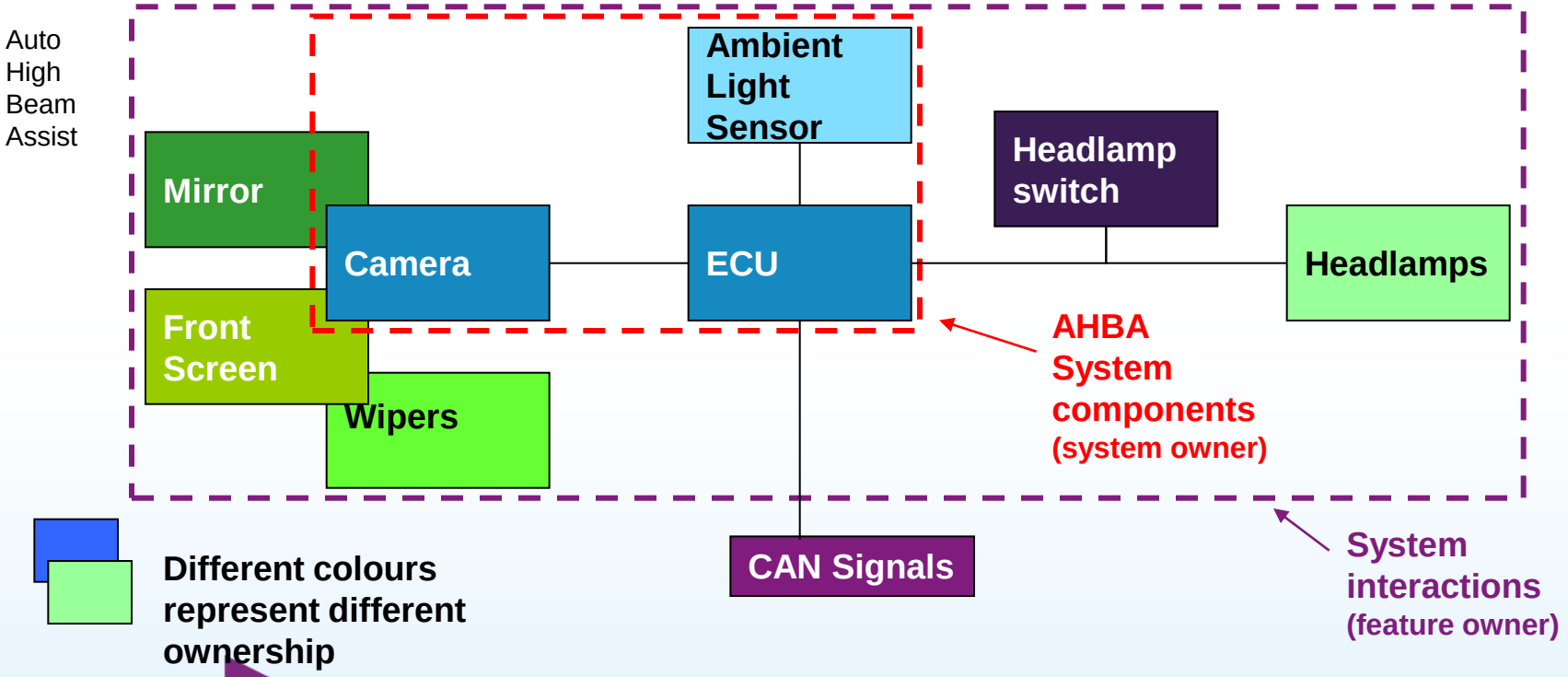


# System Level Example

## Auto High Beam Assist (AHBA) - Introduced in 2010:

- Automatically turns on high beam when no other vehicle present
- Automates high and low beam switching
- Communicates to headlamps and changes pattern

# System Boundary Diagram



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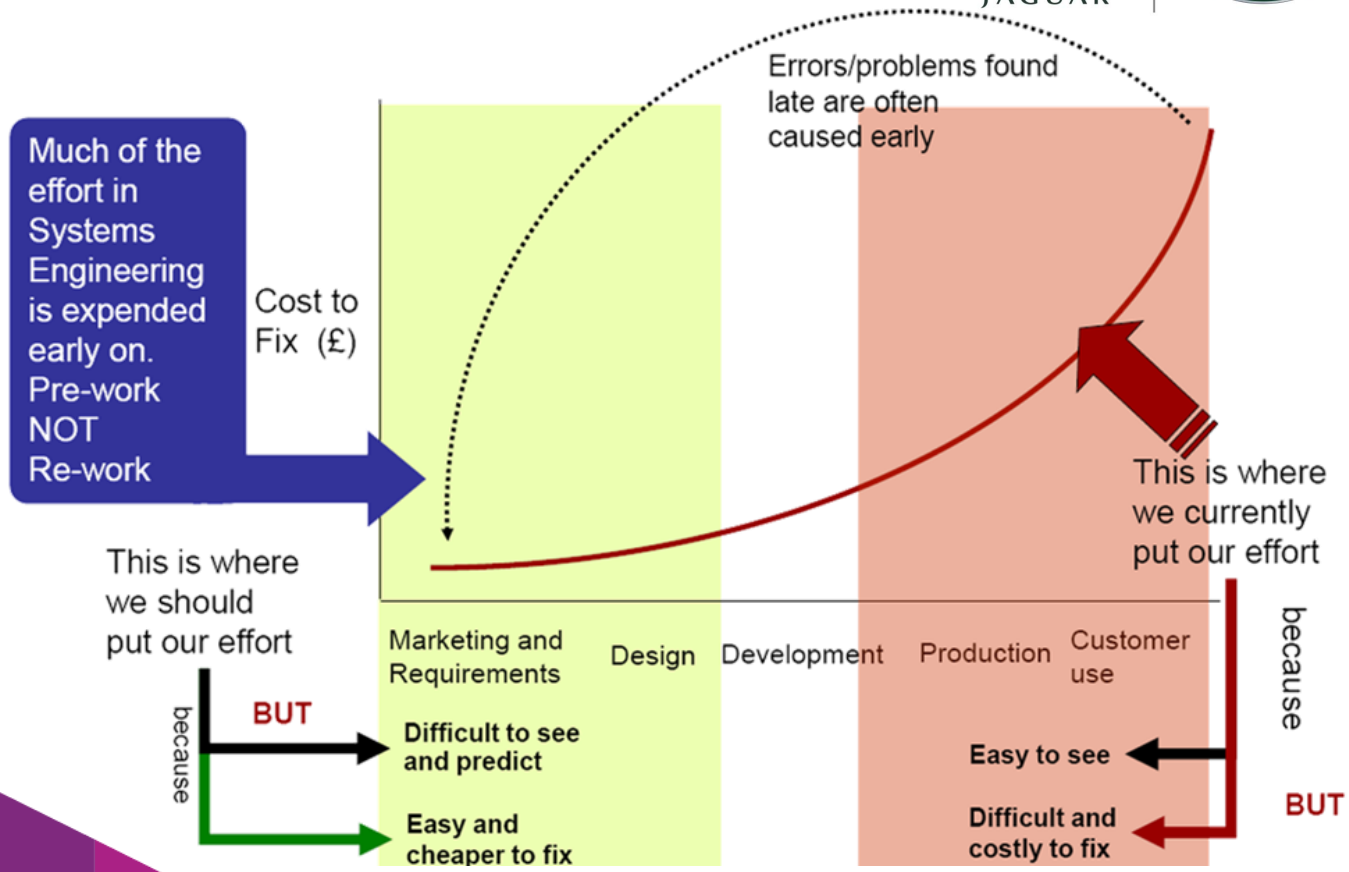
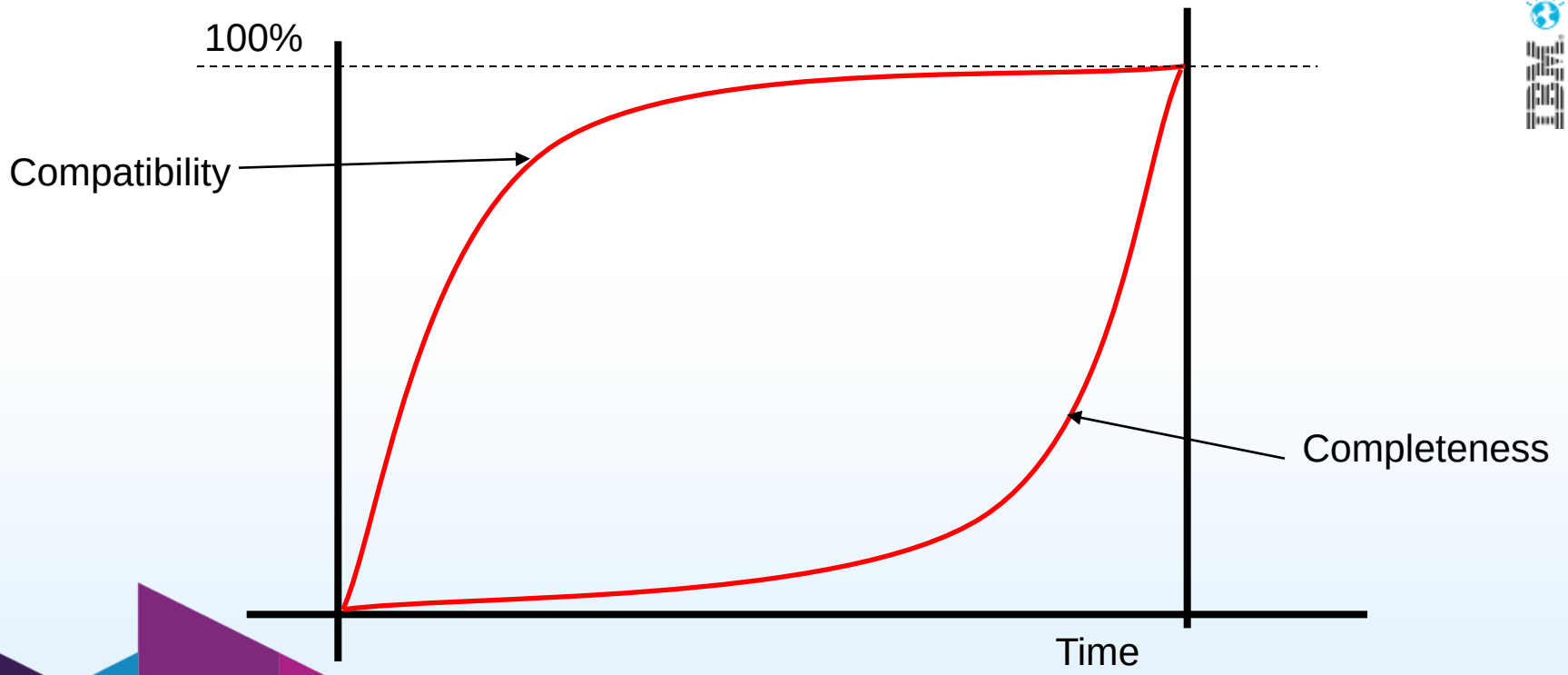
# Design & Build V&V



# Compatibility vs Completeness

**….consistent with a true system approach**



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# Summary: The Challenges

Globalization / Emergent Market Needs

Sustainability Needs…

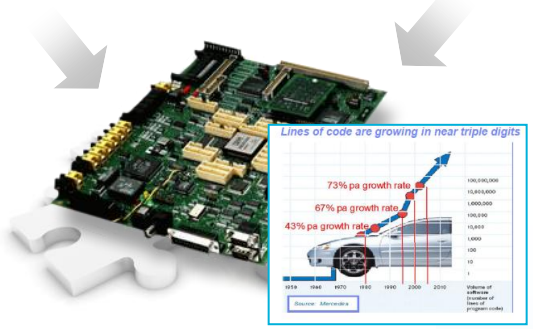
**Global markets are driving new requirements**

- New emergent markets are driving change
- Niche and luxury markets require understanding of new customer and environmental needs
- Increase in regulatory requirements from new markets
- Opportunities from diversification across markets and new product variants

# Summary: The Challenges

"Intelligent" vehicles

Interconnected technologies




**Increased usage of electronics and embedded software**

- **Growth in highly sophisticated in-vehicle electric/electronic (E/E) systems**
- **Product innovation driven from "intelligent systems"**
- **Growing customer demands and expectations**
- **Time-to-market and integration challenges**

# Summary: The Challenges

Multiple products and variants

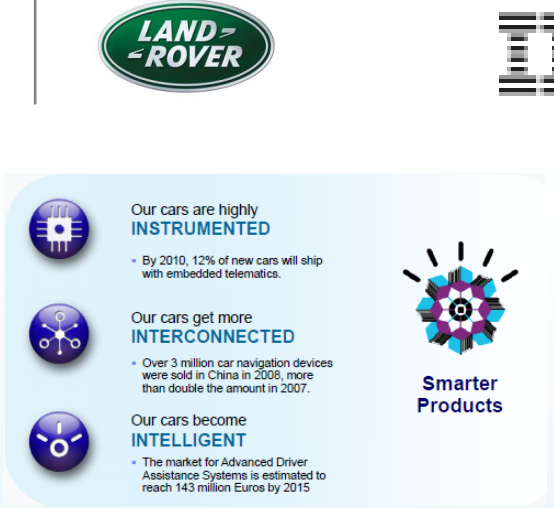
Multiple requirement sources

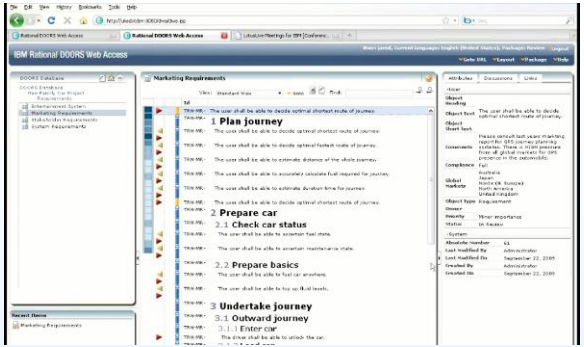
It is already complex

- Large number of product variants
- Strong competitive pressures driving change
- Development standards e.g. ISO26262
- System Engineering led approach
- Any tool must be scalable from the 10,000 re-used requirements we have today to ???,000 requirements in future.

# Partnership with industry

## E.g. Investing in Rational DOORS for requirements management…



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www.ibm/software/rational