Today’s session will be recorded.

An archive of today’s talk will be available at: www.sercuarc.org/serc-talks/

Use the Q&A box to queue questions, reserving the chat box for comments, and questions will be answered during the last 5-10 minutes of the session.

If you are connected via the dial-in information only, please email questions or comments to Ms. Mimi Marcus at mmarcus@stevens.edu.

Any issues? Use the chat feature for any technical difficulties or other comments, or email Ms. Mimi Marcus at mmarcus@stevens.edu.
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Speed, Data and Ecosystems:
How to Excel in a Software-Driven World?

Jan Bosch
Director Software Center
www.software-center.se
Professor of Software Engineering
Chalmers University of Technology
Gothenburg, Sweden.
www.janbosch.com
52% of the Fortune 500 firms since 2000 are gone
Disruption Is The New Normal

• Jim Collins (Built to last): Companies last, on average, 30 15 10 years on the Fortune 500 list. And that time period is decreasing

• Main cause: Companies fail to innovate and to build new core capabilities

Digitalization Is The New Disruptor!
Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.

- Gartner
Digitalization

The Strategic Building Blocks of Digital Transformation

<table>
<thead>
<tr>
<th>Digital and data-driven offerings and business models</th>
<th>Digitally enhanced products</th>
<th>Data-driven services</th>
<th>Digital services</th>
<th>Software products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digitization of core business</td>
<td>Sales, channels, and marketing</td>
<td>Research and development</td>
<td>Manufacturing and supply chain management</td>
<td>HR, finance, and support</td>
</tr>
<tr>
<td>Digital capabilities</td>
<td>Agile organization, IT, and development</td>
<td>Systems and technology platforms</td>
<td>Analytics and data integration</td>
<td>Digital partner ecosystem</td>
</tr>
</tbody>
</table>

Digital transformation accelerators

| Start-up incubation, venture capital, and prototyping | Lighthouses and bold M&A moves | Digital redesign process by process | Digital program and change management |
Three Key Take-Aways

• Increasing **SPEED** trumps ANY other improvement R&D can provide to the company – the goal is **continuous deployment** of new functionality

• Effective use of **DATA** from customers and products as well as the **ECOSYSTEMS** around your systems and services in the field are the next areas to exploit and monetize

• We are moving towards a new business operating mechanism focused on **EMPOWERMENT** and **autonomy**
Overview

• Vem är jag? Wie ben ik? Who am I?

• Trends in Industry: Need for Speed
• Towards a New Business Operating System
  – Speed
  – Data
  – Ecosystems
  – Empowerment

• Conclusion
Software Center

Mission: Improve the digitalization capability of the European Software-Intensive industry with an order of magnitude

Theme: Fast, continuous deployment of customer value

Success: Academic excellence
Success: Industrial impact
Research Themes

Application Domain Themes
- Autonomous Systems
- Internet of Things
- System of Systems

Technology Themes
- Continuous Delivery
- Continuous Architecture
- Metrics
- Customer Data and Ecosystems

Shared public/partner funding
- WASP
- IOTAP

Predominantly partner funding
- System of Systems
- Customer Data and Ecosystems
Some Online Companies

- Booking.com
- Spotify
- Rovio
- Klarna
- King
- Microsoft
Overview

• Vem är jag? Wie ben ik? Who am I?

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  – Speed
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• Conclusion
Gartner 2017 Technology Hype Cycle

Note: PaaS = platform as a service; UAVs = unmanned aerial vehicles
Wildly combinatorial streams of digital transformation
"We want Google to be the third half of your brain."
Sergey Brin
Deep Learning
Software Drives Everything

Self-Driving Cars
Gripen Drone
Robots
3D Cement Printing
The Cycle of Innovation

LEARN

Ideas

Data

BUILD

Product

MEASURE
Length of Innovation Cycle

Car Platform: 10-15 years
Length of Innovation Cycle

Car: 3-4 years
Length of Innovation Cycle

Car Software: 1-5 days
10x every ~7 years
Volvo XC 90

Downloadable SW Size

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.
Data Generated in the World

50 Terabytes of data are created every second
EVERY MINUTE OF THE DAY

- Pinterest: Users pin 3,472 images.
- Vine: Users share 8,333 videos.
- Youtube: Users upload 72 hours of new video.
- Email: Users send 204,000,000 messages.
- Google: Receives over 4,000,000 search queries.
- Facebook: Users share 2,460,000 pieces of content.
- Tinder: Users swipe 416,667 times.
- Yelp: Users post 26,380 reviews.
- Apple: Users download 48,000 apps.
- Pandora: Users listen to 61,141 hours of music.
- Amazon: Makes $83,000 in online sales.
- Instagram: Users post 216,000 new photos.
- Twitter: Users tweet 277,000 times.

The global internet population grew 14.3% from 2011-2013 and now represents 2.4 billion people.
Trend: Need for Speed

Value Creation Shifts

Emerging companies highlight importance of user contribution and social connectedness

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1M users</td>
<td>~6 years</td>
<td>30 months</td>
<td>10 months</td>
<td>?</td>
</tr>
<tr>
<td>50M users</td>
<td>N/A</td>
<td>~80 months</td>
<td>~44 months</td>
<td>~1 month</td>
</tr>
</tbody>
</table>
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
Overview

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• **Trends in Industry: Need for Speed**
  • Towards a New Business Operating System
    – Speed
    – Data
    – Ecosystems
    – Empowerment
• **Conclusion**
**3LPM: Three Layer Product Model**

- **Innovation and experimentation layer** (optimize for maximum number of experiments)
- **Ecosystem partners**
  - Challenges
    - Over time, products lose competitiveness
    - Platform becomes competitive disadvantage
- **New-product transition interface**
- **Differentiating functionality layer** (optimize for maximum customer value)
- **Commoditizing transition interface**
- **Commoditized functionality layer** (optimize for minimizing total cost of ownership)

**Characteristics**
- Each layer releases independently
- Each layer optimizes different metrics
- R&D efforts focus on highly differentiating functionality
How do I expand my innovation funnel?

How do I deliver innovations to market faster?

How do I know that what I'm building provides value to customers?

How do I identify commoditization of functionality?

How do I minimize total cost of ownership for commodity functionality?
A New Business Operating System

- Business agility
- Data
- Empowerment
- Ecosystem

- Instrument and measure
- Focus on differentiation
- Empower teams
- Speed
Stairway to Heaven: Speed

- Traditional Development
- R&D Organization All Agile
- Continuous Integration
- Continuous Deployment
- R&D as an Innovation System

- Sales & mrkt
- Prod. mgmt.
- Cust. Sup.
- Cust. sup.
- Release
- Release
- V&V
- V&V
- R&D teams
- R&D teams
- R&D teams
- R&D teams
Feedback Cycles

- Development cycle
- Requirements cycle
- Quality assurance cycle
- Governance cycle
- Deployment cycle
- Value creation cycle
# Feedback Cycles and Speed

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Agile</th>
<th>CI</th>
<th>CD</th>
<th>Inno System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development</td>
<td>Long</td>
<td>Sprint</td>
<td>Sprint</td>
<td>Sprint</td>
<td>Sprint</td>
</tr>
<tr>
<td>Requirements</td>
<td>Long</td>
<td>Sprint</td>
<td>Sprint</td>
<td>Sprint</td>
<td>Sprint</td>
</tr>
<tr>
<td>Quality assurance</td>
<td>Long</td>
<td>Long</td>
<td>Sprint (internal)</td>
<td>Sprint (external)</td>
<td>Sprint (external)</td>
</tr>
<tr>
<td>Governance</td>
<td>Long</td>
<td>Long</td>
<td>Sprint</td>
<td>Sprint</td>
<td>Sprint</td>
</tr>
<tr>
<td>Deployment</td>
<td>Long</td>
<td>Long</td>
<td>Long</td>
<td>Sprint</td>
<td>Sprint</td>
</tr>
<tr>
<td>Value creation</td>
<td>Long</td>
<td>Long</td>
<td>Long</td>
<td>Long</td>
<td>Sprint</td>
</tr>
</tbody>
</table>

**Slow:** opinion-based; sprint: data-driven
Dependencies

Unawareness

Duplication - reuse

Repeated wrapping

Contagious ATD

Big deliveries involving many developers

Quality issues

Hidden ATD

“Double” effort

Non-completed refactoring

Wrong estimation of effort

Time pressure

Confusion

Lack of familiarity and experience

New code

Adaptation of existing code

Testing

Bug Fixing

Finding hidden problems

Duplicated activities

Non uniformity - Policies

Temporal properties - behavior

Non identified non-functional requirements

ATD Quality issues

Hidden ATD

PHENOMENA (EFFECTS)

CAUSES

CLASSES OF ATD

EXTRA-ACTIVITIES

Visualizing Continuous Integration And Test

Customer

Release

Full Product

Partial Product

Subsystem

Component

Once /release  Month  Week  Day  Hour  Immediate/Minutes

SERC Talks  February 7, 2018
Continuous Delivery Model

requests for new functionality

Feature backlog

governance team

team
	single code base

Automated product derivation

Product 1

Product 2

Product 3

Product n

product configuration files

architect team

Refactoring & runway backlog

defect backlog

continuous integration environment
Stairway to Heaven: Data

<table>
<thead>
<tr>
<th></th>
<th>Collection</th>
<th>Analysis</th>
<th>Reporting</th>
<th>Decision making</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad-hoc</td>
<td>manual</td>
<td>manual</td>
<td>manual</td>
<td>manual</td>
</tr>
<tr>
<td>Collection</td>
<td>automated</td>
<td>manual</td>
<td>manual</td>
<td>manual</td>
</tr>
<tr>
<td>Automation</td>
<td>automated</td>
<td>automated</td>
<td>automated</td>
<td>supported</td>
</tr>
<tr>
<td>Data innovation</td>
<td>dynamic</td>
<td>dynamic</td>
<td>dynamic</td>
<td>supported</td>
</tr>
<tr>
<td>Evidence-based company</td>
<td>dynamic</td>
<td>dynamic</td>
<td>dynamic</td>
<td>automated</td>
</tr>
</tbody>
</table>
“In god we trust, all others must bring data”

- W. Edwards Deming
“Featuritis”

Features / Functions Used in a Typical System

- **Often / Always Used:** 20%
  - Sometimes: 16%
  - Always: 7%
- **Rarely / Never Used:** 64%
  - Rarely: 19%
  - Never: 45%

Standish Group Study Reported at XP2002 by Jim Johnson, Chairman
Our Research ...

![Bar chart showing service starts vs. services](chart.png)
The HYPEX Model

- **Business strategy and goals**
  - Strategic product goal

- **Feature: expected behavior (B_{exp})**
  - B_{exp}
  - Gap analysis
    - no gap (B_{act} = B_{exp})
    - relevant gap (B_{act} ≠ B_{exp})

- **Gap analysis**

- **Develop hypotheses**

- **Experimentation**
  - actual behavior (B_{act})
  - implement MVF
  - implement alternative MVF
  - extend MVF
  - abandon

- **Product**

- **Feature backlog**
  - generate
  - select
  - implement MVF
  - abandon
## Stairway to Heaven: Ecosystems

<table>
<thead>
<tr>
<th>Levels</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internally focused</td>
<td>do everything in-house unless it is really impossible</td>
</tr>
<tr>
<td>Ad-hoc ecosystem engagement</td>
<td>individuals take ad-hoc decisions to engage with ecosystem partners, but local optimization</td>
</tr>
<tr>
<td>Tactical ecosystem engagement</td>
<td>ecosystem engagement is centralized, but driven by tactical (rather than strategic) considerations</td>
</tr>
<tr>
<td>Strategic single ecosystem management</td>
<td>one of the ecosystem types is managed strategically</td>
</tr>
<tr>
<td>Strategic multi-ecosystem management</td>
<td>all three types (I, D, C) are managed strategically</td>
</tr>
</tbody>
</table>
3LPM: Three Layer Product Model

What % of R&D for Commodity?
Ecosystem Drivers | Ecosystem Type | Ecosystem Characteristics
---|---|---
External | **Innovation ecosystem**
- **Who:** Customers, 3rd party developers, suppliers
- **What:** Development of new functionality
- **Why:** Share/minimize innovation costs/risks
- **When:** High market uncertainty
- **How:** Open innovation, co-opetition, partnerships
- **Mechanisms:** Product platforming, idea competitions, customer involvement, collaborative design, innovation networks etc.

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

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

  - **Characteristics:**
    - Collaborative
    - Internal
    - Exploratory
    - Risk prone
    - Less control-driven

  - **Characteristics:**
    - Competitive
    - Internal
    - Efficient
    - Risk averse
    - Control-driven

  - **Characteristics:**
    - Collaborative
    - Internal/external
    - Cost-efficient
    - Risk averse
    - Less control-driven
TeLESM: Three Layer Ecosystem Strategy Model

Innovation ecosystem

- **internal**: Me-Myself-I Strategy, Be-My-Friend Strategy
- **external**: Copy-Cat Strategy, Cherry-Picking Strategy, Orchestration Strategy, Supplier Strategy, Preferred Partner Strategy, Acquisition Strategy

Differentiating ecosystem

- **internal**: Increase Control Strategy, Incremental Change Strategy, Radical Change Strategy
- **collaborative**: Complementing Strategy
- **external**: Platform Control Strategy

Commoditizing ecosystem

- **internal**: Rationalized in-sourcing, Push-Out Strategy
- **collaborative**: OSS Creation Strategy, Partnership Strategy, OEM partnerships
- **external**: COTS Adoption Strategy, OSS Integration Strategy, Outsourcing
company hierarchy:

- sociopaths
- clueless
- losers

@gapingvoid
## Empowered Organizations

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Agile</th>
<th>Cross-functional</th>
<th>Self-managed</th>
<th>Empowered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>Hierarchical</td>
<td>Hierarchical</td>
<td>Hierarchical</td>
<td>Hierarchical</td>
<td>Empowered</td>
</tr>
<tr>
<td>General Mgmt.</td>
<td>Hierarchical</td>
<td>Hierarchical</td>
<td>Hierarchical</td>
<td>Empowered</td>
<td>Empowered</td>
</tr>
<tr>
<td>Inter-team (PdM/R&amp;D)</td>
<td>Hierarchical</td>
<td>Hierarchical</td>
<td>Empowered</td>
<td>Empowered</td>
<td>Empowered</td>
</tr>
<tr>
<td>Local (R&amp;D)</td>
<td>Hierarchical</td>
<td>Empowered</td>
<td>Empowered</td>
<td>Empowered</td>
<td>Empowered</td>
</tr>
</tbody>
</table>
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
### Employee Engagement

**Sweden (2013)**
- Engaged: 16%
- Not engaged: 73%
- Actively disengaged: 11%

### U.S. Employee Engagement, 2013 vs. 2014

<table>
<thead>
<tr>
<th>% Employees</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engaged</td>
<td>29.6</td>
<td>31.5</td>
</tr>
<tr>
<td>Not engaged</td>
<td>51.5</td>
<td>51.0</td>
</tr>
<tr>
<td>Actively disengaged</td>
<td>18.8</td>
<td>17.5</td>
</tr>
</tbody>
</table>

**GALLUP**

### U.S. Employee Engagement, by Generation

<table>
<thead>
<tr>
<th>% Employees engaged</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millennials</td>
<td>27.5</td>
<td>28.9</td>
</tr>
<tr>
<td>Generation X</td>
<td>29.6</td>
<td>32.2</td>
</tr>
<tr>
<td>Baby boomers</td>
<td>30.9</td>
<td>32.7</td>
</tr>
<tr>
<td>Traditionalists</td>
<td>38.3</td>
<td>42.2</td>
</tr>
</tbody>
</table>

**GALLUP**

Gallup uppskattar att oengagerade medarbetare kostar USA varje minst 450 miljarder dollar varje år. Tyskland går miste om minst 151 miljarder och Storbritannien 83 miljarder.
Empowerment: 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
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
Examples

- Agile software development
- Holistic organizations
- Holacracy
- Exponential organizations
Empowerment

- **Principles** over *Orders*
- **Personal leadership** over *Leader – Follower*
- **Trust** over *Audits*
- **Customer first** over *Organization structure first*
- **Team appointed managers** over *Manager appointed teams*
- **Diversity** over *Homogeneity*
- **Agility** over *Long-term planning*
- **Emergent strategy** over *Top-down strategy*
Overview

• Vem är jag? Wie ben ik? Who am I?
• Trends in Industry: Need for Speed
• Towards a New Business Operating System
  – Speed
  – Data
  – Ecosystems
  – Empowerment

• Conclusion
“In the future, all companies will be software companies”

George F. Colony (CEO Forrester Research)
Speed

• Increasing **SPEED** trumps ANY other improvement R&D can provide to the company – the goal is **continuous deployment** of new functionality

• If you’re not a front-line engineer, there is only ONE measure that justifies your existence: how have you helped teams move faster?
• Don’t optimize efficiency, optimize speed
Data-Driven Development

Business strategy and goals → Strategic product goal

Feature: expected behavior ($B_{exp}$)

Gap analysis:
- Relevant gap ($B_{act} \neq B_{exp}$)
- No gap ($B_{act} = B_{exp}$)

Develop hypotheses:
- Implement MVF
- Implement alternative MVF
- Extend MVF
- Abandon

Experimentionation

Product

Feature backlog

generate

select

Implement MVF

actual behavior ($B_{act}$)
Software Ecosystems

**Ecosystem Drivers**

External
Internal

**Ecosystem Type**

**Innovation ecosystem**
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**Ecosystem Characteristics**

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

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

**Functionality transfer**
Empowered Organizations

- We are moving towards a new business operating mechanism focused on *empowerment* and *autonomy*
- Teams and individuals employ local decision making, peer-to-peer alignment, choose their own leaders and innovate and improve constantly
Interested In Learning More?

Speed, Data, and Ecosystems
Excelling in a Software-Driven World

Using Data to Build Better Products
A Hands-On Guide to Working with Data in R&D - The Basics

How to double your R&D EFFECTIVENESS

(draft, upcoming)
Upcoming Events
16th Annual Conference on Systems Engineering Research

Hosted by: UNIVERSITY OF VIRGINIA, School of Engineering and Applied Science Department of Systems and Information Engineering

May 8 & 9, 2018

- Theme: “Systems in Context”
- Key Dates:
  - Paper Submission: **February 9, 2018**
  - Paper Notification: March 16, 2018
  - Final Paper Submission Due: April 13, 2018
  - Conference Registration Opens: February 1, 2018
    - Direct link to registration web page: [http://edas.info/r24260](http://edas.info/r24260)
- POCs:
  - Peter A. Beling: pb3a@virginia.edu
  - William T. Scherer: wts@virginia.edu
  - Cody H. Fleming: fleming@virginia.edu
- Venue: Boar’s Head Resort
  - Reserve rooms by phone at (866) 996-7504 (referencing CSER 2018) or online at this link.
- For more information visit: [https://cser2018.com/](https://cser2018.com/)
UPCOMING TALKS:

“Successfully Applying Agile Methods for High-Criticality Systems” Series

Robin Yeman, Lockheed Martin Fellow, Lockheed Martin (LM) Information Systems and Global Solution, Agile/DevOpSec SME

April 4 | 1:00 PM ET

How Do You Use Agile Methods on Highly-Critical Systems that Require Earned Value Management?

Phyllis Marbach, INCOSE LA Chapter President; Senior Software Engineer at Boeing – Retired

June 6 | 1:00 PM ET | REGISTER NOW

Please visit the SERC Talks page for more information and updates.
UPCOMING 2018 TALKS:

“Engineering System Software Qualities” Series

Talk Dates:
August 1, 2018 | 1:00 PM ET
October 3, 2018 | 1:00 PM ET
December 5, 2018 | 1:00 PM ET

CONTACT
Editor-in-Chief: Dr. Barry Boehm, University of Southern California – boehm@usc.edu
Webinar Coordinator: Ms. Mimi Marcus, Stevens Institute of Technology – mmarcus@stevens.edu

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Please check back on the SERC website for today’s recording and future SERC Talks information!