Software Center: Theme 4

Customer Data and Ecosystem Driven Development

Theme 4: Projects

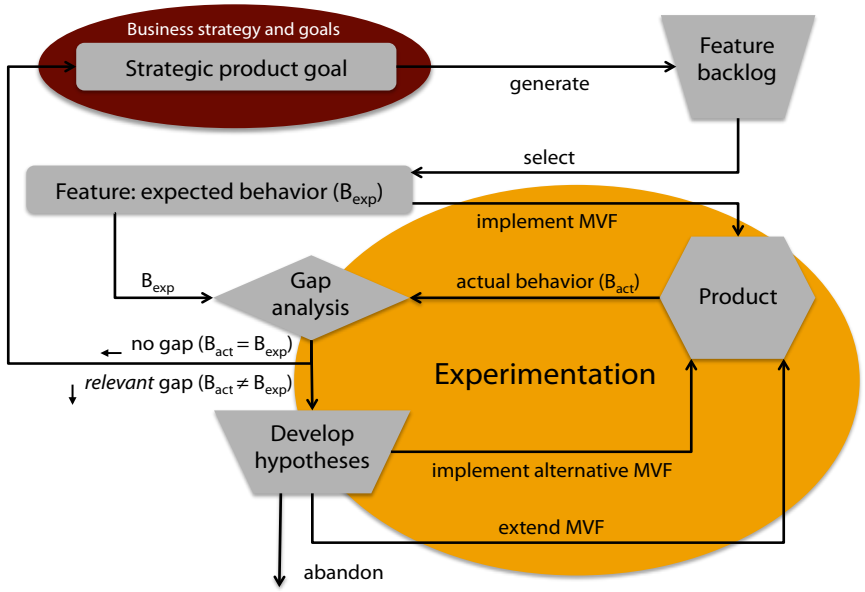
- **Fast Customer Feedback In Large-Scale SE**
  - *Helena H. Olsson, Jan Bosch (PhD student: Aleksander Fabijan)*
- **Strategic Ecosystem Driven R&D Management**
  - *Helena H. Olsson, Jan Bosch*
- **Requirements engineering for large-scale agile system development**
  - *Eric Knauss, Rashidah Kasauili (PhD student) and Grischa Liebel (PhD student)*
- **Data-driven Continuous Evolution of Autonomous Systems *(WASP)***
  - *Jan Bosch, Helena H. Olsson, Christian Berger (PhD student: David Issa Mattos)*
- **Unlocking User Value in IoT *(IOTAP)***
  - *Helena H. Olsson and Jan Bosch*

The HYPEX Model

Software Center

The HYPEX model helps companies run feature experiments during development to continuously validate customer value. The model helps companies shorten the feedback loop to customers and adopt data-driven development practices.

The HYPEX Model



- By continuously validating customer value, the HYPEX model helps companies in the feature ***road-mapping and prioritization*** process.
- By continuous experimentation and collection of customer data, the HYPEX model helps companies transition from opinions-based towards ***data-driven development.***
- By enabling access to accurate customer data, the HYPEX model closes the ***'open loop'*** between PdM and customers.

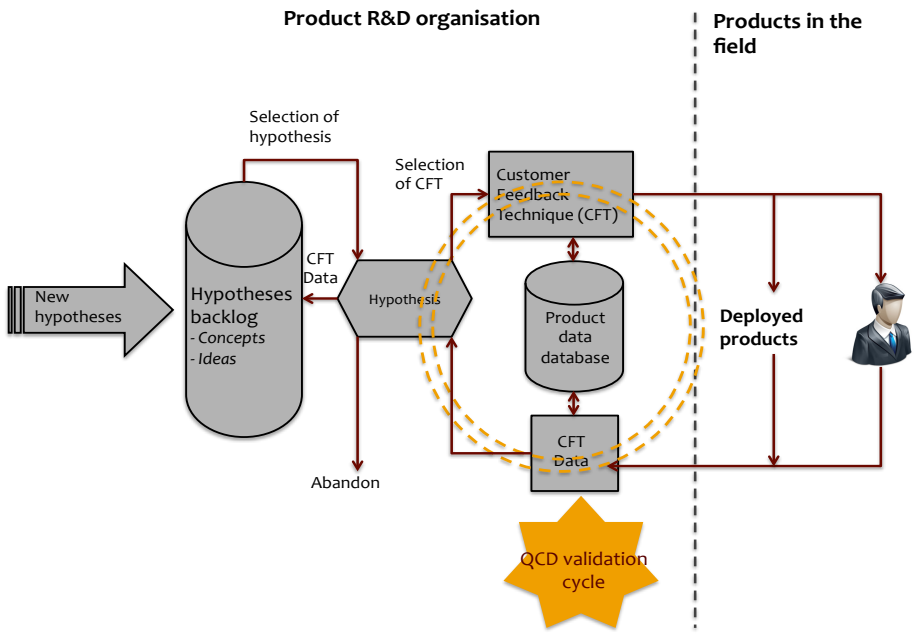
- Olsson H.H., and Bosch J. (2014). From Opinions to Data-Driven Software R&D: A Multi-Case Study On How To Close The 'Open Loop' Problem. In Proceedings of EUROMICRO, Software Engineering and Advanced Applications (SEAA), August 27-29, Verona, Italy.

For more information please contact helena.holmstrom.olsson@mah.se and/or jan.bosch@chalmers.se

The QCD Model

Software Center

The QCD model identifies qualitative and quantitative customer feedback techniques and helps companies select among these. The model helps companies continuously validate hypotheses and re-prioritize feature content pre-during and post



- By treating requirements as hypotheses, the QCD model helps companies ***continuously validate*** customer value.
- By continuous validation of hypotheses, the QCD model enables ***re-prioritization of features*** also after development has started.
- By identifying qualitative and quantitative customer feedback techniques (CFT:s), the QCD model helps companies answer both ***'what' and 'how/why'*** is customer value.

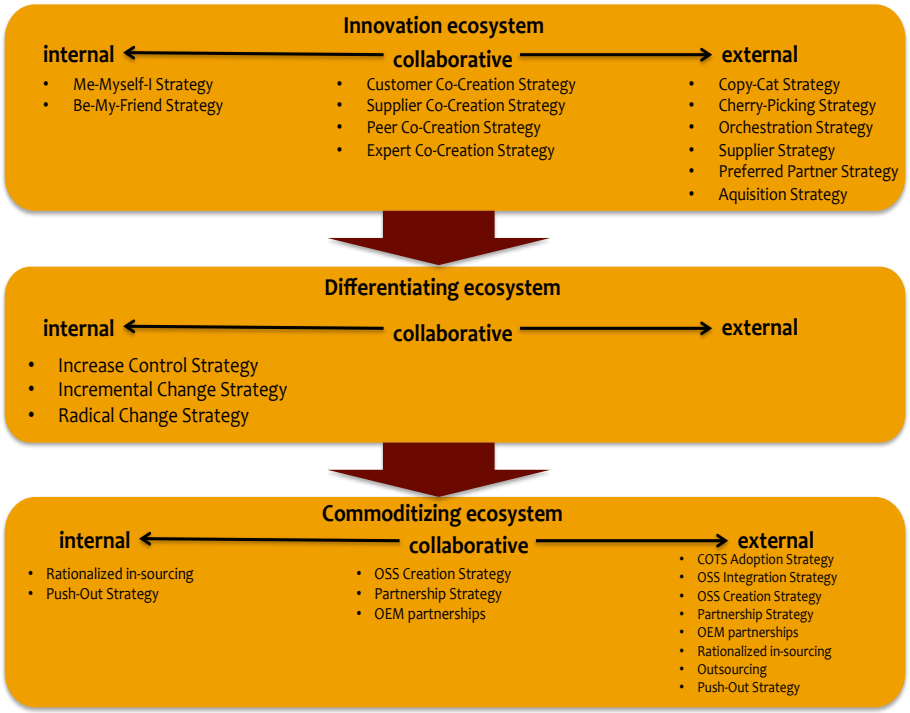
- Olsson, H.H., and Bosch, J. (2015). Towards Continuous Customer Validation: A conceptual model for combining qualitative customer feedback with quantitative customer observation. In Proceedings of the 6th International Conference on Software Business (ICSOB). June 10-12, Braga, Portugal.

For more information please contact helena.holmstrom.olsson@mah.se and/or jan.bosch@chalmers.se

The TeLESM Model

Software Center

The TeLESM model distinguishes between three types of ecosystems and identifies strategies for how to manage partners within each of these. The model helps companies in moving towards strategic management of their ecosystems.



- **TeLESM** distinguishes between the innovation, the differentiating and the commoditizing ecosystems and identifies strategies for managing each of these.
- **TeLESM** helps companies select the optimal strategies for managing each ecosystem.
- **TeLESM** helps companies identify when to transfer functionality between ecosystems to focus R&D resources on differentiating and innovative functionality.

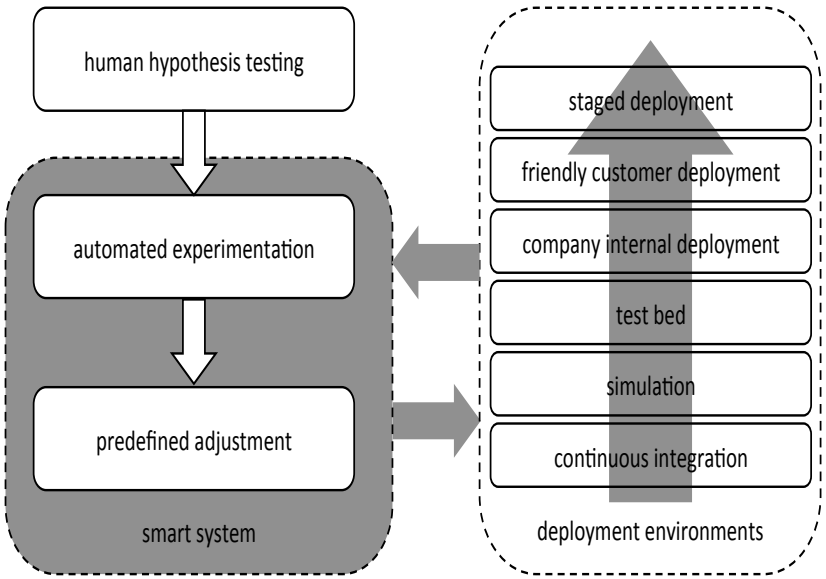
- Olsson, H.H., and Bosch, J. (2015). Strategic Ecosystem Management: A multi-case study on challenges and strategies for different ecosystem types. In Proceedings of the 41st Euromicro Conference series on Software Engineering and Advanced Applications (SEAA), August 26-28th, Madeira, Portugal

For more information please contact helena.holmstrom.olsson@mah.se and/or jan.bosch@chalmers.se

The EDAX Model

Software Center

The EDAX model defines development of autonomous systems as an integrated effort between R&D teams and the system itself. R&D teams build part of the functionality and the system experiments and adjusts its behaviors autonomously.



- The systems that we build today and in the future exhibit levels of autonomy that put new demands on SE practices.
- The EDAX model presents a method for systematically building autonomous systems that employ modern SE technology.
- The EDAX model defines three loops of data-driven adjustment of system behaviors.

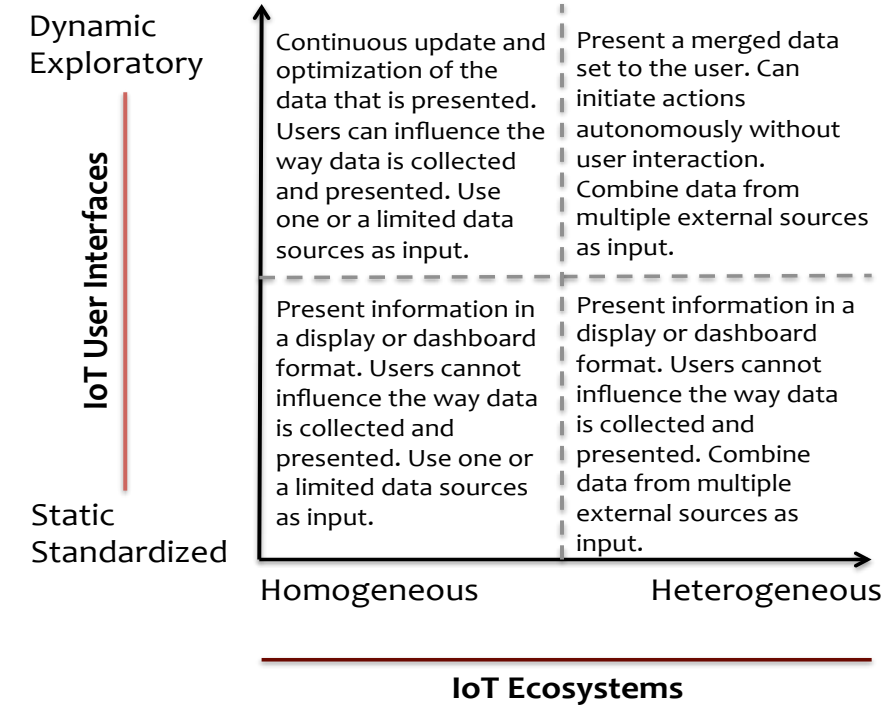
- Bosch, J., and Olsson, H.H. (2016). DataDriven Continuous Evolution of Smart Systems. In Proceedings of the 11th International Symposium on Software Engineering for Adaptive and Self-Managing Systems (SEAMS), May 16-17, 2016, Austin, Texas.

For more information please contact jan.bosch@chalmers.se and/or helena.holmstrom.olsson@mah.se

The UDIT Model

Software Center

The UDIT model helps companies assess two dimensions of IoT systems. Companies can use the model to: (1) Identify current state of their systems, (2) Identify desired state and (3) Identify the steps necessary to develop more advanced IoT systems.



- The IoT User Interface dimension identifies the format in which data is presented to users and how users interact with IoT systems.
- The IoT ecosystem dimension defines the level of which IoT systems interconnect with external systems.
- The UDIT model identifies the desired transition towards multi-source systems that require less interaction from the user.

- Olsson, H.H., Bosch, J., and Katumba, B. (2016). User Dimensions In 'Internet of Things' Systems: The UDIT Model. In Proceedings of the 7th International Conference on Software Business (ICSOB), June 13-14, Ljubljana, Slovenia.

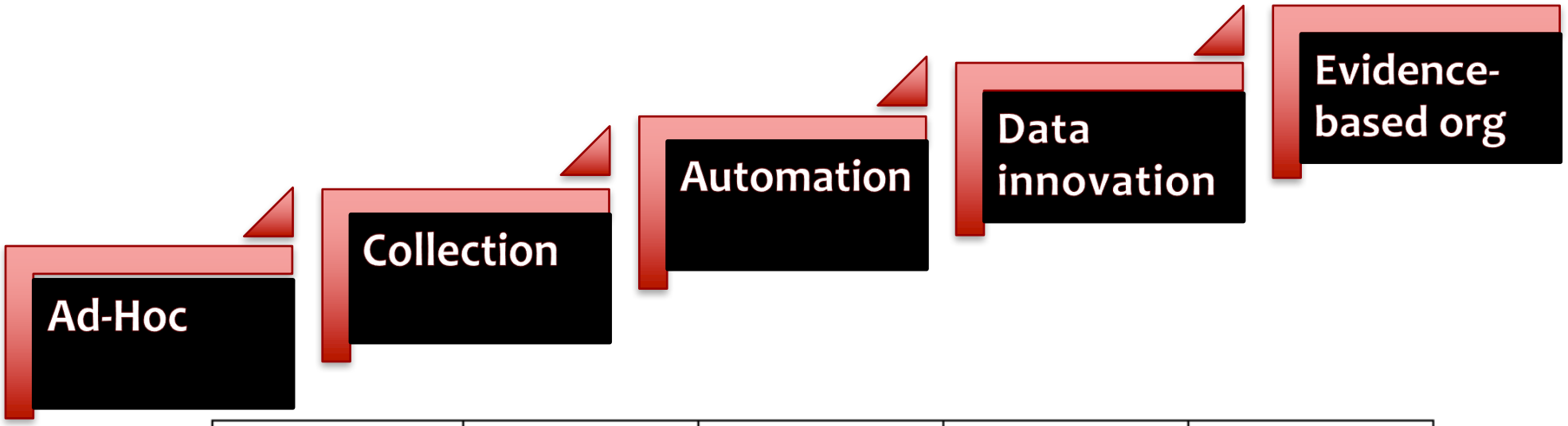
For more information please contact helena.holmstrom.olsson@mah.se and/or jan.bosch@chalmers.se

Software Center

Fast Customer Feedback In Large-Scale SE

Reporting Workshop, December 8th, 2016, Gothenburg

Stairway to Heaven: 'Data Dimension'



	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

Project Goals

- Accelerate ***data-driven development*** practices and have companies increasingly benefit from the customer and product data they collect.
- Help companies transform from ad-hoc collection of data towards ***evidence-based organizations*** in which automated data collection and analysis informs decision-making practices.
- Develop ***methods and techniques*** for continuous validation of customer value.

Sprint 11: Partners and Activities

- Cross-company workshops
- Company-specific workshop

- Industry talks, keynotes, guest seminars

- *SAAB project introduction*
- *Siemens (new project member)*

verisure
ALARMS WITH IQ

AXIS®
COMMUNICATIONS

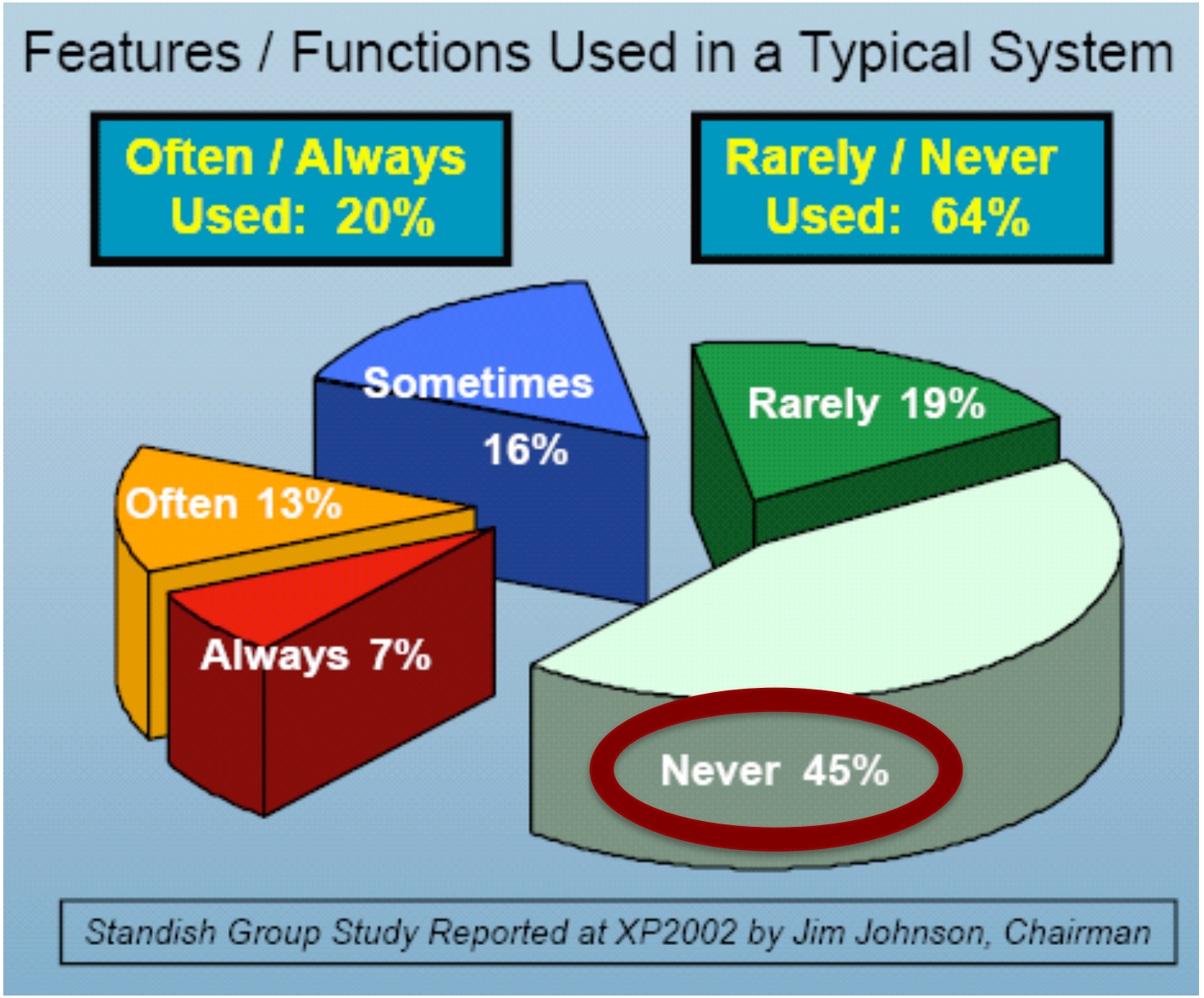
MALMÖ UNIVERSITY

CHALMERS

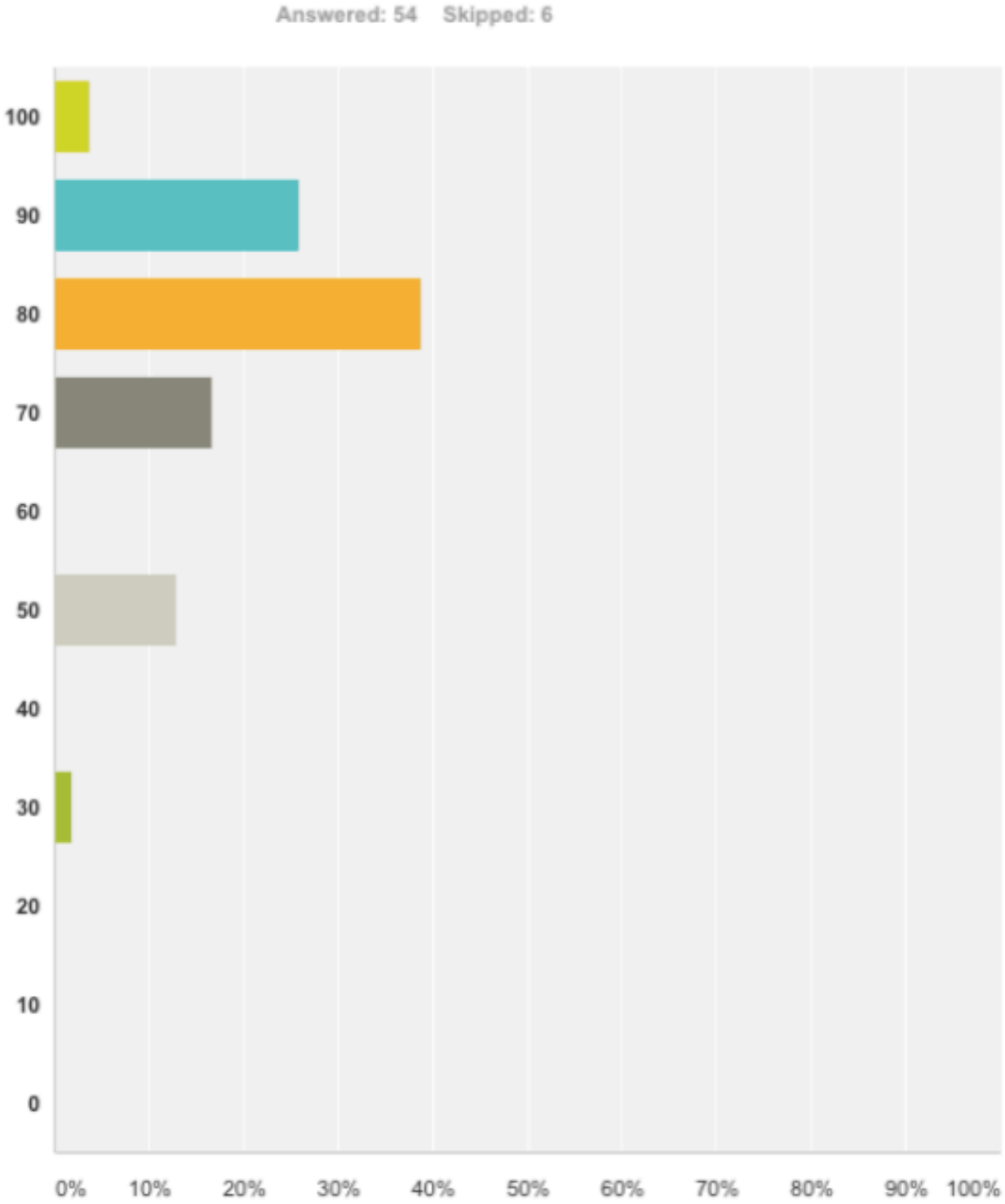
ERICSSON

JEPPESEN®
A BOEING COMPANY

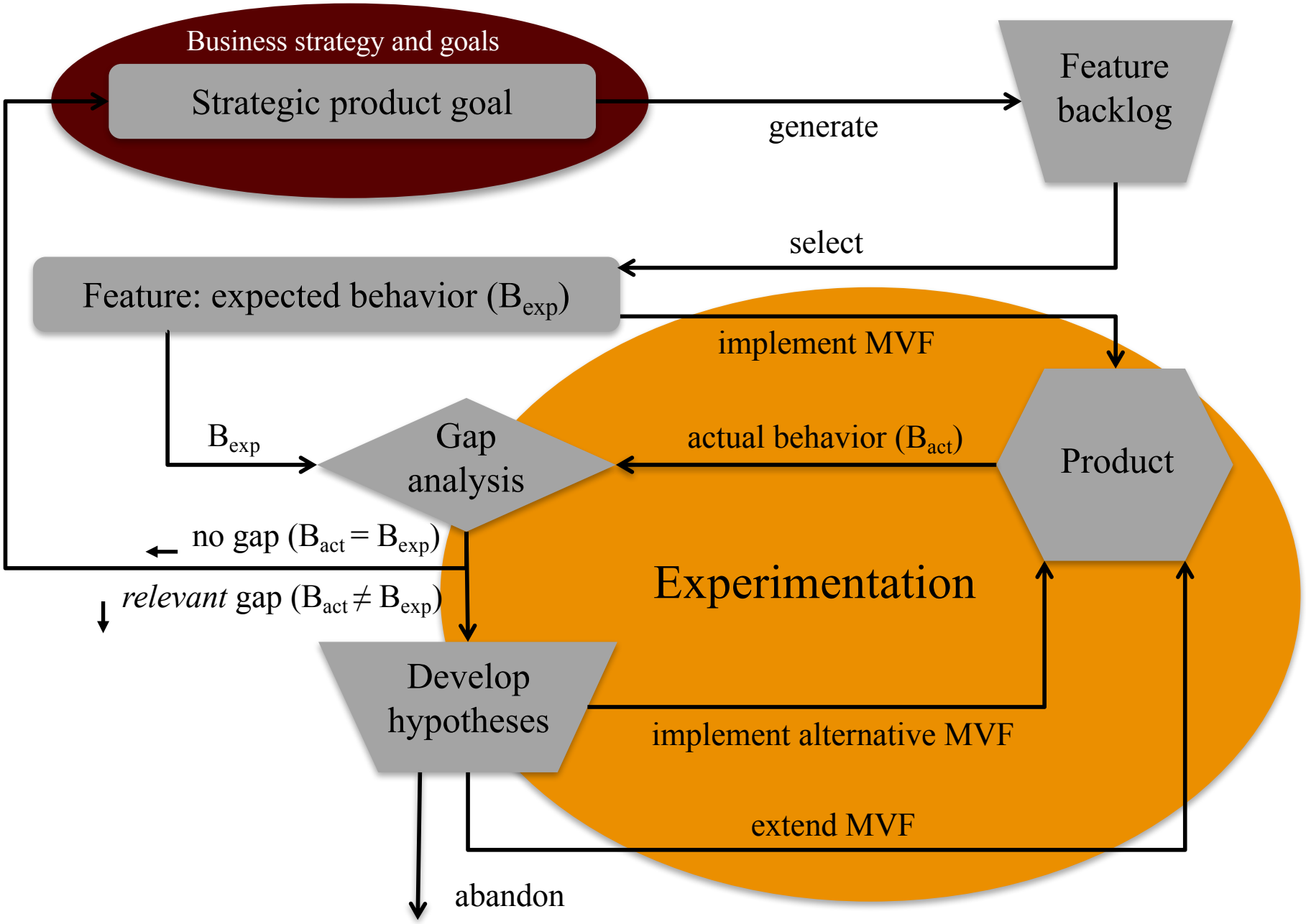
“Featuritis”


Features / Functions Used in a Typical System
Often / Always
Used: 20%
Rarely / Never
Used: 64%
Sometimes
16%
Rarely 19%
Often 13%
Always 7%
Never 45%
Standish Group Study Reported at XP2002 by Jim Johnson, Chairman

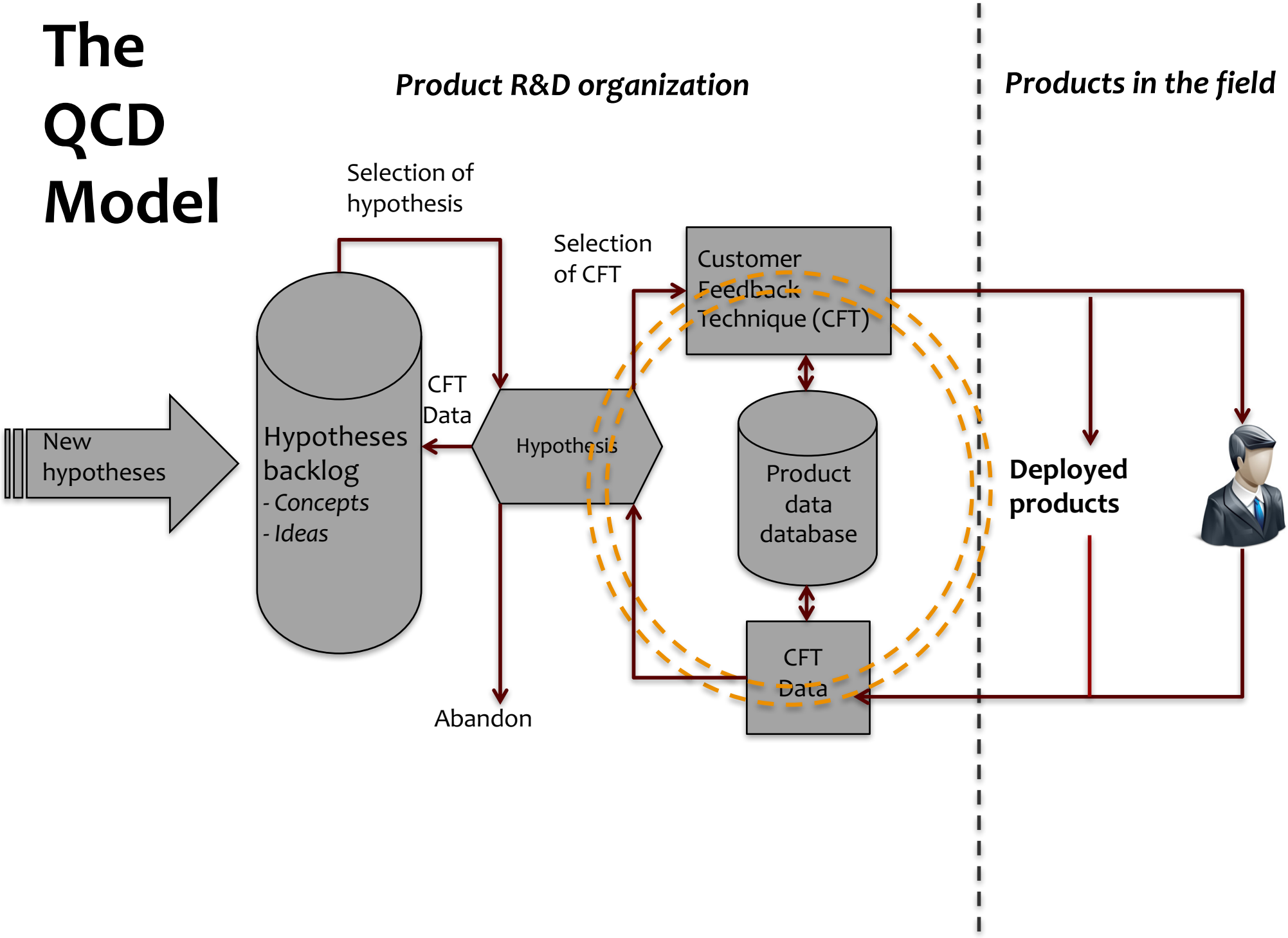
What % of R&D for Commodity

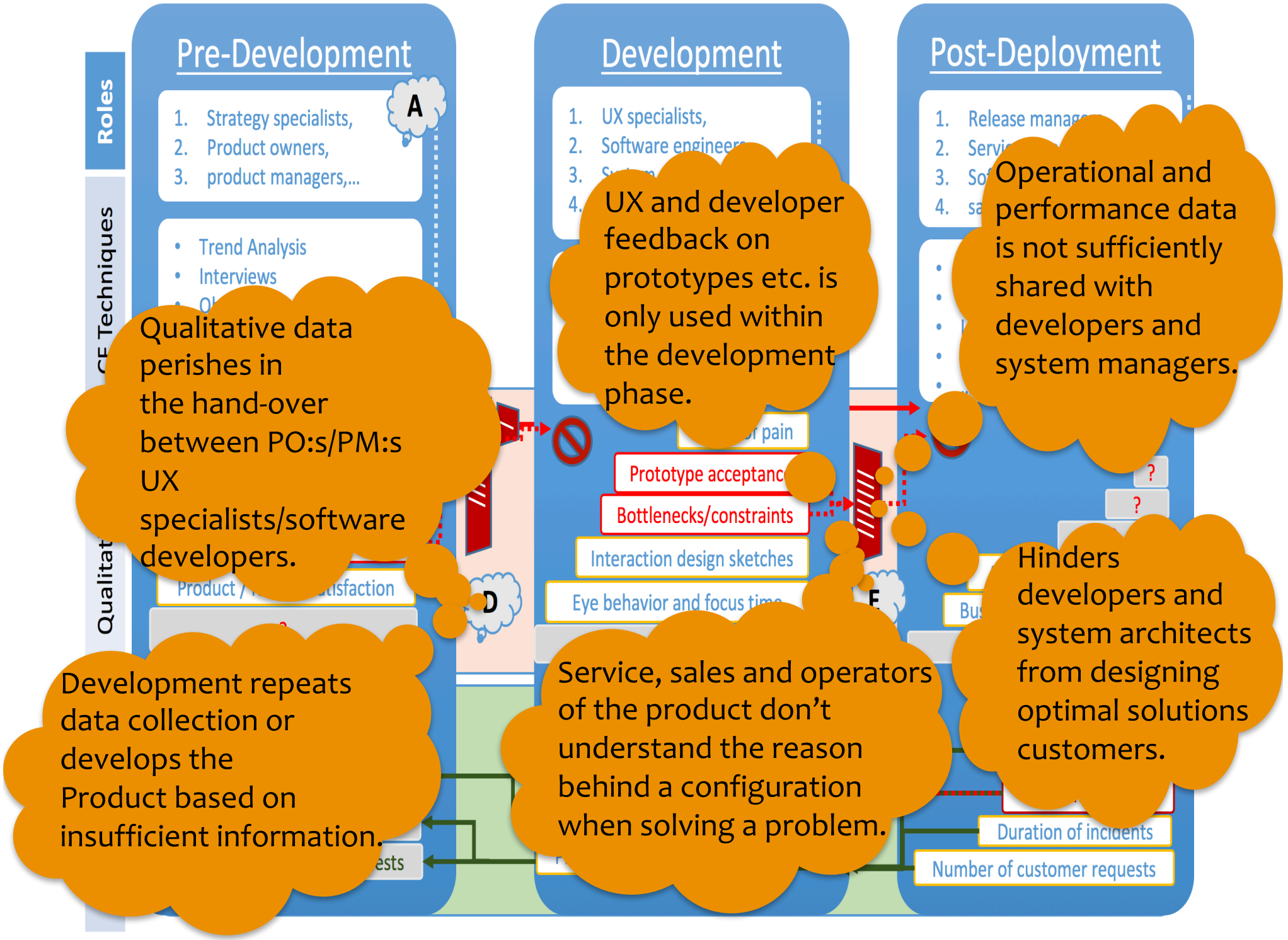


The HYPEX Model

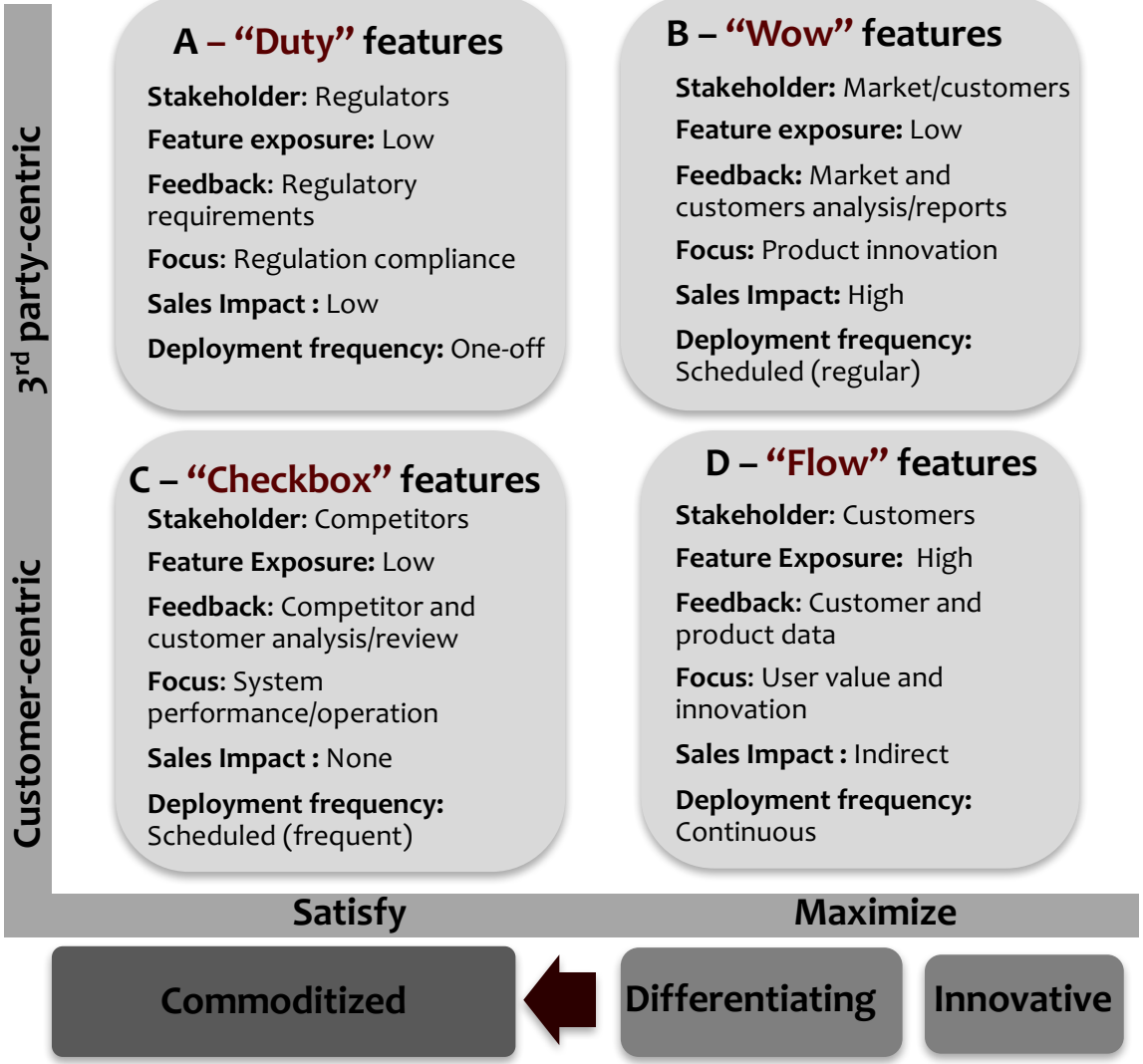


The QCD Model

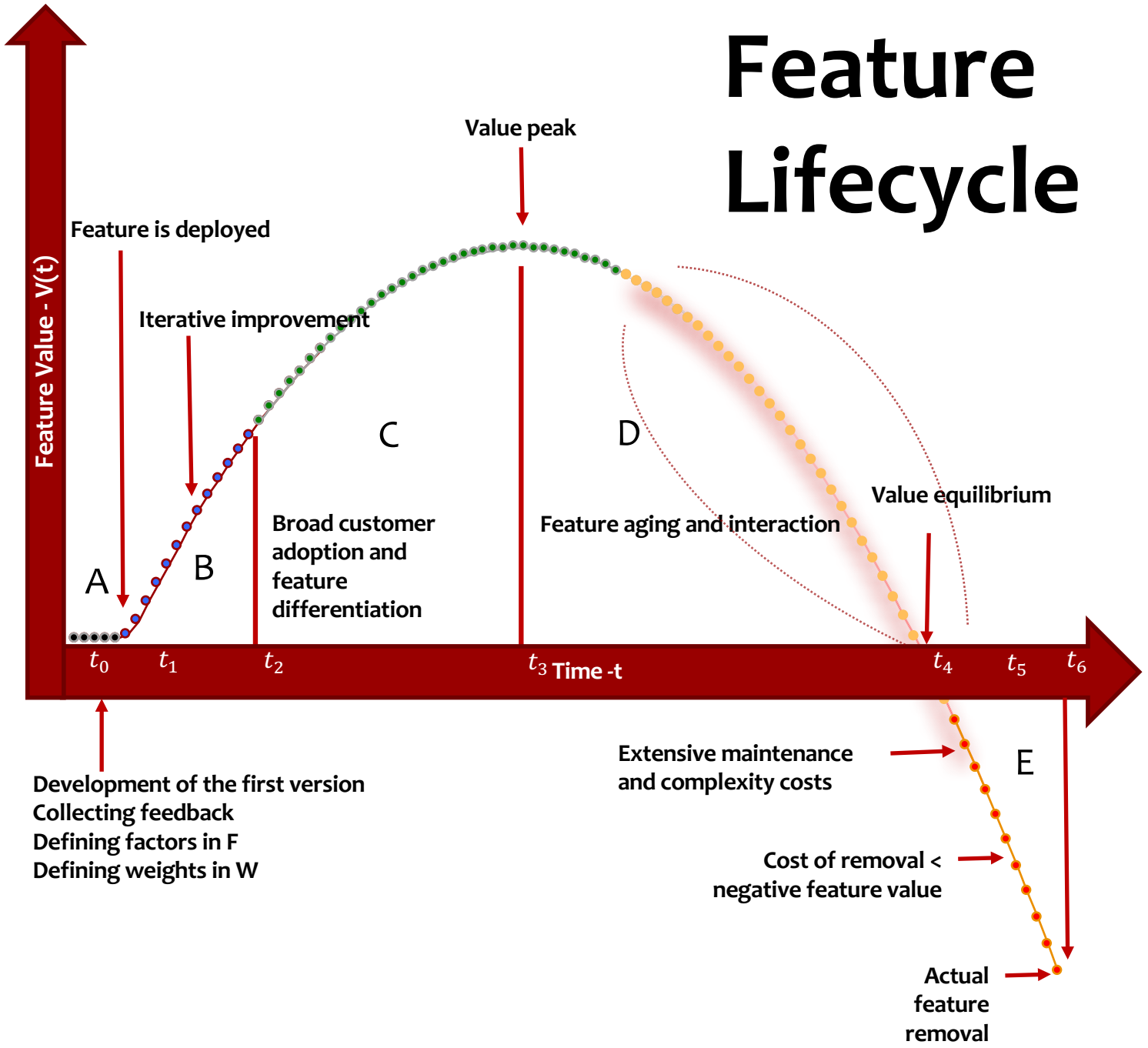



Roles
Pre-Development
1. Strategy specialists,
2. Product owners,
3. product managers,...
A
Trend Analysis
Interviews
Development
1. UX specialists,
2. Software engineers
3.
4.
Post-Deployment
1. Release manage
2. Servi
3. So
4. sa
Prototype acceptanc
Bottlenecks/constraints
Interaction design sketches
Eye behavior and focus time
Duration of incidents
Number of customer requests
D
E
Qualitative data perishes in the hand-over between PO:s/PM:s UX specialists/software developers.
UX and developer feedback on prototypes etc. is only used within the development phase.
Operational and performance data is not sufficiently shared with developers and system managers.
Development repeats data collection or develops the Product based on insufficient information.
Service, sales and operators of the product don't understand the reason behind a configuration when solving a problem.
Hinders developers and system architects from designing optimal solutions customers.

Feature Types



Feature Lifecycle



Sprint 11: Findings

- Value derived from customer and product data is ***low.***
- Insights generated from data influence only ***small*** feature improvements and optimizations at the team level.
- Decisions concerning new product development and innovation fall back on ***internal assumptions*** on what constitutes customer value.
- The impact of experiments are ***poor*** and most companies fail in having data-driven development scale to inform high-level business and innovation.
- Accumulation of insights is difficult. Typically, companies have a ***case-by-case understanding*** of their experiments but no way to effectively generalize.

Sprint 11: Publications

- Olsson, H.H., and Bosch, J. (forthcoming). Towards Evidence-Based Development: Learnings From Embedded Systems, Online Games And Internet of Things. *Accepted for publication in IEEE Software.*
- Fabijan, A., Olsson, H.H., and Bosch, J. (2016). Time to Say 'Good Bye': Feature Lifecycle. *In Proceedings of the 42nd Euromicro Conference on Software Engineering Advanced Applications, August 31st – September 2nd, Limassol, Cyprus.*
- Fabijan, A., Olsson, H.H., and Bosch, J. (2016). Commodity Eats Innovation for Breakfast: A Model for Differentiating Feature Realization. *In Proceedings of the 17th International Conference on Product-Focused Software Process Improvement (PROFES), November 22nd-24th, Trondheim, Norway.*
- Fabijan, A. (2016). Developing the right features: the role and impact of customer and product data in software product development. *Licentiate Thesis, defended November 11th, Malmö University, Sweden.*
- Fabijan, A., Olsson, H.H., and Bosch, J. *(submitted).* Customer Feedback and Data Collection Techniques: A Systematic Literature Review on the Role and Impact of Feedback in Software Product Development *(submitted to an international SE journal).*
- Fabijan, A., Dmitriev, P., Olsson, H.H., and Bosch, J. *(submitted).* The Evolution of Continuous Experimentation in Software Product Development. *(submitted to the Technical Track at the 39th International Conference of Software Engineering, ICSE 2017).*
- Olsson, H., and Bosch, J. *(submitted).* So Much Data – So Little Value: A multi-case study on improving the impact of data-driven development practices. *(submitted to the Software Engineering in Practice (SEIP) track at the 39th International Conference of Software Engineering, ICSE 2017).*

- *Fabijan, A., Dimitri, P., Olsson, H.H., Bosch, J. (to be submitted). The Benefits of Continuous Experimentation in Software Product Development. To be submitted to the 18th International Conference on Agile Software Development XP17, May 22-26, Cologne, Germany (2017).*

Conclusions

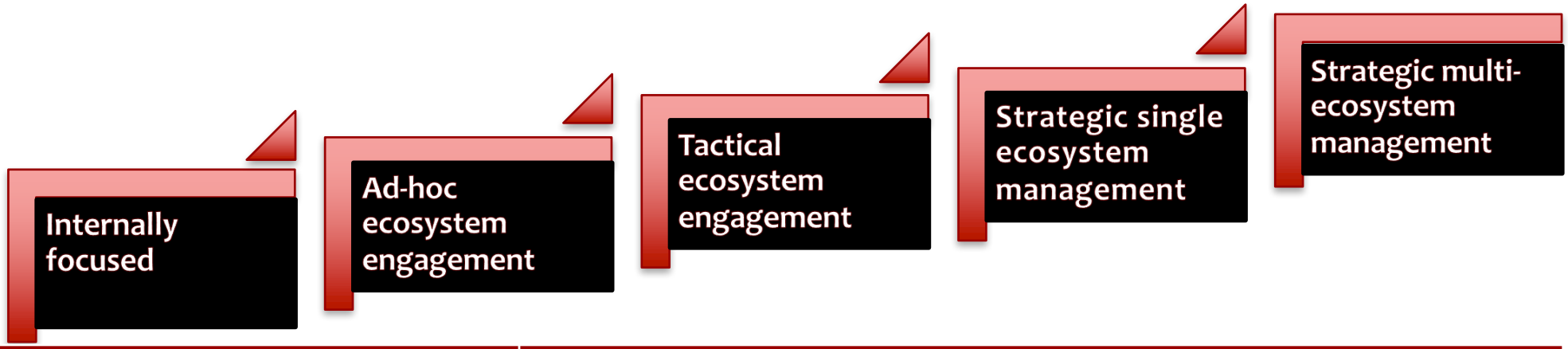
- Customer data is becoming increasingly important to help companies move away from opinions-based decision-making and instead adopt ***data-driven development*** practices.
- Collection and analysis of customer and product data is critical for ***understanding product use*** and take accurate decisions.
- To model feature value by defining ***key metrics*** helps companies avoid local sub-optimization and accelerate the impact of experiments.

Software Center

Strategic Ecosystem Driven R&D Management

Reporting workshop, December 8th, 2016.

Stairway to Heaven: 'Ecosystem Dimension'



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

Project Goals

- Help companies move from ad-hoc interactions with external stakeholders towards ***strategic management*** of the different ecosystems.
- Develop ***strategies*** that help companies better manage the innovation, the differentiation and the commodity ecosystem.
- Accelerate the adoption of ***alternative organizational models*** that emphasize empowerment and self-management in order to increase autonomy and competitiveness.

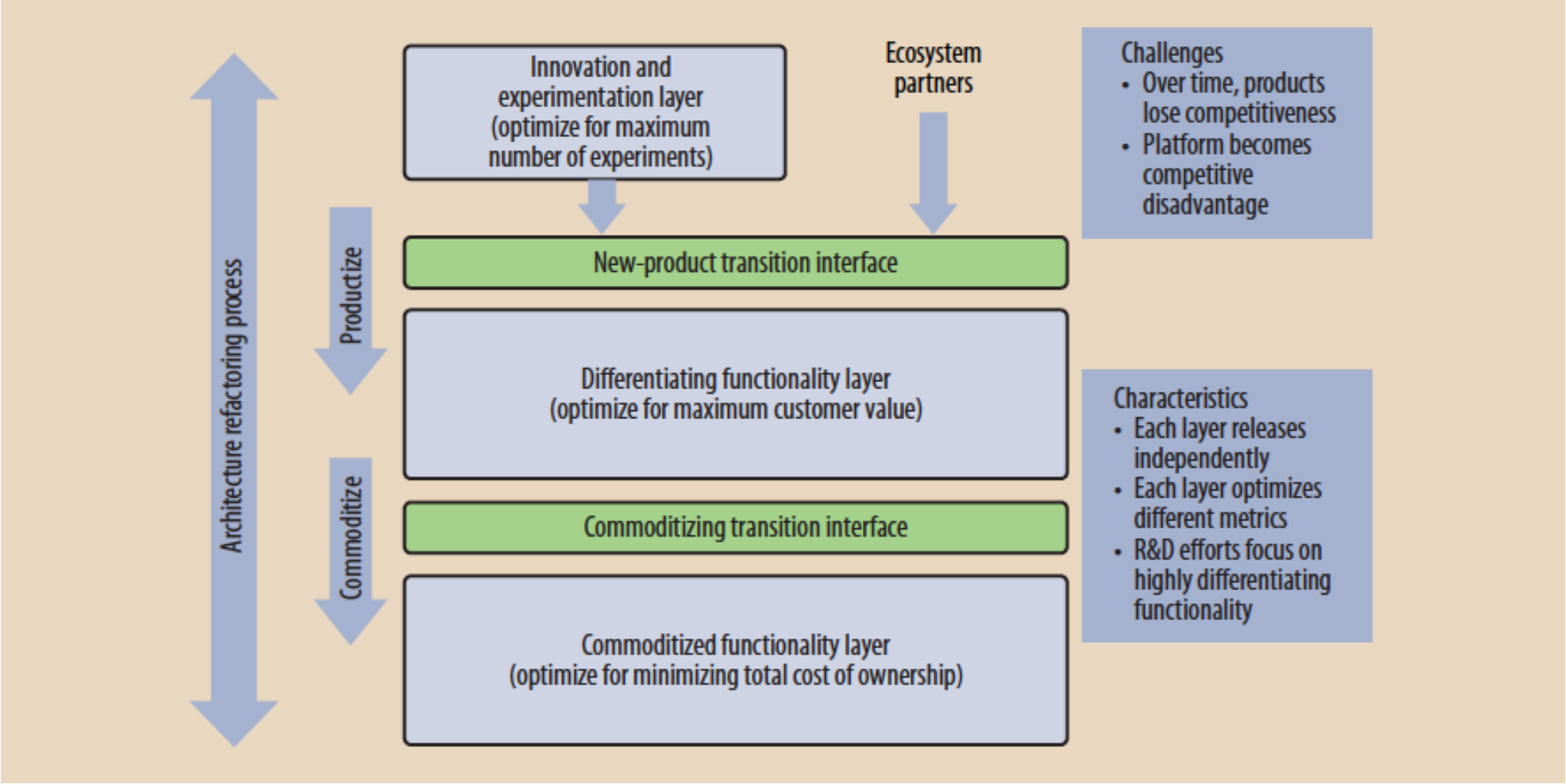
Sprint 11: Partners and Activities

- Cross-company workshops
- Company-specific workshop
- Delegation game sessions

- Industry talks, keynotes, guest seminars

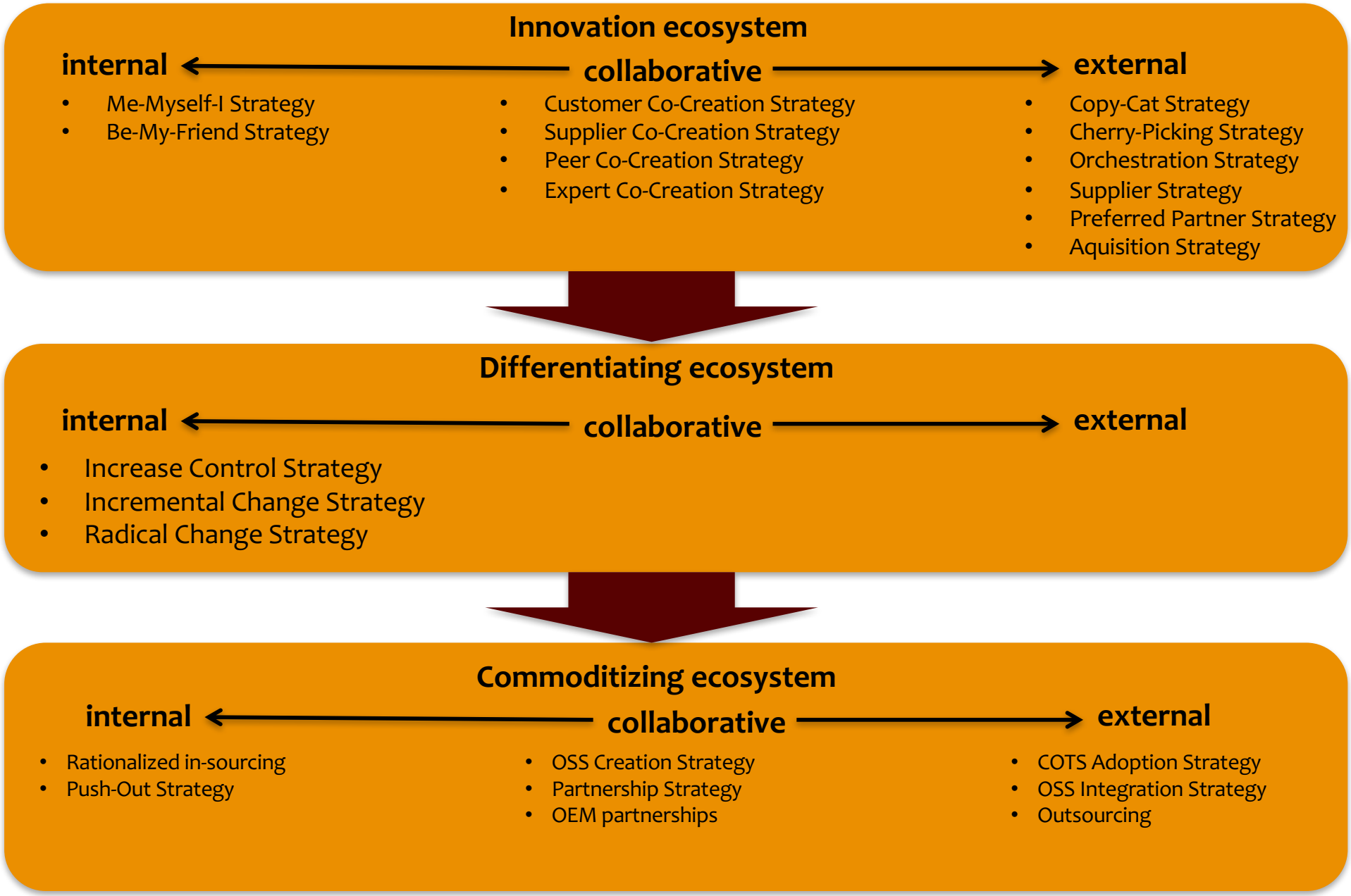
- *Tetra Pak project introduction*
- *Siemens (new project member)*

3LPM: Three Layer Product Model



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

TeLESM: Three Layer Ecosystem Strategy Model

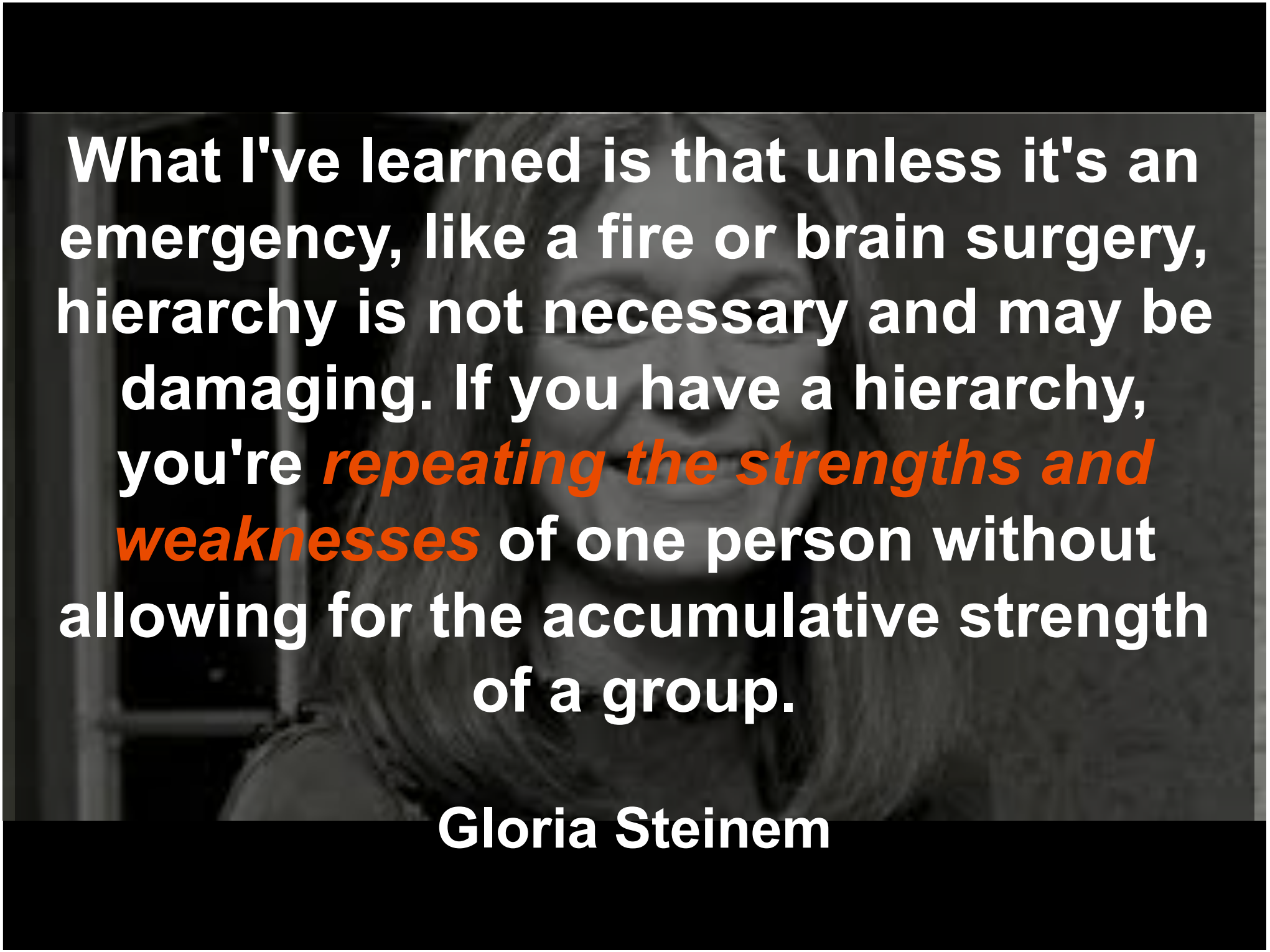


Summary

- Companies engage in ***different types of ecosystems*** in relation to development of innovative functionality, differentiating functionality and commodity functionality.
- To ***distinguish*** between the different ecosystems is critical as these require fundamentally different strategies.
- Companies that fail in distinguishing between the different ecosystems ***risk having resources tied up in commodity*** with the result that development of differentiating and innovative functionality suffers.
- Effective ecosystem management requires the use of both ***collaborative and competitive*** strategies.
- Ecosystems are ***dynamic*** in nature and change over time. This requires continuous and conscious transfer of functionality between ecosystems – and a constant assesment and evaluation of what strategies are used.

Results Sprint 11

(Empowered Organizations)


What I've learned is that unless it's an emergency, like a fire or brain surgery, hierarchy is not necessary and may be damaging. If you have a hierarchy, you're repeating the strengths and weaknesses of one person without allowing for the accumulative strength of a group.
Gloria Steinem

Hierarchical Organizations

Strengths

- Effective scaling
- Controlling many people from a central position
- Very efficient for repeatable tasks
- Harmonization of processes
- Globalization
- Handles low complexity situations well

Weaknesses

- Slow decision making processes
- Power driven by position; not capability
- Tendency to be internally focused
- Easily gravitates to politics
- Highly resistant to changes
- Challenged by high-complexity situations

Empowered Organizations: Principles

- ***Self management***
  - Nobody is in command.
  - Coordination mechanisms, but no boss
  - Natural leadership leads to spontaneous, temporary hierarchies
- ***Wholeness***
  - No acting to suit your boss/fit the culture
  - Be yourself at work
- ***Evolutionary purpose***
  - No top-down strategy
  - Wisdom of the crowds

Empowered Organizations: Characteristics

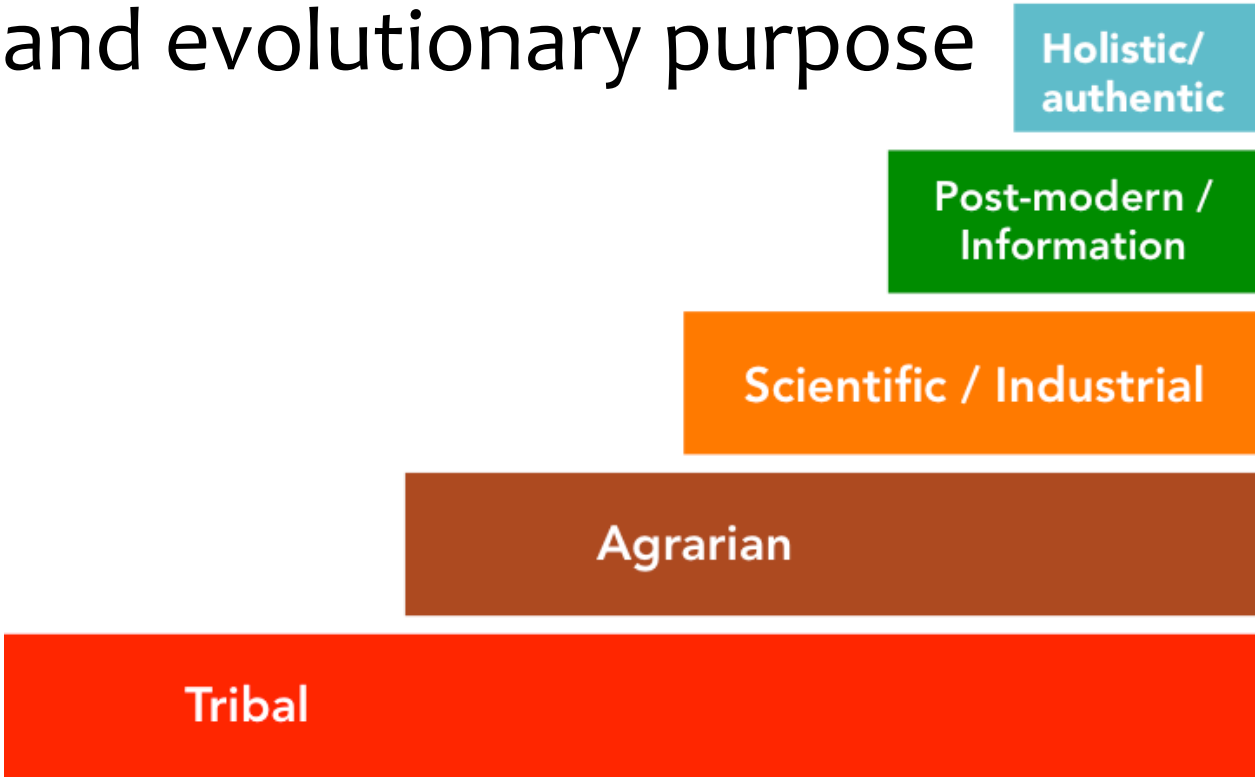
- ***Roles:*** People can shoulder one or more roles, independent on place in the organization
- ***Activities:*** Coordinate the work of one or more roles
- ***Advice process:*** Everyone has complete autonomy to make decisions pertain to their role or roles. Stakeholders need to be asked for advice though. *Note: this is NOT consensus!*
- ***Agreements:*** People can negotiate agreements to coordinate work, agree on SLAs and other relevant factors. Agreements are entered voluntarily.
- ***Evolution:*** Roles, activities and agreements evolve constantly in mutual agreement

#1: Agile Software Development

- Empowered teams
- Voluntary commitment
- Coordination through communication (daily standups)
- Customer collaboration
- Team mission is to do ‘right by the customer’

#2: Holistic Organizations

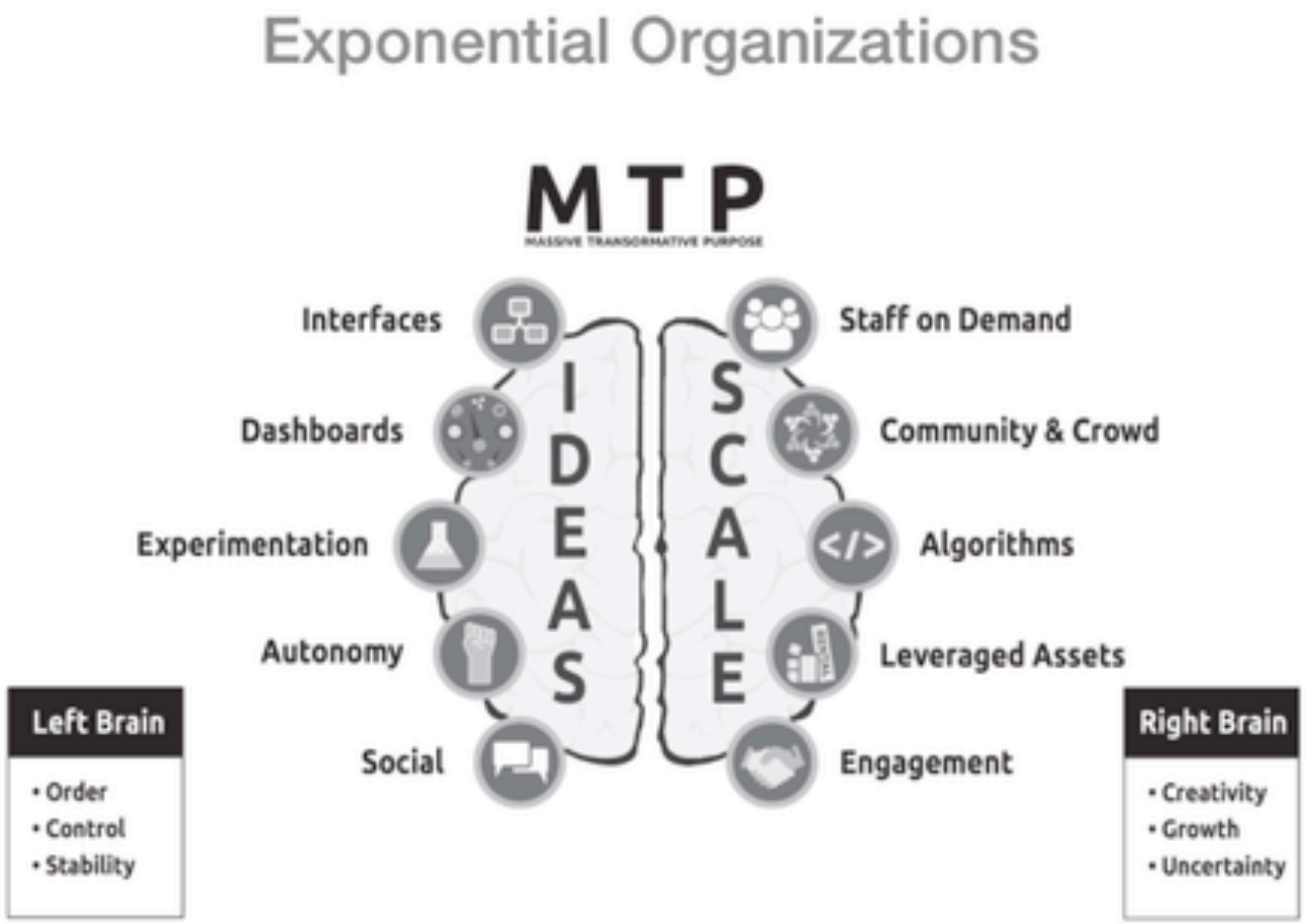
- Book by Fredrik Laloux
- Studied 17 cases of holistic organizations
- Emphasizes self management, wholeness and evolutionary purpose



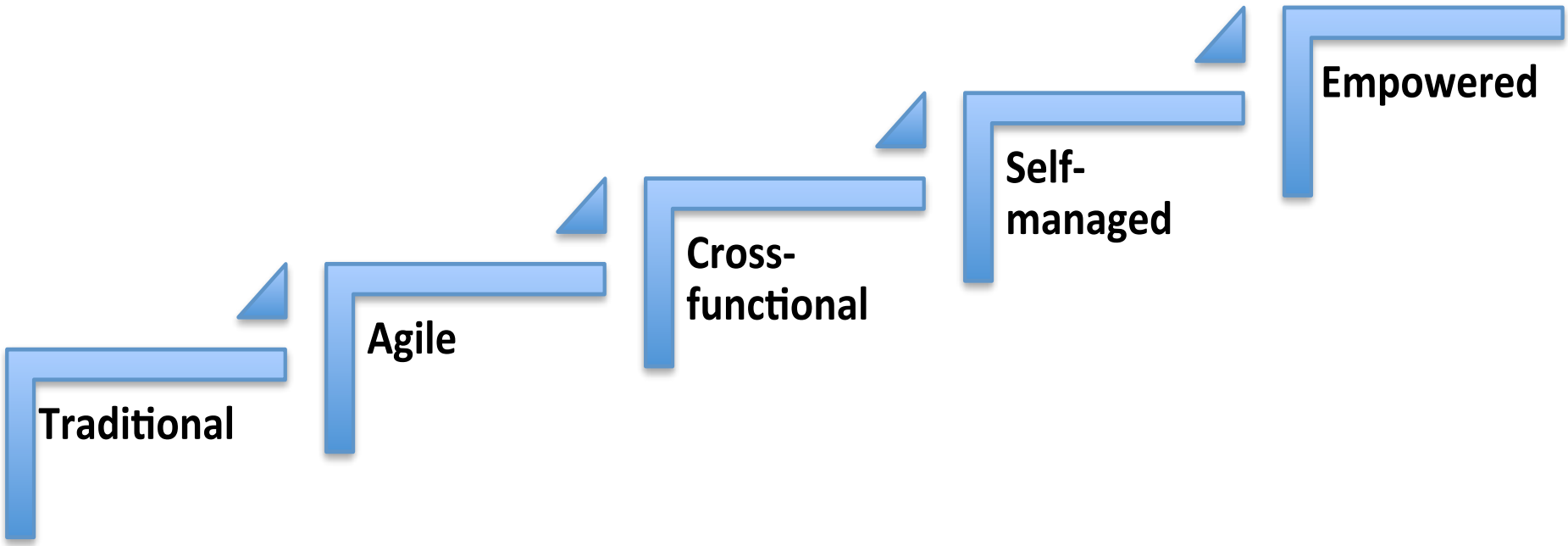
#3: Holacracy

In Traditional Companies	With Holacracy
Job descriptions Each person has exactly one job. Job descriptions are imprecise, rarely updated, and often irrelevant.	**Roles** Roles are defined around the work, not people, and are updated regularly. People fill several roles.
Delegated Authority Managers loosely delegate authority. Ultimately, their decision always trump.	**Distributed Authority** Authority is truly distributed to teams and roles. Decisions are made locally.
Big Re-Orgs The org structure is rarely revisited, mandated from the top.	**Rapid Iterations** The org structure is regularly updated via small iterations. Every team self-organizes.
Office Politics Implicit rules slow down change and favor people "in the know".	**Transparent Rules** Everyone is bound by the same rules, CEO included. Rules are visible to all.

#4: Exponential Organizations



Towards Empowered Organizations



Olsson, H.H., and Bosch, J. (2016). No More Bosses? A multi-case study on the emerging use of non-hierarchical principles in large-scale software development. *In Proceedings of the 17th International Conference on Product-Focused Software Process Improvement (PROFES), November 22nd-24th, Trondheim, Norway.*

From Traditional towards Empowered Organizations:

How organizational functions operate at each step

	Traditional	Agile	Cross-functional	Self-managed	Empowered
Culture	Hierarchical	Hierarchical	Hierarchical	Hierarchical	Empowered
General Mgmt.	Hierarchical	Hierarchical	Hierarchical	Empowered	Empowered
Inter-team (PdM/R&D)	Hierarchical	Hierarchical	Empowered	Empowered	Empowered
Local (R&D)	Hierarchical	Empowered	Empowered	Empowered	Empowered

Sprint 11: Publications

- Olsson, H.H., and Bosch, J. (2016). Collaborative Innovation: A Model for Selecting the Optimal Ecosystem Innovation Strategy. *In Proceedings of the 42nd Euromicro Conference on Software Engineering and Advanced Applications (SEAA), August 31 – September 2, Limassol, Cyprus.*
- Olsson, H.H., and Bosch, J. (2016). Collaborative Innovation In Business Ecosystems: A Strategy Selection Framework. *In Proceedings of the Swedish Workshop on the Engineering of Systems of Systems (SWESoS), September 9th, Gothenburg, Sweden.*
- Olsson, H.H., and Bosch, J. (2016). No More Bosses? A multi-case study on the emerging use of non-hierarchical principles in large-scale software development. *In Proceedings of the 17th International Conference on Product-Focused Software Process Improvement (PROFES), November 22nd-24th, Trondheim, Norway.*
- Olsson, H.H., and Bosch, J. *(in review).* From Ad-Hoc Towards Strategic Ecosystem Management: The Three-Layer Ecosystem Strategy Model. *Submitted to an international SE journal (in 2nd round of review).*

Related publications:

- Olsson, H.H., Bosch, J., and Katumba, B. (2016). User Dimensions in IoT Systems: The UDIT Model. *In Proceeding of the 7th International Conference on Software Business (ICSOB), June 13-14, Ljubljana, Slovenia.*
- Olsson, H.H., Bosch, J., and Katumba, B. (2016). Exploring IoT User Dimensions: A multi-case study on user interactions in 'Internet of Things' Systems. *In Proceedings of the 17th International Conference on Product-Focused Software Process Improvement (PROFES), November 22-24, Trondheim, Norway.*

Conclusions

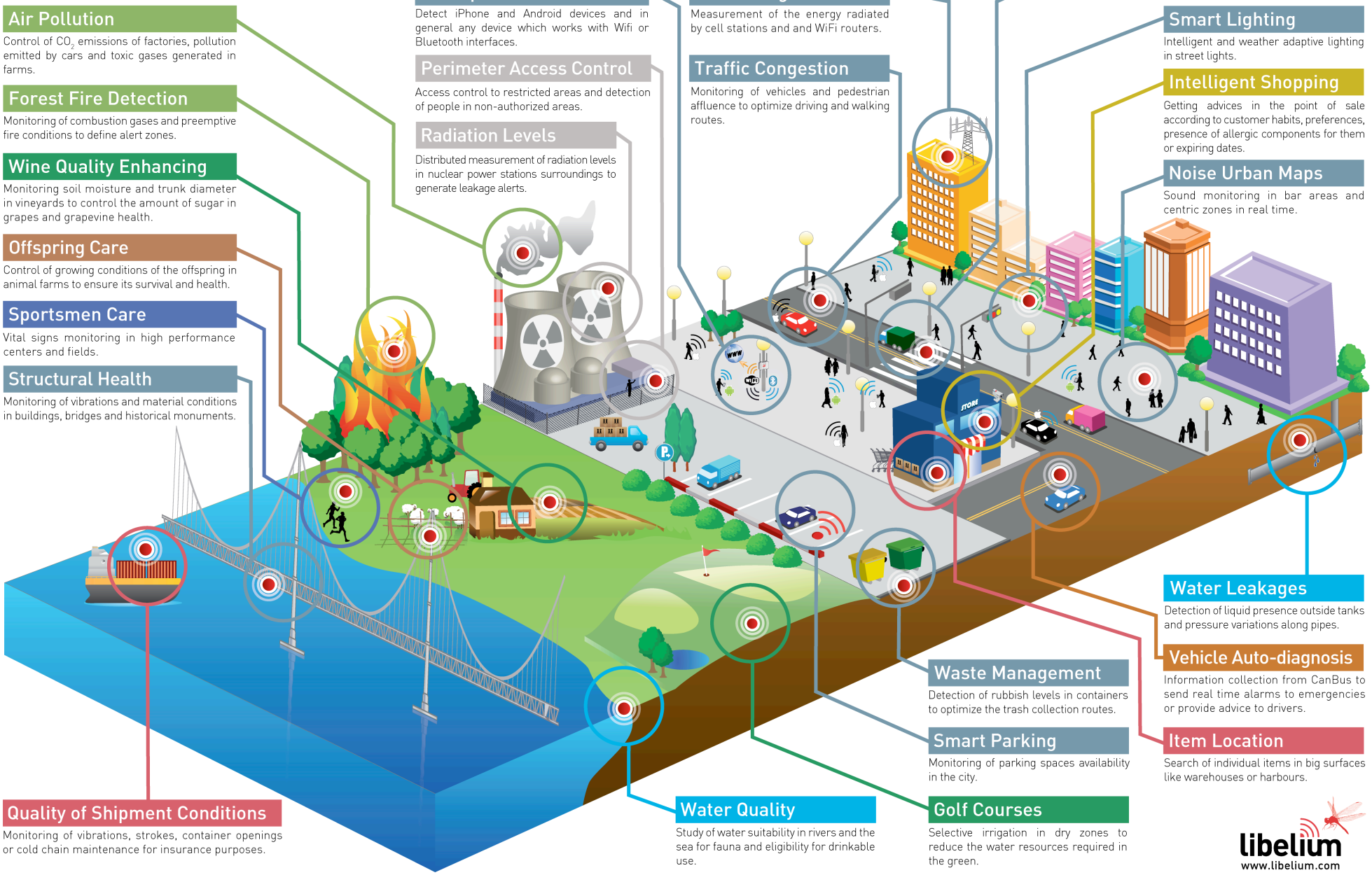
- Traditional **hierarchical organizations** have severe challenges meeting rapidly changing market and customer needs.
- Alternative organizational models are emerging addressing these challenges by focusing on **empowerment** and **autonomy** of teams.
- Companies adopting this paradigm shift early improve their **competitiveness.**

UseIT: 'Unlocking User Value in IoT'

'Internet of Things and People' (IOTAP)
Malmö University

December 8th, 2016, Gothenburg.

Internet of Things



Air Pollution
Control of CO_2 emissions of factories, pollution emitted by cars and toxic gases generated in farms.

Forest Fire Detection
Monitoring of combustion gases and preemptive fire conditions to define alert zones.

Wine Quality Enhancing
Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.

Offspring Care
Control of growing conditions of the offspring in animal farms to ensure its survival and health.

Sportsmen Care
Vital signs monitoring in high performance centers and fields.

Structural Health
Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

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

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

Perimeter Access Control
Access control to restricted areas and detection of people in non-authorized areas.

Radiation Levels
Distributed measurement of radiation levels in nuclear power stations surroundings to generate leakage alerts.

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

Traffic Congestion
Monitoring of vehicles and pedestrian affluence to optimize driving and walking 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.

Intelligent Shopping
Getting advices in the point of sale according to customer habits, preferences, presence of allergic components for them or expiring dates.

Noise Urban Maps
Sound monitoring in bar areas and centric zones in real time.

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.

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

Smart Parking
Monitoring of parking spaces availability in the city.

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.

libelium
www.libelium.com

Internet of Things and People (IoTaP)

UseIT:
Research Objectives

We study how IoT systems ***change*** traditional user behaviors and how development of IoT systems ***alter*** current SE practices.

We develop methods and techniques that help companies identify ***new user value*** and ***accelerate*** their development of IoT systems.

We conduct ***case study research*** were we bring multiple companies together to share experiences and accumulate knowledge.

UseIT:
Research Goal

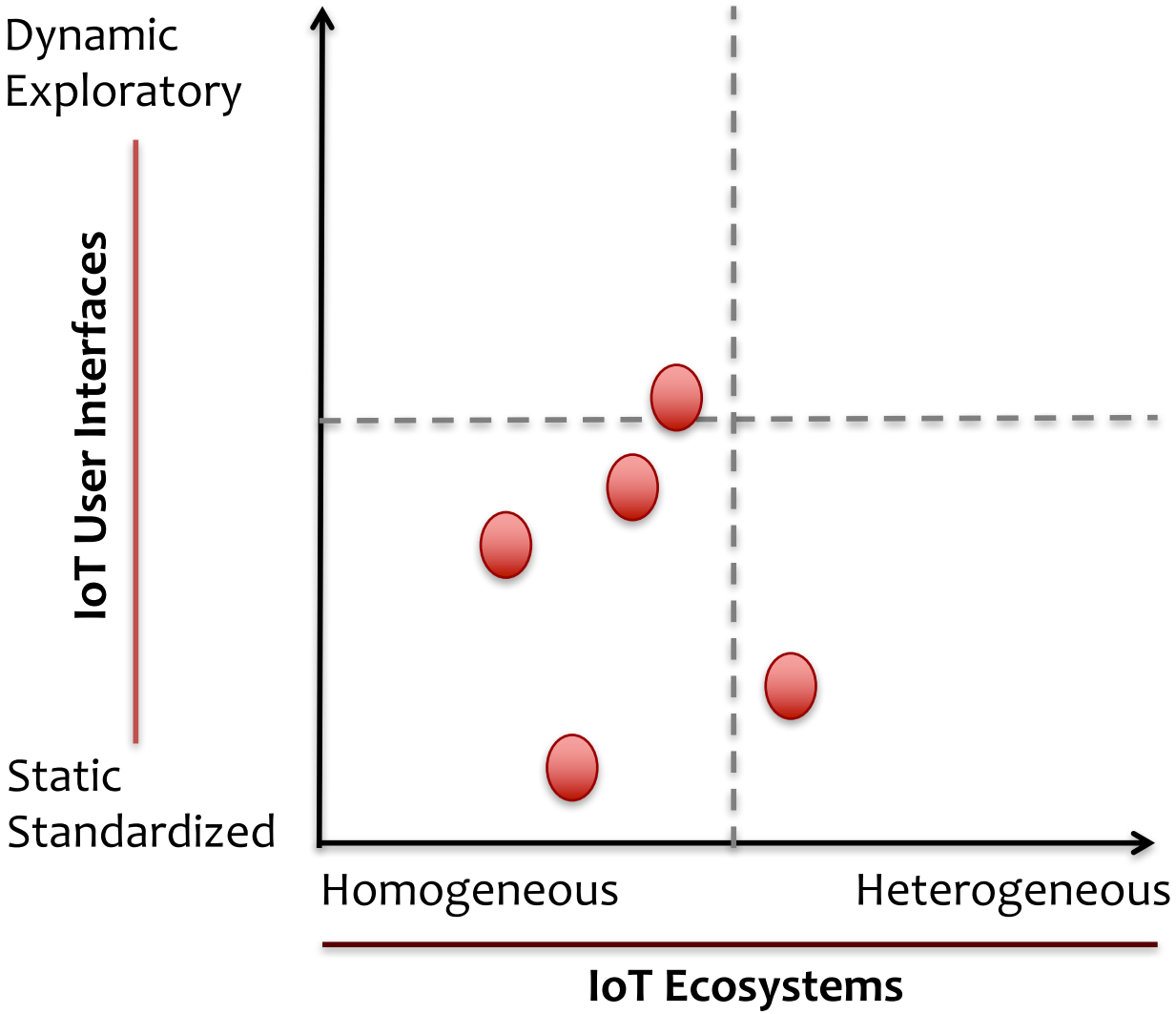
Provide support for how to effectively ***engineer and continuously improve*** IoT systems that allow and support:

- New ***user value***
- New ***behaviors and interaction patterns***
- New ***business value to monetize***

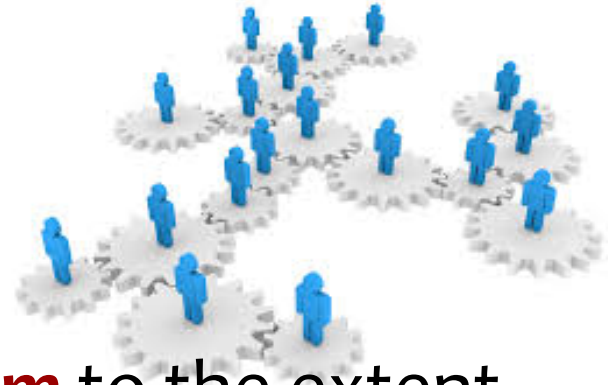
We provide ***conceptual models and frameworks*** that help assess current and desired state of IoT systems – and the transition forward.

The UDIT Model:

Map the current and desired state of your IOT products and services



Findings



- Companies ***do not utilize the ecosystem*** to the extent they could in order to create new user value.
- Companies focus their efforts and investments in one ***vertical (internal),*** but struggle in how to involve with external partners.
- While value flows towards ***customers*** are well understood, value flows towards potential ***business partners*** are not.
- Few strategies for how to ***align, orchestrate and manage*** ecosystems to enhance user value by e.g. sharing of data and sensors exist.
- While technical and architectural solutions that support IoT ecosystems exist, ***business models and incentives*** do not.

Sprint 11: Publications

- Olsson, H.H., and Bosch, J. *(forthcoming).* Towards Evidence-Based Development: Learnings From Embedded Systems, Online Games And Internet of Things *(Accepted for publication in IEEE Software).*
- Bosch, J., and Olsson, H.H. (2016). Towards Automated A/B/n Testing in Families of Smart Systems. *In Proceedings of the 42nd Euromicro Conference on Software Engineering Advanced Applications, August 31st – September 2nd, Limassol, Cyprus.*
- Olsson, H.H., and Bosch, J. (2016). Self-Learning, Self-Actuation and Decentralized Control: How Emergent System Capabilities Change Software Development. *In Proceedings of the Swedish Workshop on the Engineering of Systems of Systems (SWESoS), September 9th, Gothenburg, Sweden.*
- Olsson, H.H., Bosch, J., and Katumba, B. (2016). Exploring IoT User Dimensions: A multi-case study on user interactions in 'Internet of Things' Systems. *In Proceedings of the 17th International Conference on Product-Focused Software Process Improvement (PROFES), November 22-24, Trondheim, Norway.*

Keynote Seminars

- **Open keynote seminars (Malmö University)**
  - ***Michael Przybilski, Enevo*** *(January 13th, 2016):* 'Enevo - a case-study of the Internet of Things'.
  - ***Johan Eker, Ericsson Research Cloud Technology*** *(May 9th, 2016):* 'Merging IoT & Cloud & Everything in Between'.
  - ***Mats Melander, Tetra Pak*** *(March 22nd, 2016):* 'Digital Data and Equipment Performance at Tetra Pak'.
  - ***Mohammad Ali, Volvo Cars*** *(September 30th, 2016):* Self-driving cars development at Volvo Cars.

Thank you!

helena.holmstrom.olsson@mah.se