	Lean philosophy. 4) Have a comprehensive knowledge of methods, and tools to manage complexity and control of advanced production systems.	
5	**Assessment Criteria:** 1) Have communication and presentation skills appropriate to modern production systems in different branches. 2) Analyse practical situations and generate solutions to problems arising in the field, organise efficient team work by means of clear organisational structures and optimised communication within a corporate working atmosphere. 3) Be able to undertake successfully an extended project in failure and process analysis. 4) Have the skills to optimize the value stream with help of important lean elements.	
6	**Learning and Teaching Strategy:** Lectures, seminars, practical exercise, case studies, reports from external experts and visits to industrial plants. There is a strong emphasis on project work which is assessed through practical demonstration, report, writing and oral presentation.	
7	**Learning and Teaching Methods:** Lectures: 45 hours Discussion / Review / Tutorial: 30 hours Assignment consultation: 15 hours Coursework: 3 x 35 hours Directed reading: 45 hours Total No. Hours: 240 hours	
8	**Assessment Type:** Examination Paper ( ), Oral Exam ( ), Seminar Paper ( ), Project Assignment ( ), Combined Form of Examinations (X), Portfolio ( ), Partial Examinations during the Semester ( ), amended by Presentation ( )	
9	**Assessment Element 1** a) Written assignment about defined special production process topics Extent: ~2400 words Presentation of the paper and / or b) Assignment about optimization of a production system of a product family with help of value stream mapping method	**Assessment Element 2**
	Weighting: 100%	**Weighting:** 0%
10	**Requirements for the Award of Credits:** Successfully completed Module Assessment	
11	**Relevance for the Overall Score:** According to § 23 of the Master's Examination Regulations.	
12	**Person Responsible for the Module / Instructor:** Prof. Dr. Dominik Aufderheide / Dr. Pawel Rokicki	
13	**Learning Resources:** [OHN-93] Ohno, Taiichi: „Das Toyota Produktionssystem“; Campus, 1993 [WOM-07] Womack, James P.; Jones, Daniel T.: „The Machine That Changed the World: The Story of Lean Production-- Toyota's Secret Weapon in the Global Car Wars That Is Now Revolutionizing World Industry“; 2007 [ROT-99] Rother, Mike; Shook, John: “Learning to See: Value-Stream Mapping to Create Value and Eliminate Muda: Value Stream Mapping to Add Value and Eliminate Muda “, Lean Management Institut, 1999 [ROT-13] Rother, Mike; Harris, Rick: “Creating Continuous Flow: An Action Guide for Managers, Engineers and Production Associates“, Lean Management Institut, 2013 [WOM-03] Womack, James P.; Jones, Daniel T.: „Lean Thinking: Banish Waste And Create Wealth In Your Corporation“; 2003	

	[WOM-12] Womack, James P.; Jones: „Seeing the Whole Value Stream“; 2012 [BIC-09] Bicheno, John; Holweg, Matthias: “The New Lean Toolbox: The Essential Guide to Lean Transformation“, 2009 [DER-05] Drew, John; McCallum, Blair, Roggenhofer, Stefan: „Journey to Lean: Making Operational Change Stick“; 2004 [MAS-92] Masaaki Imai: „Kaizen“, 1992 [KLU-10] Klug, Florian: „Logistikmanagement in der Automobilindustrie“; Springer, 2010 [WOH-07] Wohland, Gerhard; Wiemeyer, Matthias: „Denkwerkzeuge der Höchstleister“; Murmann, 2007 [GOR-13] Gorecki, Pawel; Pautsch, Peter: „Praxisbuch Lean Management“; Hanser, 2013 [KOT-95] Kotter, John P.: „Das Unternehmen erfolgreich erneuern“; Harvard Business Manager, 1995 [KHO-11] Khodawandi, Darius: „Wettbewerbsfähige Prozesse am Beispiel der Porsche Produktionssystems sowie dessen Übertragung auf die Software-Entwicklung“; Vortrag bei Microsoft 2011 [HER-10] Herbek, Peter: „Strategische Unternehmensführung“; mi-Verlag, 2010

Integrated Management Systems (new: Systems Engineering)				
Code: **EEM7020**	**Workload** 210 h	**Credits ECTS / UK:** 7 / 15	**Pathway** ET / ME / MT	**Duration** 1 semester
1	**Frequency of the course** summer semester		**Contact Hours** 6 SWS / 90 h	**Self-Study** 120 h
2	**Module Outline:** This module aims to introduce students to the fundamental concepts and underlying principles of systems engineering, including systems thinking, as well as the design and management of a range of engineering systems, especially combining mechanical, electronical, and software systems. The systems will be studied from a product lifecycle management perspective to cover all stages from product market research, design, manufacturing to after-sales service and product recycles. The instruction will be supplemented with case studies and applying the knowledge in engineering simultaneously.			
3	**Indicative Content:** Product lifecycle management • System requirement analysis and specification • System architecture design, system detail design and development • Unit and system test, evaluation and validation Understand the interrelation between different engineering disciplines and to stress the importance of an integrated system design. Enable the student to think in systems, rather than in disciplines. Quality Management: • Perspectives on quality • Objectives of integrated quality management systems • ISO 9000 systems Environmental Management: • Objectives and motivation of environmental protection • Activities and procedures to set up an EMS • Environmental policy and review • Structure of ISO14000/14001 Innovation Management: • Solution oriented creativity techniques • Invention vs. Innovation • Innovation management : Principles, tools, and methods • Project assessment and selection • Implementation of innovation			
4	**Learning Outcomes:** 1) Understand the idea and principles of product lifecycle management. 2) Understand the nature of quality management and environmental management as holistic approaches. 3) Be able to successfully contribute to TQM-, ISO 9000-, and ISO 14000/14001 processes in organizations. 4) Understand innovation management as a process and a major management responsibility.			

5	**Assessment Criteria:** 1) Be able to make use of product lifecycle management with its tools 2) Be able to explain relevant management methods and tools for successful quality management and environmental management. 3) Be able to describe and analyse case studies in the area of quality management and environmental management. 4) Be able to explain and apply relevant methods and tools for project search, selection, implementation and capturing.	
6	**Learning and Teaching Strategy:** Lectures, seminars, practical exercises, case studies, reports from external experts and visits to industrial plants. There is a strong emphasis on project work which is assessed through practical demonstration, report, writing and oral presentation.	
7	**Learning and Teaching Methods:** Lectures: 45 hours Computer based exercises: 15 hours Discussion / Review / Tutorial: 15 hours Assignment consultation: 15 hours Coursework: 3 x 20 & 1 x 30 hours Directed reading: 30 hours Total No. Hours: 210 hours	
8	**Assessment Type:** Examination Paper ( ), Oral Exam ( ), Seminar Paper ( ), Project Assignment ( ), Combined Form of Examinations (X), Portfolio ( ), Partial Examinations during the Semester ( ), amended by Presentation ( )	
9	**Assessment Element 1** Assignment related to product lifecycle management and / or Assignment related to quality management or environmental management in an organisation and / or Assignment related to innovation management in an organisation	**Assessment Element 2** Oral examination or written test
	Weighting: 50%	**Weighting:** 50%
10	**Requirements for the Award of Credits:** Successfully completed Module Assessment	
11	**Relevance for the Overall Score:** According to § 23 of the Master's Examination Regulations.	
12	**Person Responsible for the Module / Instructor:** Prof. Dr. Andreas Wübbeke /	
13	**Learning Resources:** Haberfellner et. all. - Systems Engineering: Fundamentals and Applications, 2019. Weilkiens, Soley - Systems Engineering mit SysML/UML: Anforderungen, Analyse, Architektur, Dpunkt.verlag, 2014. Münch - System Architecture Design and Platform Development Strategies, Springer, 2022. Dahlgaard, Kristensen and Kanji – Fundamentals of Total Quality Management-Chapman & Hall, 1998, ISBN; 0412-57060. Juran and Gryna - Quality planning and analysis, Third edition, McGraw-Hill, 1993, ISBN; 0070331839. Pearatec - Total Quality Management – Chapman& Hall, 1998, ISBN 0 412-58640. Caplen – The Quality system: A sourcebook for managers and engineers, Chilton 1980. Davis - Productivity improvements through TPM – Prentice Hall – 1995, ISBN; 013	

	133034-9. O'Conner – Practical Reliability Engineering – John Wiley and Sons, 1991, ISBN: 0471926965. Lewis – Introduction to Reliability Engineering – Second Edition, John Wiley and Sons, 1996, ISBN: 0471018333. P. Crosby " Quality is free" McGraw Hill 1978. Sherwin and Bossche – The Reliability, Availability and Productiveness of Systems – Chapman and Hall, 1993, ISBN: 0412393204. O'Conner – Practical Reliability Engineering – John Wiley and Sons, 1991, ISBN: 0471926965. Lewis – Introduction to Reliability Engineering – Second Edition, John Wiley and Sons, 1996, ISBN: 0471018333. Jackson, Suzan L: The ISO 14001 Implementation Guide, John Wiley & Sons, Inc., ISBN 0-471-15360-5. Dr. John Terninko, Alla Zusman, Boris Zlotin Step-by-step TRZ: Creating Innovation solution concepts, 1997. Robert M. Verburg, J. Roland Ortt , Willemijn M. Dicke: Managing Technology and Innovation: An Introduction, December 16, 2005, ISBN-10: 0415362296. Allan Afuah: Innovation Management: Strategies, Implementation, and Profits, 2002, ISBN-10: 0195142306. TRIZ research report: An Approach To Systematic Innovation, 1998, ISBN:1879364999. Altshuller G. The Innovation Algorithm. TRIZ, Systematic Innovation and Technical Creativity. Technical Innovation Center, Inc. Worcester, MA, 1999. Altshuller G., Zlotin B., Zusman A., and Philatov V. Tools of Classical TRIZ. Ideation International Inc. 1999. G. Altshuller, Lev Shulyak, Dana Clarker Sr: '40 Principles Extended Edition: TRIZ keys to Innovation', Technical Innovation Center, Inc. April 2005. Darrell Mann: 'Hands On: Systematic Innovation', Creax ISBN:9077071024, 2002.