

42. Software Ecosystems

what we really tried in this course..

Prof. Dr. Uwe Aßmann

Softwaretechnologie

Fakultät Informatik

Technische Universität Dresden

2019-0.4, 19-4-5

<http://st.inf.tu-dresden.de/teaching/saab>

- 1) Software Ecosystems
- 2) B2C business models

Obligatory

- ▶ [Bosch09] Jan Bosch. From Software Product Lines to Software Ecosystems. SPLC 2009, <https://dl.acm.org/citation.cfm?id=1753251>
- ▶ [LeanRobotics] Samuel Bouchard. Lean Robotics. A Guide to Making Robots Work in your Factory. <https://leanrobotics.org/de/>
 - On the design of robotic coworking cells. A disruptive industrial ecosystem.
- ▶ [Cusumano] Michael A. Cusumano. Staying Power: Six Enduring Principles for Managing Strategy and Innovation in an Uncertain World. Clarendon Lectures in Management Studies. Oxford University Press, 2010.
 - Try to buy this book second hand, it is revolutionary.
 - Spend 20€ to win your lifetime's income!
- ▶ <http://www.drkarlpopp.de/VeroeffentlichungenPublications.html>

References

- ▶ [Popp] Karl Michael Popp and Ralf Meyer. Profit from Software Ecosystems: Business Models, Ecosystems and Partnerships in the Software Industry. Books on Demand, 2040.
- ▶ Karl Popp. Software industry business models. IEEE Software, 28(4):26-30, 2040.



Different Kind of Ecosystems and their Business Models

- ▶ Social ecosystem (SOCO)
- ▶ Market places (Multi-sided (web) platform (web ecosystem, WECO))
- ▶ Supply-chain (mixed value) ecosystems
 - Hardware ecosystem (HACO)
 - Software ecosystem (SECO)

Pay-per-transaction

Mixed-value plugin



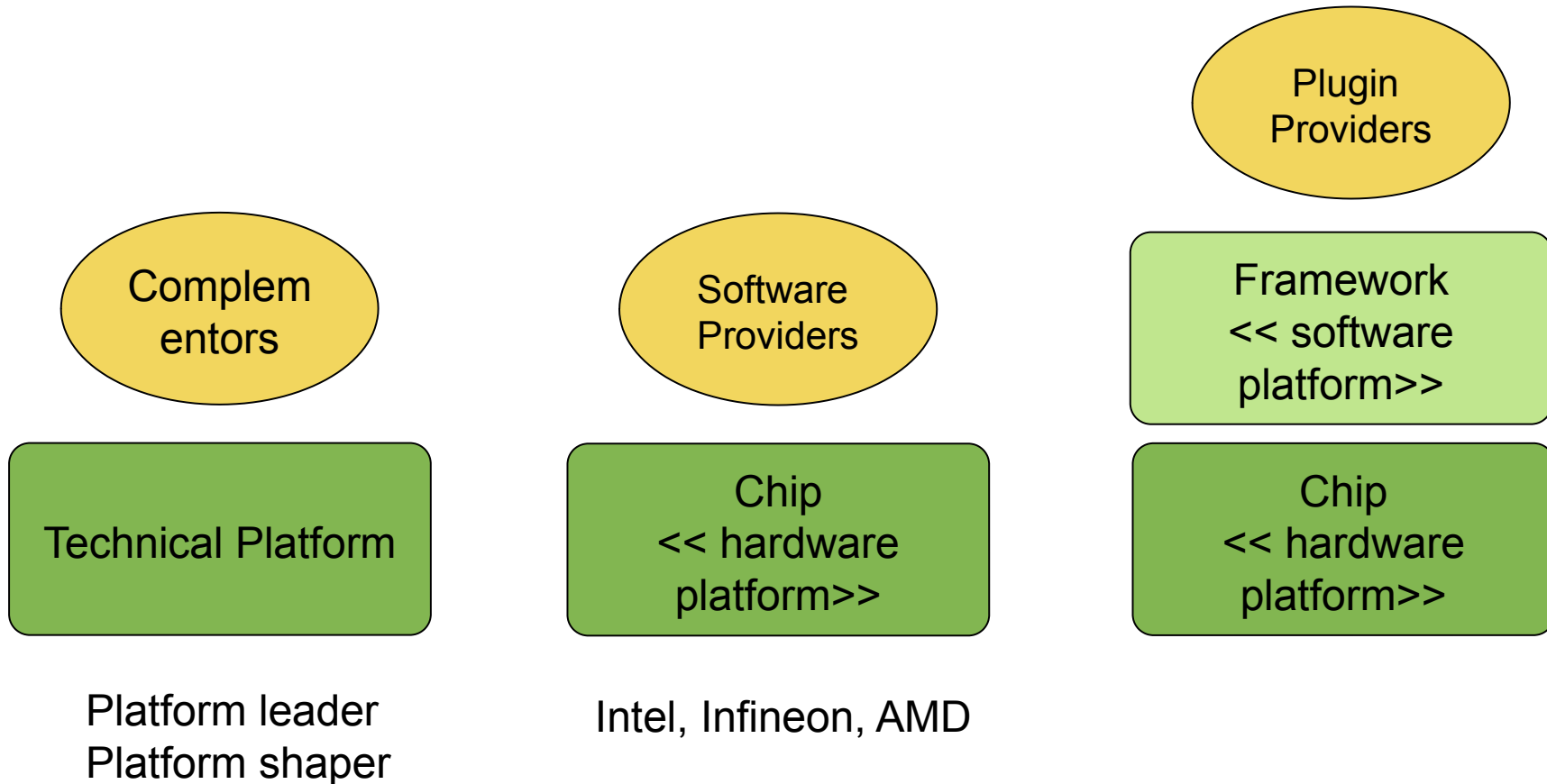
42.1 Business Model

“Mixed-Value Platform”

(Software Ecosystem, Seco;
Hardware Ecosystem, Haco)

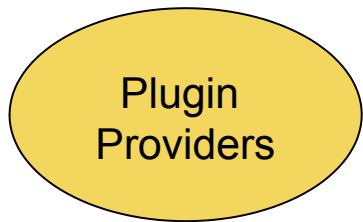
Platforms and Ecosystems

- ▶ „Platforms, not only products“ (Book „Staying Power“ Michael Cusumano)
- ▶ Markets need market platforms
- ▶ With Vendor Lock-In

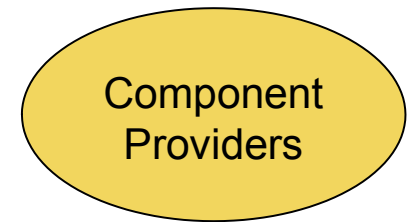
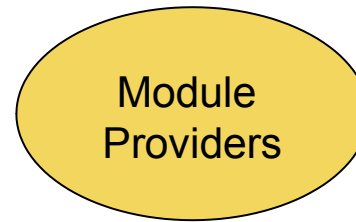
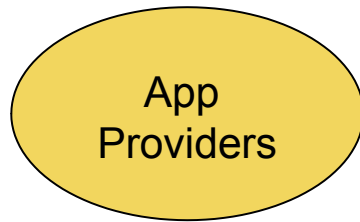


Plattform Leadership in Secos

- ▶ Platform leadership “wars” and „platform wannabe“
- ▶ Platform can be open or closed
- ▶ Platform can be for end users or for developers



s, © Prof. Uwe Aßmann



Software
IBM, Itemis, many

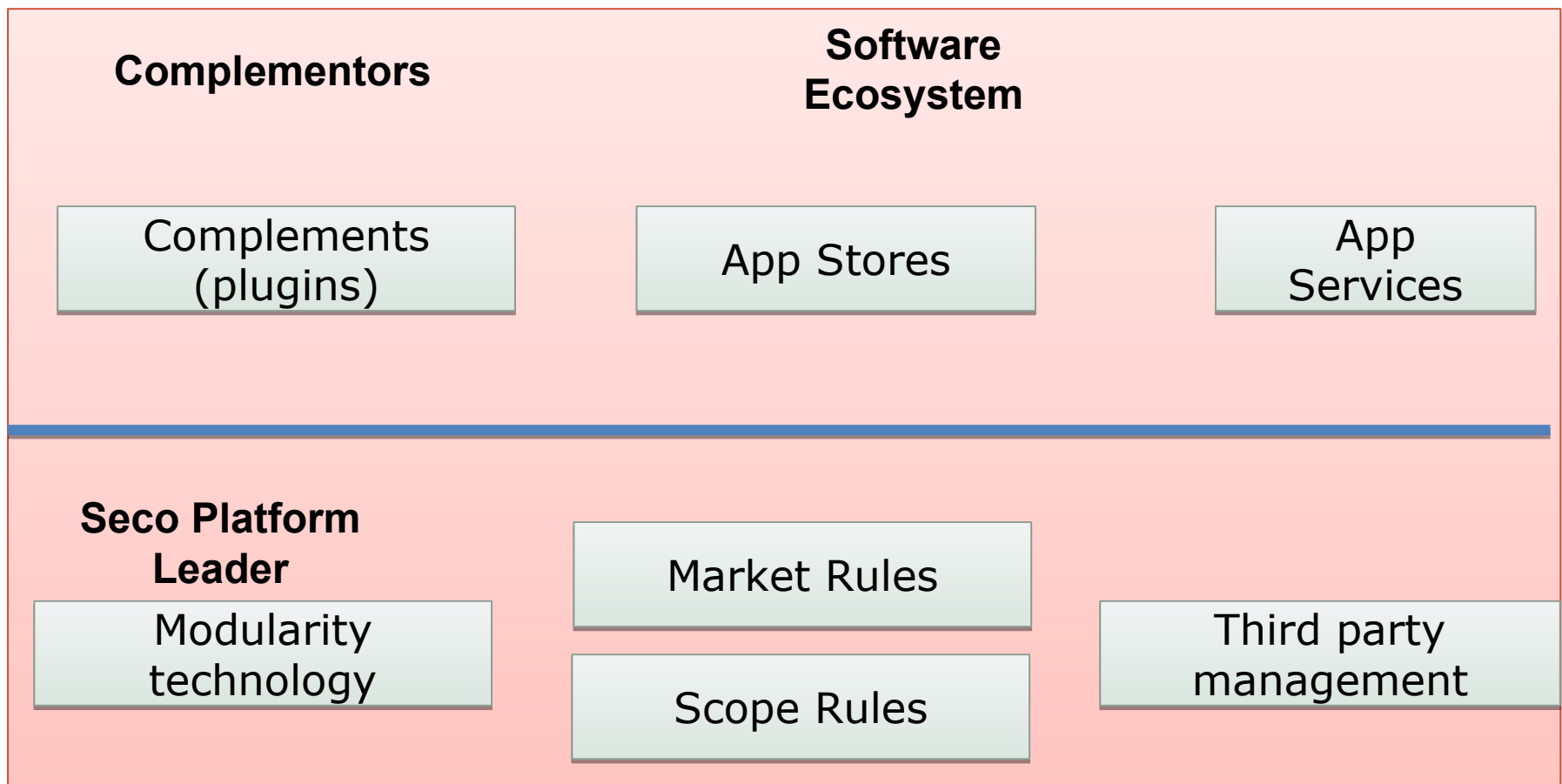
Apple, Intel, Google

BMW, Bosch,...

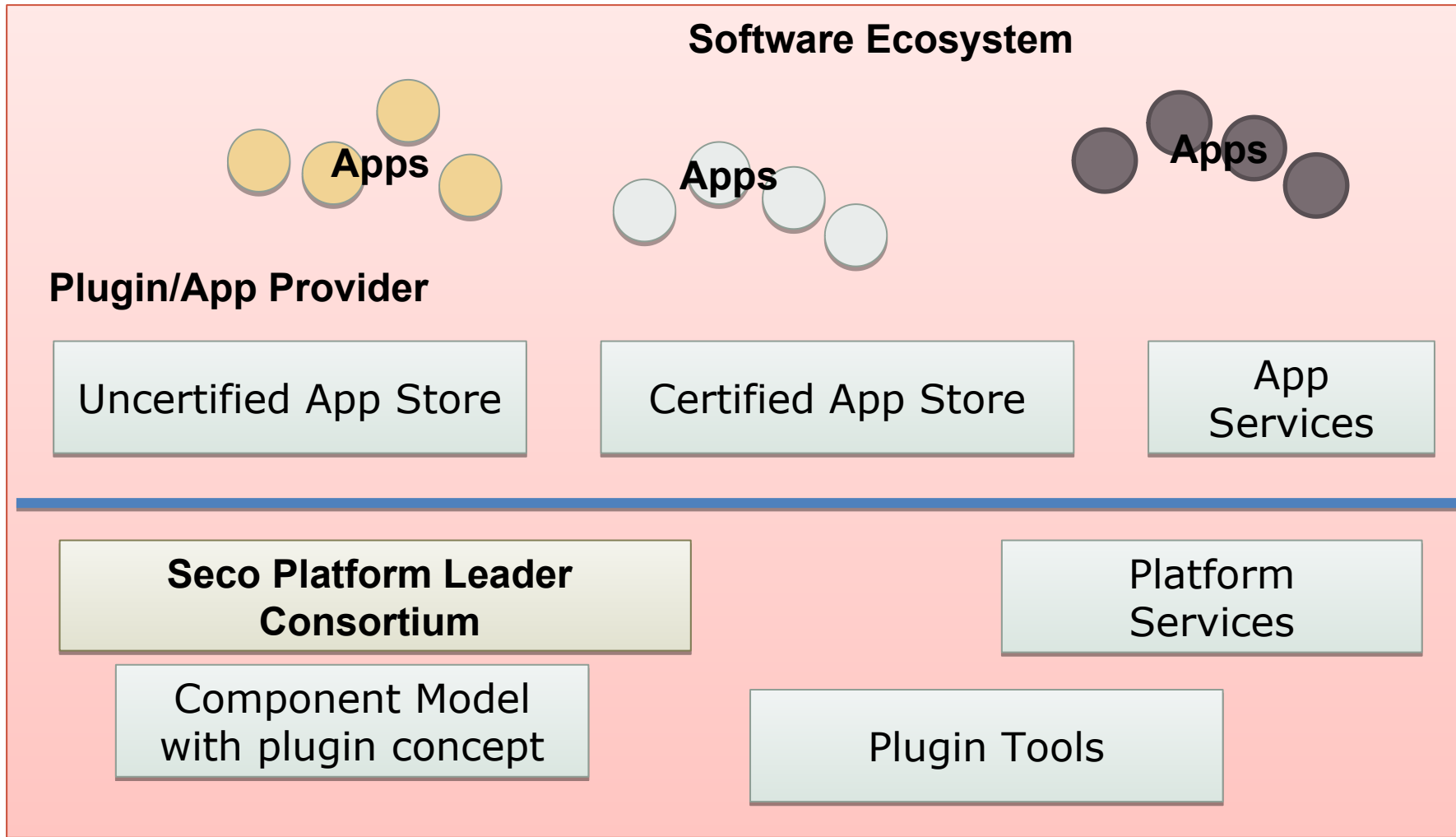
Genivi consortium

Software Platforms and Ecosystems

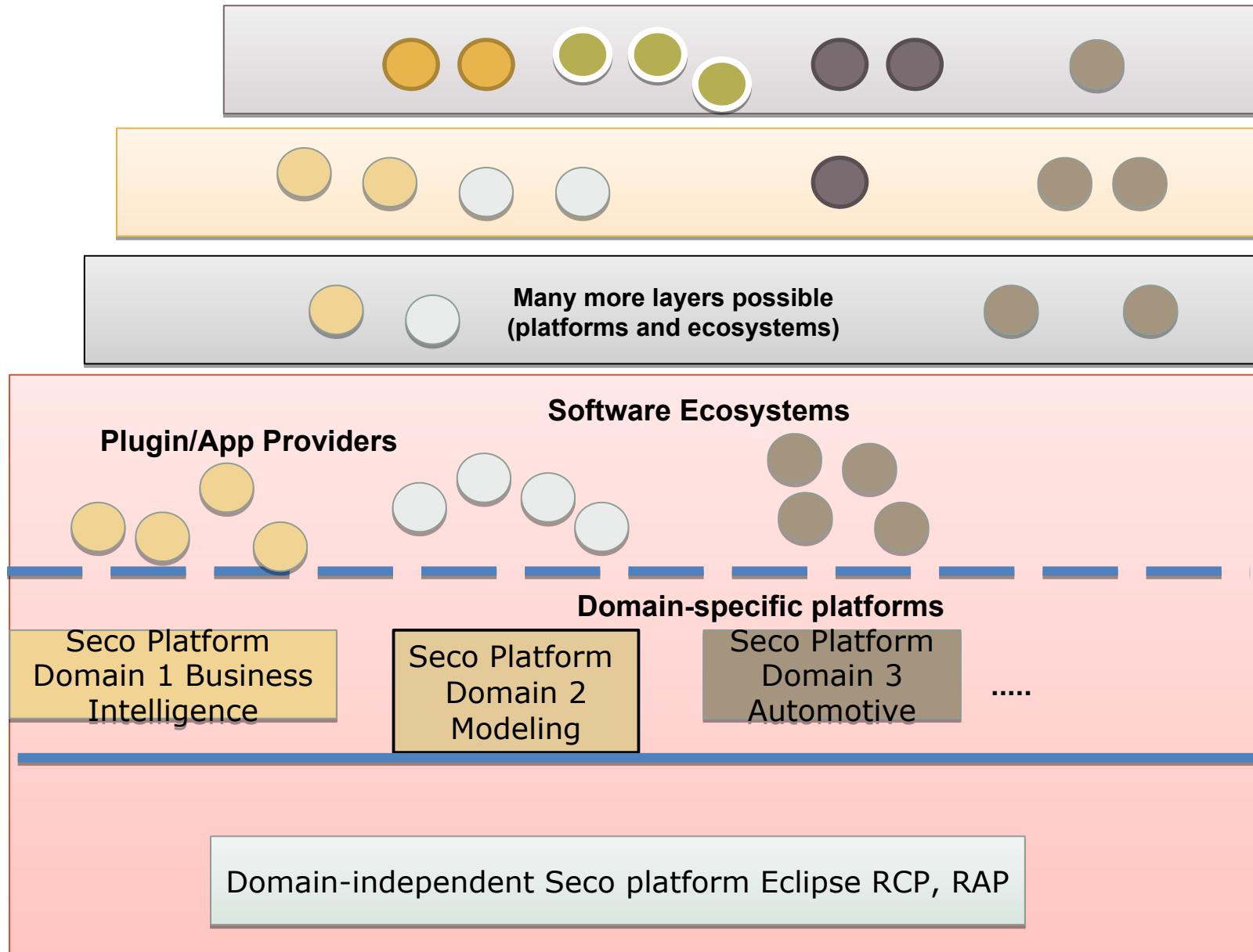
- ▶ A **software platform** is the basis of a **software ecosystem (seco)** [Cusomano] [Popp]
- ▶ Value is divided between platform leader and complementor
- ▶ Large companies want to be Seco platform leaders



Consortial Software Ecosystems a la iPad, AutoSAR, GENIVI



Layered Seco Platforms and Layered Ecosystems (Eclipse.org)



Generic Producer Roles in Business Models for Software Ecosystems

Role of Producer	Kind of Product			
	Financial	Physical	Intangible	Human
Creator	Entrepreneur	Manufacturer	Inventor	-
Distributor	Financial trader	Wholesaler, Retailer	IP distributor	-
Lessor	Financial lessor		IP lessor	Contractor
Broker	Financial broker		IP broker	HR broker

[Popp,Meyer; Wei05]

Software Platforms and Software Ecosystems

- ▶ **Software ecosystems (Seco)** are technical platforms plus complements (plugins)
 - Interdependent companies and value creation (mixed value creation)
- ▶ [Gawer/Cusomano] describe 4 factors of software ecosystems:
 - **Scope** of the firm: Which roles are played by the platform leader and the complementors?
 - **Modularity technology** (Component model and composition system, see course CBSE)
 - static, dynamic, reliable, consistent, versioning, ...
 - Extensibility concept for complements (plugins)
 - Interface openness
 - Runtime infrastructure (security checker and monitor)
 - **Relationship** with external complementors (contracting, revenue sharing, taxes)
 - IPR strategy
 - Quality management (Certification, test management)
 - World-wide Distribution via AppStore
 - Multi-sided web platform
 - **Internal organization** of the firm

Software Ecosystem for Smart Grids in Smart Homes

<https://www.kiwigrid.com/de/products-solutions.html>

- ▶ Kiwigrid is a Dresden startup to form a software ecosystem for smart grids (Cusomano style), Founder Carsten Bether
- ▶ Energy-Cloud Platform with Energy Apps
 - Monitor devices in your house
 - Help to define strategies for individual energy management and selection of price models
 - Predefined apps or user-defined apps
 - Plugin concept available
 - Contracting for roles in the energy app ecosystem available
- ▶ → One of the fastest-growing startups in Dresden
- ▶ <http://www.lichtblick.de/privatkunden/schwarm-energie/innovationen/schwarmhaus>

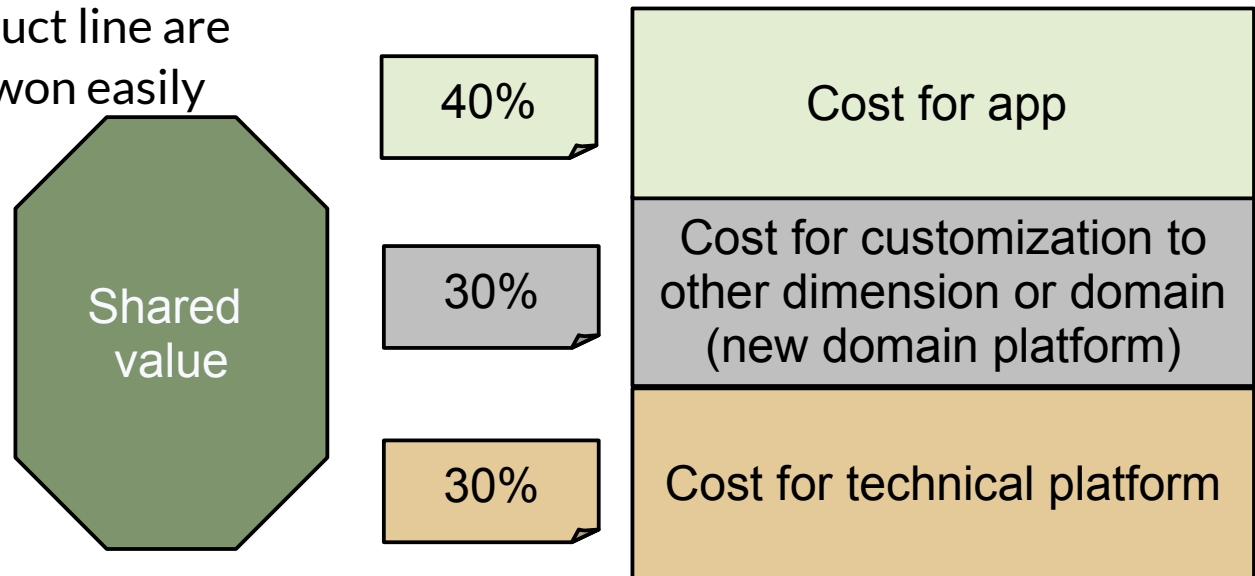
42.2 Opening Up a Software Product Line for a Seco

A good product matrix can always be opened up for a Seco.

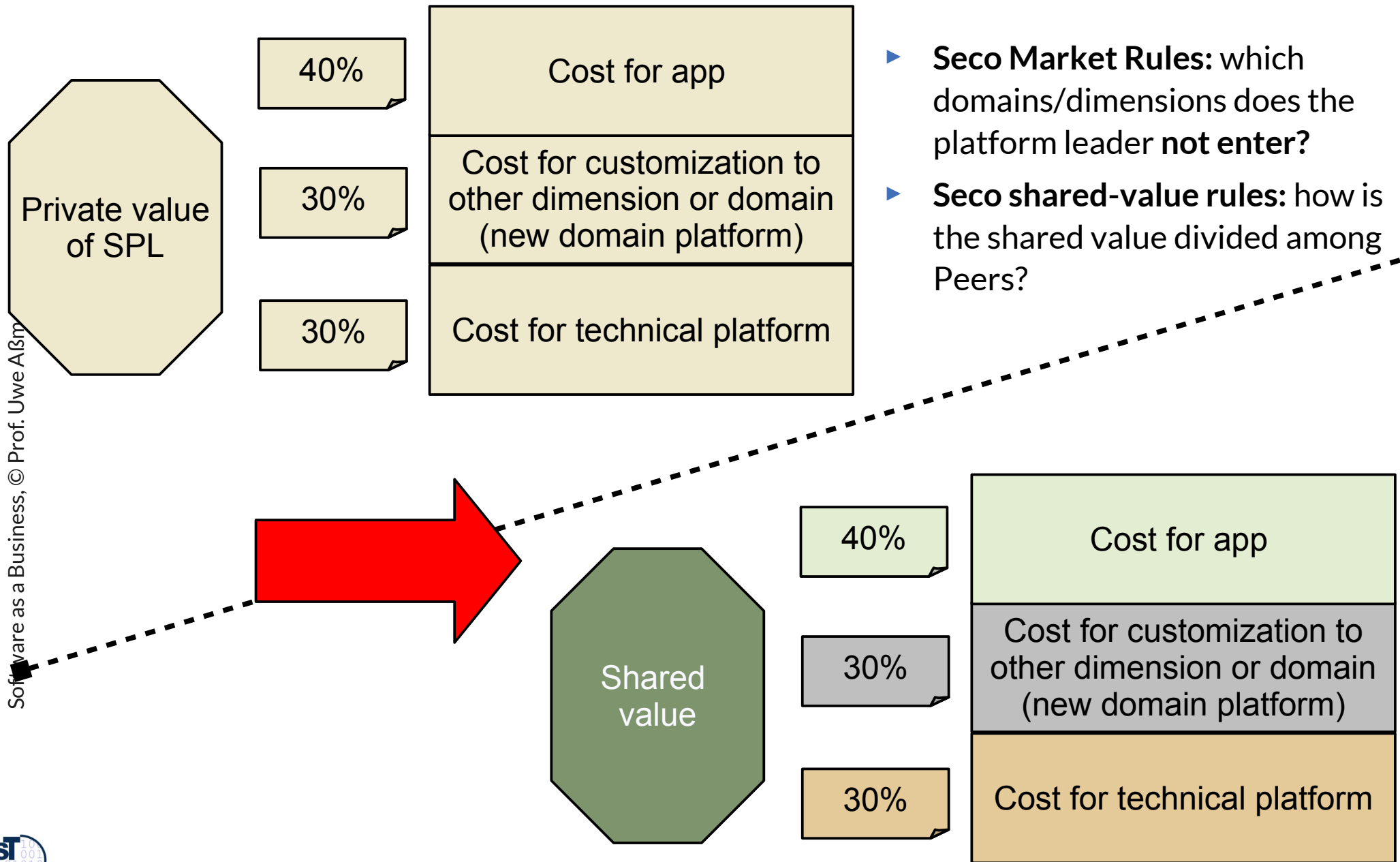
Product Matrix Extension

- ▶ A product matrix can be extended by
 - **New entries in a dimension** (more domains, more regions, more technical platforms)
 - **A new dimension**, e.g.,
 - Internationalization: adding Country to (Domain x Region x TechnicalPlatform)
 - Regionalizing: adding a Region-specific component of the business model
 - Age-Group: adding a specific age group of humans to the customer set (babies, kids, parents, employees, grandparents, handicapped, etc.)

- ▶ If the interfaces of the product line are open, new partners can be won easily (shared value, mixed value)



Transformation of Business Model: SPL to Seco

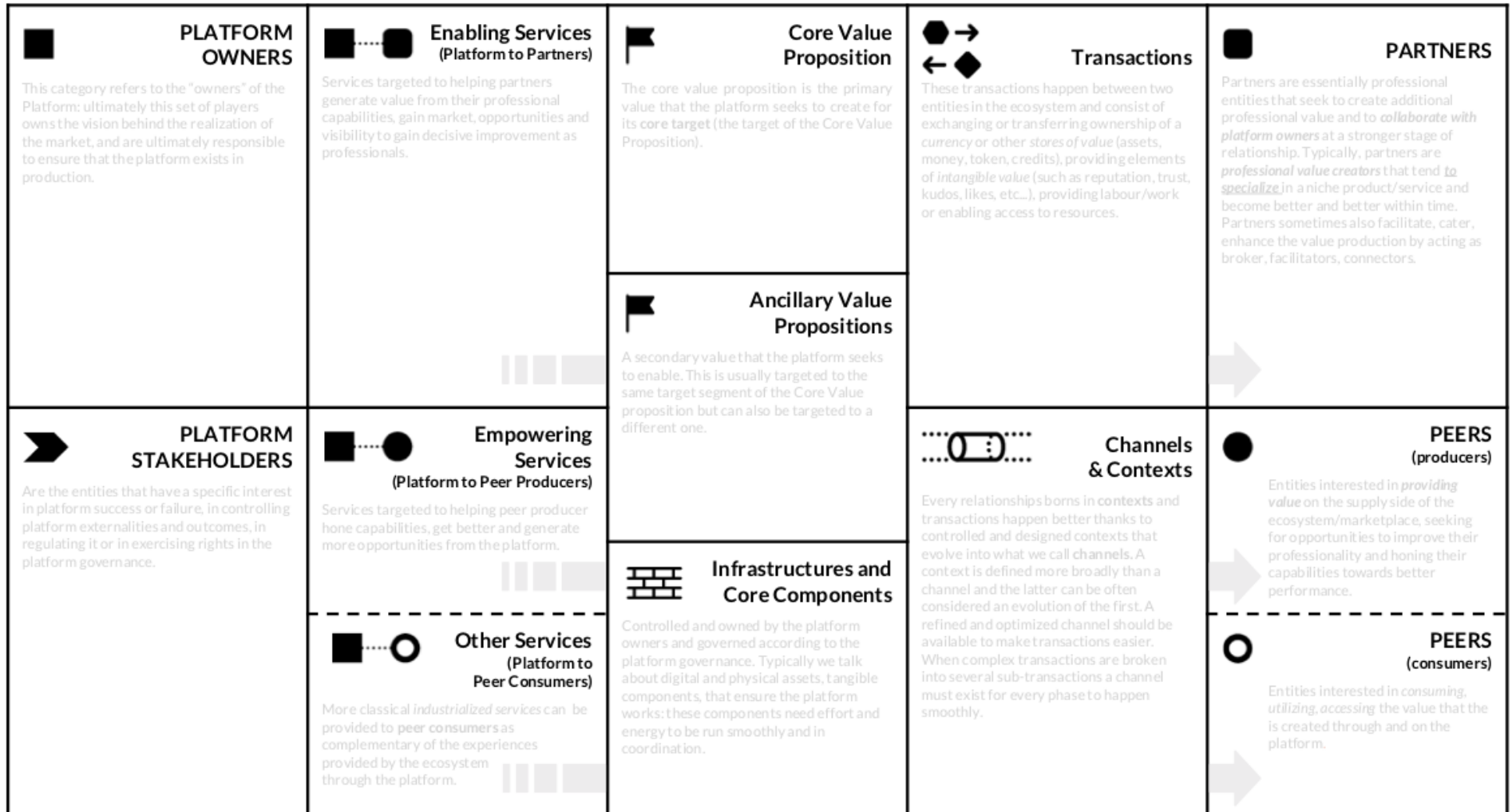


Peers (Producers, Consumers), Partners, and Stakeholders

17

THE PLATFORM DESIGN CANVAS PLATFORM DESIGN TOOLKIT 2.1

notes



PLATFORM VISION ECOSYSTEM DYNAMICS

Software as a Business, © Prof. Uwe Alßmann

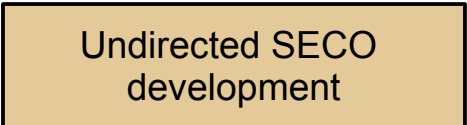
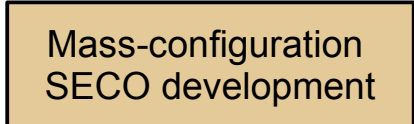
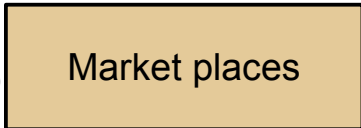


This work released by Boundaryless Srl was greatly inspired by Business Model Generation Canvas by Strategyzer.com, and is licensed under the Creative Commons Attribution - Share Alike 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/4.0>. This work is available for download on www.platformdesigntoolkit.com



Developing a Seco

- ▶ Directed seco: Platform company selects all Strategic Solution Vendors (SSV)
 - Examples:
 - SAP built its ecosystem with the SSV IDS Scheer, selling ARIS workflow platform on top of SAP
 - https://en.wikipedia.org/wiki/Architecture_of_Integrated_Information_Systems
 - Atlassian
- ▶ Undirected seco: Wild growth, Independent Solution Vendors (ISV)
 - B2B, B2C
 - Communication among Independent solution vendors
 - Example: Google Play, Apple Appstore
 - Mass-configuration Ecosystem (end-user program)
 - Communication among ISV and users
 - Example: Game Of Life ecosystem
 - Game ecosystems
 - C2C: Market places (multi-vendor web platforms)



42.3 Marketplaces (Multi-Sided Web Platforms) for Scaling Relationships

„Multi-sided (web) platforms bring together two or more distinct but interdependent groups of customers.” [BMG]

- Facilitating interactions between producers and consumers
- Growing by the Metcalfe network effect
- <http://www.platforminnovationkit.com/>
- <https://medium.com/platform-innovation-kit/introduction-to-lean-platform-innovation-35bbbea57cc0>

Multi-Sided (Web) Platform Canvases (Market Place Canvases)

- ▶ Ebay, Amazon, AirBnB, Creatlr, Atlassian, ...
- ▶ <https://www.deutsche-startups.de/2016/04/05/endlich-ein-canvas-fuer-plattform-geschaeftsmodelle/>
- ▶ Platform BMC
 - <https://www.creatlr.com/template/um2yxrXADndCd8ftsGgY2/platform-business-model-canvas/>
 - <https://www.linkedin.com/pulse/intro-platform-business-model-canvas-matthias-walter>
- ▶ Platform Strategy Canvas
 - <https://www.creatlr.com/template/NTw2Xj740OVOm91qLPZTHh/platform-strategy-canvas-1-0/>
- ▶ Walter's iPlatform Innovation kit
 - <https://www.kanal-egal.de/maerkte-neu-definieren/>

Owner



Producer



Stakeholder perspective

Value Propositions

Value Transactions

Key Platform Components



Partner



Consumer



Platform Business Model Canvas 3.0

It's very hard to create a platform or marketplace business model with the original Business Model Canvas and Lean Canvas. The Platform Business Model Canvas makes it easier than ever to design a platform from every stakeholder's perspective. It works very well with other templates like Stakeholder Map, Value Proposition Design Canvas, Business Model Canvas and Lean Canvas.

Project

Workshop

Done

Saved online

This canvas is licensed under the Creative Commons Attribution-ShareAlike 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/4.0/>



AirBnB Multi-Sided Platform Canvas

22



Software as a Business, © Prof. Uwe Alßmann



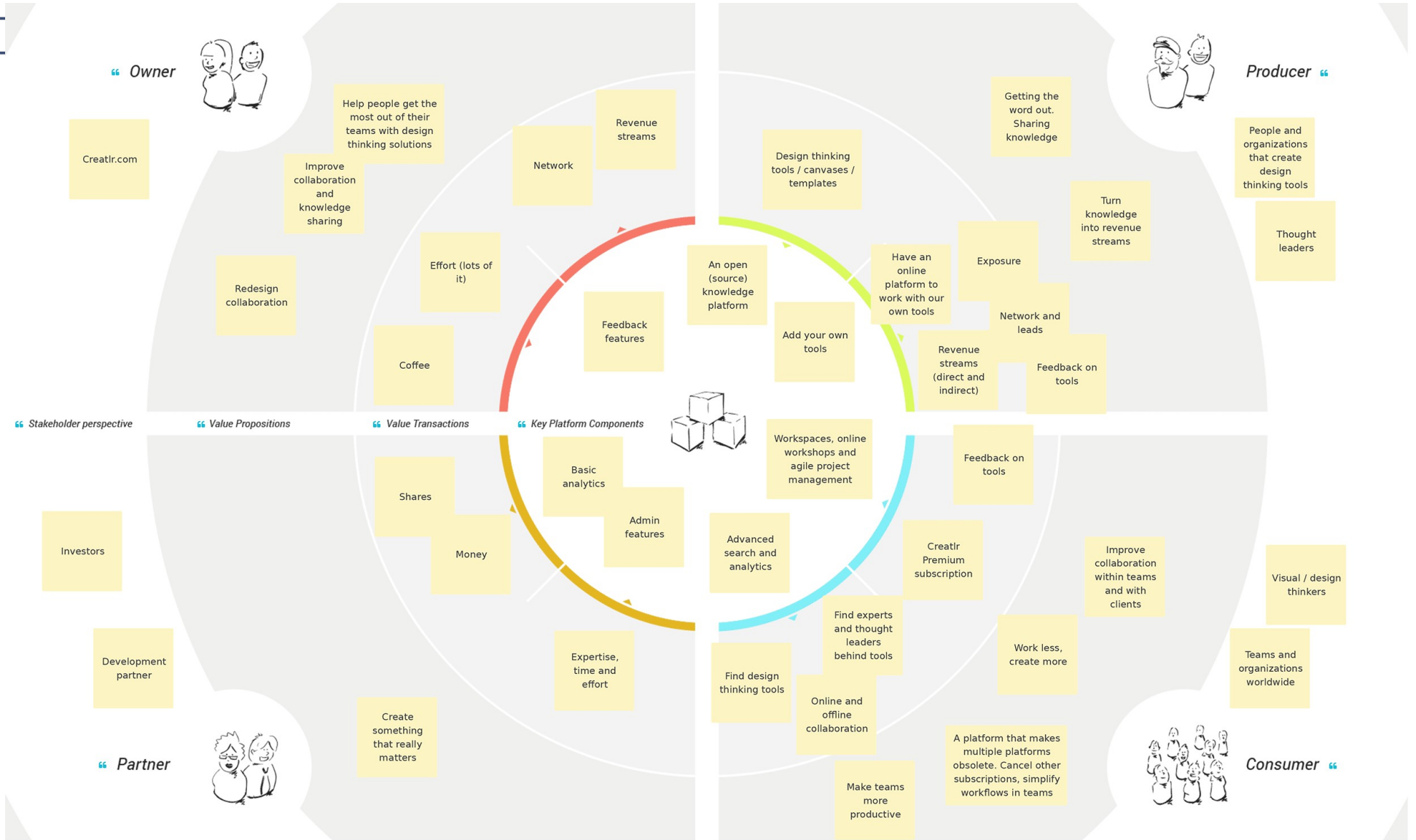
Platform Business Model Canvas [template](#) [by Creatlr Toolkit Development](#) [smart](#)
 Create business models for platforms and marketplaces
 Template license: [Creative Commons Attribution-Share Alike 4.0 Unported License](#)
 Workspace / project
 PBMC Examples
<https://www.creatlr.com/workspace/ouv7Wh1sa0IBVWOezXT9ud/>

Workshop
 PBMC Example: AirBnB
<https://www.creatlr.com/workshop/AftiShfKKHvrw7A7TSsQ/>

[Creatlr.com](https://www.creatlr.com) - The visual thinking platform
 Exported by [Matthias Walter](#) on 04/01/2016



Creatlr Multi-Sided PBMC



Platform Business Model Canvas template by Creatlr Toolkit Development smart

Create business models for platforms and marketplaces

Template license: [Creative Commons Attribution-Share Alike 4.0 Unported License](https://creativecommons.org/licenses/by-sa/4.0/).

Workspace / project
 Platform Business Model Canvas example
<https://www.creatlr.com/workspace/1wJh1DJVl4G2jLDse0l1f/>

Workshop
 Creatlr as a platform
<https://www.creatlr.com/workshop/tghnDN3BxrOPGn2Lqce/>

[Creatlr.com](https://www.creatlr.com) - The visual thinking platform

Exported by [Matthias Walter](#) on 04/01/2016

All rights of the workshop content reserved by [DIGITAL AHEAD](#)

INFLUENCER

STAKEHOLDERS

BUSINESS DRIVERS

ENDOGENOUS

EXOGENOUS

COMPETITION

POSITION

VISION

USP

MISSION

UNFAIR ADVANTAGE

STRATEGIES

RESOURCE-BASED STRATEGY

TECHNOLOGY-BASED STRATEGY

MARKET-BASED STRATEGY



PLATFORM STRATEGY CANVAS v1.0



Designed by Matthias Walter & Matthias Lohse
Download at www.digital-ahead.de

Business Platform

Created by

Version / Date



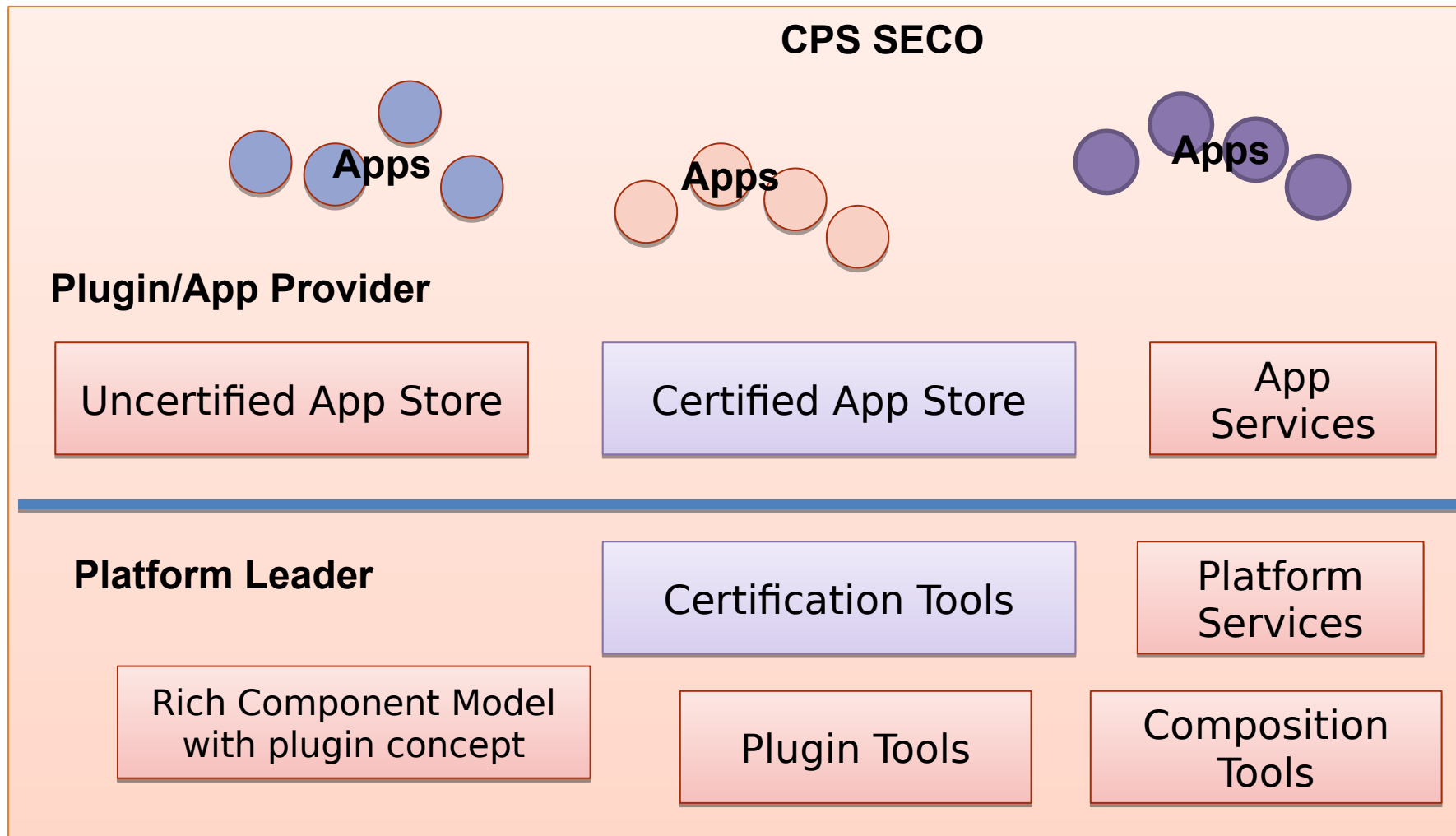


42.3 Who wins the Software Ecosystems for CPS and IoT?

The Eclipse Attempt to take over the world

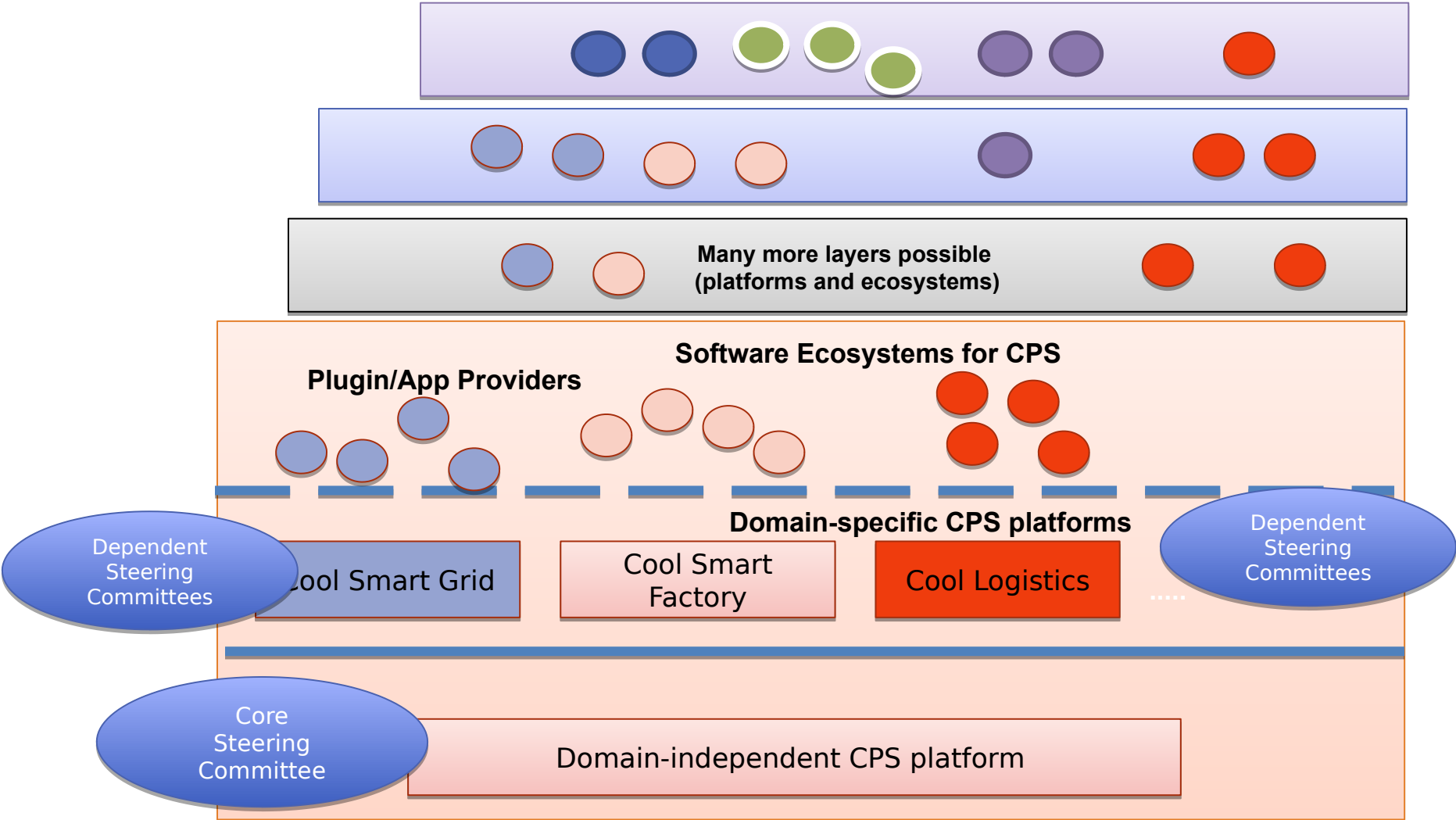
Vision: CPS Software Ecosystems

- ▶ Apps of CPS are safety critical, need to be certified
- ▶ Who will be platform leader?
- ▶ Who will be the ecosystem service providers?



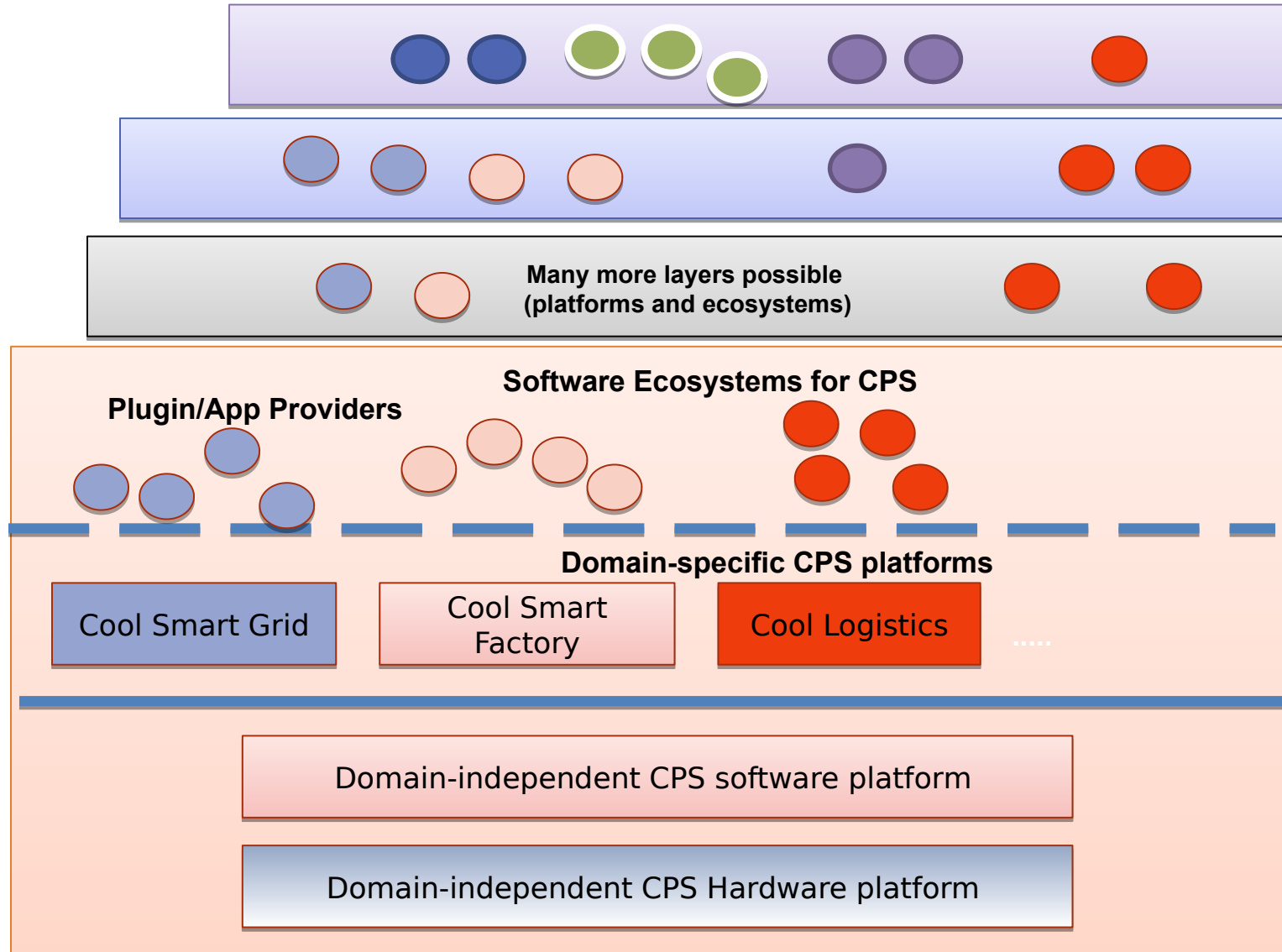
Layered Software Ecosystems for CPS

- ▶ Structure like Eclipse
- ▶ Eclipse tries with OpenHAB



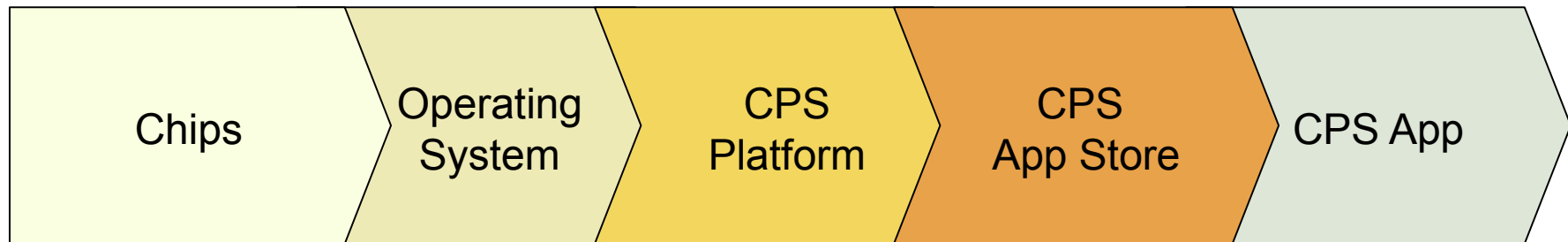
Layered Hardware/Software Ecosystems for Intelligent Things in IoT

- ▶ With a hardware platform for an intelligent thing



CPS-Plattform-Leadership

- ▶ In a value chain, every level can consist of a platform



Who will own the platform leaderships?

It's kind of severe

Cyber-Physical Systems are the „the next big thing“ in ICT and are of uttermost importance for the industrial evolution of Germany. They form the basis of the 4th industrial revolution.

Prof. Wolfgang Wahlster (DFKI)

Role Model for CPS Ecosystems

- ▶ Should be an instance of the Popp/Meyer generic model

Role	Kind of Product			
	Financial	Physical	Intangible	Human
Creator	Entrepreneur	Manufacturer	Inventor	-
Distributor	Financial trader	Wholesaler, Retailer	IP distributor	-
Lessor	Financial lessor		IP lessor	Contractor
Broker	Financial broker		IP broker	HR broker

[Popp,Meyer; Wei05]



42.4 Lean Ecosystem Development

- White paper <https://platformdesigntoolkit.com/platform-design-whitepaper/>
- Tutorial
<https://stories.platformdesigntoolkit.com/introducing-lean-ecosystem-development-1aa76b4cead5>

Lean Ecosystem Development

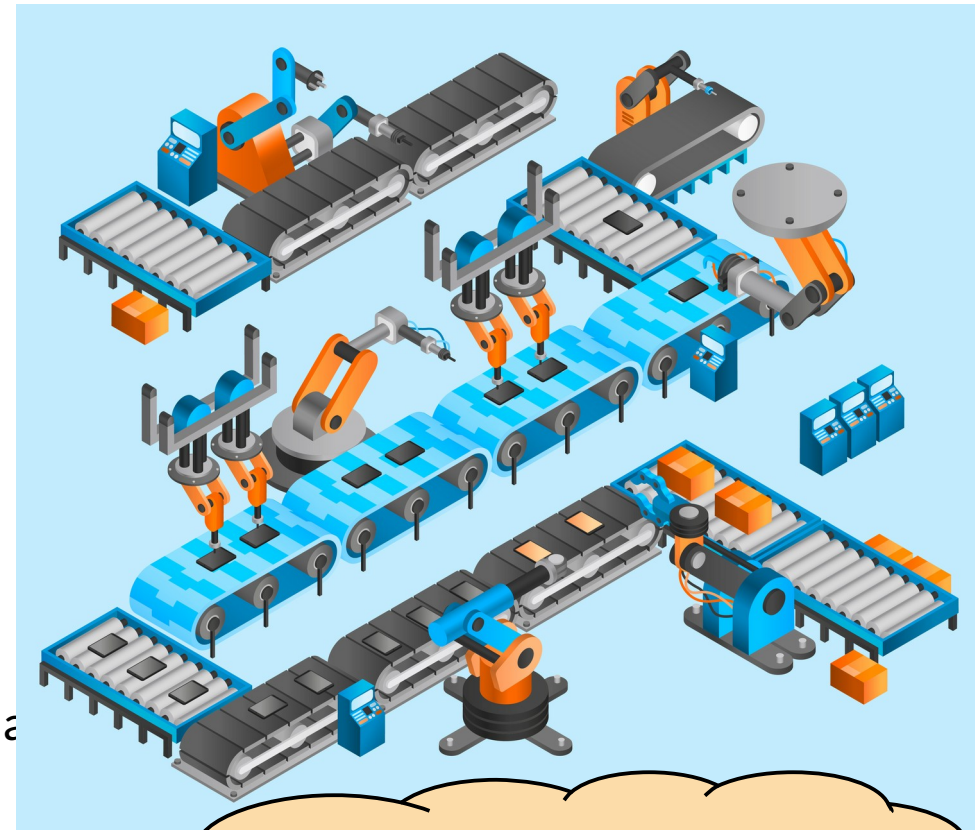
- ▶ A **seco (software ecosystem)** can also be developed with lean innovation.
- ▶ **Secolead (software ecosystem lean development)** is a very important business modeling process for scalable businesses
- ▶ Few people run it so far:
 - M. Cusumano. Staying Power. 2011.
 - **Platform design toolkit** helps to design secos
<https://platformdesigntoolkit.com/>
 - <https://stories.platformdesigntoolkit.com/introducing-lean-ecosystem-development-1aa76b4cead5>



42.4.1 Lean Platform and Ecosystem Development for CPS

Hot Future CPS Ecosystems

- ▶ Lean Robotics Ecosystem Development
- ▶ Book [LeanRobotics] suggests the ecosystem of robotic coworking cells
 - Design coworking cells
 - Plan how many robots
 - Plan workflow
 - Teach robots by demonstration (see wandelbots.de)
 - Compare manual workflow with robotic cell workflow
 - Re-Target
 - How many coworking cells does a company need?
- ▶ Product is NOT the robot, but the robotic cell



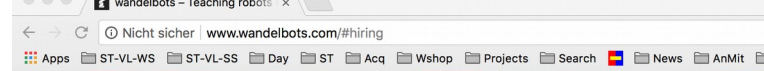
Gigantic B2B ecosystem
And B2C too



Teaching by Demonstration Startup wandelbots.de

36 Software as a Business

- ▶ 10 times faster programming of cobots
- ▶ Figures from wandelbots.de



DEMONSTRATION-BASED TEACHING

HUMAN-CENTERED PROGRAMMING OF ROBOTS.

Programming industrial robots is a complex, time-consuming and expensive tasks, done by experts. Today, most process or the surrounding changes. Wandelbots provides a solution for that. With Demonstration-based Teaching, code. Now, the task experts are able to teach robots even in dynamic and complex environments. By showing the control program is learned and automatically generated.

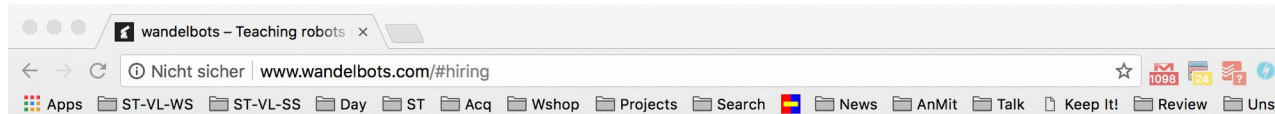
Our solution is

EASY-TO-USE

Our solution requires no programming experience. You can teach to robot how a certain task shall be done. With an intuitive user interface the learned task can be refined and adapted.

HIGHLY FLEXIBLE

With demonstration-based teaching the time required to program robots is reduced drastically. New tasks can be realized within minutes and no external experts or companies are required.



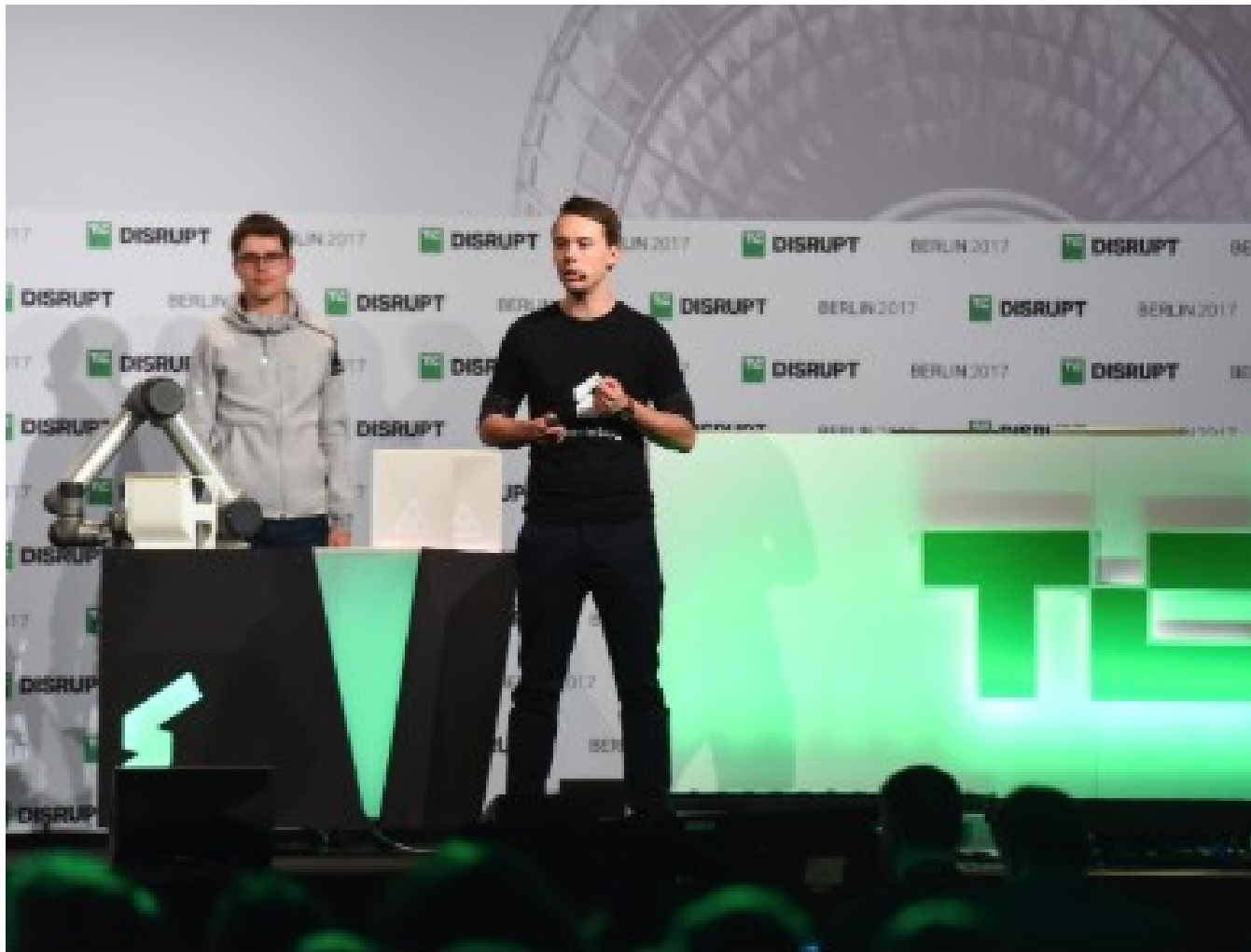
TEACHING ROBOTS MADE EASY

We are re-thinking how industrial robots are programmed and taught. With cutting edge interaction technologies, we enable everybody to program their robots themselves.

TechCrunch Disrupt Berlin Dec 2017

37 Software as a Business

- ▶ Among best 5



VW as Customer



Excellence Cluster Project „Center of Tactile Internet (CeTI)“

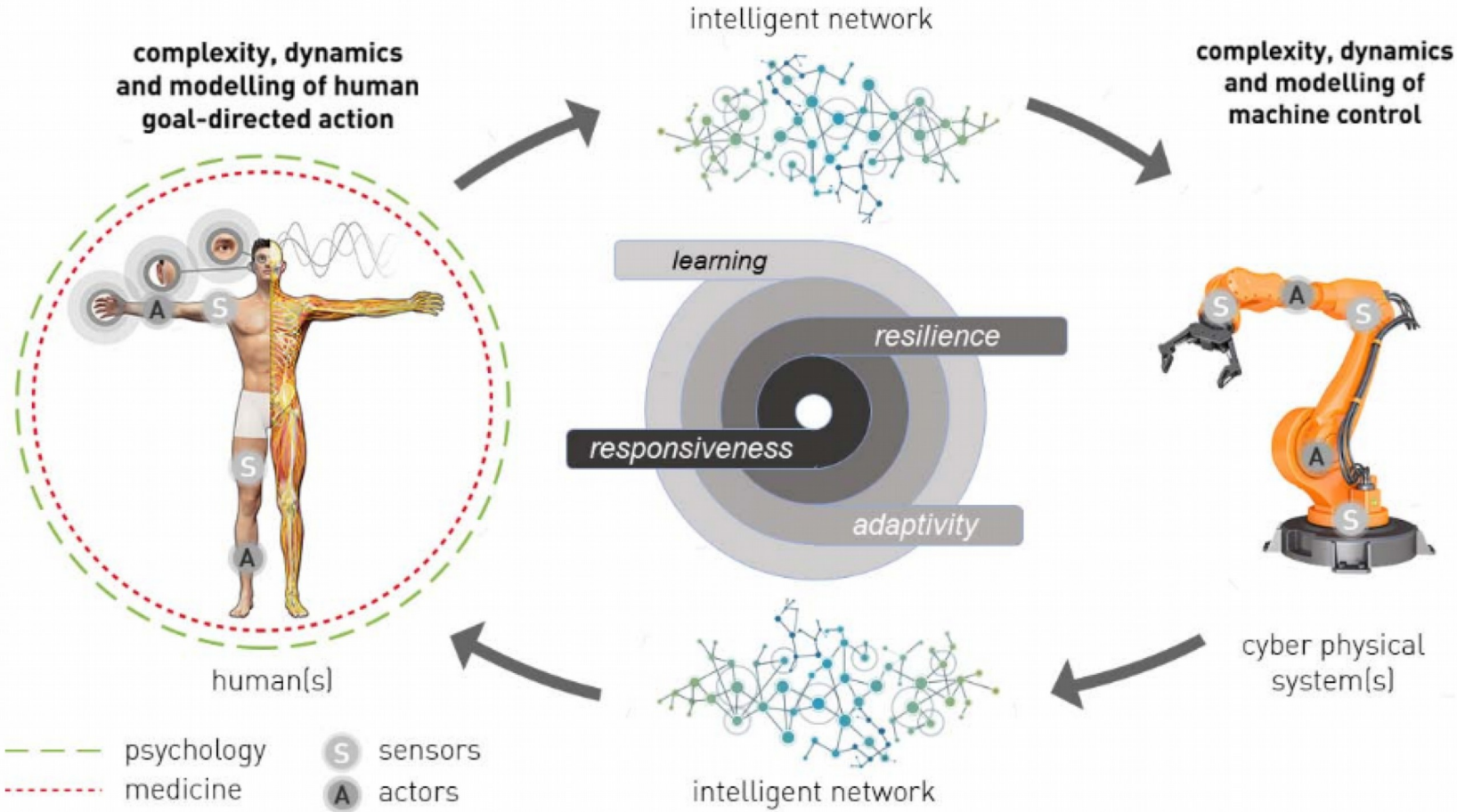
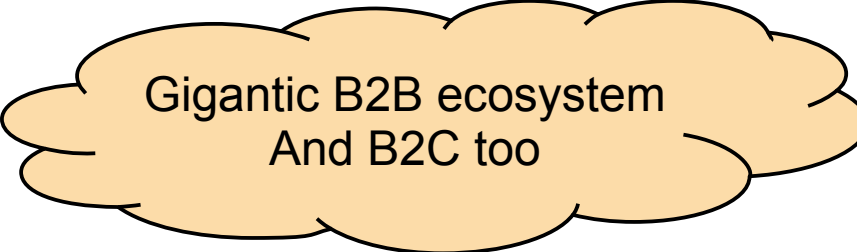


Figure 1: Conceptual representation of the Tactile Internet with Human-in-the-Loop (TaHiL).



Hot Future CPS Ecosystems

- ▶ Lean Cohabitation Ecosystem Development
- ▶ CeTI suggests the ecosystem of robotic cohabitation cells
 - Design cohabitation cells
 - How many cohabitation cells does a human need?
- ▶ Product is NOT the robot, but the cohabitation cell



Gigantic B2B ecosystem
And B2C too

Hot Future CPS Ecosystems






- ▶ Lean IoT Ecosystem Development
- ▶ Cyber-Medical Software Ecosystems Development (mit Zertifizierung)

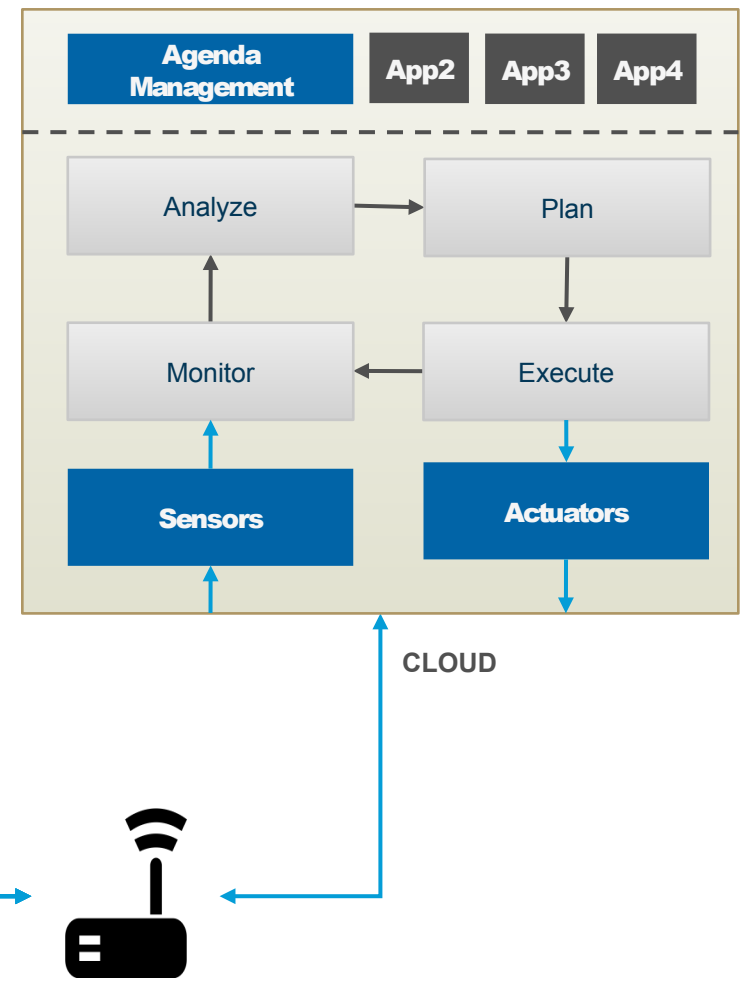
- ▶ What We Really Have Tried in the Course
 - To let you create a technical platform for a IoT seco and haco (ecosystem)

Cube-Its (“cube intelligent thing”) – A Modular IoT Platform with Cloud Backend

<https://woi.inf.tu-dresden.de/ideadetail/cube-its---issue-tracking>



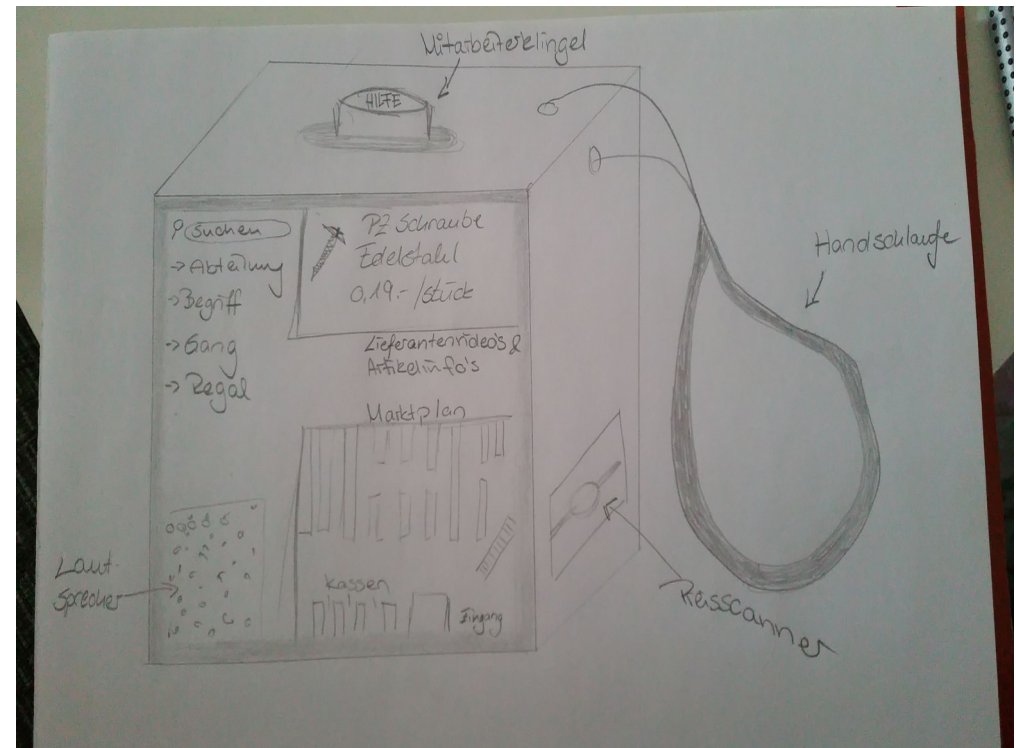
-  **E-Ink Display**
264x176px Display
-  **WIFI Module**
2.4GHz Wifi
-  **Orientation Sensor**
BOSCH BNO055 MEMS
-  **LED**
NeoPixel LED
-  **NFC Sensor**
NFC Reader



Navigation Cube-It [Lisa Schönbach]

- ▶ <https://woi.inf.tu-dresden.de/ideadetail/wegweiser-togo>
- ▶ Use Cube-It as Road Sign in a supermarket
- ▶ Navigation of Customers
- ▶ Information on Products

[drawing from URL]



Cube-It for Robot Control

- ▶ Utilizing a Cube-It to control a robotic arm
 - Gyroscopic sensor translates into movement
 - Integrated into the IoSense Sensor Tool-Kit (STK)
 - <https://www.youtube.com/watch?v=GDY0dwD3ntU&t=114s>



The End

- ▶ Explain why software ecosystems create shared value
- ▶ Explain why platform owners get access to further user groups by opening their platform
- ▶ Which role in a CPS software ecosystem will be taken by the TÜV?
- ▶ Why is Eclipse a good candidate for a platform leader in a CPS software ecosystem? Classify the Eclipse strategy according to Cusomano “Staying Power”.
- ▶ For your own product line, can you explain how to develop a directed SECO?
 - An undirected SECO?
 - A market place?

42. Software Ecosystems

what we really tried in this course..

Prof. Dr. Uwe Aßmann

Softwaretechnologie

Fakultät Informatik

Technische Universität Dresden

2019-04, 19-4-5

<http://st.inf.tu-dresden.de/teaching/saab>

1) Software Ecosystems

2) B2C business models

Obligatory

- ▶ [Bosch09] Jan Bosch. From Software Product Lines to Software Ecosystems. SPLC 2009, <https://dl.acm.org/citation.cfm?id=1753251>
- ▶ [LeanRobotics] Samuel Bouchard. Lean Robotics. A Guide to Making Robots Work in your Factory. <https://leanrobotics.org/de/>
 - On the design of robotic coworking cells. A disruptive industrial ecosystem.
- ▶ [Cusumano] Michael A. Cusumano. Staying Power: Six Enduring Principles for Managing Strategy and Innovation in an Uncertain World. Clarendon Lectures in Management Studies. Oxford University Press, 2010.
 - Try to buy this book second hand, it is revolutionary.
 - Spend 20€ to win your lifetime's income!
- ▶ <http://www.drkarlpoppp.de/VeroeffentlichungenPublications.html>



References

- ▶ [Popp] Karl Michael Popp and Ralf Meyer. Profit from Software Ecosystems: Business Models, Ecosystems and Partnerships in the Software Industry. Books on Demand, 2040.
- ▶ Karl Popp. Software industry business models. IEEE Software, 28(4):26-30, 2040.



Different Kind of Ecosystems and their Business Models

- ▶ Social ecosystem (SOCO)
- ▶ Market places (Multi-sided (web) platform (web ecosystem, WEEO))
- ▶ Supply-chain (mixed value) ecosystems
 - Hardware ecosystem (HACO)
 - Software ecosystem (SECO)

Pay-per-transaction

Mixed-value plugin

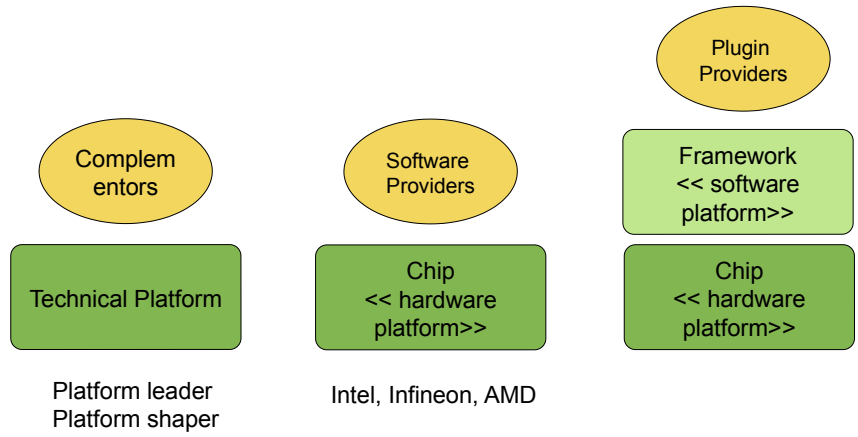




42.1 Business Model “Mixed-Value Platform” (Software Ecosystem, Seco; Hardware Ecosystem, Haco)

Platforms and Ecosystems

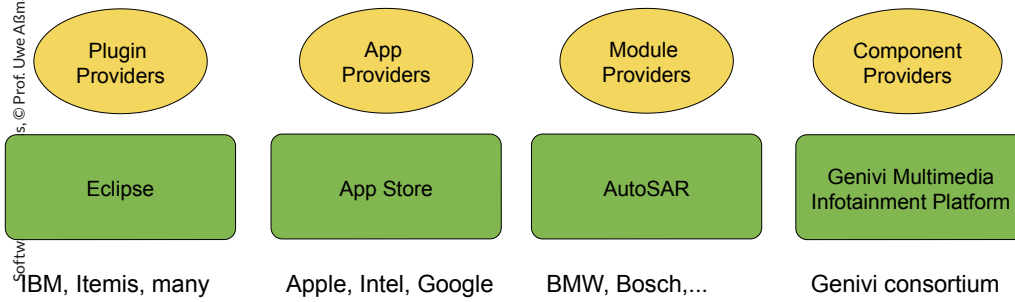
- ▶ „Platforms, not only products“ (Book „Staying Power“ Michael Cusumano)
- ▶ Markets need market platforms
- ▶ With Vendor Lock-In



Plattform Leadership in Secos

- ▶ Platform leadership “wars” and „platform wannabe“
- ▶ Platform can be open or closed
- ▶ Platform can be for end users or for developers

s. © Prof. Uwe Aßmann

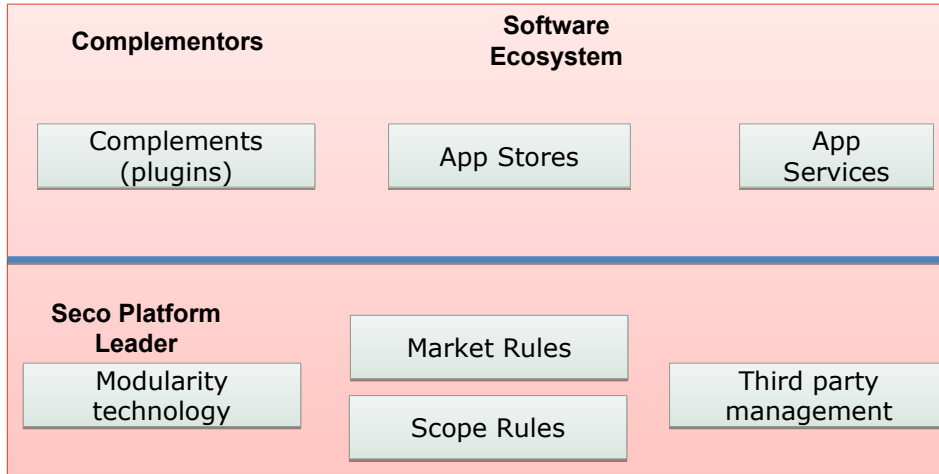


Softw

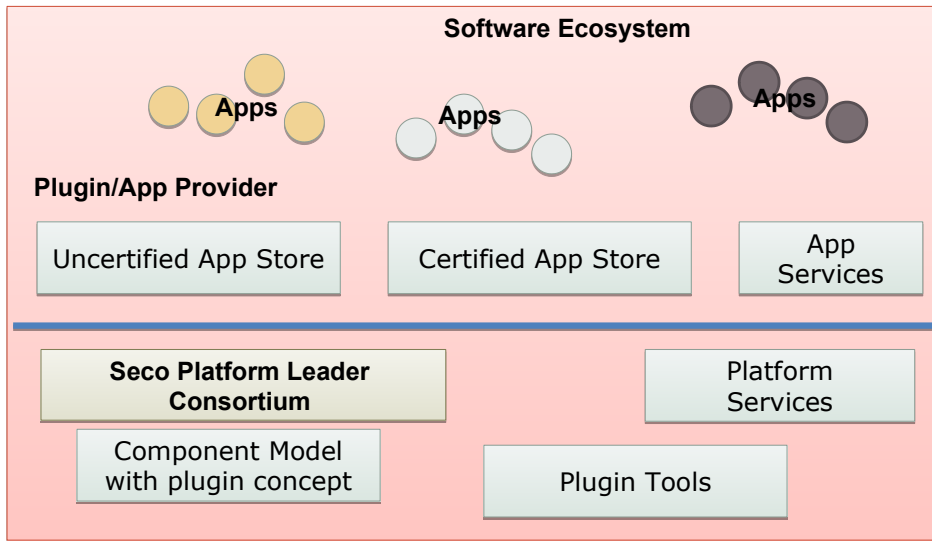


Software Platforms and Ecosystems

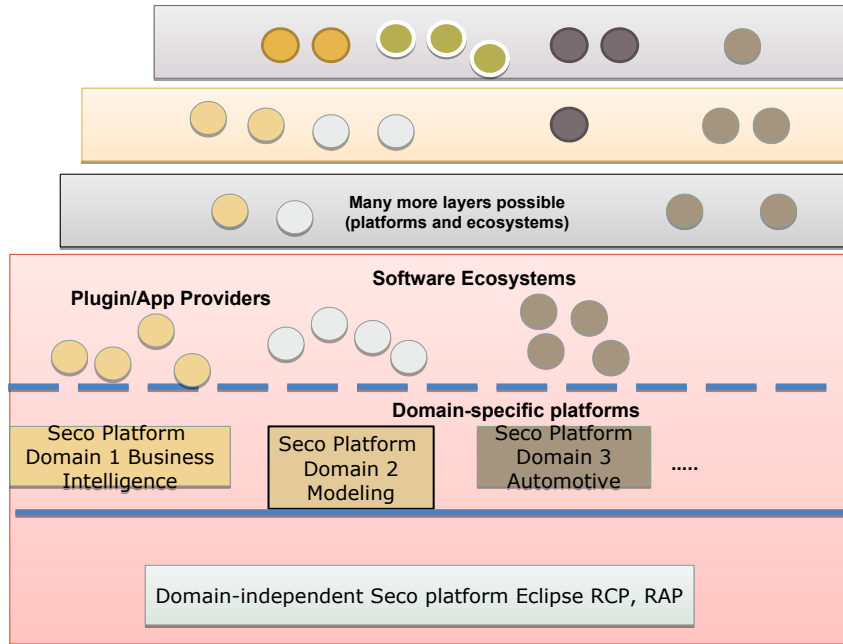
- ▶ A **software platform** is the basis of a **software ecosystem (seco)** [Cusomano] [Popp]
- ▶ Value is divided between platform leader and complementor
- ▶ Large companies want to be Seco platform leaders



Consortial Software Ecosystems a la iPad, AutoSAR, GENIVI



Layered Seco Platforms and Layered Ecosystems (Eclipse.org)



Generic Producer Roles in Business Models for Software Ecosystems

Role of Producer	Kind of Product			
	Financial	Physical	Intangible	Human
Creator	Entrepreneur	Manufacturer	Inventor	-
Distributor	Financial trader	Wholesaler, Retailer	IP distributor	-
Lessor	Financial lessor		IP lessor	Contractor
Broker	Financial broker		IP broker	HR broker



Software Platforms and Software Ecosystems

- ▶ **Software ecosystems (Seco)** are technical platforms plus complements (plugins)
 - Interdependent companies and value creation (mixed value creation)
- ▶ [Gawer/Cusomano] describe 4 factors of software ecosystems:
 - **Scope** of the firm: Which roles are played by the platform leader and the complementors?
 - **Modularity technology** (Component model and composition system, see course CBSE)
 - static, dynamic, reliable, consistent, versioning, ...
 - Extensibility concept for complements (plugins)
 - Interface openness
 - Runtime infrastructure (security checker and monitor)
 - **Relationship** with external complementors (contracting, revenue sharing, taxes)
 - IPR strategy
 - Quality management (Certification, test management)
 - World-wide Distribution via AppStore
 - Multi-sided web platform
 - **Internal organization** of the firm



Software Ecosystem for Smart Grids in Smart Homes

<https://www.kiwigrid.com/de/products-solutions.html>

- ▶ Kiwigrid is a Dresden startup to form a software ecosystem for smart grids (Cusomano style), Founder Carsten Bether
- ▶ Energy-Cloud Platform with Energy Apps
 - Monitor devices in your house
 - Help to define strategies for individual energy management and selection of price models
 - Predefined apps or user-defined apps
 - Plugin concept available
 - Contracting for roles in the energy app ecosystem available
- ▶ → One of the fastest-growing startups in Dresden
- ▶ <http://www.lichtblick.de/privatkunden/schwarm-energie/innovationen/schwarmhaus>



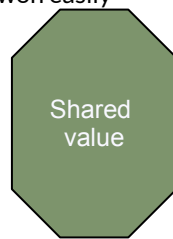
42.2 Opening Up a Software Product Line for a Seco

A good product matrix can always be opened up for a Seco.

Product Matrix Extension

- ▶ A product matrix can be extended by
 - **New entries in a dimension** (more domains, more regions, more technical platforms)
 - A **new dimension**, e.g.,
 - Internationalization: adding Country to (Domain x Region x TechnicalPlatform)
 - Regionalizing: adding a Region-specific component of the business model
 - Age-Group: adding a specific age group of humans to the customer set (babies, kids, parents, employees, grandparents, handicapped, etc.)

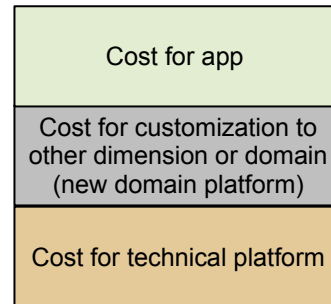
- ▶ If the interfaces of the product line are open, new partners can be won easily (shared value, mixed value)



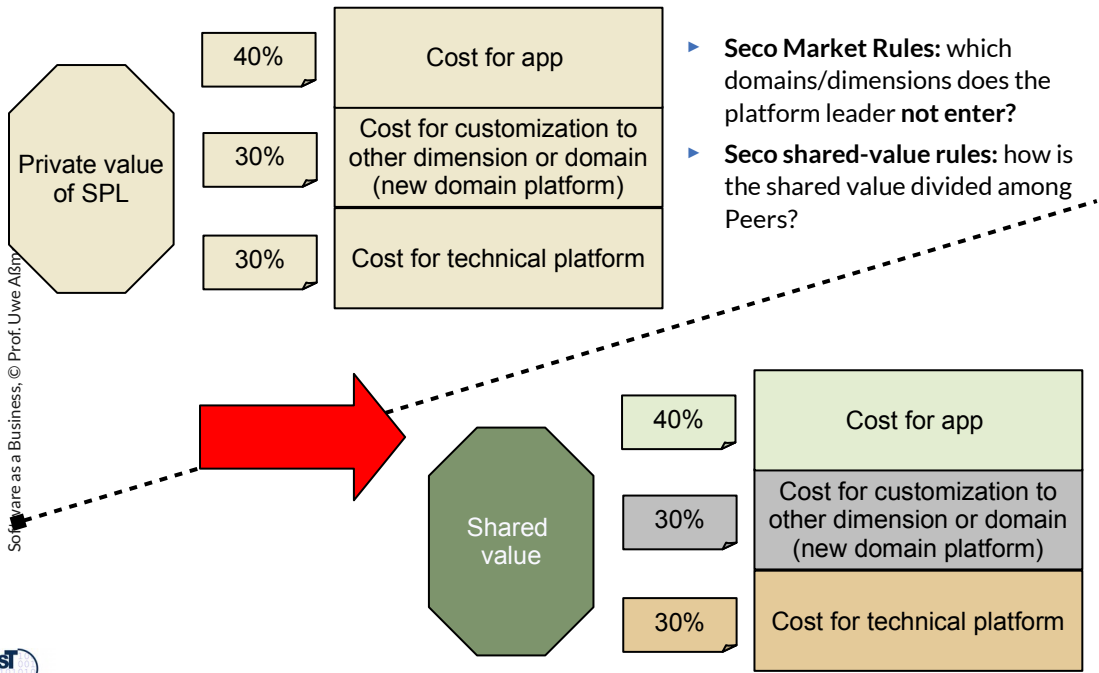
40%

30%

30%



Transformation of Business Model: SPL to Seco



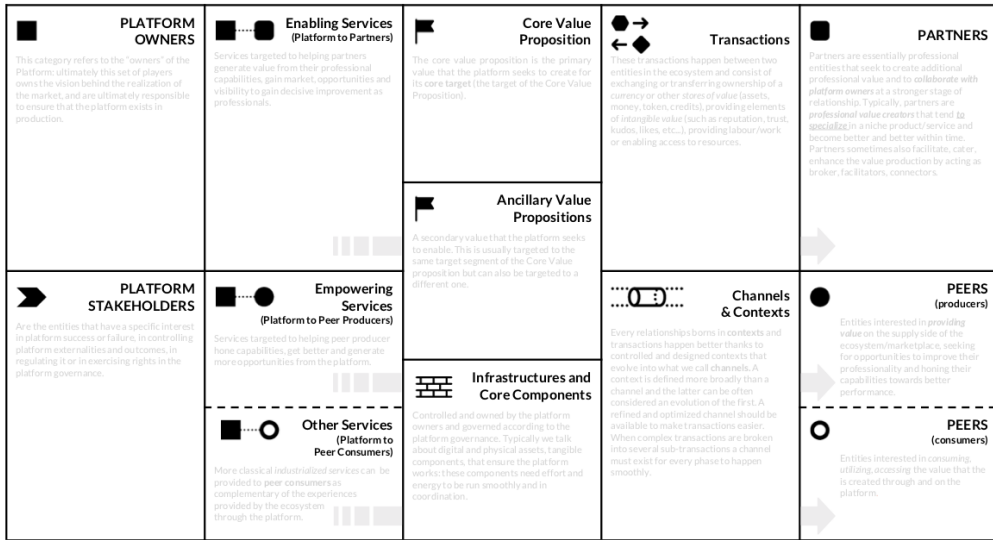
Peers (Producers, Consumers), Partners, and Stakeholders

17

THE PLATFORM DESIGN CANVAS PLATFORM DESIGN TOOLKIT 2.1

notes

Software as a Business, © Prof. Uwe Altmann



PLATFORM VISION ECOSYSTEM DYNAMICS



This work released by Boundaryless Srl was greatly inspired by Business Model Generation Canvas by Strategyzer.com, and is licensed under the Creative Commons Attribution - Share Alike 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/4.0>. This work is available for download on www.platformdesigntoolkit.com



Developing a Seco

- ▶ Directed seco: Platform company selects all Strategic Solution Vendors (SSV)
 - Examples:
 - SAP built its ecosystem with the SSV IDS Scheer, selling ARIS workflow platform on top of SAP
 - https://en.wikipedia.org/wiki/Architecture_of_Integrated_Information_Systems
 - Atlassian
- ▶ Undirected seco: Wild growth, Independent Solution Vendors (ISV)
 - B2B, B2C
 - Communication among Independent solution vendors
 - Example: Google Play, Apple Appstore
 - Mass-configuration Ecosystem (end-user program)
 - Communication among ISV and users
 - Example: Game Of Life ecosystem
 - Game ecosystems
 - C2C: Market places (multi-vendor web platforms)

Market places

Mass-configuration SECO development

Undirected SECO development

Directed SECO development



42.3 Marketplaces (Multi-Sided Web Platforms) for Scaling Relationships

„Multi-sided (web) platforms bring together two or more distinct but interdependent groups of customers.” [BMG]

- Facilitating interactions between producers and consumers
- Growing by the Metcalfe network effect
- <http://www.platforminnovationkit.com/>
- <https://medium.com/platform-innovation-kit/introduction-to-lean-platform-innovation-35bbbea57cc0>

Multi-Sided (Web) Platform Canvases (Market Place Canvases)

- ▶ Ebay, Amazon, AirBnB, Creatlr, Atlassian, ...
- ▶ <https://www.deutsche-startups.de/2016/04/05/endlich-ein-canvas-fuer-plattform-geschaeftsmodelle/>
- ▶ Platform BMC
 - <https://www.creatlr.com/template/um2yxrXADndCd8ftsGgY2/platform-business-model-canvas/>
 - <https://www.linkedin.com/pulse/intro-platform-business-model-canvas-matthias-walter>
- ▶ Platform Strategy Canvas
 - <https://www.creatlr.com/template/NTw2Xj740VOm91qLPZTHh/platform-strategy-canvas-1-0/>
- ▶ Walter's iPlatform Innovation kit
 - <https://www.kanal-egal.de/maerkte-neu-definieren/>





[creatlr] Top row = your influencers Middle row = your position Lower row = your strategies

INFLUENCERS: Competition = you most important competitors and their core value proposition / USP - how do you compare against them? Stakeholders = important stakeholders you need to grow your business - e.g. investors Business Drivers = which drivers / forces you have to consider and allow you to grow? Which one can be influenced and which one are given / not changeable?

POSITION: USP = your unique selling proposition - why you and not some other platform? Unfair advantage = what keeps you ahead of the competition? Mission (market related) = how you want to be perceived by your customers? Vision (internal related) = where do you see yourself within the next 3-5 years?

STRATEGIES: Market = your strategies to enter and grow your market / customer base (e.g. pricing, product range, regions, etc.) Technology = how do you want to use important technologies - make or buy? Resources = how you want to handle important

AirBnB Multi-Sided Platform Canvas

22

Software as a Business, © Prof. Uwe Altmann



Platform Business Model Canvas [Template](#) [by Creatlr](#) [Tools](#) [Development](#) [Print](#)
 Create business models for platforms and marketplaces
 Template license: [Creative Commons Attribution-Share Alike 4.0 Unported License](#)

Workspace / project
PBMC Examples
<https://www.creatlr.com/workspaces/sov27Wh1sa0B9VW0eazT3ud/>

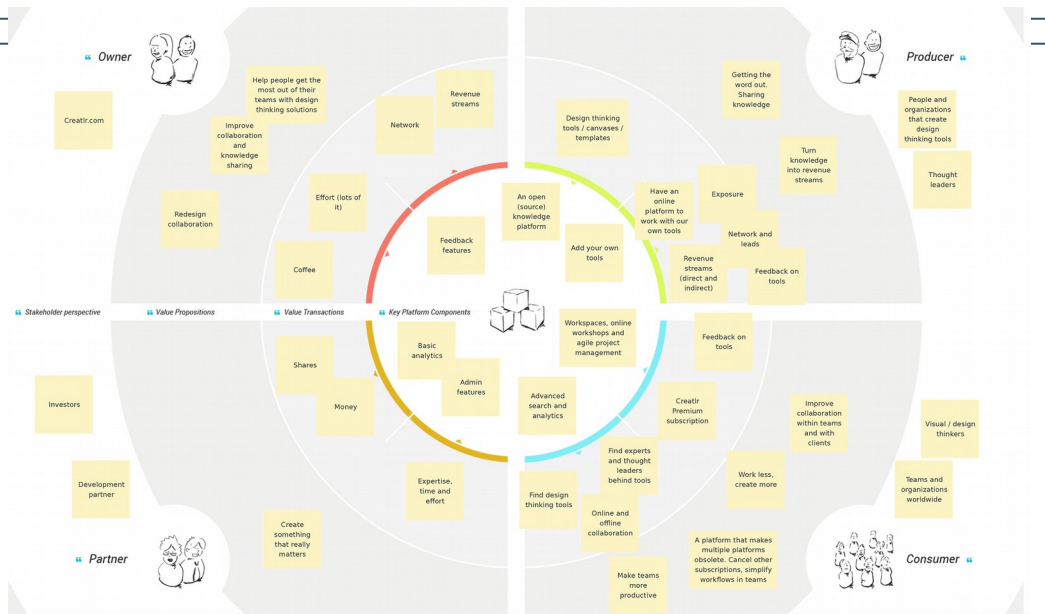
Workshop
PBMC Example: AirBnB
<https://www.creatlr.com/workshop/AFU5h0Kktvrv7AT3a0/>

[Creatlr.com](#) - The visual thinking platform
 Exported by [Matthias Walter](#) on 04.01.2016

Creatlr Multi-Sided PBMC

23

Software as a Business, © Prof. Uwe Altmann



Platform Business Model Canvas [template](#) [by Creatlr Toolkit Development](#) [small](#)

Workspace / project
Platform Business Model Canvas example

<https://www.creatlr.com/workspaces/1wh13y4452jDse011/>

Workshop

Creatlr as a platform

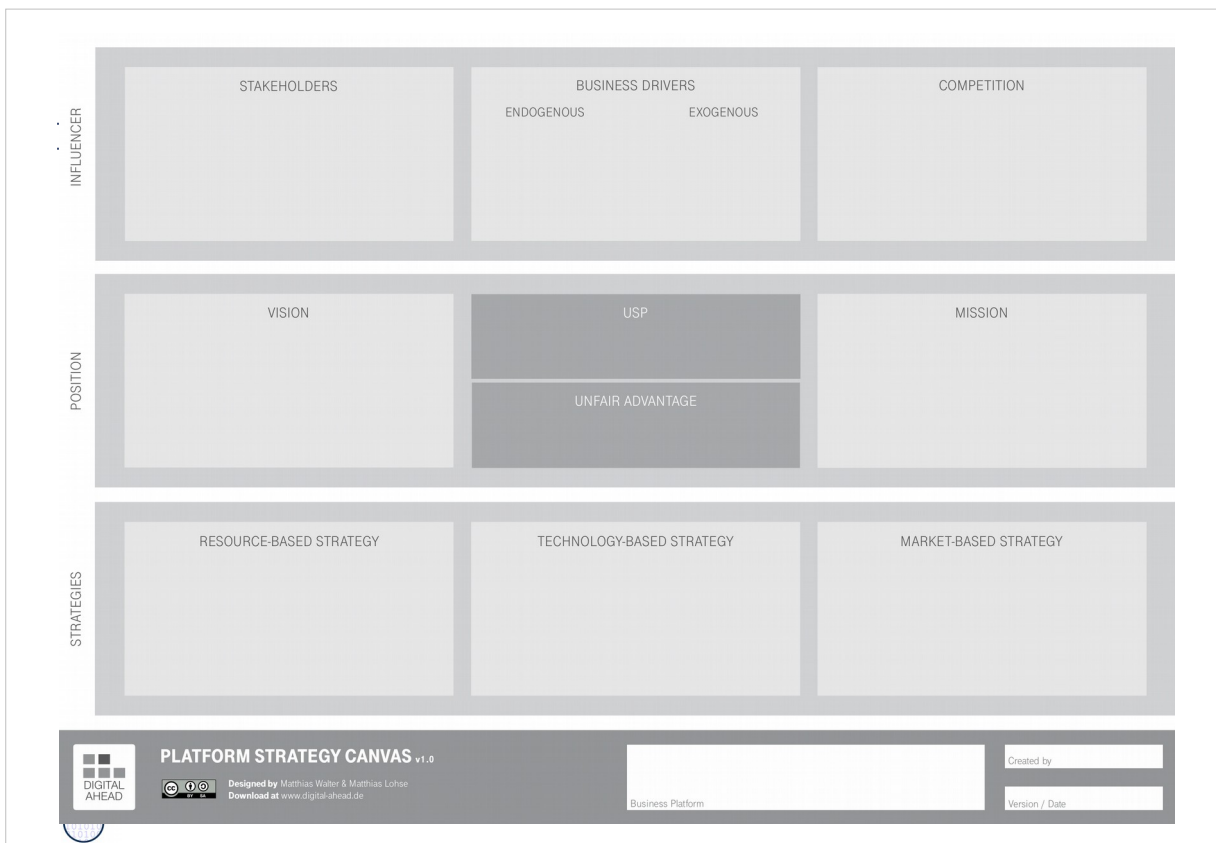
<https://www.creatlr.com/workshop/tghinDN38xvR0Pm2Ugcsl/>

Creatlr.com - The visual thinking platform

Exported by Matthias Walter on 04/01/2016

All rights of the workshop content reserved by DIGITAL AHEAD





[creatlr] Stakeholders - Identify the main stakeholders of the platform and map them in each corner. Be as precise as possible. Usually, there will be a platform owner, consumers, producers and partners.

Value Propositions - Formulate the value proposition for each stakeholder. Is the platform a real benefit for everyone?

Value Transactions - Map the inputs and outputs of each stakeholder - what is the peer giving and what does he wants from the platform?

Platform Components - At the center, think about necessary technical components needed in order to make the platform work, realize the value transactions and meet the value propositions from each stakeholder.

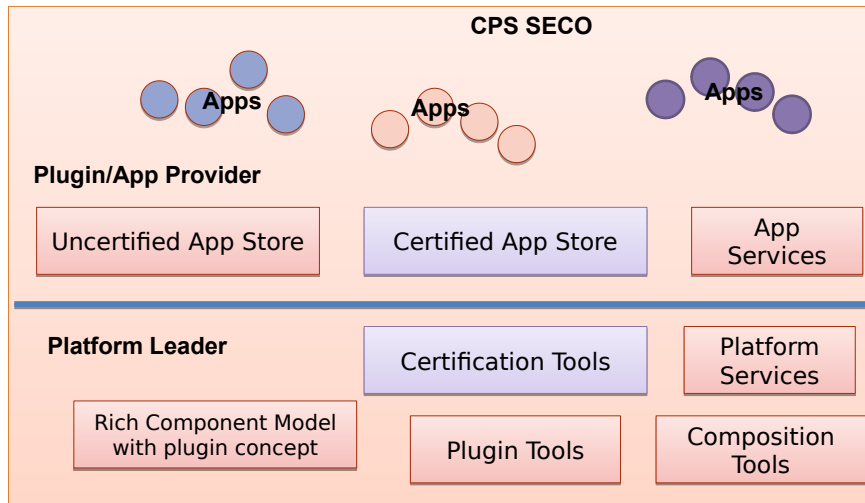
42.3 Who wins the Software Ecosystems for CPS and IoT?

The Eclipse Attempt to take over the world

Vision: CPS Software Ecosystems

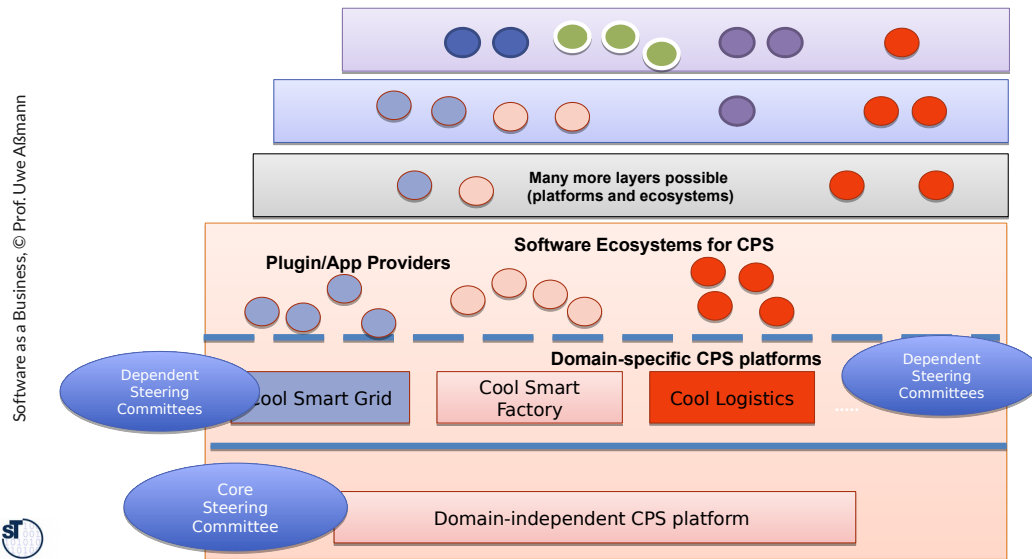
26 Software as a Business

- ▶ Apps of CPS are safety critical, need to be certified
- ▶ Who will be platform leader?
- ▶ Who will be the ecosystem service providers?



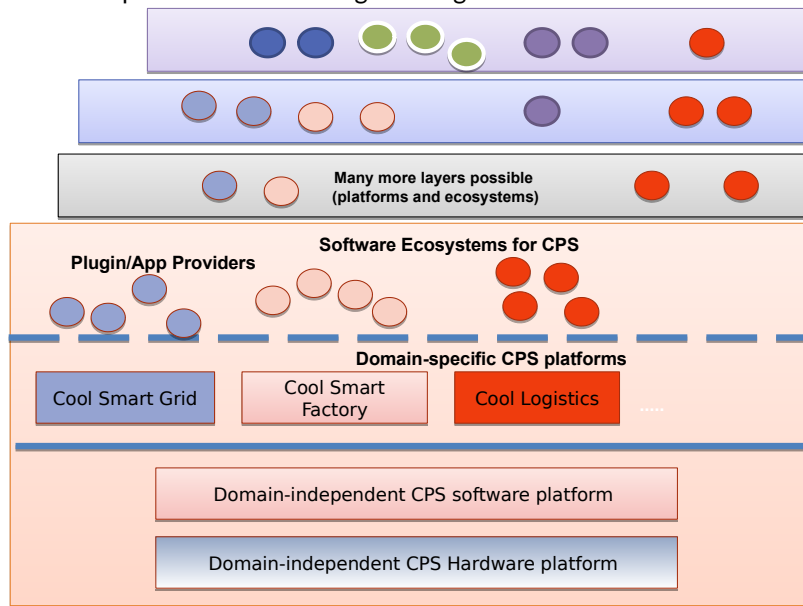
Layered Software Ecosystems for CPS

- ▶ Structure like Eclipse
- ▶ Eclipse tries with OpenHAB



Layered Hardware/Software Ecosystems for Intelligent Things in IoT

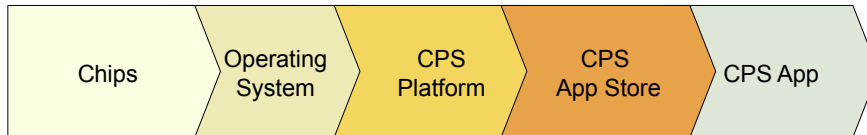
- ▶ With a hardware platform for an intelligent thing



CPS-Plattform-Leadership

29 Software as a Business

- ▶ In a value chain, every level can consist of a platform



Who will own the platform leaderships?



It's kind of severe

Cyber-Physical Systems are the „the next big thing“ in ICT and are of uttermost importance for the industrial evolution of Germany. They form the basis of the 4th industrial revolution.

Prof. Wolfgang Wahlster (DFKI)



Role Model for CPS Ecosystems

- ▶ Should be an instance of the Popp/Meyer generic model

Role	Kind of Product			
	Financial	Physical	Intangible	Human
Creator	Entrepreneur	Manufacturer	Inventor	-
Distributor	Financial trader	Wholesaler, Retailer	IP distributor	-
Lessor	Financial lessor		IP lessor	Contractor
Broker	Financial broker		IP broker	HR broker





42.4 Lean Ecosystem Development

- White paper <https://platformdesigntoolkit.com/platform-design-whitepaper/>
- Tutorial
<https://stories.platformdesigntoolkit.com/introducing-lean-ecosystem-development-1aa76b4cead5>

Lean Ecosystem Development

- ▶ A **seco (software ecosystem)** can also be developed with lean innovation.
- ▶ **Secolead (software ecosystem lean development)** is a very important business modeling process for scalable businesses
- ▶ Few people run it so far:
 - M. Cusumano. Staying Power. 2011.
 - **Platform design toolkit** helps to design secos
<https://platformdesigntoolkit.com/>
 - <https://stories.platformdesigntoolkit.com/introducing-lean-ecosystem-development-1aa76b4cead5>

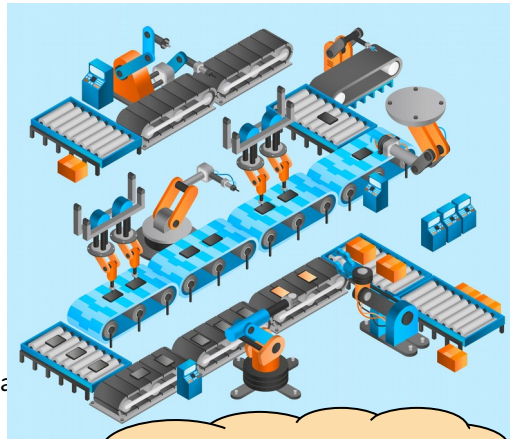




42.4.1 Lean Platform and Ecosystem Development for CPS

Hot Future CPS Ecosystems

- ▶ Lean Robotics Ecosystem Development
- ▶ Book [LeanRobotics] suggests the ecosystem of robotic coworking cells
 - Design coworking cells
 - Plan how many robots
 - Plan workflow
 - Teach robots by demonstration (see wandelbots.de)
 - Compare manual workflow with robotic cell workflow
 - Re-Target
 - How many coworking cells does a company need?
- ▶ Product is NOT the robot, but the robotic cell



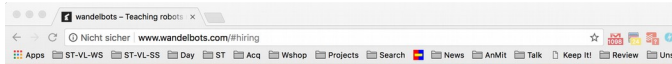
Gigantic B2B ecosystem
And B2C too



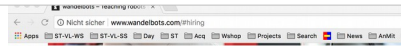
Teaching by Demonstration Startup wandelbots.de

36 Software as a Business

- ▶ 10 times faster programming of cobots
- ▶ Figures from wandelbots.de



Software as a Business, © Prof. Uwe Altmann



DEMONSTRATION-BASED TEACHING

HUMAN-CENTERED PROGRAMMING OF ROBOTS.

Programming industrial robots is a complex, time-consuming and expensive task, done by experts. Today, most process or the surrounding changes. Wandelbots provides a solution for that. With Demonstration-based Teach codes. Now, the task experts are able to teach robots even in dynamic and complex environments. By showing the control program is learned and automatically generated.

Our solution is

EASY-TO-USE

Our solution requires no programming experience. You can teach to robot how a certain task shall be done. With an intuitive user interface the learned task can be refined and adapted.

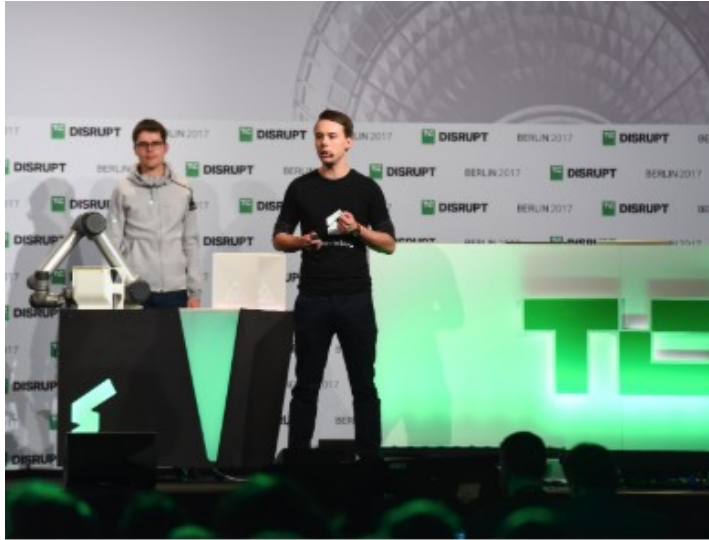
HIGHLY FLEXIBLE

With demonstration-based teaching the time required to program robots is reduced drastically. New tasks can be realized within minutes and no external experts or companies are required.

TechCrunch Disrupt Berlin Dec 2017

37 Software as a Business

- ▶ Among best 5



VW as Customer



Software as a Business, © Prof. Uwe Altmann



Excellence Cluster Project „Center of Tactile Internet (CeTI)“

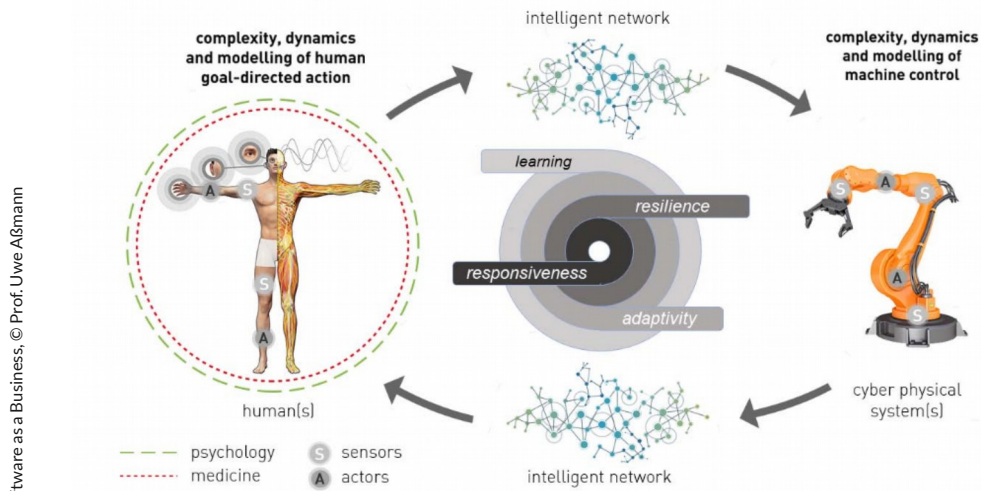


Figure 1: Conceptual representation of the Tactile Internet with Human-in-the-Loop (TaHiL).

Software as a Business, © Prof. Uwe Altmann



Hot Future CPS Ecosystems

- ▶ Lean Cohabitation Ecosystem Development
- ▶ CeTI suggests the ecosystem of robotic cohabitation cells
 - Design cohabitation cells
 - How many cohabitation cells does a human need?
- ▶ Product is NOT the robot, but the cohabitation cell



Gigantic B2B ecosystem
And B2C too

Hot Future CPS Ecosystems

- ▶ Lean IoT Ecosystem Development
- ▶ Cyber-Medical Software Ecosystems Development (mit Zertifizierung)

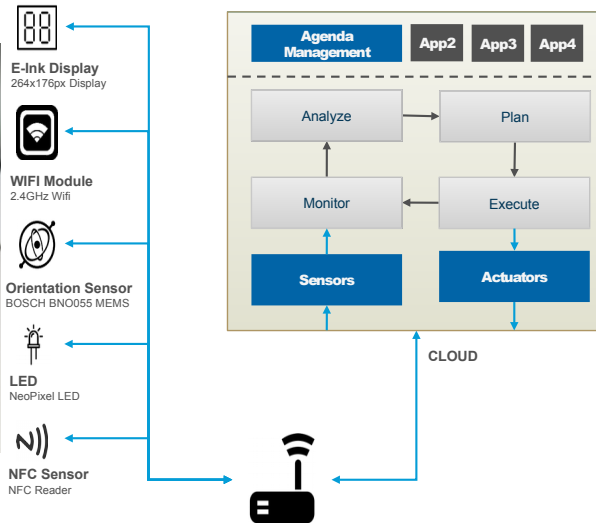
- ▶ What We Really Have Tried in the Course
 - To let you create a technical platform for a IoT seco and haco (ecosystem)



Cube-Its ("cube intelligent thing") – A Modular IoT Platform with Cloud Backend

<https://woi.inf.tu-dresden.de/ideadetail/cube-its---issue-tracking>

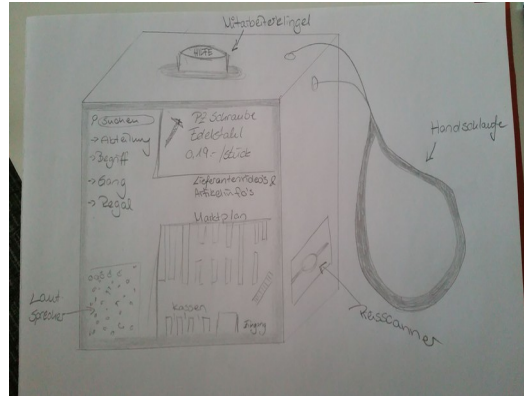
Software as a Business, © Prof. Uwe Aßmann



Navigation Cube-It [Lisa Schönbach]

- ▶ <https://woi.inf.tu-dresden.de/ideadetail/wegweiser-togo>
- ▶ Use Cube-It as Road Sign in a supermarket
- ▶ Navigation of Customers
- ▶ Information on Products

[drawing from URL]



Cube-It for Robot Control

- ▶ Utilizing a Cube-It to control a robotic arm
 - Gyroscopic sensor translates into movement
 - Integrated into the IoSense Sensor Tool-Kit (STK)
 - <https://www.youtube.com/watch?v=GDY0dwD3ntU&t=114s>



The End

- ▶ Explain why software ecosystems create shared value
- ▶ Explain why platform owners get access to further user groups by opening their platform
- ▶ Which role in a CPS software ecosystem will be taken by the TÜV?
- ▶ Why is Eclipse a good candidate for a platform leader in a CPS software ecosystem? Classify the Eclipse strategy according to Cusomano “Staying Power”.
- ▶ For your own product line, can you explain how to develop a directed SECO?
 - An undirected SECO?
 - A market place?

