Software Center

SOFTWARE CENTER ANNUAL REPORT 2020

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Software Center 2020

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Blogs

Jan Bosch: http://janbosch.com/blog/

Metrics: http://metrics.blogg.gu.se/

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Jan Bosch,
Director of Software Center
Department of Computer Science and Engineering,
Chalmers/University of Gothenburg

End of year message 2020

The last year 2020 will go into the annals of history as the year of the COVID-19 pandemic. Many people have seen their lives disrupted, gotten sick or worse and suffered from mental health issues due to isolation and loneliness. All the mayhem caused by the pandemic, though, easily makes us lose sight of all the good that happened in Software Center this year.

We started the year with the fourth phase of Software Center and it is hard to believe that we will be celebrating our 10 year anniversary next year. Having been part of Software Center since the beginning, I am still amazed at how fast time has flown by, even if I am acutely aware of how much progress the companies have made. When we started, most companies were struggling with adopting agile practices at the team level. Today, the discussion is most focused on DevOps, A/B experimentation and the use of artificial intelligence. I believe that we are continuing to deliver on our mission of accelerating the digitalization of the European software intensive industry.

One of the characteristics that has made Software Center so successful is that everyone, both in the companies and in academia, is constantly reinventing themselves. We see this at the project level where, for example, the project by Antonio Martini is now transitioning from architecture technical debt to a new focus on process debt. At the theme level, we introduced the AI Engineering theme in June of this year to give a home to all the research around providing engineering solutions for developing, deploying and evolving machine- and deep-learning models.

This year we also saw a significantly higher activity level in the communities. The software engineering community organized a variety of workshops and events and the product management community organized workshops around business agility, data pricing and digital business models.

One of the surprises this year was the increased research output. With the researchers unable to travel, clearly many of us took the opportunity to write more papers than during previous years. This year was my most productive year ever from a publications perspective and I have good reason to believe that this may well be the case for several of the researchers in Software Center. We also continue to graduate PhD students with Terese Besker defending her PhD in September and Robbert Jongeling defending his licentiate degree.

One of the highlights, for me at least, is when new companies join and this year DEIF decided to join Software Center. A wonderful addition to the center that I am extremely grateful for and we already have had quite a bit of interaction and collaboration with Jan Harding Gliemann, Allan Agerholm and their colleagues.

The reporting workshops were one of the things that I worried about as we had to go online for those. Although we still haven't solved the social interaction part, I am happy that we have many more participants than ever before with the events drawing between 175 and 200 participants. We were also able to share much more material than otherwise in the parallel sessions and the sessions are now available online via the Software Center intranet and our YouTube channel. I am grateful for all the efforts that the coordination team put into these reporting workshops.

Concluding, for all the mayhem that Covid-19 brought with it, Software Center has had a pretty amazing year nevertheless. I would like to thank all of you who contribute to making Software Center the successful initiative that it is, including the steering committee, task force, coordination team, community leaders, operations team and of course all of you in the companies and universities that spend your time and effort. Thank you for an amazing year and I look forward to celebrating our 10 year anniversary next year with all of you!

Continuous Delivery

Theme leader:
Kristian Sandahl
Linköping University

The use of agile and flexible development methods has increased the demand for frequent integration and testing to maintain the quality of the resulting code. As a result, companies have gradually invested more in the organization and automation of continuous delivery capabilities. Nowadays, continuous delivery systems are complicated systems themselves and many co-workers are dependent on them in their daily work.

In the theme we are working to find solutions to minimize the feed-back time from automated testing. This is done by investigating methods for test-case selection, automation of flaky tests detection, optimizing parallel test execution, improved test case design, and static checking of test cases. We are also doing case studies on how exploratory testing finds a role in continuous delivery. Implementing the continuous delivery environment is addressed both from the perspective of the system architecture as well as processes and attitudes among developers.

To operate and maintain continuous integration systems many stakeholders need information to monitor the progress, identify bottlenecks, perform troubleshooting, or verify that intended operations were actually carried out. Currently we are exploring solutions using real-time data visualization tools that can be used all over a company.

We are also hosting two associated projects in the areas of modeling and analyzing collaborative autonomous systems, and human aspects of software engineering.

Projects

- Visualization of Continuous Integration: Azeem Ahmad, Linköping University
- Aspects of Automated Testing: Kristian Sandahl, Linköping University
- Enterprise Scale Continuous Integration and Delivery: Torvald Mårtensson, Saab Aeronautics
- Modeling and Analyzing Collaborating Machines: Marian Sirjani, Mälardalen University
- An Analysis of Team-based Development within an Activity Based Working Environment Robert Feldt, Chalmers

Continuous Architecture

Theme leader:
Jan Carlson
Mälardalen University

Development of high quality complex software systems, in particular in modern embedded and cyber-physical systems, requires careful attention to the software architecture and design. The overall scope of the Continuous Architecture theme is to identify and develop means to help companies improve their processes, methods and technologies related to software architecture, in order to support development of increasingly complex products and to react and adapt quicker to changed market needs.

One long-running research topic addressed in the theme is how architectural debt can be identified, managed and reduced in different software domains. During 2020, the work has focused on technical debt in microservice-based systems and investigating the relation between technical debt and developer's morale. Initial work was also started on the topic of process debt, which is now continued in a new project going forward.

We also continued the research on how to identify, manage and reduce inconsistencies between different development artefacts, for example between architectural models and code, or between models at different granularity or levels of abstraction. One concrete example of a recently addressed challenge in this area is the automatic identification of manual changes to generated code made after deployment, and how to support some of the identified changes to be propagated back to the original design model.

This year, we also started two new projects on the topics of functional safety and sustainability, respectively. Functional safety has been addressed in previous projects but the new project focused on safety assurance in the context of continuous deployment. The other new project investigated how sustainability aspects can be considered in decision making related to system/software development.

Projects

- Managing Architectural Technical Debt
- Safety Assurance in Continuous Deployment
- Managing Inconsistent Development Artefacts
- Evaluating Sustainability: Making Decisions
- On predicting the effects of code changes in continuous software development

Metrics

Theme leader:
Miroslaw Staron,
Chalmers

Theme leader:
Wilhelm Meding,
Ericsson

http://metrics.blogg.gu.se/

Innovation and improvement in software development need effective and efficient measurement. In the age of continuous deployment and focus on speed, ecosystems and data, one of the cornerstones is the development of new metrics (data), processes (speed) and infrastructure (ecosystems) to support modern software development. The metrics theme addresses needs of data collection, analysis and visualization. Our research team supports the development and introduction of new methods as well as organizes knowledge exchange workshops to help cross-company knowledge sharing.

The metrics theme focuses on:

- Measurement, assessment and visualization of product and organizational performance
- Use of machine learning to improve software engineering
- Smart techniques for data management and decision support (e.g. machine learning)
- Infrastructure for continuous experimentation and simulation of organizational performance (e.g. metrics portfolio, self-healing)
- Optimization of measurement processes in modern software development enterprises (e.g. measurement program robustness assessment)
- Pro-active complexity reduction in large scale software development
- Prediction and assessment of impact of metamodel changes on product cost and quality

Projects

1. Continuous Product and Organizational Performance, Miroslaw Staron, Chalmers | University of Gothenburg
2. DeVeLoP, Development of Machine Learning Systems in Cars, Darko Durisic, Volvo Cars
3. Improving Communication challenges between metrics teams and Stakeholders, Dina Koutsikouri, Nataliya Berbyuk Lindström, University of Gothenburg
4. Metrics Team Maturity Model, Wilhelm Meding, Ericsson


Volvo AB

Customer Data- and Ecosystem-Driven Development

Theme leader:
Helena H. Olsson,
Malmö University

With digitalization and with technologies such as software, data and artificial intelligence (AI), companies in the embedded systems domain are experiencing a rapid transformation of their conventional businesses. Across industry domains, we see physical products and traditional product sales being complemented with service offerings, new data-driven services and digital products that allow continuous value creation and delivery to customers. To successfully navigate the digital transformation, and to effectively explore and exploit new technologies, companies need to continuously rethink and reinvent their processes and ways-of-working, their monetization strategies and the ways in which they interact and learn from customers and other stakeholders. Also, the ability to reposition in the business ecosystem is critical in order to avoid disruption by new entrants.

The customer data- and ecosystem-driven development theme focuses on methods, processes, tools and techniques that help software-intensive embedded systems companies accelerate the adoption of novel practices and increase overall business agility. We study both technical and organizational implications of digitalization and we provide support for roles and functions at all levels in the companies.

In the projects

- We develop techniques that help continuous monitoring of customer value as well as support for how to increase business agility
- We provide guidelines for how to successfully manage the digital transformation process and evolve from a traditional to a digital company
- We develop best practices to manage requirements and related knowledge in large-scale system development
- We provide industrial partners with support for how to build an API strategy that involve both internal and external stakeholders

Projects

- Accelerating Digitalization Through Data: Helena H. Olsson, Malmö University, Jan Bosch, Chalmers
- Strategic Ecosystem-Driven R&D Management: Helena H. Olsson, Malmö University, Jan Bosch, Chalmers
- API Strategies: Jennifer Horkoff, Chalmers | University of Gothenburg
- Requirements Engineering for Large-Scale Agile System Development: Eric Knauss, Chalmers | University of Gothenburg

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AI Engineering

Theme leader:
Jan Bosch

Volvo AB

Artificial intelligence (AI) and machine learning (ML) are increasingly broadly adopted in industry, However, in our research we have learned that deploying industry-strength, production quality ML models in systems proves to be challenging. Companies experience challenges related to data quality, design methods and processes, performance of models as well as deployment and compliance. To address this, a new, structured engineering approach is required to construct and evolve systems that contain ML/DL components. We refer to this as AI Engineering, i.e. an extension of Software Engineering with new processes and technologies needed for development and evolution of AI systems, i.e. systems that include AI components. During the last year, in Software Center, we have built up a team of 10 people working on AI engineering, funded by Vinnova, WASP and CHAIR. An overview of the research activities is shown in the figure below. Currently, we conduct research federated learning, DataOps, automatic labelling, A/B testing of models, monitoring & logging, transfer learning, heterogeneous hardware, automated experimentation and autonomously improving systems. We are always looking for more companies to become involved, so please reach out in case you want to learn more and get involved.

Projects

- AI data quality and Pipeline Robustness: Aiswarya Raj Munappy (Chalmers), Jan Bosch (Chalmers), Helena H. Olsson (Malmö University)
- Design methods and processes for ML/DL models: Meenu Mary John (Malmö University), Helena H. Olsson (Malmö University) and Jan Bosch (Chalmers)

Associated projects

- Data-Driven Continuous Evolution of Autonomous Systems of Systems: David Issa Mattos (Chalmers - WASP), Teodor Fredriksson (Chalmers - WASP), Hongyi Zhang (Chalmers - CHAIR), Jan Bosch (Chalmers) and Helena H. Olsson
- A/B test driven Systems Engineering (ABSE): Yuchu Liu (Volvo Cars), Jonn Lantz (Volvo Cars), Jan Bosch (Chalmers) and Helena H. Olsson (Malmö University)

Organization

Director

Jan Bosch, Department of Computer Science and Engineering, Chalmers/University of Gothenburg

Steering Committee

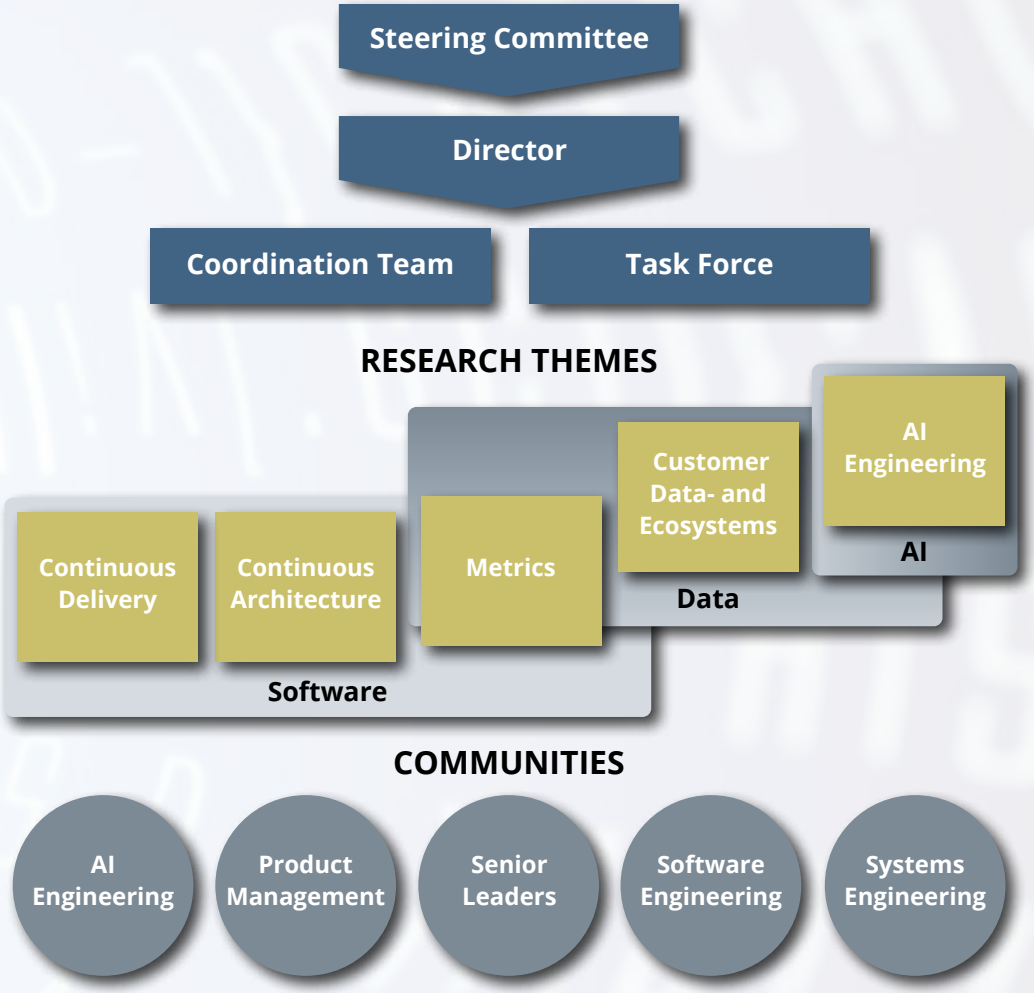
Chair: Anders Caspár, Ericsson
Vangel Cukalevski, Axis Communications AB
Stefan Carlsson, CEVT
Lennart Krook, CEVT
Claes Strannegård, Chalmers
Erik Ström, Chalmers
Allan Agerholm, DEIF
Jan Harding Gliemann, DEIF
Catrin Granbom, Ericsson AB
Mats Lindén, Ericsson AB
Eva Nielsen, Grundfos AB
Niels Jørgen Strøm, Grundfos AB
Anders Forsman, Jeppesen AB
Peter Sutton, Jeppesen AB
Kristian Sandahl, Linköping University
Ola Leifler, Linköping University
Jan Carlson, Mälardalen University
Hans Hansson, Mälardalen University
Helena Holmström Olsson, Malmö University
Andreas Jacobsson, Malmö University
Robert Lagerstedt, Robert Bosch AB
Axel Franke, Robert Bosch AB
Staffan Lindgren, Robert Bosch AB
Hanna Svantesson, Saab AB
Ulf Näsström, Saab AB
Viktor Kaznov, Scania
Cornel Klein, Siemens AG
Frances Paulisch, Siemens Healthineers
Olivier Germain, Tetra Pak AB
Paolo Scarabelli, Tetra Pak AB
Miroslaw Staron, University of Gothenburg
Mari Hiljemark, Volvo AB
Anders Henriksson, Volvo AB
Hans Alminger, Volvo Cars
Kent Niesel, Volvo Cars
Markus Mesimäki, Wärtsilä
Tomi Vuollet, Wärtsilä
Jonas Åkerman, Wärtsilä
Johan Lassing, Qamcom

Task force

Ola Söder, Axis Communications AB
Axel Franke, Bosch AB
Robert Lagerstedt, Bosch AB
Staffan Lindgren, Bosch AB
Stefan Carlsson, CEVT
Jan Harding Gliemann, DEIF
Catrin Granbom, Ericsson AB
Mats Lindén, Ericsson AB
Jonas Wigander, Ericsson AB
Niels Jörgen Ström, Grundfos AB
Anders Forsman, Jeppesen
Vilhem Bergman, Saab AB
Christoffer Höglund, Saab AB
Torvald Mårtensson, Saab AB
Sven Nilsson, Saab AB
Viktor Kaznov, Scania
Christoph Elsner, Siemens AG
Magnus Johansson, Tetra Pak
Johan Persson, Tetra Pak
Jens Svensson, AB Volvo
Anders Henriksson, Volvo AB
Joakim Ohlsson, Volvo AB
Jens Svensson, Volvo AB
Ruben Alexandersson, Volvo Cars
Jonn Lantz, Volvo Cars
Kent Niesel, Volvo Cars
Jonatan Rosgren, Wärtsilä

Coordination Team

Jan Bosch, Chalmers
Miroslaw Staron, Chalmers/University of Gothenburg
Wilhelm Meding, Ericsson
Daniel Ståhl, Ericsson
Anders Forsman, Jeppesen
Kristian Sandahl, Linköping University
Jan Carlson, Mälardalen University
Helena Holmström Olsson, Malmö University
Peter Thorngren, Volvo



Meetings

- **Steering committee** meets 4 times per year. Once mid-sprint, once at end of sprint. Typically, meetings are held 10-13.
- **Task force** meets 2 times per year, before the end-of-sprint steering committee meeting.
- **Coordination team** meets once per month
- Every sprint, we organize a 1-day reporting workshop offering all interested parties at the SC companies an opportunity to learn about the ongoing research. This workshop is held one day before the task force meeting
- Every sprint, there is a senior management workshop
- Every sprint, there is a product management workshop

Meeting schedule Sprint 18

- January 20: Coordination team meeting
- February 17: Coordination team meeting
- March 16: Coordination team meeting
- March 30: Mid-sprint steering committee meeting
- April 27: Coordination team meeting
- May 25: Coordination team meeting
- June 11: Reporting workshop for all companies and other interested parties
- June 12: Task force meeting for planning sprint 17
- June 15: Steering committee meeting
- June 15: Coordination team meeting

Meeting schedule Sprint 19

- August 17: Coordination team meeting
- August 17: General Assembly and strategy workshop
- September 14: Coordination team meeting
- October 5: Mid-sprint steering committee meeting
- October 12: Coordination team meeting
- November 16: Coordination team meeting
- December 3: Reporting workshop for all companies and other interested parties
- December 4: Task force meeting for planning sprint 16
- December 7: Coordination team meeting
- December 7: Steering committee meeting

Vangel Cukalevski,
Axis Communcations

Ola Söder,
Axis Communcations

Axel Franke,
Bosch

Robert Lagerstedt,
Bosch

Florian Marcard,
Bosch

Stefan Carlsson,
CEVT

Lennart Krook,
CEVT

Jan Bosch,
Chalmers

Ivica Crnkovic,
Chalmers

Charlotte Wiberg,
Chalmers

Miroslaw Staron, *Chalmers/*
University of Gothenburg

Anders Caspár,
Ericsson (Chair)

Mats Lindén,
Ericsson

Wilhelm Meding,
Ericsson

Niels Jørgen Strøm,
Grundfos

Anne Katrine Windfeld,
Grundfos

Kristian Sandahl,
Linköping University

Helena Holmström Olsson,
Malmö University

Jan Carlson,
Mälardalen University

Hans Hansson,
Mälardalen University

Torvald Mårtensson,
Saab

Sven Nilsson,
Saab

Ulf Nässtrom,
Saab

Hanna Svantesson,
Saab

Christoph Elsner,
Siemens AG

Olivier Germain,
Tetra Pak

Mari Hiljemark,
Volvo AB

Jens Svensson,
Volvo AB

Peter Thorngren,
Volvo AB

Jonn Lantz,
Volvo Cars

Software Center reporting workshop, December

10.00-10.30 Opening: Jan Bosch

10.30-11.00 Shifting Gears: Towards Continuous Value Flow
Keynote presentation by Dr Frances Paulisch, Siemens Healthineers

11.00-12.00 Community updates in parallel

- **Software engineering,** chairs: Miroslaw Staron, Wilhelm Meding, Jan Carlson and Kristian Sandahl
- **Product management,** chair: Helena H Olsson
- **Systems engineering,** chairs: Anders Kvist, Ericsson, and Magnus Timmerby, Tetra Pak
- **AI engineering,** chair: Jan Bosch. Presentation by Björn Treje, Peltarion

12.00-13.00 Lunch break

13.00-15.00 Up-dates from Software Center projects – parallel tracks (detailed up-date closer to the event):

- **Theme 1: Continuous delivery:**
  - Daniel Ståhl: *Test automation challenges in CD and mob programming*
  - Torvald Mårtensson: *Maturity levels for exploratory testing*
  - Azeem Ahmad: *Tool for flaky test detection. Tool for diversity-based testing*
- **Theme 2: Architecture**
  - Antonio Martini: #2 *Managing Architectural Technical Debt*
  - *– How do companies experience Process Debt? A first exploration*
  - *– The assessment of technical debt management maturity. Experiences from its application at two SwC companies*
  - Patricia Lago: #38 *Evaluating Sustainability: Making Decisions*
  - Robbert Jongeling: #35 *Managing Inconsistent Development Artefacts*
  - Masud Abu Naser: #40 *On predicting the effects of code changes in continuous software development*
- **Theme 3: Metrics**
  - Jennifer Horkoff: *Modelling and Taxonomy for Data Anomaly Analysis.*
  - Khaled Al-Sabbagh: *Test case selection in the presence and absence of noise: a controlled experiment*
  - Dina Koutsikouri and Nataliya Berbyuk Lindström: *Communication Challenges*
  - Vasili Mosin: *Anomaly score evaluation on real images/Develop*
- **Theme 4: Customer Data and Ecosystem Driven Development**
  - Helena H. Olsson: #5 *Accelerating Digitalization Through Data*
  - Helena H. Olsson: #9 *Strategic Ecosystem Driven R&D Management*
  - Eric Knauss/Jennifer Horkoff: #27 *RE for Large-Scale Agile System Development*
  - QA and discussion
- **Theme 5: AI Engineering**
  - *Automatic Data Validation* – Lucy Lwakatare
  - *On Industrial Data Pipelines* – Aiswarya Raj
  - *Design methods for ML/DL* – Meenu John
  - *(Semi) Automatic labeling of data* – Teodor Fredriksson
  - *Asynchronous Federated Learning* – Hongyi Zhang
  - Update on CHAIR by Ivica Crnkovic

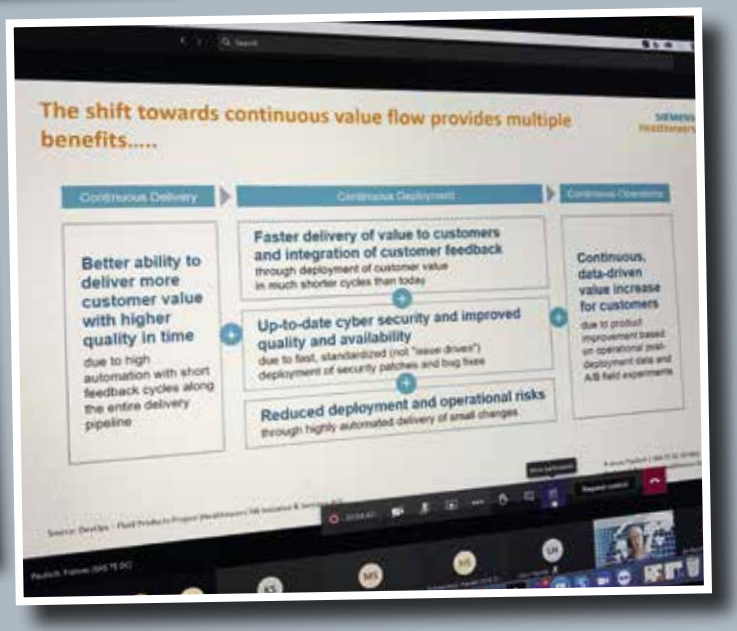
15.15-15.45 Enabling A/B testing at scale: It's all about trustworthiness & keeping the momentum
Keynote presentation by Dr Aleksander Fabijan, Data Scientist at Microsoft's Experimentation Platform (ExP) team

15.45-16.15 Plans, reflections & closing: Jan Bosch

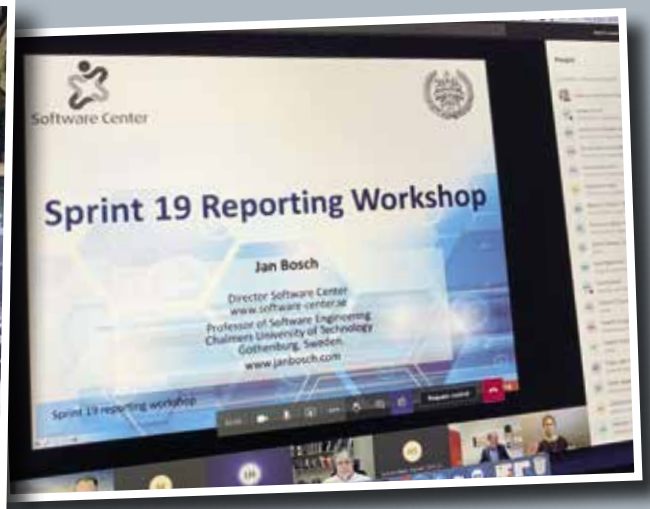
Highlights
Reporting workshops

Since we were not able to meet physically during 2020 both reporting workshops were run digitally. The reporting workshops were well attended with some 200 participants at both events. A special thank you to those who contributed with selfies from your home office! Recordings from the reporting workshops are available in the Software Center YouTube channel.


A/B Testing Flywheel


The shift towards continuous value flow provides multiple benefits.....
Continuous Delivery
Continuous Deployment
Better ability to deliver more customer value with higher quality in time
due to high automation with short feedback cycles along the entire delivery pipeline
Faster delivery of value to customers and integration of customer feedback
through deployment of customer value in much shorter cycles than today
Up-to-date cyber security and improved quality and availability
due to fast, standardized (not "issue driven") deployment of security patches and bug fixes
Reduced deployment and operational risks
through highly automated delivery of small changes
Continuous, data-driven value increase for customers
due to product improvement based on operational post-deployment data and A/B field experiments


Creative


Software Center
Sprint 19 Reporting Workshop
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Sprint 19 reporting workshop

Software Center reporting workshop, June

10.00-10.15 Opening: Jan Bosch

10.15-10.30 Introduction of new partners: DEIF, Allan Agerholm, Vice President, R&D Product & Application and Martin Mallan, Vice President, R&D

10.30-11.00 Keynote: "Our digital transformation journey"
Niclas Nygren, Vehicle Software & Electronics at Volvo Cars

11.00-12.00 Community updates in parallel

- **Software engineering** – chairs: Miroslaw Staron, Wilhelm Meding, Jan Carlson and Kristian Sandahl
  Leif Jonsson, Senior Specialist Machine Learning and Analytics Platform at Ericsson: "From idea to production: Finally one year of ML driven TR routing in production"
  Birgit Penzenstadler, Assistant Professor at Chalmers University of Technology: "Neuroplasticity practices – for sustainable, resilient individuals in IT"
- **Product management** – chair: Helena H Olsson
  Hanna Svantesson, Head of Product Management at SAAB: "Time to Act"
- **Systems engineering** – chairs: Anders Kvist, Ericsson, and Magnus Timmerby, Tetra Pak
  Ericsson with support from Magnus Timmerby, Tetra Pak.
  Example and discussions from the real life, an AI system by Ericsson.
- **AI engineering** – chair: Jan Bosch
  Alberto Barroso, Global Head of Decision Science at Tetra Pak

12.00-13.00 Lunch break

13.00-15.00 Up-dates from Software Center projects – parallel tracks

- **Track I: Chaired by Helena Holmström Olsson**
  #27, RE for Large-Scale Agile System Development: Eric Knauss
  #5, Accelerating Digitalization Through Data: Helena H. Olsson and Meenu Mary John
  #9, Strategic Ecosystem-driven R&D Management: Helena H. Olsson
  #19, Data-driven continuous evolution of autonomous systems: David Issa Mattos
- **Track II: Chaired by Miroslaw Staron**
  #2, Process Debt and Holistic Assessment of Technical Debt Management: Antonio Martini
  #6, Exploratory Excellence and Beyond: The ExET Model and Next Steps: Torvald Mårtensson
  #37, Communication with stakeholders: Nataliya Berbyuk Lindström
  #3, Team maturity model: Wilhelm Meding
- **Track III: Chaired by Kristian Sandahl**
  #35, Managing Model Inconsistencies: Robbert Jongeling
  #29, Agile Verification-Driven Development of Cyber-Physical Systems: Marjan Sirjani
  #18, Information Filtering in Eiffel Vici- A Visualisation Tool: Azeem Ahmad
  #30 Improved test effectiveness via behavioural diversity: Kristian Sandahl, Jean Malm, Francisco Gomes
  Develop, Autoencoders and anomaly detection: Vasilii Mohsin

15.15-15.45 Keynote: The Challenges of Data Quality
Sima Shahsavari, Senior data scientist at Ericsson

15.45-16.15 Plans, reflections & closing: Jan Bosch

Brown bag seminars

During autumn 2020 we launched a new series of lunch seminars – brown bag meetings - to increase to number of arenas for Software Center partners so meet and discuss. The seminars have attracted a large number of participants and will continue in 2021. Recordings of brown bag seminars are available in the Software Center YouTube channel.

November 9:

Multi-factor Approach for Flaky Test Detection and Automated Root Cause Analysis

Speaker: Azeem Ahmad, Linköping University
Abstract: Re-running test cases is the most popular and adopted approach to detect flaky test in large scale industries. Re-running is costly because it consumes a lot of computing power. Google uses 2-16% of its testing budget just to re-run flaky tests. Re-running is unreliable because it is hard to determine the number of re-runs to find discrepancy in output. We developed, implemented and evaluated multi-factor approach to detect flaky test without re-running. The contributed factors are (1) number of test smells in the test cases, (2) whether test case failed after executing on the corresponding change in production code, (3) test case history, and (4) test case size. The machine learning algorithm is implemented to find relationships between the contributed factors and the possibility of test flakiness. Once the build is failed, our tool can determine whether the failed test case is a real failure or flaky.

November 16:

"Sorry, there is no digital transformation without software sustainability"

Speakers: Patricia Lago and Birgit Penzenstadler
Abstract: This talk presents a brief overview of the results of the first sprint of the Sustainability Analysis project and gives insights into the ongoing sprint from our partnership with Jeppesen-Boeing which focuses on Design Decision Maps and Sustainability Goals as a basis for a Sustainability Quality Model. We bring a few questions to discuss with attendees and look forward to more opportunities for collaboration.

November 23:

Putting up an effective metrics program in only 18 months

Speaker: Ola Söder, Expert Engineer from Axis Communications – presents the experiences from establishing a modern measurement program in close collaboration with Ericsson and Software Center.
Abstract: Company-wise measurement programs are socio-technological systems, which combine social aspects of what, when and where to measure with technical aspects of how to measure. These programs are usually difficult to establish as utilizing the measurement information in decision-making is more difficult than it seems.

Brown bag seminars

November 30:

Towards Business Agility 2.0

Speaker: Helena H. Olsson from Malmö University.
Business agility is critical for companies across domains. It involves the ability to quickly respond to market dynamics and to emerging technologies. While business agility has predominantly been associated with the software industry it is rapidly becoming key for companies in the embedded systems industry. However, while business agility refers the speed with which an organization can respond to changes, the adoption of agile practices is fundamentally different in embedded systems companies compared to companies in the software industry. For embedded systems companies, business agility requires all parts of the system to be agile, including traditional technologies such as mechanics and electronics as well as digital technologies such as software, data and AI. Hence, agility means different things for the different technologies involved in an embedded system. Moreover, while traditional technologies have so far been monetized using transactional business models, digital technologies allow for continuous business models in which frequent improvements of system functionality makes systems improve throughout their economic life. In this talk, we describe the shortcomings of what we refer to as Business Agility 1.0 and what is required for a company in order to achieve full business agility, i.e., Business Agility 2.0.

December 7:

Towards Continuous Delivery of ML/DL Systems

Speaker: Meenu Mary John, Malmö University
Abstract: Artificial intelligence (AI) is becoming increasingly popular within companies across domains due to the success of machine learning (ML) and deep learning (DL) technologies. For companies across domains, the end-to-end process of developing, deploying and successfully adopting ML/DL models in operation introduces several challenges related to the design, the evolution and the scaling of these models. For example, access and availability of data is often challenging and activities such as data collection, data cleaning, data pre-processing, data storing, as well as uploading, training, deployment, and placement of model(s) in operation is complex. This is true particularly for large, complex, highly regulated and safety-critical embedded systems in areas such as e.g., telecom, automotive, defence, security, healthcare etc. As part of the research, we conduct studies covering the end-to-end process of ML/DL model development, as well as in-depth studies focusing on the specifics of the deployment phase and how to operationalize these models in large-scale embedded systems, and how to continuously deliver and evolve Machine Learning Systems (MLOps) to improve the key quality attributes of the larger system of which these are part.

December 14:

Exploring the cognitive processes used by testers

Speaker: Eduard Paul Enoiu
Abstract: In theme one Eduard Paul Enoiu from Mälardalen University has been working towards a cognitive model of software testing based on how problem solving is conceptualized in cognitive psychology. This approach instantiates a general problem solving process for the specific problem of creating test cases in automated testing. A preliminary study led to a pilot experiment to understand the mechanisms by which human testers choose, design, implement and evaluate test cases and test design strategies. With such a model comes the opportunity to improve training and support of testing. One example of improvement, observed in previous sprints, is to augment human-created test suites with other automated test generation strategies (e.g., combinatorial coverage).

MIROSLAW STARON

Who and when needs automated code reviews...

Miroslaw Staron,
Chalmers

> *"Code review tools are still far from being supporting for software developers"*

Having worked with code reviews for a while, I strongly sympathize with the thesis put forward by the authors of this paper – code review tools are still far from being supporting for software developers.

Yes, they do automate the process and organize it. Yes, they help in assuring that all code is reviewed and yes, they do help to capture problems in the code and help to spread the knowledge.

However, what I expect from such a tool is to help me to find problems in the code. I would like to have a tool that would help me, as a designer, get better: avoid mistakes, use cool programming constructs, make better design. None of the tools I know help with that.

This paper shows that my understanding is similar to the developers studied in the paper. Documentation – automatically fixing and suggesting were top priority. Renaming suggestions, commenting and explaining were some others.

Detection of duplicated code, architectural analysis and similar things were also mentioned as expectations.

Image by Arek Socha from Pixabay

I cannot agree more! These things are priority 1 – I would also expect them to be there.

Now, some are more difficult that others – like analyzing the architecture. Not a trivial task at all, cause what is the architecture? Where are the patterns? How to find it from the code? How to rely on the tools that research provides? W're not there yet.

Duplicate code, however, is something we should be able to fix. I've looked at some repository that had over 200 papers about code clones, duplicates and what have you. Are all these papers good? Probably not, but even if 10% is good, then here we have 20 tools we can try.

I agree, we do have SonarQube and similar tools, but they are not integrated with code review. I cannot just link to a report from SQ when writing a review comment. I cannot add a review comment to a detected technical debt in SQ. So, no integration then?

Maybe it's just a friday afternoon thing, but I hope that we can get better in making the last mile with our tools. Hope that we can address the expectations that the developers have …

JAN BOSCH

Towards business agility 2.0

Soon after the introduction of agility in software development, the notion of business agility was introduced as well. The basic idea was to scale the concepts behind agile software development to larger scopes, with the ambition to reach the entire organization, including R&D and IT. In practice, however, for many organizations, it proved difficult to go beyond the software part of the organization and things often got stuck at DevOps. Also, the basic mindset often was to treat changes as disruptions in a steady-state system, focused on returning to a steady state as soon as possible. Agile was concerned with minimizing the impact of changes by rapidly responding to them. The notion of business agility was very popular around 2010 and then started to fade as it didn't provide the benefit that companies were looking for. To quote a manager in one of the Software Center partners: "We use SAFe and say we're all agile but we didn't change a thing…"

More recently, we can see a development that's not entirely dissimilar to the first incarnation of business agility (1.0) but that has a number of unique characteristics and is leading up to a 2.0 version of business agility. This version has, at least, three unique aspects: business models, technology scope and fast feedback loops.

First, many companies have started to realize that agility at the business level starts with the business model that you employ. It has to start with a transition from a transactional to a continuous model. If you build the capability to deliver value to customers but don't have a way to monetize the continuous value capture, there's no business incentive at all. If you improve the product, system or offering along some dimension, you need to be able to capture some of that value. For instance, if you run a truck company and you conduct A/B testing on the engines of your customers in the field to improve fuel efficiency, you want to capture some of the savings that your customers are enjoying. Why else would you bother with experimentation in the first place? So, whereas business agility 1.0 started bottom-up with the software development teams, the 2.0 incarnation starts top-down from the business model.

Second, in the embedded-systems industry, there's a growing awareness that continuous deployment or DevOps doesn't need to be limited to software. Under the right incentives and business models, it's entirely feasible to periodically update electronic and mechanical parts of systems in the field to improve system performance. Among others, Tesla offers chip upgrades and hardware retrofits providing significantly improved capabilities, which the software can then use to improve the functionality in the car. So, business agility 2.0 doesn't just focus on software but extends to electronics and mechanics on the one end and includes data and AI on the other.

Third, the focus in business agility 2.0 is on fast feedback loops across the company and all technologies. This has

To get more insights earlier, sign up for the newsletter at jan@janbosch.com or follow on janbosch.com/blog, LinkedIn (linkedin.com/in/janbosch) or Twitter (@JanBosch).

Image by Marc Sendra Martorell on Unsplash

two aspects. First, each technology has an optimal feedback length where the customer and business benefit of new releases are balanced with the cost of manufacturing, distributing and installing. This of course means that software (including AI models) can afford to have very fast cycles as the cost of distribution and installation is very low and there's no manufacturing cost. For electronics, especially when keeping the mechanical interface constant (pin configuration, power usage, EMC, and so on), the cost is higher and perhaps a yearly or biannual cycle makes the most sense. Finally, for mechanical parts, the update frequency should be even lower as they're even more costly to manufacture, distribute and install. Still, when the continuous business model has liberated you from the "let's save all improvements for the next product" attitude, also improved mechanical parts can be distributed, say, every three to five years.

The second aspect is that no slower cycle can slow down the faster cycle. Traditionally, the software release frequency was bound to the product release cycle. In business agility 2.0, no faster cycle (software or electronics) can be slowed down by a slower cycle (eg electronics or mechanics).

We're entering the era of business agility 2.0, which starts from the adoption of a continuous business model and then optimizes the entire company to capitalize on fast feedback loops that allow for all technologies in products to improve at their own pace. Even if your customers aren't asking for it yet, your suppliers are complaining and your partners aren't yet ready to play ball, you better get going on this as the second incarnation of business agility provides major benefits, as well as improvements in efficiency and effectiveness that you can't do without. Go agile, but go 2.0!

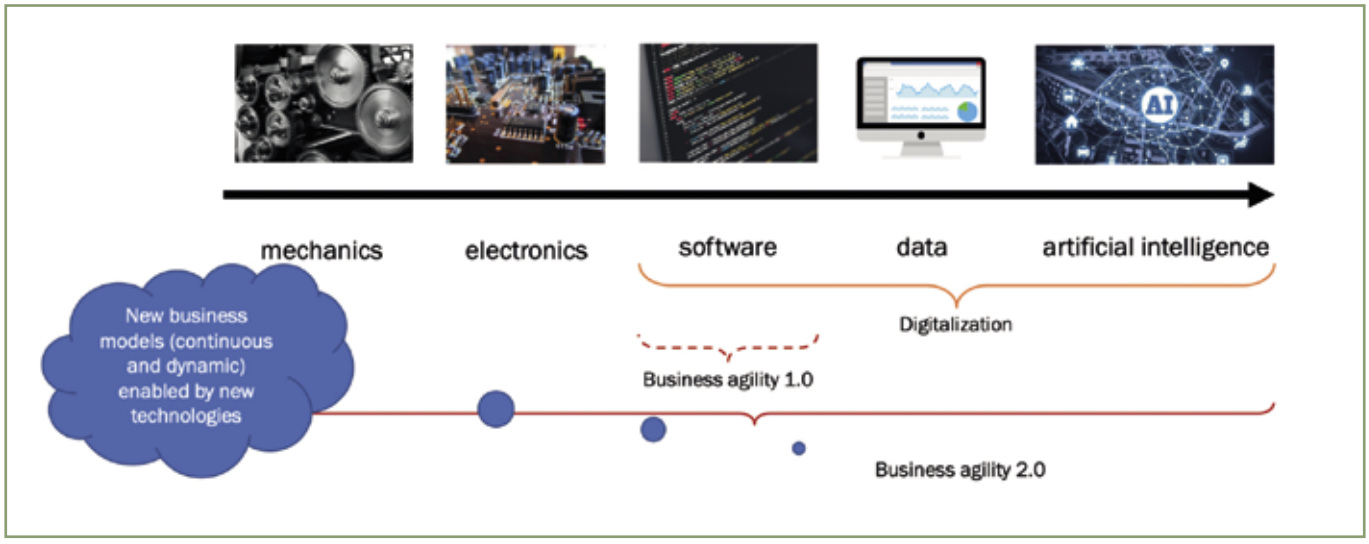


Figure: Business agility 1.0, digitalization and business agility 2.0


Image by Stefan Keller from Pixabay

Are you building a minimal viable elephant?

JAN BOSCH

As part of the research in Software Center, I work with dozens of companies in the software-intensive embedded systems space on a variety of topics. One of these topics is the development of new products. Having worked with online companies, as well as startups, I've become indoctrinated with Steve Blank's ideas and the "lean startup" concepts. One of the key tenets is that you validate with customers every step of the way. In fact, you seek to minimize the amount of R&D investment between customer proof points. The second tenet is to only rely on what customers say when you absolutely need to, but whenever possible rely on measuring their behavior... *Read the whole article on janbosch.com/blog*


Image by h heyerlein on Unsplash

What's with all the Ops?

JAN BOSCH

DevOps, DataOps, MLOps – the number of different "Ops" combinations seems to have exploded over the last year or so. There are manifestos, meetups, lots of blog posts and research articles about these various approaches. In order to get clear on terminology, I think it's good to define what we're talking about. So, first, DevOps is a set of practices that combines software development (Dev) and information technology operations (Ops) with the aim to shorten the system development life cycle and provide continuous delivery with high software quality (Wikipedia)... *Read the whole article on janbosch.com/blog*

Image by Gerd Altmann from Pixabay

Six reasons why your digital transformation is failing

JAN BOSCH

The common theme over the last weeks, as I started to talk to more and more folks in companies, is the difficulty of realizing digital transformations. Granted, I work with many who are expected or having taken it on themselves to drive the digital transformation of their organization, but I believe the challenge is widespread. Especially in the embedded systems industry, there's a large group of people who originate in the mechanical or electronics world and can't see beyond the limits of their technological perspective. With a digitalizing business, mechanics and electronics don't go away – we still need a chassis and a computing platform... *Read the whole article on janbosch.com/blog*

Events

January:

AI and Professions

Lunch talk at Ericsson by Miroslaw Staron, Wilhelm Meding

January:

Kick-off workshop project 5, 9, 19, 33

Cross-company workshop to introduce and initiate the research collaborations for sprint 18
Helena H. Olsson

February 28

Workshop on exploratory testing at the Ericsson site in Gothenburg

A total of 29 people participated at a workshop on exploratory testing at the Ericsson site in Gothenburg. The participants came from Axis Communications, Ericsson, Grundfos, Saab, Volvo Cars and Volvo Trucks. The workshop was organized by Daniel Ståhl (Ericsson), Torvald Mårtensson (Saab) and Antonio Martini (Chalmers).

The workshop was arranged as part of the Software Center Project #6 studies on exploratory testing. The day started with a presentation of the results from phase two of the "ExET" study, including interviews and workshops with testers and test managers in all the participating companies. This was followed by a mix of discussions in large group, presentations from the participating companies, and group work in smaller groups.

February:

PhD course: “Software Development Measurement Programs”

Miroslaw Staron, Wilhelm Meding

February:

Workshop on Communication in Metrics, co-organized with Bosch

Miroslaw Staron, Wilhelm Meding

April 17

Brokerage event

A virtual brokerage event to plan for even better project proposals for the next sprint, based on industrial needs and challenges. Industrial Software Center partners presented challenges and project ideas.

May:

Metrics theme presentation for Siemens Gamesa

Miroslaw Staron, Wilhelm Meding, Gert Frost

May:

Workshop on Metrics culture, co-organized with Bosch

Miroslaw Staron, Wilhelm Meding

August

Kick-off workshop project 5, 9

Cross-company workshop to introduce and initiate the research collaborations for sprint 19
Helena H. Olsson

August

Kick-off workshop for the AI Engineering theme

Cross-company workshop to introduce and initiate the research collaborations for sprint 19
Jan Bosch, Ivica Crnkovic, Helena H. Olsson

August 20:

DEIF and Software Center

Digital meeting focusing on DEIF and collaboration within Software Center.

September 3

Scania and Software Center

Digital meeting focusing on Scania and collaboration within Software Center.

September 23

Cross-company workshop for automotive industry

Cross-company workshop on digital business models and service-oriented revenue streams. This workshop involves e.g. pricing of data, data ownership and the potential to develop a two-sided business. For the purpose of this workshop, we invite the automotive companies in Software Center.

September 25

Software Engineering Community workshop

Continuous Integration and Continuous Deployment workshop to discuss the current activities, find synergies and identify topics for the next events, including Hackathons.

October 9

PdM community workshop on 'Business Agility'

Chair: Helena H. Olsson
In this workshop, we:

- Discuss the current ways-of-working in the participant companies with regards to the different technologies involved in a system (i.e. mechanics – electronics – software – data – AI). In this discussion, we explore the level of agility for each technology and to what extent agile practices are applicable.
- Identify the challenges that companies experience when applying agile practices to the more traditional (and non-software) parts of the organization as well as how they typically manage these challenges.
- Explore the potential to complement, and/or replace, traditional business models with models for continuous value capture and how the combination of the two helps improve business agility.

October 13

KPI workshop: Successful Introduction of KPIs for Software Development

The goal of the workshop is to exchange good practices about KPIs and address topics around:

- Which KPIs and metrics have been found to work well,
- What the most common communication challenges are when communicating KPIs/metrics,
- How to design a well-working system for working with KPIs, and
- How to make KPIs that drive the company's development in the right direction

Scope of workshop

- What to measure: Accelerate KPIs, Other approaches
- KPI/Measurement program introduction strategies: Vocabulary, Metrics teams and roles, organization around the metrics team
- Soft factors, Communication and cooperation: models, communication with stakeholders, Communication roles and channels
- DOs and DON'Ts

October 20

Knowledge exchange workshop around Over The Air updating

Presentations by Volvo Cars, AB Volvo, Siemens and Grundfos.

November 5:

Product management workshop: Data pricing


HELENA H. OLSSON

Often, data is described as the "new oil" and very recently it was described as an "anti-commodity" in a presentation highlighting the potential of data to reshape and redefine business models and revenue streams.

In this workshop, we explore how the participating companies create and exploit value out of the data they collect from products in the field in (1) monetary and/or non-monetary ways and for (2)interorganizational use and/or external use. The data can be both historical data and real-time data and in aggregated and/or non-aggregated form. In the workshop, we provide an introduction of the topic as well as selected research findings before we invite the participating companies to share experience and expertise on the topics mentioned above. We end the workshop with discussions and reflections and we plan for next steps. The workshop is a cross-company workshop to which all Software Center companies are invited to exchange knowledge and best practices. It is organized especially for product managers as part of the PdM community workshop series but is open also to other roles and for everyone with an interest in the topic(s) we explore.

November 20

Lic seminar: Advancing continuous model-based development in industry


ROBERT JONGELING

PhD student: Robert Jongeling, Mälardalen University
Advisors: Jan Carlson, Antonio Cicchetti and Federico Ciccozzi

November:

Workshop on Aspects for automated testing

- Flaky Test Detection and Automated Root Cause Analysis: Intro. & Demo (Azeem Ahmad)
- Concluding Similarity Bases Test Case Selection: The Tool (Azeem Ahmad)
- Test Execution Parallelization: Preliminary Results and Demonstration (Gregory Gay)
- Test Design Practices and Test Automation (Eduard Paul Enoiu)
- Enforcing test code quality using static analysis (Jean Malm)

December:

Improving Continuous Integration through optimization of testing activities and data visualization


AZEEM AHMAD

Azeem Ahmad, PhD student at Linköping University gave his 60% ready seminar summarizing projcts #18 and #30. This is an alternative to the licentiate seminar.

New member:

Established in Denmark in 1933, today the DEIF Group is a global market leader in green, safe a nd reliable control solutions for decentralised power production on land or at sea. The DEIF Group has more than 550 employees and are represented in 50+ key markets in all regions of the world. All DEIF production facilities are located at the Danish headquarters in Skive and 20% of the employees work in R&D identifying new environmentally friendly ways of increasing overall performance, reducing maintenance intervals and fuel consumption for the world's power generating industries. DEIF sets out to supply the world's best and most reliable control solutions for a sustainable future.

Open-source software from Software Center projects

LINKÖPING UNIVERSITY

AZEEM AHMAD

Azeem Ahmad, PhD student at Linköping University, has released two open-source tools during 2020:

Tool 1: **Multi-factor Approach for Flaky Test Detection and Automated Root Cause Analysis:**
https://gitlab.liu.se/azeah70/multifactorftdetector

Tool 2: **Test Subset Generator using Similarity Based Test Case Selection in CI:**
https://gitlab.liu.se/azeah70/diversitybasedtesting

Terese Besker, Chalmers, PhD

Technical Debt: An empirical investigation of its harmfulness and on management strategies in industry

Advisors: Jan Bosch, Antonio Martini

Link: https://research.chalmers.se/publication/518318

Abstract:

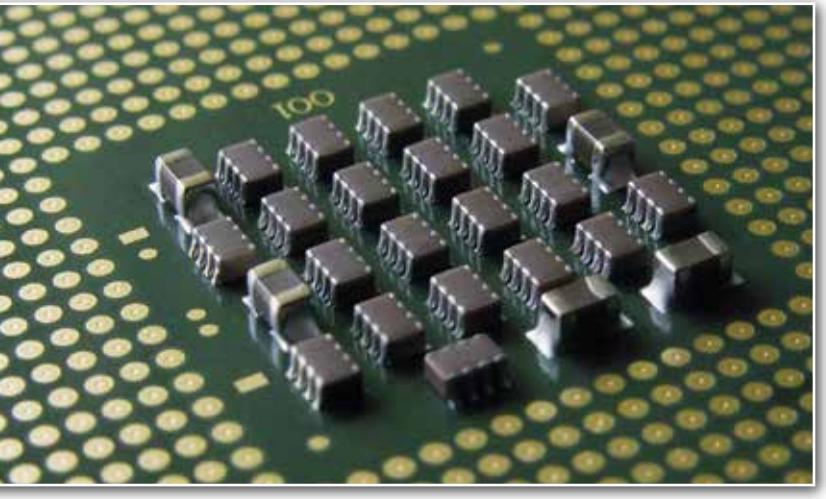
Background: In order to survive in today's fast-growing and ever fast-changing business environment, software companies need to continuously deliver customer value, both from a short- and long-term perspective. However, the consequences of potential long-term and far-reaching negative effects of shortcuts and quick fixes made during the software development lifecycle, described as Technical Debt (TD), can impede the software development process.

Objective: The overarching goal of this Ph.D. thesis is twofold. The first goal is to empirically study and understand in what way and to what extent, TD influences today's software development work, specifically with the intention to provide more quantitative insight into the field. Second, to understand which different initiatives can reduce the negative effects of TD and also which factors are important to consider when implementing such initiatives.

Method: To achieve the objectives, a combination of both quantitative and qualitative research methodologies are used, including interviews, surveys, a systematic literature review, a longitudinal study, analysis of documents, correlation analysis, and statistical tests. In seven of the eleven studies included in this Ph.D. thesis, a combination of multiple research methods are used to achieve high validity.

Results: We present results showing that software suffering from TD will cause various negative effects on both the software and the developing process. These negative effects are illustrated from a technical, financial, and a developer's working situational perspective. These studies also identify several initiatives that can be undertaken in order to reduce the negative effects of TD.

Conclusion: The results show that software developers report that they waste 23% of their working time due to experiencing TD and that TD required them to perform additional time-consuming work activities. This study also shows that, compared to all types of TD, architectural TD has the greatest negative impact on daily software development work and that TD has negative effects on several different software quality attributes. Further, the results show that TD reduces developer morale. Moreover, the findings show that intentionally introducing TD in startup companies can allow the start-ups to cut development time, enabling faster feedback and increased revenue, preserve resources, and decrease risk and thereby contribute to beneficial effects. This study also identifies several initiatives that can be undertaken in order to reduce the negative effects of TD, such as the introduction of a tracking process where the TD items are introduced in an official backlog. The finding also indicates that there is an unfulfilled potential regarding how managers can influence the manner in which software practitioners address TD.



Rebekka Wohlrab, Chalmers, PhD

Living Boundary Objects to Support Agile Inter-Team Coordination at Scale

Advisors: Patrizio Pelliccione, Miroslaw Staron, Erik Knauss

Link: https://research.chalmers.se/publication/515968

Abstract:

Context: In the last decades, large-scale agile development has received increasing attention, as also organizations with many stakeholders and large systems aim for higher development speed and focus on customer value. A recognized research challenge in large-scale agile development relates to inter-team coordination. To coordinate effectively, organizations need to identify what knowledge is required across team borders and how it can be managed over time. Knowledge is potentially manifested in boundary objects – artifacts that create a shared understanding between teams (e.g., requirements or architecture descriptions). Traceability between artifacts is a key necessity to manage change in agile contexts. Moreover, agile practitioners aim to reduce the documentation effort to absolutely crucial artifacts and trace links.

Objective: This thesis aims to improve how practitioners can manage knowledge for inter-team coordination in large-scale agile development. We focus especially on how knowledge can be made explicit in artifacts and trace links that are evolved over time.

Method: We empirically investigated problems and developed solutions using a research approach that was inspired by design science. Case studies, an in-depth design science study, a mixed methods study, and surveys were performed. Using this mix of research methods, we leveraged both qualitative and quantitative data.

Results: We coined the concept of living boundary objects to manage knowledge for inter-team coordination. Living boundary objects are boundary objects that are traced to other artifacts, kept up to date, and serve for inter-team coordination. They should be established early in the lifecycle to create a common understanding of the product to be developed. We scrutinized architecture descriptions, interfaces, and requirements and traceability information models as examples of concrete boundary objects. We recommend establishing alignment using a common high-level structure, but also supporting diverse knowledge management practices to fulfill the individual needs of agile teams.

Conclusions: Our contributions help to establish knowledge management practices that are considered beneficial by practitioners and focus on the crucial aspects to align agile teams on. We suggest concepts and requirements for knowledge management tools that take the distinct role of living boundary objects into consideration and can be adjusted as organizations' needs evolve.

Salome Maro, University of Gothenburg, PhD

Improving software traceability tools and processes

Advisors: JP Steghöfer, Miroslaw Staron

Link: http://hdl.handle.net/2077/65837

Abstract:

Context: Development of large and complex software leads to a large number of interconnected artifacts such as requirements, design models, code and implementation. Traceability enables understanding and managing these artifacts as they evolve. However, establishing traceability is not trivial. It requires the development organization to design effective traceability strategies and provide tools to support the traceability activities. Establishing traceability in practice faces many challenges such as the amount of effort needed to establish traceability, unclear traceability processes and difficulty in measuring the benefits of traceability.

Objective: The overall objective of this research is to improve traceability processes and tools in software development. In this thesis we started with exploring the state of the art as well as the state of practice of traceability in order to identify persisting challenges and existing solutions. We then propose and implement solutions for four of the identified challenges: manual work of establishing traceability, lack of configurable tools, diverse artifacts and tools, and unclear traceability processes.

Method: To identify existing traceability challenges and solutions, we conducted a systematic tertiary literature review, a multi-vocal literature review, and a case study to understand how these challenges and solutions manifest in practice. To design solutions we took an empirical approach where we used case studies and design science for the different studies.

Results: Our results show that there are still many traceability challenges which are not solved by current solutions in literature due to practical constraints and limitations that exist especially in safety critical domains. To address the challenge of manual work needed to maintain trace links we propose a set of important factors and guidelines for traceability maintenance aimed at traceability tool developers and companies acquiring traceability tools. The feasibility of these factors and guidelines are demonstrated through a prototype implementation. The prototype implementation also shows how to design traceability solutions that are both configurable and support tracing to and from diverse artifacts and tools. To address the challenge of manual work in creating traceability links we have investigated how to improve the trace link vetting process as part of a way to transfer automated techniques of creating trace links to industry. We provide insights and lessons learned on how to improve the trace link vetting process. Lastly the thesis proposes a traceability introduction methodology (TracIMo), which consists of concrete steps that companies can take to design, deploy and evaluate traceability strategies.


Volvo AB


Volvo AB

Rashidah Kasauli, Chalmers, PhD

Requirements Engineering that Balances Agility of Teams and System-level Information Needs at Scale

Advisors: Miroslaw Staron, Benjamin Kanagwa

Link: https://research.chalmers.se/publication/517099

Abstract:

Context: Motivated by their success in software development, large-scale systems development companies are increasingly adopting agile methods and their practices. Such companies need to accommodate different development cycles of hardware and software and are usually subject to regulation and safety concerns. Also, for such companies, requirements engineering is an essential activity that involves upfront and detailed analysis which can be at odds with agile development methods. Objective: The overall aim of this thesis is to investigate the challenges and solution candidates of performing effective requirements engineering in an agile environment, based on empirical evidence. Illustrated with studies on safety and system-level information needs, we explore RE challenges and solutions in large-scale agile development, both in general and from the teams' perspectives.

Method: To meet our aim, we performed a secondary study and a series of empirical studies based on case studies. We collected qualitative data using interviews, focus groups and workshops to derive challenges and potential solutions from industry.

Findings: Our findings show that there are numerous challenges of conducting requirements engineering in agile development especially where systems development is concerned. The challenges discovered sprout from an integration problem of working with agile methods while relying on established plan-driven processes for the overall system. We highlight the communication challenge of crossing the boundary of agile methods and system-level (or plan-driven) development, which also proves the coexistence of both methods.

Conclusions: Our results highlight the painful areas of requirements engineering in agile development and propose solutions that can be explored further. This thesis contributes to future research, by establishing a holistic map of challenges and candidate solutions that can be further developed to make RE more efficient within agile environments.

Robbert Jongeling, Mälardalen University, Licentitate

Advancing continuous model-based development in industry

Advisors: Jan Carlson, Antonio Cicchetti and Federico Ciccozzi

http://www.idt.mdh.se/personal/jcn01/theses/RobbertJongeling-Lic/

Abstract:

For the development of complex software systems, two paradigms have become popular in industry: model-based development and Agile software development. In model-based development, models are the core development artifacts, particularly in early development phases such as specification and design. The short development cycles of Agile development, and in particular continuous integration, are sometimes seen as conflicting with the apparent longer development phases in model-based development. We study how software development can benefit from combining these two paradigms successfully into continuous model-based development.

In this licentiate thesis, we present four papers studying continuous model-based development of complex embedded systems in industry. The first two papers present investigations of the current state-of-the-art and state-of-practice of combining model-based development and continuous integration. In particular, specific challenges to the combination are identified. In the third and fourth papers, we focus on one of those challenges: model synchronization, i.e., the management of consistency between disparate development artifacts describing the same system or parts of it. We propose a lightweight approach that notifies developers of arisen inconsistency between different models. Lastly, we consider the aspect of variability among different development artifacts. In particular, we provide automated support for alleviating manual tasks in maintaining consistency across model variants organized in a product line.

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Publications

Azeem Ahmad, Ola Leifler, Kristian Sandahl. “An Evaluation of Machine Learning Methods for Predicting Flaky Tests”. In Proceedings of the 8th International Workshop on Quantitative Approaches to Software Quality, pp 37-48

Al-Sabbagh KW, Hebig R, Staron M. The Effect of Class Noise on Continuous Test Case Selection: A Controlled Experiment on Industrial Data. InInternational Conference on Product-Focused Software Process Improvement 2020 Nov 25 (pp. 287-303). Springer, Cham.

Al-Sabbagh KW, Staron M, Ochodek M, Hebig R, Meding W. Selective Regression Testing based on Big Data: Comparing Feature Extraction Techniques. In2020 IEEE International Conference on Software Testing, Verification and Validation Workshops (ICSTW) 2020 Oct 24 (pp. 322-329). IEEE.

Al-Sabbagh KW, Staron M, Hebig R, Meding W. Improving Data Quality for Regression Test Selection by Reducing Annotation Noise. In2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA) 2020 Aug 26 (pp. 191-194). IEEE.

Maryam Bagheri, Edward A. Lee, Eunsuk Kang, Marjan Sirjani, Ehsan Khamespanah, Ali Movaghar: Lightweight Formal Method for Robust Routing in Track-based Traffic Control Systems. MEMOCODE 2020: 1-10

T. Besker, H. Ghanbari, A. Martini, and J. Bosch: “The Influence of Technical Debt on Software Developer Morale”. Journal of Systems and Software 2020

T. Besker, A. Martini, and J. Bosch: “Carrot and Stick approaches when managing Technical Debt”. Third International Conference on Technical Debt 2020, Best paper Award

T. Besker,” Technical Debt: An empirical investigation of its harmfulness and on management strategies in industry”. Thesis for the Degree of Doctor of Philosophy, Chalmers 2020

Block L, El-Merhi A, Liljencrantz J, Naredi S, Staron M, Odenstedt Hergès H. Cerebral ischemia detection using artificial intelligence (CIDAI)–A study protocol. Acta Anaesthesiologica Scandinavica. 2020 Oct;64(9):1335-42.

Diamantopoulos, N., Wong, J., Mattos, D., Gerostathopoulos, I., Wardrop, M., Mao, T., & McFarland, C. (2020). Engineering for a science-centric experimentation platform. In Proceedings of the ACM/IEEE 42nd International Conference on Software Engineering: Software Engineering in Practice (pp. 191–200)

Elliot VH, Paananen M, Staron M. Artificial intelligence for decision-makers. Journal of Emerging Technologies in Accounting. 2020;17(1):51-5.

Eduard Paul Enoiu, Gerald Tukseferi , Robert Feldt, Towards a Model of Testers’ Cognitive Processes: Software Testing as a Problem Solving Approach (Nov 2020), IEEE International Workshop on Human and Social Aspects of Software Quality (HASQ 2020)

Figalist, Iris, Christoph Elsner, Jan Bosch, and Helena Holmström Olsson. “Breaking the Vicious Circle: Why AI for software analytics and business intelligence does not take off in practice.” In 2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA), pp. 5-12. IEEE, 2020.

Figalist, Iris, Christoph Elsner, Jan Bosch, and Helena Holmström Olsson. “An End-to-End Framework for Productive Use of Machine Learning in Software Analytics and Business Intelligence Solutions.” In International Conference on Product-Focused Software Process Improvement, pp. 217-233. Springer, Cham, 2020.

Figalist, Iris, Christoph Elsner, Jan Bosch, and Helena Holmström Olsson. “Fast and curious: A model for building efficient monitoring-and decision-making frameworks based on quantitative data.” Information and Software Technology 132 (2021): 106458.

Figalist, Iris, Marco Dieffenbacher, Isabella Eigner, Jan Bosch, Helena Holmström Olsson, and Christoph Elsner. “Mining Customer Satisfaction on B2B Online Platforms Using Service Quality and Web Usage Metrics.” In 2020 27th Asia-Pacific Sofwtare Engineering Conference (APSEC). IEEE, 2020.

Giorgio Forcina, Ali Sedaghatbaf, Stephan Baumgart, Ali Jafari, Ehsan Khamespanah, Pavle Mrvaljevic, Marjan Sirjani: Safe Design of Flow Management Systems Using Rebeca. J. Inf. Process. 28: 588-598 (2020)

T. Fredriksson, J. Bosch, and H. H. Olsson, ‘Machine learning models for automatic labeling: A systematic literature review’, in ICSOFT 2020 - Proceedings of the 15th International Conference on Software Technologies, Virtual, Online, Frankrike, 2020, pp. 552–566.

Fredriksson, T., Mattos, D., Bosch, J., & Olsson, H. (2020). Data Labeling: An Empirical Investigation into Industrial Challenges and Mitigation Strategies. In International Conference on Product-Focused Software Process Improvement (pp. 202–216)

Robbert Jongeling, Antonio Cicchetti, Federico Ciccozzi, Jan Carlson: "Towards boosting the OpenMBEE platform with model-code consistency". Workshop on Open Model Based Engineering Environment (OpenMBEE) 2020

Robbert Jongeling, Johan Fredriksson, Federico Ciccozzi, Antonio Cicchetti, Jan Carlson: "Towards Consistency Checking Between a System Model and its Implementation". International Conference on Systems Modelling and Management (ICSMM) 2020

Robbert Jongeling: "Advancing Continuous Model-Based Development in Industry". Licentitate Thesis Mälardalen University 2020

John, M.M., Olsson, H.H. and Bosch, J., 2020, June. Developing ML/DL models: A design framework. In Proceedings of the International Conference on Software and System Processes (pp. 1-10).

John, M.M., Olsson, H.H. and Bosch, J., 2020, August. AI on the Edge: Architectural Alternatives. In 2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA) (pp. 21-28). IEEE.

John, M.M., Olsson, H.H. and Bosch, J., 2020, December. AI Deployment Architecture: Multi-Case Study for Key Factor Identification: In Asia-Pacific Software Engineering Conference (APSEC)

John, M.M., Olsson, H.H. and Bosch, J., 2020, November. Architecting AI Deployment: A Systematic Review of State-of-the-Art and State-of-Practice Literature. In International Conference on Software Business (pp. 14-29). Springer, Cham.

Kasauli, R., Knauss, E., Horkoff, J., Liebel, G., and de Oliveira Netoa, F. G. (2020a): Requirements engineering challenges and practices in large-scale agile system development. In: Systems and Software. Download PDF at https://doi.org/10.1016/j.jss.2020.110851.

Kasauli, R.; Knauss, E.; Nakatumba-Nabende, J. & Kanagwa, B. (2020): Agile Islands in a Waterfall Environment: Requirements Engineering Challenges and Strategies in Automotive. In: Proceedings of International Conference on Evaluation and Assessment in Software Engineering (EASE), pg. 31-40, https://dl.acm.org/doi/pdf/10.1145/3383219.3383223

Kasauli, R.; Wohlrab, R.; Knauss, E.; Steghofer, J.-P.; Horkoff, J. & Maro, S (2020): Charting Coordination Needs in Large-Scale Agile Organizations with Boundary Objects and Methodological Islands. In: Proceedings of International Conference on Software and System Processes (ICSSP), https://arxiv.org/pdf/2005.05747.pdf

Mahsa Zarneshan, Fatemeh Ghassemi, Ehsan Khamespanah, Marjan Sirjani, John Hatcliff: Specification and Verification of Timing Properties in Interoperable Medical Systems. CoRR abs/2012.04025 (2020)

Jean Malm, Adnan Causevic, Björn Lisper, and SigridEldh. Automated Analysis of Flakiness-mitigating Delays. Proc. IEEE/ACM 1st International Conference on Automation of Software Test, Oct. 2020. http://www.es.mdh.se/publications/5842-

Maro, S. H.; Steghöfer, J.-P.; Knauss, E.; Horkoff, J.; Kasauli, R.; Korsgaard, J. L.; Wartenberg, F.; Strøm, N. J. & Alexandersson, R. (2020): Managing Traceability Information Models: Not such a simple task after all. In: IEEE Software.

A. Martini, T. Besker, and J. Bosch, "Process Debt: a First Exploration". Proceedings in the 26rd Asia-Pacific Software Engineering Conference (APSEC) 2020

Mattos, D., Bosch, J., Olsson, H., Korshani, A., & Lantz, J. (2020). Automotive A/B testing: Challenges and Lessons Learned from Practice. In 2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA) (pp. 101–109)

Mattos, D., Dakkak, A., Bosch, J., & Olsson, H. (2020). Experimentation for Business-to-Business Mission-Critical Systems: A Case Study. In Proceedings of the International Conference on Software and System Processes (pp. 95–104).

Meding W, Staron M. Making software measurement standards understandable. InProceedings of the Evaluation and Assessment in Software Engineering 2020 Apr 15 (pp. 368-370).

Fereidoun Moradi, Sara Abbaspour Asadollah, Ali Sedaghatbaf, Aida Causevic, Marjan Sirjani, Carolyn L. Talcott: An Actor-Based Approach for Security Analysis of Cyber-Physical Systems. FMICS 2020: 130-147

Munappy, A., Mattos, D., Bosch, J., Olsson, H., & Dakkak, A. (2020). From Ad-Hoc Data Analytics to DataOps. In Proceedings of the International Conference on Software and System Processes (pp. 165–174).

Ochodek M, Kopczyńska S, Staron M. Deep learning model for end-to-end approximation of COSMIC functional size based on use-case names. Information and Software Technology. 2020 Jul 1;123:106310.

Ochodek M, Staron M, Meding W, Bosch J. LegacyPro—a DNA-inspired method for identifying process legacies in software development organizations. IEEE Software. 2020 Feb 5;37(6):76-85.

Ochodek M, Staron M, Meding W. On Identifying Similarities in Git Commit Trends—A Comparison Between Clustering and SimSAX. InInternational Conference on Software Quality 2020 Jan 14 (pp. 109-120). Springer, Cham.

Ochodek M, Hebig R, Meding W, Frost G, Staron M. Recognizing lines of code violating company-specific coding guidelines using machine learning. Empirical Software Engineering. 2020 Jan;25(1):220-65.

Olsson, H.H., and Bosch, J. (2020). Going digital: Disruption and transformation in software-intensive embedded systems ecosystems. Journal of Software: Evolution and Process, e2249.

Olsson, H.H., and Bosch, J. (2020). The Five Purposes of Value Modeling. In Proceedings of the Euromicro Conference on Software Engineering and Advanced Applications (SEAA), August 26-28th, Slovenia.

Pickerill P, Jungen HJ, Ochodek M, Maćkowiak M, Staron M. PHANTOM: Curating GitHub for engineered software projects using time-series clustering. Empirical Software Engineering. 2020 Jul;25:2897-929.

Raj, A., Mattos, D. I., Bosch, J., Olsson, H. H., & Dakkak, A. (2020). From adhoc data analytics to dataops. In International Conference on Software and Systems Process.

Raj, A., Bosch, J., & Olsson, H. H. (2020, November). Data Pipeline Management in Practice: Challenges and Opportunities. In International Conference on Product-Focused Software Process Improvement (pp. 168-184). Springer, Cham.

Raj, A., Bosch, J., Olsson, H. H., & Wang, T. J. (2020, August). Modelling Data Pipelines. In 2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA) (pp. 13-20). IEEE.

Raj, A., Bosch, J., Olsson, H. H., & Wang, T. J, "Towards automated detection of data pipeline faults". Proceedings in the 26rd Asia-Pacific Software Engineering Conference (APSEC) 2020

Sanchez CC, Capilla R, Staron M. Estimating the Complexity of Architectural Design Decision Networks. IEEE Access. 2020 Sep 11;8:168558-75.

Zeinab Sharifi, Ramtin Khosravi, Marjan Sirjani, Ehsan Khamespanah: Towards Formal Analysis of Vehicle Platoons Using Actor Model. ETFA 2020: 1820-1827

Marjan Sirjani, Edward A. Lee, Ehsan Khamespanah: Model Checking Software in Cyberphysical Systems. COMPSAC 2020: 1017-1026

Marjan Sirjani, Luciana Provenzano, Sara Abbaspour Asadollah, Mahshid Helali Moghadam: From Requirements to Verifiable Executable Models Using Rebeca. SEFM 2020: 67-86

Marjan Sirjani, Edward A. Lee, Ehsan Khamespanah, Verification of cyberphysical systems, Mathematics 8 (7), 1068

Staron M, Meding W, Söder O, Ochodek M. Improving Quality of Code Review Datasets–Token-Based Feature Extraction Method. InInternational Conference on Software Quality 2021 Jan 19 (pp. 81-93). Springer, Cham.

Staron M, Ochodek M, Meding W, Söder O. Using machine learning to identify code fragments for manual review. In2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA) 2020 Aug 26 (pp. 513-516). IEEE.

Staron M. Action Research in Software Engineering. Springer International Publishing; 2020.

R. Wohlrab, J. Horkoff, R. Kasauli, S. Maro, J.-P. Steghöfer, and E. Knauss (2020): Modeling and Analysis of Boundary Objects and Methodological Islands in Large-Scale Systems Development. In: Proceedings of 39th International Conference on Conceptual Modeling (ER), Vienna, Austria. https://arxiv.org/pdf/2008.07879

Wohlrab, R.; Pelliccione, P.; Shahrokni, A. & Knauss, E. (2020): Why and How Your Traceability Should Evolve: Insights from an Automotive Supplier. In: IEEE Software, https://arxiv.org/pdf/2005.09414

Farnaz Yousefi, Ehsan Khamespanah, Mohammed Gharib, Marjan Sirjani, Ali Movaghar: VeriVANca framework: verification of VANETs by property-based message passing of actors in Rebeca with inheritance. Int. J. Softw. Tools Technol. Transf. 22(5): 617-633 (2020)

Zhang, H., Bosch, J., & Olsson, H. H., 2020, November. Engineering Federated Learning Systems: A Literature Review. In International Conference on Software Business (pp. 210-218). Springer, Cham.

Zhang, H., Bosch, J., & Olsson, H. H., 2020, December. Federated Learning Systems: Architecture Alternatives: In Asia-Pacific Software Engineering Conference (APSEC)

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