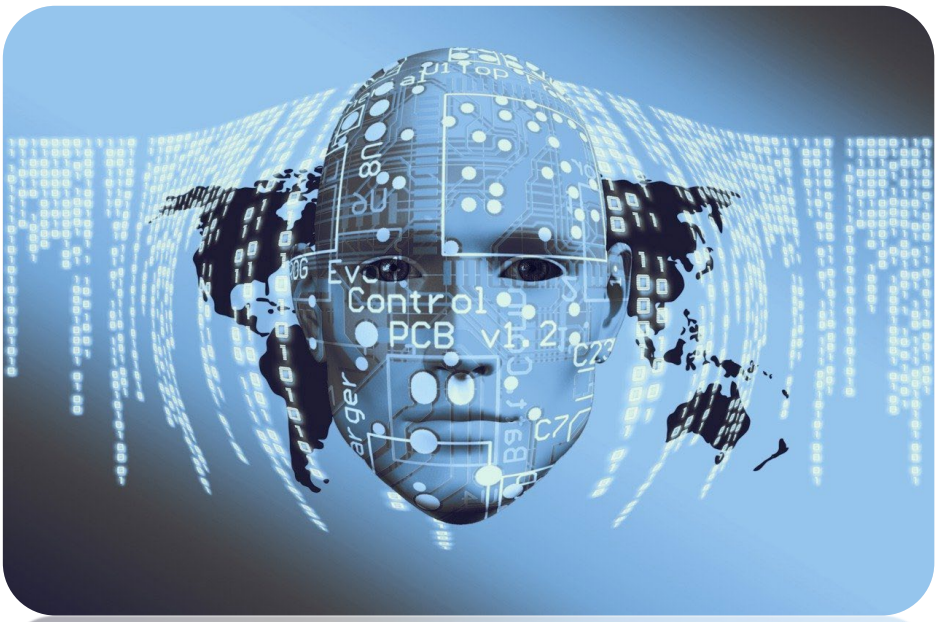
Hochschule
Albstadt-Sigmaringen

Albstadt-Sigmaringen University

Module Handbook

Faculty of Engineering

Industrial Artificial Intelligence (M. Sc.)



Master of Science

StuPO IAI 25.2	from WS 2025/26
Created by:	Industrial Artificial Intelligence degree program (M. Sc.)
Responsible:	Prof. Dr. L. Sommer

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1. Foreword

Digital transformation is the ongoing, comprehensive process of change in business that has been triggered by the emergence of extremely powerful digital technologies. As expected, the comprehensive transformation of industry is continuing, i.e. from the intelligent production process, supply chain, logistics, development, production management through to marketing and the business model. The Federal Ministry for Economic Affairs and Climate Protection sees this as follows:" The use of digital technologies in industry will give rise to a large number of new production processes, business models and products" (BMWK, 2024). From the perspective of companies - such as FESTO - the challenge of industrial transformation can be described as follows:

> Industrial transformation and Industry 4.0 have fundamentally changed the way companies produce. IoT, digitalization and globalization are influencing the industrial automation landscape and shaking up the market. At the heart of this change are advanced machine concepts that enable more efficient, flexible and intelligent production. How can you design your machine concepts in industrial production to meet future requirements and remain competitive? In this blog post, we take a look (FESTO, 2024).

With Industry 4.0, the industrial transformation has already begun, e.g. how companies develop, manufacture and distribute products. Digital technologies, such as the industrial internet, IoT and cloud solutions, have changed the face of production. However, one driver of the speed of change is of particular importance: Artificial Intelligence or Machine Learning, Deep Learning and now Generative AI. Some companies and scientists are now of the opinion that the digital transformation is now being massively driven by AI (https://solutionsreview.com/):

> An Accenture report states that enterprises that successfully deploy artificial intelligence can increase profitability by nearly 38 percent by 2035. Enterprises today seek to transition from digital transformation to AI-led digital transformation as AI is closely tied to value creation, driving businesses to think bigger and transform at scale.

The combination of **industry and AI** - Industrial Artificial Intelligence - is a particularly promising combination with regard to the future of industrial processes, as the following forecast of expected changes shows (https://labmidwest.com/):

- Prediction 1: Autonomous trucks and vehicles will transport materials from suppliers to production lines and to customers
- Prediction 2: Robots will use vision systems to load and unload your production facilities.
- Prediction 3: Artificial intelligence will tell suppliers the exact value of the materials they need to produce, store and ship.
- Prediction 4: The difference between material suppliers will be who can best predict customer demand and meet it in real time.
- Prediction 5: Your supplier's MRP or ERP system will tell your MRP or ERP system that the materials are on their way.
- Prediction 6: Your production lines will plan themselves
- Prediction 7: Process-based manufacturing will be completed automatically
- Prediction 8: Quality defects will be eliminated from your manufacturing processes through in-process inspections and digital twins.
- Prediction 9: Leading manufacturers will use artificial intelligence with smart technology to improve their profit margins.
- Prediction 10: As we cut costs, those closest to the customer will win.
- Prediction 11: The differentiator between manufacturing equipment providers will be who can incorporate the right smart technology into their systems.

A Germany-wide survey by Bosch confirms that AI is not only seen as a key technology for industrial applications, but is also being used (https://www.ipk.fraunhofer.de/).

AI content is becoming increasingly important within degree programs. The reason: AI topics open up new horizons with regard to new fields of activity. Graduates of the **Master - Industrial Artificial Intelligence** course have various advantages. These include a sound theoretical education in the areas of:

- Artificial intelligence - building and developing knowledge in the fields of machine learning, deep learning and generative AI. The focus is on imparting specialist knowledge and its practical application - using no-coding and low-coding approaches - in industry. The aim is also to use suitable software packages that meet operational needs.
- Data Engineering and Data Science - The ability to obtain, process and analyze data and make it available in databases via data pipelines.
- Digital Technology and Management - The module provides you with the knowledge, skills and tools to manage / organize the potentials and challenges that digital change and digital technologies bring.
- Operational Excellence - Is understood here as a multidimensional management concept that aims to achieve permanent improvement in various areas of a company. It is based on the principles of lean management philosophy, which aim to minimize waste on the one hand and optimize value for customers on the other.

In addition, elective courses are provided that offer students the opportunity to deepen their knowledge individually, e.g:

- Blockchain-Technologie, Business Intelligence, Database-Management, Python-Programming, Production Management, Lean Six Sigma, Project Management, Digital Business and Entrepreneurship as well as Digital Consulting

In addition to the theoretical foundation, there is also application-oriented training in the field of Industrial Artificial Intelligence:

- Project Industrial Operations and Transformation - The subject of this course is the practical application of the acquired knowledge in company-oriented projects. The focus is on the challenge of practically implementing the transformation in industrial companies.
- Project Artificial Intelligence and Data Engineering - The subject of this course is the practical application of the acquired knowledge in company-oriented projects. The focus is on the challenge of practically implementing artificial intelligence in industrial companies.

The Industrial Artificial Intelligence Master's degree program focuses on the areas of technology, management and computer science within the industrial sector, with a particular focus on production and production management.

Graduates of the Master's degree course take on tasks both in a team/project and in senior management positions (e.g. department, management). Classic" areas of activity include production planning, organization, logistics, production or controlling, but also consulting / in-house consulting or consulting as a service. It has been shown that the field of activity of graduates has changed significantly in the context of increasing digitalization. New fields of activity such as big data, machine learning, cloud solutions, digital consulting, data engineering and much more are becoming increasingly important. The degree program is internationally oriented and is taught in English.

The Master's degree program leads to an advanced professional qualification. The Master's examination determines whether in-depth scientific knowledge can be demonstrated and the ability to work independently according to scientific principles and to apply and further develop scientific methods and findings.

Building on the fundamentals taught at Bachelor's level, students are systematically prepared to take on interdisciplinary specialist and management tasks in a national and international professional environment by systematically expanding and deepening their skills. Students are enabled to grasp methodically complex interrelationships and to independently and autonomously implement scientific

findings from technology, business and IT in problem solving. The aim is to qualify students with a focus on Industrial Artificial Intelligence. Furthermore, the Master's concept is intended to open up the option of an academic career (doctorate) or access to the higher civil service.

Methods and skills

The IAI Master's degree program teaches the necessary specialist skills as well as methodological and social skills through lectures, projects, seminars and case studies as well as the academic Master's thesis. Some of the course content is provided in the form of e-learning course units, which must be completed as part of self-study. This trains important soft skills such as independence and self-organization.
Particular emphasis is placed on practical relevance, which is ensured by two company-relevant projects focusing on 'Artificial Intelligence and Data Engineering' and 'Industrial Operations and Transformation' as well as the use of experts from the field.

The course can be studied full-time or part-time.

2. Overview of the modules

Industrial Operations and Transformation

XX010 Digital Technology and Management
XX020 Operational Excellence
XX030 Project – Industrial Operations and Transformation
XX040 Compulsory elective modules – Industrial Operations and Transformation

Artificial Intelligence and Data Engineering

XX010 Artificial Intelligence
XX020 Data Science
XX030 Project – Artificial Intelligence and Data Engineering
XX030 Compulsory elective modules - Artificial Intelligence and Data Engineering

Thesis

55010 Master's Thesis

3. Qualification objective module matrix

Qualification Aim – Level 1 to 6

Modul-Nr.	Qualifikationsziel (QuZ) (gemäß Q-Bericht) Modulbezeichnung	Summe Unterstütz.	Qualifikationsziel 1 weiterführender berufsqualifizier-ender Abschluss	Qualifikationsziel 2 Vertiefung/ Erweiterung der Fach- und Methodenkenntnisse	Qualifikationsziel 3 Befähigung zu selbstständiger wissenschaftlicher Arbeit	Qualifikationsziel 4 Vorbereitung auf Übernahme von interdisziplinären Fach- und Führungsaufgaben	Qualifikationsziel 5 Befähigung zu wissenschaftlicher Karriere/ höherem Dienst	Qualifikationsziel 6 Perfektionierung der Kommunikations-fähigkeit, interkulturellen und Sprachkompetenz
	INDUSTRIAL OPERATIONS and TRANSFORMATION							
XX010	Digital Technology and Management	11	2	2	2	2	1	2
XX020	Operational Excellence	12	2	2	2	2	2	2
XX030	Project - Industrial Operations and Transformation*	12	2	2	2	2	2	2
XX040	WPM - Industrial Operations and Transformation*	9	2	2	1	2	1	1
	ARTIFICIAL INTELLIGENCE and DATA ENGINEERING							
XX010	Artificial Intelligence	10	2	2	2	1	1	2
XX020	Data Science	10	2	2	2	1	1	2
XX030	Project - Artificial Intelligence and Data Engineering*	12	2	2	2	2	2	2
XX040	WPM - Artificial Intelligence and Data Engineering*	9	2	2	1	2	1	1
	Master-Thesis							
55010	Masterthesis	12	2	2	2	2	2	2

4. Program competence matrix

Competence Level – Level 1 to 7

Modul-Nr.	Kompetenzen / Ausprägung	Fachkompetenz					Personale Kompetenz					
		Wissen		Fertigkeiten			Sozialkompetenz			Selbständigkeit		
		Tiefe	Breite	Instrumentelle Fertigkeiten	systemische Fertigkeiten	Beurteilungs-fähigkeit	Team-/ Führungs-fähigkeit	Mitgestaltung	Kommunikation	Eigenständigkeit / Verantwortung	Reflexivität	Lernkompetenz
	INDUSTRIAL OPERATIONS and TRANSFORMATION											
XX010	Digital Technology and Management		7	7	7	7		7	7	7	7	7
XX020	Operational Excellence		7	7	7	7	7	7	7	7	7	7
XX030	Project - Industrial Operations and Transformation*	7	7	7	7	7	7	7	7	7	7	7
XX040	WPM - Industrial Operations and Transformation*	7	7	7	7	7				7	7	7
	ARTIFICIAL INTELLIGENCE and DATA ENGINEERING											
XX010	Artificial Intelligence	7		7	7	7		7		7	7	7
XX020	Data Science	7		7	7	7		7		7	7	7
XX030	Project - Artificial Intelligence and Data Engineering*	7	7	7	7	7	7	7	7	7	7	7
XX040	WPM - Artificial Intelligence and Data Engineering*	7	7	7	7	7				7	7	7
	Thesis											
55010	Master's Thesis	7	7	7	7	7	7	7	7	7	7	7
	Niveau des Studiengangs:			**7**								

5. Module descriptions

INDUSTRIAL OPERATIONS and TRANSFORMATION

<table>
<tr><td colspan="7">Module: Digital Technology and Management</td></tr>
<tr><td colspan="2">ID number
XX010</td><td>Workload
150 h</td><td>Module type
Compulsory module</td><td>Semester of study
2nd semester</td><td>Duration
1 semester</td><td>Frequency
Annual / summer semester</td></tr>
<tr><td>1</td><td colspan="3">Course(s)

Digital Technology and Management</td><td>Languages

English</td><td>Contact time
60 h</td><td>Self-study

90 h</td><td>Credits (ECTS)
5</td></tr>
<tr><td>2</td><td colspan="6">Teaching form(s) / SWS:

Lecture + exercise/ 4 SWS</td></tr>
<tr><td>3</td><td colspan="6">Learning outcomes, competencies:

Competence Knowledge
Students have extended or deepened knowledge and skills in the field of automation and simulation as well as digital technologies. [knowledge, 7]

Competence Skills
They are familiar with common processes, procedures and methods and can configure and apply them independently. [Instrumental skills, 7]

Social skills
You are able to assess situations on the basis of the knowledge and skills you have acquired. [Co-creation, 7]

Independence
They are able to draw their own conclusions and derive and evaluate proposed solutions. [Autonomy/responsibility, 7]</td></tr>
<tr><td>4</td><td colspan="6">Contents:

1. Automation
• Introduction to PLC programming including self-study of the basics of programmable logic controllers (PLC)
• Practical exercises “Control with PLC”
• Introduction to the processing of sensor data via MES/ERP
• Introduction to scientific laboratory work and the creation of laboratory reports

After an introduction to the production laboratory and the model production plant, students work independently on practical tasks and document the results in the form of a measurement protocol and laboratory report. The conclusions drawn from the knowledge gained should provide a differentiated view of the possibilities and limitations of the technologies presented and show potential for optimizing the problem.

2. Simulation
• Virtual modeling of products and processes
• Modeling theory,
• Selected algorithms of geometry-oriented and process-oriented systems,
• Feature classification,</td></tr>
</table>

	• Value stream and process simulation, • Data interfaces, • Management concepts for development and production structures. The aim is to become familiar with methods and algorithms for the virtual modelling of products and processes as well as the use of algorithms in exemplary implementations. 3. Digital technologies Students learn about selected digital technologies for managing processes and workflows in order to be able to use these technologies and effective change management strategies despite the complexity of new and innovative tools. Management and leadership skills, including interdisciplinary thinking to recognize interrelationships and effectively act as a link between the various stakeholders, are essential for overcoming the above-mentioned challenges. This also includes developing management skills to introduce digital technologies on a larger scale in the company. An introduction to business analytics helps with the appropriate analysis, implementation and use of data.
	Empfohlene Literatur: • Documentation and manuals for the MPS Transfer Factory on ILIAS in the Magazine " Bachelor's degree programs ' Industrial engineering and management ' All professors " Festo production plant • https://process-simulator.de/index.html • Bauernhansl, T.; ten Hompel, M.; Vogel-Heuser, B:(2014). Industry 4.0 in production, automation and logistics. ISBN: 978-3-658-04681-1. Springer Verlag • Kletti, J: Manufacturing Execution Systems (2016): Modern information technology for process capability in value creation. ISBN 10 3-540-28010-3 Springer Verlag Berlin Heidelberg • Finkenzeller, K.: RFID Handbook (2010). Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication. Third Edition. ISBN 978-0-470-69506-7. John Wiley & Sons, Ltd. • Wellenreuther, G.; Zastrow, D. (2015): Automation with PLC. Theory and practice, 6th ed. ISBN 978-3-8348-2597-1. Vieweg+Teubner • Ebel, F. et al. (2008): Fundamentals of automation technology. Textbook. Festo Didactic GmbH & Co. KG, D-73770 Denkendorf • Spur, G.; Krause, F.-L. (2017): The virtual product, Carl Hanser Verlag • Tecnomatix (2023): Reference Manual
5	**Participation requirements:** None
6	**Forms of examination:** Presentation (2.5) + Laboratory (2.5) – Graded
7	**Requirements for the awarding of credit points:** Passed presentation + passed laboratory work
8	**Applicability of the module:** Industrial Artificial Intelligence (M.Sc.) WIW - Digital Production Management (M.Sc.)
9	**Person responsible for the module:** Prof. Dr. Sommer
10	**Optional information:**

<table>
<tr><td colspan="7">Module: Operational Excellence</td></tr>
<tr><td colspan="2">ID number
XX020</td><td>Workload
150 h</td><td>Module type
Compulsory module</td><td>Semester of study
2nd semester</td><td>Duration
1 semester</td><td>Frequency
Annual / summer semester</td></tr>
<tr><td>1</td><td colspan="3">Course(s)
Operational Excellence</td><td>Language
English</td><td>Contact time
60 h</td><td>Self-study
90 h</td><td>Credits (ECTS)
5</td></tr>
<tr><td>2</td><td colspan="6">Teaching form(s) / SWS:
Lecture/ seminar + exercise/ 4 SWS</td></tr>
<tr><td>3</td><td colspan="6">Learning outcomes, competencies:

Competence Knowledge

Students have a basic understanding of the two management concepts Lean and Six Sigma, know their origins, the underlying philosophies and application principles. They know which synergies result from the combination of Lean Management and Six Sigma and how these two management concepts can be meaningfully combined. They know important methods and instruments from lean management (store floor management, KAIZEN, 3 Mu, 5S, ...) and can classify them. [Knowledge, 7]

Competence Skills

You are familiar with systematic selection procedures for Six Sigma improvement projects and know how to formulate a project assignment. They are also aware of the importance of change management and recognize what needs to be considered to achieve sustainable change [Systemic skills, 7].

Social skills

They know and understand the various roles and responsibilities in the application and implementation of Lean Six Sigma concepts in organizations as well as the factors that are crucial to the success of the sustainable introduction of Lean Six Sigma. [Team/leadership skills, 7]

Independence

They are able to select appropriate process indicators in process management and use suitable stat. You will be able to use suitable statistical instruments in the context of the application and implementation of Lean Six Sigma in order to derive and evaluate measures. [Independence/responsibility, 7]</td></tr>
<tr><td>4</td><td colspan="6">Contents:

The course is divided into three sections: Teaching the theoretical basics, introduction to suitable software packages and carrying out a case study.

<u>Part 1: Teaching the theoretical basics</u>
• Introduction to the two concepts of Lean Management (Toyota Production System) and Six Sigma - comparison, differentiation, synergies of Lean Management and Six Sigma
• Practical examples of the application of Lean Six Sigma, potential for success and stumbling blocks
• Procedure for Six Sigma projects according to the DMAIC cycle and important tools to be used for problem solving within the framework of the DMAIC cycle as well as their synergetic interaction
• Importance of KPI systems for process control, their systematic development and use in process management
• Common methods and key figures for evaluating the performance of processes
• Coincidence or not? - The role and importance of statistical methods in Six Sigma
• Change management to successfully implement internal improvements</td></tr>
</table>

	• Important elements from lean management and how they relate to Six Sigma (KAI ZEN, Poka Yoke, 3-Mu, 5-S, Jidoka, TPM, visualization, standardization, ...) • Value stream mapping Part 2: Introduction to relevant software packages and their application to practice case studies Part 3: Implementation of a case study based on fictitious data
	Recommended literature: • Erlach, K.: Value stream design (2020): The path to the lean factory, Springer Verlag, ISBN: 978-3-540-89867-2 • Six Sigma+Lean Toolset (2014): Mindset for the successful implementation of improvement projects (Stephan Lunau) • R. Jochem, D. Geers, M. Giebel (Eds.): Six Sigma made easy. A textbook with sample projects for practical success. Symposion Publishing, Düsseldorf. ISBN 978-3-939707-83-7. • Lean Six Sigma and Minitab: The Complete Toolbox Guide for Business Improvement, (2022) • Frank Bornhöft, Norbert Faulhaber: Implementing Lean Six Sigma successfully. Frankfurt School Verlag (2010), Edition: 2nd expanded and updated, ISBN 978-3-937519-60-9. • Six Sigma: A Case Study Approach Using Minitab®; English edition (Timothy D. Blackburn, 2023)
5	**Participation requirements:** None
6	**Forms of examination:** Term paper – graded (5)
7	**Requirements for the awarding of credit points:** Passed examination
8	**Applicability of the module:** Industrial Artificial Intelligence (M.Sc.) WIW - Digital Production Management (M.Sc.)
9	**Person responsible for the module:** Prof. Dr. Sommer
10	**Optional information:** A Lean Six Sigma Yellow Belt certificate can be acquired during the course. The course can be credited towards the Lean Six Sigma Green Belt

Module: Project - Industrial Operations and Transformation*

ID number	**Workload**	**Module type**	**Semester of study**	**Duration**	**Frequency**
XX030	375 h	Compulsory module	2nd semester	1 semester	Annually / summer semester

	Course(s)	**Language**	**Contact time**	**Self-study**	**Credits (ECTS)**
1	Project - Industrial Operations and Transformation	English	60 h	315 h	12.5

2 **Teaching form(s) / SWS:**

Introduction + Case Study / 1 SWS
Accompanied project / 3 SWS

3 **Learning outcomes, competencies:**

Competence Knowledge
Students acquire extended or in-depth knowledge and skills in a specific subject area from business practice. *[Knowledge, 7]*

Competence Skills

They are able to work on a practical problem in an engineering manner, taking into account operational circumstances and by selecting suitable project management methods and tools, and to derive and evaluate proposed solutions. *[Assessment ability, 7]*

Social competence

They develop both creative and critical thinking, problem-solving and analytical skills and improve their abilities in communicating with various stakeholders and in self-reflection. *[Communication, 7]*

Independence

They are able to independently investigate in-depth questions on selected topics using research literature and apply the findings to project-specific problems in order to derive proposed solutions. *[Independence/Responsibility, 7]*

4 **Contents:**

An elementary component of the Master's concept is the integration of research aspects, whereby the research can take place at the university, a partner university, a research institution or a company. The purpose of this course is to systematically work on and solve specific research problems in a project team and to present your own proposed solutions to a high-caliber panel.

Focus of the research projects: Practically relevant topics with reference to the subjects trained in the degree program as well as with regard to lean aspects.

1. Introduction to the topic and processing of a case study under supervision
2. Independent processing of a project topic from company practice in a team
   - Familiarization with the theoretical basis for the project topic to be worked on
   - Project planning in coordination with the company involved
   - Independent processing of the topic by the students in project groups using the usual project management methods

	Project documentation must be prepared by all participants and the project results must be presented to a high-caliber committee at the end of the project.
	Recommended reading: • Guidelines - Scientific work (2023), Albstadt-Sigmaringen University of Applied Sciences • Patzak, G./Rattay, G. (2004): Project Management, 4th ed., Vienna • Kuster, J., Bachmann, C., etc. (2022): Manual Project Management: Agile - Classic - Hybrid, 5th edition, Springer • APA Manual 7th Edition 2024 Referencing Guide • Project-specific technical literature
5	**Participation requirements:** none
6	**Forms of examination:** Portfolio examination – Graded (12.5)
7	**Requirements for the awarding of credit points:** Active participation/cooperation in the project + passed partial performance
8	**Applicability of the module:** M.Sc. Industrial Artificial Intelligence
9	**Person responsible for the module:** Prof. Dr. Sommer
10	**Optional information:** Project can be credited towards the Lean Six Sigma Green Belt certificate or DGQ certificate if the topic is suitable.

Module: Compulsory elective modules -Industrial Operations and Transformation						
ID number XX040	**Workload** 225 h	**Module type** Compulsory module	**Semester of study** 2. Semester	**Duration** 1 semester	**Frequency** Annually / summer semester	
1	**Course(s)** Various WPF according to selection list	**Language** English	**Contact time** 90 h	**Self-study** 135 h	**Credits (ECTS)** 7.5	
2	**Teaching form(s) / SWS:** Diverse / 6 SWS					
3	**Learning outcomes, competencies:** *Competence Knowledge* Students have extended or deepened knowledge and skills in the chosen subjects in the field of Industrial Operations and Transformation *[knowledge, 7]* *Competence Skills* They are familiar with common processes, procedures and methods and can configure and apply them independently *[Instrumental skills, 7]* *Social competence* You will be able to assess situations on the basis of the knowledge and skills you have acquired. *[Co-creation, 7]* *Independence* They are able to draw their own conclusions and derive and evaluate proposed solutions *[Autonomy/responsibility, 7]*					
4	**Contents:** Various elective subjects in the field of Industrial Transformation according to the selection list *Recommended literature:* Specific specialist literature - will be announced by the lecturers in the respective Compulsory elective modules.					
5	**Participation requirements:** According to the respective module description of the subjects named in the compulsory elective catalog.					
6	**Examination forms:** X (7.5) - Graded Examinations in accordance with the respective module description of the subjects listed in the compulsory electives catalog					
7	**Requirements for the awarding of credit points:** Passed examinations in the selected compulsory elective subjects					
8	**Applicability of the module:** Industrial Artificial Intelligence (M.Sc.)					

9	**Module coordinator(s):** Dean of Studies
10	**Optional information:**

ARTIFICIAL INTELLIGENCE and DATA ENGINEERING

<table>
<tr><td colspan="7">Module: Artificial Intelligence</td></tr>
<tr><td colspan="2">ID number
XX010</td><td>Workload
150 h</td><td>Module type
Compulsory module</td><td>Semester of study
1st semester</td><td>Duration
1 semester</td><td>Frequency
Annual / winter semester</td></tr>
<tr><td>1</td><td colspan="2">Course(s)

Artificial Intelligence</td><td>Language

English</td><td>Contact time
60h</td><td>Self-study
90h</td><td>Credits (ECTS)
5</td></tr>
<tr><td>2</td><td colspan="6">Teaching format(s) / SWS:

Lecture + exercise/ 4 SWS</td></tr>
<tr><td>3</td><td colspan="6">Learning outcomes, competencies:

Competence Knowledge
Students are familiar with various algorithms for data analysis and can apply them appropriately. [Knowledge, 7]

Competence Skills
Students know data mining methods and are able to carry out qualified data analysis according to CRISP-DM and with the help of Minitab or RapidMiner software. [Instrumental skills, 7]

Social competence
They are able to assess situations on the basis of the knowledge and skills they have acquired. [Co-creation, 7]

Independence
Students know the programming language ‘Python’ and are able to program their own applications with it. [Independence/responsibility, 7]</td></tr>
<tr><td>4</td><td colspan="6">Contents:

One area of artificial intelligence is machine learning. With the help of machine learning, IT systems are enabled to recognize patterns and regularities and develop solutions based on existing databases and algorithms. Artificial knowledge is generated from experience, so to speak" (www.bigdata-insider.de).
The aim of the course is to provide students with knowledge that enables them to predict future events and forecast developments. This will enable them to optimize their decision-making as future executives/profit center managers/managing directors in Germany and abroad.
As part of the course, students acquire basic knowledge of machine learning. In the first part, theoretical basics are taught. In the second part, suitable software packages are presented, which are then tested by the students. In the last part, the theoretical and software-based knowledge is implemented as part of a project in order to consolidate the skills learned.

As part of the course, students can acquire internationally recognized certificates for their knowledge of Python programming, depending on their own performance.</td></tr>
</table>

	1. Theoretical basics - terms and objectives - data analysis process CRISP DM - algorithms (classical ML/deep learning) o Regressions o Cluster analyses o Classifications o Reinforcement learning o Naive Bayes o Neural networks: ➔ Convolutional Neural Networks ➔ Recurrent Neural Networks ➔ Generative Adversarial Networks (GANs)Use Cases in Python - Use cases in Python 2. Introduction to software - - Python and comparable apps - - use of suitable platforms 3. Project - - practical application of the knowledge in relation to selected use
	Recommended reading: • Sebastian Raschka, Vahid Mirjalili: Machine Learning with Python and Scikit-Learn and TensorFlow (2017): The comprehensive practical handbook for data science, predictive analytics and deep learning. MITP-Verlags GmbH & Co. KG, ISBN 978-3-95845-735-5. • Andreas C. Müller, Sarah Guido (2017): Introduction to Machine Learning with Python. O'Reilly-Verlag, ISBN 978-3-96009-049-6. • Christopher M. Bishop (2008): Pattern Recognition and Machine Learning. Information Science and Statistics. Springer-Verlag, ISBN 978-0-387-31073-2. • Thomas Mitchell: Machine Learning. Mcgraw-Hill, London 1997, ISBN 978-0-07-115467-3. • David Barber (2012): Bayesian Reasoning and Machine Learning. Cambridge University Press, Cambridge 2012, ISBN 978-0-521-51814-7 • Machine Learning for Software Developers: From the Phython Code Line to the Deep Learning Application (Paolo Perrotta, 2020)
5	**Prerequisites for participation:** None
6	**Forms of examination:** Term paper (ungraded) as a preliminary examination Presentation as an examination – Graded (5)
7	**Prerequisites for awarding credit points:** Passed preliminary examination and examination
8	**Applicability of the module:** Industrial Artificial Intelligence (M.Sc.)
9	**Module coordinator(s):** Prof. Dr. Sommer
10	**Optional information:**

<table>
<tr><td colspan="7">Module: Data Science</td></tr>
<tr><td colspan="2">ID number
XX020</td><td>Workload
150 h</td><td>Module type
Compulsory module</td><td>Semester of study
1st semester</td><td>Duration
1 semester</td><td>Frequency
Annual / winter semester</td></tr>
<tr><td>1</td><td colspan="2">Course(s)

Data Science</td><td>Language

English</td><td>Contact time
60h</td><td>Self-study
90h</td><td>Credits (ECTS)
5</td></tr>
<tr><td>2</td><td colspan="6">Teaching format(s) / SWS:

Lecture + exercise/ 4 SWS</td></tr>
<tr><td>3</td><td colspan="6">Learning outcomes, competences:

Competence Knowledge
Students know and understand the various methods of analytical and descriptive statistics. [Knowledge, 7]

Competence Skills
They can use the MINITAB® statistics software and are able to carry out statistical design of experiments (DoE). [Instrumental skills, 7]

Social skills
You are able to assess situations on the basis of the knowledge and skills you have acquired.
[Co-creation, 7]

Independence
You are able to draw your own conclusions and derive and evaluate proposed solutions [Independence/Responsibility, 7]</td></tr>
<tr><td>4</td><td colspan="6">Contents:

Knowledge in the field of data science is a core competence of executives/profit center managers/managing directors in Germany and abroad. The aim of the course is to build on basic knowledge from the bachelor's degree and to provide students with advanced skills with a focus on production.
The course is divided into three parts: Theoretical foundations, familiarization with the company software MINITAB - with the option of acquiring a certificate - and a project to apply the theoretical knowledge as well as the software MINITAB®:

1. Theoretical foundations - Basics
- Basics of data acquisition
- Descriptive statistics

2. Theoretical foundations - Advanced
• Analytical statistics
• Statistical design of experiments
• Logistic regressions
• Analysis of variance
• Discriminant analysis
• Probability theory
• Distribution functions
• Path analysis</td></tr>
</table>

	• Design of experiment 3. Use of the MINITAB® software 4. Implementation of a case study
	Recommended reading: • Braun, Morgenstern, Radeck (2010): Prozessoptimierung mit statistischen Verfahren; Hanser Verlag • Brook (2014): Lean Six Sigma & Minitab: the complete toolbox guide for business improvement; Opex Resources • Minitab 21 or higher: https://www.minitab.com/de-de/products/minitab/ • Hippmann (2007): Statistik- Praxisbezogenes Lehrbuch mit Beispielen; Schäffer-Poeschel Verlag • Pavlo Baron (2013): Big data für IT-Entscheider - riesige Datenmengen und moderne Technologien profitably nutzen. Hanser, Munich 2013, ISBN 978-3-446-43339-7. • Rudolf Klausnitzer (2013): Das Ende des Zufalls, wie Big Data uns und unser Leben vorhersagbar macht. Ecowin, ISBN 978-3-7110-0040-8. • Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman (2014): Mining of Massive Datasets. 2nd edition. Cambridge University Press, Cambridge 2014, ISBN 978-1-107-07723-2 (English). • Benjamin M. Abdel-Karim (2022): Data Science: Best Practices with Python, Springer Verlag, ISBN 978-3658334598 • Tom Alby (2022): Data Science in der Praxis Eine verständliche Einführung in alle wichtigen Verfahren, Rheinwerk Computing, ISBN 978-3-8362-8462-2 • Klaus Mainzer (2014): Die Berechnung der Welt: von der Weltformel zu Big Data. Beck, Munich 2014, ISBN 978-3-406-66130-3.
5	**Prerequisites for participation:** None
6	**Forms of examination:** Portfolio examination – Graded (5)
7	**Requirements for the awarding of credit points:** All examination components passed
8	**Applicability of the module:** Industrial Artificial Intelligence (M.Sc.) WIW - Digital Production Management (M.Sc.) Data Engineering and Consulting (M.Sc.)
9	**Module coordinator(s):** Prof. Dr. Sommer
10	**Optional information:** In addition, an internationally recognized certificate of knowledge in MINITAB® can be acquired.

Module: Project - Artificial Intelligence and Data Engineering						
ID number XX030	**Workload** 375 h	**Module type** Compulsory module	**Semester of study** 1st semester	**Duration** 1 semester	**Frequency** Annually / winter semester	
1	**Course(s)** Project - Artificial Intelligence and Data Engineering		**Language** English	**Contact time** 60 h	**Self-study** 315 h	**Credits (ECTS)** 12.5
2	**Teaching format(s) / SWS:** Introduction + Case study / 1 SWS Supervised project / 3 SWS					
3	**Learning outcomes, competences:** *Competence Knowledge* Students acquire extended or in-depth knowledge and skills in a specific subject area from business practice. *[Knowledge, 7]* *Competence Skills* They are able to work on a practical problem in an engineering manner and to derive and evaluate proposed solutions, taking into account operational circumstances and by selecting suitable project management methods and tools. *[Assessment skills, 7]* *Social skills* You will develop both creative and critical thinking, problem-solving and analytical skills and improve your ability to communicate with various stakeholders and in self-reflection. *[Communication, 7]* *Independence* You are able to independently investigate in-depth questions on selected topics using research literature and apply the findings to project-specific problems in order to derive proposed solutions. *[Independence/Responsibility, 7]*					
4	**Contents:** An elementary component of the Master's concept is the integration of research aspects, whereby the research can take place at the university, a partner university, a research institution or a company. The purpose of this course is to systematically work on and solve specific research problems in a project team and to present your own proposed solutions to a high-caliber panel. 1. Focus of the research projects: Practically relevant topics with reference to the topics trained in the degree program with regard to Artificial Intelligence and Data Engineering. 2. Introduction to the topic and processing of a case study under supervision 3. Independent processing of a project topic from company practice in a team • Familiarization with the theoretical foundations for the project topic to be processed • Project planning in coordination with the company involved • Independent processing of the topic by the students in project groups using the usual project management methods Project documentation must be prepared by all participants and the project results must be presented to a high-caliber committee at the end of the project.					

	Recommended literature: • Leitfaden - Wissenschaftliches Arbeiten (2023), Albstadt-Sigmaringen University of Applied Sciences • Patzak, G./Rattay, G. (2004): Projektmanagement, 4th ed., Vienna • Kuster, J., Bachmann, C., etc. (2022): Handbuch Projektmanagement: Agil - Klassisch - Hybrid, 5. Aulage, Springer • APA Manual 7th Edition 2024 Referencing Guide • project-specific specialist literature
5	**Prerequisites for participation:** none
6	**Forms of examination:** Portfolio examination - Graded (12.5)
7	**Requirements for awarding credit points:** Active participation/cooperation in the project + passed partial performance
8	**Applicability of the module:** Industrial Artificial Intelligence (M.Sc.)
9	**Module coordinator(s):** Prof. Dr. Sommer
10	**Optional information:**

Module: Compulsory elective modules - Artificial Intelligence and Data Engineering						
ID number XX040	**Workload** 225 h	**Module type** Compulsory elective	**Semester of study** 2nd semester	**Duration** 1 semester	**Frequency** Annual / summer semester	
1	**Course(s)** Various Compulsory elective modules according to selection list		**Language** English	**Contact time** 90 h	**Self-study 135 h**	**Credits (ECTS)** 7.5
2	**Teaching method(s) / SWS:** Different methods / 6 SWS					
3	**Learning outcomes, competencies:** *Competence Knowledge* Students have extended or deepened knowledge and skills in the chosen subjects in the fields of Artificial Intelligence and Data Engineering *[Knowledge, 7]* *Competence Skills* They are familiar with common processes, procedures and methods and can configure and apply them independently *[Instrumental skills, 7]* *Social competence* They are able to assess situations on the basis of the knowledge and skills they have acquired. *[Co-creation, 7]* *Independence* They are able to draw their own conclusions and derive and evaluate proposed solutions *[Independence/Responsibility, 7]*					
4	**Contents*:*** Various elective subjects in the fields of Artificial Intelligence and Data Engineering *Recommended literature:* Specific technical literature - will be announced by the lecturers in the respective subject					
5	**Participation requirements:** In accordance with the respective module description of the subjects listed in the compulsory electives catalog					
6	**Forms of examination:** X (7.5) graded Examinations according to the respective module description of the subjects listed in the compulsory electives catalog.					
7	**Requirements for the awarding of credit points:** Passed examinations in the selected elective subjects					
8	**Applicability of the module:** Industrial Artificial Intelligence (M.Sc.)					

9	**Module coordinator:** Dean of Studies
10	**Optional information:**

Thesis

<table>
<tr><td colspan="7">Module: Master’s Thesis</td></tr>
<tr><td colspan="2">ID number
55010</td><td>Workload
900 h</td><td>Module type
Compulsory module</td><td>Semester of study
3rd semester</td><td>Duration
1 semester</td><td>Frequency
winter semester / summer semester</td></tr>
<tr><td>1</td><td colspan="2">Lehrveranstaltung(en)

keine</td><td>Sprache

English</td><td>Kontakt-zeit
Nach Bedarf</td><td>Selbst-studium
900 h</td><td>Credits (ECTS)
30</td></tr>
<tr><td>2</td><td colspan="6">Course(s)

Independent final project</td></tr>
<tr><td>3</td><td colspan="6">Learning Outcomes, Competencies:

The students
• Demonstrate extensive knowledge and a deep understanding of a specific engineering topic (understanding/ knowledge)
• Are able to conduct a critical analysis based on comprehensive data research or their own investigations and scientifically interpret the results (understanding and application competence)
• Are capable of evaluating their research results using recognized methods and techniques, drawing clear and well-founded conclusions, and deriving appropriate solution proposals (evaluation and application competence)

Knowledge Level 7, Skills Level 7, Social Competence Level 7, Autonomy Level 7</td></tr>
<tr><td>4</td><td colspan="6">Content:

The Master's program culminates in the Master's thesis, which represents the final integration of the knowledge, skills, and competencies acquired during the theoretical semesters in an engineering-based academic project. Building on the theoretical foundations of the program, students systematically and independently work on a problem from the production environment with a practical or research-oriented focus, applying scientific methods and analytical tools.</td></tr>
<tr><td></td><td colspan="6">Recommended Literature:
• Guide – Academic Writing (2023), Albstadt-Sigmaringen University
• Patzak, G. / Rattay, G. (2004): Project Management, 4th edition, Vienna
• Kuster, J., Bachmann, C., etc. (2022): Handbook of Project Management: Agile – Traditional – Hybrid, 5th edition, Springer
• APA Manual 7th Edition 2024 Referencing Guide</td></tr>
<tr><td>5</td><td colspan="6">Participation Requirements:

At least 50 ECTS credits completed in the Master’s program in Industrial Engineering (WIW); further details are specified in the study and examination regulations.</td></tr>
<tr><td>6</td><td colspan="6">Examination Forms:

Scientific final thesis – Graded (30)</td></tr>
<tr><td>7</td><td colspan="6">Requirements for the Awarding of Credit Points:

Independently conducted scientific project; passed examination performance</td></tr>
</table>

8	**Applicability of the Module:** Industrial Artificial Intelligence (M.Sc.) WIW – Digital Production Management (M.Sc.) Data Engineering and Consulting (M.Sc.)
9	**Module Coordinator:** Dean of Studies
10	**Optional Information:** The Master's thesis can be carried out at the university or in cooperation with a company.

6. Imprint

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Faculty of Engineering

Department of Industrial Engineering

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