

CURRICULUM VITAE – Massimo Panarotto

PERSONAL DATA

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Short biography

- Massimo Panarotto, born 1985 and raised in Verona (Italy), is since May 2017 working as a Postdoctoral Research Fellow (Senior researcher) at Chalmers University of Technology (CTH) in Sweden. Massimo works in the research group Systems Engineering Design (SED, led by Professor Ola Isaksson) at the Department of Industrial and Materials Science (IMS, Division of Product Development).
- Massimo obtained his PhD in Mechanical Engineering at Blekinge Institute of Technology (BTH, Sweden) in December 2015. This followed a Bachelor (2008) and Master (2011) degree in Mechanical Engineering earned at University of Padua (Italy). The Master Thesis work was conducted at Luleå University of Technology (LTU, Sweden).
- During the PhD work Massimo focused on how to assess the lifecycle value of design alternatives, targeting the development of products and product service systems (PSS). In PSS the emphasis is on meeting needs and expectations of stakeholders, wherein the solution may be a combination of hardware, software and services. The application areas were in the automotive and road construction equipment sectors. During this time, Massimo spent 6 months part-time located in industry at Dynapac Compaction AB, analyzing documents and running interviews about the decision-makers' needs when assessing lifecycle value. During the PhD Massimo has conducted research in healthcare, assessing national-wide collaboration modes in cancer diagnostic enabled by medical imaging (project ExDin with Karolinska Institutet).
- It is from this work that emerges Massimo's current focus on developing applications for the early design phases where digital models are used as collaborative and multidisciplinary decision supports to determine the lifecycle value of a new system.
- The current application areas are space products (e.g., project CHEOPS, where alternatives for electric satellite propulsion are explored), and additive manufactured components (e.g, projects DISAM, DILAM, see below).
- Massimo currently supervises 2 PhD Students as co-supervisor. He has published 17 peer reviewed publications in conferences and journals, h-index 4.
- Massimo is also involved in education as teacher in product development courses at CTH. During the teaching and research activity he builds from previous leadership experiences as certified youth football instructor.
- Team collaboration is a capability Massimo constantly attempts to develop, building on experiences in team sports playing football and rugby in amateur teams, both in Italy and Sweden.

Professional academic positions

- 2017 – , Senior Researcher at Chalmers University of Technology
- 2016 – 2017, Senior Researcher at Blekinge Institute of Technology
- 2011 – 2015, Ph.D. Candidate at Blekinge Institute of Technology

Current research responsibilities

Massimo is currently responsible for conducting research in the following projects:

- CHEOPS - Consortium for Hall Effect Orbital Propulsion System (2016-2020)
 - A EU-funded space project with the goal to develop three different Hall Effect Thrusters (HET) electric propulsion systems for satellite operations.
 - Partners: Safran (Coordinator), Airbus, Thales Alenia Space, OHB, Sital, SME4SPACE, UC3M, Bradford Engineering, CNRS, AST, DLR, Chalmers.
 - Massimo's Role: Work Package Leader, responsible for design exploration of alternative space propulsion technologies and architectures, applying value/cost measurements for success linked to business and operational scenarios.
 - <https://www.cheops-h2020.eu/>
- RIQAM - Radical Innovation and Qualification using Additive Manufacturing (2017-2019)
 - The purpose of the project is to demonstrate the potential of AM for space applications and examine how qualification methodologies can be integrated into the product development process.
 - Partners: LTU (Coordinator), GKN, Ruag, OHB Sweden, Chalmers
 - Massimo's Role: Senior researcher and co-supervisor of Ph.D. candidate Olivia Borgue.
- DiSAM - Digitalization of Supply Chain in Swedish Additive Manufacturing (2018-2022)
 - DiSAM will demonstrate how AM and digitalization can increase flexibility while reducing the threshold and associated risks for the supply chain and the manufacturing industry.
 - Partners: Swerea IVF (Coordinator), 26 partners including GKN and Chalmers.
 - Massimo's role: researcher responsible for definition of a digital platform for AM supply chain collaboration.
 - <https://www.swerea.se/disam>
- DiLAM - Digitalized Large Scale Additive Manufacturing (2017-2020)
 - DiLAM will demonstrate how AM and digitalization can increase flexibility while reducing the associated risks of introducing AM for the manufacturing of large-scale components.
 - Partners: Swerea IVF (Coordinator), ABB, BLB industries, Chalmers.
 - Massimo's role: researcher responsible for definition of a model-based development approach for design of large-scale AM components.
 - <https://www.vinnova.se/en/p/digitaliserad-additiv-tillverkning-av-stora-komponenter/>
- INGREPPI - Innovation through Establishing Platform Based Development (2016-2018)
 - The project aim to support implementation and exploitation of the methodology for Platform Based Development (with associated methods and tools) that is the result from nearly 10 years research collaboration between Chalmers, Volvo AB and GKN Aerospace Engine Systems.
 - Partners: Chalmers (Lead), Volvo AB, GKN, COPE SWEDEN and YOLEAN.

- Massimo's role: researcher responsible for defining and following the implementation plan with the collaborating companies.
- <https://www.chalmers.se/en/projects/Pages/INGREPPI---INnovation-Genom-etablering-av-Plattformsbaserad.aspx>
- MEPHISTO - Modelling for Early Phase Investigation into alternative System and Technology Options (2017-2020)
 - The project aims to bridge the gap in maturity of alternative technologies using generative modelling methods. A successful outcome is to enable exploration of radical systems- and technology alternatives already in early phases.
 - Partners: GKN (Lead), Chalmers.
 - Massimo's role: Senior researcher and co-supervisor of Ph.D. candidate Jakob Muller.
- AMOS - Additive Manufacturing Optimisation and Simulation (2016-2020)
 - The project is working with a number of different AM processes and material so as to assess their use for repair.
 - Partners: McGill University (Lead), 10 partners including GKN.
 - Massimo's role: researcher collaborating with McGill's PhD students Lydia Lawand and Khalil Alhandawi to develop a method for assessing AM repair strategies.
- Research Theme "Product Development 4.0" within the Wingquist Laboratory at Chalmers University of Technology
 - Product Development 4.0 (PD 4.0) aims to understand and develop theory, methods and tools necessary for new products and manufacturing systems, aligned with the ideas of Industry 4.0.
 - Partners: Chalmers, FCC (Fraunhofer-Chalmers Centre), 10 companies including IKEA, Volvo Car, Volvo AB, Scania.
 - Massimo's role: Theme Leader.
 - <http://www.chalmers.se/en/centres/wingquist/research/research-themes/Pages/platform-based-development.aspx>

Finalized projects

Massimo has been responsible for conducting research in the following projects:

- DINA++ - Digitalization of additive manufacturing processes (2017-2018)
 - The project is about streamlining processes throughout the AM chain, from design / CAD definition - preparation - manufacturing - to post-control. The goal for the project is to achieve 50% efficiency while enabling a "First Time Right" production within AM.
 - Partners: Swerea KIMAB (Coordinator), GKN Aerospace, FCC (Fraunhofer-Chalmers Centre), Chalmers, SAAB, Siemens, Jernkontoret, Swerea IVF, SWEREA SWECAST, SICS, Brogren Industries, LaserTechy.
 - Massimo's role: Work Package Leader, he developed a digital workflow for AM design space exploration adopting a Set-Based Concurrent Engineering (SBCE) approach.
- MD3S – Model Driven Development and Decision Support (2013-2019)
 - This project aims at develop, disseminate, and integrate relevant, user-friendly and efficient support methods and tools for sustainable product-service system innovation into the manufactures' daily working environments, enabling and inspiring industry to thrive in the changing global context
 - Partners: BTH (Coordinator) Aura Light, Avalon Innovation, Dynapac Compaction AB, GKN, Tetra Pack, Volvo Construction Equipment

- Massimo's role: researcher in value/cost modelling, in collaboration with Dynapac Compaction AB, a manufacturer of road compaction equipment.
- <https://www.bth.se/eng/research/product-development/model-driven-development-decision-support/>
- ExDin (Phase 3) – More effective analysis within medical imaging using collaboration based on networking structure (2015- 2016)
 - Analysis and demonstration of collaborative digital work through medical imaging, focusing on networked and remoted collaboration in cancer analysis.
 - Partners: Landstinget Blekinge (Coordinator), BTH, Karolinska Institutet, ReXeye, Unilabs, Region Skåne.
 - Massimo's role: senior researcher, simulating cost and benefits of medical imaging for healthcare institutions such as Landstinget Blekinge and Karolinska Institutet.
 - <https://www.productdevelopment.se/?p=54>
- Så Nätt - Leverantörsstruktur för lättare fordon (2011-2013)
 - The project aims at creating opportunities for the Swedish automotive industry to increase its competitiveness by developing new forms of cooperation, support methods and technologies in the field of lightweight construction.
 - Partners: Volvo Cars (Coordinator), BTH, Chalmers, Fordonskomponentgruppen.
 - Massimo's role: assessment of value/cost of alternative automotive solutions.

Description of Research profile

Despite significant technology assessment efforts, product development projects frequently struggle in integrating new radical technologies (combining mechanical, electrical, and software elements) into innovative products that add value to the stakeholders. New technologies are typically developed as prototypes “in the laboratory” (inside the company or at universities) where they are gradually matured. When these technologies are proposed for integration into the product architecture, engineers compare the value of technologies “in isolation”, i.e. compare how a new technology improves the performances of an existing technology. Great advantages are missed for the integration of radical technologies which may present potentially a lower level of performance compared to an existing technology, but may provide higher benefits when looking at the behavior of the whole system over the lifecycle (e.g., in production, use or service). This is because such technologies - of radical nature - establish new interactions and linkages with other elements of the system. The challenge Massimo focuses on can be summarized as: *“How can system lifecycle value be assessed – when radically integrating technologies into the product architecture?”*

The aim of Massimo's research is to support the effective integration of radical technology alternatives into new products and production systems, by developing “Product Development 4.0” capabilities. The aim is to understand and develop theory, methods and tools necessary for the design of new products and production systems, aligned with the ideas of Industry 4.0. This research covers mainly three areas:

A. Data-driven Value Modelling and Simulation

The design of products – such as trucks – often relies on the personal experience and intuition of human decision-makers, who decide on what to design by *recognizing* and *predicting* patterns of relationships between design alternatives and lifecycle value, based on experience with previous products. The challenge is that human decision makers (even if very experienced) are able to recognize only a subset of the all the possible patterns. This area of research aims at increasing decision-makers' confidence by making use of data mining and machine learning techniques to automatically discover patterns in databases and make predictions about which design

alternatives can add value to the stakeholders. This opportunity is opened up by the large amount of data that is nowadays continuously logged by devices installed in products.

B. Generative Design for Radical Innovation

The manufacturing industry is transforming, bringing in novel digital, electrical and autonomous technologies into both products and production processes at a rapid pace. This research area aims at defining approaches to effectively represent and configure the behavior of novel technology alternatives along the system lifecycle, already from the early design phases. This requires the ability to represent and configure novel technologies - of radical nature - as well as their new interactions and linkages with other elements of the product architecture. Generative design has been ongoing for some 25 years, but is limited to incremental design variations through parametric geometry modelling. For extending generative design and to be able to represent more radical technology alternatives, more flexible approaches are needed.

C. Circular Economy Compliant Design

This area is focused on capturing the long-term benefits of a circular business strategy (for example, product life extension) combined with the integration of novel technologies. For example, Additive Manufacturing (AM) techniques can be used to upgrade the product over time, enabling product life extension and contribute towards circular economy. This research is focused on supporting decisions about when and how the technology (AM in this example) can be used to timely upgrade a product (achieving a “planned product upgradability” through AM).

Formal Academic Degrees

2015 Ph.D. in Mechanical Engineering, Blekinge Institute of Technology

PhD Thesis: Panarotto, Massimo. “A Model Based Methodology for Value Assessment in Conceptual Design” Blekinge Institute of Technology 2015:14

2013 Tech. Lic. in Mechanical Engineering, Blekinge Institute of Technology

Licentiate Thesis: Panarotto, Massimo. “Capturing Value in Conceptual PSS Design” Blekinge Institute of Technology 2013:09

2011 M.Sc. in Mechanical Engineering, University of Padua

Master Thesis: Panarotto, Massimo, “Creative Methods for Sustainability Driven Innovation”, University of Padua (work conducted at Luleå University of Technology)

Invitation to international research collaboration initiatives

- July 2018: invited to Cambridge University (Engineering Design Center) for a joint industry/academy workshop to outline research challenges for joint UK and Sweden collaborations.

Scientific committee responsibilities

Member of scientific committee for re-occurring conferences:

- Design, Member of scientific committee for the Design Society conference “International Design Conference”, held bi-annually in Dubrovnik, Croatia. Member of the SC since 2018. Attended since 2012.
- CIRP IPSS, Member of the scientific committee for the CIRP society conference “Industrial Product/Service Systems – IPSS”, held annually around the world. Member of the SC since 2016. Attended since 2012.
- NordDesign, Member of scientific committee for the Design Society conference “NordDesign”, held bi-annually in the Nordic countries. Member of the SC since 2018. Attended since 2018.
- ICoRD, Member of scientific committee for the Design Research Society conference “International Conference on Research into Design” held every two years in India. Member of the SC since 2018.

Conference review responsibilities

Participated in review and planning of conferences:

- ICoRD 19, 7th International Conference on Research Into Design, January 9-11, 2019, Indian Institute of Science, Bangalore, India
Reviewer
- NordDesign 2018, 11th Nord Design Conference, August 14-17, 2015, Linköping, Sweden
Reviewer, contributor
- DESIGN 2018, 15th International Design Conference, May 21-24, 2015, Dubrovnik, Croatia
Reviewer, contributor
- CIRP IPSS 2016, 8th International Conference on Industrial Product-Service Systems, June 20-21, Bergamo, Italy
Reviewer, contributor

Journal review responsibilities

Reviewer for

- International Journal of Production Research
 - Reviewer,
- International Journal of Product Development
 - Reviewer,
- Journal of Engineering Design
 - Reviewer,

Supervisor responsibilities

Massimo is currently supervisor for 2 PhD students (as co supervisor)

- Jakob Muller, Massimo Co Supervisor, PhD student at Chalmers. Ola Isaksson is Main Supervisor.
- Olivia Borgue, Massimo Co Supervisor, PhD student at Chalmers. Ola Isaksson is Main Supervisor.

Pedagogic courses

Massimo has completed the following pedagogical courses:

- Higher Education Pedagogy – Introductory course (PE2517), 7.5 ECTS, BTH.

Massimo has enrolled and will participate in the following courses:

- Pedagogical Project, (CIU926), 5 ECTS, fall 2018.
- Theories of Learning, 2.5 ECTS, Fall 2018.
- Supervising Research Students, 3 ECTS, Fall 2018.

Course Development

Massimo was responsible for the development of the following courses:

- Production and Product Service Systems (PPU231), 7.5 ECTS, 2018
 - Master in Product Development and Master in Production Engineering,
 - Massimo's role: planning of lectures, project and assignments, planning of coordinated project work between Product Development students and Production Engineering students in order to collaboratively design both a Product Service System and a Production Service System.

Pedagogic Vision

Product development and innovation requires training in creativity, system thinking, entrepreneurship and a strong business sense together with more technical knowledge within, for example, mechanical engineering. The engineering education has hence to shift to more proactive forms where students are encouraged to gain their knowledge actively rather than passively built through theoretical lectures in classes. The pedagogic idea is to run live course projects with entrepreneurs and industry, where students can actively

work with real open-ended problems to solve. Reflection reports are used extensively as a tool to support their individual knowledge creation process where students work in teams and perform projects.

However, the open-ended nature of the real projects with industry has the risk to leave the students with uncertainty and ambiguity, if not properly supported by teachers/instructors. At the same time, a strong theoretical basis is needed to allow the students to generalize the knowledge gained through the activities performed in single projects to other contexts via abstract reasoning. To balance the need for theory and practice in engineering education, Massimo Panarotto has become interested in the concept of 'flipped classrooms'¹. In the flipped classrooms concept, students watch theoretical video lectures at home at their own pace, communicating with peers and teachers via online discussion. Actual activities and homework takes instead place in the classroom with the help of instructor. Educational technology and activity learning are two key concepts of the flipped classroom model. In current applications of the flipped classrooms model, students watch the 5-7 minutes lecture at home, or at school if they do not have Internet access at home. Massimo Panarotto's ambition is to introduce the flipped classrooms model in engineering education. Massimo Panarotto's ambition is then to become responsible for the development of one or more courses based on the concept of flipped classrooms.

Teaching

Courses taught by Massimo Panarotto together with role in course (together with students statements where such are collected):

- Production and Product Service Systems (PPU231), 7.5 ECTS
 - Master in Product Development and Master in Production Engineering,
 - Course Developer and Teacher, 2018-.
- Product Development Project (PPU126), 15 ECTS
 - Master in Product Development,
 - Teacher and project supervisor, 2018-.
- Product Planning, Needs and Opportunities (PP085), 7.5 ECTS
 - Master in Product Development,
 - Teacher, 2017-.
- Introduction to Mechanical Engineering (MMF176), 7 ECTS
 - Bachelor in Mechanical Engineering,
 - Teacher, 2017-.
- (BTH) Value Innovation (MT2536), 7.5 ECTS
 - Master in Sustainable Product-Service System Innovation,
 - Teacher, 2012-2017.
- (BTH) PSS Extreme Innovation (MT2534), 15 ECTS
 - Master in Sustainable Product-Service System Innovation,
 - Teacher and project supervisor, 2012-2017.
- (BTH) Systems Engineering (MT2530), 7.5 ECTS
 - Master in Sustainable Product-Service System Innovation,
 - Teacher responsible for design sessions, 2013-2017.
 - *"it was a very nice session. I like the way of working with stuff like this".*
- (BTH) Product-Service Systems Design Research Methodology, 7.5 ECTS
 - Master in Sustainable Product-Service System Innovation,
 - Teacher, 2014-2017.
- (BTH) Methods for Product and Service Development (MT2543), 7.5 ECTS
 - Master in Sustainable Product-Service System Innovation,
 - Teacher, 2012-2016.

¹ Bishop, J. L., & Verleger, M. A. (2013, June). The flipped classroom: A survey of the research. In *ASEE national conference proceedings, Atlanta, GA* (Vol. 30, No. 9, pp. 1-18).

- (BTH) Creativity for Product and Service Development (MT2531), 7.5 ECTS
 - Master in Sustainable Product-Service System Innovation,
 - Teacher assistant, 2011-2012.

Master thesis supervising

Massimo has supervised some 15+ MSc theses within the mechanical engineering and sustainable product innovation area. Below are some examples:

- Gróf, Clemens, 2018. "Multidisciplinary engineering and lifecycle modeling to support preliminary design for additive manufacturing in the aerospace industry". Institute of Aerospace Systems, RWTH Aachen University. The thesis was performed at Chalmers under Massimo's supervision.
- Smailagic, A., Smailagic, S. 2014. "Designing and Implementing Process Management in R&D – a practical application in the flooring industry". Industrial Economy programme, BTH.
- Blomquist, A., Gustafsson, R., 2013. "Product-Service Systems and Modular Development – Implications and opportunities for the Construction Equipment Industry". Industrial Economy programme, Mechanical Engineering programme, BTH.
- Lewis, A., Simmons, M., 2012. "P2P car sharing service systems design – informing user experience development". Master programme in Sustainable Product-Service Systems Innovation, BTH.

Awards

- 2017 – Three Reviewers favourite awards (for three different papers), top 10%. ICED'17 conference.
- 2014 – Runner up of the local (Karlshamn) qualifying round of "Forskar Grand Prix 2014", organized by Vetenskap & Allmänhet Formas research council, Forte, VINNOVA och Vetenskapsrådet.
- 2013 – One Reviewers favourite award top 10%. ICED'13 conference.

Academic broadcasted sessions

- 2015 – Presentation of Doctoral dissertation: <https://youtu.be/dGbfvEQtkMA>
- 2015 – Doctoral discussion: <https://youtu.be/-dyhVRJP9jE>
- 2013 – Presentation of Licentiate thesis: <https://youtu.be/A1Yz9o4JczE>

PUBLICATIONS

Journal Contributions (1)

Bertoni, A., Bertoni, M., **Panarotto, M.**, Johansson, C., & Larsson, T. C. (2016). Value-driven product service systems development: Methods and industrial applications. *CIRP Journal of Manufacturing Science and Technology*, 15, 42-55.
<https://doi.org/10.1016/j.cirpj.2016.04.008>

Peer reviewed Conference Publications (16)

Borgue, O., Müller, J. R., **Panarotto, M.**, & Isaksson, O. (2018). Function modelling and constraints replacement to support design for additive manufacturing of satellite components. In: *Proceedings of the NordDesign Conference* (accepted for publication).

Landahl, J., **Panarotto, M.**, Johannesson, H., Isaksson, O., & Lööf, J. (2018). Towards Adopting Digital Twins to Support Design Reuse during Platform Concept Development. In: *Proceedings of the NordDesign Conference* (accepted for publication).

Panarotto, M., Isaksson, O., & Asp, L. (2018). Assessing the value of radical technology alternatives at system level. In *DS92: Proceedings of the DESIGN 2018 15th International Design Conference* (pp. 633-642).
<https://doi.org/10.21278/idc.2018.0398>

Borgue, O., **Panarotto, M.**, & Isaksson, O. (2018). Impact on design when introducing additive manufacturing in space applications. In *DS92: Proceedings of the DESIGN 2018 15th International Design Conference* (pp. 997-1008).
<https://doi.org/10.21278/idc.2018.0412>

Müller, J. R., **Panarotto, M.**, Malmqvist, J., & Isaksson, O. (2018). Lifecycle design and management of additive manufacturing technologies. *Procedia Manufacturing*, 19, 135-142.
<https://doi.org/10.1016/j.promfg.2018.01.019>

Panarotto, M., Wall, J., Bertoni, M., Larsson, T., & Jonsson, P. (2017). Value-driven simulation: Thinking together through simulation in early engineering design. In *21st International Conference on Engineering Design (ICED)*, Vancouver (Vol. 4, pp. 513-522). The Design Society.

Bertoni, M., **Panarotto, M.**, & Jonsson, P. (2017). Value-driven engineering design: Lessons learned from the road construction equipment industry. In *ICED17 21st International Conference on Engineering Design*, Vancouver (Vol. 1, pp. 319-328). The Design Society.

Johansson, C., Wall, J., & **Panarotto, M.** (2017). Maturity of models in a multi-model decision support system. In *21st International Conference on Engineering Design (ICED)*, Vancouver (Vol. 6, pp. 237-246). The Design Society.

Panarotto, M., Wall, J., & Larsson, T. (2017). Simulation-driven design for assessing strategic decisions in the conceptual design of circular PSS business models. *Procedia CIRP*, 64, 25-30.
<https://doi.org/10.1016/j.procir.2017.03.026>

Bertoni, M., **Panarotto, M.**, & Larsson, T. C. (2016). Boundary objects for PSS design. *Procedia CIRP*, 47, 329-334.
<https://doi.org/10.1016/j.procir.2016.03.226>

- Panarotto, M.**, Bertoni, M., & Bertoni, A. (2016). Experimenting the use of value models as boundary objects in conceptual PSS design. *Procedia CIRP*, 47, 370-375.
<https://doi.org/10.1016/j.procir.2016.03.235>
- Bertoni, A., Bertoni, M., **Panarotto, M.**, Johansson, C., & Larsson, T. (2015). Expanding value driven design to meet lean product service development. *Procedia CIRP*, 30, 197-202.
<https://doi.org/10.1016/j.procir.2015.02.153>
- Panarotto, M.**, Ericson, Å., & Larsson, T. C. (2013). Intangibles in design of PSS value propositions. In *The Philosopher's Stone for Sustainability* (pp. 85-90). Springer, Berlin, Heidelberg.
https://doi.org/10.1007/978-3-642-32847-3_14
- Panarotto, M.**, Larsson, T., & Larsson, A. (2013). Enhancing supply chain collaboration in automotive industry by value driven simulation. In *International Conference on Engineering Design, ICED13*, Seoul, Korea. ICED.
- Panarotto, M.**, & Larsson, T. C. (2012). Towards value driven simulation of product-service systems: a conceptual scenario. In *DS 70: Proceedings of DESIGN 2012*, the 12th International Design Conference, Dubrovnik, Croatia.
- Panarotto, M.**, & Törlind, P. (2011). Sustainability Innovation in early phases. In *DS 68-5: Proceedings of the 18th International Conference on Engineering Design (ICED 11)*, Vol. 5: Design for X/Design to X, Lyngby/Copenhagen, Denmark, 15.-19.08. 2011 (pp. 187-197).

Monographs (2)

- Panarotto, M.** (2015). A Model-Based Methodology for Value Assessment in Conceptual Design. *Doctoral dissertation*, Blekinge Institute of Technology.
- Panarotto, M.** (2013). Capturing Value in Conceptual PSS Design: Perspectives from the Automotive Supply Chain. *Licentiate dissertation*. Blekinge Institute of Technology.