



Software Center



Boschonian



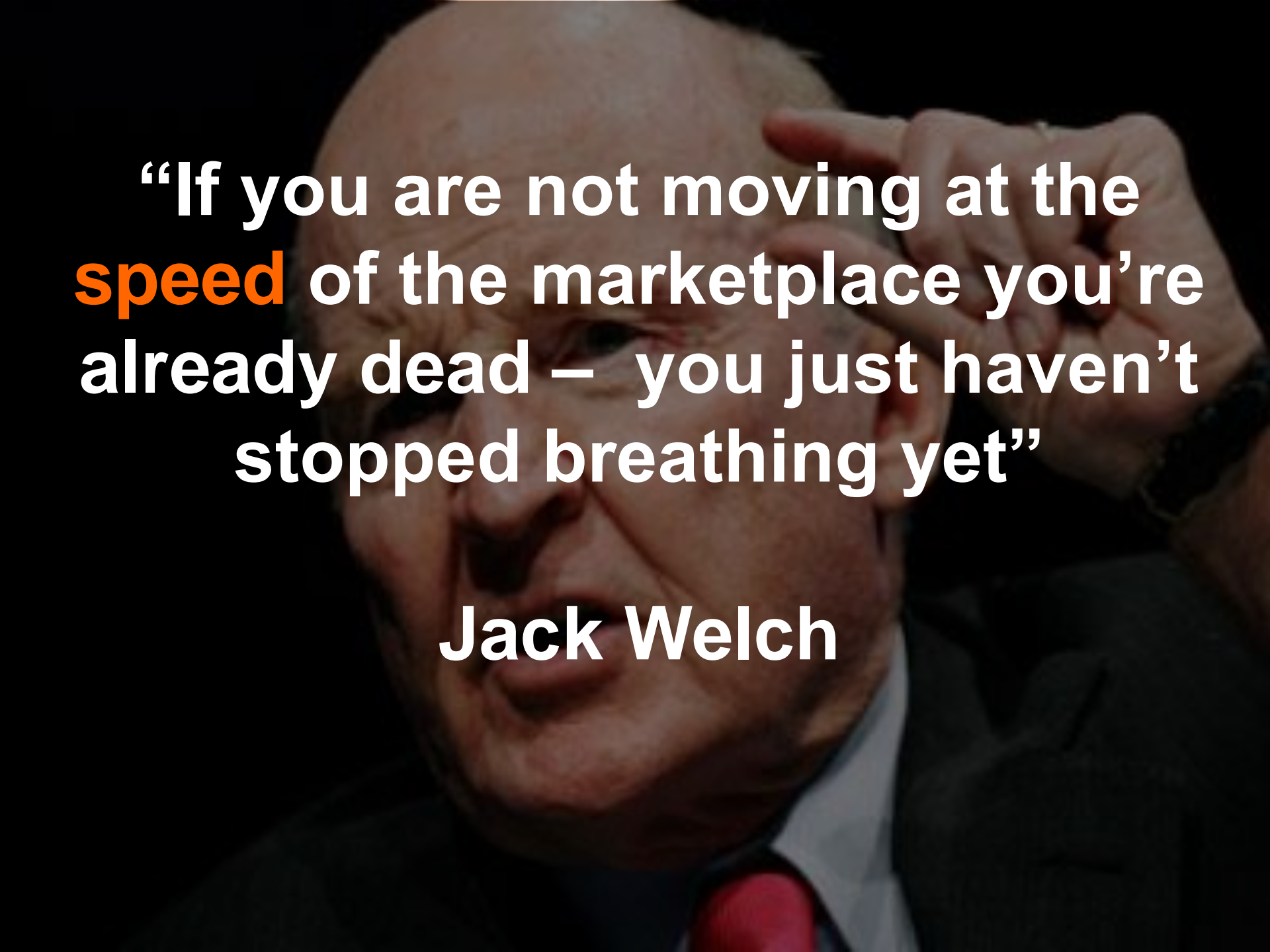
Speed, Data and Ecosystems: Engineering in the 21st Century

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Framtiden inom mjukvaruutveckling, Växjö, November 2016

A close-up photograph of Jack Welch, an older man with a balding head, wearing a dark suit, white shirt, and red tie. He is pointing his right index finger towards the camera with a serious expression. The background is dark and out of focus.

**“If you are not moving at the
speed of the marketplace you’re
already dead – you just haven’t
stopped breathing yet”**

Jack Welch

Three Key Take-Aways

- Increasing **SPEED** trumps ANY other improvement R&D can provide to the company – the goal is **continuous deployment** of new functionality
- Effective use of **data** from customers and products in the field is the next area to exploit and monetize
- Strategic use of the **ecosystems** around your systems and services is critical as it allows for agility, risk sharing and allows the company to focus on the key differentiators

Overview

- Vem är jag? Wie ben ik? Who am I?
- Trends in Industry: Need for Speed
- Stairway to Heaven
 - Speed
 - Data
 - Ecosystems
- Implications for Systems Engineering
- Conclusion



Academic Research

10X

Software Center



Software Center



Consultancy



Entrepreneur



Remente

Industry Innovation



Industry Operations



Software Center

Mission: Improve the software engineering capability of the Nordic Software-Intensive industry with an order of magnitude

Theme: Fast, continuous deployment of customer value

Success: Academic excellence

Success: Industrial impact



CHALMERS



MALMÖ UNIVERSITY



MÄLARDALEN UNIVERSITY
SWEDEN

Research Themes

Application Domain Themes

Shared
public/partner
funding

Autonomous
Systems

WASP

Internet
of
Things

IOTAP

System
of
Systems

Predominantly
partner
funding

Continuous
Delivery

Continuous
Architecture

Metrics

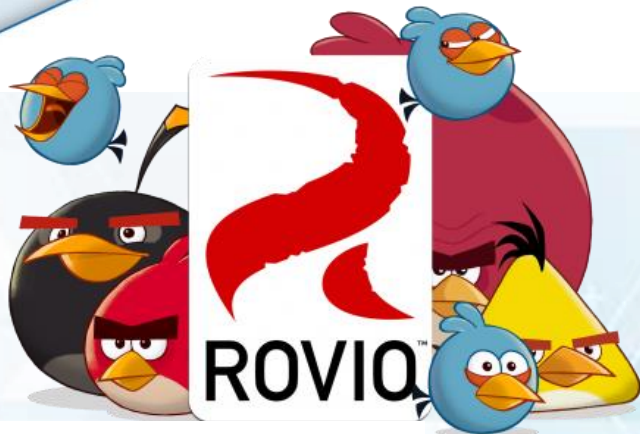
Customer
Data and
Ecosystems

Technology Themes

Some Online Companies



BOOKING.COM
online hotel reservations



Klarna
Simplifying Buying

Wing

bing

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Software Changes Everything

Air Pollution

Control of CO₂ emissions of factories, pollution emitted by cars and toxic gases generated in farms.

Forest

Monitoring of fire conditions

Wine C

Monitoring in vineyards grapes and

Offspri

Control of g animal farm

Sports

Vital signs centers and

Struct

Monitoring of in buildings,

Smartphones Detection

Detect iPhone and Android devices and in general any device which works with Wifi or Bluetooth interfaces.

Perimeter Access Control

Electromagnetic Levels

Measurement of the energy radiated by cell stations and WiFi routers.

Traffic

Monitor affluent routes.

Smart Roads

Warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

Smart Lighting

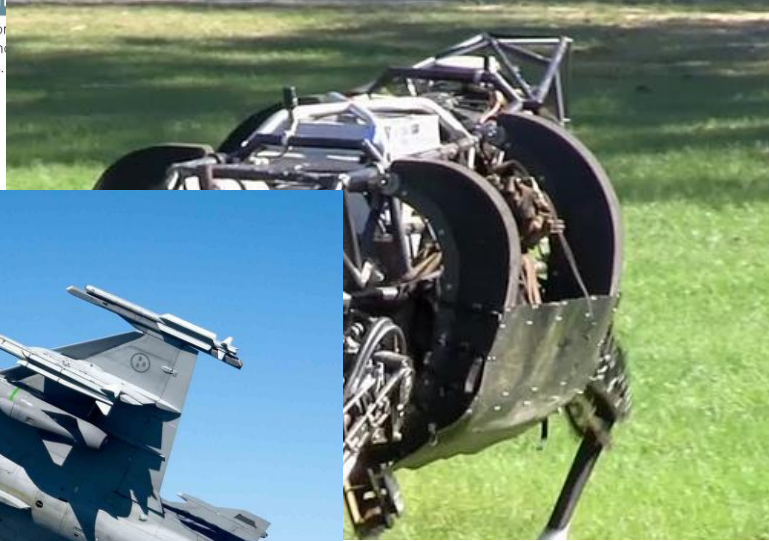
Intelligent and weather adaptive lighting in street lights.

Shopping

Point of sale, preferences, elements for them

Maps

Car areas and



Self-D

Robots

Gripen Drone

Quality of Shipment Conditions

Monitoring of vibrations, strokes, container openings or cold chain maintenance for insurance purposes.

Water Quality

Study of water suitability in rivers and the sea for fauna and eligibility for drinkable use.

Golf Courses

Selective irrigation in dry zones to reduce the water resources required in the green.

Smart Parking

Monitoring of parking spaces availability in the city.

Waste Management

Detection of rubbish levels in containers to optimize the trash collection routes.

Water Leakages

Detection of liquid presence outside tanks and pressure variations along pipes.

Vehicle Auto-diagnosis

Information collection from CanBus to send real time alarms to emergencies or provide advice to drivers.

Item Location

Search of individual items in big surfaces like warehouses or harbours.

Nature of Product Innovation is Shifting

- More than 90% of R&D is related to software according to Ericsson
 - The world's 5th largest software company
- 70% of all innovation is related to software according to AB Volvo
- 80-90% of all innovation in a car is related to electronics (HW & SW) according to Volvo Cars

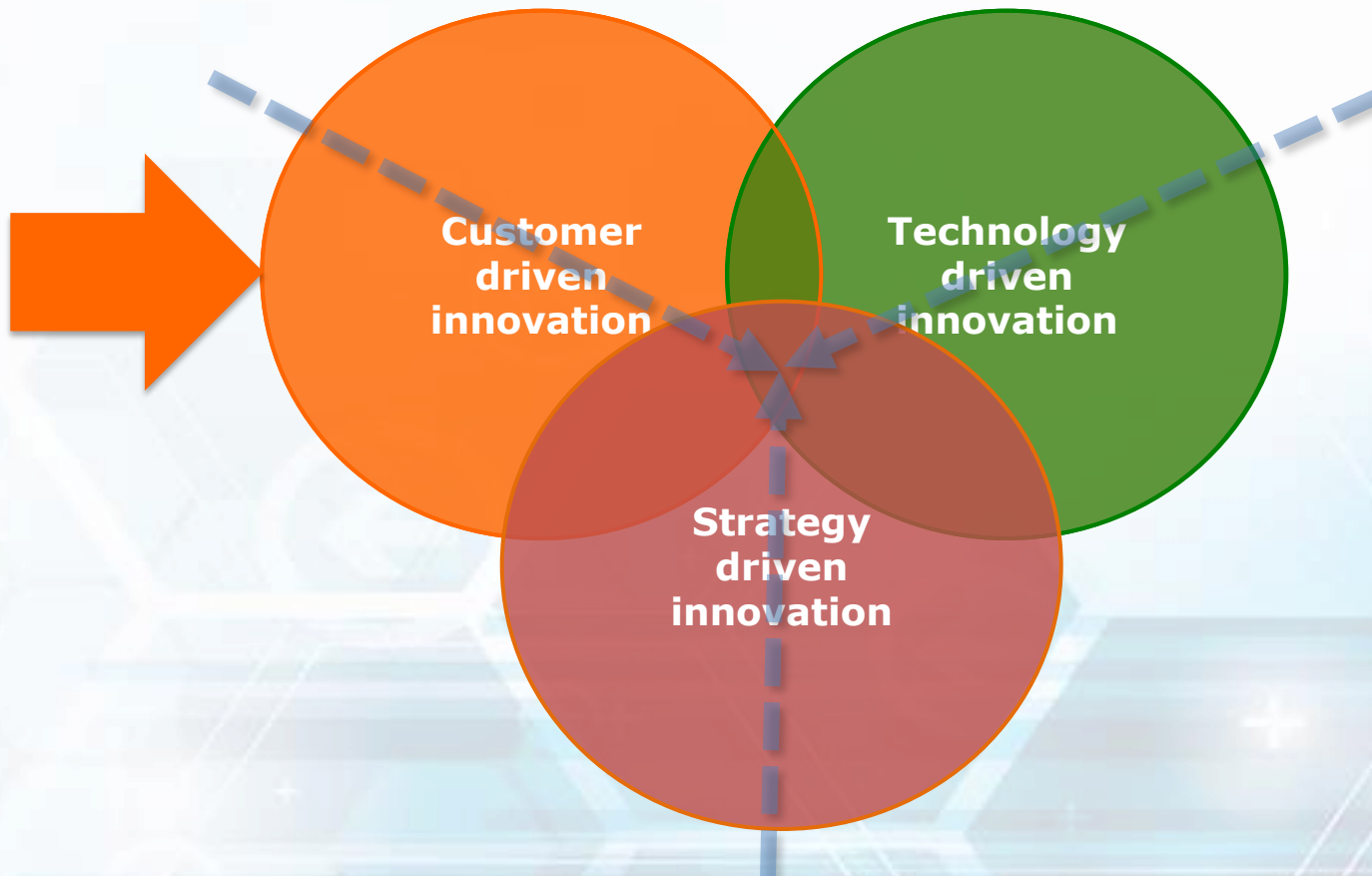


Towards Product as a Service

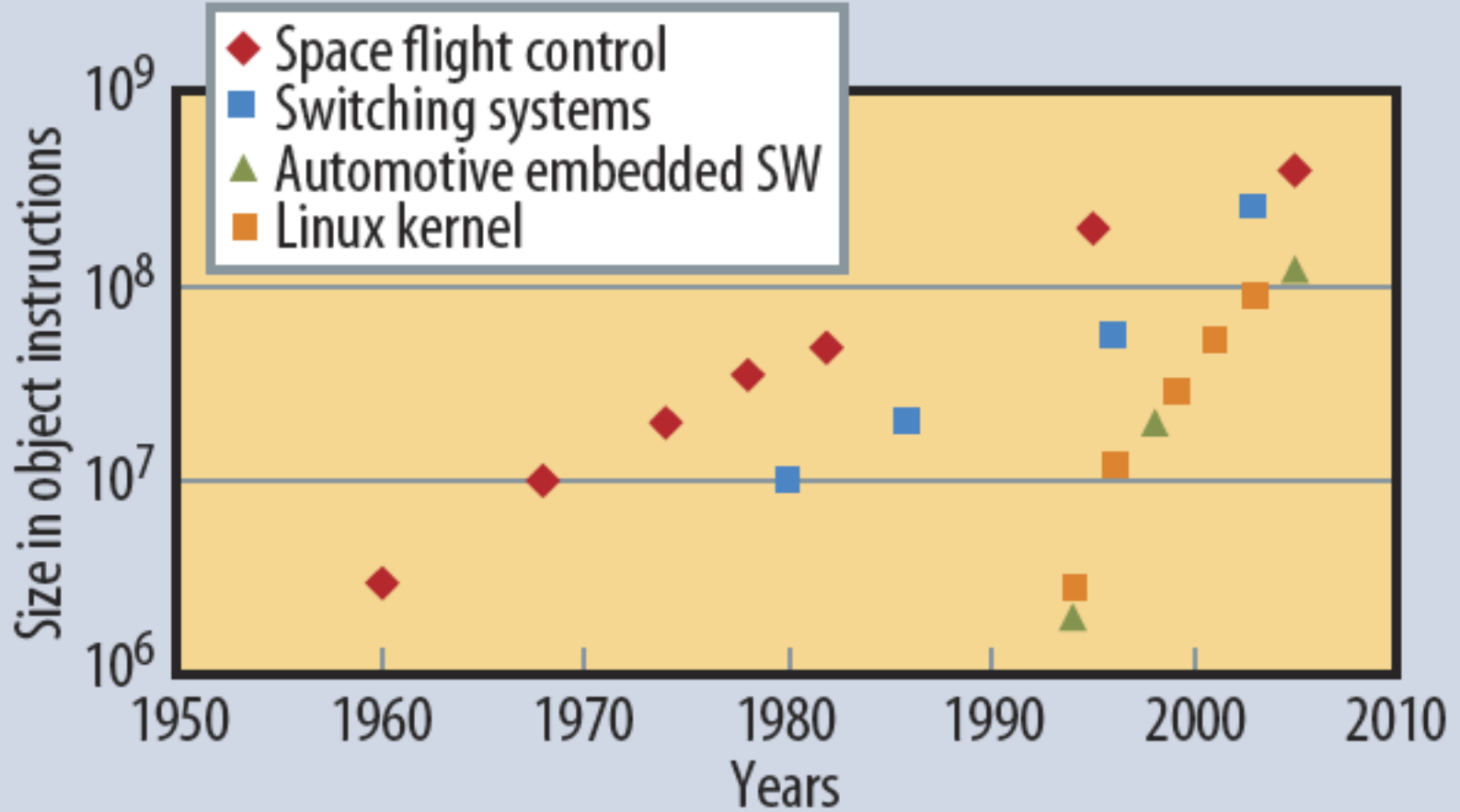


This requires continuous deployment throughout the lifetime of the product

Innovation Approaches

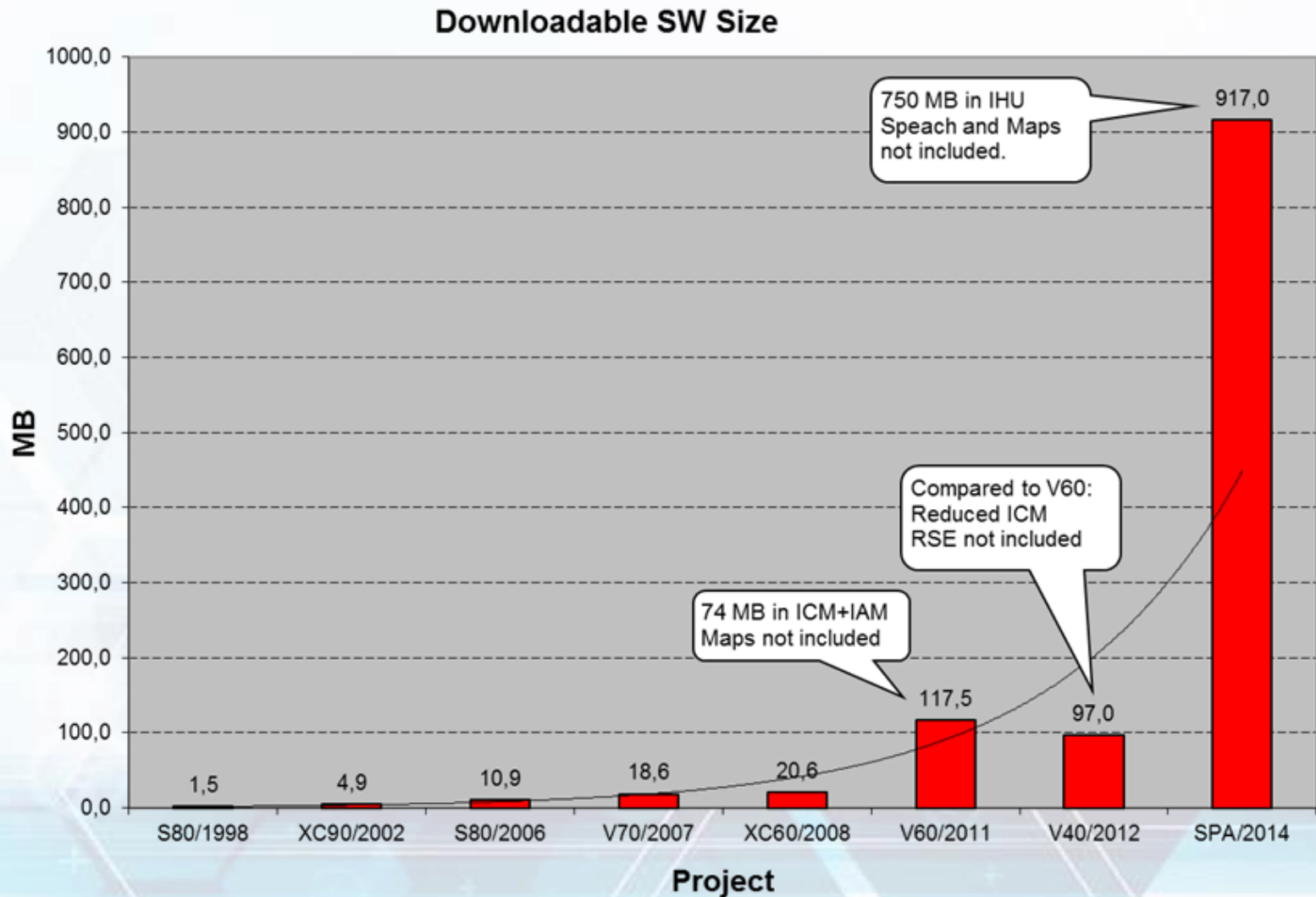


This requires continuous experimentation with customers



10x every ~7 years

Volvo XC 90



Volvo Cars

- 90% of innovations in “electronics and SW”
- Moving major parts of SW development in-house
- Connected cars get updated with new functionality every 2 days
- Volvo has defined the “system scope” to include the car, the cloud services and the mobile apps

Data Generated in the World

 **65 billion**
Location-tagged payments
made in the U.S. annually

154 billion

E-mails sent per day

 **87%**
U.S. adults whose location is
known via their mobile phone

Digital Information Created Each Year, Globally

2,000 BILLION GIGABYTES

1,800

1,600

1,400

1,200

1,000

800

600

400

2,000%

Expected increase in
global data by 2020

**111
Megabytes**

Video and photos stored
by Facebook, per user

75%

50 Terabytes of data are created every second

Trend: Need for Speed

Value Creation Shifts

Emerging companies highlight importance of user contribution and social connectedness



Level of User Contribution

Founded	1984	1995	2004	2009
1M users	~6 years	30 months	10 months	?
50M users	N/A	~80 months	~44 months	~ 1 month

Need for Speed in R&D – An Example

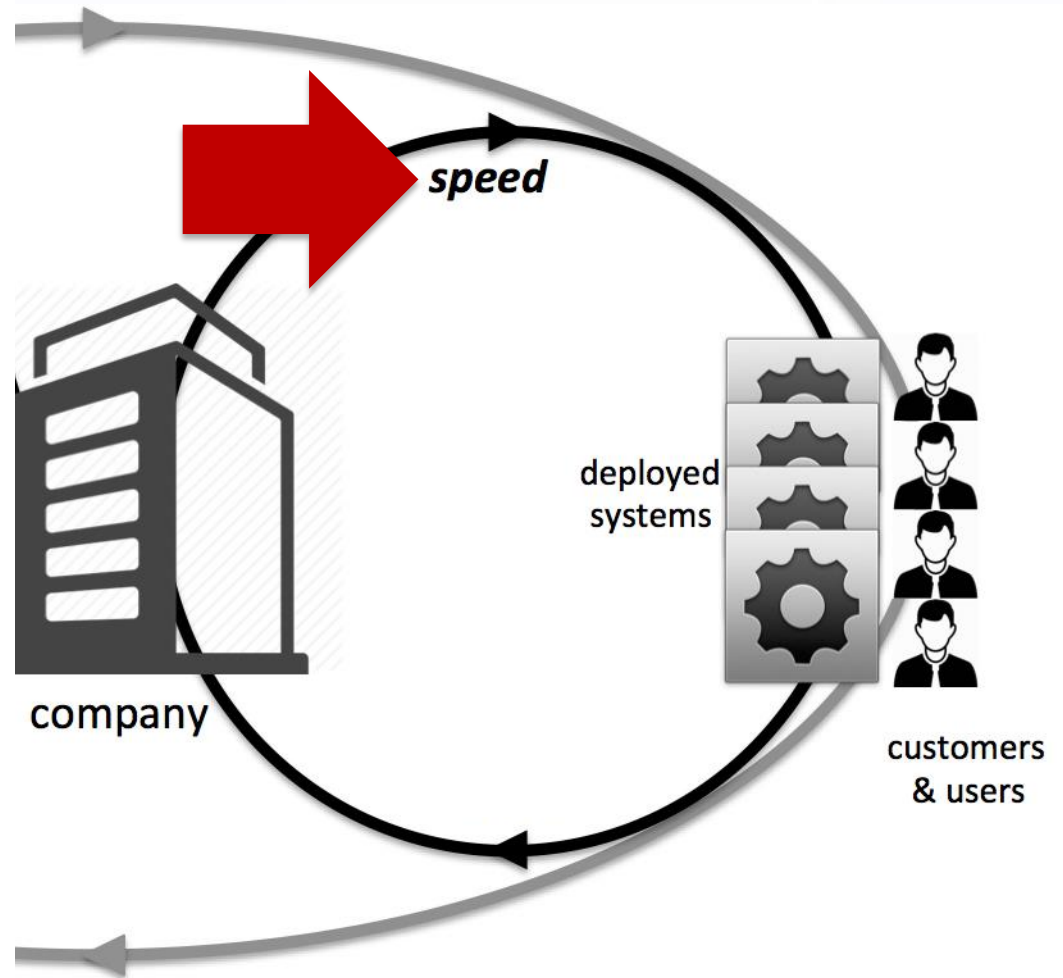
- Company X: R&D is **10%** of revenue, e.g. 100M\$ for a 1B\$ product
- New product development cycle: **12 months**
- Alternative 1: improve efficiency of development with 10%
 - **10 M\$** reduction in development cost
- Alternative 2: reduce development cycle with 10%
 - **100M\$** add to top line revenue (product starts to sell 1.2 months earlier)

No efficiency improvement will outperform cycle time reduction

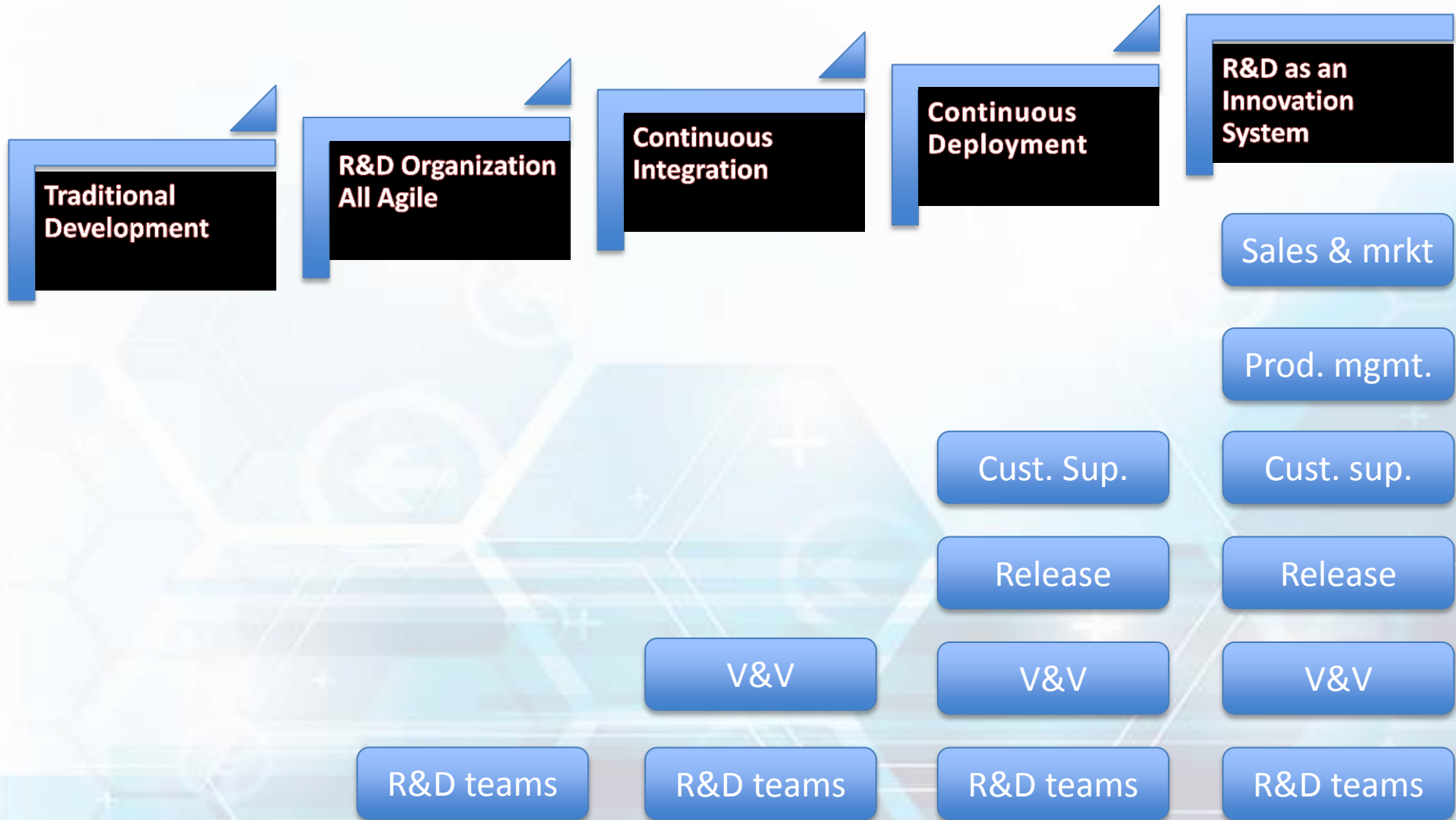
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Stairway to Heaven 2.0

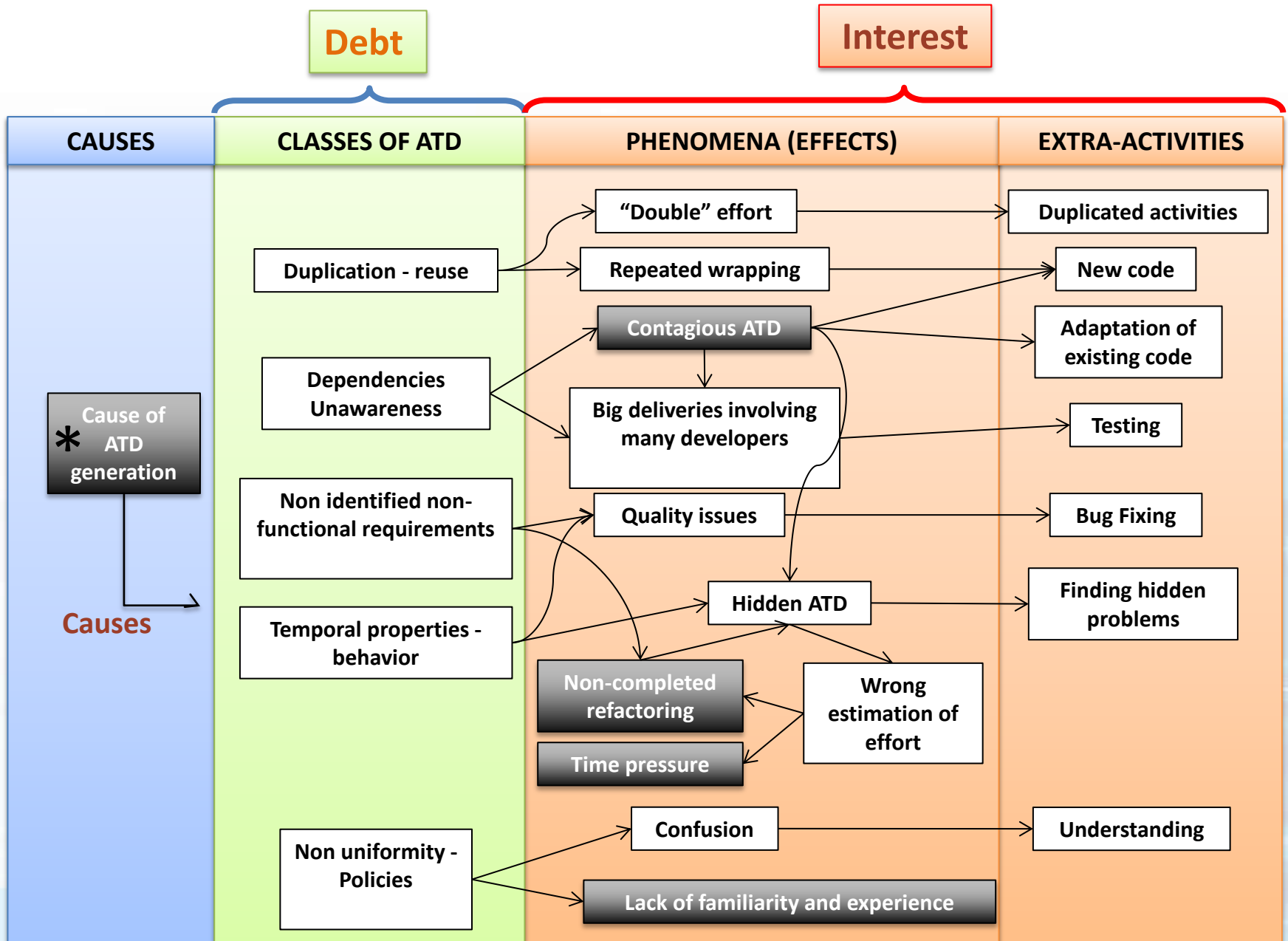


Stairway to Heaven: Speed

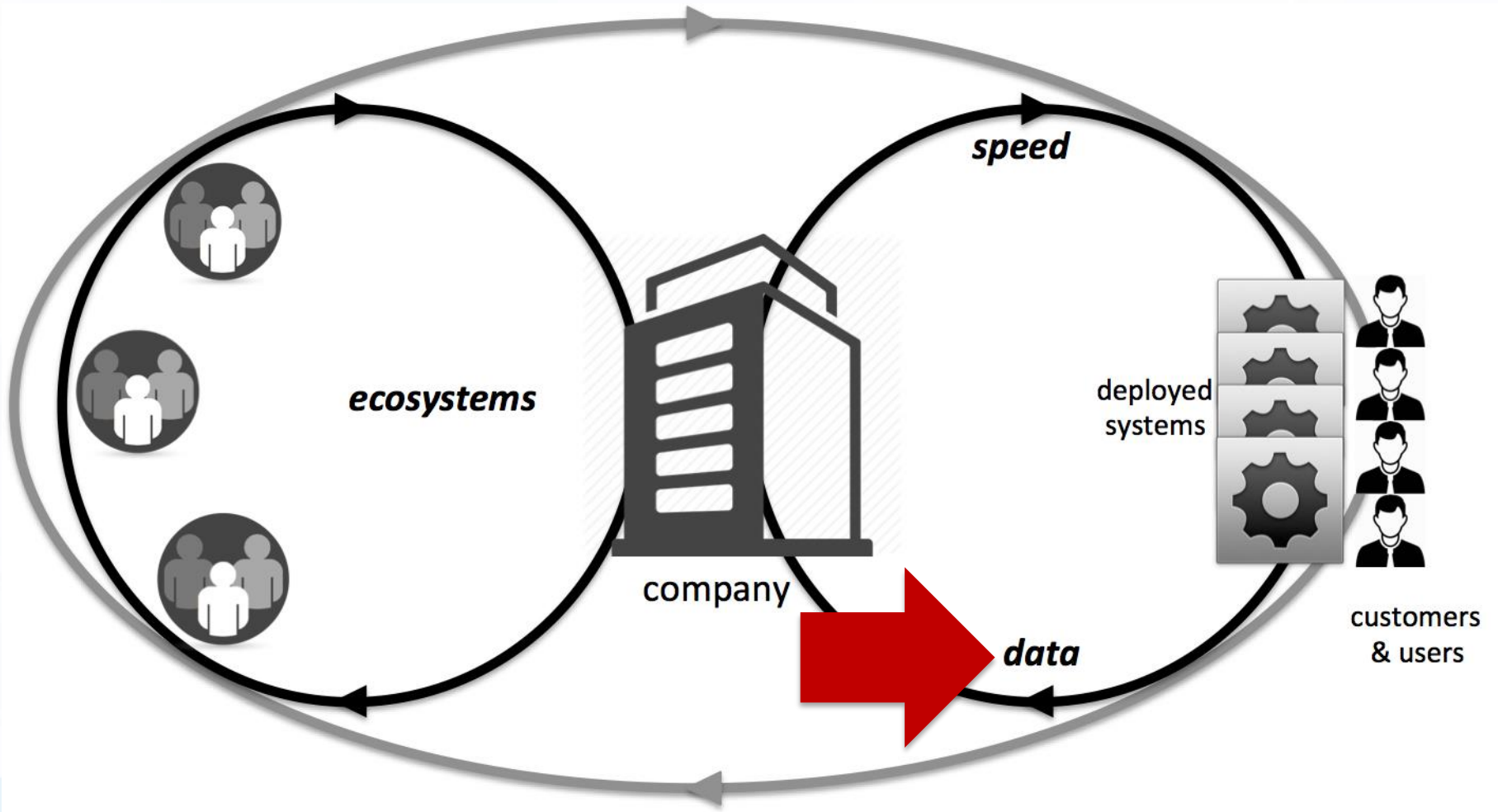


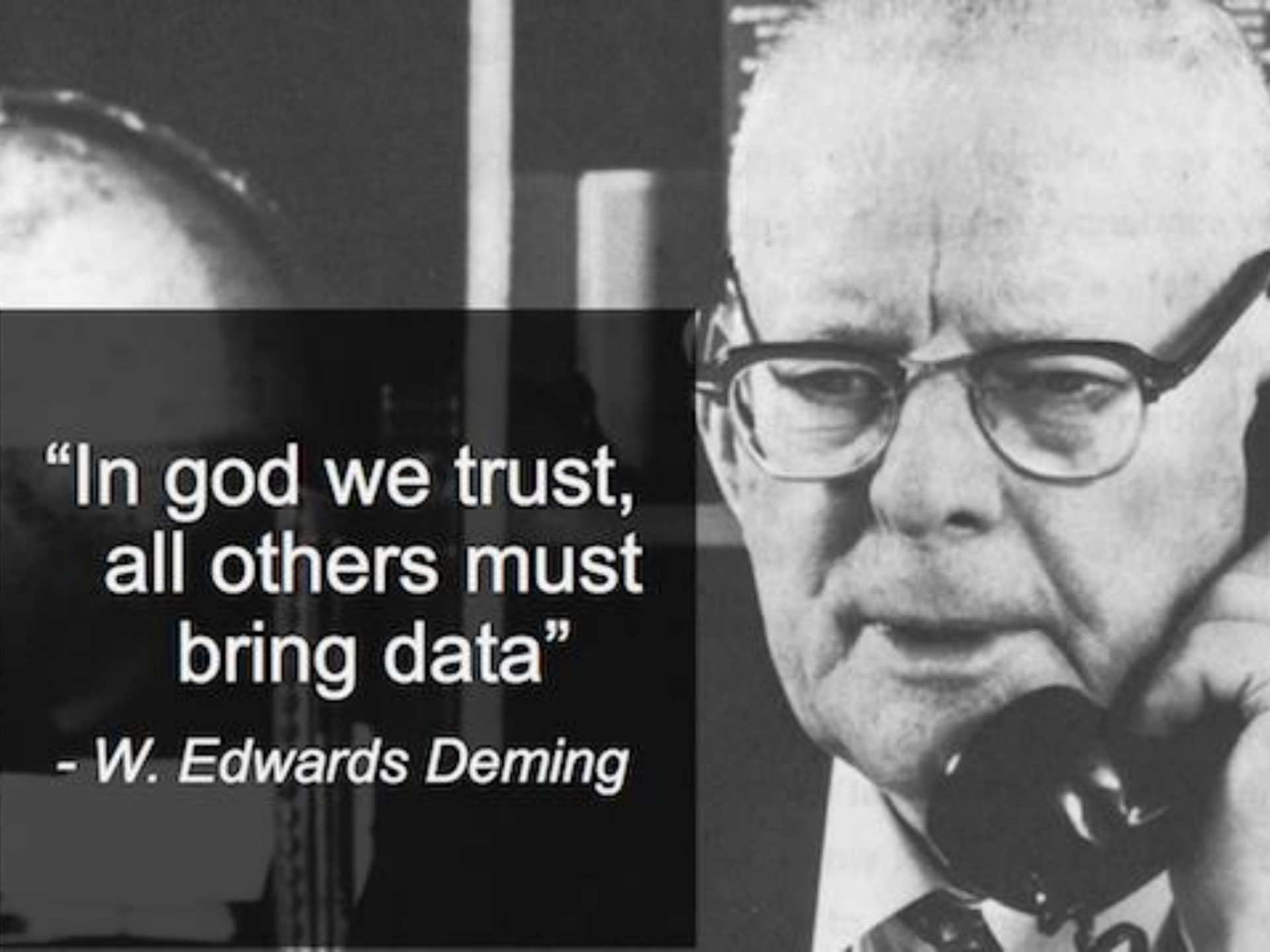
CIVIT: Continuous Integration Visualization Technique





Stairway to Heaven 2.0

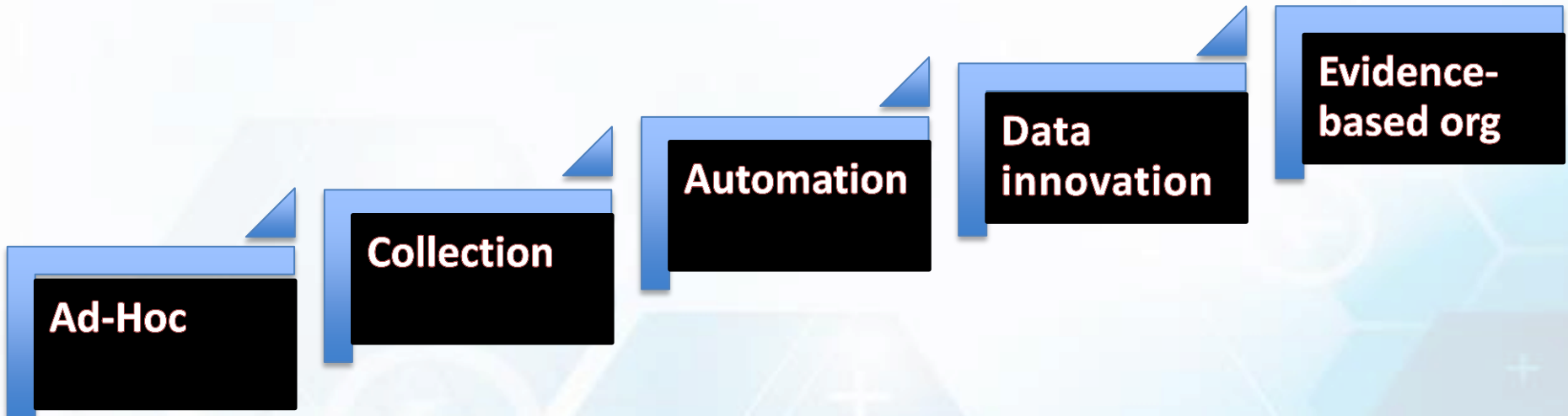


A black and white photograph of W. Edwards Deming, an older man with glasses, wearing a suit and tie, holding a telephone receiver to his ear. The image is partially obscured by a dark rectangular box containing white text.

**“In god we trust,
all others must
bring data”**

- W. Edwards Deming

Stairway to Heaven: Data



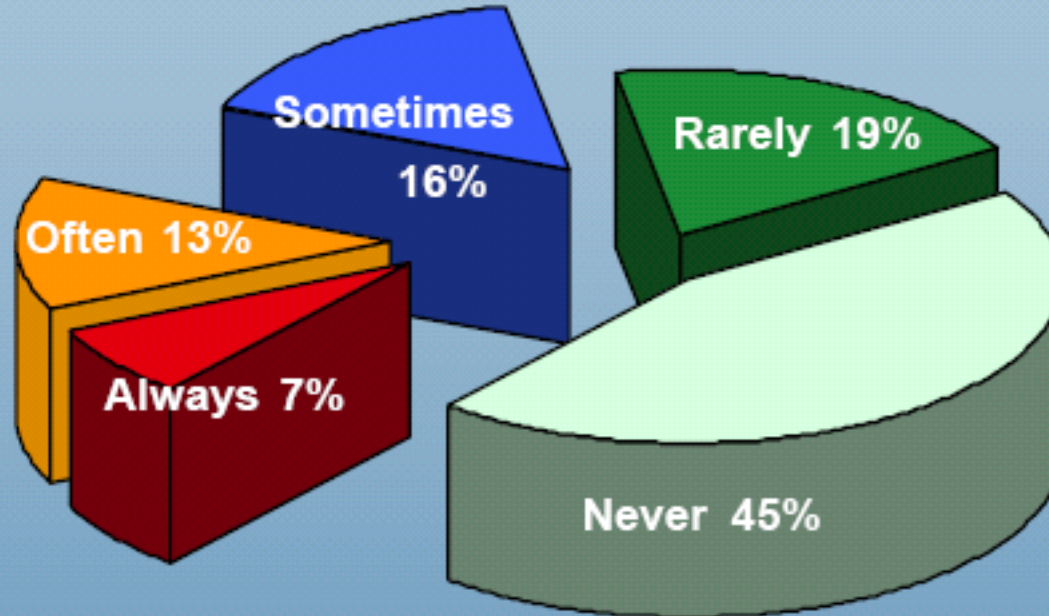
	Collection	Analysis	Reporting	Decision making
Ad-hoc	manual	manual	manual	manual
Collection	automated	manual	manual	manual
Automation	automated	automated	automated	supported
Data innovation	dynamic	dynamic	dynamic	supported
Evidence-based company	dynamic	dynamic	dynamic	automated

“Featuritis”

Features / Functions Used in a Typical System

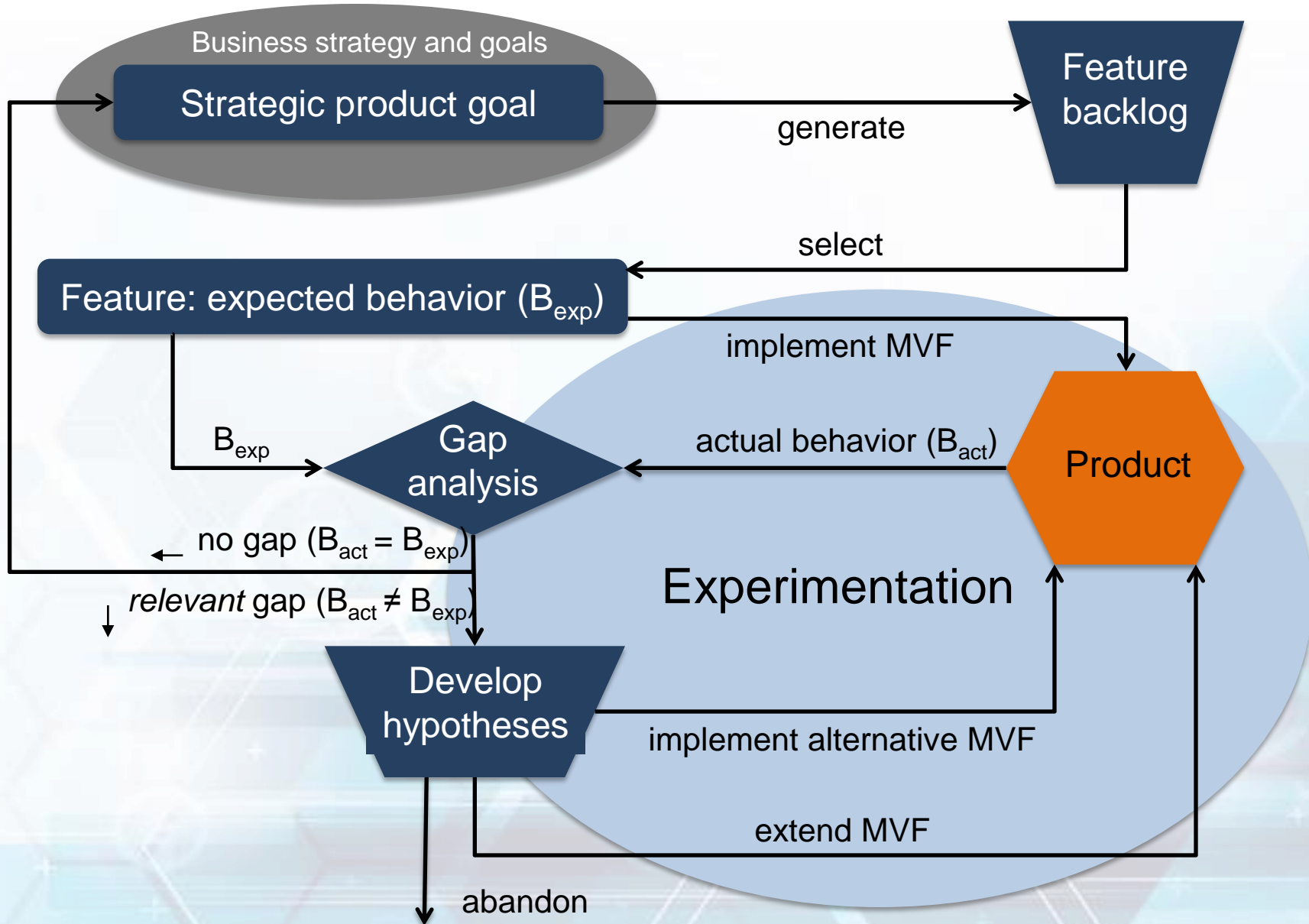
**Often / Always
Used: 20%**

**Rarely / Never
Used: 64%**

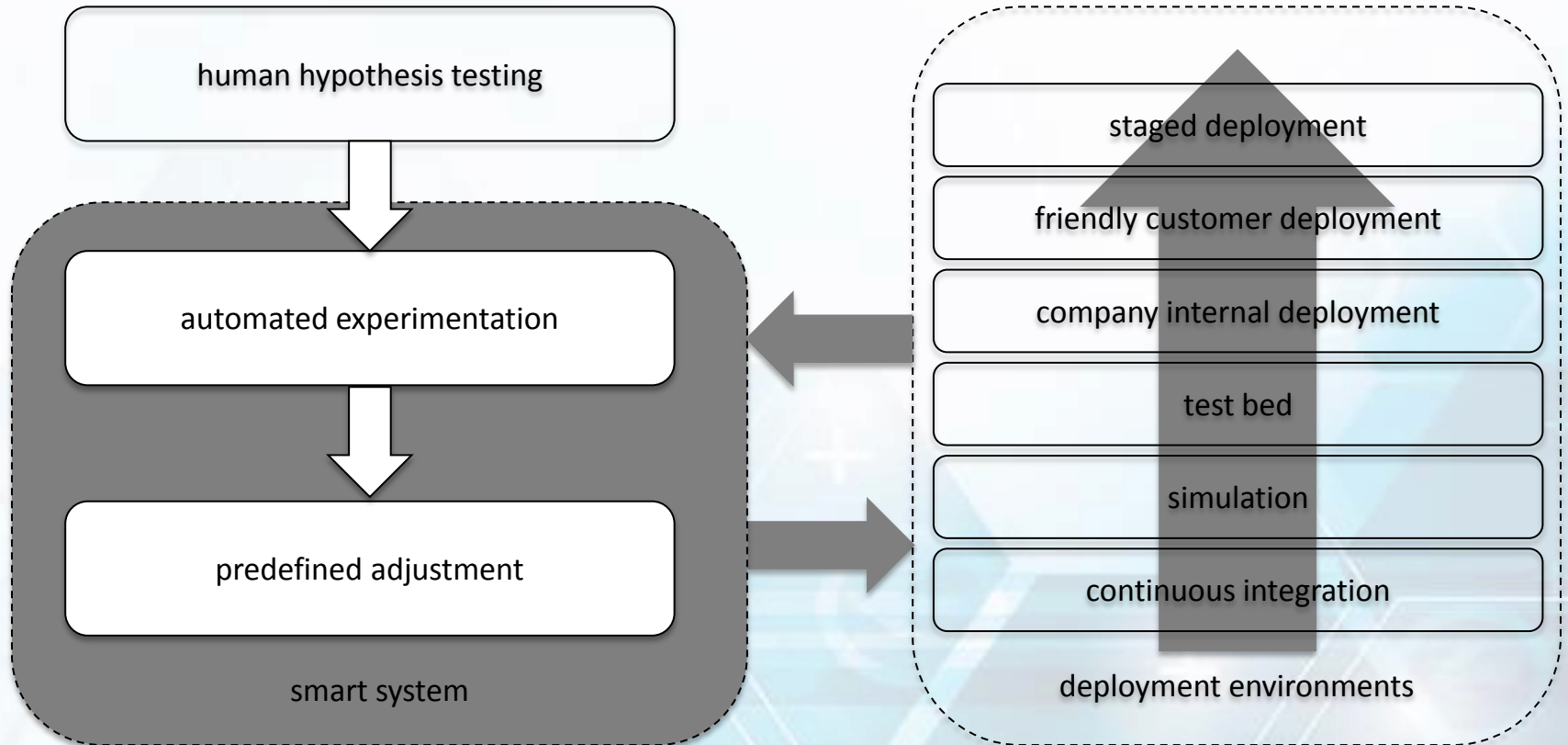


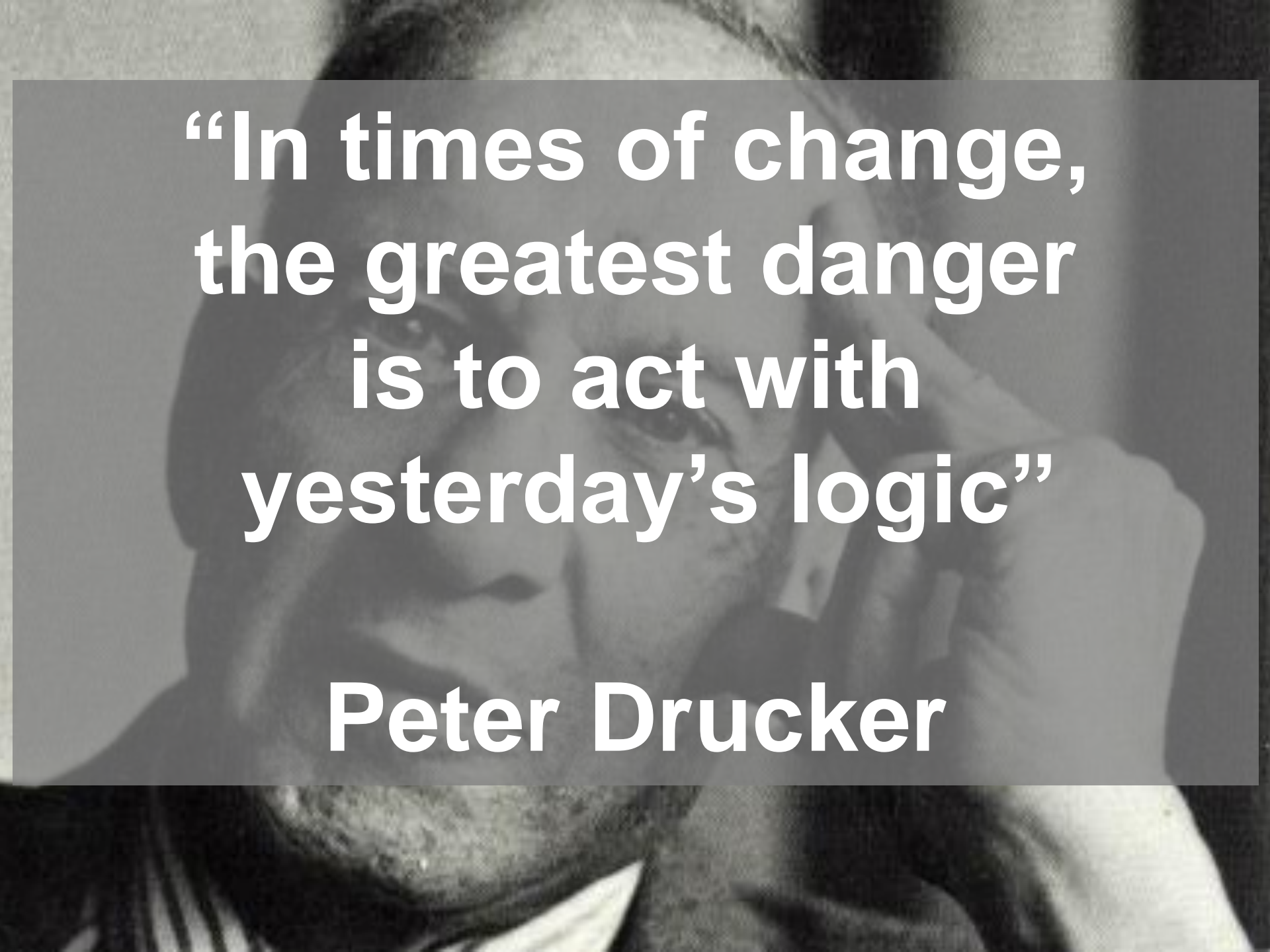
Standish Group Study Reported at XP2002 by Jim Johnson, Chairman

The HYPEX Model



Data-Driven Continuous Evolution of Autonomous Systems

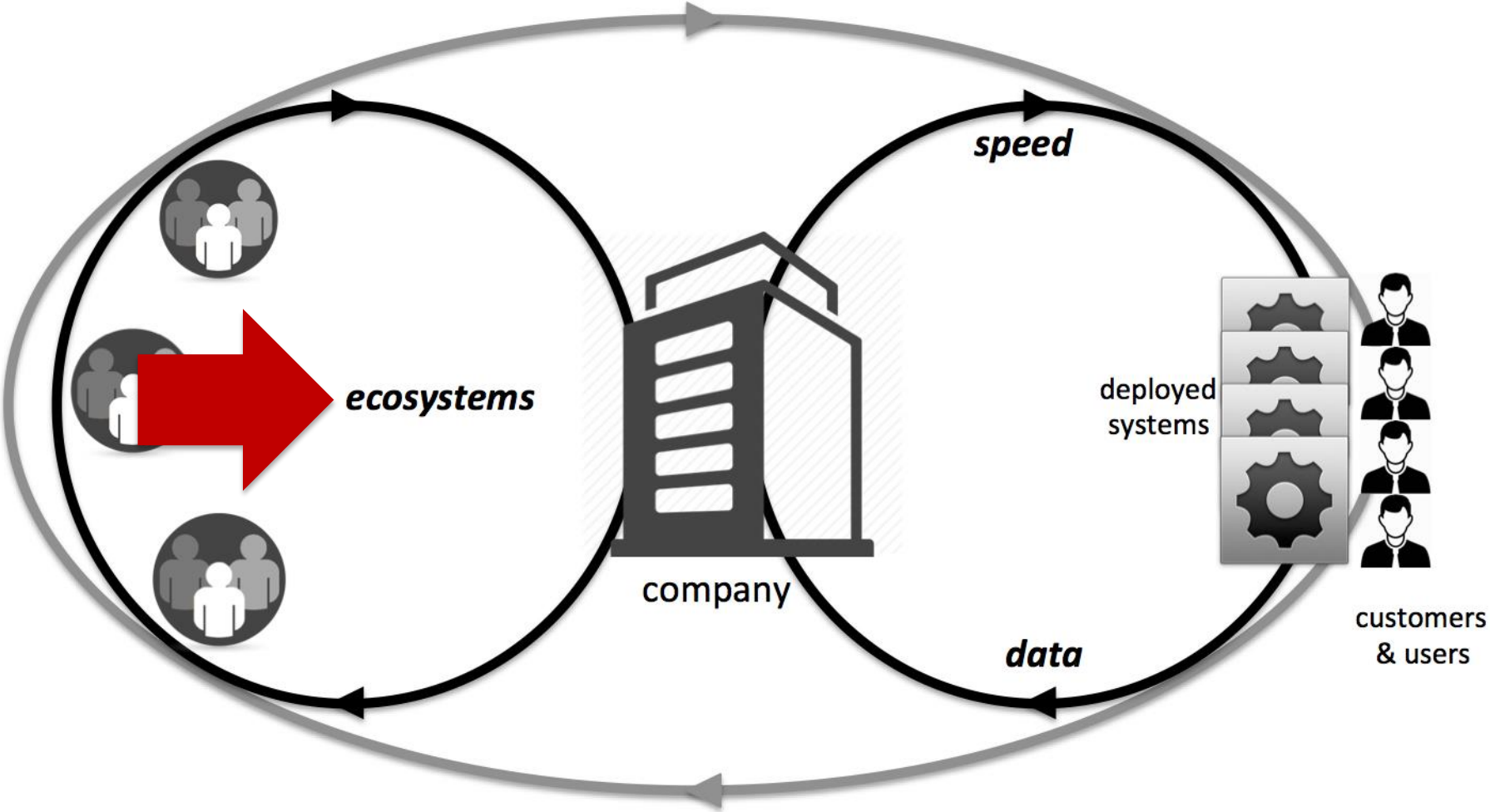




**“In times of change,
the greatest danger
is to act with
yesterday’s logic”**

Peter Drucker

Stairway to Heaven 2.0

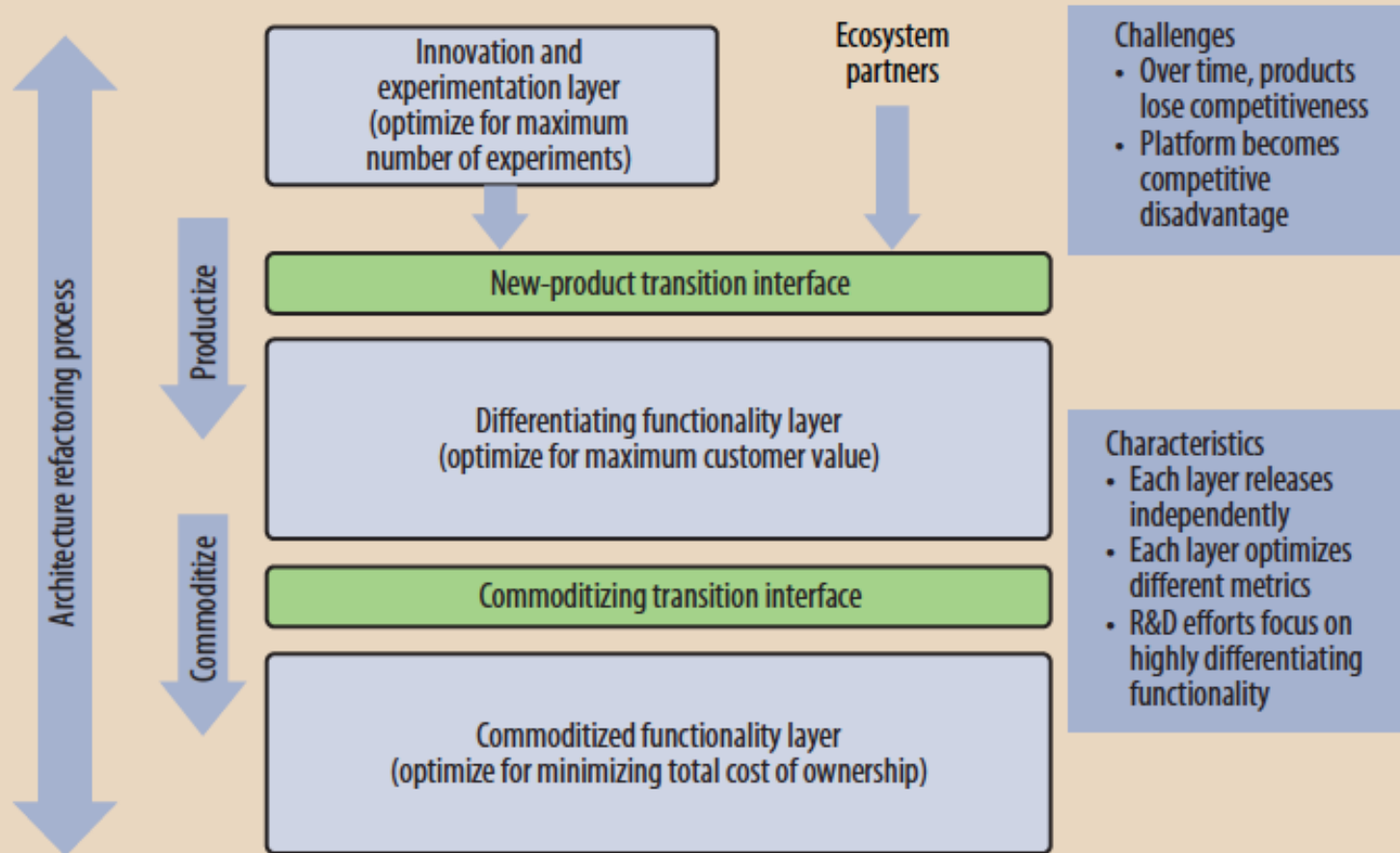


Business Ecosystem

Economic community supported by a foundation of interacting organizations and individuals, which can also be perceived as organisms of the business world (Moore, 1993).

1. Symbiotic relationship
2. Co-evolution
3. Platform: tools, services and technology used in ecosystem to enhance performance

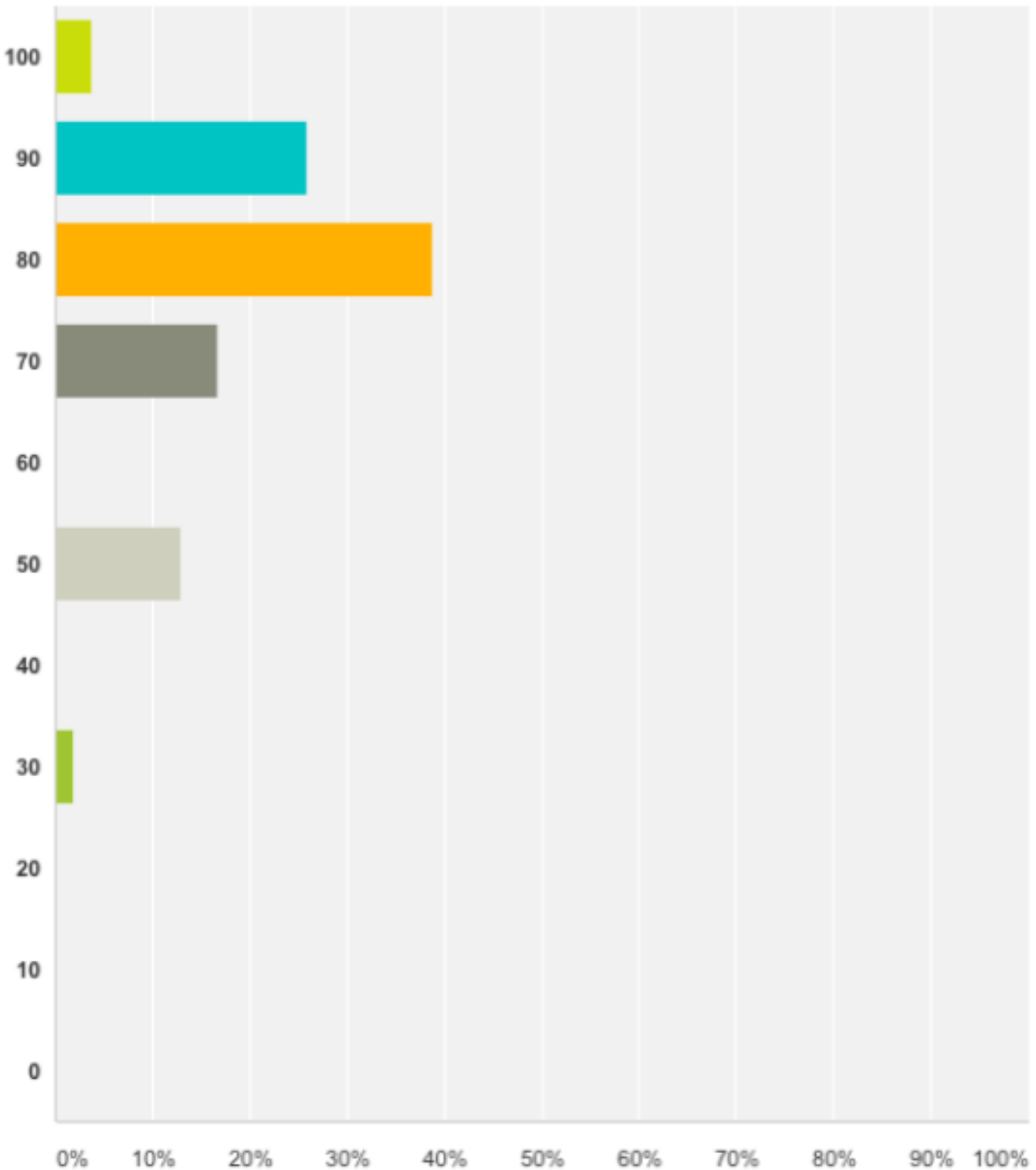
3LPM: Three Layer Product Model



Bosch, J. (2013). Achieving Simplicity with the Three-Layer Product Model, *IEEE Computer*, Vol. 46 (11), pp. 34-39.

What % of R&D for Commodity?

Answered: 54 Skipped: 6



TeLESM: Three Layer Ecosystem Strategy Model

Innovation ecosystem

internal ←

- Me-Myself-I Strategy
- Be-My-Friend Strategy

← **collaborative** →

- Customer Co-Creation Strategy
- Supplier Co-Creation Strategy
- Peer Co-Creation Strategy
- Expert Co-Creation Strategy

→ **external**

- Copy-Cat Strategy
- Cherry-Picking Strategy
- Orchestration Strategy
- Supplier Strategy
- Preferred Partner Strategy
- Aquisition Strategy



Differentiating ecosystem

internal ←

- Increase Control Strategy
- Incremental Change Strategy
- Radical Change Strategy

← **collaborative** →

→ **external**



Commoditizing ecosystem

internal ←

- Rationalized in-sourcing
- Push-Out Strategy

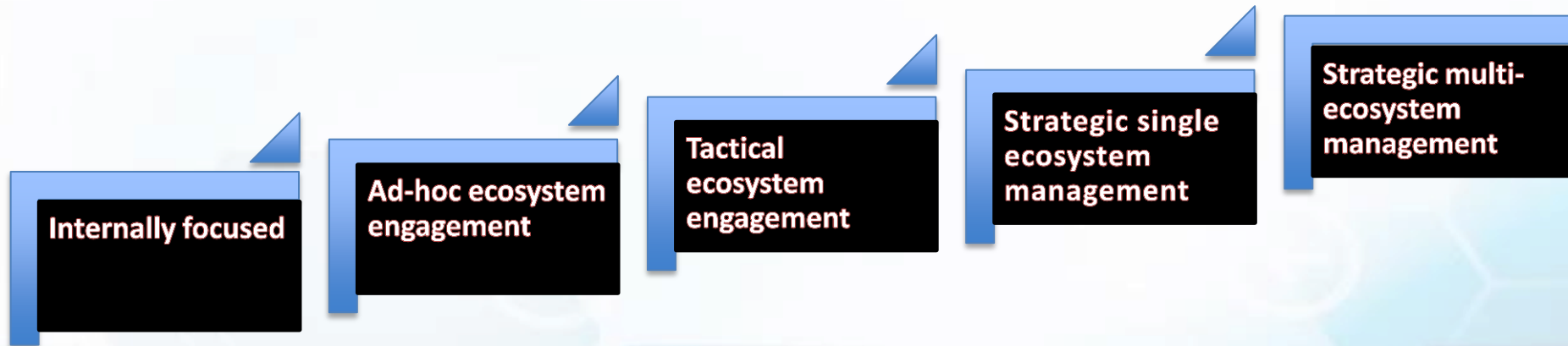
← **collaborative** →

- OSS Creation Strategy
- Partnership Strategy
- OEM partnerships

→ **external**

- COTS Adoption Strategy
- OSS Integration Strategy
- Outsourcing

Stairway to Heaven: Ecosystems

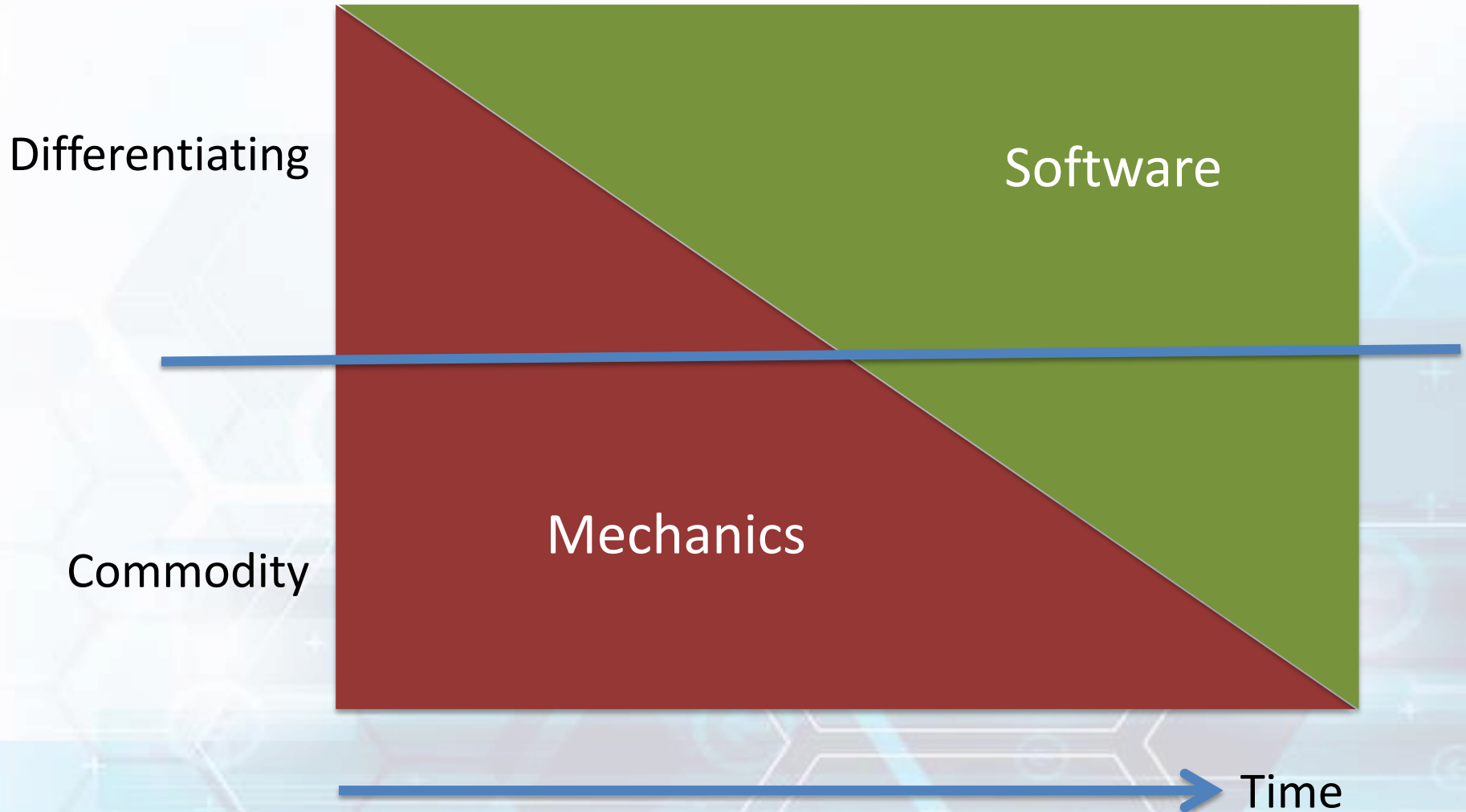


Levels	
Internally focused	do everything in-house unless it is really impossible
Ad-hoc ecosystem engagement	individuals take ad-hoc decisions to engage with ecosystem partners, but local optimization
Tactical ecosystem engagement	ecosystem engagement is centralized, but driven by tactical (rather than strategic) considerations
Strategic single ecosystem management	one of the ecosystem types is managed strategically
Strategic multi-ecosystem management	all three types (I, D, C) are managed strategically

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Atoms versus Bits



Implications

1. Build it in **software** unless you really, really can't
2. Build it in **hardware** and keep it flexible (FPGAs instead of ASICS) unless you really, really can't
3. Build it in **mechanics** if you HAVE to and keep modular, easily replaceable and simple

Implications

From


- Systems built to last
- Opinions-based decision making (experience)
- Deeply integrated architectures
- Hierarchical organizational model
- Satisfying the requirements
- Static certification

To

- Systems built to evolve
- Data-driven decision making
- Modularized architectures
- Ecosystem of partners
- Constant experimentation and innovation
- Dynamic, continuous certification

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A photograph of George F. Colony, CEO of Forrester Research, speaking at a conference. He is wearing a dark suit, a white shirt, and a blue patterned tie. He has his hand near his chin in a thoughtful gesture. The background is a dark blue wall with a repeating pattern of the Forrester Research logo.

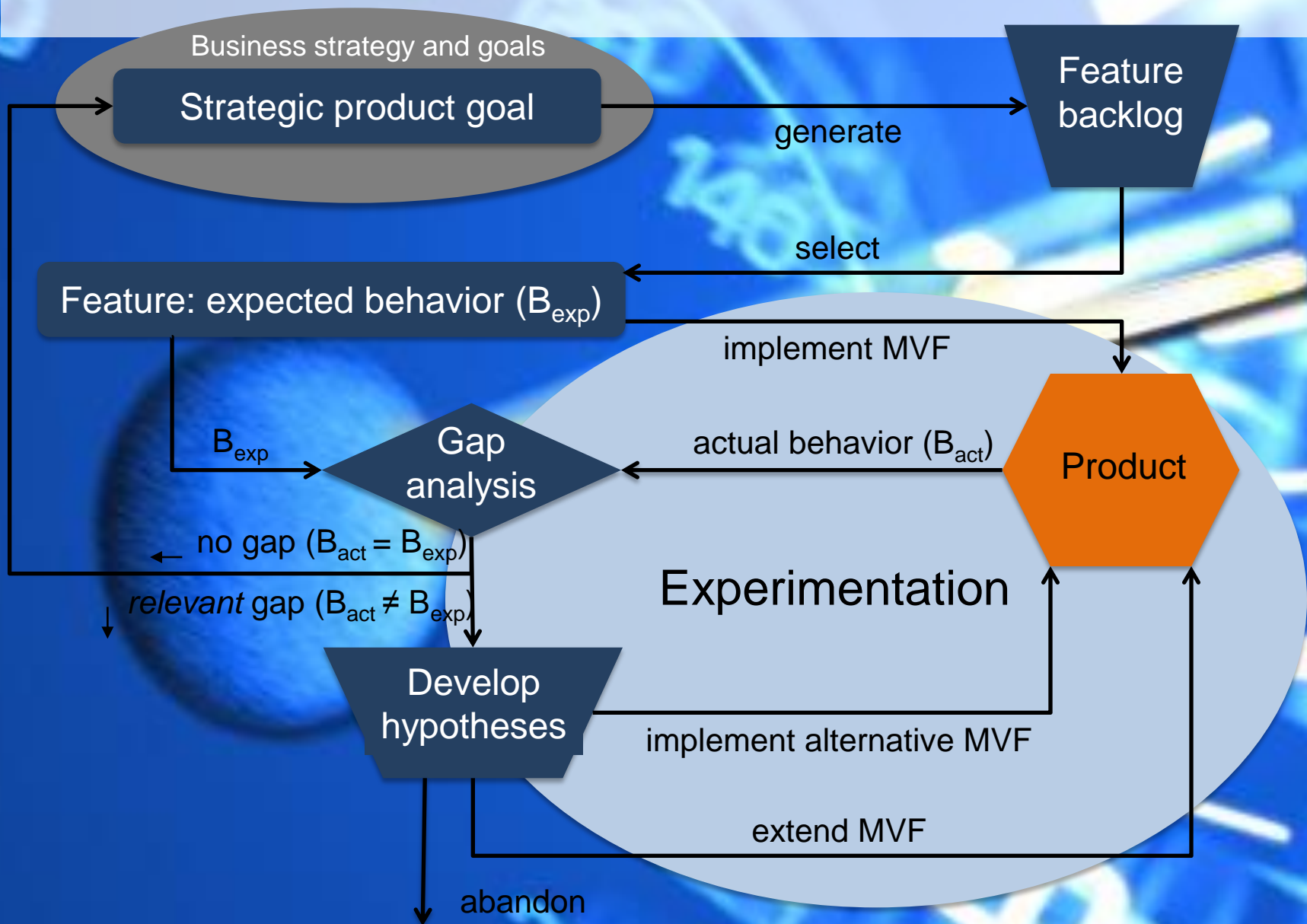
**“In the future, all companies
will be software companies”**

George F. Colony (CEO Forrester Research)

Speed

- Increasing **SPEED** trumps ANY other improvement R&D can provide to the company – the goal is **continuous deployment** of new functionality
- If you're not a front-line engineer, there is only ONE measure that justifies your existence: how have you helped teams move faster?
- Don't optimize efficiency, optimize speed

Data-Driven Development



Software Ecosystems

Ecosystem Drivers

External

Internal

Internal

External

Internal

Ecosystem Type

Innovation ecosystem

- **Who:** Customers, 3rd party developers, suppliers
- **What:** Development of new functionality
- **Why:** Share/minimize innovation costs/risks
- **When:** High market uncertainty
- **How:** Open innovation, co-opetition, partnerships
- **Mechanisms:** Product platforming, idea competitions, customer involvement, collaborative design, innovation networks etc.

Differentiating ecosystem

- **Who:** Keystone player
- **What:** Optimization and extension of existing functionality
- **Why:** Turn innovations into core product offerings, keep internal control over value-adding functionality, optimize for maximum customer value
- **When:** When innovative functionality have proven valuable for customers
- **How:** Innovation transfer, R&D management, monetizing strategies
- **Mechanisms:** Data-driven development, patents, contracts, licenses etc.

Commoditizing ecosystem

- **Who:** Suppliers, competitors, developers
- **What:** Reduce efforts related to old, non value-adding functionality
- **Why:** Share/minimize maintenance costs
- **When:** Functionality that has become so integral to the product that it no longer offers customer value
- **How:** OSS, COTS, inner source, standardization, shared supplier
- **Mechanisms:** Open platforms and API's, connecting services etc.

Ecosystem Characteristics

- Collaborative
- Internal/external
- Exploratory
- Risk prone
- Less control-driven

Functionality transfer

- Competitive
- Internal
- Efficient
- Risk averse
- Control-driven

Functionality transfer

- Collaborative
- Internal/external
- Cost-efficient
- Risk averse
- Less control-driven

Not My Job?!



Strong LEADERSHIP needed from YOU

Information Technology

"This book gives you a great set of tools on how to bring business architecture and technology architecture together to drive a common set of goals and objectives."

– Brendan Bank, CTO Booking.com

"A must read for any leader or professional in the software industry. Simple, but insightful, Stairway models provide compelling and practical guidance for both every-day challenges and extensive transformations in the realm of software development."

– Mladen Pilipovic, Director of Engineering, Spotify

"SDE offers a fascinating and well-researched overview of the major trends in the software industry. If you want to survive as a software company in the 21st century, add this wonderful book to your reading list."

– Jurgen Appelo, author of Management 3.0 and Managing for Happiness

"Jan Bosch is a pioneer in how he systematically demonstrates the strength of changing the perspective for working with software. He shows how new services, products and value is created by drawing on the deep knowledge software developers have of customers, coupled with tools such as software architecture knowledge and ways of working, user feedback and data collection."

– Ingrid Nordmark (CEO Swedish Institute for Computer Science)

This book unifies those three of the most current best practices of the software-driven industry: speed, data, and ecosystems. Speed in value creation through software, namely continuous integration, continuous delivery, and continuous experimentation. Data to feedback what we did is actually the most effective and efficient to create value. Ecosystems to supersede classical business models by factors. The book explains the relationships, gives examples, and guides you with frameworks so that the application in your next project will let you harvest all the smartness and profitability that is possible in today's software development."

– Michael Kircher, CTO DATEV eG, Germany

"The excellent book of Speed, Data and Ecosystems by Jan Bosch captures the essence for any industry and company that is in the process of transforming into a digital future. Jan Bosch builds his knowledge based on academic research and experience from the industry combining this into a holistic approach how to work with software leveraging from the opportunities and meeting the challenges."

– Mats Melander, Director Automation Solutions at Tetra Pak

CHAPMAN & HALL/CRC INNOVATIONS IN
SOFTWARE ENGINEERING AND SOFTWARE DEVELOPMENT

Speed, Data, and Ecosystems

Excelling in a Software-Driven World

Speed, Data, and Ecosystems

Jan Bosch

Bosch

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