IS THE AUTOMOTIVE INDUSTRY IN THE SLOW LANE?

Monday 18th May 2020

FUTURE OF TECHNOLOGY SERIES

SHARING IDEAS
UNLOCKING OPPORTUNITIES

Monday 18 May

10.30 – 10.55am

Keynote

Professor Neville Jackson FREng – IDE / APC

10.55am – 12pm

Is the automotive industry in the slow lane?

Mark Bowman – BAE Systems
Mark Mathieson – McLaren Racing
Sarah Kenny OBE – BMT Group / Maritime UK

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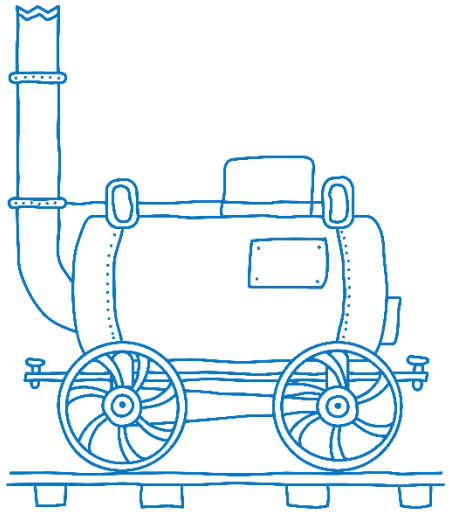
IS THE AUTOMOTIVE INDUSTRY IN THE SLOW LANE?

Prof. Neville Jackson

Chair of the Advisory Board – Institute of Digital Engineering

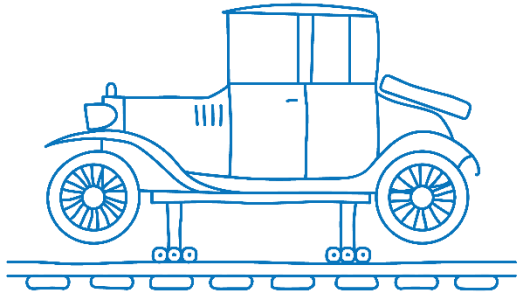
IDE INSTITUTE of DIGITAL ENGINEERING

The next industrial revolution emerges from the connected information age – smart complex systems in a virtual world



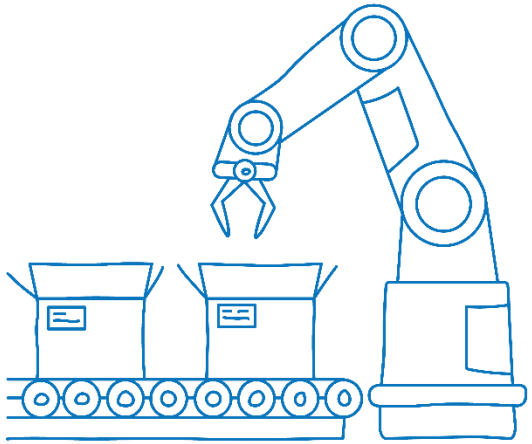
Industry 1.0 Mechanisation

From horsepower and wood to coal iron, steel & steam engines



Industry 2.0
Mass Production

From craftwork & "prototypes" to mass production & assembly lines



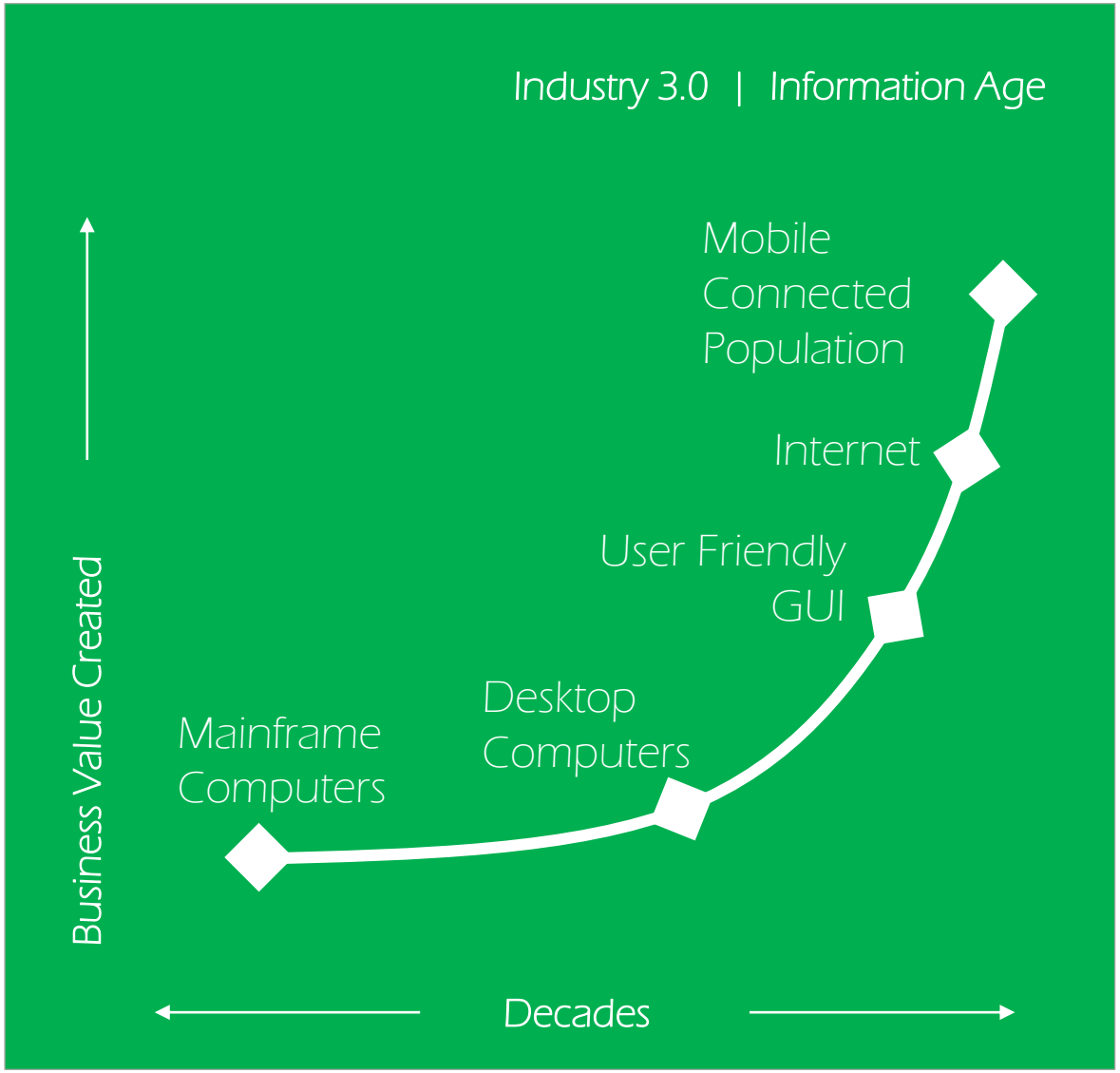
Industry 3.0
Information Age

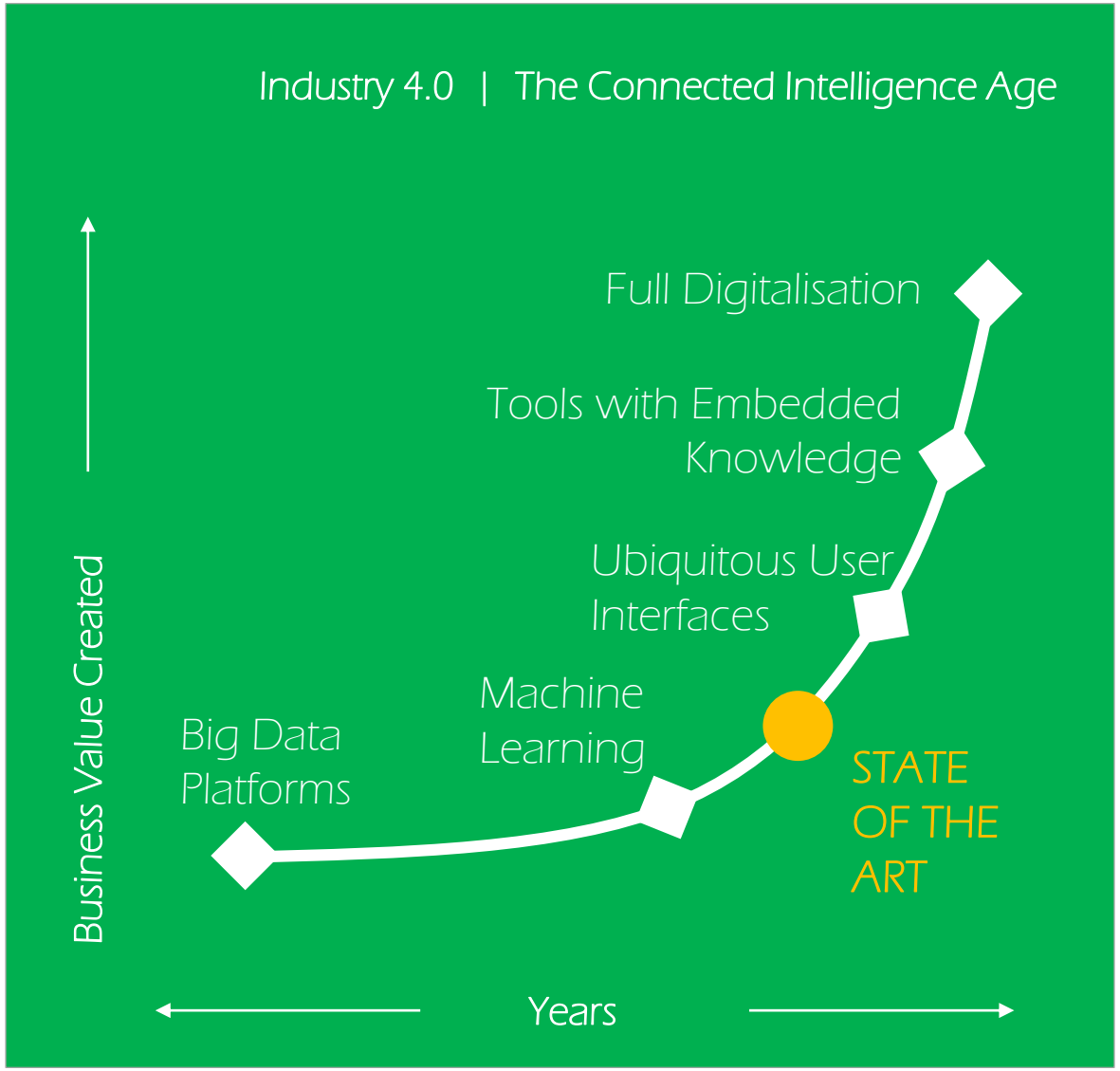
Connecting devices and people via the Internet of Things – the data explosion

Industry 4.0
Connected Intelligence

Making sense of & extracting value from the information age – Artificial Intelligence

Industry 4.0 implementation at faster pace than 3.0 – and accelerating...





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Source: Publicis:Salient May 2016

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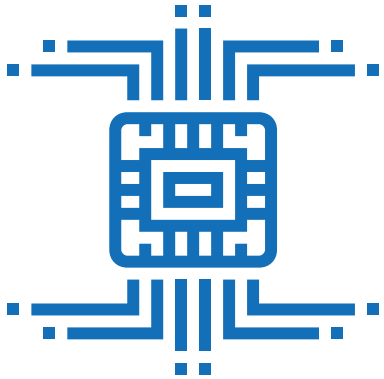
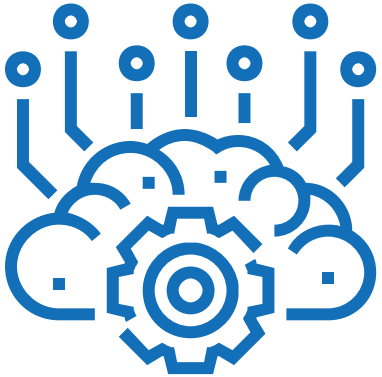
Terminology can be Confusing...

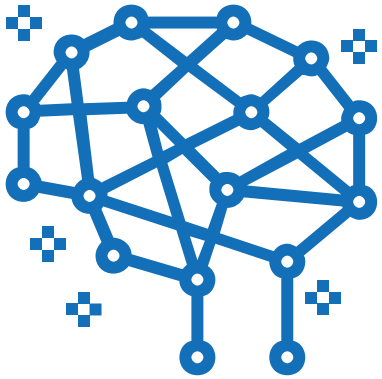
Big data



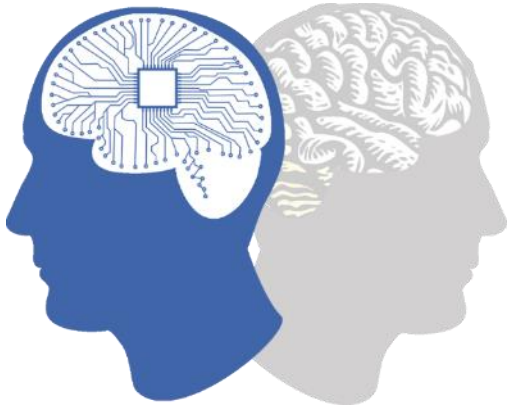
Machine learning



Deep learning



Artificial intelligence



What is Digitalisation?

There are a number of definitions but perhaps the engineering:

"Turning a **physical** test or labour intensive **process** into a virtual or **digital form** to add **value** and increase **efficiency**."

Neville Jackson
Ricardo Chief Technology and Innovation Officer

Machine Learning & AI in Financial Technology (Fintech)

The global Fintech market is expected to grow to $309.98 billion by 2022 - an AGR of 24.8%*
Use of AI in Fintech was estimated at USD 7.27 billion in 2019 and is expected to reach USD 35.40 billion by 2025 - a CAGR of 31.5% to 2025^

Example: AI for Agent based trading:

Systems are “taught” to respond to data and inputs

Existing data used to develop and tune behaviours

Model able to predict market movements

Current adoption of AI includes:

- Hedge funds / AI systems
- Siemens use AI and ML to forecast and manage renewable energy resources and future raw material prices

Source: *https://www.prnewswire.com/news-releases/, ^AI in Fintech Market - Growth, Trends, and Forecast (2020 - 2025)

Machine Learning & Artificial Intelligence in Pharma / Healthcare

McKinsey estimates that big data and machine learning in pharma and medicine could generate a value of up to $100B annually, via better decision-making, optimised innovation, improved efficiency of research/clinical trials, and new tool creation for all stakeholders

Example: AI and ML for data analysis and improved diagnosis

AI helps to request the right tests

Diagnose medical conditions more accurately

Improve the focus and probability of success in new drug development

AI used to analyse vast quantities of technical papers and data

- Natural Language Processing (NLP) with AI

Automotive Sector - Advances in computing power, AI & flexible manufacture offer significant productivity & cost benefits despite system complexity challenges

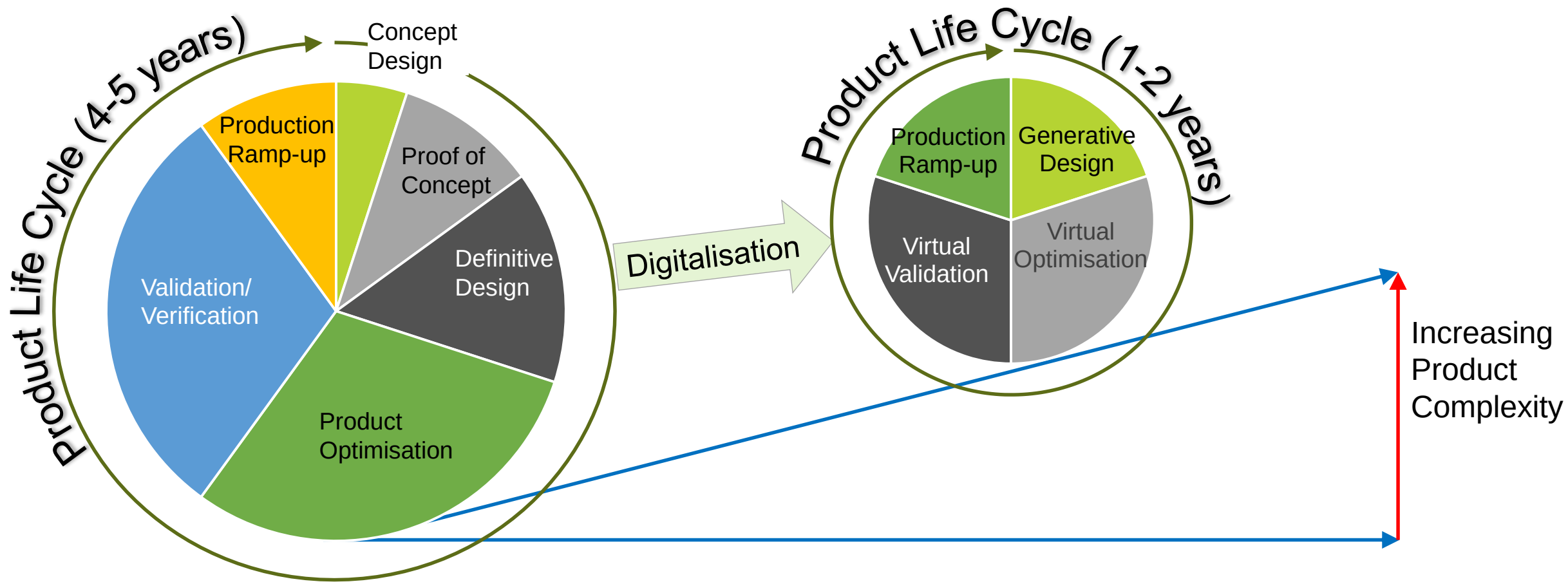
Challenges

- **Productivity Improvements**
  - Increasing product complexity & optimisation requirements
    - Current PD durations of 5-7 years not sustainable in the digital age
- **Product Development Costs**
  - Cost of new product launch ~ $1-2 billion for mass market
    - Need route to lower total costs despite increases in complexity
- **Connected & Autonomous Functions**
  - Optimisation, validation & certification of ADAS & Autonomous functions
    - Not feasible via physical testing – need virtual test environment

Opportunities/Enablers

- **Exponential growth in Computing capabilities**
  - Increase in hardware via parallel computing and GPU's (10^{12} FLOPS)
    - Affordable computer systems competing with human brain by 2025?
- **Growth of Machine Learning & Artificial Intelligence**
  - Significant progress in Machine Learning & AI in FinTech & Medicine
    - Self learning systems, turning data into knowledge, auto-optimisation
- **Flexibility in Advanced Manufacturing Technologies**
  - Machine & routing flexibility coupled with Computer Integrated Manufacture
    - Ability to accommodate new products – reducing dedicated operations

Increasing complexity & need for total system optimisation requires PD&D process to evolve to virtual approach with less hardware/testing



Vehicle software now emerging as critical path for new product development

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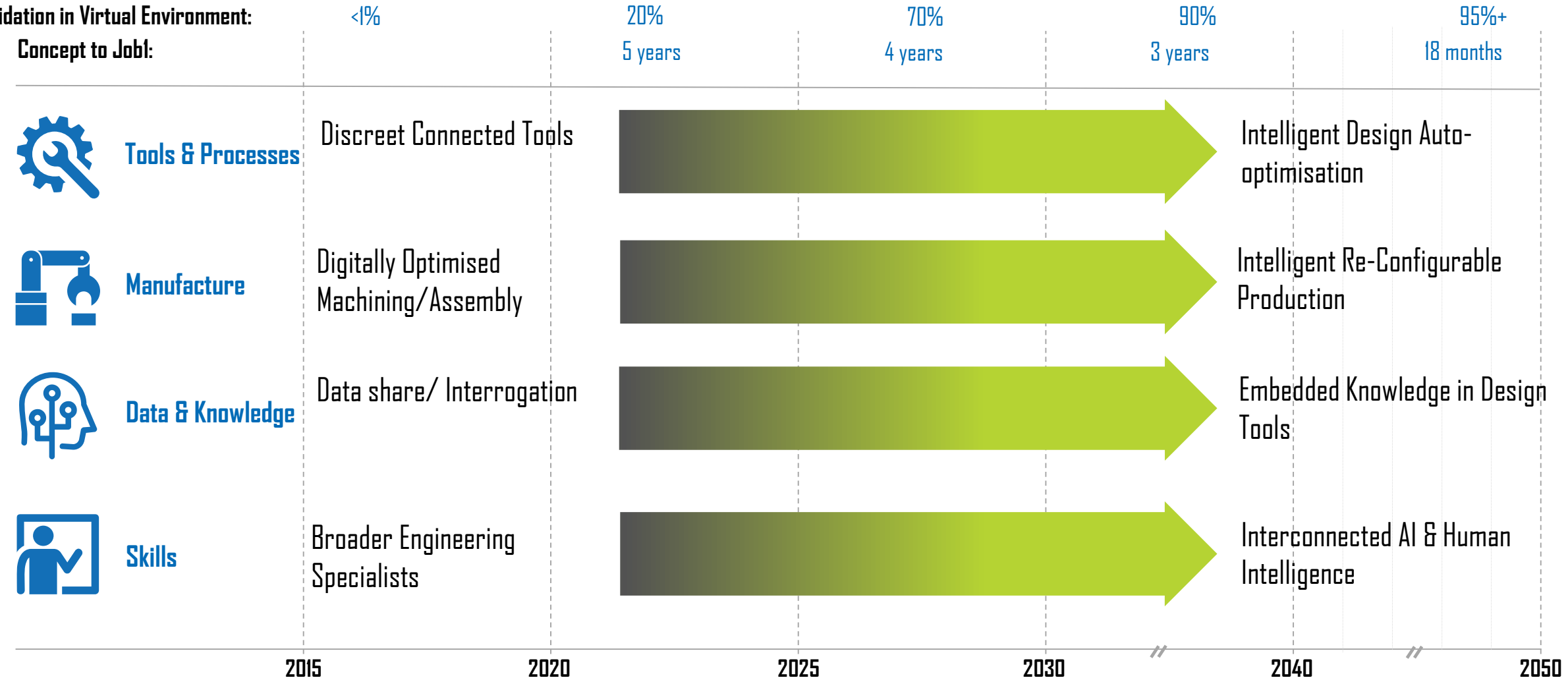
Virtual Product Engineering – high level drivers & roadmap



IDE will lead a detailed national Roadmapping programme for Digitalisation

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Machine Learning & AI in Product design and development

In the Automotive sector, machine learning and AI are mostly associated with automated driving but there are significant opportunities to employ these techniques in design, development, calibration, validation & manufacturing processes

Example: Knowledge based Design

Past product design, performance & manufacturing knowledge embedded in design tools

Analyses and auto optimisation integrated into design process

Design as an output from component or product attribute requirements

Manufacturing & cost implications embedded in design process

The UK Automotive Council has restructured to focus on three core missions – with Digitalisation as a key focus area

TRANSITION TO ZERO

Industry Lead

Delivery Lead

ADVANCING DIGITALISATION

Mark Mathieson
McLaren

Bradley Yorke-Biggs
IDE UK/Loughborough University

CONNECTED AUTOMATED MOBILITY

Industry Lead

Delivery Lead

Delivering world class UK automotive capabilities through Digital Innovation

The Brunel Challenge is a plan for UK engineering to lead the world by delivering ever more complex products in half the time, for half the cost

- The Brunel Challenge is an **urgent call for action** initially spearheaded by **5 large industrial sectors** (Auto, Aero, Defence, Maritime & Energy)

Solving 21st Century Societal Challenges through World-Leading Engineering Excellence

- These sectors all face **exponential growth in system complexity** and the need for knowledge based high value design and **virtual product development & validation** integrated throughout their **supply chains**
- The programme harnesses **new technologies such as AI & Big Data** to transform engineering agility, fidelity and efficiency, thus delivering **globally-leading** productivity for the UK.
- Brunel is a multi-faceted 5 year, £348m programme, of which 55% will be funded by the industries themselves to demonstrate **depth of commitment**. It has a delivery model and fast-start projects that are **ready to go** and that **build on existing national infrastructure** and capabilities.
- An accelerated **£50m Brunel fast start proposal** has been created (**Brunel Slingshot**) based on lessons learned from the Ventilator initiative to accelerate adoption of virtual processes into the UK industrial base

The future "interconnected digitalised economy" will need a new set of engineering and business skill sets

Future Generations of Engineers:

- Brought up in social media & virtual reality gaming
- Broader view of environmental responsibilities
- Seamless social interactions via the digital & physical world
- Driving growth of on-demand services

Engineering challenges:

- Ever more complex systems interactions
- Reliance on digital tools & techniques
- Multi-physics challenges & opportunities
- Growth and domination of mechatronics

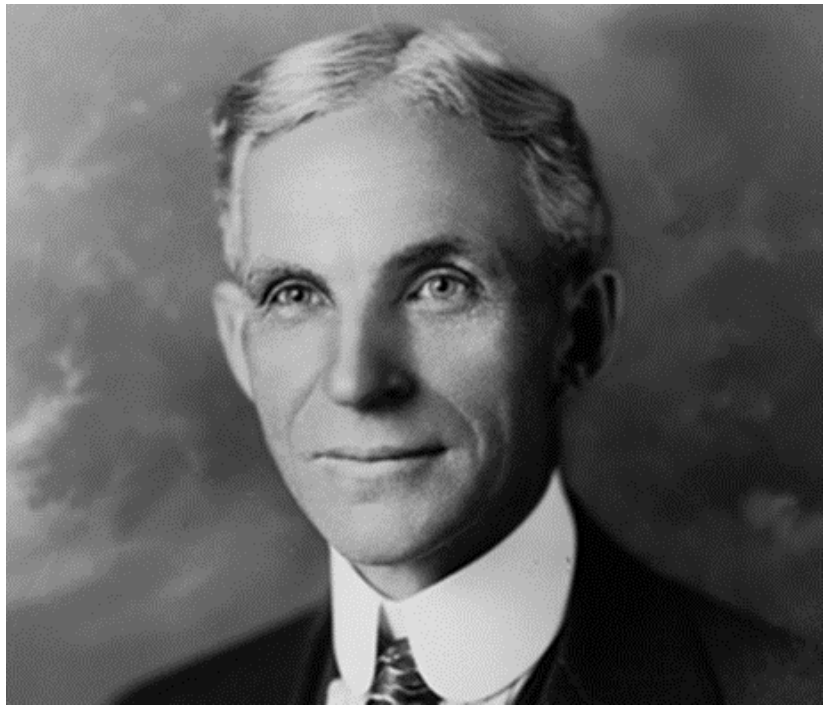
Future Skills:

- Capabilities in digital tools validating solutions
- Understanding physical processes but also digitalisation
- Broader understanding of all engineering disciplines
- Open innovation & digitally connected world

Sir Brian Burridge keynote will expand on this topic in the Friday webinar

"If you **always do** what you've **always done**, you'll **always always get** what you've **always got**."

Henry Ford
Founder, Ford Motor Company



UNFORTUNATELY MARK BOWMAN WAS UNABLE TO MAKE THE EVENT SO WE DO NOT HAVE HIS SLIDES TO SHARE

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A DIGITAL REVOLUTION IN PRODUCT DEVELOPMENT

Mark Mathieson
Lead Partner, Technical Services

McLaren

SUMMARY

- Background – Product Development
- Current Process versus Future Process
- Example Cases
- Conclusions

OUR FUTURE WILL BE SHAPED BY ENGINEERING….

British engineers shaped today's society.

Steam railways changed where we live and what we eat

The jet engine that made global travel accessible to the masses

In the future, engineers will develop …

Autonomous cars and flying taxis that make urban mobility faster, easier and cleaner

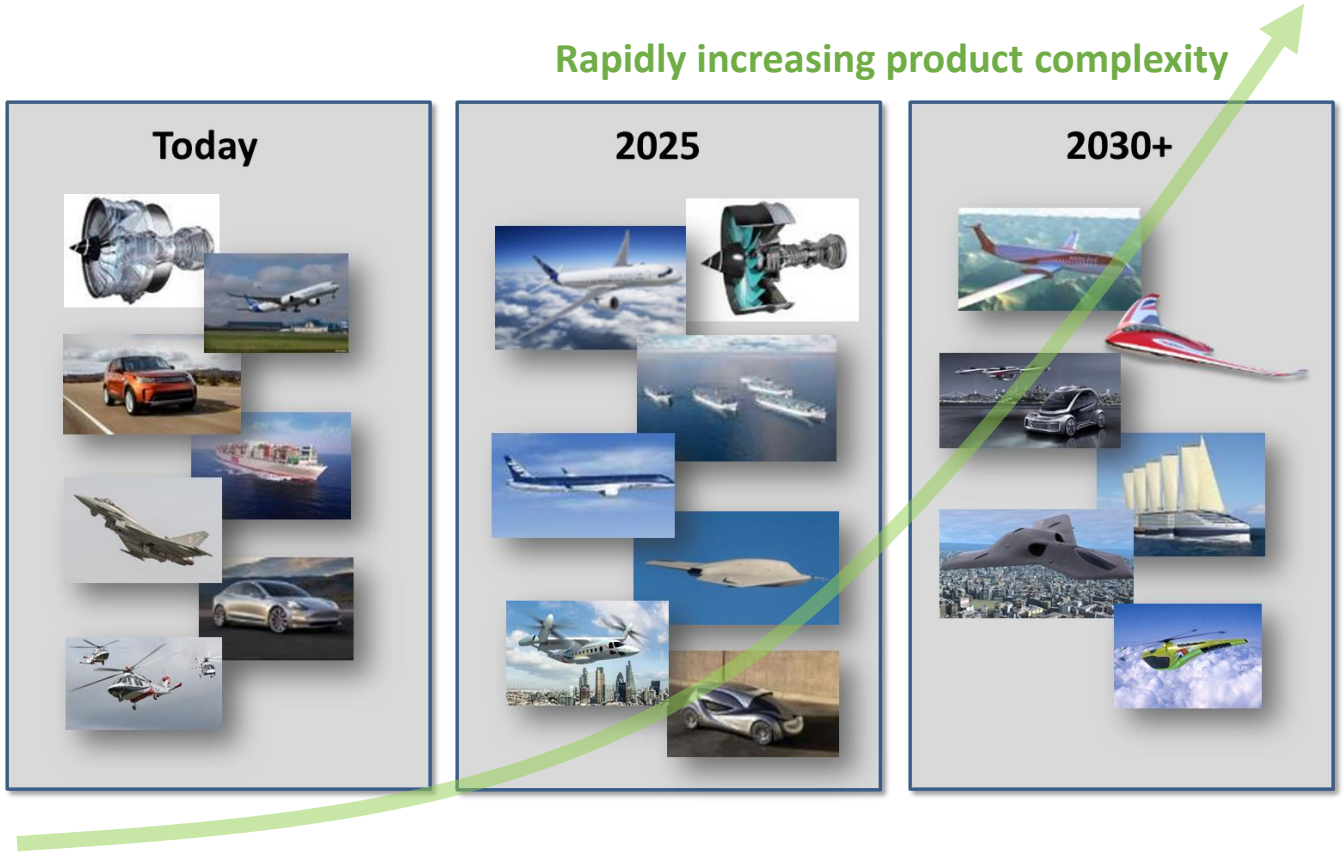
Autonomous ships that are more efficient, safe and productive

Intelligent equipment making farming more sustainable

… once again, changing our lives

… and undoubtedly a cross-sector revolution

TOMORROW'S PRODUCTS CANNOT BE DELIVERED BY TODAY'S ENGINEERING CAPABILITIES



Unprecedented requirements push costs to non-viable levels -

- Ground-breaking products
- Fully validated, transformational designs
- Ever more challenging regulatory requirements
- Radically altering commercial models
- Right first time, every time
- Faster to market, at a reduced cost

Smart approaches will be required -

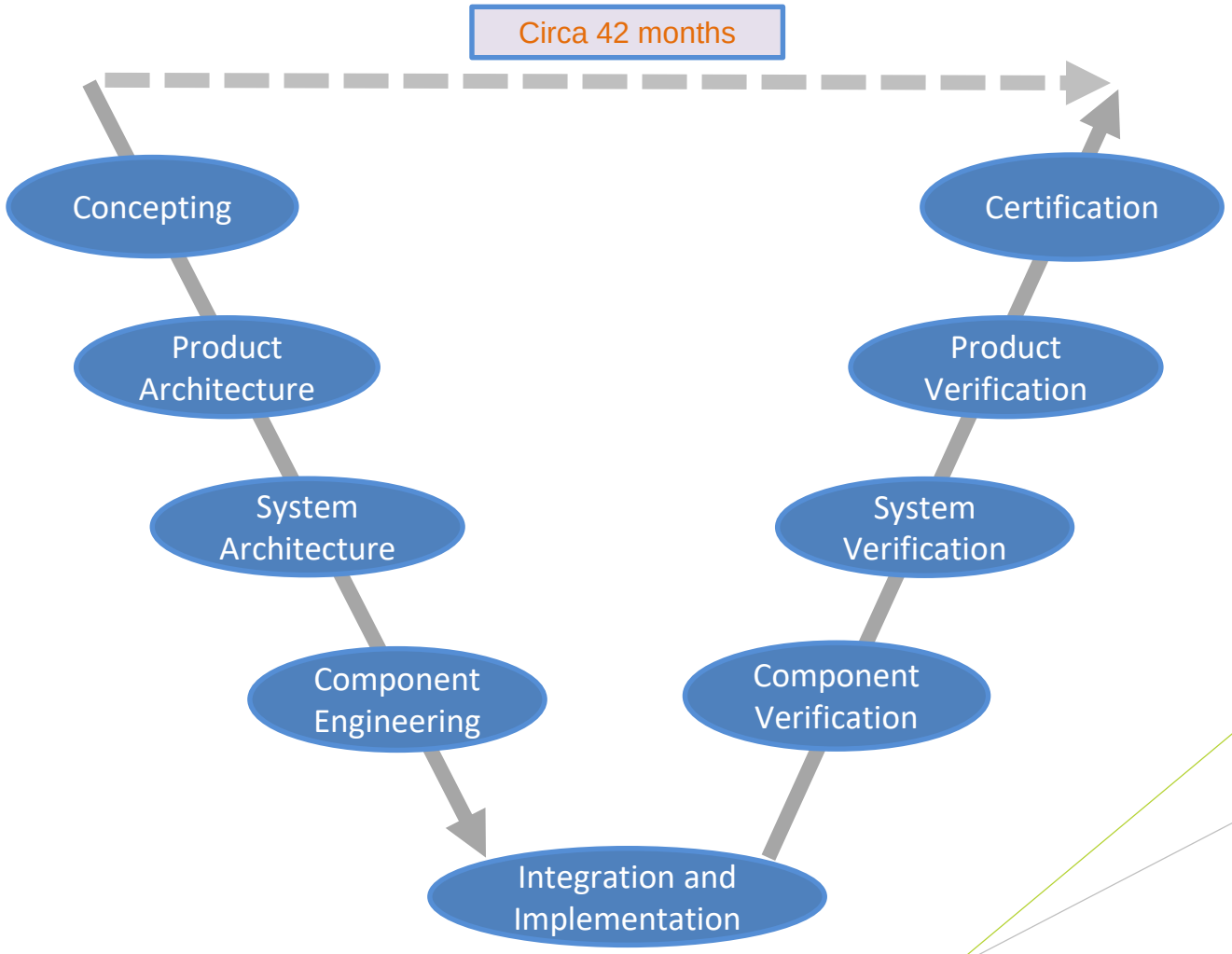
- ***Cross-sector collaboration*** - sharing the investment burden
- ***Virtual verification and certification*** – reduces expensive empirical testing
- Step change in productivity through adoption of ***digital tools & techniques***

The engineering approach must transform to reduce time and cost, enable creativity and handle increased complexity.

The UK has a tremendous opportunity to take a global lead – but must act now.

Current Product Development Process – 'V' Model

- Heavily dependent on ***physical hardware*** and ***empirical testing***, driving cost and time into programmes.
- Increasing ***product complexity*** makes this traditional approach ***unsustainable*** in a competitive global market.
- ***Autonomous vehicles*** will be the most complex products ever produced, across multiple sectors. Burning platform – ***virtual verification and certification is essential***.

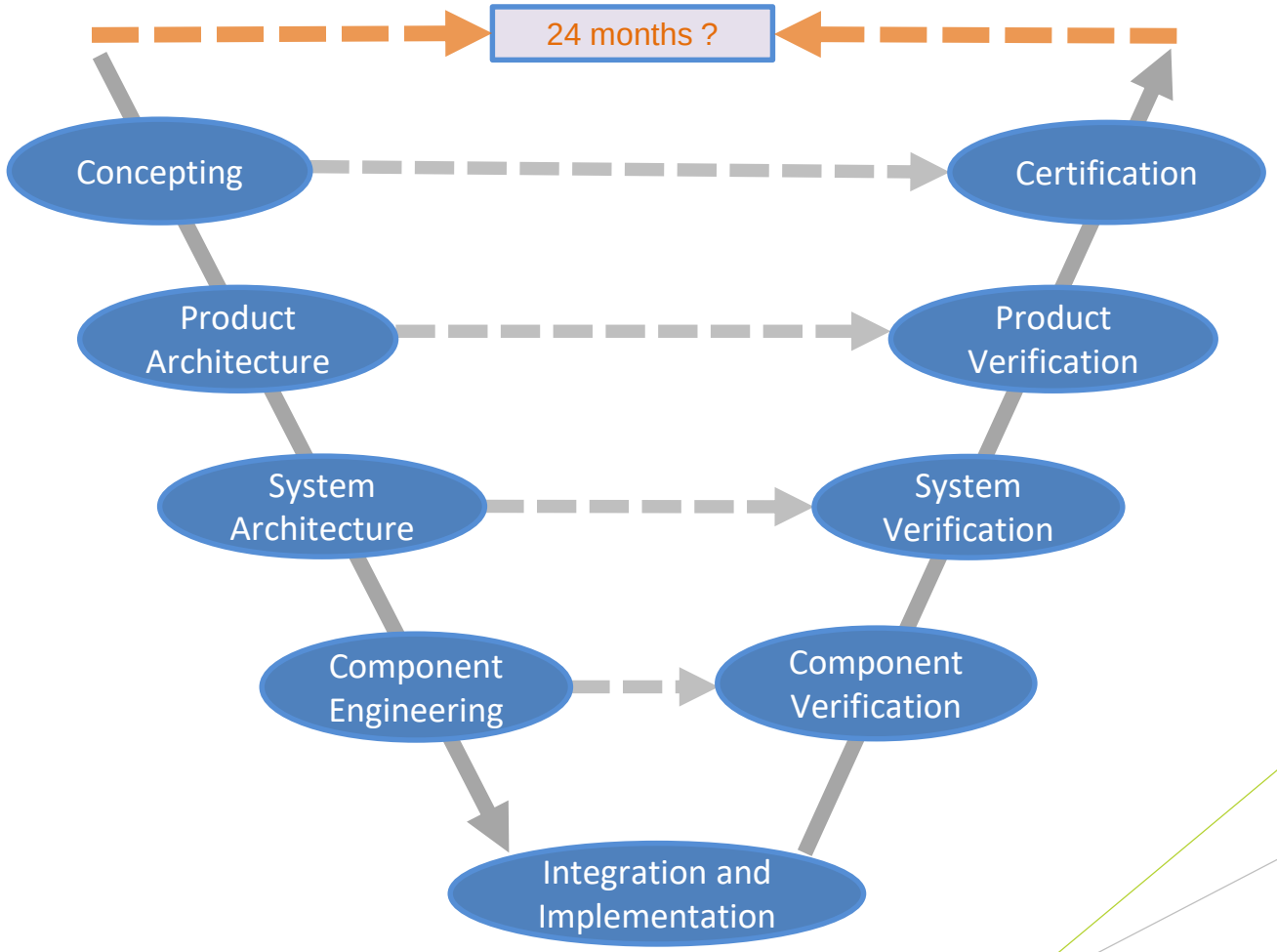


Future Product Development Process

- Intelligent approach → ***'squeeze'*** the V-diagram to obtain ***early verification*** based on ***models*** built in the ***product definition*** phase

- Rather than separating the two arms of the V, the most effective strategy is to ***invest in digital tools*** that can be used in most stages of the product development journey.

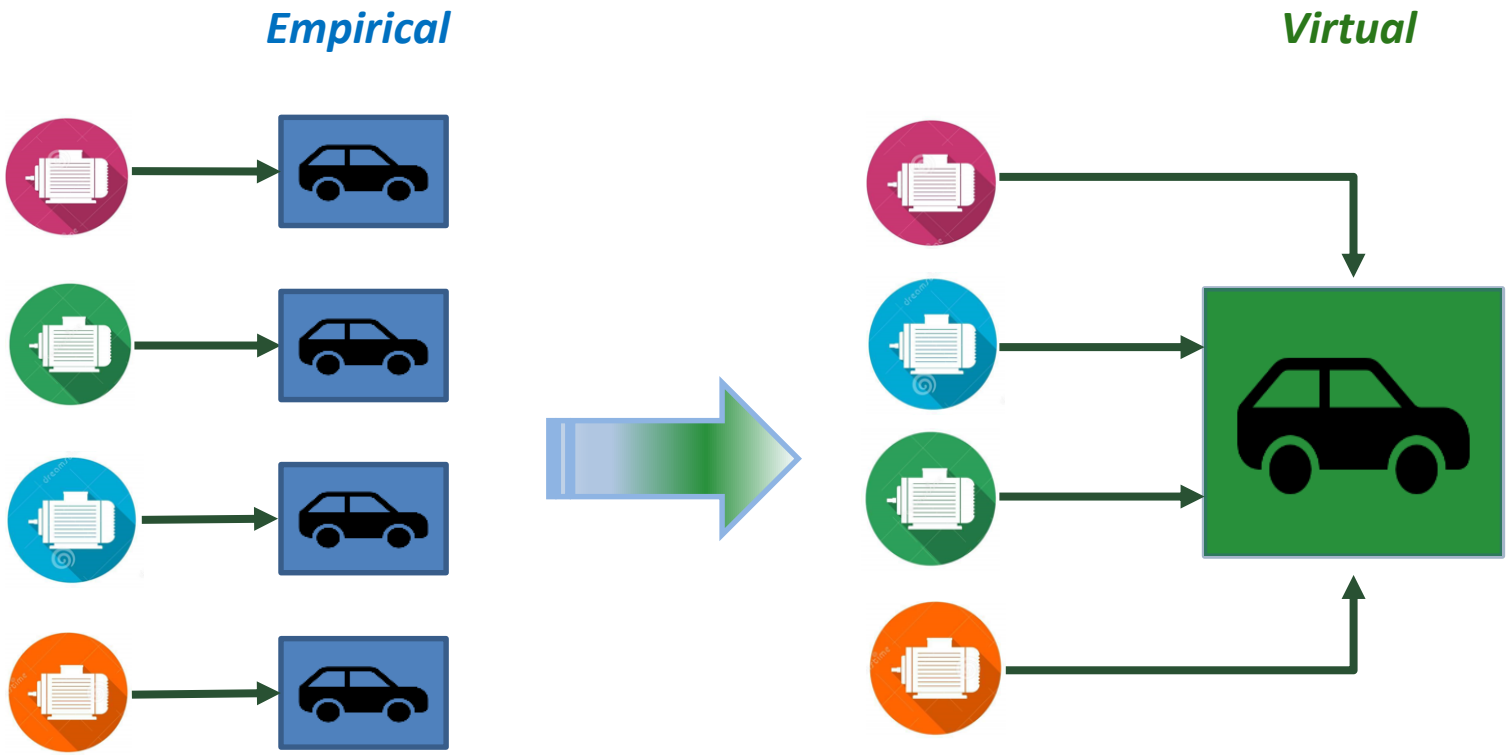
- The investment made to improve one side of the V can then be exploited on the other side of the V.



FUTURE DEVELOPMENT PROCESS – DIGITAL APPROACH

Example use case:

- 4 potential e-motor architectures to be assessed at vehicle concept phase -
  - Today 4 prototype car builds might be required (£0.5-1.0m per prototype, 6-12 months development time)
  - Virtual engineering approach enables 4 ***certified*** e-motor models are integrated into a single vehicle model → no prototype vehicles required
    - ***Transformation of supply chain*** capability required, plus an independent, trusted model certification process



We should not underestimate the magnitude of the transformation – skills, tools, techniques, culture will experience a step change on an unprecedented scale

MCLAREN VEHICLE SIMULATOR – DIGITAL TWIN DERIVED IN F1

Reduction in track testing

Virtual tools and

techniques Dynamic

vehicle simulator

>95% virtual race car set-up

Auto industry – paradigm

shift?

MCLAREN AUTOMOTIVE – PRODUCT DEVELOPMENT PROCESS

Fresh approach from the outset – motorsport heritage

No pre-conceptions, limited budget, limited time

Utilisation of F1-derived virtual engineering tools
Example case: McLaren P1 – fully virtual concept
Key question – does this approach scale?

24 months

CONCEPT

LAUNCH

PROJECT VIVID – VIRTUAL VEHICLE INTEGRATION AND DEVELOPMENT

APC11 PROJECT

Consortium

Ford, MAT, IPG, Loughborough University, Institute of Digital Engineering (IDE).

Objective

Demonstrate and embed cutting edge simulation-led automotive design capability into the development of the next generation Ford Transit platform.

CONCLUSIONS

– Unprecedented engineering challenges

– With challenge comes opportunity

– UK is well placed to exploit

– Must embrace technology

– Challenge the paradigms

– Collaboration

SARAH KENNY PRESENTED WITHOUT SLIDES – TO SEE HER PRESENTATION PLEASE GO TO WWW.FUTUREOFTECHNOLOGY.CO.UK