Do As I Say; Not As I Do?

Building Products Customers Want to Use

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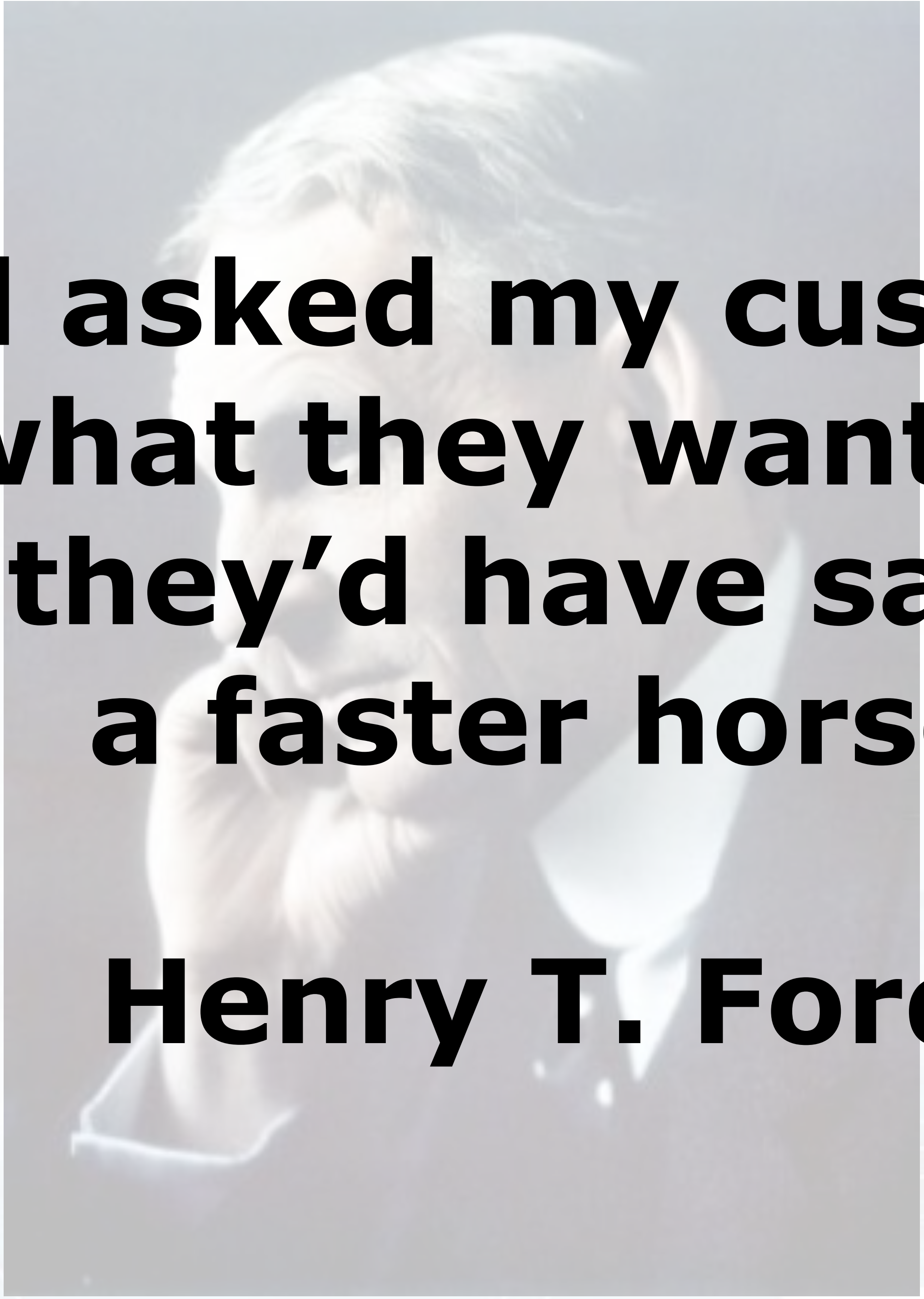
Industrial Engineering and Management
Guest lecture



If I’d asked my customers
what they wanted,
they’d have said
a faster horse

Henry T. Ford

Customers don’t know what they want. It’s very hard to envision the solution you want without actually seeing it.

Marty Cagan

The critical failing of user interviews is that you’re asking people to either remember past use or speculate on future use of a system

Jakob Nielsen

[The assumption that a] reasonably well-defined set of requirements exists, if only we take the time to understand them, is wrong

Dean Leffingwell

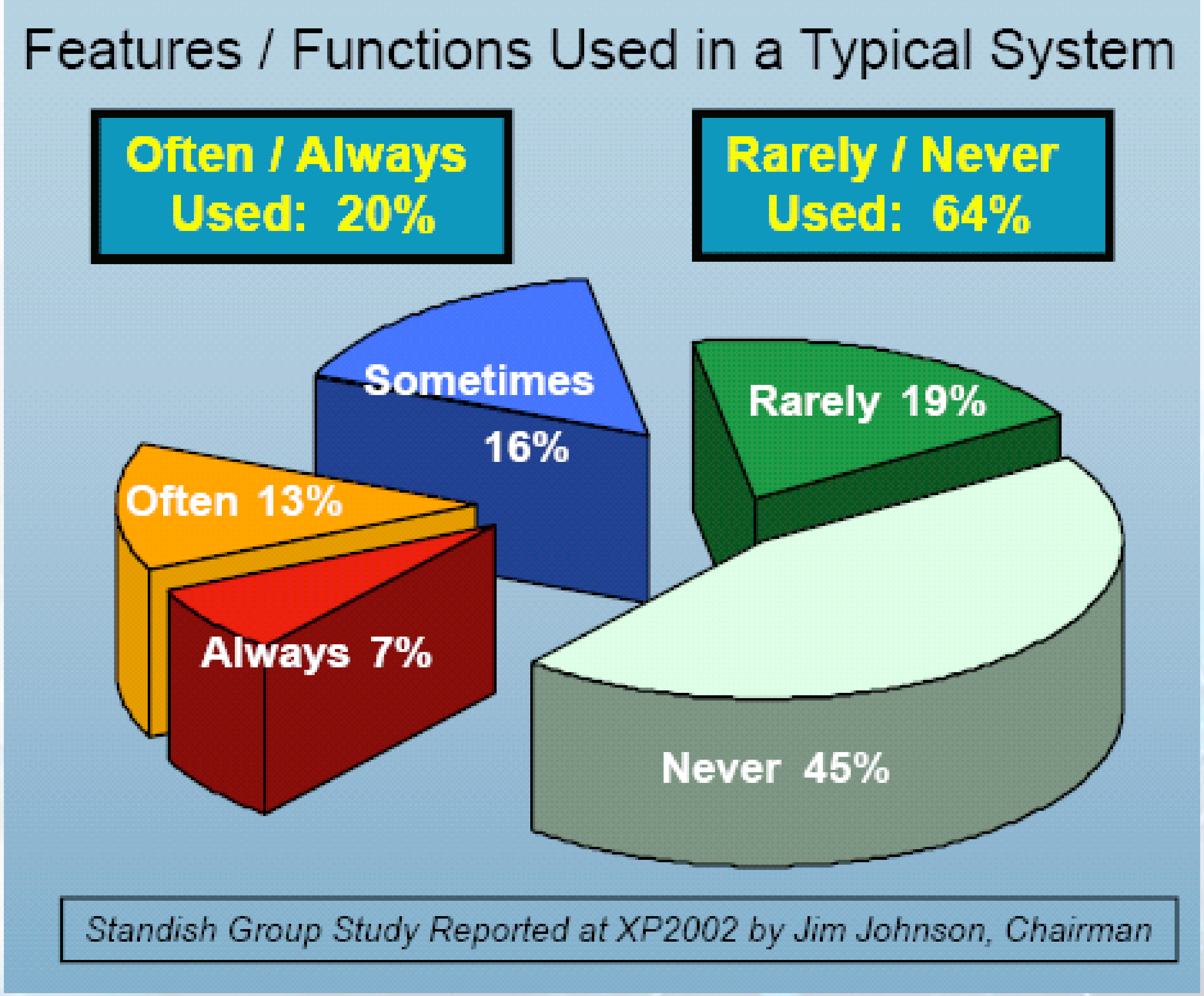
Customers don’t know what’s possible. Most have no idea about the enabling technologies involved

Marty Cagan

You can't just ask customers
what they want and then
try to give that to them.
By the time you get it built,
they'll want something new.

Steve Jobs

Featuritis



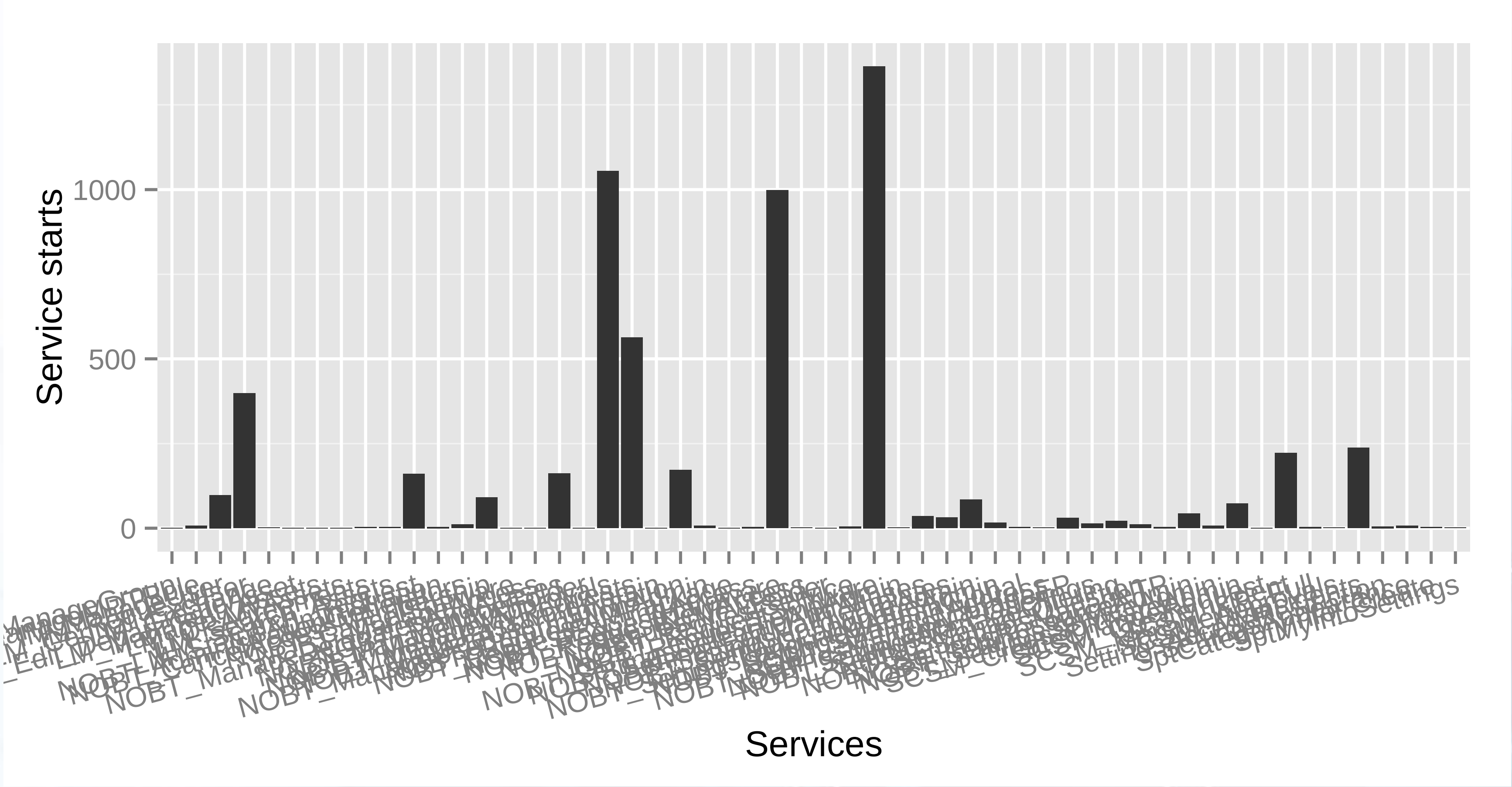
Features / Functions Used in a Typical System

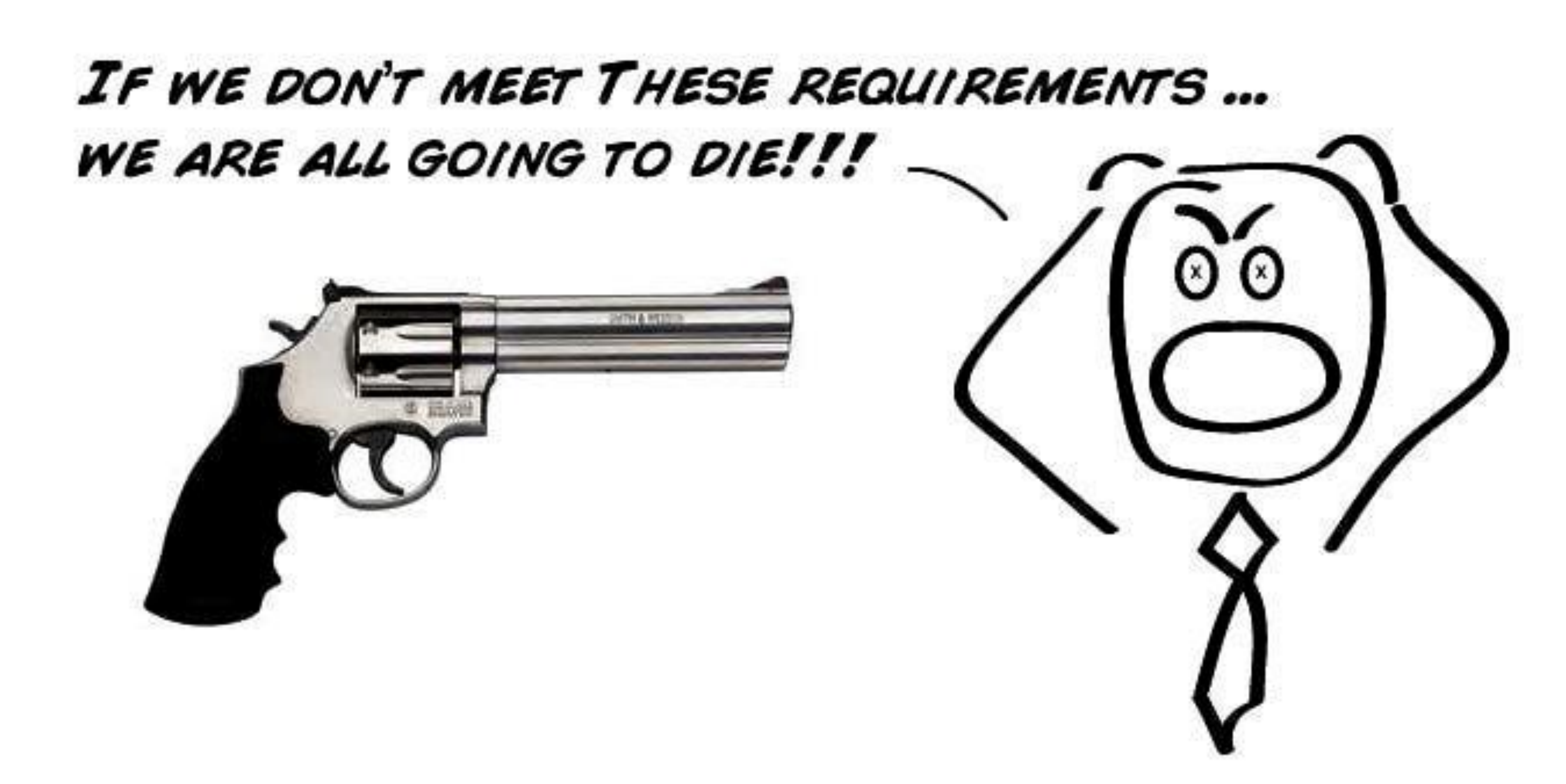
Often / Always Used: 20%

Rarely / Never Used: 64%

Standish Group Study Reported at XP2002 by Jim Johnson, Chairman

Our Research …




IF WE DON'T MEET THESE REQUIREMENTS ...
... WE ARE ALL GOING TO DIE!!!

Three Key Take-Aways

- Customer don’t know what they want until you show it to them – this requires **fast experimentation**

- Increasing **SPEED** gives you the short cycle times that allow for fast experimentation

- Continuous deployment allows you to organize R&D as **innovation experiment system**

Overview

- Vem är jag? Wie ben ik? Who am I?
- Trends in Software: Need for Speed
- Innovation Experiment Systems
- How to Get There: Stairway to Heaven
- Involving the Customer
- HYPEX and QCD Frameworks
- Case studies
- Conclusion

Academic Research

10X Software Center

Software Center

Consultancy

ERICSSON BOSCH SIEMENS BASF The Chemical Company

GRUNDFOS SONY make.believe JEPPESEN THALES

VARIAN medical systems AirTies wireless networks transmode SEB

Entrepreneur

fidesmo Remente

AUQTUS
Automated Quality Testing of User Scenarios

Industry Innovation

intuit. NOKIA

Industry Operations

NOKIA

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

Tetra Pak

SAAB TECHNOLOGIES

AXIS® COMMUNICATIONS

VOLVO

VOLVO

JEPPESEN®
A BOEING COMPANY

CHALMERS

UNIVERSITAS GOTHOBURGENSIS 1891

MALMÖ UNIVERSITY

ERICSSON

LINKÖPINGS UNIVERSITET

MÄLARDALEN UNIVERSITY SWEDEN

GRUNDFOS

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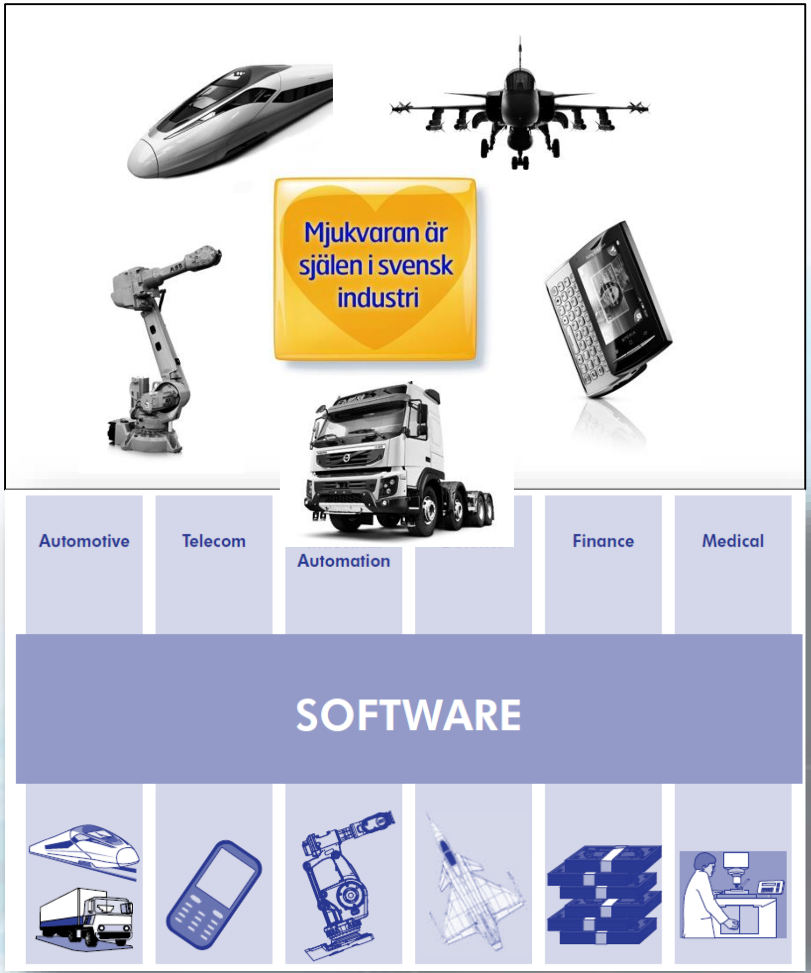
Nature of Product Innovation is Shifting

- More than 80% 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

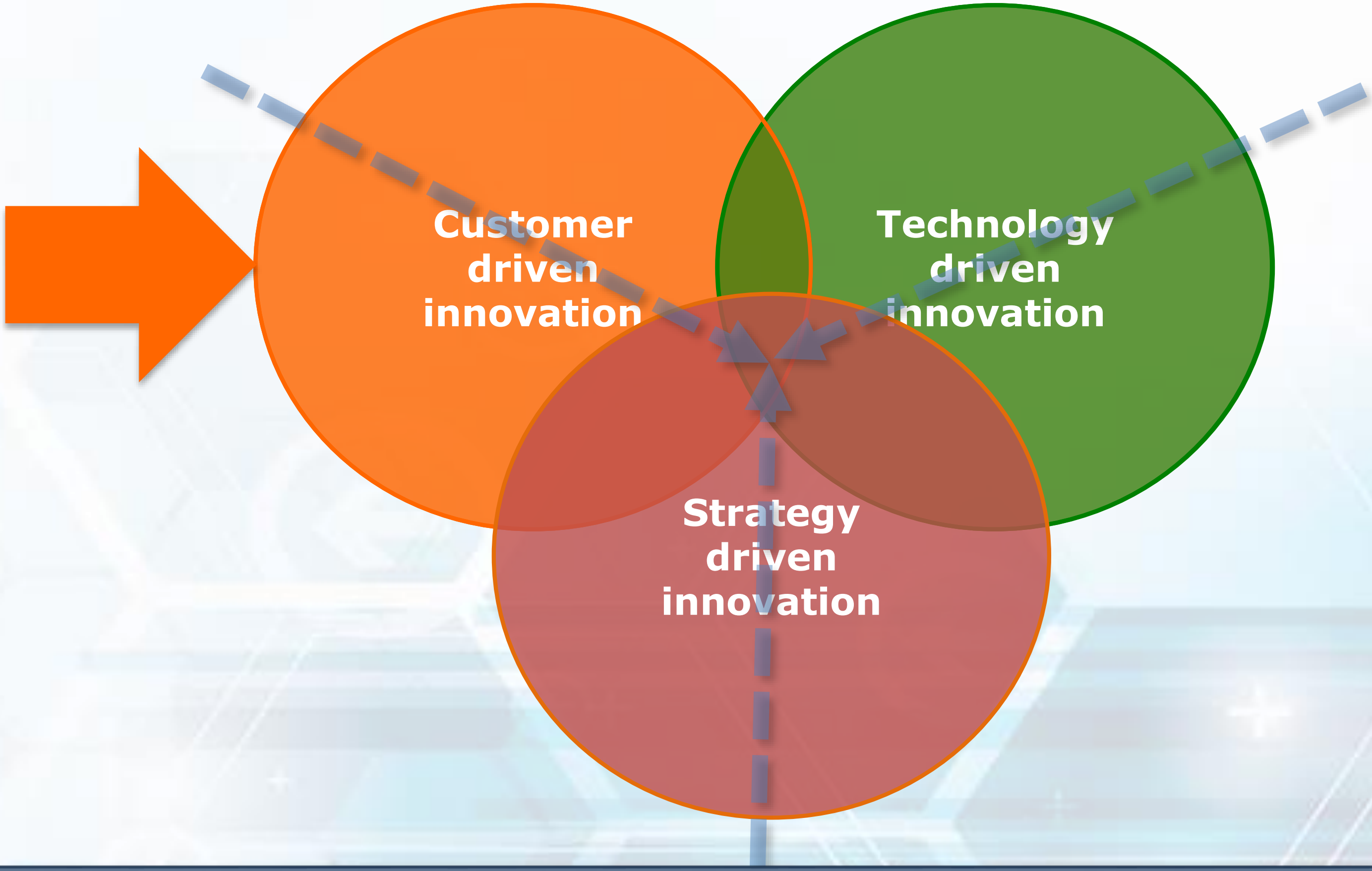


https://hbr.org/2015/06/does-hardware-even-matter-anymore

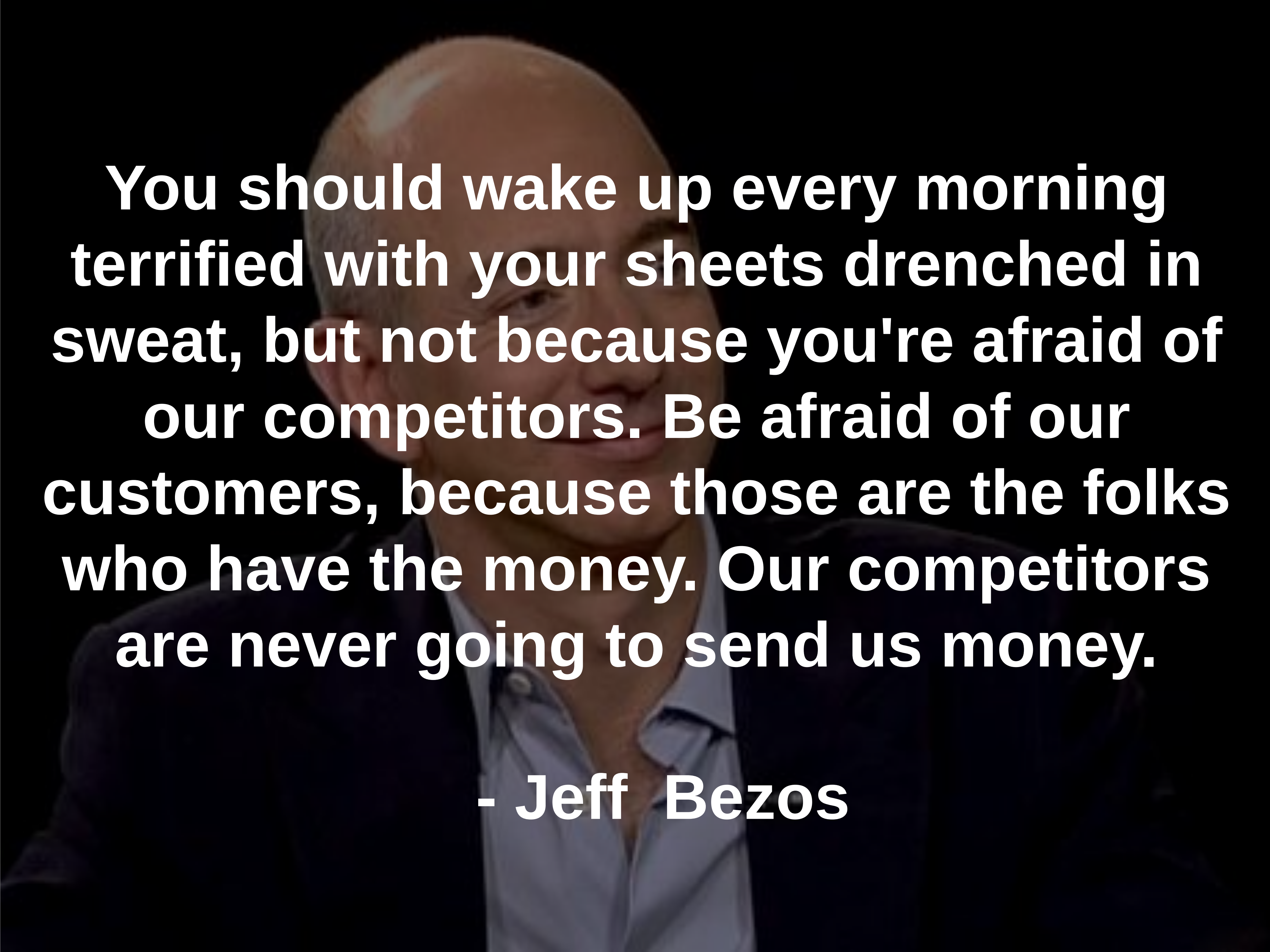
Trend: Products to Services

This requires continuous deployment throughout the lifetime of the product

Innovation Approaches


Customer driven innovation
Technology driven innovation
Strategy driven innovation

This requires continuous experimentation with customers



You should wake up every morning terrified with your sheets drenched in sweat, but not because you're afraid of our competitors. Be afraid of our customers, because those are the folks who have the money. Our competitors are never going to send us money.

- Jeff Bezos

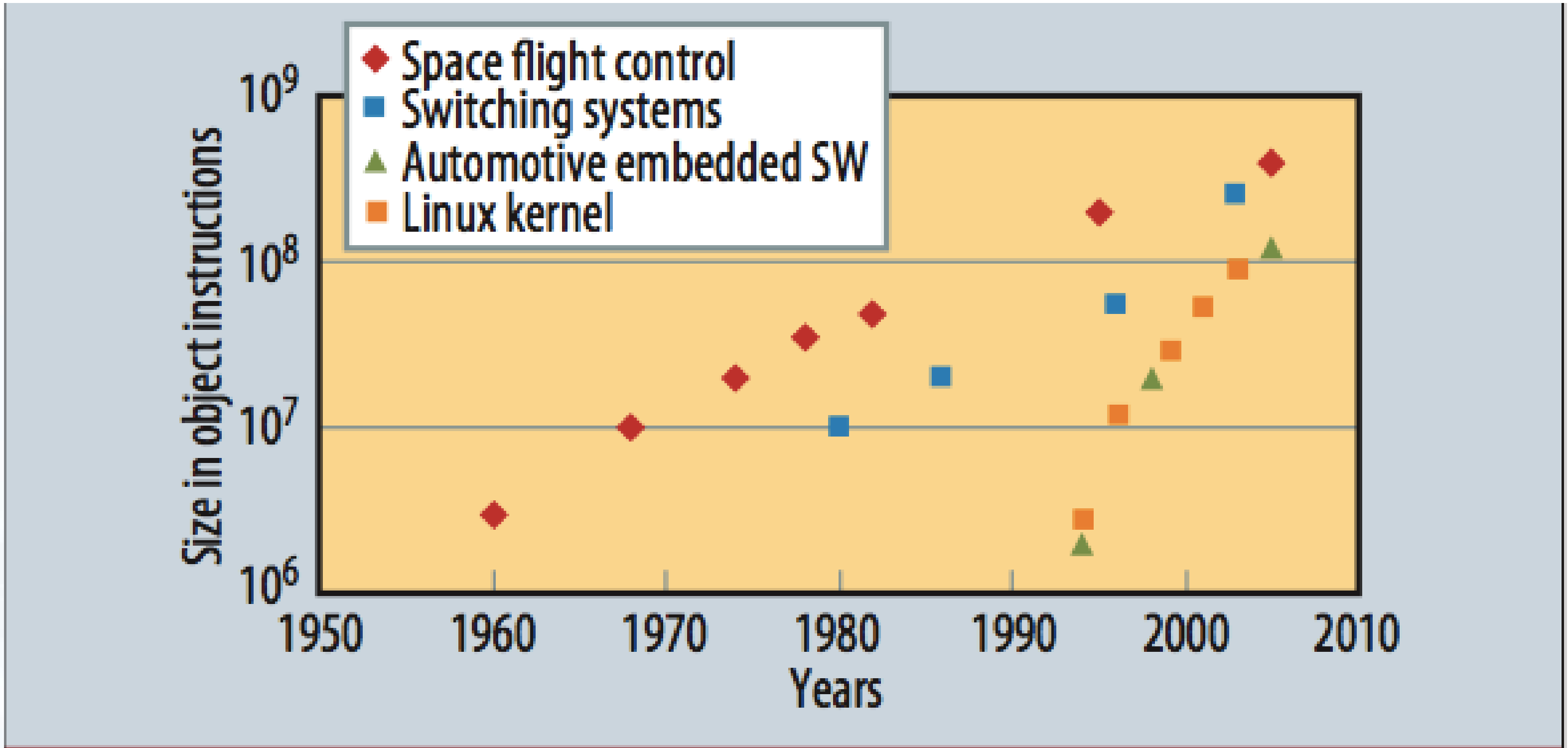
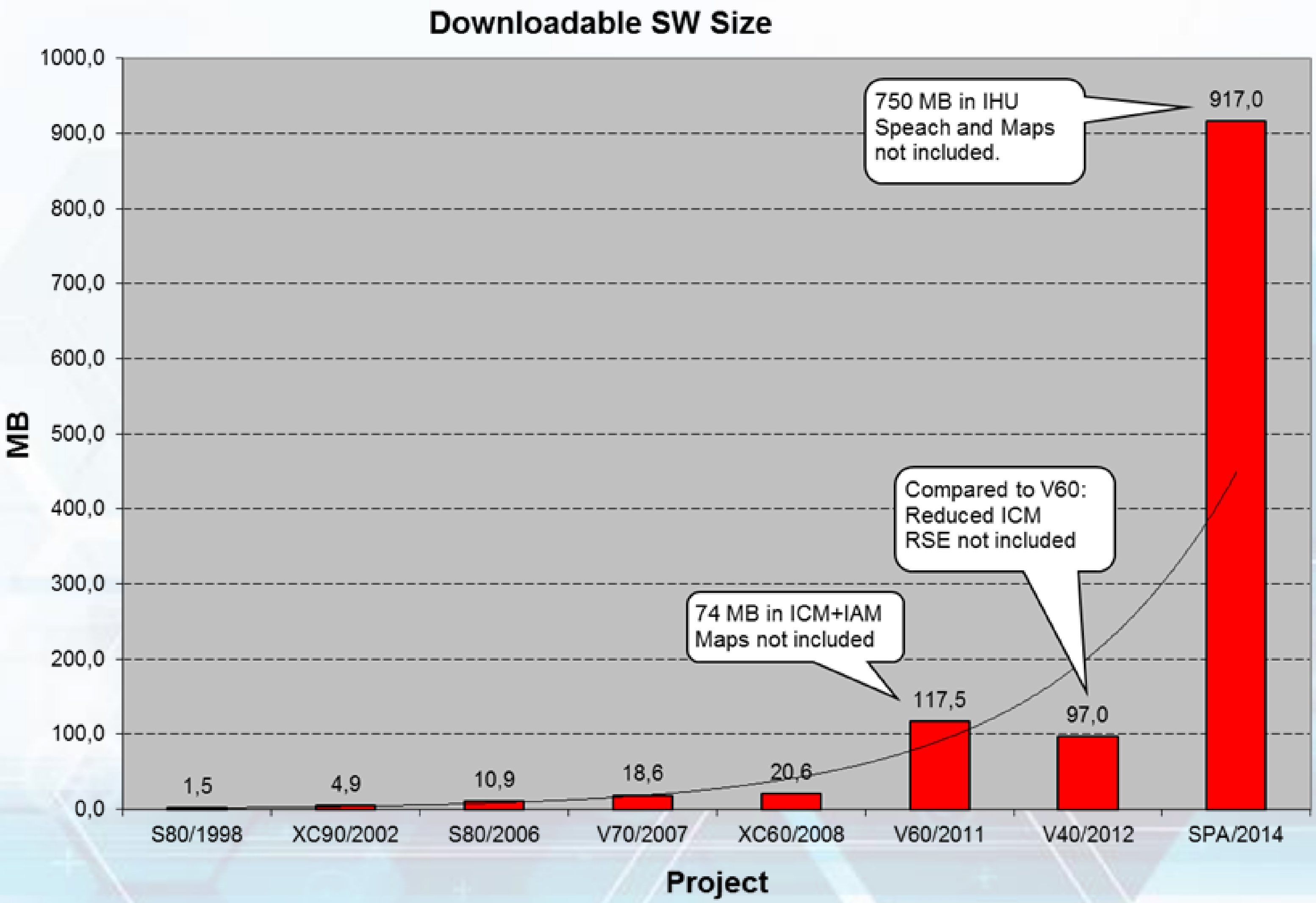


Figure 2. Complexity growth of embedded systems.

10x every ~7 years

Volvo XC 90


Downloadable SW Size
MB
1000,0
900,0
800,0
700,0
600,0
500,0
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200,0
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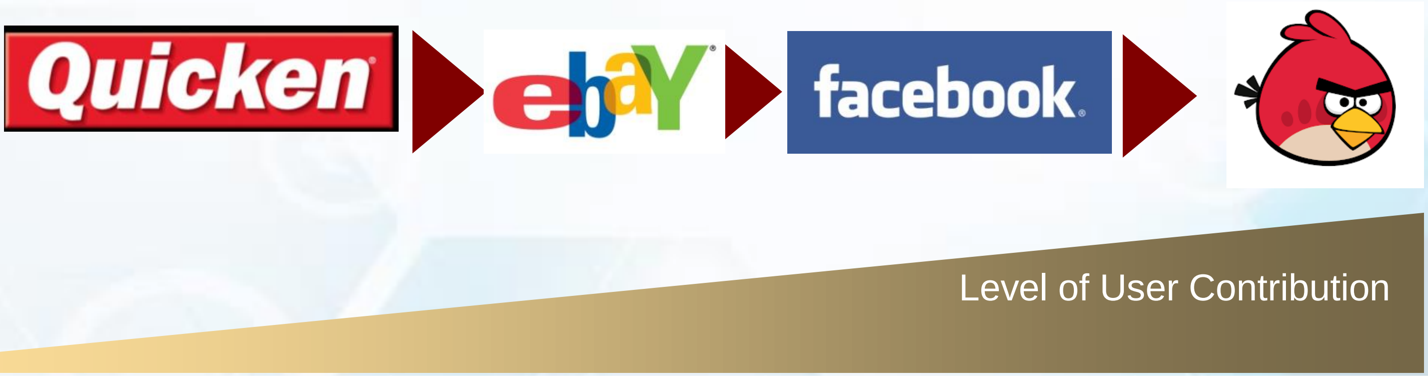
1,5
4,9
10,9
18,6
20,6
117,5
97,0
917,0
S80/1998
XC90/2002
S80/2006
V70/2007
XC60/2008
V60/2011
V40/2012
SPA/2014
Project
750 MB in IHU Speach and Maps not included.
Compared to V60: Reduced ICM RSE not included
74 MB in ICM+IAM Maps not included

Trend: Need for Speed

Value Creation Shifts

Emerging companies highlight importance
of user contribution and social connectedness



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

Need for Speed - Principles

Team

- 2 pizza’s
- self-selected, directed and managed
- quantitative output metrics

Architecture

- simplicity – 3 API rule
- backward compatibility – no versions!
- focus on compositionality

Release process

- continuous, independent deployment
- all the way to customers – installed base
- measure usage to feed back into development

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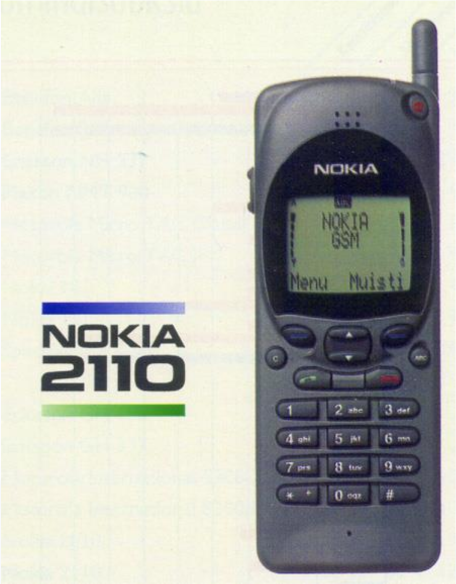
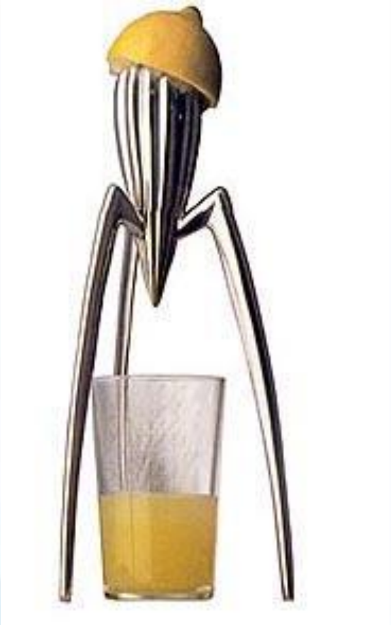
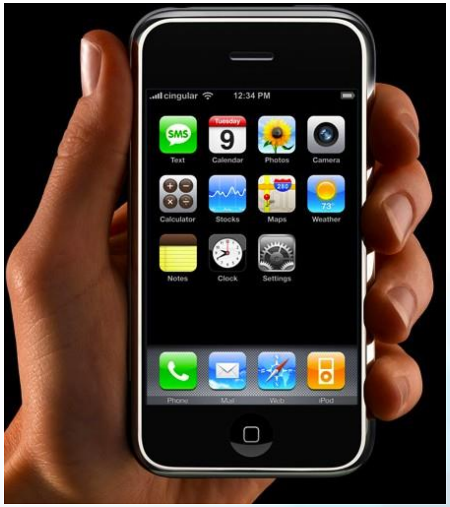
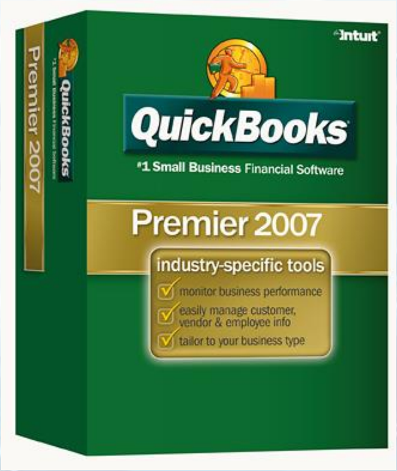
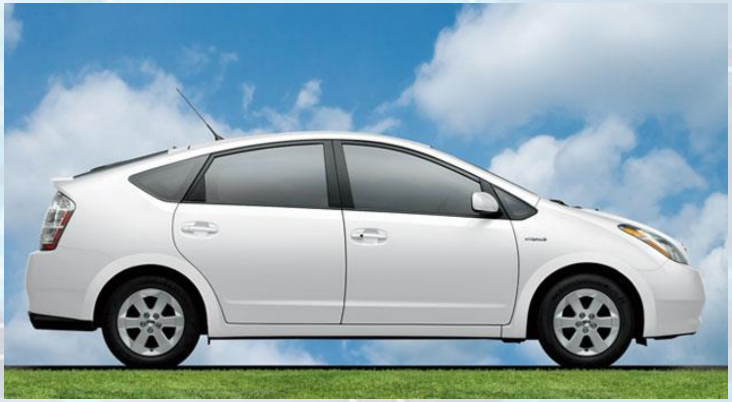
What Do These Product Have in Common?








Intuit
QuickBooks
#1 Small Business Financial Software
Premier 2007
industry-specific tools
monitor business performance
easily manage customer, vendor & employee info
tailor to your business type



Example: Apple

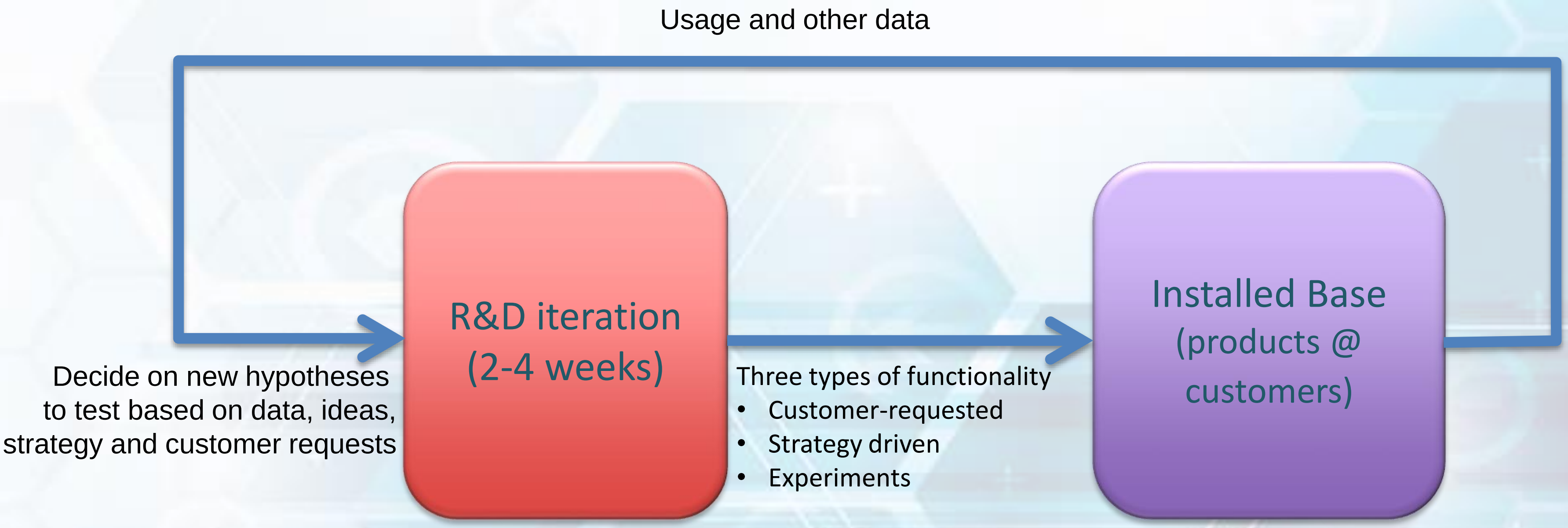
The Myth	The Reality
Inspired innovation	Create and winnow 10 pixel-perfect prototypes
Inspired design	Build a better backstory (intricate layers of business design behind the products)
Brilliantly inspired marketing	Engineer the perfect customer experience to create customer experience and buzz

Reference: http://blogs.hbr.org/cs/2011/08/steve_jobs_and_the_myth_of_eur.html

R&D as an Experiment System

Learning: the company running the most experiments against the lowest cost per experiment wins

Goal: increase the number of experiments (with customers) with an order of magnitude to ultimately accelerate organic growth



Usage and other data

R&D iteration (2-4 weeks)

Installed Base (products @ customers)

Decide on new hypotheses to test based on data, ideas, strategy and customer requests

Three types of functionality

- Customer-requested
- Strategy driven
- Experiments

Decisions should be based on DATA, not opinions

We have an unprecedented opportunity to run A/B tests with online users and innovate more quickly based on actual user response. Microsoft needs to shift the culture from planning the exact features to planning a set of possible features, and letting customers guide us.

- Ray Ozzie

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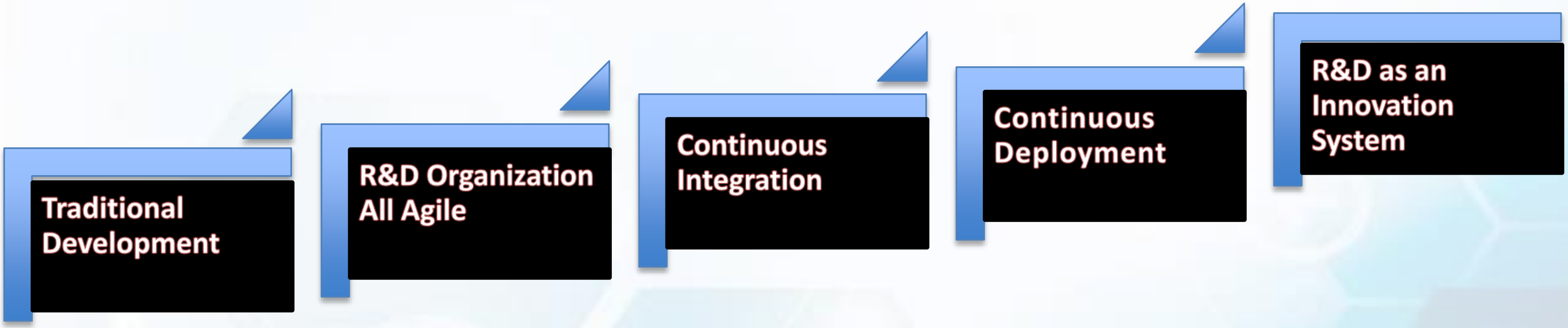
Stairway to Heaven



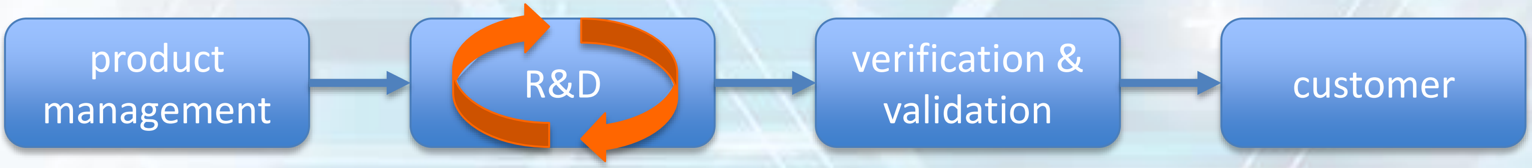
Traditional Development

R&D Organization All Agile

Continuous Integration

Continuous Deployment

R&D as an Innovation System



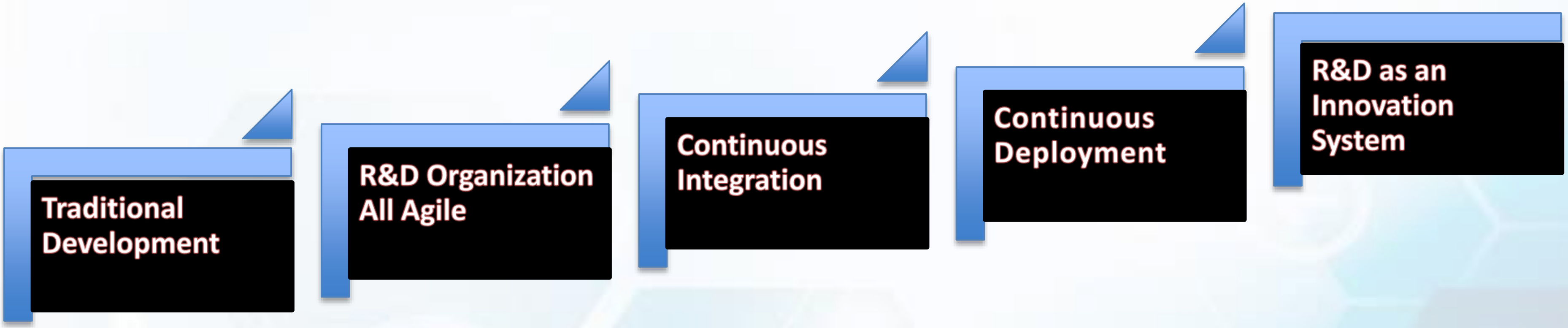
product management

R&D

verification & validation

customer

Stairway to Heaven



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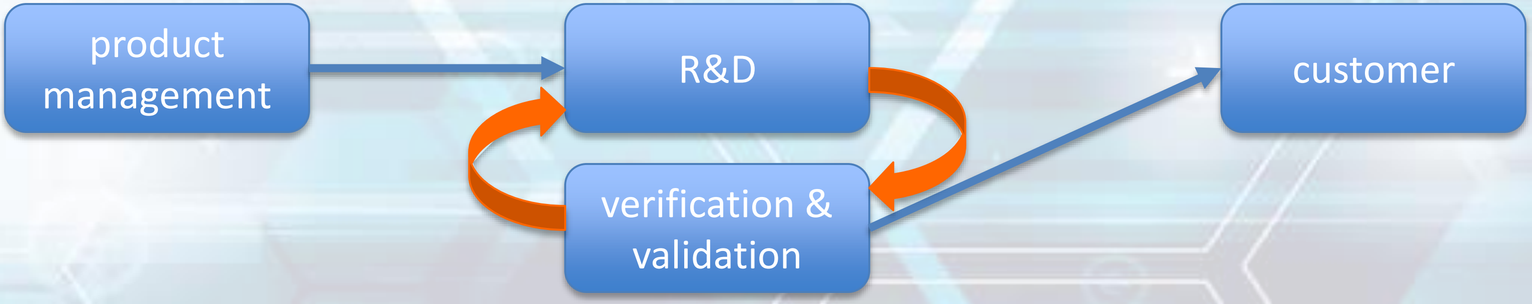


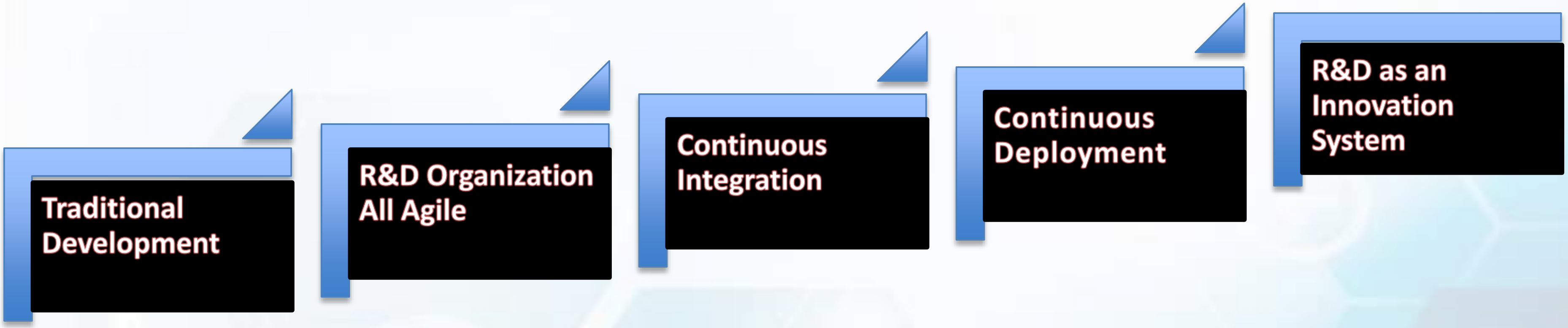
product management

R&D

verification & validation

customer

Stairway to Heaven



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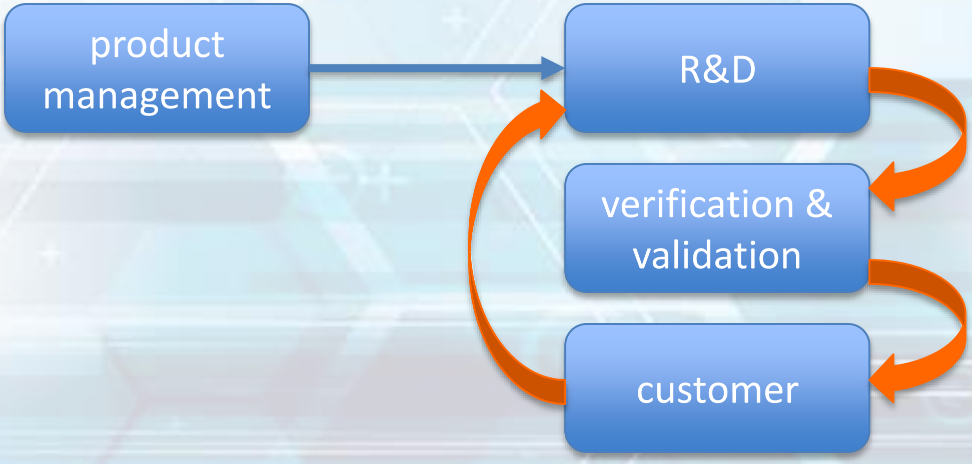


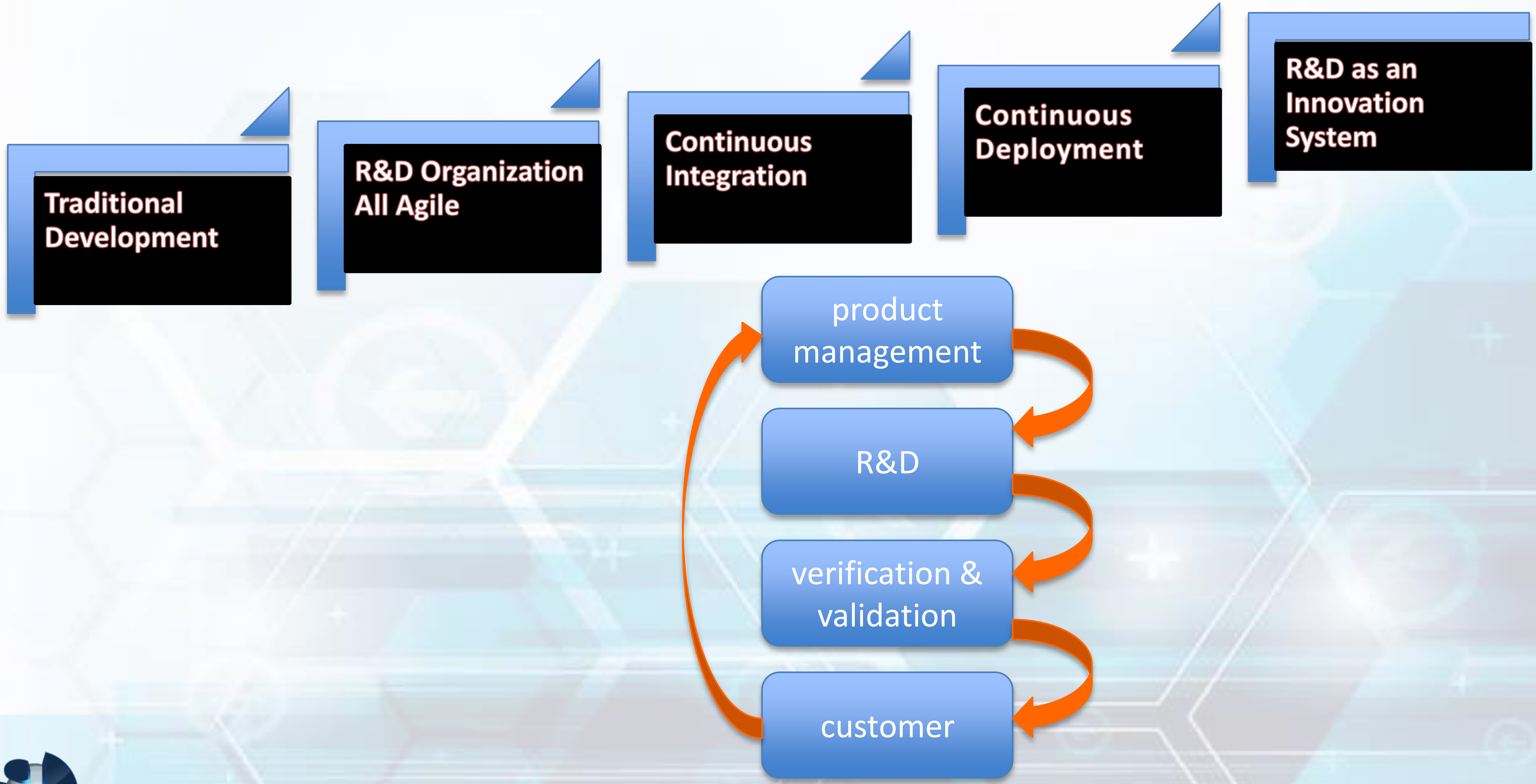
product management

R&D

verification & validation

customer

Stairway to Heaven



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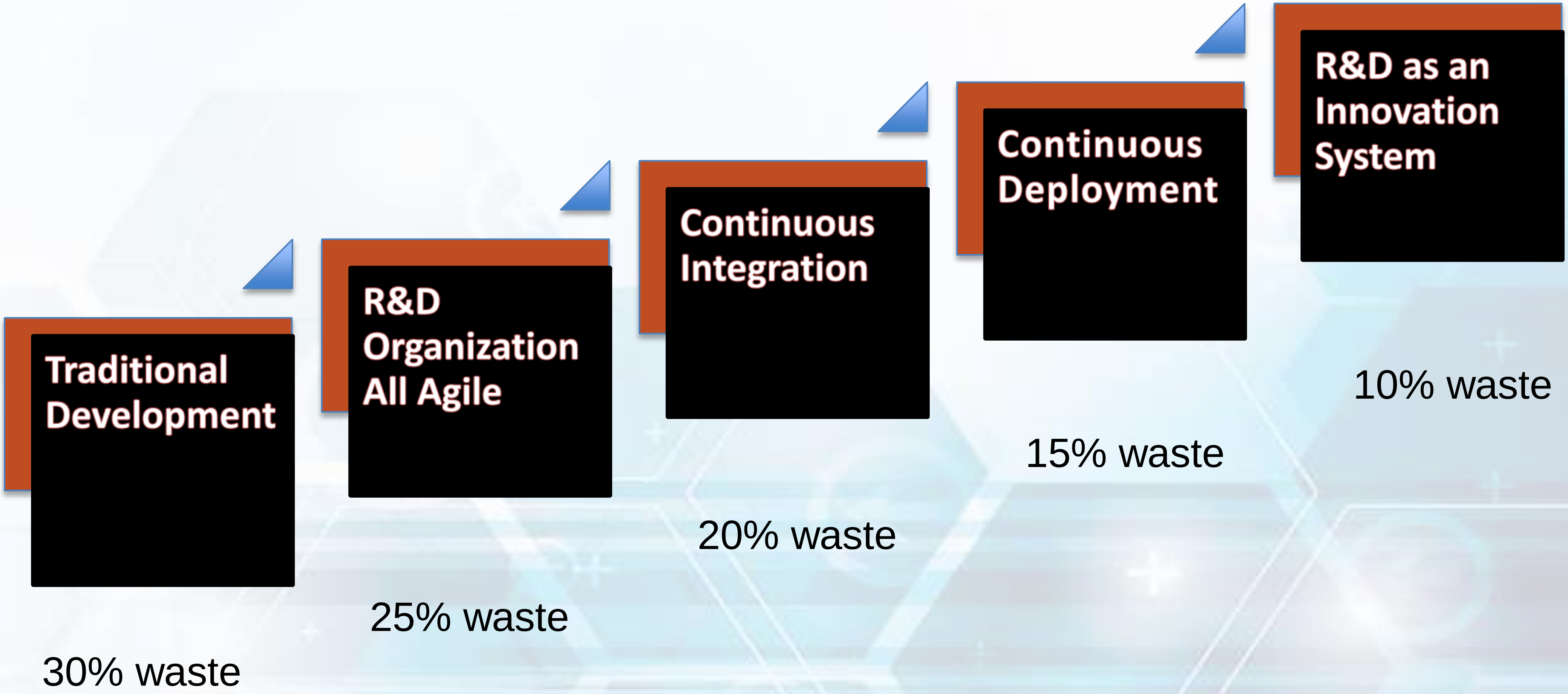


Traditional Development

R&D Organization All Agile

Continuous Integration

Continuous Deployment

R&D as an Innovation System

30% waste

25% waste

20% waste

15% waste

10% waste

Rough estimation of waste and benefits

Financial Impact Potential

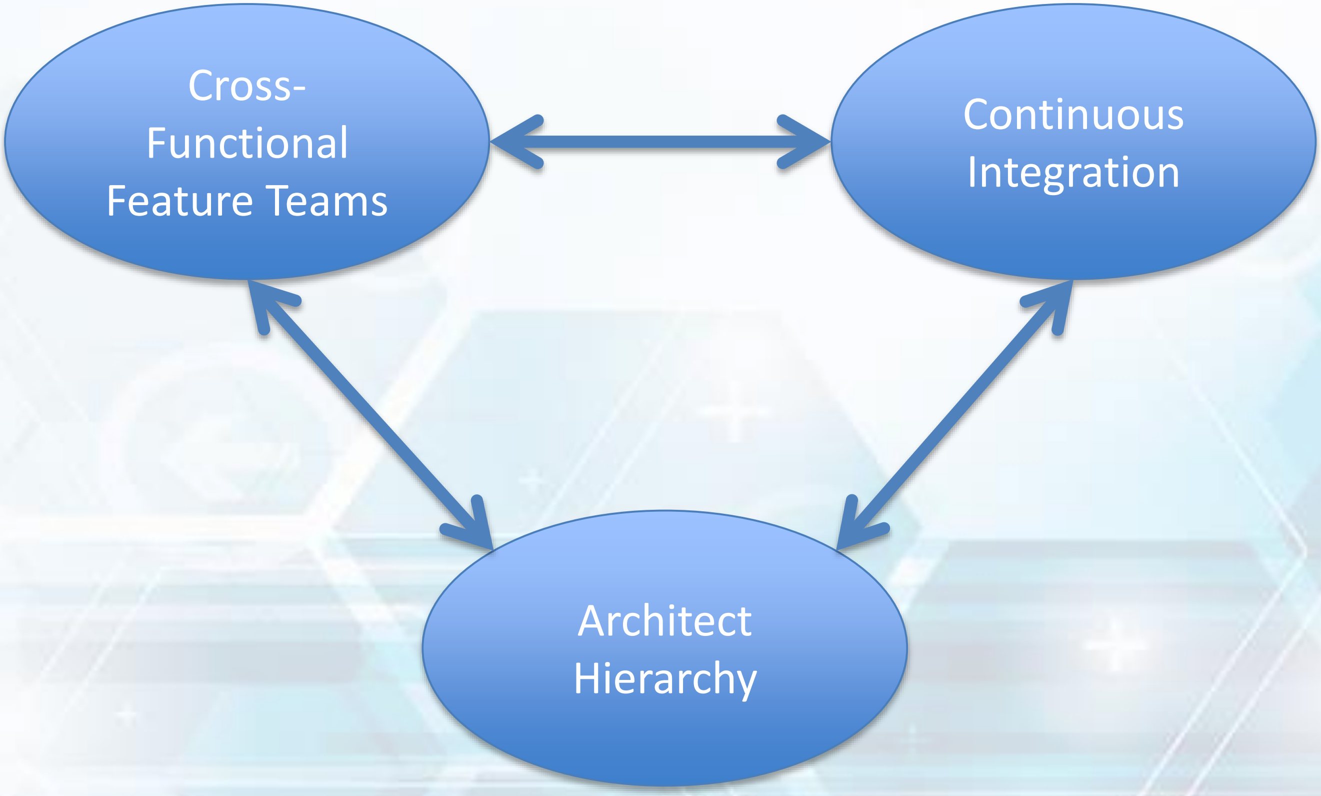
Ericsson

- R&D budget July 2011 – June 2012: 4,864 M$
- Software R&D (80%): 3891 M$
- Value of removing 5% waste: **195 M$ (1280 MSEK)**

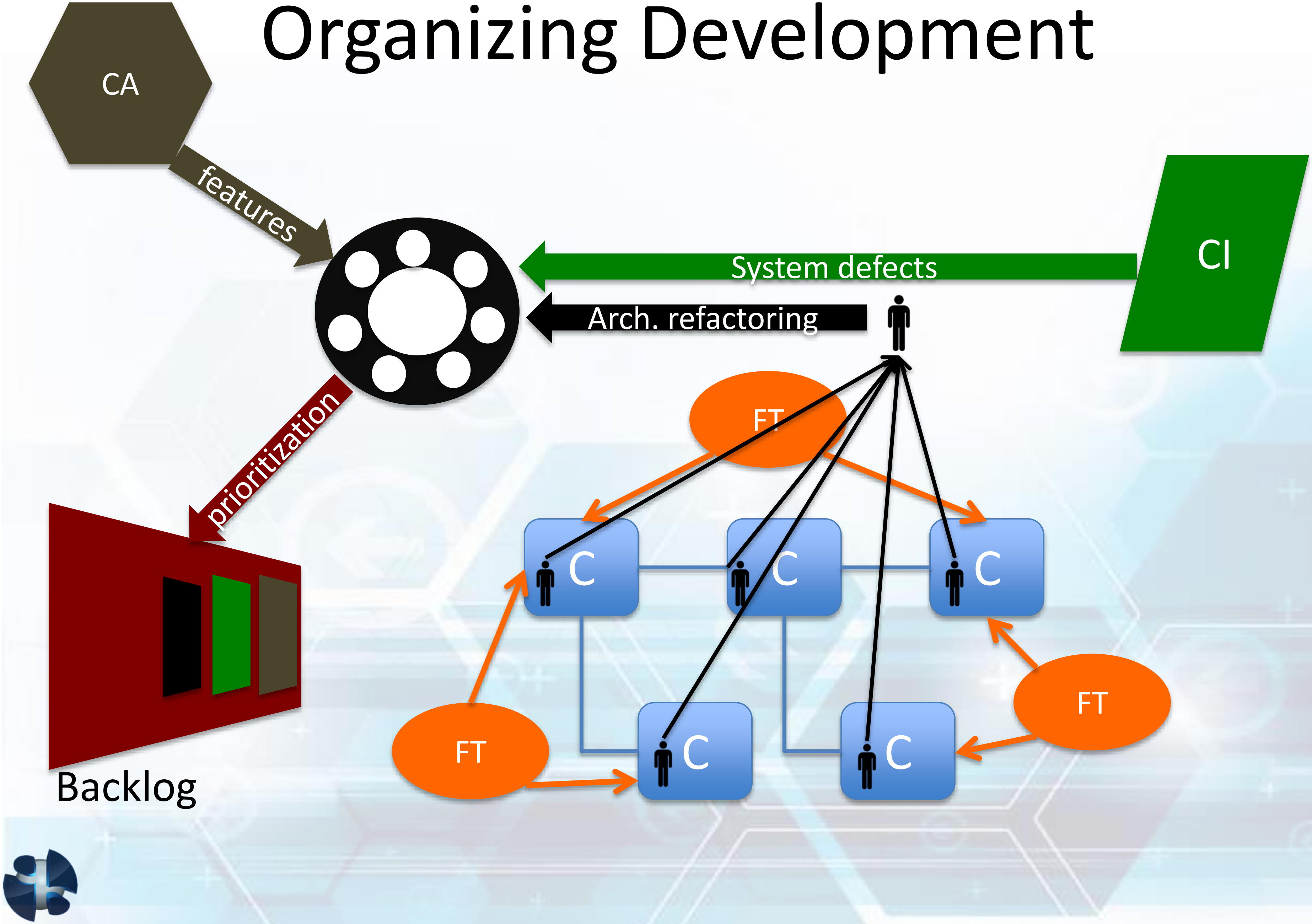
AB Volvo

- Revenue 2011: 310 BSEK
- R&D budget 2011 (est. 5%): 16 BSEK
- Software R&D (25%): 4 BSEK
- Value of removing 5% waste: **200 MSEK**

CI: Three Core Elements



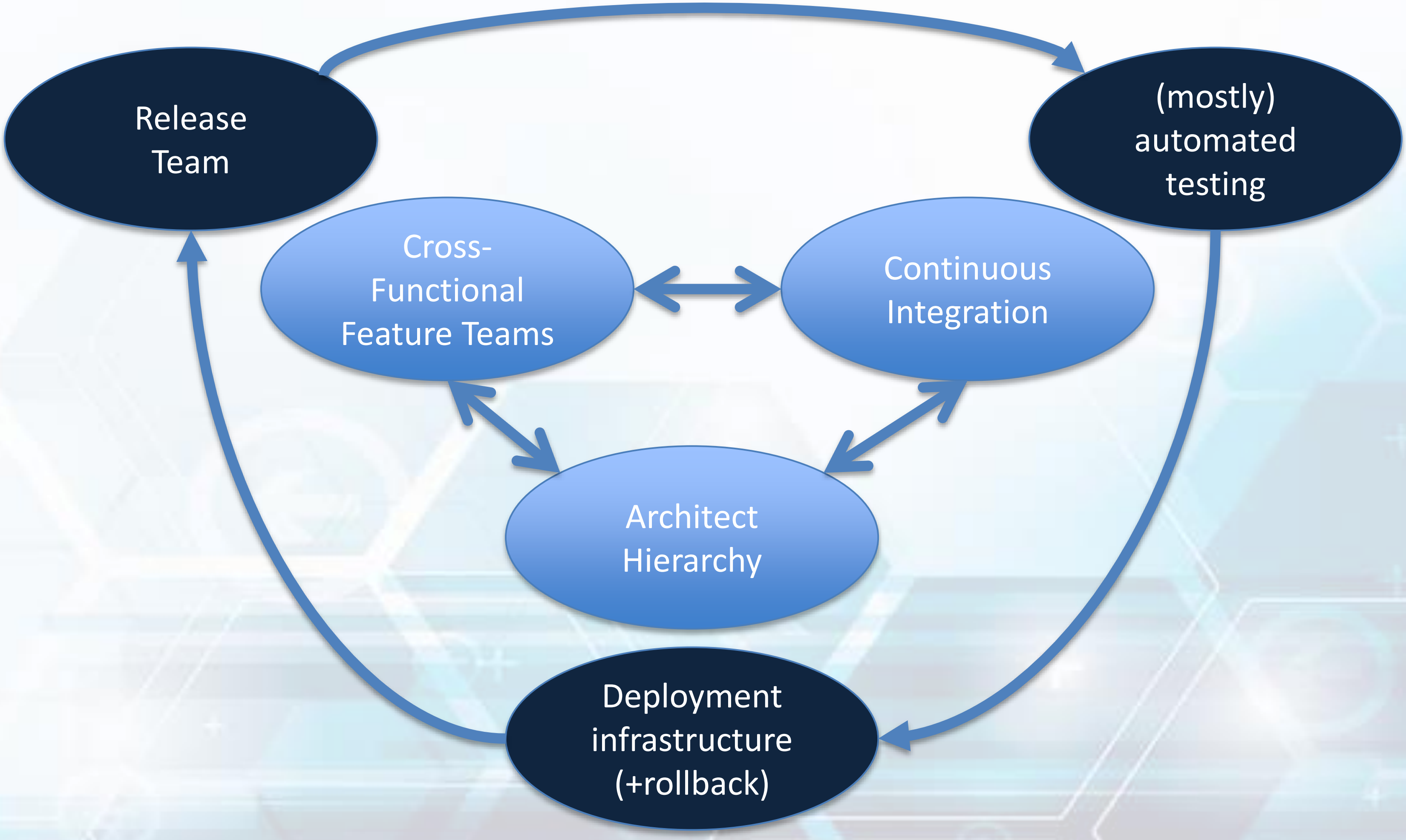
Organizing Development



Continuous Deployment

- **Continuous Deployment** is the frequent (at least every 4 weeks) deployment of new software at products in the field initiated by the producer without (or with minimal) interaction with and approval from the customer.

CD: Two Loops


Release Team
(mostly) automated testing
Cross-Functional Feature Teams
Continuous Integration
Architect Hierarchy
Deployment infrastructure (+rollback)

Later: collapse the loops

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Interview Quotes

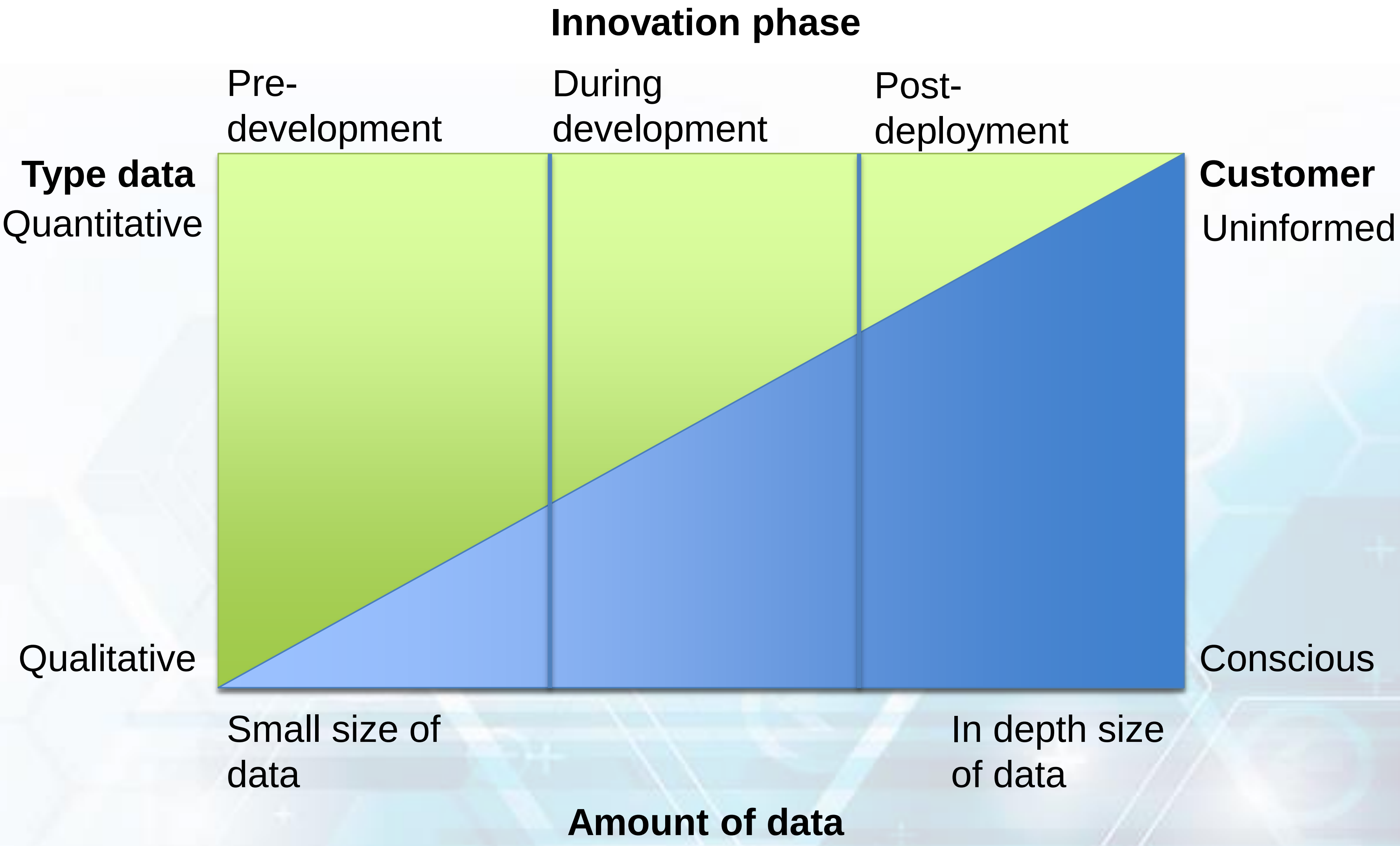
- ”We DON’T know what features our customers use”.
- ”We have an idea on what functionality that is used…based on sales…but we DON’T really know…”.
- ”We can see some of the functionality that is used, but we CAN’T see how it is used”.
- ”Our development is affected in that we DON’T know what customers want”.
- ”We get feedback only on things that DON’T work…things that are problematic. This is not necessarily an indication of what is used the most…”.
- ”Does silence mean that things are OK? We DON’T know…”.

Stages and Techniques

	Pre-Development	Development	Commercial deployment
Optimization	Ethnographic studies	Independently deployed extensions	Random selection of versions (A/B testing)
New features	Solution jams	Feature alpha In-product surveys	Instrumentation/ collecting metrics
New Products	Advertising Mock-ups BASES testing	Product alpha Labs website In-product advertising	Surveys Performance metrics

"In the field"

"In product"



Innovation phase

Pre-development

During development

Post-deployment

Type data

Quantitative

Qualitative

Customer

Uninformed

Conscious

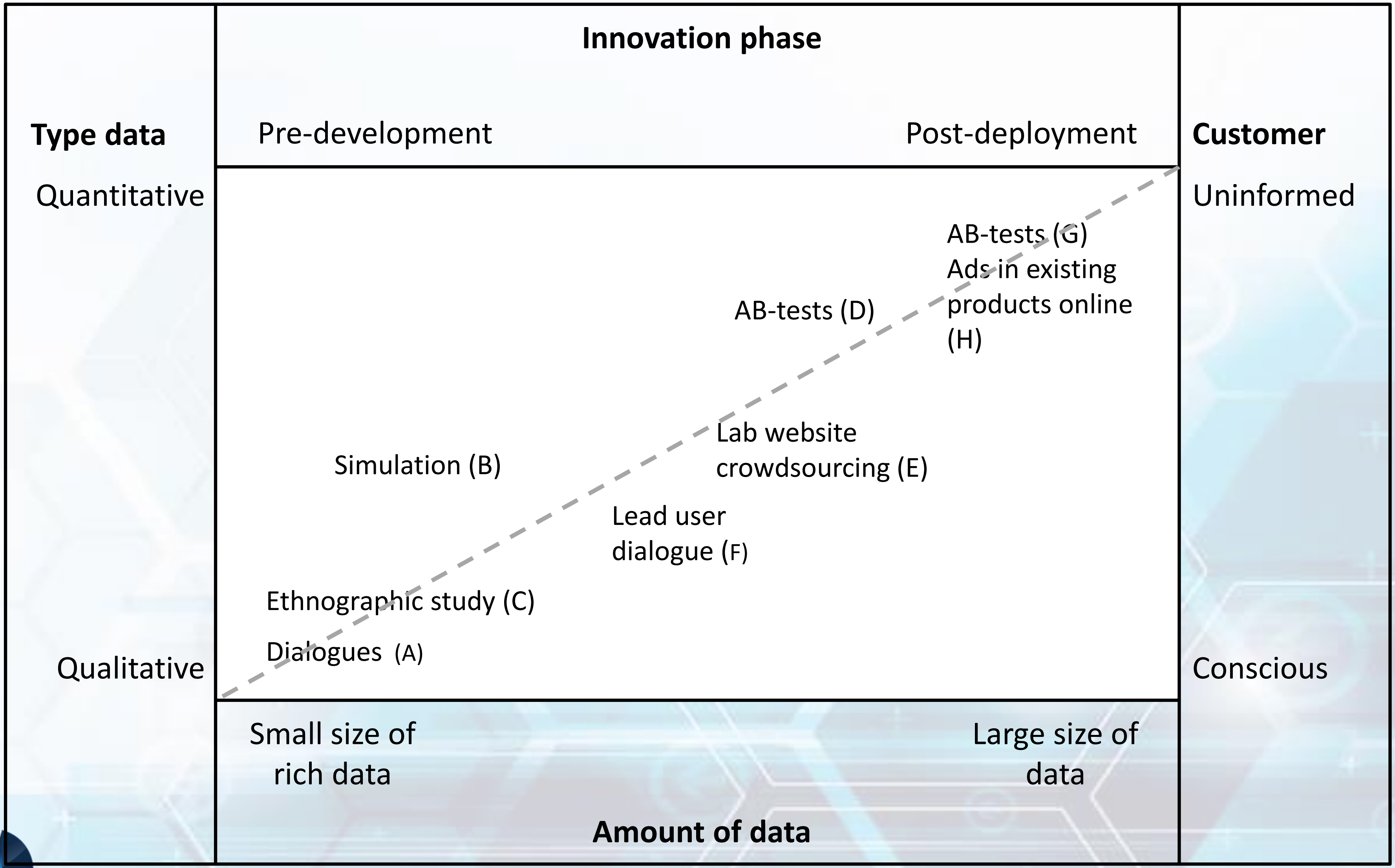
Small size of data

In depth size of data

Amount of data

Source: Bosch-Sijtsema & Bosch, 2015

Conceptual Model



Innovation phase

Pre-development

Post-deployment

Type data

Quantitative

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Conscious

AB-tests (G)
Ads in existing products online (H)

AB-tests (D)

Lab website crowdsourcing (E)

Simulation (B)

Lead user dialogue (F)

Ethnographic study (C)

Dialogues (A)

Small size of rich data

Large size of data

Amount of data

Pre-Development: Concept Testing

- What
  - Technique to test a concept before start of development.
  - Active Customer: Respondents are exposed to graphical or written product description. Answer a survey
  - Passive customer: Cross-sell, upsell or market a non-existing product (e.g. AdWords) to measure market interest
- To think about
  - Measure the conversion funnel
  - Consider A/B testing on your ad & pages

Quickbooks Online

- Cross-sell and upsell “ads” in the online product
- Measure conversion of those ads
- Decide on development of feature/product based on data

Evolution: A/B Testing

- What
  - A/B testing is a method of comparing a baseline control sample to a variety of single-variable test samples for improving some metric
- Alternatives
  - “Marketing” testing, e.g. colors, buttons and order of options
  - Alternative implementations of a feature
- To think about
  - Run multiple experiments simultaneously
  - Verify statistical relevance (free online tools exist)

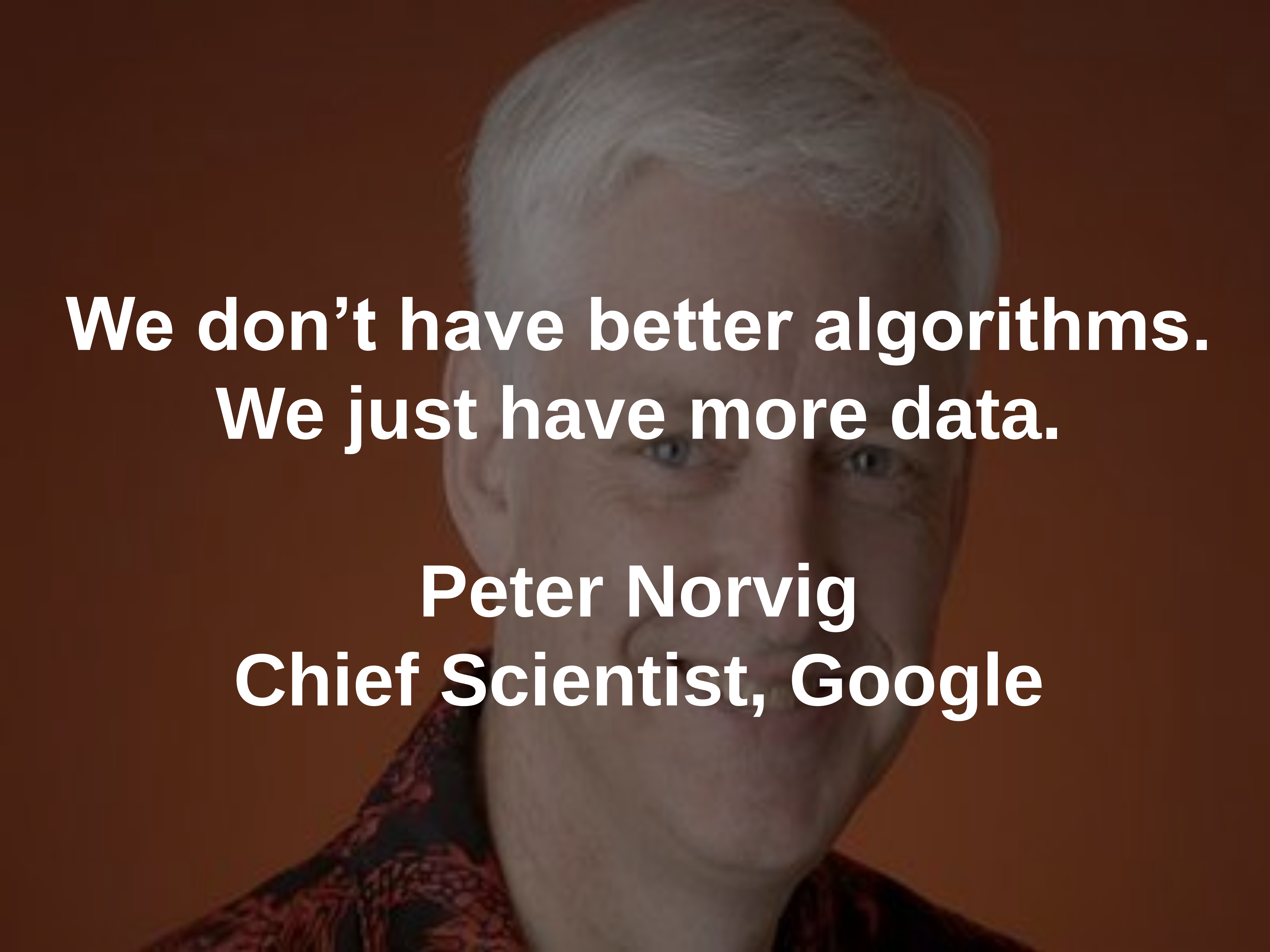
Case: Open Infotainment Labs

Case: Open Infotainment Labs

- Feature development from a nominal lead-time of 1-3 years to 4-12 weeks?
- Working software was continuously validated in "real" environments
  - installed in both a driving simulator and real test cars
  - users evaluated the system
- 4th sprint: A/B experiment
  - Evaluating two layouts of the start screen
    - Implemented as two different launchers in Android
  - Mounted in a vehicle
  - 7 test drivers in total (3 used A, 4 used B)

A/B Testing Examples

- 37signals tested the headline on its pricing page. It found that “30-Day Free Trial on All Accounts” generated 30% more sign-ups than the original “Start a Highrise Account.”
- Dustin found that “You should follow me on Twitter here” worked 173% better than his control text, “I’m on Twitter.”
- A surprising conclusion from two separate A/B tests: putting human photos on a website increases conversion rates by as much as double.
- CareLogger increased its conversion rate by 34% simply by changing the color of the sign-up button from green to red.
- A software product company redesigned their product page to give it a modern look and added trust building elements (such as seals, guarantees, etc.). End result: they managed to increase total sales by 20%.



We don’t have better algorithms.
We just have more data.

Peter Norvig
Chief Scientist, Google

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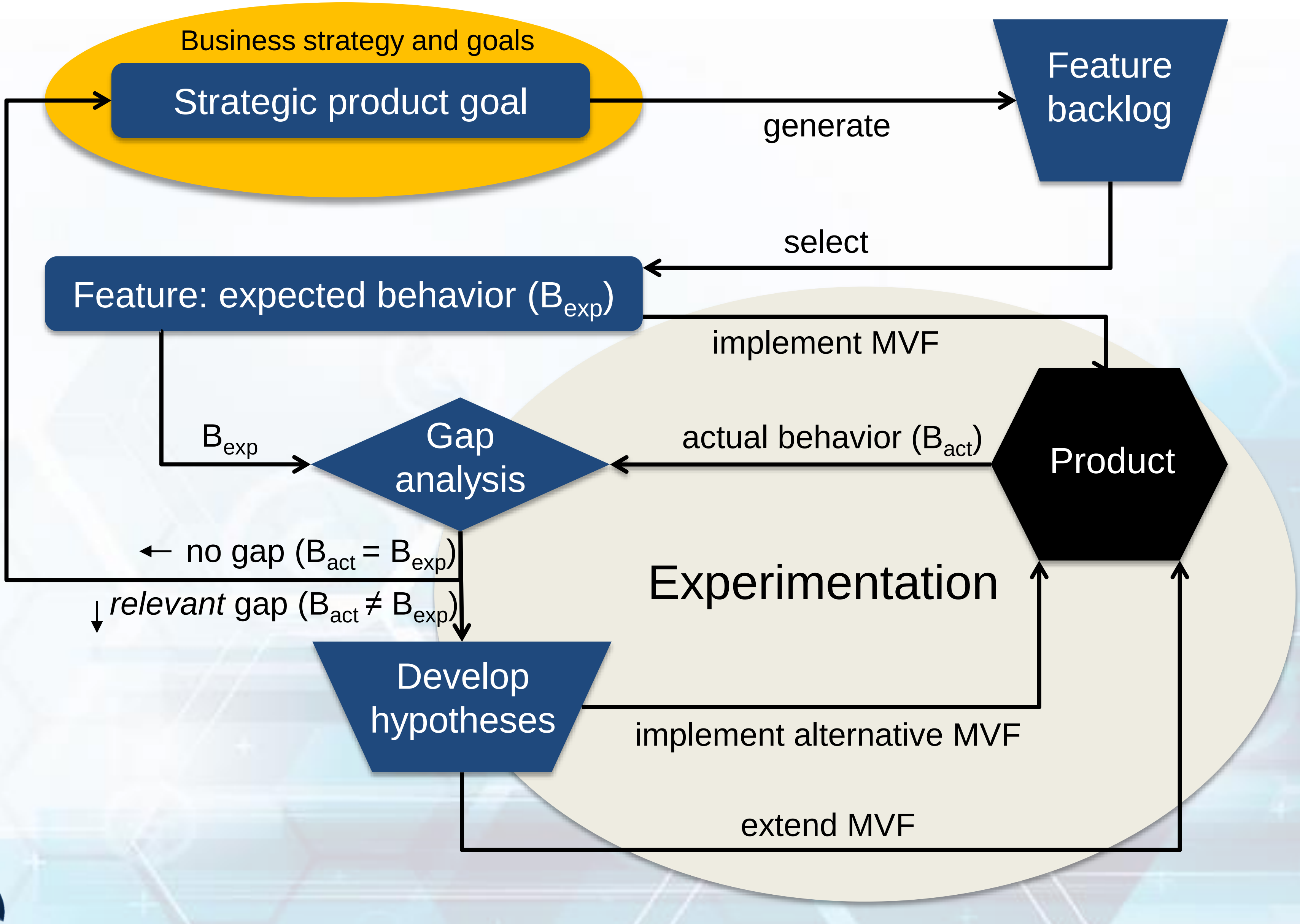
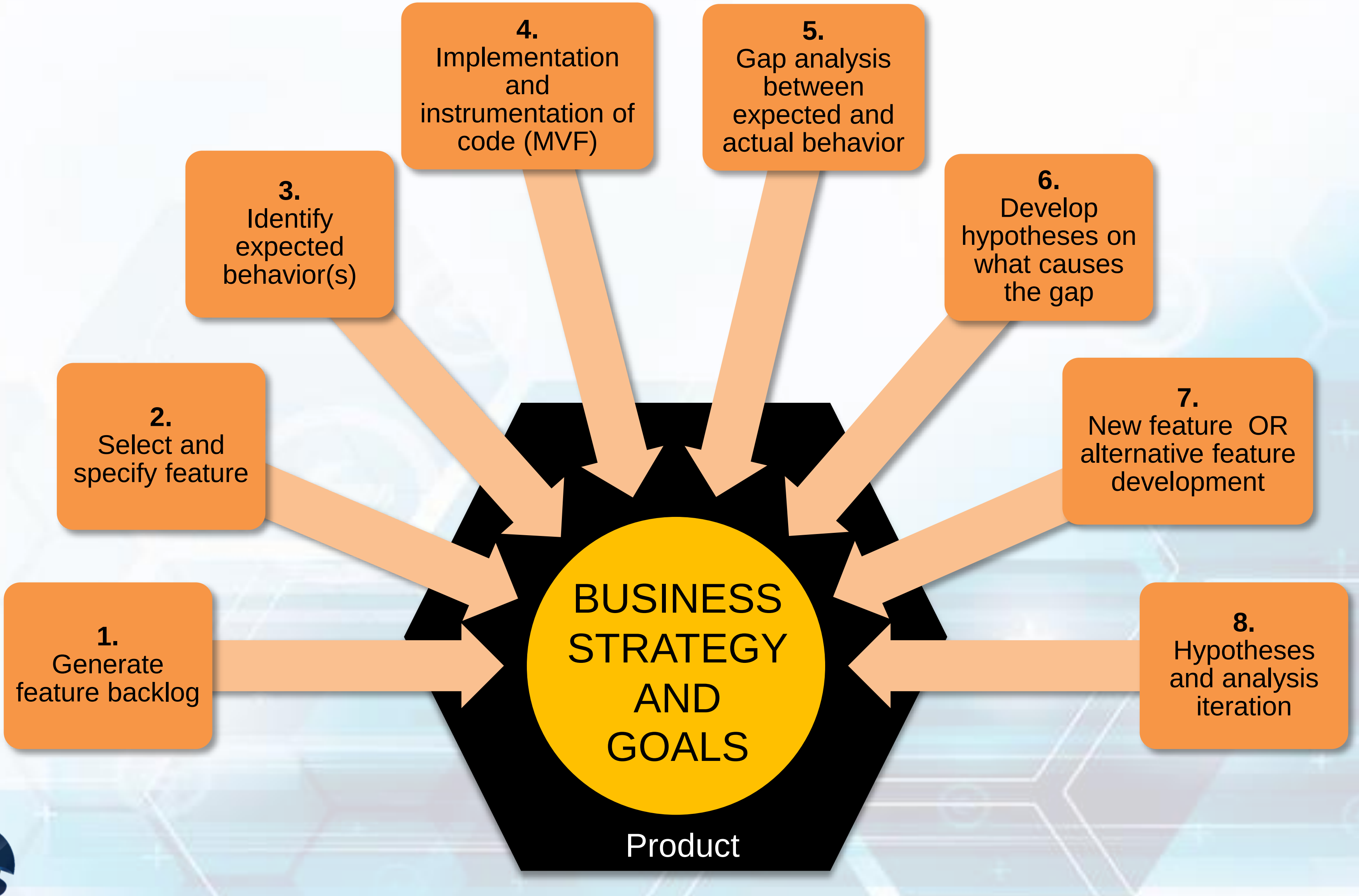
The HYPEX Model

- **WHAT?**
  - Process model for conducting feature experiments
- **HOW?**
  - A set of practices that allow for continuous validation of customer value
- **WHY?**
  - To significantly shorten feedback loops to customers
  - To increase accuracy of R&D investments

The HYPEX Model


Business strategy and goals
Strategic product goal
generate
Feature backlog
select
Feature: expected behavior (B_{exp})
implement MVF
B_{exp}
Gap analysis
actual behavior (B_{act})
Product
← no gap ($B_{act} = B_{exp}$)
Experimentation
↓ *relevant* gap ($B_{act} \neq B_{exp}$)
Develop hypotheses
implement alternative MVF
extend MVF

The HYPEX practices



1. Generate feature backlog

2. Select and specify feature

3. Identify expected behavior(s)

4. Implementation and instrumentation of code (MVF)

5. Gap analysis between expected and actual behavior

6. Develop hypotheses on what causes the gap

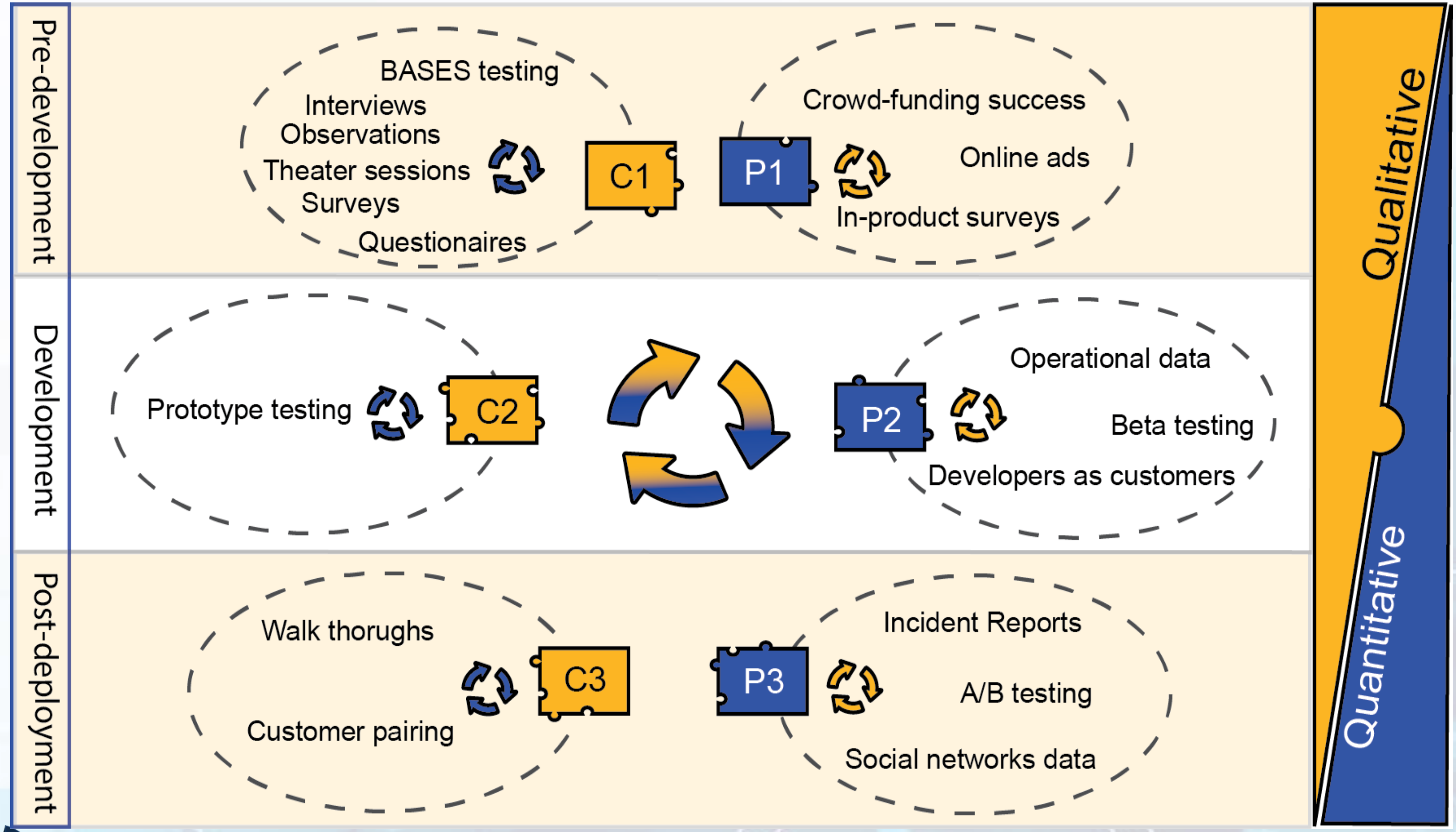
7. New feature OR alternative feature development

8. Hypotheses and analysis iteration

The QCD model: Qualitative/quantitative Customer-driven Development

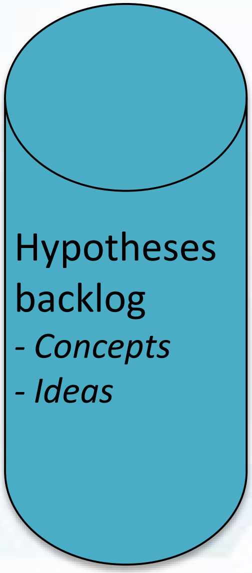
- Emphasizes the need for combining qualitative feedback with quantitative customer observation.
- Requirements are treated as hypotheses that are continuoulsly validated with customers.
- The validation data is used to decide whether to run another validation cycle, whether to have the hypothesis put back into the backlog, or whether to abandon the hypothesis.
- Allows for continuous re-prioritization of feature content.
- Could be used to better understand the content of large amounts ofquantitative data, and/or to validate qualitative data with a large customer base.

Qualitative And Quantitative Customer Feedback Techniques* (CFT's)



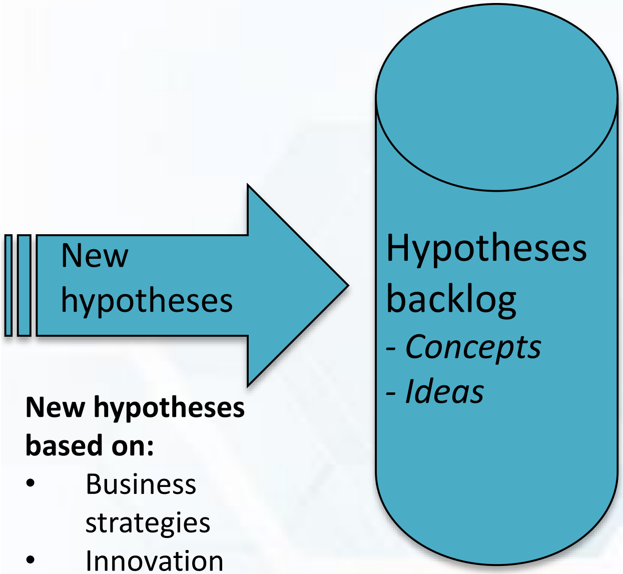
*Fabijan et al (2015). Customer Feedback and Data Collection Techniques: A literature review.

Not Requirements; Hypotheses



Hypotheses backlog

- *Concepts*
- *Ideas*



New hypotheses

Hypotheses backlog

- *Concepts*
- *Ideas*

New hypotheses based on:

- Business strategies
- Innovation initiatives
- Qualitative customer feedback
- Quantitative customer feedback
- Results from QCD cycles

Product R&D organisation

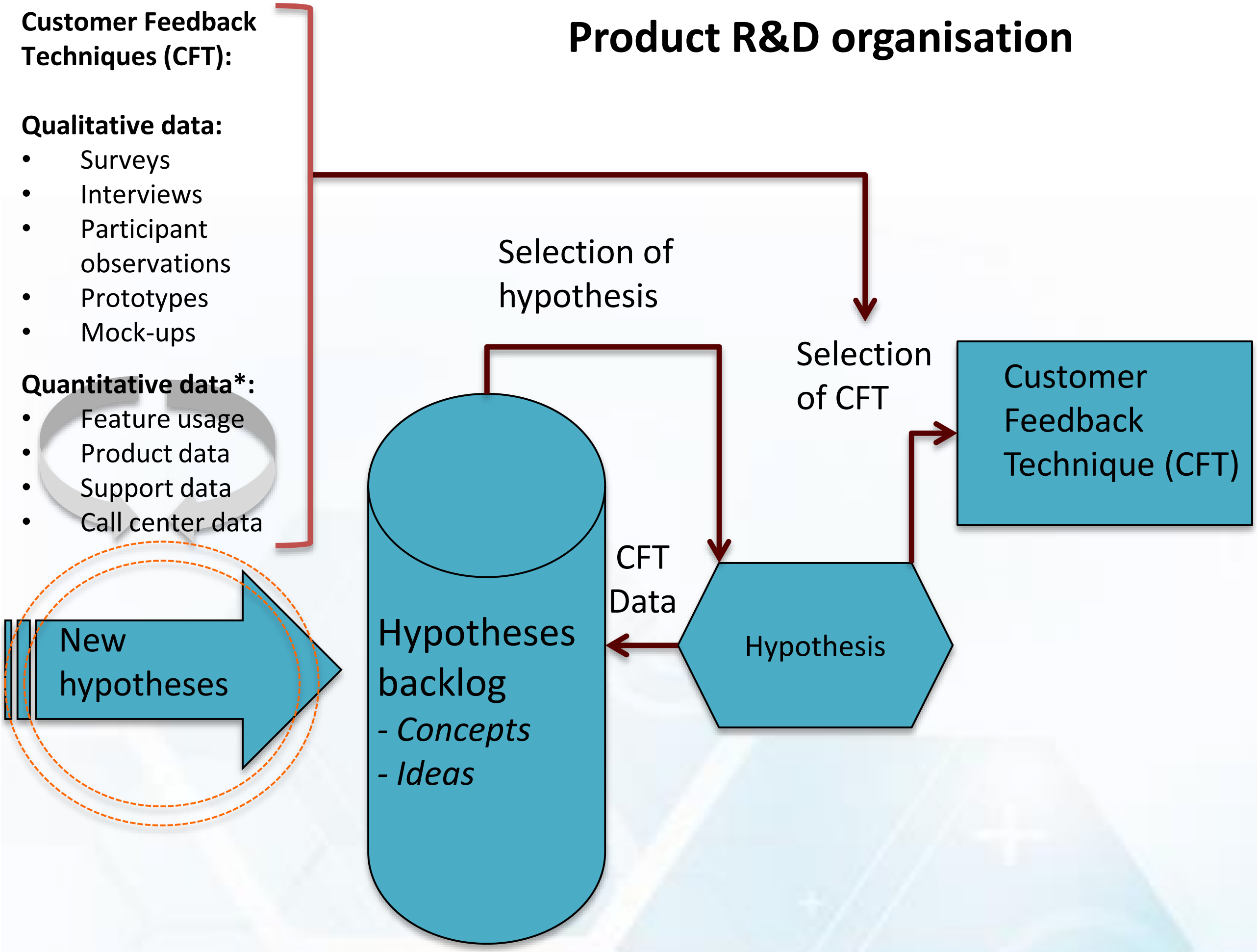
Customer Feedback Techniques (CFT):

Qualitative data:

- Surveys
- Interviews
- Participant observations
- Prototypes
- Mock-ups

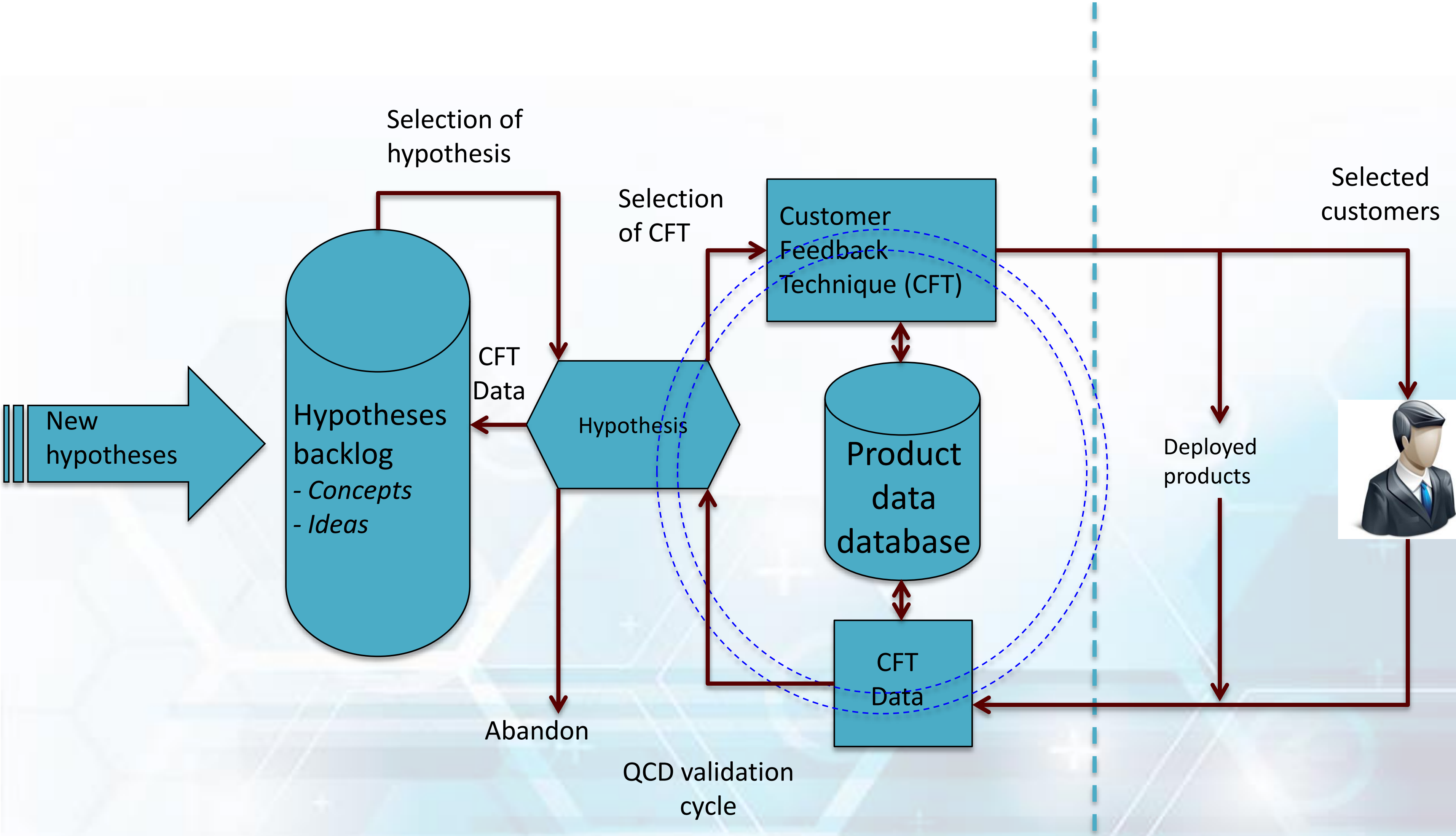
Quantitative data*:

- Feature usage
- Product data
- Support data
- Call center data



Product R&D organisation

Products in the field



New hypotheses

Hypotheses backlog

- *Concepts*
- *Ideas*

Selection of hypothesis

CFT Data

Hypothesis

Abandon

Selection of CFT

Customer Feedback Technique (CFT)

Product data database

CFT Data

QCD validation cycle

Selected customers

Deployed products

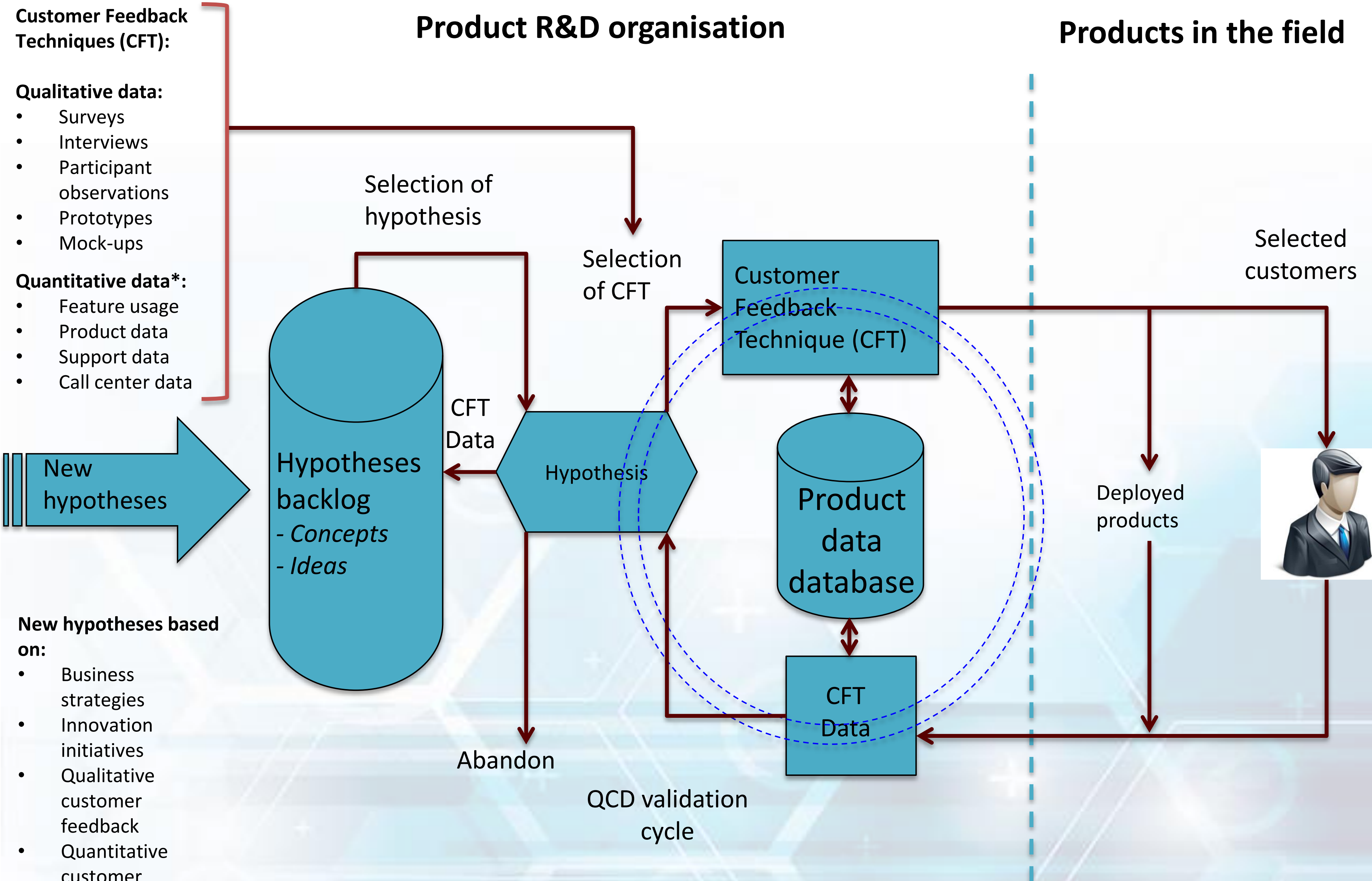
Customer Feedback Techniques (CFT):

Qualitative data:

- Surveys
- Interviews
- Participant observations
- Prototypes
- Mock-ups

Quantitative data*:

- Feature usage
- Product data
- Support data
- Call center data



New hypotheses based on:

- Business strategies
- Innovation initiatives
- Qualitative customer feedback
- Quantitative customer feedback
- Results from QCD cycles

Continuous prioritization of hypotheses!

*Loop in which decisions are taken on whether to do more qualitative customer feedback collection.

Customer Feedback Techniques (CFTs):

Quantitative data

Goal: When or if

Logic: Deductive or inductive

- Feature usage
- Product data
- Support data
- Call center data
- Performance data

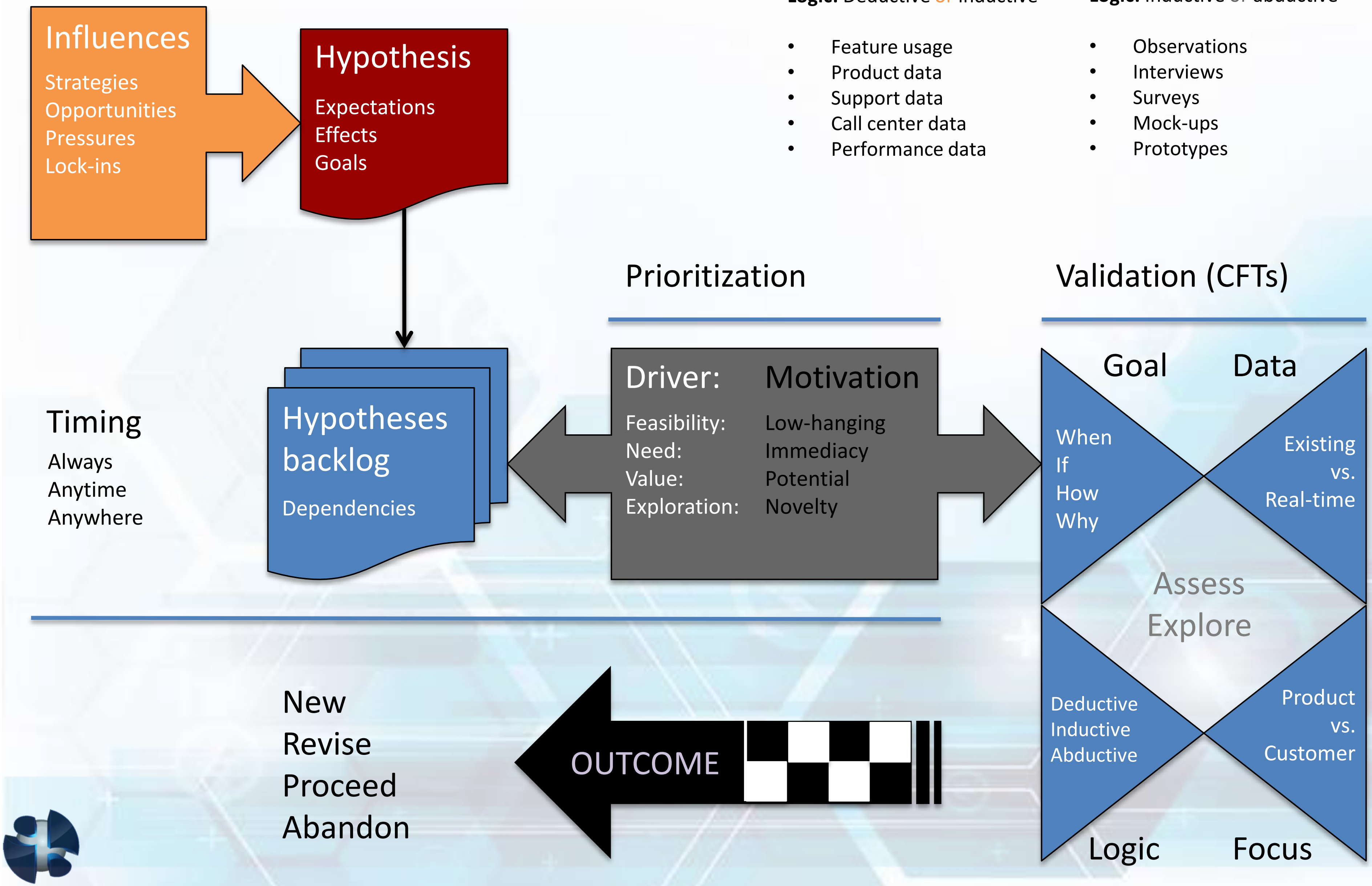
Qualitative data

Goal: How or why

Logic: Inductive or abductive

- Observations
- Interviews
- Surveys
- Mock-ups
- Prototypes

Hypothesis development



Influences

Strategies
Opportunities
Pressures
Lock-ins

Hypothesis

Expectations
Effects
Goals

Timing

Always
Anytime
Anywhere

Hypotheses backlog

Dependencies

Prioritization

Driver: Motivation

Driver:	Motivation
Feasibility:	Low-hanging
Need:	Immediacy
Value:	Potential
Exploration:	Novelty

Validation (CFTs)

Goal

When
If
How
Why

Data

Existing
vs.
Real-time

Assess
Explore

Deductive
Inductive
Abductive

Logic

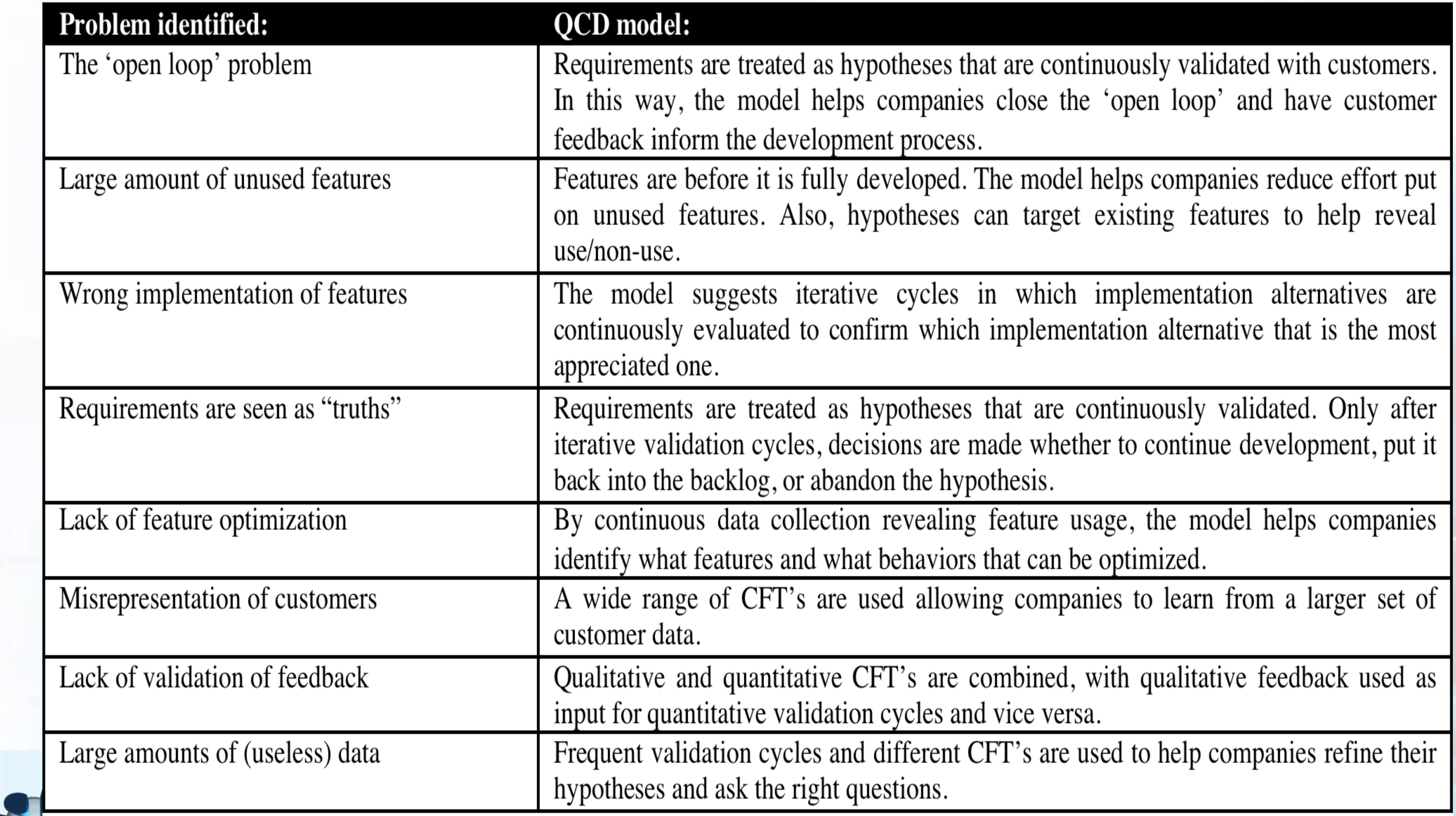
Product
vs.
Customer

Focus

OUTCOME

New
Revise
Proceed
Abandon

Key Problems And ’QCD’ Solutions



Problem identified:	QCD model:
The ‘open loop’ problem	Requirements are treated as hypotheses that are continuously validated with customers. In this way, the model helps companies close the ‘open loop’ and have customer feedback inform the development process.
Large amount of unused features	Features are before it is fully developed. The model helps companies reduce effort put on unused features. Also, hypotheses can target existing features to help reveal use/non-use.
Wrong implementation of features	The model suggests iterative cycles in which implementation alternatives are continuously evaluated to confirm which implementation alternative that is the most appreciated one.
Requirements are seen as “truths”	Requirements are treated as hypotheses that are continuously validated. Only after iterative validation cycles, decisions are made whether to continue development, put it back into the backlog, or abandon the hypothesis.
Lack of feature optimization	By continuous data collection revealing feature usage, the model helps companies identify what features and what behaviors that can be optimized.
Misrepresentation of customers	A wide range of CFT’s are used allowing companies to learn from a larger set of customer data.
Lack of validation of feedback	Qualitative and quantitative CFT’s are combined, with qualitative feedback used as input for quantitative validation cycles and vice versa.
Large amounts of (useless) data	Frequent validation cycles and different CFT’s are used to help companies refine their hypotheses and ask the right questions.

Qualitative/quantitative Customer Development Model (QCD)

- Qualitative and quantitative CFT’s.
- From requirements to hypotheses.
- The validation data is used to decide whether to:
  - Run another validation cycle
  - Have the hypothesis put back into the backlog
  - Abandon the hypothesis
- Continuous re-prioritization of hypotheses.

Overview

- Vem är jag? Wie ben ik? Who am I?
- Trends in Software: Need for Speed
- Innovation Experiment Systems
- How to Get There: Stairway to Heaven
- Involving the Customer
- HYPEX and QCD Frameworks
- Case studies
- Conclusion

Case: Company A

- **Domain:**
  - Network cameras, video surveillance, video management SW

- **Feature experiment:**
  - New approach on an existing feature for accessing the cameras remotely by using mobile devices.
  - The new approach will improve the success rate of the ’one-click’ workflow.
  - When accessing a camera from a remote device it will relay through a mediator that will authenticate the connection.
  - Initially, the feature experiment is conducted with company employees worldwide.

Lessons Learned

- ☺
  - Improved communication (HW/SW)
  - Rewarding definition of metrics
  - How to collect data from our products
  - What data to collect from our products
- ☹
  - Establishing an ”experiment mind-set”
  - Identifying feature
  - Identifying customers to work with
  - Slow development lead-time
  - Slow distribution of cameras to customers

Case: Company B

- **Domain:**
  - Navigational IS, optimization solutions, crew and fleet management systems.
- **Feature experiment:**
  - Improve the ability to compare KPI’s for optimization runs.
  - A new feature is developed that allows the user to tune input parameters in correspondence with KPI’s, and to send new optimization runs based on these.

Lessons Learned

- ☺
  - Understanding of quality issues
  - Understanding for early user involvement
  - Communication between service managers and product development
  - Knowledge exchange within company ecosystem
- ☹
  - Definition of metrics – what data to log?
  - Deployment of builds to customers
  - Customer training
  - Uncertainty if customers attend training sessions

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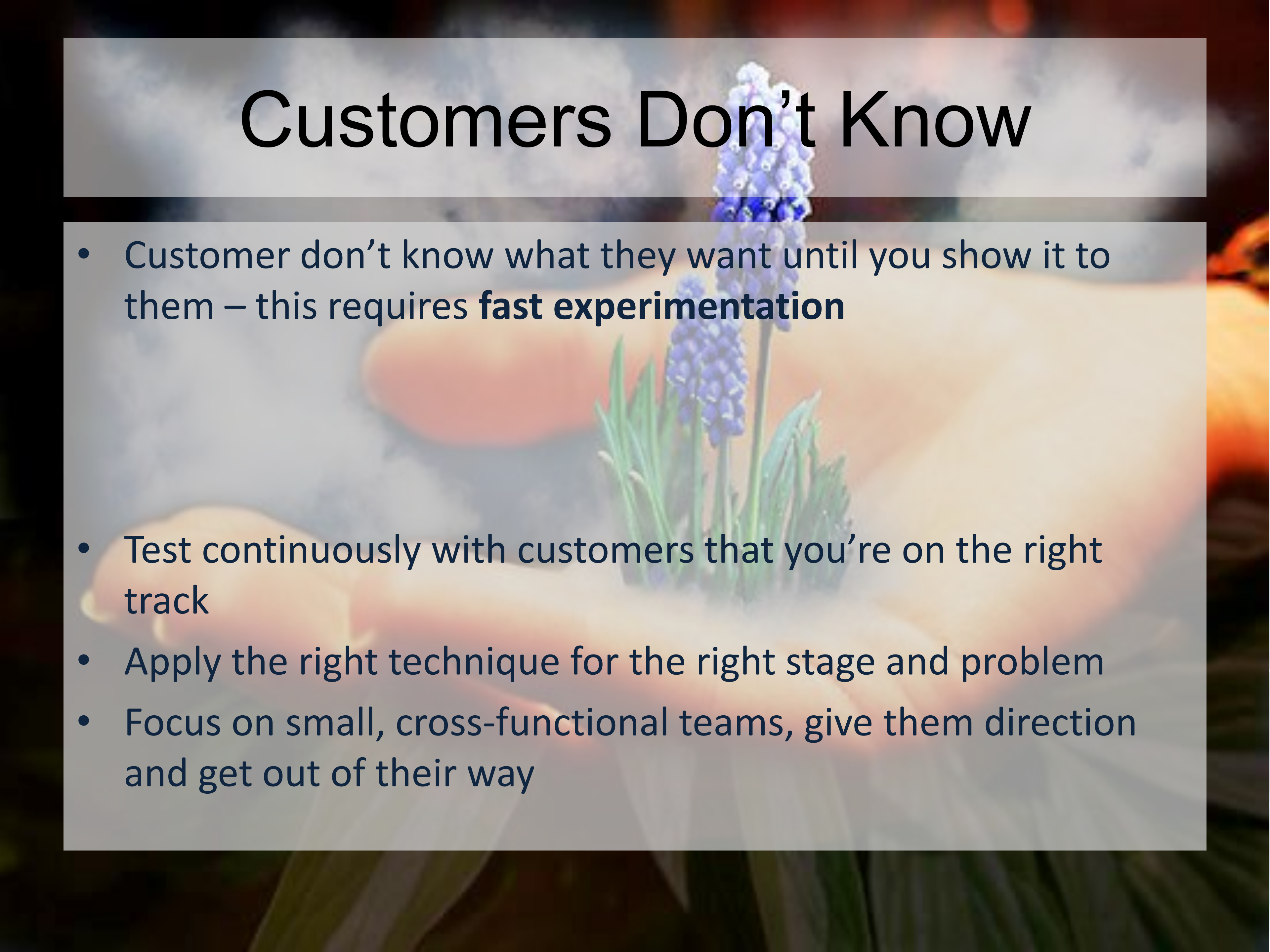
Customers Don’t Know



- Customer don’t know what they want until you show it to them – this requires **fast experimentation**
- Test continuously with customers that you’re on the right track
- Apply the right technique for the right stage and problem
- Focus on small, cross-functional teams, give them direction and get out of their way

Speed

- Increasing **SPEED** gives you the short cycle times that allow for fast experimentation
- 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

Innovation Experiment Systems

- Continuous deployment allows you to organize R&D as **innovation experiment system**
- Legacy system != slow (necessarily)
- Traditional working methods no longer apply
- Decouple components, decouple teams and decouple organizations
- Lean and agile at scale

Not My Job?!

Strong LEADERSHIP needed from YOU

“One accurate measurement is worth more than a thousand expert opinions.”

- Admiral Grace Hopper

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